

INTERNATIONAL STANDARD

**Industrial networks – Coexistence of wireless systems –
Part 4: Coexistence management with central coordination of wireless
applications**

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Part 4: Coexistence management with central coordination of wireless
applications**

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This redline version of the official IEC Standard allows the user to identify the changes made to the previous edition IEC 62657-4:2022. A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text.

IEC 62657-4 has been prepared by subcommittee 65C: Industrial networks, of IEC technical committee 65: Industrial-process measurement, control and automation. It is an International Standard.

This second edition cancels and replaces the first edition published in 2022. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition.

- a) The data item (parameter) to be exchanged between CCP and CMWCA and CMWD to ensure interoperability between CCP providers and device providers.
- b) The sequence of services conducted between CCP and CMWCA and CMWD are now defined. When the CCP providers and the device providers implement similar process, clearly defined sequence and unified execution specifications ensure interoperability as expected.
- c) The message formats of sequence diagram to be exchanged between CCP and CMWCA and CMWD are defined. By defining the message formats, the hierarchical structure of each data (parameter), and implementing the same message format by the CCP provider and the device provider, enables to exchange data correctly and ensure interoperability.

The text of this International Standard is based on the following documents:

Draft	Report on voting
65C/1330/FDIS	65C/1338/RVD

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

A list of all parts in the IEC 62657 series, published under the general title *Industrial networks – Coexistence of wireless systems*, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn, or
- revised.

INTRODUCTION

The IEC 62657 series provides background, foundations, process and examples to achieve wireless coexistence. With a coexistence management process according to IEC 62657-2, a predictable assuredness of coexistence can be achieved for a given spectrum while ensuring that application requirements continue to be met. The present document provides an automated coexistence management.

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INDUSTRIAL NETWORKS – COEXISTENCE OF WIRELESS SYSTEMS –

Part 4: Coexistence management with central coordination of wireless applications

1 Scope

This part of IEC 62657 specifies a concept and methods for central coordination (CC) of automation applications using wireless communications to extend the coexistence management according to IEC 62657-2. It establishes system elements, interfaces and relationships for a central coordination. Functions, data, and data exchange for assessing and maintaining the coexistence state are specified.

This document specifies the central coordination point (CCP) approach as one example of the usage of the formal description given in IEC 62657-3.

This document is applicable to develop, implement, or modify procedures or solutions.

This document provides requirements for automated coexistence management systems.

This document provides requirements for:

- determination of the coexistence state,
- automated coexistence management procedures,
- CC amendments for existing wireless communication solutions,
- CC functions that coordinate legacy and new wireless communication systems,
- CC sequences and message formats for data exchange.

This document is not restricted to a specific radio frequency range nor is it restricted to a specific wireless communication technology.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes the requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 62657-2:2025, *Industrial networks – Coexistence of wireless systems – Part 2: Coexistence management*¹

~~IEC 62443 (all parts), *Security for industrial automation and control systems*~~

ISO/IEC 10731, *Information technology – Open Systems Interconnection – Basic Reference Model – Conventions for the definition of OSI services*

¹ Under preparation. Stage at the time of publication: IEC/FDIS 62657-2:2024.

IETF RFC 8259, Tim Bray, *The JavaScript Object Notation (JSON) Data Interchange Format*, available at RFC 8259 – The JavaScript Object Notation (JSON) Data Interchange Format (ietf.org) [viewed 2024-09-03]

3 Terms, definitions, abbreviated terms and conventions

3.1 General

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- IEC Electropedia: available at <https://www.electropedia.org/>
- ISO Online browsing platform: available at <https://www.iso.org/obp>

3.2 Terms and definitions specific for this document

3.2.1

allocation

entry in the table of frequency allocations of a given frequency band for the purpose of its use by one or more radio communication services or the radio astronomy service under specified conditions

3.2.2

antenna

device designed to transmit or receive electromagnetic waves

3.2.3

coexistence distance

difference between the threshold value for the coexistence state and the actual value of the coexistence state function expressing the distance before reaching the coexistence state

3.2.4

coexistence margin

difference between the actual value of the coexistence state function and the threshold for the coexistence state expressing the reserve before leaving the coexistence state

3.2.5

database service

service officially operated under the rules of the local regulatory authority that provides a list of available channels and possibly the maximum EIRP allowable on these channels based on queries containing the geolocation of the wireless regional area network (WRAN) devices

3.2.6

geolocation

process of acquiring the location data of a device, determining its latitude and longitude

3.2.7

harmful interference

any emission, radiation or induction that endangers the functioning of a radio navigation service or of other safety services or seriously degrades, obstructs, or repeatedly interrupts a radiocommunications service operating in accordance with the ITU and local regulations

3.2.8

incumbent radio system

wireless communication system that is not under the control of, and is not affected by, the coexistence manager

3.2.8

logical link

~~application oriented communication relationship which enables the transmission of user data between one logical end point of the reference interface in a source device and one logical end point of the reference interface in a target device~~

3.2.9

master station

data station that has been designated by the control station to ensure data transfer to one or more slave stations

Note 1 to entry: At a given instant, there can be only one master station on a data link.

[SOURCE: IEC 60050-721:1991, 721-19-12]

3.2.10

service flow

QoS parameters for the PDUs that are exchanged on a connection, and provide a mechanism for upstream and downstream QoS management

3.2.11

service flow identifier

SFID

unique identifier for a service flow dealing with how higher layer packets/application sessions are mapped to their QoS requirements and scheduling constraints

3.2.12

slave station

data station that is selected by a master station to receive data

3.2.13

spectrum sensing system

SSS

combination of dedicated spectrum sensing nodes (SSN) and embedded spectrum sensing functions (SSF) integrated into the wireless devices for automation applications

3.3 Additional terms and definitions for the templates

3.3.1

array of frequency

collected values from sensing start frequency to sensing end frequency during the sensing process

3.3.2

array of power spectral density

collected values of power spectral density from sensing start frequency to sensing end frequency during the sensing process

3.3.3

CCP address

communication partner identification of the central coordination point for a service

3.3.4

coexistence assessment

process of evaluating wireless communication coexistence

3.3.5

communication link ID

identifier (ID) as part of the response of a service execution related to the communication link

3.3.6**destination address**

communication partner identification for a service

3.3.7**limits of performance parameter**

value returned with the limit for a performance parameter

3.3.8**medium sensing report type**

requested type of information related to the generation type of medium resource report

Note 1 to entry: The type is represented by a number with the following code: 1: Event driven; 2: Cyclic; 3: Requested.

3.3.9**parameter ID**

identifier (ID) of a parameter that is specified by a standard or vendor and identifies the parameter whose value is returned

3.3.10**parameter value**

value of the parameter to be returned

3.3.11**performance parameter type**

requested type of information related to a communication link ID

Note 1 to entry: The type is represented by a number with the following code: 1: Transmission time; 2: Update time; 3: Response time; 4: Data throughput; 5: Communication availability.

3.3.12**radio regulation database ID**

identifier (ID) of the radio regulation database

3.3.13**received signal strength indication****RSSI**

value of the power present in a received radio signal

3.3.14**received signal strength indication mean****RSSI mean**

mean value of the power present in a received radio signal

3.3.15**received signal strength indication standard deviation****RSSI standard deviation**

standard deviation value of the power present in a received radio signal

3.3.16**report interval**

interval time of cyclic reports

Note 1 to entry: This belongs to the cyclic "medium sensing report type".

3.3.17**sensing duration**

parameter specifying the duration of a sensing process

3.3.18

sensing end frequency

parameter specifying the stop frequency of sensing

3.3.19

sensing interval

parameter specifying the interval between sensing processes

3.3.20

sensing start frequency

parameter specifying the start frequency of sensing

3.3.21

service status

parameter that provides information on the result of service execution

Note 1 to entry: The service status can be either ABORTED or TIMEOUT.

3.3.22

SINR

signal to interference plus noise ratio

value of the power of a certain signal of interest divided by the sum of the interference power from all the other interfering signals and the power of some background noise

3.3.23

spectrum sensing entity ID

identifier (ID) of the spectrum sensing entity containing either SSN or SSF

3.3.24

status

parameter that specifies the behaviour of the wireless device concerning configuration by a code

Note 1 to entry: The status is represented by a number with the following code: 0: No address assigned; 1: Unconfigured; 2: Configured.

3.3.25

system address

communication partner identification of the system for a service

3.3.26

Timestamp

information concerning time of collected attribute data

3.3.27

wireless system ID

identifier (ID) as part of a service execution related to the concerned wireless system

~~3.3.27~~

~~wireless type~~

~~parameter that characterizes the model of a wireless system or a wireless device~~

~~Note 1 to entry: The parameter can contain either the wireless system or wireless device. If using the IEC CDD, then use the unique identifier.~~

3.3.28

wireless ID

identifier (ID) as part of a service execution related to the model of a wireless system or a wireless device

3.4 Terms and definitions given in IEC 62657-2

For ease of understanding, the most important terms from IEC 62657-2 used within this document are listed but the definitions are not repeated in the list.

- antenna type,
- antenna gain,
- antenna radiation pattern
- automation application,
- bandwidth,
- centre frequency,
- coexistence (wireless communication coexistence),
- ~~coexistence assessment,~~
- coexistence planning,
- coexistence management,
- communication load,
- device,
- device type,
- duty cycle,
- dwell time,
- frequency band,
- frequency channel,
- logical link
- lower cut-off frequency,
- mechanisms for adaptivity,
- medium utilization factor
- message,
- number of consecutive lost messages,
- plant,
- power spectral density,
- radio channel,
- signal to interference and noise ratio,
- received signal strength indication,
- receiver sensitivity,
- transfer interval,
- wireless application,
- wireless communication,
- wireless communication application,
- wireless communication solution,
- wireless communication system,
- wireless device,
- wireless network,
- wireless system type,
- total radiated power,
- upper cut-off frequency.

3.5 SRF specific definitions

3.5.1

SRF Wireless Platform

specification of hardware and software architecture for coexistence management

3.5.2

SRF Gateway

managed gateway used for SRF Wireless Platform

3.5.3

SRF Device

managed wireless device used for SRF Wireless Platform

3.5.4

SRF Sensor

sensing node used for SRF Wireless Platform to monitor the radio environment

3.5.5

SRF Wireless Set

group consisting of SRF Gateway and SRF Devices to communicate wirelessly between each other

3.5.6

Non-SRF Wireless Set

wireless devices that are not supporting the SRF Wireless Platform

3.6 Abbreviated terms

ACRM	application communication requirements management
AFH	adaptive frequency hopping
AL	application layer
AP	access point
ble	Bluetooth low energy
CC	central coordination
CCP	central coordination point
CDD	common data dictionary
CMWCA	CCP managed wireless communication application
CMWD	CCP managed wireless device
CONF	confirmation
CS	convergence sublayer
C-SAP	control service access point
DAA	detect and avoid
DAR	detect and reduce
DAS	detect and suppress
DoA	direction of arrival
EIRP	equivalent isotropic radiated power
HMI	human machine interface
ID	identifier
IETF	Internet engineering task force
IND	event notification

IP	Internet protocol
ISM	industrial, scientific and medical
JSON	JavaScript object notation
LAN	local area network
MAC	medium access
MLME	medium access layer management entity
MRM	medium resource management
M-SAP	management service access point
PE	policy engine
PHY	physical layer
PLC	programmable logic controller
PLME	physical layer management entity
PSD	power spectral density
QoS	quality of service
REQ	request
RES	response to the request message
RF	radio frequency
RSSI	received signal strength indication
SAP	service access point
SDU	service data units
SFID	service flow identifier
SINR	signal to interference plus noise ratio
SSF	spectrum sensing function
SSN	spectrum sensing node
SSS	spectrum sensing system
~~TRP~~	~~Total radiated power~~
STA	station
WCA	wireless communication application
WCD	wireless communication device
WCS	wireless communication system
WCSDCC	wireless communication system and device configuration and control
WCSDS	wireless communication system and device subscription
WIA	wireless industrial automation
WSAN	wireless sensor actuator network

3.7 Conventions used for service descriptions

This document uses the descriptive conventions given in ISO/IEC 10731.

The service model and service primitives used are entirely abstract descriptions; they do not represent a specification for implementation.

Service primitives, used to represent service user/service provider interactions (see ISO/IEC 10731), convey parameters that indicate information available in the user/provider interaction.

The parameters that apply to each group of primitives are set out in tables throughout the remainder of this document. Each table consists of ~~up to six~~ **five** columns, containing the name of the service parameter, and a column each for those primitives and parameter-transfer directions used by the service:

- the request primitive's input parameters;
- ~~– the request primitive's output parameters;~~
- the indication primitive's output parameters;
- the response primitive's input parameters, and
- the confirm primitive's output parameters.

One parameter (or part of it) is listed in each row of each table. ~~For local services, only request primitive with input and output parameters is used.~~ Under the appropriate service primitive columns, a code is used to specify the type of usage of the parameter on the primitive and parameter direction specified in the column:

M	parameter is mandatory for the primitive.
U	parameter is a user option and may or may not be provided depending on the dynamic usage of the ~~DLS~~ -service user. When not provided, a default value for the parameter is assumed.
S	only one parameter in a group of parameters using this code is required.
C	parameter is conditional upon other parameters or upon the environment of the ~~DLS~~ -service user.
CU	parameter is a conditional user option, and may or may not be permitted depending upon other parameters or upon the environment of the ~~DLS~~ -service user. When permitted, it may or may not be provided depending on the dynamic usage of the ~~DLS~~ -service user. When permitted and not provided, a default value for the parameter is assumed.
(blank)	parameter is never present.

In this document the service message formats are described using JSON notation according to IETF RFC 8259.

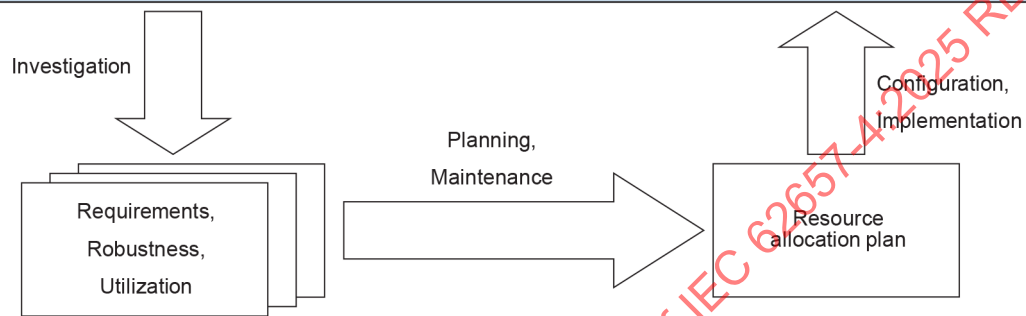
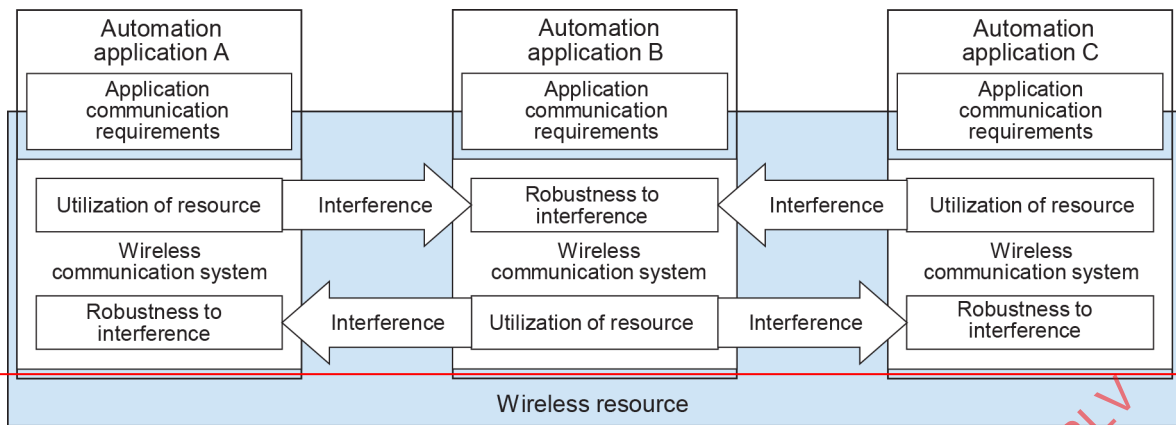
4 Area of consideration

4.1 Coexistence conceptual model

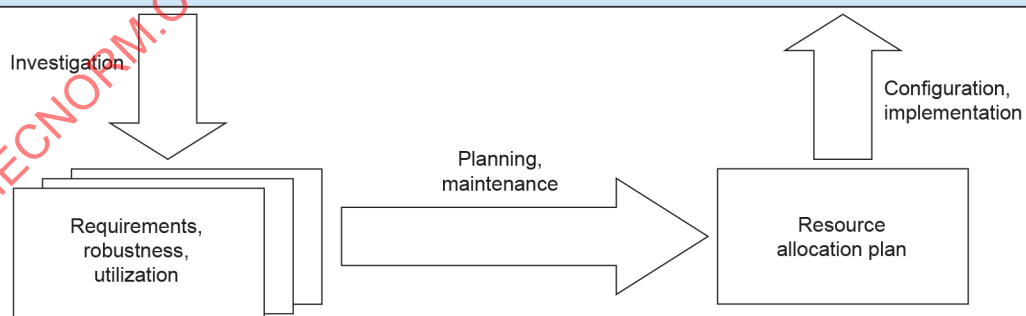
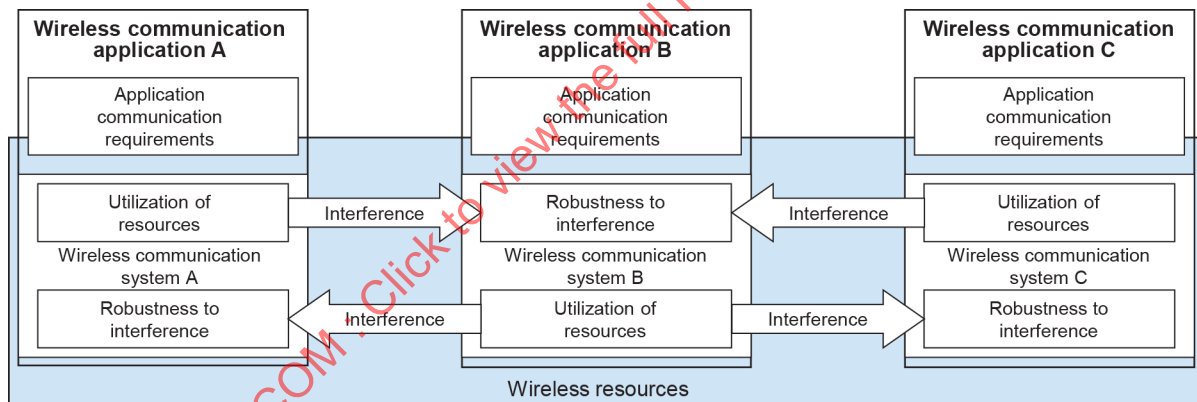
In Figure 1, the coexistence conceptual model, described in IEC 62657-2, is shown. In this example, three wireless communication applications – A, B and C are assumed. According to the definition of wireless coexistence, all three wireless communication applications shall fulfill their application communication requirements. One part of the wireless communication application (WCA) A is a selected wireless communication system (WCS) A. It uses the wireless ~~medium~~ **resources** for communication and can interfere with other WCS, e.g. WCS B. WCS B can be of the same wireless technology or of another one. Each WCS is characterized by a certain robustness against interference. Thus, not every interference leads to errors in communication or to application failures.

Coexistence management requires the investigation of the coexistence state throughout the entire life cycle of the system. This requires that measurements be taken to determine whether all wireless communications applications are fulfilling their application communications requirements.

An investigation of the application communication requirements and the characteristics of the wireless system (immunity and utilization) shall be reported in an inventory. The resulting coexistence planning shall be reported in a resource allocation plan. This shall be the basis for implementing the radio resources and their utilization.



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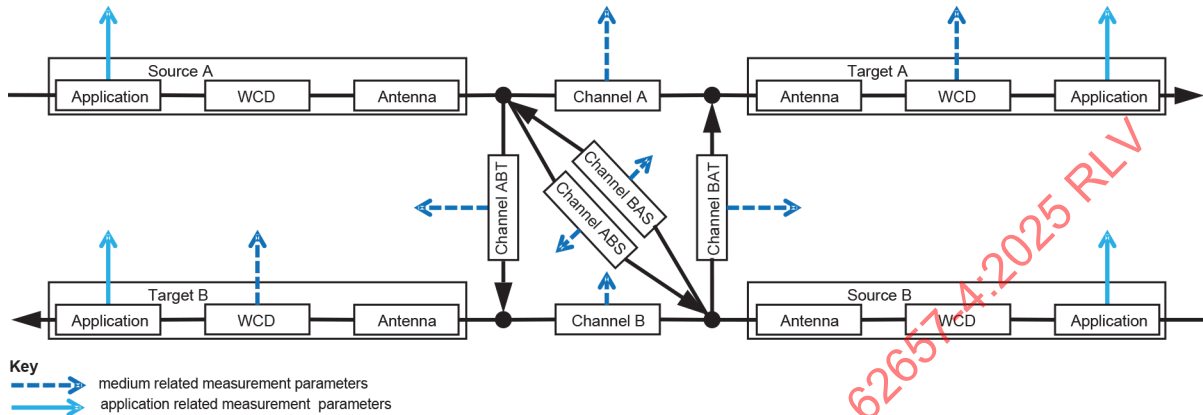
IEC

Figure 1 – Wireless coexistence conceptual model according to IEC 62657-2

4.2 Investigation of coexistence state

An essential task for coexistence management is to calculate and to evaluate the coexistence state. With respect to the definition of the term coexistence, in addition to spectrum parameters (e.g. frequency channel or power spectral density), application related **characteristic** parameters (e.g. transmission time) are also required to calculate the coexistence state.

Figure 2 is intended to show where relevant parameters can be determined. The figure shows a scenario with two WCA (A and B) with one logical link per WCA. Messages of a distributed application are transferred via the source device, transmitter antenna, radio channel, receiver antenna, and target device to the target of the distributed application. Interferences can occur from the source antenna of one WCS to the antennas of the other WCS. These interferences are influenced by the radio channel characteristic between the relevant antennas. Table 1 lists the relevant radio channels of the scenario shown in Figure 2.



IEC

Figure 2 – Sources to determine parameters for coexistence state calculation

Table 1 – Explanations of radio channels

Radio channel	Explanation
Channel A	passiveActive environmental influences for transmissions from source A to target A
Channel ABT	passiveActive environmental influences for interferences from source A to target B
Channel ABS	passiveActive environmental influences for interferences from source A to source B
Channel B	passiveActive environmental influences for transmissions from source B to target B
Channel BAT	passiveActive environmental influences for interferences from source B to target A
Channel BAS	passiveActive environmental influences for interferences from source B to source A

Relevant parameters can be determined by:

- spectrum sensing function (e.g. frequency channel);
- source application (e.g. number of transferred messages);
- target wireless communication device (e.g. number of correct received messages);
- target application (e.g. transmission time).

Relevant parameters to determine and assess coexistence are specified in detail in Clause 6. In ECC Report 206, an approach is introduced to holistically assess the dependability of industrial communication. This approach is well-suited to derive a coexistence state function defined as follows.

$\sigma_i(t)$ is the normalized parameter of the characteristic parameter i , according to Clause 6, at time t . Index i with $i = 1 \dots n$ specifies one of n types of characteristic parameters. Factors for normalizing depend on the type of the characteristic parameter and are specified in Clause 6. The parameter $\sigma(t)$ expresses the quality of a logical connection of a WCS at time t .

A weighting factor $u_i(t)$ is introduced with a possible range of 0 to 1. This factor allows to adapt a parameter of type i according to the requirements. While, for example, the transmission time

is more relevant for applications with event driven communication, the update time is important to applications with periodic traffic. This can be expressed with $u_i(t)$. The time dependence of this factor considers emerging flexible concepts of industrial automation that could require adaptations of the relevance of different parameter types.

The coexistence state function shall consider all known $k = 1 \dots p$ WCS. The priority of an application that uses WCS k is expressed with the weighting factor $w_k(t)$. Furthermore, the logical links $j = 1 \dots m$ of a WCS should be taken into account. The importance of a logical link is expressed by the weighting factor $v_j(t)$.

Thus, a coexistence state function $\chi(t)$ according to Formula (1) can be defined.

$$\chi(t) = \frac{1}{\sum w_k(t)} \sum_{k=1}^p w_k(t) \times \left(\frac{1}{\sum v_j(t)} \sum_{j=1}^m v_j(t) \times \left(\frac{1}{\sum u_i(t)} \sum_{i=1}^n u_i(t) \times \sigma_i(t) \right) \right) \quad (1)$$

Assuming a threshold χ_{Thr} that specifies the state in which the application communication requirements of all wireless communication applications are fulfilled, the coexistence state can be specified as shown in Formula (2).

$$s(\chi(t) \geq \chi_{\text{Thr}}) = 1 \quad (2)$$

The complementary state of non-coexistence is defined according to Formula (3).

$$s(\chi(t) < \chi_{\text{Thr}}) = 0 \quad (3)$$

The difference of actual value $\chi(t)$ and threshold χ_{Thr} is called coexistence margin (see Formula (4)). The difference of threshold χ_{Thr} and actual value $\chi(t)$ is called coexistence distance (see Formula (5)).

$$\chi_M(t) = \chi(t) - \chi_{\text{Thr}} \quad (4)$$

$$\chi_D(t) = \chi_{\text{Thr}} - \chi(t) \quad (5)$$

A coexistence state function with its main values is shown as an example in Figure 3.

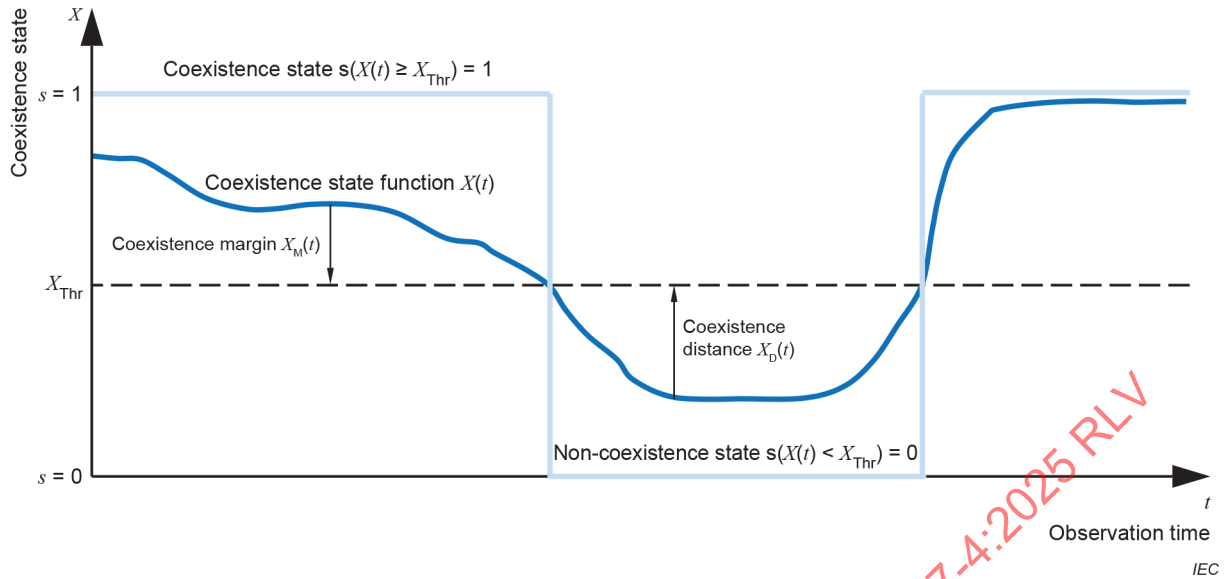


Figure 3 – Coexistence state function

The coexistence state function can be used to assess the level of coexistence and to derive measures to maintain coexistence. The characteristic parameters $\sigma_i(t)$ referred to WCS k and to logical link j offer the possibility to identify weak points within the area of consideration. Based on that algorithm, the central coordination approach is able to derive specific resource allocations.

4.3 Implementing radio resources and their utilization

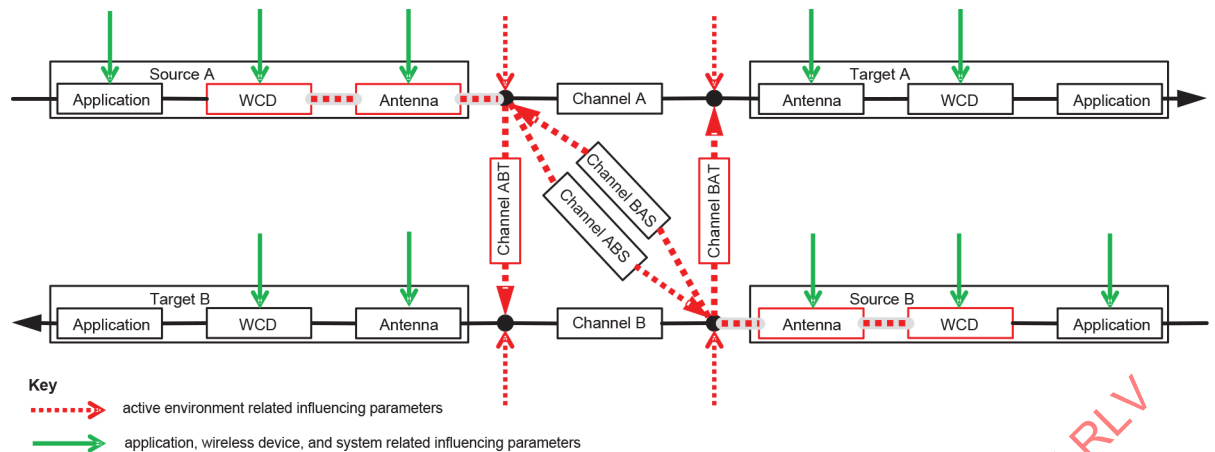
In Figure 4, active environmental influences and targets to control coexistence are depicted. The scenario is the same as in Figure 3. In addition to the mutual interference of both systems, external interferences that cannot be influenced are indicated by dotted arrows. The mutual interference is attenuated by the radio channels ABT, BAS, BAT and ABS (see also Table 1).

Relevant parameters can be controlled by:

- source application (e.g. transfer interval);
- source wireless communication device (e.g. frequency channel);
- antenna type (e.g. beam forming);
- target wireless communication device (e.g. buffer management).

Changing the values of the above-mentioned parameters affects not only the coexistence (fulfilment of the requirements of all applications) but also directly the fulfilment of the requirements of the controlled application. An extension of the transfer interval, for example, can be helpful for other applications, but critical for the controlled application. Controlling the parameters accordingly should therefore be considered.

Relevant parameters to control coexistence are specified in detail in Clause 7. To comply with this document, the WCD shall implement parameters and services that allow the control of coexistence.



IEC

Figure 4 – Parameters describing active influences and control parameters used to manage coexistence

4.4 Coexistence management equipment

In compliance with the area of operation (industrial automation), coexistence management equipment shall be treated throughout the entire life cycle as automation equipment. This applies to the device description (for example field device integration according to the IEC 62769 series, the information exchange and management as well as questions of how much security, intrinsic safety, functional safety, high availability, etc. is needed). For example, a spectrum sensing function will be a vulnerability point in an automated coexistence management system by jamming radio waves. It is recommended to apply the IEC 62443 series for cyber security concerns like denial of service (wireless jamming). In an operational space, there are typically multiple control systems with separate wireless communication systems due to the separation of functionalities and concerns. The automated coexistence management system interacts with the devices of the wireless systems and the control system to receive information and to configure them.

5 Wireless coexistence management system architecture

5.1 General

This document deals with the basic idea of automated coexistence management of wireless communication systems for automation applications with central coordination (CC) of several wireless communication systems within industrial plants. This automated coexistence management with centralized coordination is an example implementation of the class `CoexistenceManagementSystem` described in IEC 62657-3:2022, 5.2. The wireless communication systems can use the same communication technology, called homogenous wireless communication infrastructure or different communication technologies, called heterogeneous wireless communication infrastructure. The aim is to further improve the efficient use of the radio resource. The main idea is to

- deal with wireless devices that can be controlled and take into account devices that cannot be controlled;
- consider available per device mitigation techniques in a central coordination approach;
- stop transmitting radio energy or to activate the per device mitigation technique if central coordination fails;
- ensure the compliance of wireless devices with local regulations by having a central coordination controlling and managing the use of the spectrum in the boundaries declared for the devices.

In general, the functional architecture for central coordination of wireless communication systems for automation applications shall fulfill the following basic requirements:

- provide coordination mechanisms to achieve and maintain coexistence between different wireless communication solutions in the same frequency range;
- avoid harmful interferences. Provide mechanisms for automatic spectrum access and utilization, with the aim of:
 - recognition of free and occupied spectrum;
 - detection and classification of wireless communication solutions including incumbent radio systems;
 - establishment of communication channels;
 - registration of wireless communication systems in the location(s) of interest in the plant;
 - inventorying wireless automation applications with the associated wireless communication system;
 - release or rejection of newly registered wireless communication systems for automation applications;
 - gathering the requirements for the use of wireless communication based on the agreed decisions of the internal procedure;
- providing mechanisms for continuous monitoring of
 - the frequency spectrum condition, and
 - the coexistence state.

The available medium resources can be organized by assigning resource blocks to different wireless systems and/or devices by the CC. The resource blocks represent a combination of resources from the time, frequency and space domains and the coding.

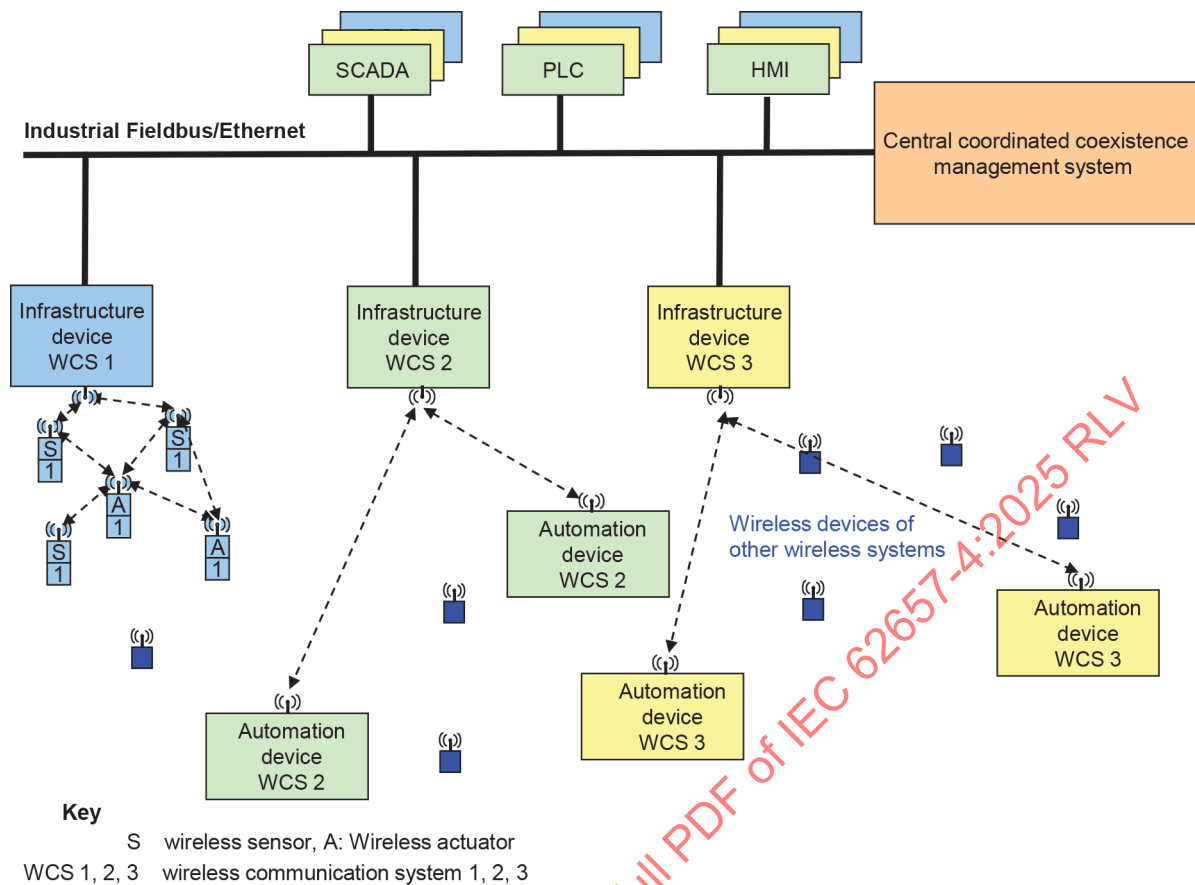
The CC shall include communication with wireless systems or with wireless devices by means of one or more communication channels and protocols. Therefore, the CC shall fulfill the following requirements:

- support of different radio technologies;
- support of interface for coordination.

The coexistence management for intra-system coexistence can substitute manual coexistence management as defined by IEC 62657-2.

The CC is used to schedule resources to the different wireless communication solutions. This can include CC of single devices and CC of wireless systems. In the latter case, the wireless systems will then use the CC information to configure and control its own wireless network.

If the wireless communication applications are not controlled by CC and operate independently using the medium access control mechanisms of the wireless communication systems, then there is no coordination between them, and they rely on their own techniques for network formation, network discovery, service discovery and interference management, including the protection of incumbent radio systems.



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Figure 5 – Example instance of class CoexistenceSystem in accordance with IEC 62657-3

Figure 5 shows an example representation of the class model CoexistenceSystem from IEC 62657-3:2022, 5.2. The class DistributedAutomationSystem is represented by local automation functions implemented in Supervisory Control and Data Acquisition (SCADA), Programmable logic controller (PLC), Human Machine Interface (HMI), Sensor (S), Actuator (A), and the application component of the automation devices. The wireless communication components of the Wireless Communication Systems WCS 1 to WCS 3 are instances of the class WirelessCommunicationSystem. The wireless devices of other wireless systems are instances of the class ActiveEnvironmentalInfluence. The central coordinated coexistence management system is an instantiation of the class CoexistenceManagementSystem. In the following, the example representation of Figure 5 is used to describe the system elements, the architecture, the functions and the interfaces of a CCP system in more detail.

The central coordinated coexistence management system has three entities, as shown in Figure 6:

- central coordination point (CCP);
- spectrum sensing system (SSS), which is a combination of spectrum sensing nodes (SSN) and spectrum sensing functions (SSF), see 5.2.4;
- database services with information and configuration database and regulation database.

Each entity is defined by its functional roles and interaction with other entities.

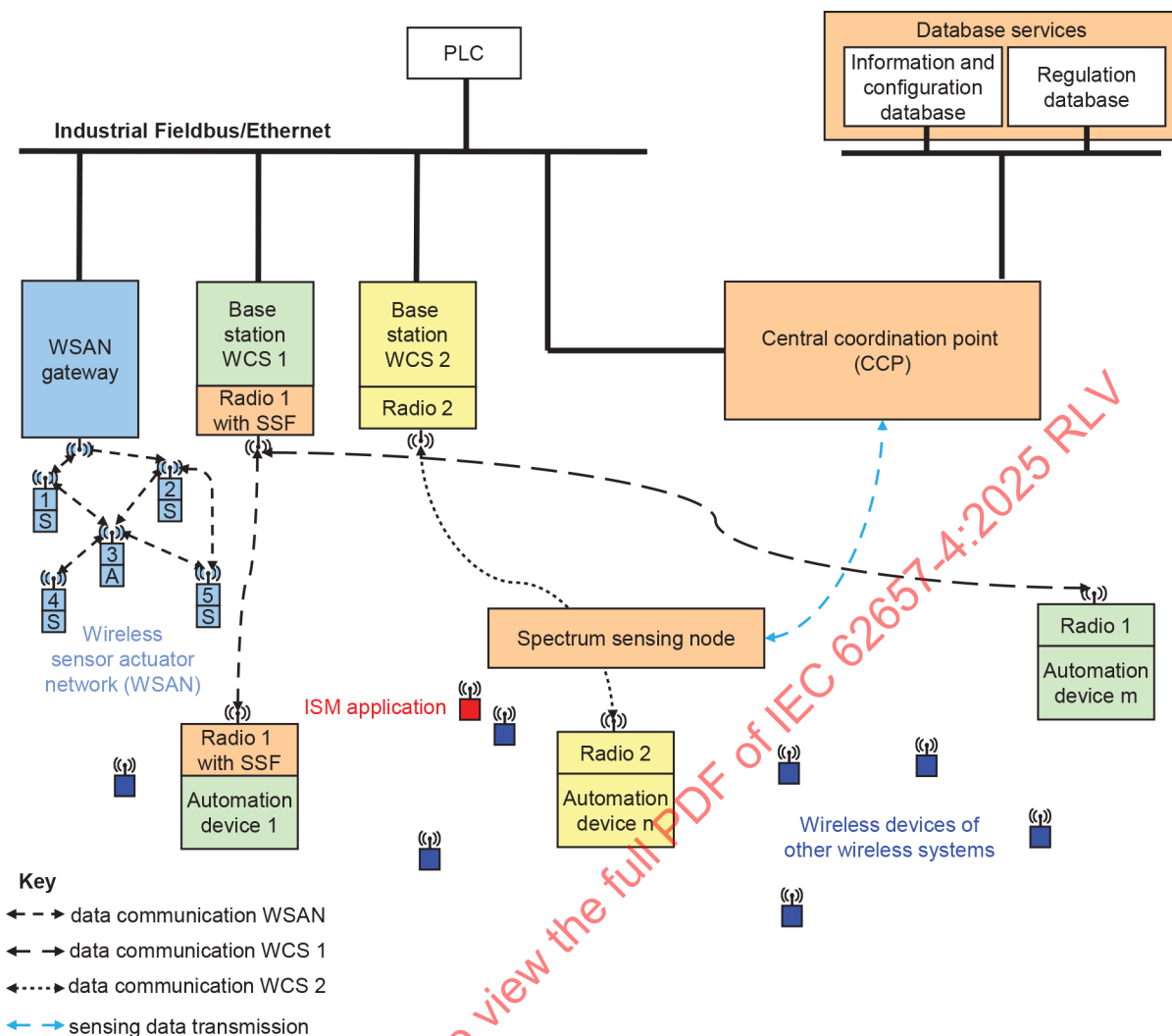
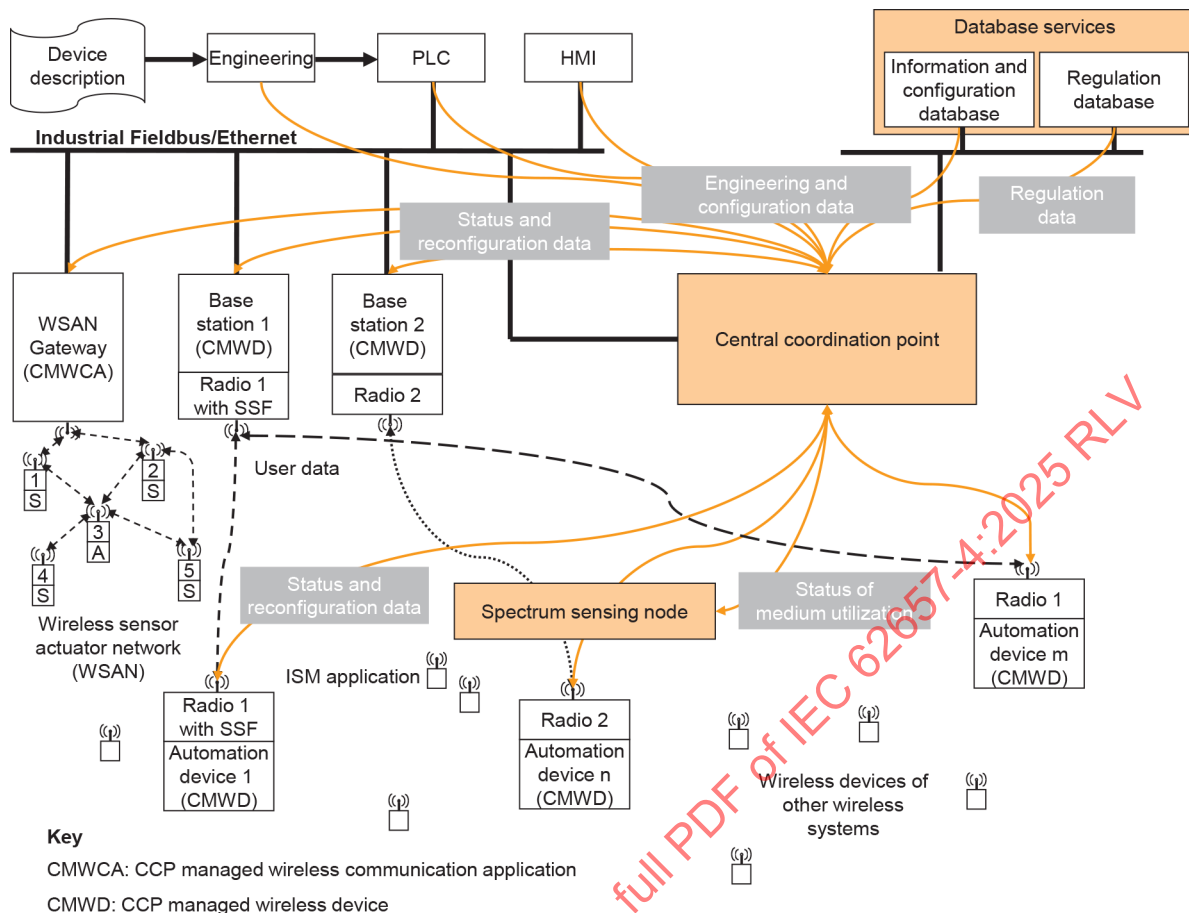


Figure 6 – Elements of central coordinated coexistence management system

Figure 6 shows three independent wireless communication systems that are subject to central coordination. A wireless sensor actor network (WSAN), a wireless communication system 1 (Radio 1) and a wireless communication system 2 (Radio 2). Furthermore, there are wireless devices of other wireless communication systems that are not under control of the CC (incumbent radio systems) and an ISM application that may can interfere with the wireless communication applications of interest. A line-based industrial communication system is used as a backbone to connect the wireless communication systems and the CCP.



IEC

Figure 7 – Data exchange in central coordinated coexistence management system

Figure 7 shows the data exchange between the elements in a central coordinated coexistence management system. The central coordination point (CCP) is the key element of the coexistence management system. The CCP makes coexistence management decisions based on engineering baseline data, information from databases and current measurements of application behaviour and spectrum. Current measured values of application behaviour and spectrum can be collected for wireless systems via their central device, for example a base station, or directly from wireless devices. In the first case, there is only one connection between the CCP and the central component, as with WSAN in Figure 7. Then the application using the WSAN is a CCP managed wireless communication application (CMWCA). In the other case, there are connections from the CCP to the wireless devices, as with the wireless communication system 1 and wireless communication system 2. These are then called CCP managed wireless devices (CMWD). The exchange of coexistence data can take place directly between CCP and CMWD or via the central device of the WCS. Current measured values of spectrum are also provided by the spectrum sensing node (SSN).

The CCP manages the available resources spectrum, time and space and assigns the resources to the CMWCA and/or CMWD with respect to the requirements of the automation application. The central device of CMWCA receives the resource information and acts as master station and manages the registered and connected slave station of CMWCA. Therefore, the CMWCA uses available spectrum resources with additional knowledge about spectrum usage by its neighbour CMWCA and about incumbent radio systems.

5.2 System elements

5.2.1 Wireless systems and wireless devices for automation applications

5.2.1.1 Wireless device with per device mechanisms for adaptivity and medium access control

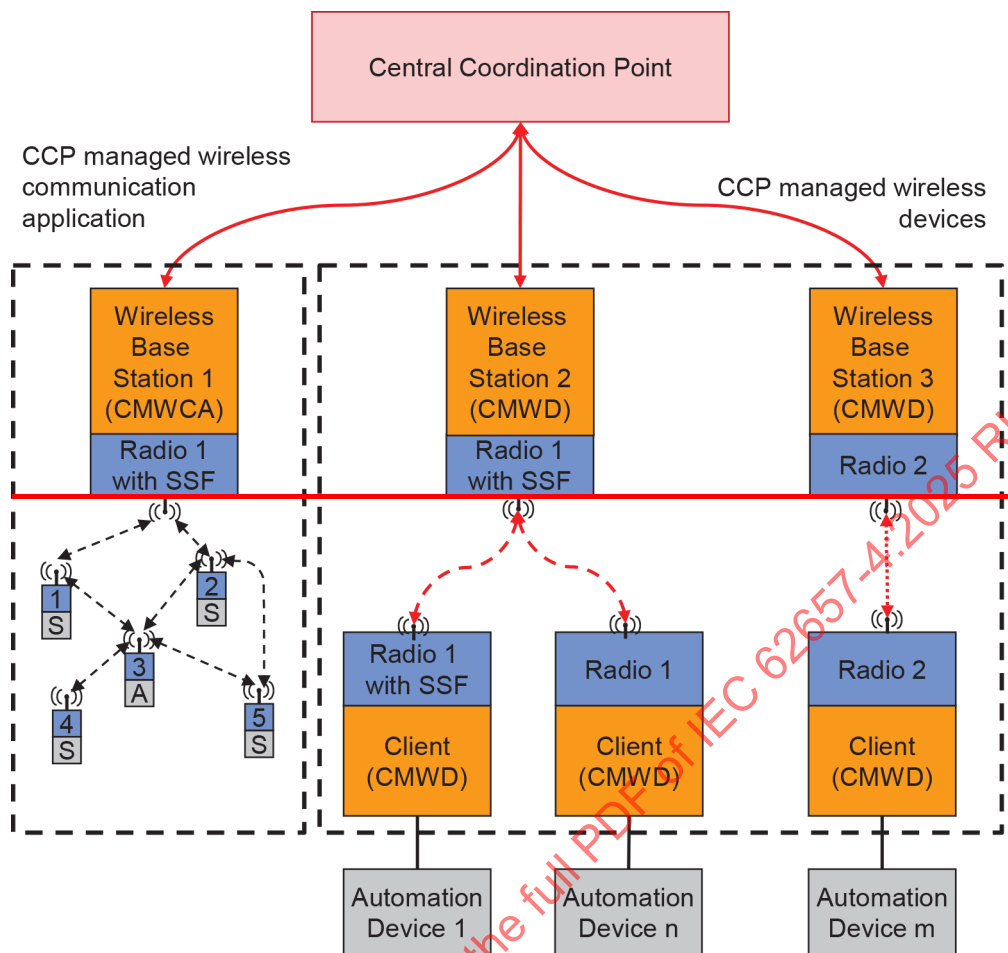
Wireless devices with per device mechanisms for adaptivity and medium access control mechanism shall provide the needed mechanisms for adaptivity and medium access control mechanism for the assigned frequency band, such as dynamic frequency selection and frequency agility mechanisms. Manual coexistence management according to IEC 62657-2 can be used for intra-system coexistence but cannot replace mandatory mechanisms to fulfill regulatory requirements (for example protect incumbent radio system). IEC 62657-2 should be established to improve the efficient use of the medium in an industrial environment if the device cannot participate in the CCP concept.

5.2.1.2 CCP managed wireless communication application and wireless device

The CCP managed wireless communication application (CMWCA) and/or the CCP managed wireless devices (CMWD) are supervised, managed and controlled by the CCP. The CCP managed wireless communication application combines all related functions in one wireless device, ~~which are necessary in order to ensure its role as master. Station for the wireless communication application and slave station for CCP. The CCP managed wireless devices function as slave station for CCP only and can take over the role as end device or infrastructure device in a wireless communication system, as depicted in Figure 7.~~ That is, the control functions (for example base station or access point functions) for the wireless communication system and the client functions for the CCP. The CCP managed wireless devices include the client functions for the CCP and the functions of a wireless communication module (WCM) or an infrastructure device in a wireless communication system, as depicted in Figure 8.

The CCP controlled wireless communication application and wireless device shall not transmit wireless data messages by itself. If the communication between CCP and CCP managed wireless device is established and the CCP enables the transmission, then the CCP managed wireless device can transmit wireless data messages with or without mechanisms for adaptivity and/or medium access control mechanism. If the communication between CCP and the CCP managed wireless device fails, the wireless transmission shall stop if, for example, the regulatory required mitigation is not in the device, or the device does not have access to the antenna. A heart-beat signal or similar mechanisms shall enable monitoring of the communication between CCP and CCP managed wireless communication application and wireless device.

CCP managed wireless devices can have implemented spectrum sensing functions. These can be integrated into the overall spectrum sensing system (see 5.2.4).



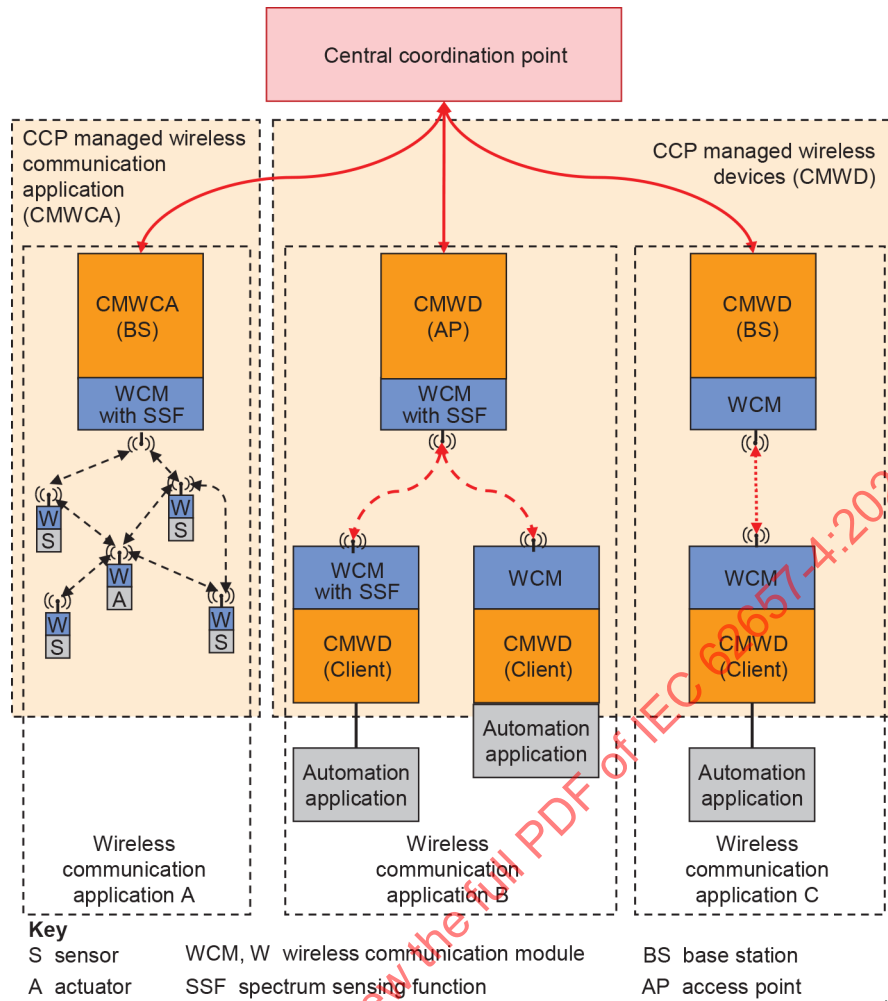


Figure 8 – CCP managed wireless devices and CCP managed wireless systems

Wireless devices of CMWCA that do not perform active spectrum sensing to save power have limited sensing capability and are therefore subject to dynamic interference. In that context, the spectrum sensing system can perform specific sensing measurements to support a wireless system consisting of such low-power wireless devices with limited sensing capability.

5.2.1.3 CCP managed wireless device with per device mechanisms for adaptivity and medium access control mechanism

Wireless devices with per device adaptivity and medium access control mechanisms which are also CCP controlled shall fulfill the requirements of 5.2.1.1.

If the communication between CCP and a CMWCA or a CMWD is established and the CCP enables the transmission, the wireless device or wireless system can transmit without adaptivity and medium access control mechanisms. If the communication between CCP and a CMWCA or a CMWD fails, the transmission shall be in line with adaptivity and medium access control mechanisms.

5.2.2 Central coordination point

5.2.2.1 General

The central coordination point (CCP) is a centralized coordination device or system for management of heterogeneous wireless infrastructures for spatially distributed automation applications. As shown in Figure 9, the CCP consists of an access to backplane(s) and an access to the RF channel, a spectrum engine, a resource engine and a policy engine.

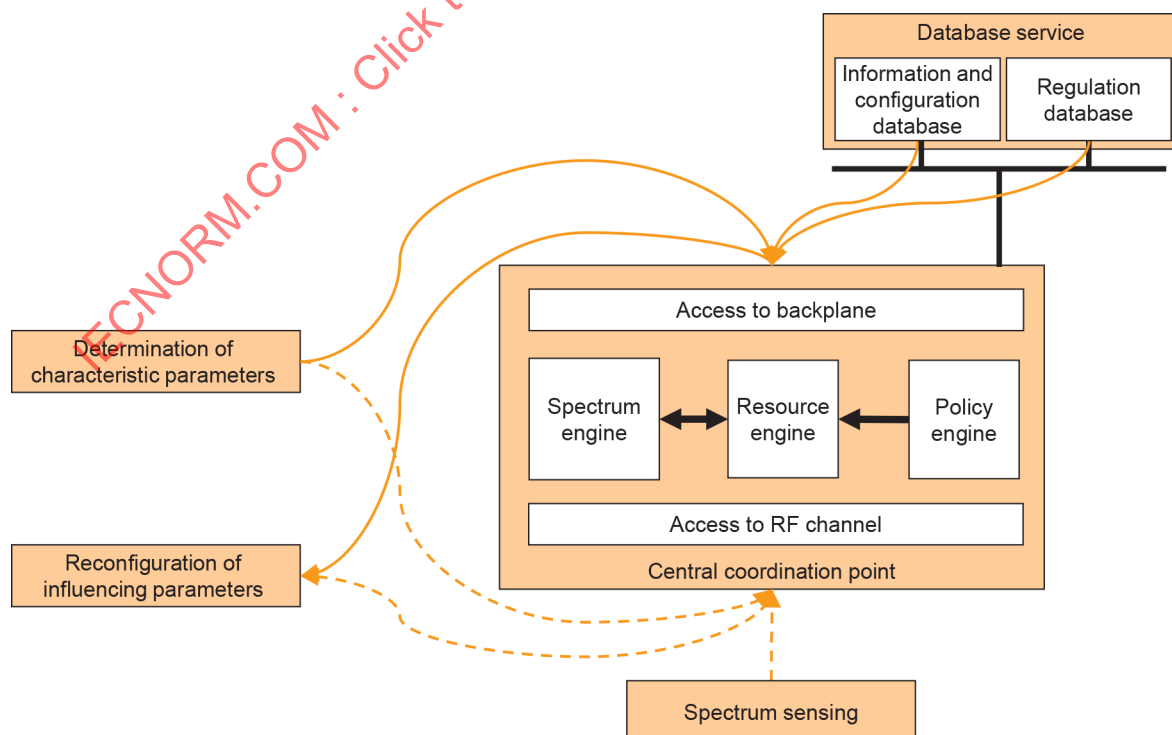
The tasks for the CCP are:

- management (control and coordination) of a heterogeneous wireless communication infrastructure for **spatially distributed** automation applications;
- establishment of automatic coexistence management within a heterogeneous wireless communication infrastructure for automation applications;
- consideration of the automation application requirements;
- detection and protection of wireless communication applications;
- consideration and fulfilment of regional regulatory requirements for wireless communication systems and wireless devices with support of geolocation.

The CCP shall:

- establish a wired or wireless communication to the information and configuration data base containing geolocation and medium usage information from wireless communication applications and incumbent radio systems;
- detect incumbent radio systems and select the appropriate mitigation technique to protect these systems;
- use application related characteristic parameters according to IEC 62657-2:2025, 6.6 to determine the coexistence state described in 4.2;
- obtain the requirements of the automation applications (see IEC 62657-2) and assign resources accordingly to the CMWCA and CMD;
- establish a wired or wireless connection to the CMWCA and CMD;
- establish a wired or wireless connection to the regulation database.
- reconfigure CCP managed wireless communication applications and wireless devices using influencing parameters defined in IEC 62657-2:2025, Clause 7.

If more than one CCP is in use in a certain configuration, then wired or wireless communication shall be established directly or indirectly between the CCPs. All requirements of a single CCP shall apply.



IEC

Figure 9 – Overview of CCP

5.2.2.2 Spectrum engine

The spectrum engine (SE) is a management and control function and an entity of the CCP. The SE centralizes all medium usage decisions for various wireless communication applications, taking into account medium availability information and location-specific medium utilization.

In summary, the SE shall be responsible for:

- maintaining medium availability and medium utilization information;
- channel classification and selection;
- association control;
- channel set management;
- accessing the database service;
- scheduling spectrum sensing operation;
- making channel move decisions for one or more CCP managed wireless systems or wireless devices for the automation application;
- supporting coexistence of wireless communication applications;
- considering incumbent radio systems and other wireless applications;
- establishing a wired or wireless connection to all CCP managed wireless communication applications and devices;
- establishing a connection to the resource engine.

5.2.2.3 Resource engine

The resource engine (RE) is a management and control function and an entity of CCP. The RE centralizes all information about automation application, application communication requirements and general plant characteristics. This information shall be analysed and processed with respect to the use of the wireless medium by the wireless communication applications. Furthermore, the RE shall consider the radio regulation restrictions.

The resource engine (RE) within the CCP shall be responsible for:

- collection, analysing and processing of engineering and automation application data;
- providing coexistence control parameters to the SE with respect to the radio regulation restrictions and limitations;
- maintaining the requirements of the automation application;
- maintaining and monitoring QoS information of the communication links.

5.2.2.4 Policy engine

The policy engine (PE) is a management function and an entity of CCP. The PE centralizes all location-dependent radio regulation restrictions and limitations about the used frequency ranges. The PE shall be responsible for:

- maintaining regulatory requirements, restrictions and limits regarding the geographical location, as well as the range of frequencies used by the wireless systems and wireless devices for automation applications;
- establishing a wired or wireless communication to the regulation database containing geolocation limit of radio spectrum regulation.

It is impossible to get a general approval of administrations for the CC concept in general. To get an assuredness that vendors can start to invest in products compliant with this document, it is important to know that a vendor that put products on the market and put the product into service is responsible to comply with local and regional policies. There exist two principles on the worldwide markets:

- the process of self-declaration of conformity;
- type approval.

NOTE 1 In Europe, as a harmonized standard for this type of product does not exist, the process is to ask a notified body for its expert opinion.

NOTE 2 The responsibility for the product remains by the vendor.

The product description shall provide the needed information to describe the system:

- CCP;
- CCP managed wireless communication applications and devices,

with their CCP-service-interfaces to operate using a communication interface. The communication interface could be based for example on IEEE Std 802.11. The CCP-service-interfaces shall be according to this document.

Table 2 – Level of effectiveness of wireless automation

Scenario	Achievement of coexistence	Spectrum efficiency
Without coexistence management	Hardly	—
With coexistence management	Most likely	Not efficient
With CCP based coexistence management	Most likely	Efficient
With CCP based coexistence management and only controlled traffic	For sure	Efficient

As shown in Table 2, the CCP increases the achievement of the coexistence of wireless communication applications compared to not using a CCP concept. That means the policy engine shall contain all relevant restrictions to fulfil the regional and local requirements of regulations, policies and others.

5.2.3 Coordination database

5.2.3.1 Information and configuration database

The information and configuration database (ICD) stores information about automation application communication requirements, CCP managed wireless applications and CCP managed devices, wireless systems and wireless devices with per-device adaptivity and medium access control mechanisms, location-specific information, and radio-specific information. The ICD shall provide this information to the CCP. The radio-specific information shall include information on available radio frequencies and associated maximum EIRP values, implemented adaptivity mechanisms, and medium access control mechanisms used by the systems wireless and wireless devices under consideration. This enables the protection of incumbent radio systems. The information is derived from documentation of the wireless systems and wireless devices.

5.2.3.2 Regulation database

The regulation database (RD) contains regulation information about the used frequency band(s). The RD shall include information on radio regulation limits and information on incumbent radio systems and other wireless applications, as well as which frequency bands or parts of them can be used during operation.

Furthermore, the RD contains information on how wireless communication systems will respond when an incumbent radio system is detected. The CCP's policy uses the RD to configure wireless systems and wireless devices according to regulatory requirements. The incumbent radio systems are defined by:

- frequency band;
- incumbent type:
 - defense (radiolocation);
 - fixed service;
 - transportation;
- incumbent operation characteristic:
 - static;
 - dynamic by time;
 - dynamic by geography;
 - dynamic by time and geography.

Due to incumbent radio systems, a number of disadvantages can arise for wireless communication systems and thus for wireless communication applications (WCA), for example:

- reduced frequency band;
- reduced coverage;
- decreased capacity;
- decelerated access to spectrum.

5.2.4 Spectrum sensing system

The spectrum sensing system (SSS) is a combination of dedicated spectrum sensing nodes (SSN) and embedded spectrum sensing functions (SSF) integrated into the wireless devices for automation applications. The SSS shall continuously provide medium utilization information to the CCP. The SSS observes the relevant frequency bands in and around the environment of the local industrial premises to determine the occurrence of wireless applications including incumbent radio systems. This process is called sensing and takes into account parameters of the radio channel, of the known wireless applications, of the automation application, and of the environment. Furthermore, the determined spectrum values can provide information about the location of a transmitting wireless device.

Spectrum sensing is generally a passive process and shall not interfere with wireless applications. The sensed signals shall be detected from the SSS and the parameters shall be transferred to the SE function in CCP. ~~The parameters indicate frequency range, energy level, and occupation time and so identify the radio pattern of the transmitter. Based on this information, the SE can characterize, catalog and classify incumbent radio systems, wireless communication systems and devices, ISM applications and other wireless applications.~~ The parameters indicate frequency range, energy level and occupation time. To assess the energy level, for example the received signal strength indication (RSSI) or the signal to interference plus noise ratio (SINR) are used as parameters. Based on this information, the SE can identify the radio pattern of the transmitter and can so characterize, catalog and classify incumbent radio systems, wireless communication systems and devices, ISM applications and other wireless applications.

The spectrum sensing nodes (SSN) independently implement specific procedures for sensing the radio frequency environment inside and outside the local automation environment. The SSN shall permanently sense the radio frequency environment and report to the CCP so that it can refresh the status of the medium resources.

The spectrum sensing function (SSF) is present at the CMWCA and CMWD. The SSF in CMWCA independently implement specific procedures for sensing the radio frequency

environment at initialization of the master station and before the registration of a slave station with the master station and during operation.

The SSF in a CMWD shall contain essential features to allow proper operation when the device is not under the control of the WCS master station, for example, during initialization or during a channel change. When a CMWD is idle, the SSF shall conduct out-of-band sensing and report to the master station so that it can refresh the status of the channels in the backup/candidate channel list. At any other time, the SSFs in the CMWD are under the control of the CCP. When the master station is not transmitting, the SSF is active to conduct out-of-band sensing. The SSF can then also carry out sensing to clear channels.

CMWD may be subject to limitations in terms of processing capacity, memory resources or power requirements (battery powered). In these cases, the following measures can be applied:

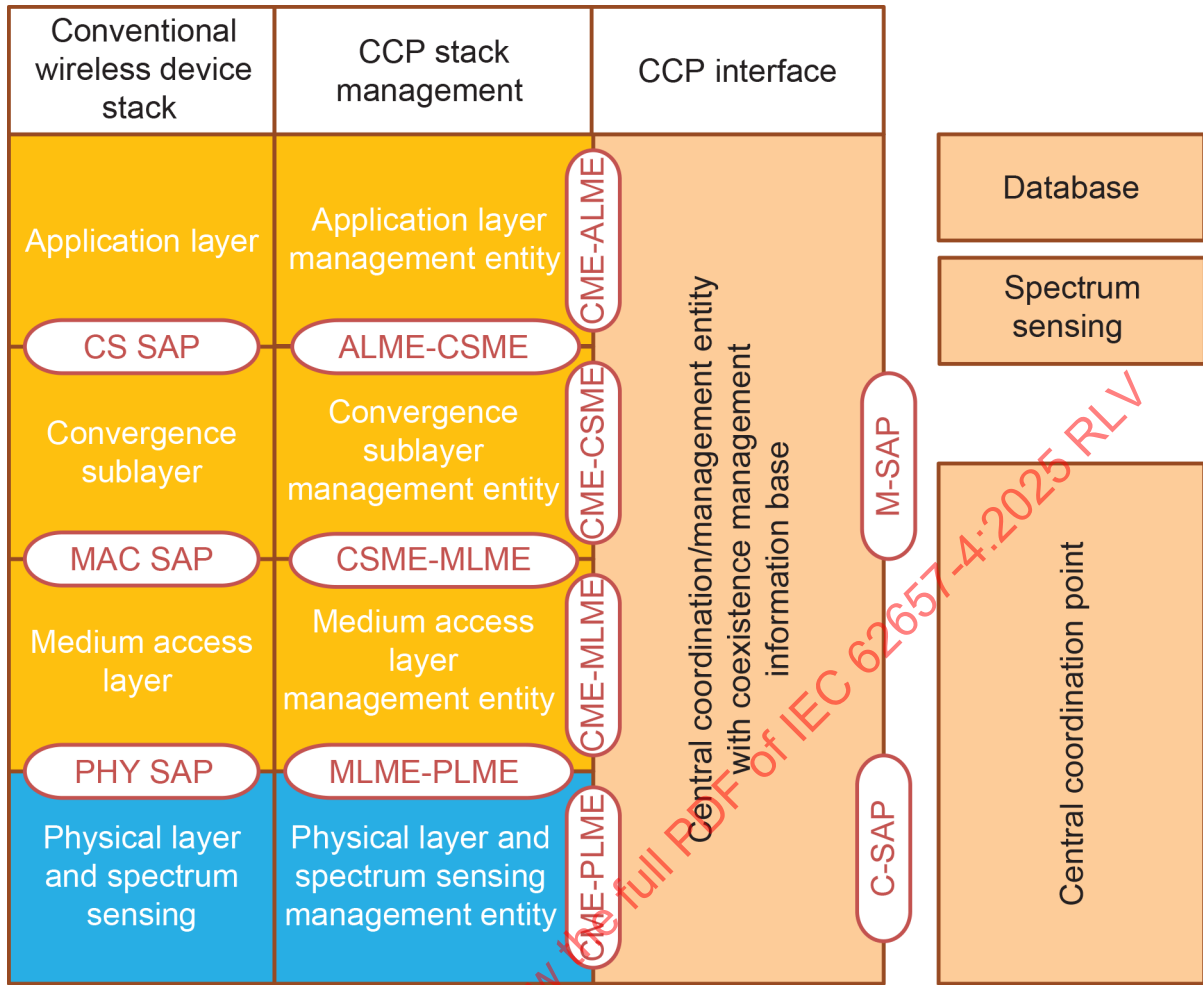
- The SSF is not started immediately after registration of the CMWD but on command of the CCP.
- The SSF senses only the frequency range that the wireless device can use operationally.
- The SSF can be suspended to conserve battery power.

These spectrum sensing limitations can be compensated by using information from the SSN and/or by selectively activating SSFs and performing sophisticated data analysis.

5.3 Protocol reference architecture

5.3.1 General

The protocol reference model (PRM) of CCP managed wireless automation applications and wireless devices, shown in Figure 10, is divided in three parts. The conventional wireless device stack transfers the user data. It is called user plane or data plane. The CCP stack management provides the CCP management and control services of the device according to Clause 8. The CCP interface contains the management/control plane functionality, creating a new coordination plane to support the central coordination capabilities.



IEC

Figure 10 – Protocol reference model of CCP managed wireless device

5.3.2 Data plane

The data plane consists of the physical layer (PHY), the medium access control (MAC) layer, the convergence sublayer (CS) and application layer (AL). Service access points (SAPs) are added in between these layers to allow modularization of the system. An SAP is provided with a well-defined interface or a set of primitives to exchange information, by virtue of which these different components can talk to each other.

The service-specific CS shall provide transformation or mapping of external network data that is received through the CS SAP from AL, into MAC service data units (SDUs). This transformation or mapping shall include classifying external network SDUs and associating them to the proper MAC service flow identifier. Multiple CS specifications are provided for interfacing with various protocols.

The MAC shall provide the functionality of system access, connection establishment and connection maintenance. The data that the MAC layer receives from the various CSs through the MAC SAP shall be assigned to particular MAC connections. Quality of Service (QoS) is applied to the transmission and scheduling of data over the PHY. Data, PHY control, and monitoring statistics (spectrum sensing, RSSI, etc.) shall be transferred between the MAC and the PHY via the PHY SAP.

The parameter for coexistence assessment shall be determined from the message transfer in the data plane. The PHY, MAC, CS and AL shall provide the determined parameters to the central coordination/management entity with coexistence management information base, where these parameters are available for the CCP.

5.3.3 Management and control plane

5.3.3.1 General

The management and control plane shall consist of physical layer and spectrum sensing management entity (PLME), medium access layer management entity (MLME), convergence sublayer management entity (CLME), application layer management entity (ALME) and the central coordination entity (CCE) with a coexistence management information base (CMIB). Service primitives are used to communicate with the CMIB database and some of its primitives ~~may~~ can be used to manage the wireless system and wireless device entities. The CMIB primitives shall be used for system configuration, monitoring statistics, notifications, triggers and session management, medium resources management, communication with the database, the spectrum sensing system and the CCP. The CMIB data ~~may~~ can be obtained either from the wireless system, pre-defined within the system, or obtained from other devices after an exchange of information using the communication medium. The CCP has a key role in the overall architecture. It is the central coordinator for all CMWCA and CMWD, where all information about the availability of the spectrum is collected, resulting from the database and the spectrum sensing system. Based on this combined information, local regulations and predefined CCP policies, the CCP shall provide the needed configuration information to the MAC, which shall remotely configure all registered CMWCA and CMWD.

5.3.3.2 Management plane

The CCP shall reside in the management plane of the wireless communication application. The management SAP (M-SAP) may include, but is not limited to, primitives related to the following:

- general plant characterization;
- application communication requirements;
- communication system and device management;
- monitoring statistics;
- notifications/triggers;
- sensing management.

5.3.3.3 Control plane

The control plane shall be comprised of the spectrum sensing system (SSS) function and central coordination point (CCP) function. The SSS shall implement spectrum sensing algorithms and the RE shall provide the information to determine the location of the CMWCA and CMWD.

The CCP shall maintain medium availability information, manage channel lists, manage quiet periods, scheduling and implement coexistence mechanisms. The CCP shall also take requests from the MAC and PHY. For example, the MAC shall inform the CCP if an interference situation has been detected during normal operation in the channel. The CCP shall then take appropriate actions to resolve the issue such as moving to another channel. For this purpose, the CCP first requests sufficient idle time from the wireless communication application to perform an in-band sensing. It shall update the list of backup and candidate channels in a prioritized order. The CCP then ensures that the wireless communication application has sufficient idle time to select a sufficient number of backup channels. If an incumbent is found during in-band sensing, the MAC uses the corresponding service to inform the CCP to perform the switching operation.

C-SAP shall be used by the CCP to initiate channel move, to configure the spectrum sensing function at the wireless devices (backup or candidate channel list, specific channels to be sensed, etc.) as well as to gather information from the wireless devices (local sensing information, etc.).

The C-SAP may include, but is not limited to primitives related to the following:

- subscriber and session management;
- medium resource report;
- sensing result.

5.4 System of wireless communication applications

5.4.1 CCP concept for sharing with incumbent radio systems

The CCP concept is intended to reduce the effort required to implement the necessary mitigation techniques for the used spectrum in each device. Another advantage of this approach is that the CCP can detect incumbent radio systems at the edges of the plant with a higher receiver sensitivity than the wireless devices can. While the location of a wireless device in a building depends on the automation application, SSNs can be placed in positions with optimal receiving performance.

If the available frequency band not used by incumbent radio systems is identified by the CCP, then the CCP shall calculate the most efficient spectrum assignments that can be assigned to the CCP managed wireless communication applications and CCP managed wireless devices based on their automation application requirements on communication needs.

Wireless communication applications in a factory environment may operate exclusively over one or more network access technologies and many of these applications may be capable of operating simultaneously in a factory environment.

An example of a CCP controlled WCA and incumbent services/applications within the 5,8 GHz WIA band is provided in Annex A.

Another example of a CCP controlled WCA is provided in Annex D.

5.4.2 Protection of incumbent radio systems

CCP controlled WCA employ centralized coordination with centralized or distributed spectrum sensing to identify free and occupied frequency ranges. The spectrum sensing node (SSN) may have multiple radio interfaces or a universal radio interface for monitoring a number of channels or frequency ranges simultaneously. It determines the operation of incumbent services on certain channels or frequencies. If available, SSF of the devices of the CMWCA can be used to obtain a more accurate status of the utilization of the medium, especially with respect to the spatial distribution.

To protect incumbent services and applications, an automated non-collaborative metrics-based coexistence management shall be used, as WCA and incumbent services/applications are not capable of exchanging information. Since they are fully independent, WCA ~~will have to~~ shall rely only on incumbent service/application detection and estimation. In other words, each potentially interfered WCA classifies the behaviour of the interfering incumbent services or applications and adapts its own behaviour to the new conditions.

5.4.3 CCP concept for intra-system coexistence

The intra-system coexistence, as achieved by the CCP concept, fulfils the viewpoint of an automatic adaptive coexistence management mechanism.

The CCP shall organize the spectrum access for multiple WCA within the frequency band. Currently many coexistence issues and mitigation techniques exist, because there is no coordination between WCA. Therefore, WCA should use new intra-system coexistence schemes in order to optimize radio resource usage. These coexistence schemes can be enabled by a CCP. The CCP can provide assistance for wireless coexistence via the transmission of context information such as quality of service, priority of service, etc. and measurement results. The CCP also can enable control for multiple WCA.

The CCP organizes the simultaneous operation of multiple WCA and wireless devices in industrial environments. Therefore, the CCP, CCP controlled WCA and CCP controlled wireless devices shall provide a control channel for information collection from WCA and wireless devices to the CCP as well as to carry control or assistance information from the CCP to the WCA and wireless devices. In order to provide control or assistance services, the CCP performs decision making via a control channel. In order to provide information collection services, the CCP shall provide information on available WCA and wireless devices via a control channel. The control channel can use

- line-bound connections between CCP and CCP controlled WCA;
- wireless connections between CCP and CCP controlled WCA or CCP controlled wireless devices;
- wireless connections between CCP controlled WCA and CCP controlled wireless devices;
- wireless connections between CCP controlled WCA;
- wireless connections between CCP controlled wireless devices.

The CCP shall provide multi radio technology capability and a line-bound network access.

WCA in an industrial environment may operate exclusively over a single radio technology, but wireless devices within these networks may be capable of operating on multiple different radio technologies simultaneously. Therefore, multiple WCA control shall use the ability of specific wireless devices to communicate on more than one WCA in order to provide advanced services to WCA on which that device is not active. A device with multi-radio access capability can be used to provide assistance to WCA in an effort to coordinate transmissions across WCA and to improve the performance within a WCA. Intra-network wireless devices can exist that are capable to communicate with WCA 1 and also capable to communicate with WCA 2. This wireless device can be seen as marked in green in Figure 11. WCA with single radio access capability need assistance from CCP. The CCP manages the medium utilization of WCA by coordinating their transmissions.

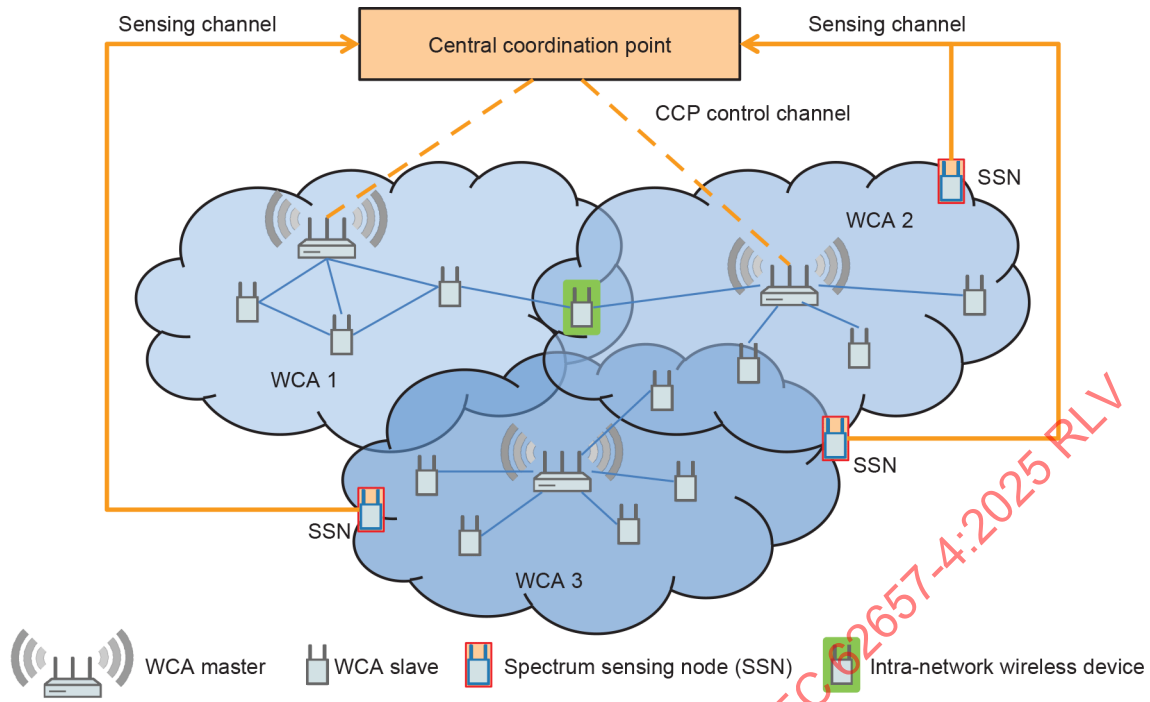


Figure 11 – CCP for intra-system coexistence

Conceptually, multi-radio access technology assistance or line-bound technology assistance helps to cooperate with coexistence issues not only by minimizing harmful interference, but also by expanding the services available to wireless devices and to include services from devices outside the local network. The services offered by every device are added to the CCP, but in order to access this CCP, a common control channel capable of WCA-agnostic communication is required.

WCA 1 (see Figure 11) or wireless devices belonging to WCA 1 can be requested to sense the operating channel of WCA 2 and report the results to a CCP. This could be useful for networks consisting of low-powered devices with limited sensing capability.

The CCP collects location information and operating characteristics of different WCA including the operating channel of the low complexity WCA. The CCP then instructs SSN or wireless devices to perform periodic sensing on the operating channel of the low complexity WCA with specific sensing algorithms applicable to detect low complexity WCA with low medium utilization. If harmful interference is detected, the CCP informs the low complexity WCA and instructs it to move to another operation channel provided no incumbent service is operating on that channel.

Optionally, the CCP can also instruct the SSN to monitor one or more alternative channels for the WCA. Once high interference is detected, the CCP can instruct the WCA to change the acting channels to a validated alternative channel. Hence, the service discontinuity, which occurs as a result of the harmful interference, is reduced at the WCA.

5.5 Interfaces

5.5.1 CCP

The CCP is interfaced to the AL, CS, MAC and PHY layer entities of the CCP managed wireless communication applications and devices through the two SAPs M-SAP and C-SAP. The M-SAP is used for less time sensitive management plane primitives and the C-SAP is used for more time-sensitive control plane primitives.

The CCP is interfaced to the SSN through the M-SAP and C-SAP. The M-SAP is used for the management plane primitives and the C-SAP is used for more control plane primitives.

The CCP is interfaced to the database via the M-SAP, which used the management plane primitives.

The CCP is interfaced to the automation application via the M-SAP, which used the management plane primitives.

The CCP provides a user interface for management, control and engineering.

5.5.2 CCP managed wireless communication application and wireless device

The CCP managed wireless communication applications and wireless devices shall include a control-SAP (C-SAP) and management-SAP (M-SAP) that provide CCP access to the control plane and management plane functions.

The CMWD shall provide an interface to the automation application.

5.5.3 Database

The coordination database shall provide an M-SAP that provides CCP access to the database content.

The database provides a user interface for management, control and engineering.

5.5.4 Spectrum sensing system

The SSN and SSF shall provide a C-SAP that provides CCP access to the spectrum sensing results.

6 Parameter for coexistence assessment

Characteristic parameters are used to describe and assess the behaviour of the media access mechanism and the performance of the complete communication of a wireless solution. In this Clause 6, the characteristic parameters are specified to assess wireless communication systems and especially media access mechanisms with respect to industrial automation applications. The parameters can be distinguished in the description of the time and error behaviour and in measures concerning all kinds of spectrum efficiency.

The assessment of coexistence shall be done by using the parameters listed in Table 3.

Table 3 – List of parameters for coexistence assessment

Parameter name	Symbol	Unit	Data type
Data throughput	T_D	bit/s	REAL_MEASURE_TYPE
Communication availability			
Message loss ratio	MLR	%	REAL_MEASURE_TYPE
Number of consecutive lost messages	N_{SML}	.	INT_TYPE
Transmission time	t_{TT}	s	REAL_MEASURE_TYPE
Update time	t_{UT}	s	REAL_MEASURE_TYPE
Response time	t_{RT}	s	REAL_MEASURE_TYPE

The specifications of the parameters are provided in IEC 62657-2.

7 Parameter for coexistence control

7.1 General

The values of the characteristic parameters are influenced by several parameters. That is why it is important to control and manage parameters and their values. The first set of influencing parameters is related to the application. This includes, for instance, the communication load. Another set of influencing parameters is related to the radio devices, e.g. the frequency band or transmission power. In 7.2 and 7.3, the relevant influencing parameters for the management and control of media utilization and coexistence are listed and declared.

This document describes general parameters for coexistence management. Depending on the specific radio technology, special resource allocation parameters could be available, for example, routing parameters of a mesh network. Other special parameters are available due to the evolution of radio technologies, for example parameters for frequency-time resource block assignments or for beamforming of smart antenna types.

NOTE The tools supporting the CCP can also be based on the catalogue data definitions and specifications given in the IEC 61360 series and the data base, called common data dictionary (CCD-IEC CDD), filled with the classes and properties of the IEC 62657 series. Annex B provides an overview of the processes by which the content of the IEC CDD can be filled and used in an application. Annex C provides templates as a possible basis to fill the IEC CDD with the parameters used in the services of this document.

7.2 Application parameter

The CCP can control the application parameters for coexistence control in Table 4. Especially in the context of smart manufacturing, there is the possibility to efficiently use communication resources according to the flexible changing requirements of the application.

Table 4 – List of application parameters for coexistence control

Parameter name	Symbol	Unit	Data type	Description
Communication load	A_{CL}	bit/s	REAL_MEASURE_TYPE	Communication load per communication link
Initiation of data transmission	A_{IDT}	-	ENUM_STRING_TYPE	Type of initiations of data transmission for each automation device for communication link
Length of user data per transmission transfer interval	A_{LUD}	octet	INT_TYPE	Length of user data for each automation device for communication link
Transfer interval	A_{TI}	s	LEVEL(MAX) of REAL_MEASURE_TYPE	Transfer interval for each automation device for communication link

The specifications of the parameters are provided in IEC 62657-2.

7.3 Radio parameter

The CCP can control the radio parameters for coexistence control in Table 5.

Table 5 – List of radio parameters for coexistence control

Parameter name	Symbol	Unit	Data type	Description
Frequency band				
Lower cut-off frequency	f_{BL}	Hz	REAL_MEASURE_TYPE	Lower cut-off frequency of frequency band
Upper cut-off frequency	f_{BU}	Hz	REAL_MEASURE_TYPE	Upper cut-off frequency of frequency band
Frequency channel				
Centre frequency	f_C	Hz	REAL_MEASURE_TYPE	Centre frequency of frequency channel
Bandwidth	BW	Hz	REAL_MEASURE_TYPE	Bandwidth of frequency channel
Lower cut-off frequency	f_{CL}	Hz	REAL_MEASURE_TYPE	Lower cut-off frequency of frequency channel
Upper cut-off frequency	f_{CU}	Hz	REAL_MEASURE_TYPE	Upper cut-off frequency of frequency channel
Type of radio channel identification	Ch		ENUM_STRING_TYPE	Radio channel number or identification of frequency channel
Power spectral density	PSD	dBm/Hz	REAL_MEASURE_TYPE	PSD of frequency channel
Number of frequency hopping channels	N_{HC}	-	INT_TYPE	Number of frequency channels for frequency hopping
Dwell time	t_{dwell}	s	LEVEL(MAX)REAL_MEASURE_TYPE	Time period of frequency hopping
Operational frequency channel				
Type of frequency channel identification			ENUM_STRING_TYPE	Centre frequency of frequency channels for operation
Blocked frequency list				
Type of frequency channel identification			ENUM_STRING_TYPE	Centre frequency of blocked frequency channels
Transmit power				
Equivalent isotropic radiated power	EIRP	W	REAL_MEASURE_TYPE	EIRP of radio device
Equivalent radiated power	ERP	W	REAL_MEASURE_TYPE	ERP of radio device
Transmitter output power	P_{out}	W	REAL_MEASURE_TYPE	Transmit output power of radio device
Channel occupancy time				
Duty cycle	DC	%	LEVEL(MAX)REAL_MEASURE_TYPE	Duty cycle per communication link
Transmitter sequence	t_{seq}	s	LEVEL(MAX)REAL_MEASURE_TYPE	Transmitter sequence per wireless device
Maximum number of retransmissions	N_{RT}	-	LEVEL(MAX)INT_MEASURE_TYPE	Maximum number of retransmissions per wireless device
Mechanisms for adaptivity			ENUM_STRING_TYPE	Mechanisms for adaptivity per wireless system
CCP	-	-	Char	A central systems element controls the medium utilization.
DAA	-	-	Char	If the channel is occupied, change the channel (for example AFH).
DAR	-	-	Char	If the channel is occupied, reduce the output power.
DAS	-	-	Char	If the channel is occupied, don't transmit (for example listen before talk). The Clear Channel Assessment might be an equivalent term but is a precondition.

The specifications of the parameters are provided in IEC 62657-2.

8 Management and control services

8.1 General

The primitive name defined on the SAP consists of three fields – SAP, Function, and Operation:

a) SAP

- C-SAP: Control plane SAP;
- M-SAP: Management plane SAP;

b) Function

- Application communication requirements management;
- Wireless communication system and device subscription;
- Wireless communication system and device configuration and control;
- Medium resource management;
- Database access;

c) Operation

- REQ – Request;
- RES – Response to the REQ message;
- CONF – Confirmation;
- IND – Event notification.

The CCP, CCP managed wireless communication applications (CMWCA) and CCP managed wireless devices (CMWD), the SSN and the database can send these primitives depending on the functional behaviour defined for M-SAP and C-SAP.

- A service primitive of type REQ is used whenever a response to the primitive is solicited. If there is an REQ message, it is generally mapped to a REQ on C-SAP/M-SAP.
- A service primitive of type RSP is used in response to a REQ primitive. Moreover, if there is an RSP message, it is generally mapped to an RSP on C-SAP/M-SAP.
- A service primitive of type IND is used at C-SAP or M-SAP for event notification if a response to this primitive is not solicited, and if the primitive is not sent in response to an REQ primitive.

The specific usage of these operation types for the respective control and management functions is specified in 8.2 to 8.6.

8.2 Application communication requirements management services

8.2.1 Supported services

This Subclause 8.2 contains the definition of services that are unique to this application communication requirements management (ACRM) service. The services defined for this ACRM are:

- GetGeneralPlantCharacteristic, see 8.2.2;
- SetGeneralPlantCharacteristic, see 8.2.3;
- GetApplicationCommunicationRequirements, see 8.2.4;
- GetApplicationCommunicationStatus, see 8.2.5;
- SetApplicationCommunicationReport, see 8.2.6 and
- NotificationApplicationCommunicationstatus, see 8.2.7.

8.2.2 GetGeneralPlantCharacteristic

8.2.2.1 Service overview

GetGeneralPlantCharacteristic service is a confirmed service and uses the M-SAP. The CCP sends the GetGeneralPlantCharacteristic service request attempts to the database. The primitive flow of GetGeneralPlantCharacteristic service is depicted in Figure 12. Legacy engineering and database implementation should be supplemented by a software module for this service.

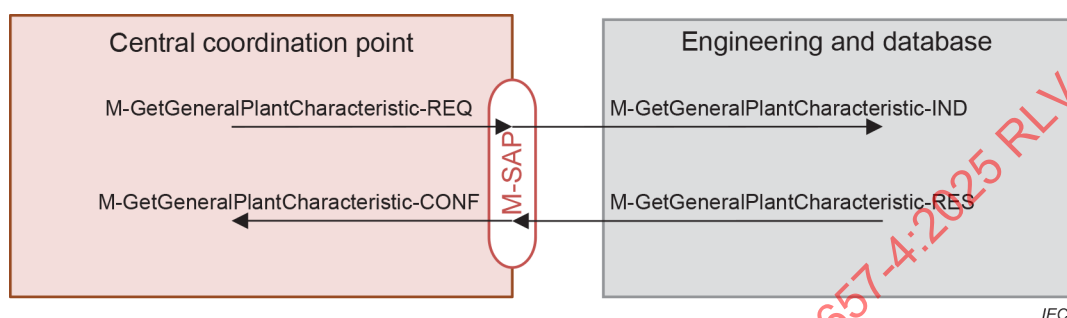


Figure 12 – Primitive flow of GetGeneralPlantCharacteristic

8.2.2.2 Service primitives

The service parameters for GetGeneralPlantCharacteristic service are shown in Table 6.

Table 6 – GetGeneralPlantCharacteristic service parameters

Parameter name	Request	Indication	Response	Confirm
Argument				
Destination address	M	M(=)		
Result (+)			S	S(=)
CCP address			M	M(=)
Attribute data			M	M(=)
Regional radio regulations			M	M(=)
Future expansion plan			M	M(=)
Area of operation			M	M(=)
Object movement			M	M(=)
Geographical dimension of the plant			M	M(=)
Natural environmental condition			M	M(=)
Intervisibility			U	U(=)
Frequency band			M	M(=)
Wireless communication solution density			M	M(=)
Interference type			M	M(=)
Limitation from neighbours of the plant			M	M(=)
Result (-)			S	S(=)
Service status			M	M(=)

Argument

The argument contains the parameters of the service request.

Destination address

This parameter specifies the destination address to which the service request is to be sent.

Result (+)

This selection type parameter indicates that the service request succeeded.

CCP address

This parameter specifies the address of the requested CCP. It is present in the response primitive.

Attribute data

This parameter returns a stream of information containing all the attributes.

- regional radio regulations;
- future expansion plan;
- area of operation;
- object movement;
- geographical dimension of the plant;
- natural environmental condition;
- intervisibility;
- frequency band;
- wireless communication solution density;
- interference type;
- limitation from neighbours of the plant.

Result (-)

This selection type parameter indicates that the service request failed.

Service status

This parameter provides information on the result of service execution. It shall be one of ABORTED or TIMEOUT.

8.2.2.3 Service procedure

The GetGeneralPlantCharacteristic request shall send a message to the database, which contains the general plant characteristic from the engineering. When the message arrives at the target device (database), this shall result in a GetGeneralPlantCharacteristic indication at the database. The database, in turn, shall forward the message to the appropriate target object. When the object responds, the database shall forward the response via the GetGeneralPlantCharacteristic response primitive. When the response arrives at the CCP which originated the request, a GetGeneralPlantCharacteristic confirmation shall be returned to the application object which sent the request. The application delivers the requested attributes for plant characterization.

8.2.2.4 Service sequence

The service sequence of GetGeneralPlantCharacteristic service is shown in Figure 13. Alt in the figure means a conditional branch on the service sequence.

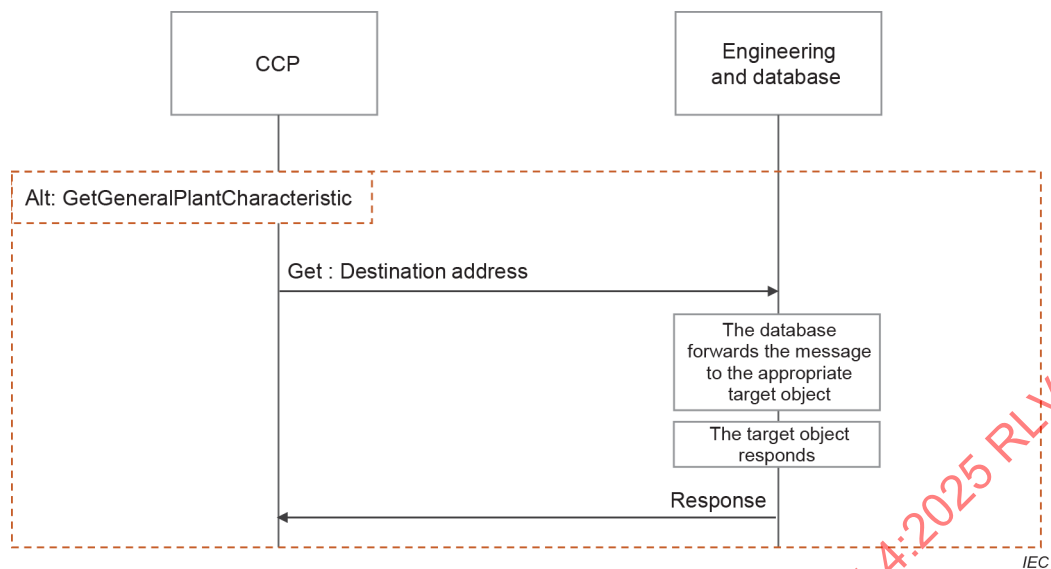


Figure 13 – Sequence diagram (GetGeneralPlantCharacteristic)

8.2.2.5 Service message format

The message format of `GetGeneralPlantCharacteristic` service shall be according to Table 7.

Table 7 – GetGeneralPlantCharacteristic service message format

Message format	Explanation
<pre> { "Argument": { "Destination address": "02004CAABBDD", "Result (+)": [{ "CCP address": "02004CAABBFF ", "Attribute data": [{ "Regional radio regulations ": "ETSI EN 300 328", "Future expansion plan": " phase 3", "Area of operation": "over the entire factory", "Object movement": "1600", "Geographical dimension of the plant": "[20, 20, 5]" "Natural environmental condition": " temperature, humidity air pressure ", "Intervisibility": "Ios", "Frequency band": "429, 920", "Wireless communication solution density": "10", "Interference type": "electromagnetic interfering sources", "Limitation from neighbours of the plant": "high power radio source" }], }], "Result (-)": { "Service status": "aborted", } } </pre>	Parameters of the service request. Destination address to which the service request is to be sent. Service request succeeded. CCP address to which the service request is to be sent. Regulation of important coexistence parameters such as frequency band and output power 868 related to the region where the wireless application is intended to be used. Possible installation of new wireless communication solutions and buildings that can affect coexistence. Distinguishing properties of the area where the wireless communication system is operated. Specification of the trajectory of mobile assets that can significantly influence the radio propagation conditions. Length, width and height of the intended space of the wireless system. Condition that surrounds the wireless device and wireless system. Property of a logical link that describes a possible influence on radio signal propagation by obstruction, refraction or reflection. Ratio of the number of wireless communication solutions and the spatial coverage of the plant. Kind of unwanted energy caused by a certain source or Application. Description of the neighbours of the plant that are likely to cause limitations for wireless communication. Service request failed. Information on the result of service execution.

8.2.3 SetGeneralPlantCharacteristic

8.2.3.1 Service overview

SetGeneralPlantCharacteristic service is a confirmed service and uses the M-SAP. The user sends via user interface a SetGeneralPlantCharacteristic service request to CCP. The primitive flow of SetGeneralPlantCharacteristic service is depicted in Figure 14.

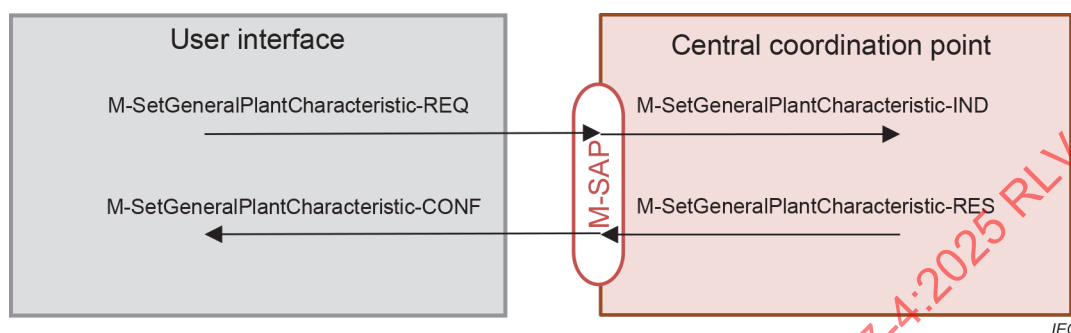


Figure 14 – Primitive flow of SetGeneralPlantCharacteristic

8.2.3.2 Service primitives

The service parameters for SetGeneralPlantCharacteristic service are shown in Table 8.

Table 8 – SetGeneralPlantCharacteristic service parameters

Parameter name	Request	Indication	Response	Confirm
Argument				
Destination address	M	M(=)		
Attribute data			M	M(=)
Regional radio regulations			M	M(=)
Future expansion plan			M	M(=)
Area of operation			M	M(=)
Object movement			M	M(=)
Geographical dimension of the plant			M	M(=)
Natural environmental condition			M	M(=)
Intervisibility			U	U(=)
Frequency band			M	M(=)
Wireless communication solution density			M	M(=)
Interference type			M	M(=)
Limitation from neighbours of the plant			M	M(=)
Result (+)			S	S(=)
			-	-
Result (-)			S	S(=)
Service status			M	M(=)

Argument

The argument contains the parameters of the service request.

Destination address

This parameter specifies the destination address to which the service request is to be sent.

Attribute data

This parameter returns a stream of information containing all the attributes.

- regional radio regulations;
- future expansion plan;
- area of operation;
- object movement;
- geographical dimension of the plant;
- natural environmental condition;
- intervisibility;
- frequency band;
- wireless communication solution density;
- interference type;
- limitation from neighbours of the plant.

Result (+)

This selection type parameter indicates that the service request succeeded.

Result (-)

This selection type parameter indicates that the service request failed.

Service status

This parameter provides information on the result of service execution. It shall be one of ABORTED or TIMEOUT.

8.2.3.3 Service procedure

The SetGeneralPlantCharacteristic request shall send a message to the CCP, which contains the general plant characteristic from the engineering. When the message arrives at the target device (CCP), this shall result in a SetGeneralPlantCharacteristic indication at the CCP. The CCP, in turn, shall forward the message to the appropriate target object. When the object responds, the CCP shall forward the response via the SetGeneralPlantCharacteristic response primitive. When the response arrives at the user interface which originated the request, a SetGeneralPlantCharacteristic confirmation shall be returned to the application object which sent the request.

8.2.3.4 Service sequence

The service sequence of SetGeneralPlantCharacteristic service is shown in Figure 15.

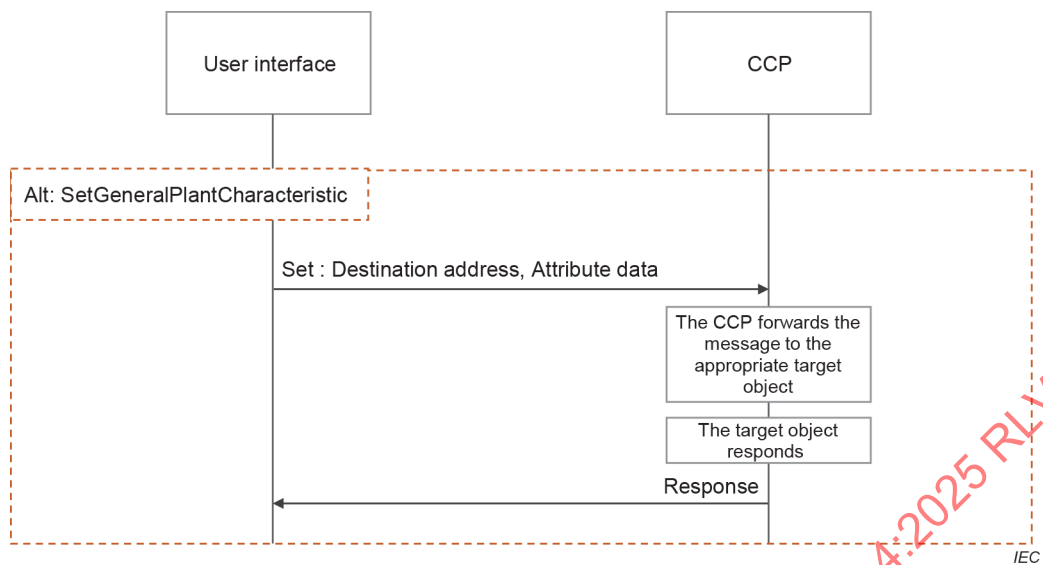


Figure 15 – Sequence diagram (SetGeneralPlantCharacteristic)

8.2.3.5 Service message format

The message format of `SetGeneralPlantCharacteristic` service shall be according to Table 9.

Table 9 – SetGeneralPlantCharacteristic service message format

Message format	Explanation
<pre> { "Argument": [{ "Destination address": "02004CAABBDD", "Attribute data": [{ "Regional radio regulations": "xxxxxxx", "Future expansion plan": "ETSI EN 300 328", "Area of operation": "all over the entire factory", "Object movement": "1600", "Geographical dimension of the plant": "[20, 20, 5]" "Natural environmental condition ": "temperature, humidity air pressure", "Intervisibility": "los", "Frequency band": "429, 920", "Wireless communication solution density": "10", "Interference type": "electromagnetic interfering sources", "Limitation from neighbours of the plant": "high power radio source" }], }], "Result (+)": "Result (-)": { "Service status": "aborted", }, } </pre>	Parameters of the service request. Destination address to which the service request is to be sent. Regulation of important coexistence parameters such as frequency band and output power related to the region where the wireless application is intended to be used. Possible installation of new wireless communication solutions and buildings that can affect coexistence. Distinguishing properties of the area where the wireless communication system is operated. Specification of the trajectory of mobile assets that can significantly influence the radio propagation conditions. Length, width and height of the intended space of the wireless system. Condition that surrounds the wireless device and wireless system. Property of a logical link that describes a possible influence on radio signal propagation by obstruction, refraction or reflection. Ratio of the number of wireless communication solutions and the spatial coverage of the plant. Kind of unwanted energy caused by a certain source or application. Description of the neighbours of the plant that are likely to cause limitations for wireless communication. Service request succeeded. Service request failed. Information on the result of service execution.

8.2.4 GetApplicationCommunicationRequirements

8.2.4.1 Service overview

GetApplicationCommunicationRequirements service is a confirmed service and uses the M-SAP. The CCP sends a GetApplicationCommunicationRequirements service request to the automation application. The primitive flow of GetApplicationCommunicationRequirements service is depicted in Figure 16. Legacy application implementation should be supplemented by a software module for this service.

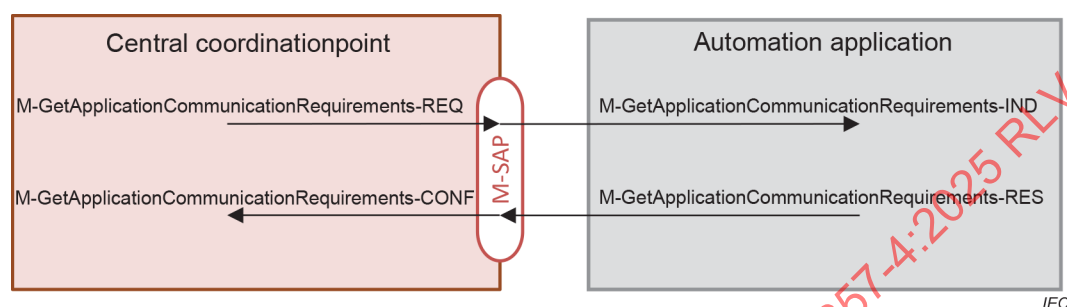


Figure 16 – Primitive flow of GetApplicationCommunicationRequirements

8.2.4.2 Service primitives

The service parameters for GetApplicationCommunicationRequirements service are shown in Table 10.

Table 10 – GetApplicationCommunicationRequirements service parameters

Parameter name	Request	Indication	Response	Confirm
Argument				
Destination address	M	M(=)		
Communication link ID	M	M(=)		
Result (+)			S	S(=)
CCP address			M	M(=)
Communication link ID			M	M(=)
Performance parameter type			M	M(=)
Limits of performance parameter			M	M(=)
Result (-)			S	S(=)
Service status			M	M(=)

Argument

The argument contains the parameters of the service request.

Destination address

This parameter specifies the destination address to which the service request is to be sent. Depending on the destination address, the values of a logical link or average values of a device are provided.

Communication link ID

This parameter specifies the identifier of the communication link. It is present in the request primitive and in the response primitive.

Result (+)

This selection type parameter indicates that the service request succeeded.

CCP address

This parameter specifies the address of the requested CCP. It is present in the response primitive.

Communication link ID

This parameter specifies the identifier of the communication link. It is present in the response primitive.

Performance parameter type

This parameter specifies the type of performance parameter related to communication link ID:

- 1: Transmission time
- 2: Update time
- 3: Response time
- 4: Data throughput
- 5: Communication availability

It is present in the response primitive.

Limits of performance parameter

This parameter specifies the limit value for a performance parameter. It is present in the response primitive.

Result (-)

This selection type parameter indicates that the service request failed.

Service status

This parameter provides information on the result of service execution. It shall be one of ABORTED or TIMEOUT.

8.2.4.3 Service procedure

The GetApplicationCommunicationRequirements request shall send a message to the automation application, which contains the requested communication link ID. When the message arrives at the target device (automation application), this shall result in a GetApplicationCommunicationRequirements indication at the automation application. The automation application, in turn, shall forward the message to the appropriate target object. When the object responds, the automation application shall forward the response via the GetApplicationCommunicationRequirements response primitive. When the response arrives at the CCP which originated the request, a GetApplicationCommunicationRequirements confirmation shall be returned to the object which sent the request.

8.2.4.4 Service sequence

The service sequence of GetApplicationCommunicationRequirements service is shown in Figure 17.

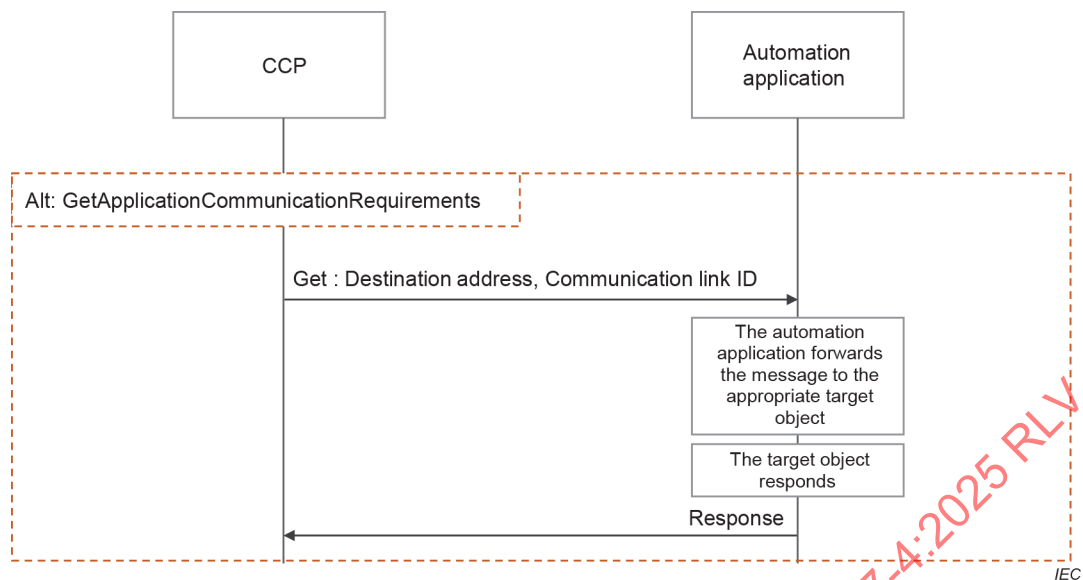


Figure 17 – Sequence diagram (GetApplicationCommunicationRequirements)

8.2.4.5 Service message format

The message format of `GetApplicationCommunicationRequirements` service shall be according to Table 11.

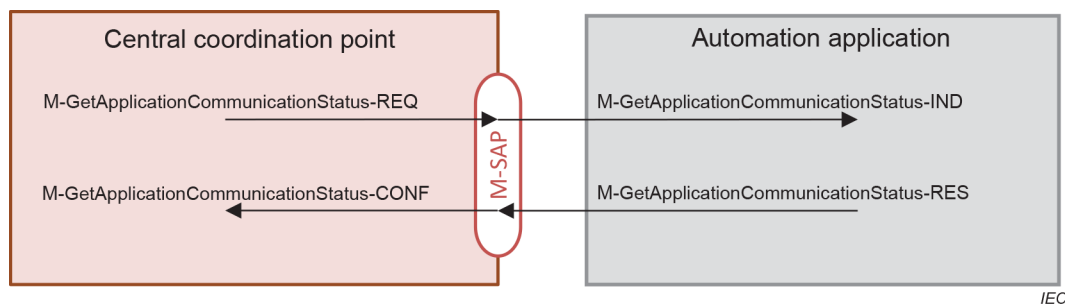
Table 11 – GetApplicationCommunicationRequirements service message format

Message format	Explanation
<pre> { "Argument": [{ "Destination address": "02004CAABBDD", "Communication link ID": "1000" }] "Result (+)": [{ "CCP address": "02004CAABBFF ", "Communication link ID": "1000", "Performance parameter type": 1, "Limits of performance parameter": 0.015 }] "Result (-)": { "Service status": "aborted", } } </pre>	Parameters of the service request. Destination address to which the service request is to be sent. Identifier of the communication link. Service request succeeded. CCP address to which the service request is to be sent. Identifier of the communication link. Type of performance parameter related to communication link ID. Limit value for a performance parameter. Service request failed. Information on the result of service execution.

8.2.5 GetApplicationCommunicationStatus

8.2.5.1 Service overview

GetApplicationCommunicationStatus service is a confirmed service and uses the M-SAP. The CCP sends a GetApplicationCommunicationStatus service request to the automation application. The primitive flow of GetApplicationCommunicationStatus service is depicted in Figure 18. Legacy application implementation should be supplemented by a software module for this service.



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Figure 18 – Primitive flow of GetApplicationCommunicationStatus

8.2.5.2 Service primitives

The service parameters for GetApplicationCommunicationStatus service are shown in Table 12.

Table 12 – GetApplicationCommunicationStatus service parameters

Parameter name	Request	Indication	Response	Confirm
Argument				
Destination address	M	M(=)		
Communication link ID	M	M(=)		
Result (+)			S	S(=)
CCP address			M	M(=)
Communication link ID			M	M(=)
Performance parameter type			M	M(=)
Statistical values of parameter			M	M(=)
Result (-)			S	S(=)
Service status			M	M(=)

Argument

The argument contains the parameters of the service request.

Destination address

This parameter specifies the destination address to which the service request is to be sent. Depending on the destination address, the values of a logical link or average values of a device are provided.

Communication link ID

This parameter specifies the identifier of the communication link. It is present in the request primitive and in the response primitive.

Result (+)

This selection type parameter indicates that the service request succeeded.

CCP address

This parameter specifies the address of the requested CCP. It is present in the response primitive.

Communication link ID

This parameter specifies the identifier of the communication link. It is present in the response primitive.

Performance parameter type

This parameter specifies the type of performance parameter related to communication link ID:

- 1: Transmission time
- 2: Update time
- 3: Response time
- 4: Data throughput
- 5: Communication availability

It is present in the response primitive.

Statistical values of parameter

This parameter specifies the statistical values of the performance parameter. It is present in the response primitive.

Result (-)

This selection type parameter indicates that the service request failed.

Service status

This parameter provides information on the result of service execution. It shall be one of ABORTED or TIMEOUT.

8.2.5.3 Service procedure

The GetApplicationCommunicationStatus request shall send a message to the automation application, which contains the requested communication link ID. When the message arrives at the target device (automation application), this shall result in a GetApplicationCommunicationStatus indication at the automation application. The automation application, in turn, shall forward the message to the appropriate target object. When the object responds, the automation application shall forward the response via the GetApplicationCommunicationStatus response primitive. When the response arrives at the CCP which originated the request, a GetApplicationCommunicationStatus confirmation shall be returned to the object which sent the request.

8.2.5.4 Service sequence

The service sequence of GetApplicationCommunicationStatus service is shown in Figure 19.

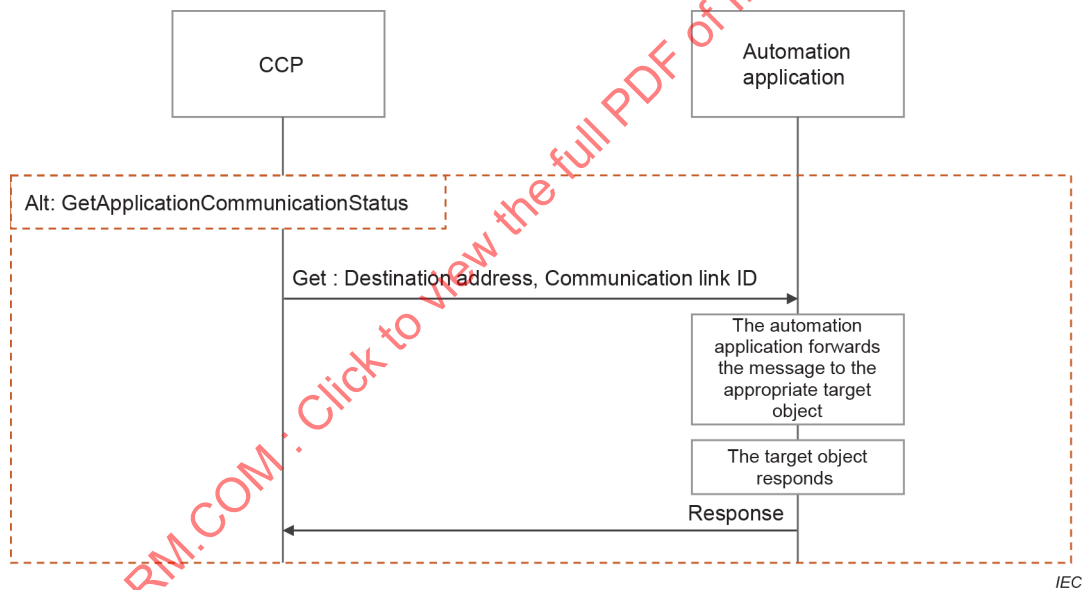


Figure 19 – Sequence diagram (GetApplicationCommunicationStatus)

8.2.5.5 Service message format

The message format of GetApplicationCommunicationStatus service shall be according to Table 13.

Table 13 – GetApplicationCommunicationStatus service message format

Message format	Explanation
<pre> { "Argument": [{ "Destination address": "02004CAABBDD", "Communication link ID": "1000" }] "Result (+)": [{ "CCP address": "02004CAABBFF", "Communication link ID": "1000", "Performance parameter type": 1, "Statistical values of parameter": 0.8 }] "Result (-)": { "Service status": "aborted", } } </pre>	Parameters of the service request. Destination address to which the service request is to be sent. Identifier of the communication link. Service request succeeded. CCP address to which the service request is to be sent. Identifier of the communication link. Type of performance parameter related to communication link ID. Statistical values of the performance parameter. Service request failed. Information on the result of service execution.

8.2.6 SetApplicationCommunicationReport

8.2.6.1 Service overview

SetApplicationCommunicationReport service a set of primitives for setting periodically or event driven management resource reports procedures at automation application.

SetApplicationCommunicationReport service is a confirmed service and uses the M-SAP.

The CCP sends the Set application Communication Report service request attempts to automation application.

The primitive flow of SetApplicationCommunicationReport service is depicted in Figure 20.

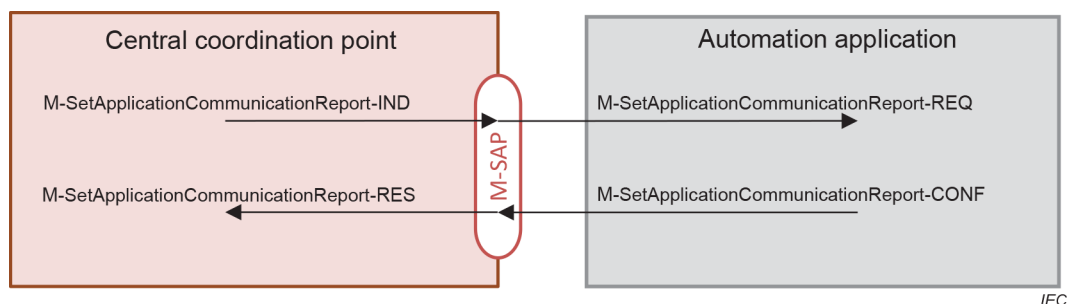


Figure 20 – Primitive flow of SetApplicationCommunicationReport

8.2.6.2 Service primitives

The service parameters for SetApplicationCommunicationReport service are shown in Table 14.

Table 14 – SetApplicationCommunicationReport service parameters

Parameter name	Request	Indication	Response	Confirm
Argument				
Destination address	M	M(=)		
Performance report type	M	M(=)		
Report interval	M	M(=)		
Assessment interval	M	M(=)		
Result (+)			S	S(=)
CCP address			M	M(=)
Performance Assessment entity ID			M	M(=)
Result (-)			S	S(=)
Service status			M	M(=)

Argument

The argument contains the parameters of the service request.

Destination address

This parameter specifies the destination address to which the service request is to be sent.

Performance report type

This parameter specifies the generation type of Performance report (Notification Application Communication status). The report types are event driven, cyclic or requested. It is present in the request primitive.

- 1: Transmission time
- 2: Update time
- 3: Response time
- 4: Data throughput
- 5: Communication availability

Report interval

This parameter specifies the interval time of cyclic reports, if the performance report type is cyclic.

Assessment interval

This parameter specifies the interval between performance assessment processes.

Result (+)

This selection type parameter indicates that the service request succeeded.

CCP address

This parameter specifies the address of the requested CCP. It is present in the response primitive.

Performance Assessment entity ID

This parameter specifies the identifier of the Performance Assessment entity ID either automation application.

Result (-)

This selection type parameter indicates that the service request failed.

Service status

This parameter provides information on the result of service execution. It shall be one of ABORTED or TIMEOUT.

8.2.6.3 Service procedure

The CCP may use this primitive to SetApplicationCommunicationReport at the automation application. The SetApplicationCommunicationReport request shall send a message to the automation application. When the message arrives at the target automation application, this shall result in a SetApplicationCommunicationReport indication at the automation application. The automation application shall forward the message to the appropriate target objects. When the object responds, the automation application shall forward the response via the SetApplicationCommunicationReport response primitive. When the response arrives at the device which originated the request, a SetApplicationCommunicationReport confirmation shall be returned to the application object which sent the request.

8.2.6.4 Service sequence

The service sequence of SetApplicationCommunicationStatus service is shown in Figure 21.

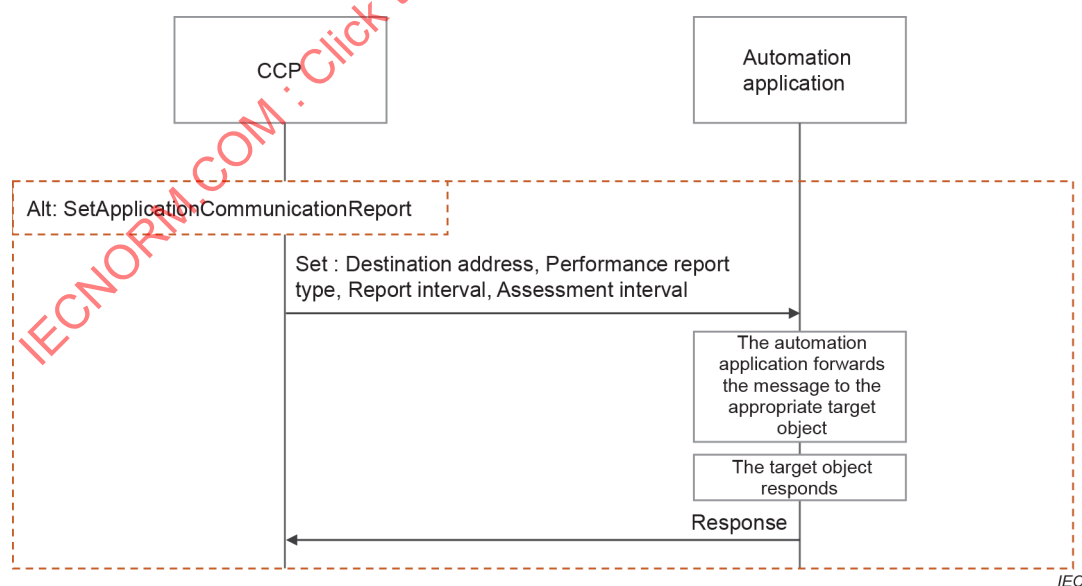


Figure 21 – Sequence diagram (SetApplicationCommunicationReport service parameters)

8.2.6.5 Service message format

The message format of SetApplicationCommunicationStatus service shall be according to Table 15.

Table 15 – SetApplicationCommunicationReport service message format

Message format	Explanation
<pre>{ "Argument": [{ "Destination address": "02004CAABBDD", "Communication link ID": "1000" }] "Result (+)": [{ "CCP address": "02004CAABBDD", "Performance Assessment entity ID": "A6000", }] "Result (-)": { "Service status": "aborted", } }</pre>	Parameters of the service request. Destination address to which the service request is to be sent. Identifier of the communication link. Service request succeeded. CCP address to which the service request is to be sent. Identifier of the Performance Assessment entity ID either automation application. Service request failed. Information on the result of service execution.

8.2.7 NotificationApplicationCommunicationstatus

8.2.7.1 Service overview

NotificationApplicationCommunicationstatus service uses a primitive for supporting coexistence assessment reports from automation application to CCP.

NotificationApplicationCommunicationstatus service is an unconfirmed service and uses the M-SAP. The automation application sends the Application Communication status service attempts to CCP.

The primitive flow of NotificationApplicationCommunicationstatus service is depicted in Figure 22.

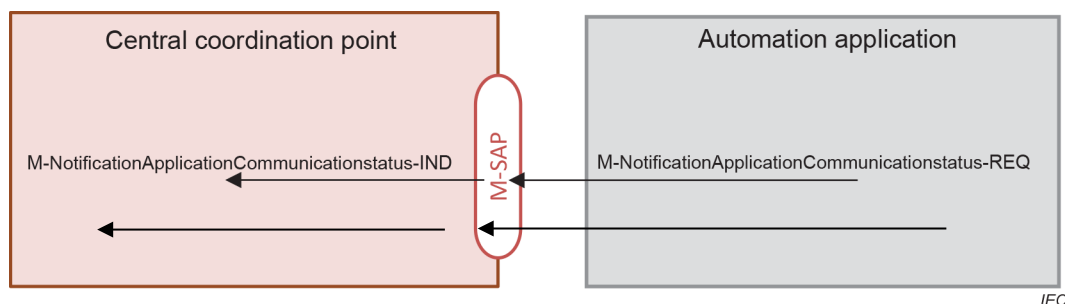


Figure 22 – Primitive flow of NotificationApplicationCommunicationstatus

8.2.7.2 Service primitives

The service parameters for NotificationApplicationCommunicationstatus service are shown in Table 16.

Table 16 – NotificationApplicationCommunicationstatus service parameters

Parameter name	Request	Indication	Response	Confirm
Argument				
CCP address	M	M(=)		
Communication link ID	M	M(=)		
Attribute data	M	M(=)		
Timestamp	M	M(=)		
Performance parameter type	M	M(=)		
Statistical values of parameter	M	M(=)		

Argument

The argument contains the parameters of the service request.

CCP address

This parameter specifies the address of the requested CCP. It is present in the response primitive.

Communication link ID

This parameter specifies the identifier of the communication link. It is present in the request primitive and in the response primitive.

Attribute data

This parameter returns a stream of information containing all the attributes.

Timestamp

Information concerning time of collected attribute data.

Performance parameter type

This parameter specifies the type of performance parameter related to communication link ID:

- 1: Transmission time
- 2: Update time
- 3: Response time
- 4: Data throughput
- 5: Communication availability

Statistical values of parameter

This parameter specifies the statistical values of the performance parameter.

8.2.7.3 Service procedure

The CCP may configure the NotificationApplicationCommunicationstatus service with the SetApplicationCommunicationstatus service primitive.

The NotificationApplicationCommunicationstatus request shall send a message from the automation application to the CCP. When the message arrives at the target device (CCP), this shall result in a NotificationApplicationCommunicationstatus indication at the CCP. The CCP shall forward the message to the appropriate target object.

8.2.7.4 Service sequence

The service sequence of NotificationApplicationCommunicationstatus service is shown in Figure 23.

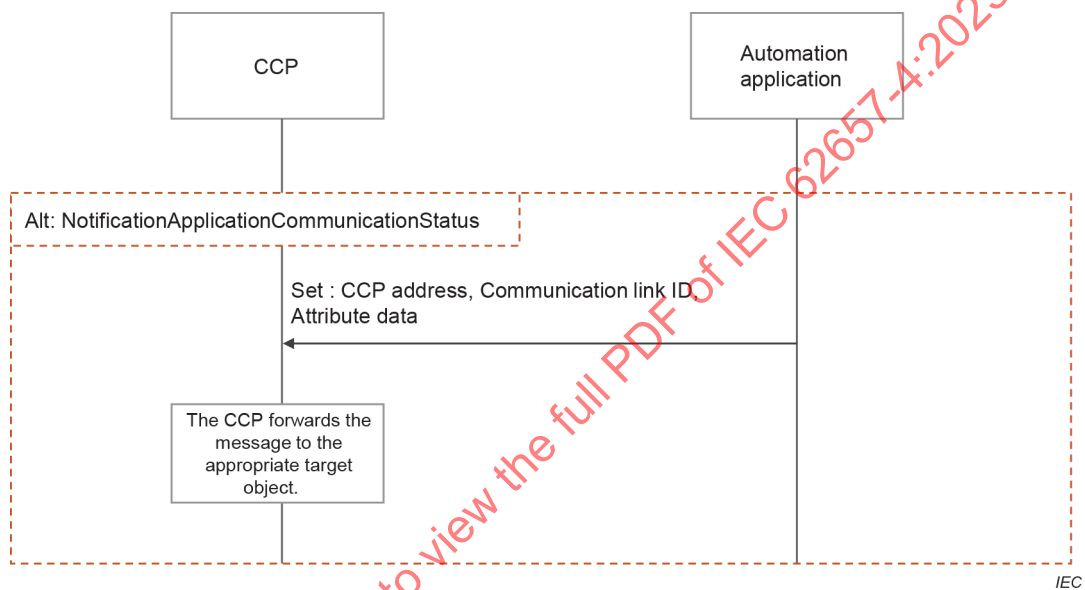


Figure 23 – Sequence diagram (NotificationApplicationCommunicationstatus)

8.2.7.5 Service message format

The message format of NotificationApplicationCommunicationstatus service shall be according to Table 17.

Table 17 – NotificationApplicationCommunicationstatus service message format

Message format	Explanation
<pre> { "Argument": [{ "CCP address": "02004CAABBDD", "Communication link ID": "1000", "Attribute data": [{ "Timestamp": "1569855600", "Performance parameter type": 1, "Statistical values of parameter": 0.8, }], }], } </pre>	Parameters of the service request. CCP address to which the service request is to be sent. Identifier of the communication link. Information concerning time of collected attribute data. Type of performance parameter related to communication link ID. Statistical values of the performance parameter.

8.3 Wireless communication system and device subscription services

8.3.1 Supported services

This Subclause 8.3 contains the definition of services that are unique to this wireless communication system and device subscription (WCSDS). The services defined for this ~~WSDS~~ WCSDS are:

- SubscribeDevice, see 8.3.2;
- UnsubscribeDevice, see 8.3.3;
- SubscribeSystem, see 8.3.4;
- UnsubscribeSystem, see 8.3.5;
- GetDeviceAttributes, see 8.3.6.

8.3.2 SubscribeDevice

8.3.2.1 Service overview

SubscribeDevice service is a confirmed service and uses the M-SAP. The CMWD sends the SubscribeDevice service request attempts to CCP. The primitive flow of SubscribeDevice service is depicted in Figure 24.

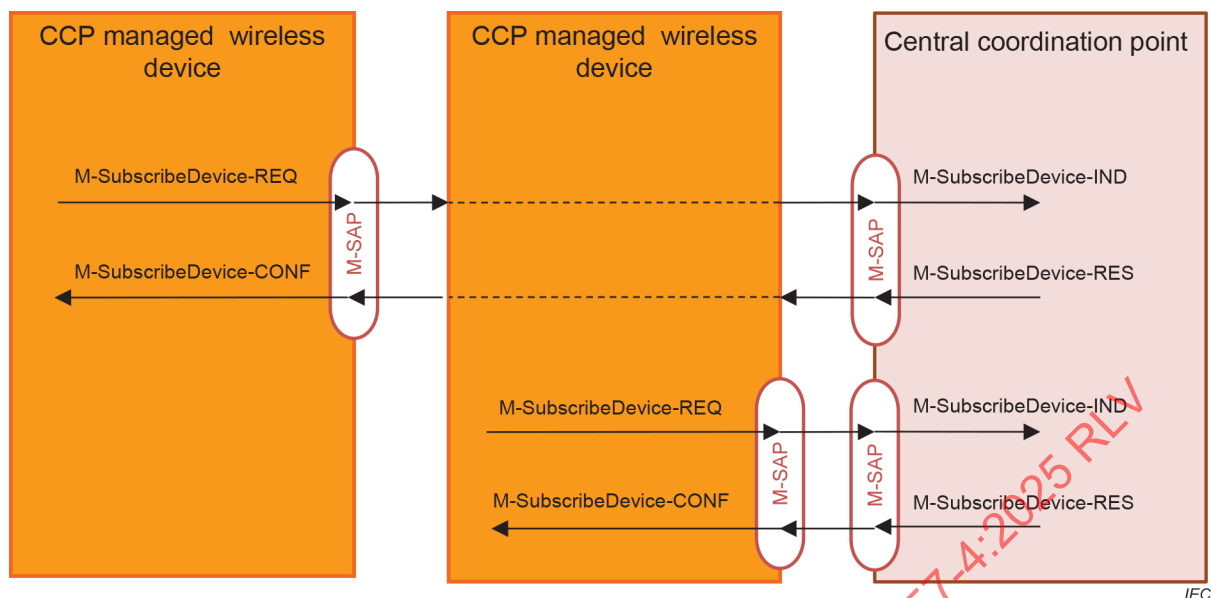


Figure 24 – Primitive flow of SubscribeDevice

8.3.2.2 Service primitives

The service parameters for SubscribeDevice service are shown in Table 18.

Table 18 – SubscribeDevice service parameters

Parameter name	Request	Indication	Response	Confirm
Argument				
Destination address	M	M(=)		
Device type	M	M(=)		
Result (+)			S	S(=)
Device ID			M	M(=)
Status			M	M(=)
Device type			M	M(=)
Device address			M	M(=)
Result (-)			S	S(=)
Service status			M	M(=)

Argument

The argument contains the parameters of the service request.

Destination address

This parameter specifies the destination address to which the service request is to be sent.

Device type

This parameter specifies the type of the requested wireless device. It is present in the request primitive.

Result (+)

This selection type parameter indicates that the service request succeeded.

Device ID

This parameter specifies the identifier of the wireless device.

Status

This parameter specifies the following status of the wireless device.

- 0: no address
- 1: unconfigured
- 2: configured

Device type

This parameter specifies the type of the wireless device. It is present in the response primitive.

Device address

This parameter specifies the address of the requested wireless device. It is present in the response primitive.

Result (-)

This selection type parameter indicates that the service request failed.

Service status

This parameter provides information on the result of service execution. It shall be one of ABORTED or TIMEOUT.

8.3.2.3 Service procedure

The SubscribeDevice request shall send a message to the CCP. When the message arrives at the target device (CCP), this shall result in a SubscribeDevice indication at the CCP. The CCP, in turn, shall forward the message to the appropriate target object. When the object responds, the CCP shall forward the response via the SubscribeDevice response primitive. When the response arrives at the device which originated the request, a SubscribeDevice confirmation shall be returned to the application object which sent the request.

8.3.2.4 Service sequence

The service sequence of SubscribeDevice service is shown in Figure 25.

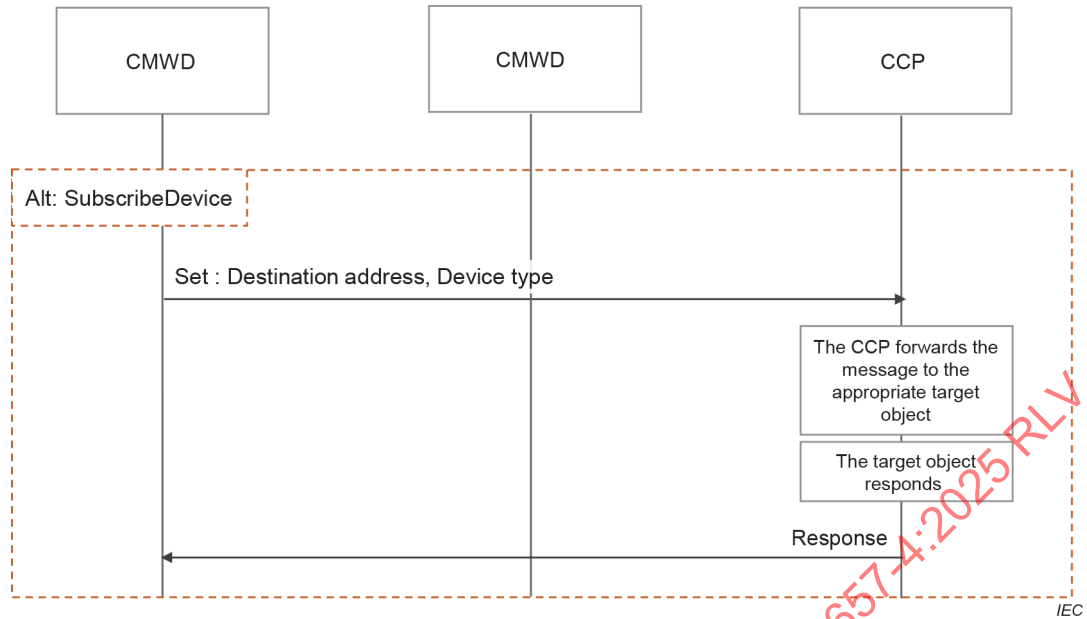


Figure 25 – Sequence diagram (SubscribeDevice)

8.3.2.5 Service message format

The message format of SubscribeDevice service shall be according to Table 19.

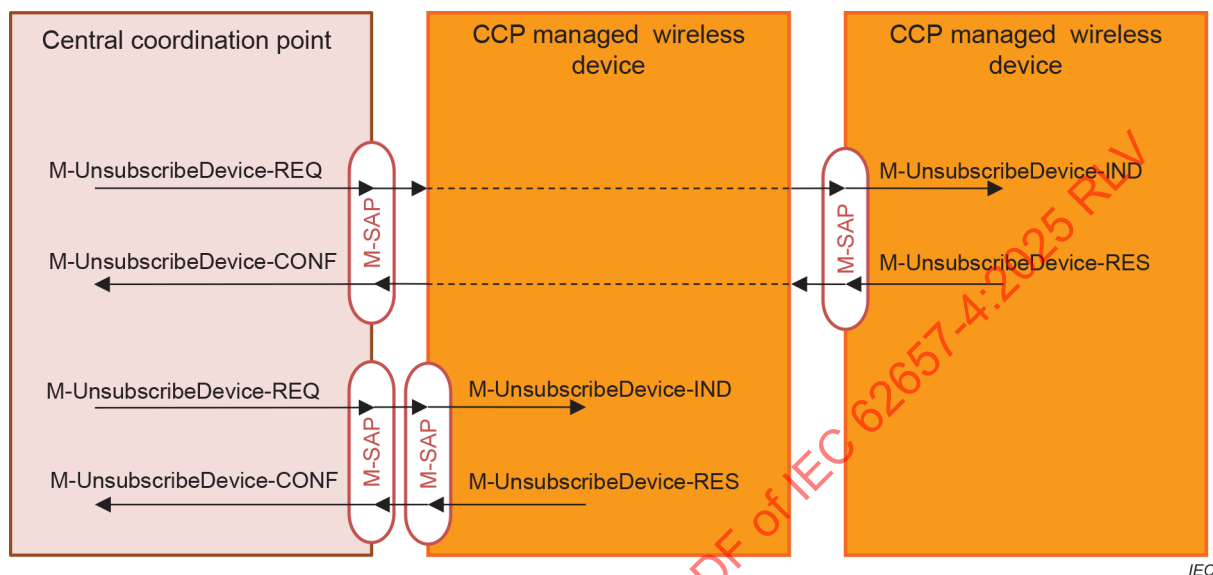
Table 19 – SubscribeDevice service message format

Message format	Explanation
<pre> { "Argument": [{ "Destination address": "02004CAABBDD", "Device type": "ABC 36, ABC company, version 3.0" }] "Result (+)": [{ "Device ID": "A3000", "Status": "connect", "Device type": "ABC 36, ABC company, version 3.0", "Device address": "02004CAABBGG" }] "Result (-)": { "Service status": "aborted", } } </pre>	Parameters of the service request. Destination address to which the service request is to be sent. Type of the requested wireless device. Service request succeeded. Identifier of the wireless device. Status of the wireless device. Type of the wireless device. Address of the requested wireless device. Service request failed. Information on the result of service execution.

8.3.3 UnsubscribeDevice

8.3.3.1 Service overview

UnsubscribeDevice service is a confirmed service and uses the M-SAP. The CCP sends the UnsubscribeDevice service request attempts to CMWD. The primitive flow of UnsubscribeDevice service is depicted in Figure 26.



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Figure 26 – Primitive flow of UnsubscribeDevice

8.3.3.2 Service primitives

The service parameters for UnsubscribeDevice service are shown in Table 20.

Table 20 – UnsubscribeDevice service parameters

Parameter name	Request	Indication	Response	Confirm
Argument				
Destination address	M	M(=)		
Device type	M	M(=)		
Device ID	M	M(=)		
Result (+)			S	S(=)
Device ID			M	M(=)
Status			M	M(=)
Device address			M	M(=)
Result (-)			S	S(=)
Service status			M	M(=)

Argument

The argument contains the parameters of the service request.

Destination address

This parameter specifies the destination address to which the service request is to be sent.

Device type

This parameter specifies the type of the destination wireless device. It is present in the request primitive.

Device ID

This parameter specifies the identifier of the wireless device.

Device address

~~This parameter specifies the address of the requested wireless device. It is present in the response primitive.~~

Result (+)

This selection type parameter indicates that the service request succeeded.

Device ID

This parameter specifies the identifier of the wireless device.

Status

This parameter specifies the unsubscribe status of the wireless device.

Device address

This parameter specifies the address of the requested wireless device. It is present in the response primitive.

Result (-)

This selection type parameter indicates that the service request failed.

Service status

This parameter provides information on the result of service execution. It shall be one of ABORTED or TIMEOUT.

8.3.3.3 Service procedure

The UnsubscribeDevice request shall send a message to the CMWD. When the message arrives at the target device (CMWD), this shall result in an UnsubscribeDevice indication at the CMWD. The CMWD, in turn, shall forward the message to the appropriate target object. When the object responds, the CCP shall forward the response via the UnsubscribeDevice response primitive. When the response arrives at the device which originated the request, an UnsubscribeDevice confirmation shall be returned to the application object which sent the request.

8.3.3.4 Service sequence

The service sequence of UnsubscribeDevice service is shown in Figure 27.

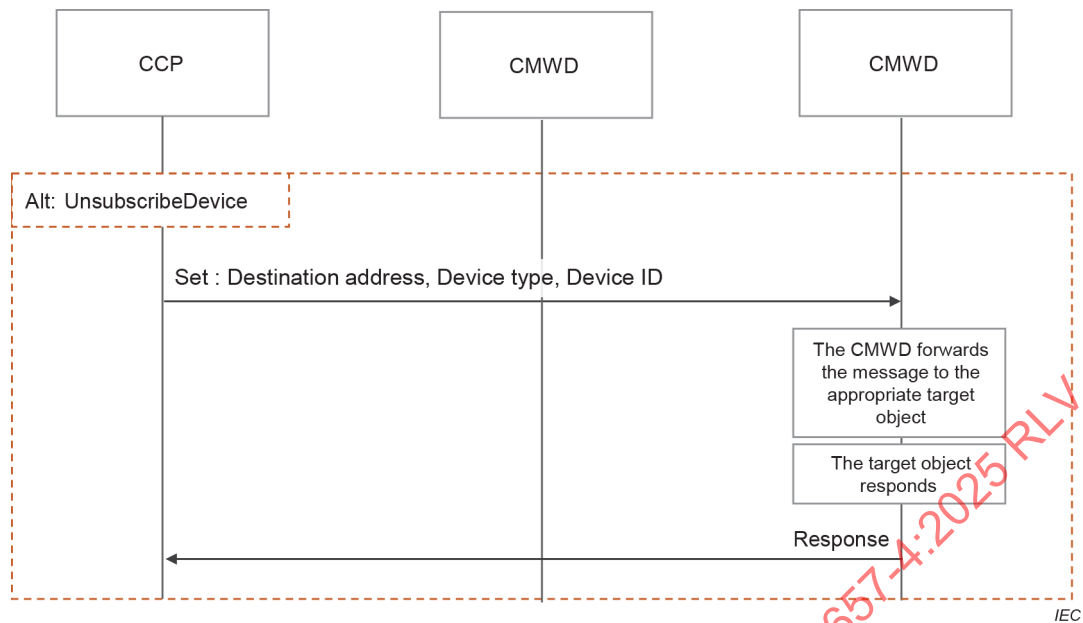


Figure 27 – Sequence diagram (UnsubscribeDevice)

8.3.3.5 Service message format

The message format of UnsubscribeDevice service shall be according to Table 21.

Table 21 – UnsubscribeDeviceservice message format

Message format	Explanation
<pre> { "Argument": [{ "Destination address": "02004CAABBDD", "Device type": "ABC 36, ABC company, version 3.0", "Device ID": "A3000", }] "Result (+)": [{ "Device ID": "A3000", "Status": "connect", "Device address": "02004CAABBGG" }] "Result (-)": { "Service status": "aborted" } } </pre>	Parameters of the service request. Destination address to which the service request is to be sent. Type of the destination wireless device. Identifier of the wireless device. Service request succeeded. Identifier of the wireless device. Unsubscribe status of the wireless device. Address of the requested wireless device. Service request failed. Information on the result of service execution.

8.3.4 SubscribeSystem

8.3.4.1 Service overview

SubscribeSystem service is a confirmed service and uses the M-SAP. The CMWCA sends the SubscribeSystem service request attempts to CCP. The primitive flow of SubscribeSystem service is depicted in Figure 28.

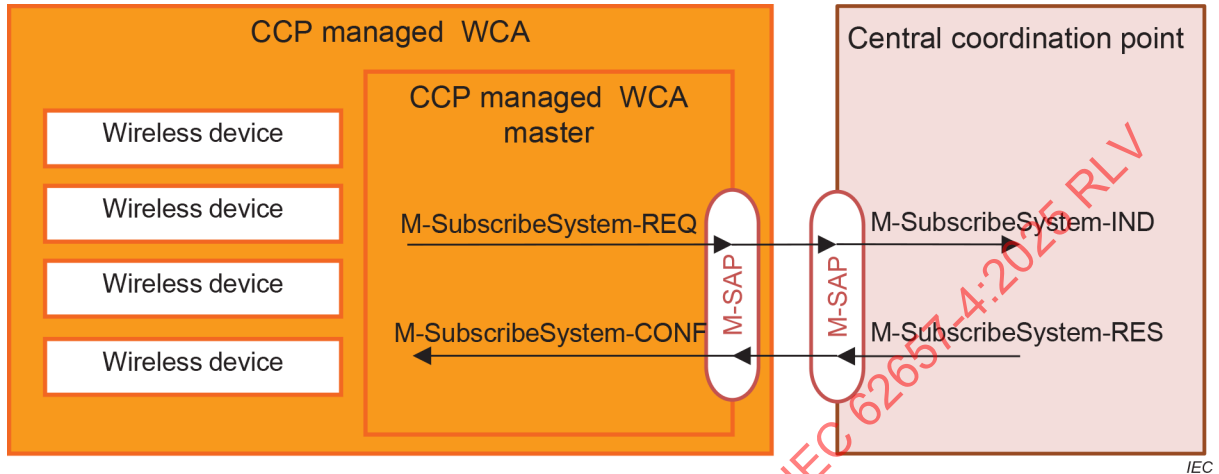


Figure 28 – Primitive flow of SubscribeSystem

8.3.4.2 Service primitives

The service parameters for SubscribeSystem service are shown in Table 22.

Table 22 – SubscribeSystem service parameters

Parameter name	Request	Indication	Response	Confirm
Argument				
Destination address	M	M(=)		
Wireless system type	M	M(=)		
Result (+)			S	S(=)
Wireless system ID			M	M(=)
Status			M	M(=)
Wireless system type			M	M(=)
System address			M	M(=)
Result (-)			S	S(=)
Service status			M	M(=)

Argument

The argument contains the parameters of the service request.

Destination address

This parameter specifies the destination address to which the service request is to be sent.

Wireless system type

This parameter specifies the type of the requested wireless system. It is present in the request primitive.

Result (+)

This selection type parameter indicates that the service request succeeded.

Wireless system ID

This parameter specifies the identifier of the wireless system.

Status

This parameter specifies the following status of the wireless system.

- 0: no address
- 1: unconfigured
- 2: configured

Wireless system type

This parameter specifies the type of the wireless device. It is present in the response primitive.

System address

This parameter specifies the address of the requested wireless device (master station of wireless system). It is present in the response primitive.

Result (-)

This selection type parameter indicates that the service request failed.

Service status

This parameter provides information on the result of service execution. It shall be one of ABORTED or TIMEOUT.

8.3.4.3 Service procedure

The SubscribeSystem request shall send a message to the CCP. When the message arrives at the target device (CCP), this shall result in a SubscribeSystem indication at the CCP. The CCP, in turn, shall forward the message to the appropriate target object. When the object responds, the CCP shall forward the response via the SubscribeSystem response primitive. When the response arrives at the device which originated the request, a SubscribeSystem confirmation shall be returned to the application object which sent the request.

8.3.4.4 Service sequence

The service sequence of SubscribeSystem service is shown in Figure 29.

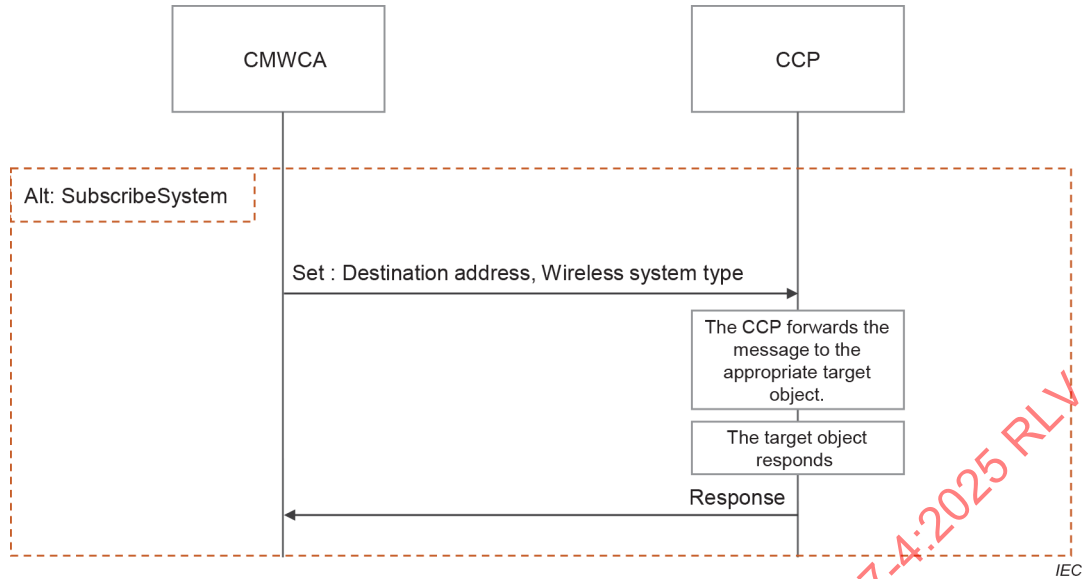


Figure 29 – Sequence diagram (SubscribeSystem)

8.3.4.5 Service message format

The message format of SubscribeSystem service shall be according to Table 23.

Table 23 – SubscribeSystem service message format

Message format	Explanation
<pre> { "Argument": [{ "Destination address": "02004CAABBDD" }, { "Wireless system type": "IEC 62591" }] } </pre>	Parameters of the service request. Destination address to which the service request is to be sent. Type of the requested wireless system.
<pre> "Result (+)": [{ "Wireless system ID": "5555", "Status": "connect", "Wireless system type": "IEC 62591", "System address": "02004CAABBHH" }] </pre>	Service request succeeded. Identifier of the wireless system. Status of the wireless system. Type of the wireless device. Address of the requested wireless device (master station of wireless system).
<pre> "Result (-)": { "Service status": "aborted", } </pre>	Service request failed. Information on the result of service execution.

8.3.5 UnsubscribeSystem

8.3.5.1 Service overview

UnsubscribeSystem service is a confirmed service and uses the M-SAP. The CCP sends the UnsubscribeSystem service request attempts to CMWCA. The primitive flow of UnsubscribeSystem service is depicted in Figure 30.

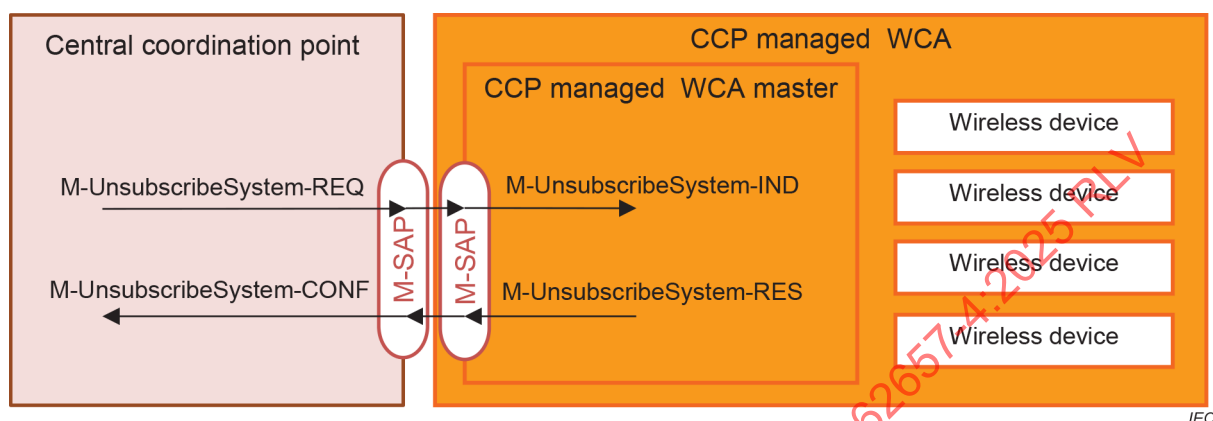


Figure 30 – Primitive flow of UnsubscribeSystem

8.3.5.2 Service primitives

The service parameters for UnsubscribeSystem service are shown in Table 24.

Table 24 – UnsubscribeSystem service parameters

Parameter name	Request	Indication	Response	Confirm
Argument				
Destination address	M	M(=)		
Wireless system type	M	M(=)		
Wireless system ID	M	M(=)		
Result (+)			S	S(=)
Wireless system ID			M	M(=)
Status			M	M(=)
System address			M	M(=)
Result (-)			S	S(=)
Service status			M	M(=)

Argument

The argument contains the parameters of the service request.

Destination address

This parameter specifies the destination address to which the service request is to be sent.

Wireless system type

This parameter specifies the type of the destination wireless system. It is present in the request primitive.

Wireless system ID

This parameter specifies the identifier of the wireless system.

Result (+)

This selection type parameter indicates that the service request succeeded.

Wireless system ID

This parameter specifies the identifier of the wireless system.

Status

This parameter specifies the unsubscribe status of the wireless device.

System address

This parameter specifies the address of the requested wireless device (master station of wireless system). It is present in the response primitive.

Result (-)

This selection type parameter indicates that the service request failed.

Service status

This parameter provides information on the result of service execution. It shall be one of ABORTED or TIMEOUT.

8.3.5.3 Service procedure

The UnsubscribeSystem request shall send a message to the CMWCA. When the message arrives at the target device (master station of CMWCA), this shall result in an UnsubscribeSystem indication at the CMWCS. The CMWCA, in turn, shall forward the message to the appropriate target object. When the object responds, the CCP shall forward the response via the UnsubscribeSystem response primitive. When the response arrives at the device which originated the request, an UnsubscribeSystem confirmation shall be returned to the application object which sent the request.

8.3.5.4 Service sequence

The service sequence of UnsubscribeSystem service is shown in Figure 31.

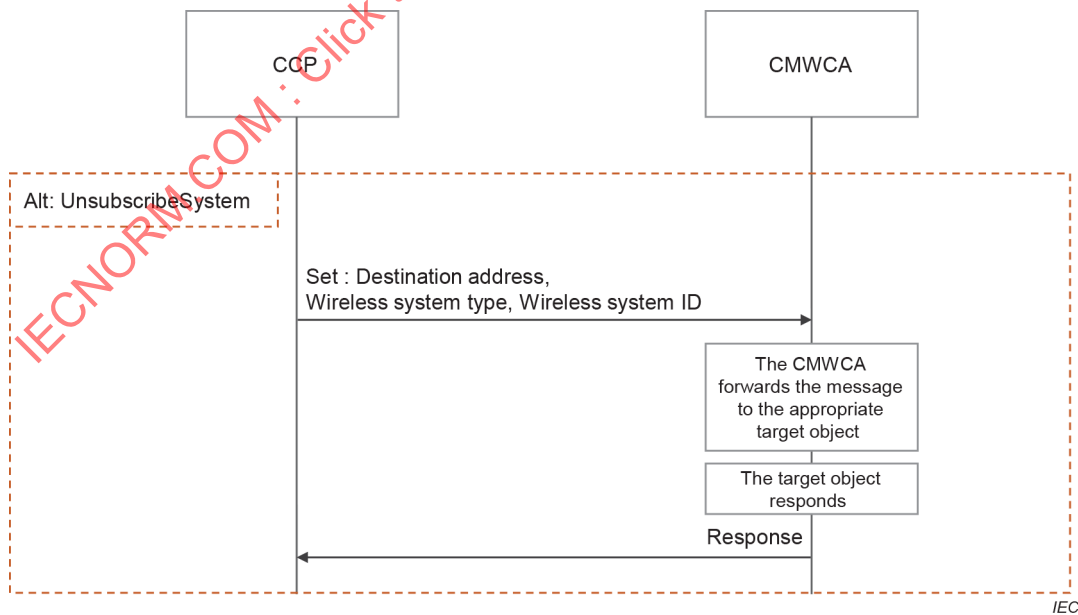


Figure 31 – Sequence diagram (UnsubscribeSystem)

8.3.5.5 Service message format

The message format of UnsubscribeSystem service shall be according to Table 25.

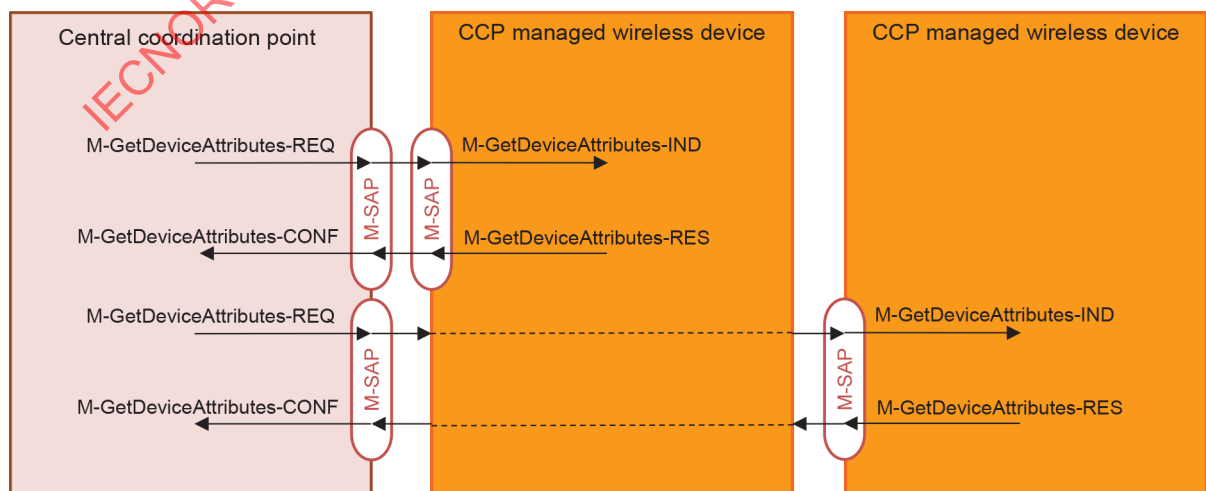
Table 25 – UnsubscribeSystemservice message format

Message format	Explanation
<pre>{ "Argument": [{ "Destination address": "02004CAABDD", "Wireless system type": "IEC 62591", "Wireless system ID": "5555" }] "Result (+)": [{ "Wireless system ID": "5555", "Status": "connect", "System address": "02004CAABHH" }] "Result (-)": { "Service status": "aborted", } }</pre>	Parameters of the service request. Destination address to which the service request is to be sent. Type of the destination wireless system. Identifier of the wireless system. Service request succeeded. Identifier of the wireless system. Unsubscribe status of the wireless device. Address of the requested wireless device (master station of wireless system). Service request failed. Information on the result of service execution.

8.3.6 GetDeviceAttributes

8.3.6.1 Service overview

GetDeviceAttributes service is a confirmed service and returns the content of all attributes. GetDeviceAttributes service uses the M-SAP. The CCP sends the GetDeviceAttributes service request to CMWD. The primitive flow of GetDeviceAttributes service is depicted in Figure 32.



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Figure 32 – Primitive flow of GetDeviceAttributes

8.3.6.2 Service primitives

The service parameters for GetDeviceAttributes service are shown in Table 26.

Table 26 – GetDeviceAttributes service parameters

Parameter name	Request	Indication	Response	Confirm
Argument				
Destination address	M	M(=)		
Device ID	M	M(=)		
Result (+)			S	S(=)
CCP address			M	M
Device ID			M	M(=)
Status			M	M(=)
Attribute data			M	M(=)
Regional radio regulation			M	M(=)
Antenna type			M	M(=)
Antenna gain			U	U(=)
Antenna radiation pattern			U	U(=)
Equivalent radiated power			S	S(=)
Equivalent isotropic radiated power			S	S(=)
Total radiated power			S	S(=)
Transmitter output power			S	S(=)
Power spectral density			U	U(=)
Frequency channel			M	M(=)
Medium access control mechanism			M	M(=)
Frequency hopping sequence			M	M(=)
Communication reliability			U	U(=)
Transfer interval			M	M(=)
Transmission gap			U	U(=)
Transmitter sequence			U	U(=)
Duty cycle			M	M(=)
Dwell time			U	U(=)
Medium Utilization factor			U	U(=)
Adjacent channel selectivity			U	U(=)
Receiver sensitivity			M	M(=)
Receiver maximum input level			U	U(=)
Receiver blocking			U	U(=)
Spurious response			U	U(=)
Result (-)			S	S(=)
Service status			M	M(=)

Argument

The argument contains the parameters of the service request.

Destination address

This parameter specifies the destination address to which the service request is to be sent.

Device ID

This parameter specifies the identifier of the wireless device.

Result (+)

This selection type parameter indicates that the service request succeeded.

CCP address

This parameter specifies the address of the requested CCP. It is present in the response primitive.

Device ID

This parameter specifies the identifier of the wireless device.

Status

This parameter specifies the following status of the wireless device.

Attribute data

This parameter returns a stream of information containing all the relevant attributes of the wireless device.

Result (-)

This selection type parameter indicates that the service request failed.

Service status

This parameter provides information on the result of service execution. It shall be one of ABORTED or TIMEOUT.

8.3.6.3 Service procedure

The GetDeviceAttributes request shall send a message to the CMWD. When the message arrives at the target wireless device (CMWD), this shall result in a GetDeviceAttributes indication at the CMWD. The CMWD, in turn, shall forward the message to the appropriate target object. When the object responds, the CMWD shall forward the response via the GetDeviceAttributes response primitive. When the response arrives at the device which originated the request, a GetDeviceAttributes confirmation shall be returned to the application object which sent the request.

8.3.6.4 Service sequence

The service sequence of GetDeviceAttributes service is shown in Figure 33.

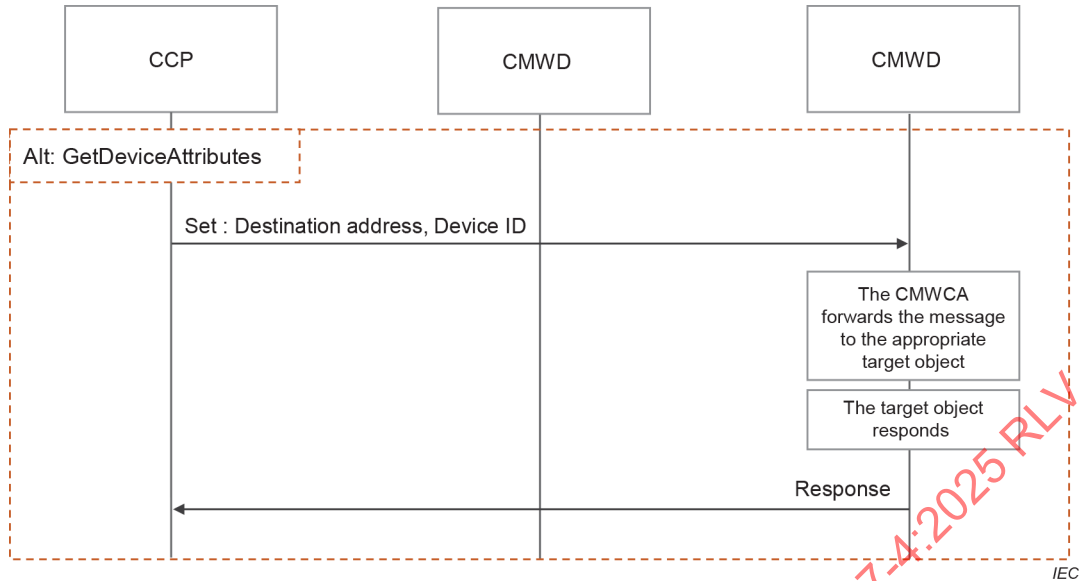


Figure 33 – Sequence diagram (GetDeviceAttributes)

8.3.6.5 Service message format

The message format of GetDeviceAttributes service shall be according to Table 27.

Table 27 – GetDeviceAttributes service message format

Message format	Explanation
<pre> { "Argument": [{ "Destination address": "02004CAABBD", "Device ID": "3000" }], "Result (+)": [{ "CCP address": "02004CAABBFF", "Device ID": "3000", "Status": "connect" }], "Attribute data": [{ "Regional radio regulation": "ETSI EN 300 328", "Antenna type": "omni-directional", }] } </pre>	Parameters of the service request. Destination address to which the service request is to be sent. Identifier of the wireless device. Service request succeeded. Address of the requested CCP. Identifier of the wireless device. Status of the wireless device. Regulation of important coexistence parameters such as frequency band and output power related to the region where the wireless application is intended to be used. Kind of part of a radio transmitting or receiving system which is designed to provide the required coupling between a transmitter or a receiver and the medium in which the radio wave propagates.

Message format	Explanation
"Antenna gain": 2,	
"Antenna radiation pattern": { "minPhi":0, "phiResolution": 30, "maxPhi": 360, "count": 12, "gain": [1,1,2....2] },	Ratio of the power required at the input of a reference antenna to the power supplied to the input of the given antenna to produce, in a given direction, the same field strength at the same distance. Variation of the field intensity of an antenna as an angular function with respect to the axis.
"Equivalent radiated power": "0.07676",	Product of the power supplied to the antenna and its gain relative to a half-wave dipole in given direction.
"Equivalent isotropic radiated power": "0.126",	Product of the power supplied to the antenna and the antenna gain in a given direction relative to an isotropic antenna (absolute or isotropic gain).
"Total radiated power": "0.0794", "Transmitter output power": 0.1", "Power spectral density":, { "Array of frequency": [2401, 2412,2406,2417....,2495],	Spatial power density integrated across the surface of the Sphere. Indicator for transmission range.
"Array of power spectral density": [-83- 83-75....,-45....,-83] } "Frequency channel": "01",	Distribution as a function of frequency of the power per unit bandwidth of the spectral components of a signal or a noise having a continuous spectrum and a finite mean power.
"Medium access control mechanism": "CSMA", "Frequency hopping sequence": "1, 04",	Span of the frequency spectrum which is characterized by lower cut-off frequency and upper cut-off frequency or by centre frequency and frequency Bandwidth. Transmission technique how to access the medium.
"Communication reliability": 400,	Sequence of frequency channels used for transmission (hopping sequence) and dwell time.
"Transfer interval": 4	Ability of a physical link and the related nodes to perform communication services under given conditions for a given time interval.
"Transmission gap": 0.1, "Transmitter sequence": 0.4,	Time difference between two consecutive transfers of user data from the automation application via the reference interface to the wireless communication function. Gap between two successive channel usages by a transmitter.
	Time that a transmitter uses a frequency channel without the

Message format	Explanation
<pre> "Duty cycle": 80, "Dwell time": 0.4, "Medium Utilization factor": 10, "Adjacent channel selectivity": -1, "Receiver sensitivity": -65, "Receiver maximum input level": 20, "Receiver blocking": -34, "Spurious response": 30 }], }], "Result (-)": { "Service status": aborted, } } </pre>	possibility to be interrupted by a wireless device of the same system. Duty cycle per communication link. Period spent at a particular frequency during any single hop of a frequency hopping system. Measure to quantify the amount of resources (power and time) used by non-adaptive equipment. Ability of a radio receiver to respond to the desired signal and to reject signals in adjacent frequency channels. Minimal signal power to receive data with a defined bit error ratio. Maximum signal power that the system can tolerate without distortion of the signal. Effect of a strong interfering signal on the receiver's ability to detect a low-level wanted signal. Receiver output due to unwanted signals Service request failed. Information on the result of service execution.

8.4 Wireless communication system and device configuration and control services

8.4.1 Supported services

This Subclause 8.4 contains the definition of services that are unique to the wireless communication system and device configuration and control (WCSDCC) service. The services defined for this WCSDCC are:

- SetTransmitPower, see 8.4.2;
- SetFrequencyChannel, see 8.4.3;
- SetBandwidth, see 8.4.4;
- SetFrequencyHoppingSequence, see 8.4.5;
- SetBlockedFrequencyList, see 8.4.6;
- SetDwellTime, see 8.4.7;
- SetMediumAccessControlMechanism, see 8.4.8;
- SetDeviceStatus, see 8.4.9;
- GetParameter, see 8.4.10;
- SetParameter, see 8.4.11.

8.4.2 SetTransmitPower

8.4.2.1 Service overview

The SetTransmitPower service uses a set of primitives for supporting control of the CMWCA and CMWD from the CCP. SetTransmitPower service is a confirmed service and uses the C-SAP. The CCP sends the SetTransmitPower service request attempts to CMWD or CMWCA. The primitive flow of SetTransmitPower service is depicted in Figure 34.

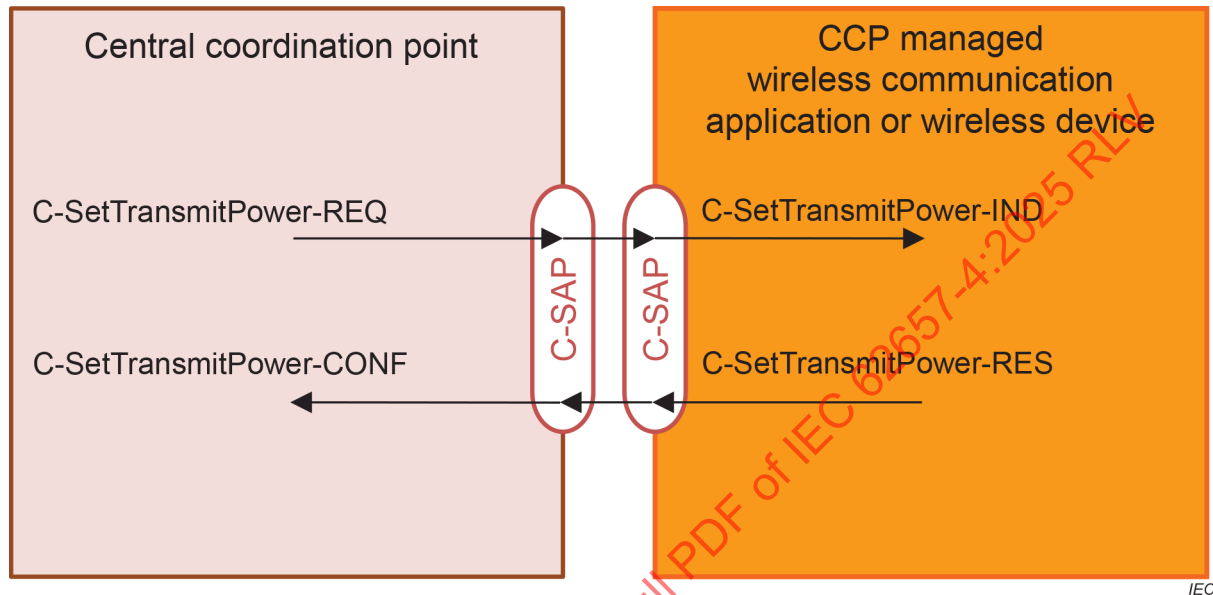


Figure 34 – Primitive flow of SetTransmitPower service

8.4.2.2 Service primitives

The structure of the service primitives is shown in Table 28.

Table 28 – SetTransmitPower service parameter

Parameter name	Request	Indication	Response	Confirm
Argument				
Destination address	M	M(=)		
System or Device ID	M	M(=)		
Transmitter output power	M	M(=)		
Result (+)			S	S(=)
Result (-)			S	S(=)
Service status			M	M(=)

Argument

The argument contains the parameters of the service request.

Destination address

This parameter specifies the destination address to which the service request is to be sent.

System or Device ID

This parameter specifies the identifier of the CMWCA or CMWD entity ID.

Transmit power value

This parameter specifies the value of transmit power.

Result (+)

This selection type parameter indicates that the service request succeeded.

Result (-)

This selection type parameter indicates that the service request failed.

8.4.2.3 Service procedure

The SetTransmitPower request shall send a message from the CCP to the CMWCA or CMWD. When the message arrives at the target wireless device, this shall result in a SetTransmitPower indication at the CMWCA or CMWD. The CCP shall forward the message to the appropriate target object.

8.4.2.4 Service sequence

The service sequence of SetTransmitPower service is shown in Figure 35.

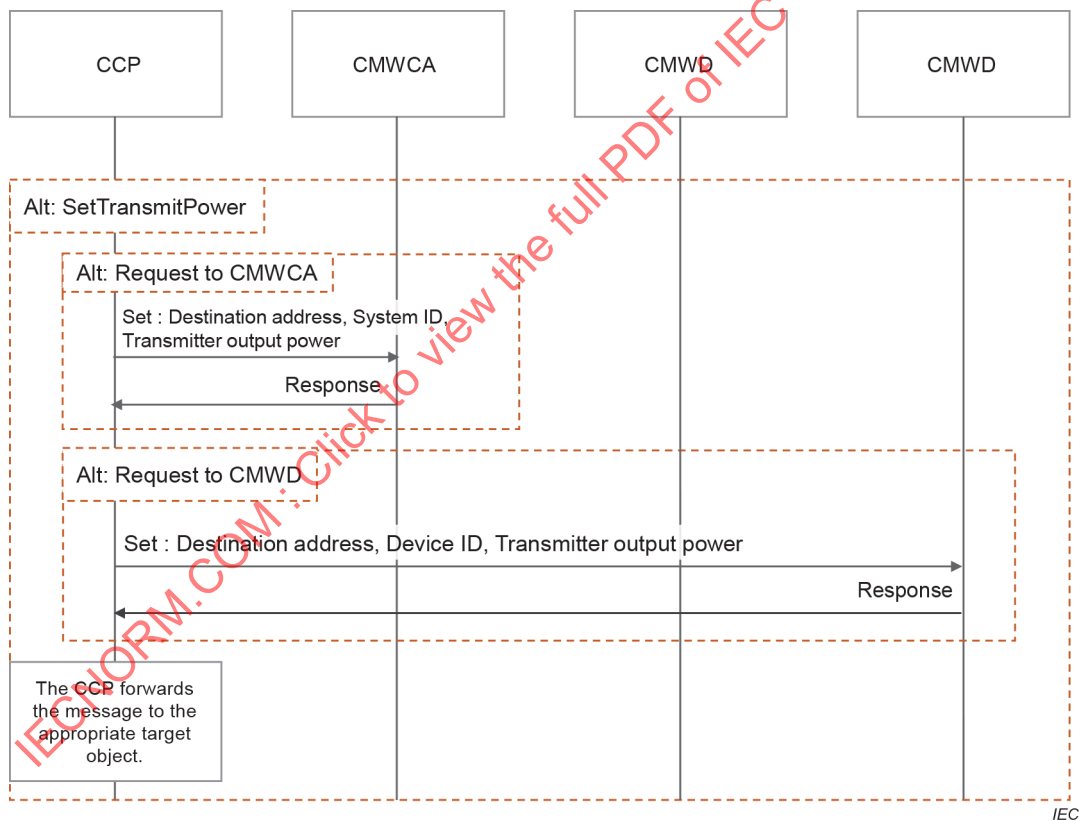


Figure 35 – Sequence diagram (SetTransmitPower)

8.4.2.5 Service message format

The message format of SetTransmitPower service shall be according to Table 29.

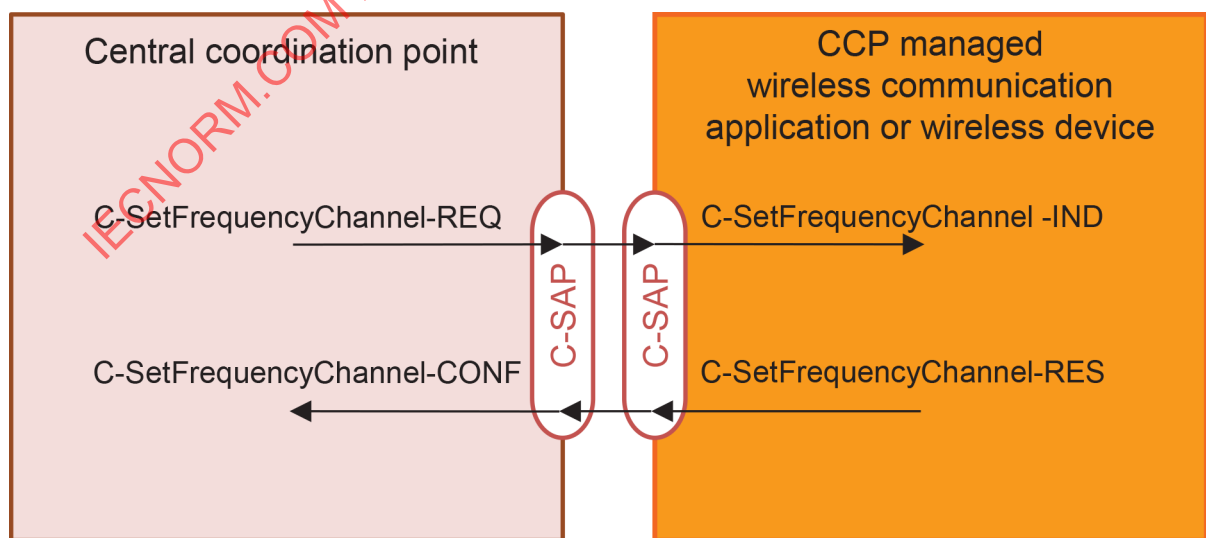
Table 29 – SetTransmitPowerservice message format

Message format	Explanation
<pre>{ "Argument": [{ "Destination address": "02004CAABBDD", "System or Device ID": "A3000", "Transmitter output power": 0.01 }], "Result (+)": "Result (-)": { "Service status": "aborted", } }</pre>	Parameters of the service request. Destination address to which the service request is to be sent. Identifier of the CMWCA or CMWD entity ID. Value of transmit power. Service request succeeded. Service request failed. Information on the result of service execution.

8.4.3 SetFrequencyChannel

8.4.3.1 Service overview

The SetFrequencyChannel service uses a set of primitives for supporting control of the CMWCA and CMWD from the CCP. SetFrequencyChannel service is a confirmed service and uses the C-SAP. The CCP sends the SetFrequencyChannel service request attempts to CMWD or CMWCA. The primitive flow of SetFrequencyChannel service is depicted in Figure 36.



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Figure 36 – Primitive flow of SetFrequencyChannel service

8.4.3.2 Service primitives

The structure of the service primitives is shown in Table 30.

Table 30 – SetFrequencyChannel service parameter

Parameter name	Request	Indication	Response	Confirm
Argument				
Destination address	M	M(=)		
System or Device ID	M	M(=)		
Frequency channel	M	M(=)		
Result (+)			S	S(=)
Result (-)			S	S(=)
Service status			M	M(=)

Argument

The argument contains the parameters of the service request.

Destination address

This parameter specifies the destination address to which the service request is to be sent.

System or Device ID

This parameter specifies the identifier of the CMWCA or CMWD entity ID.

Frequency channel centre frequency

This parameter specifies the centre frequency of the frequency channel.

Result (+)

This selection type parameter indicates that the service request succeeded.

Result (-)

This selection type parameter indicates that the service request failed.

8.4.3.3 Service procedure

The SetFrequencyChannel request shall send a message from the CCP to the CMWCA or CMWD. When the message arrives at the target wireless device, this shall result in a SetFrequencyChannel indication at the CMWCA or CMWD. The CCP shall forward the message to the appropriate target object.

8.4.3.4 Service sequence

The service sequence of SetFrequencyChannel service is shown in Figure 37.

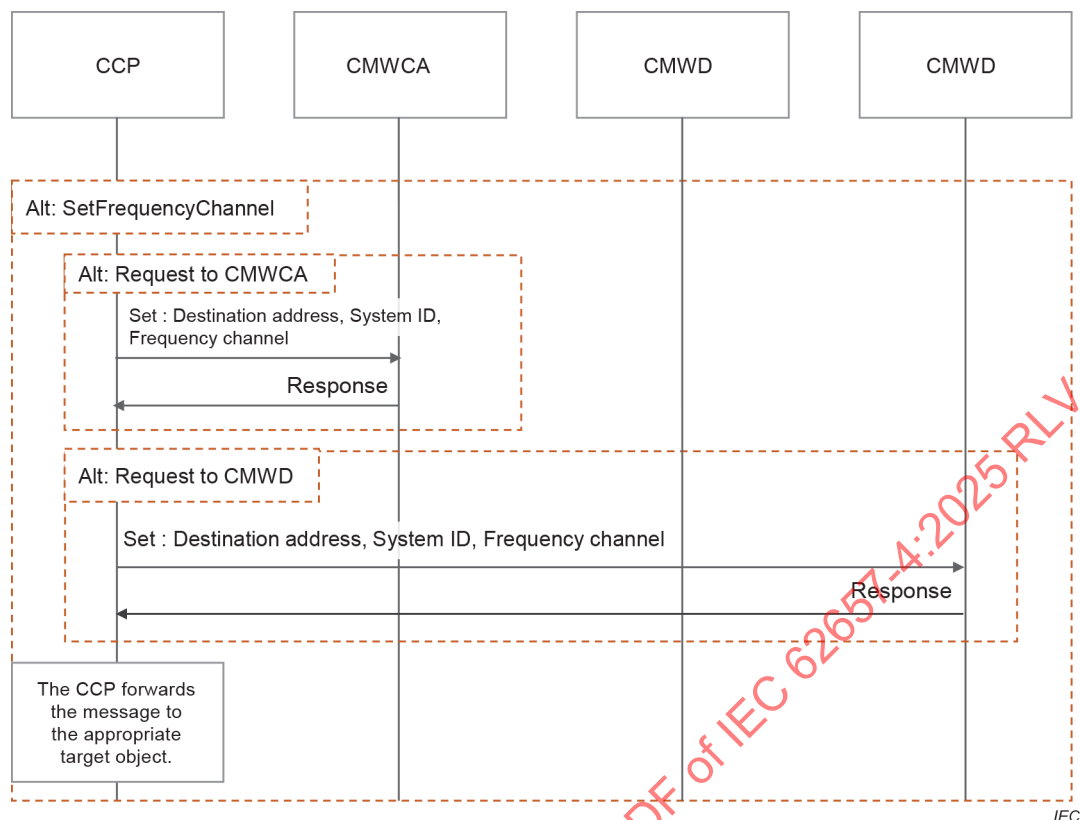


Figure 37 – Sequence diagram (SetFrequencyChannel)

8.4.3.5 Service message format

The message format of SetFrequencyChannel service shall be according to Table 31.

Table 31 – SetFrequencyChannel service message format

Message format	Explanation
<pre> { "Argument": [{ "Destination address": "02004CAABBDD", "System or Device ID": "A3000", "Frequency channel": "01" }], "Result (+)": "Result (-)": { "Service status": "aborted" } } </pre>	Parameters of the service request. Destination address to which the service request is to be sent. Identifier of the CMWCA or CMWD entity ID. Centre frequency of the frequency channel. Service request succeeded. Service request failed. Information on the result of service execution.

8.4.4 SetBandwidth

8.4.4.1 Service overview

The SetBandwidth service uses a set of primitives for supporting control of the CMWCA and CMWD from the CCP. SetBandwidth service is a confirmed service and uses the C-SAP. The CCP sends the SetBandwidth service request attempts to CMWD or CMWCA. The primitive flow of SetBandwidth service is depicted in Figure 38.

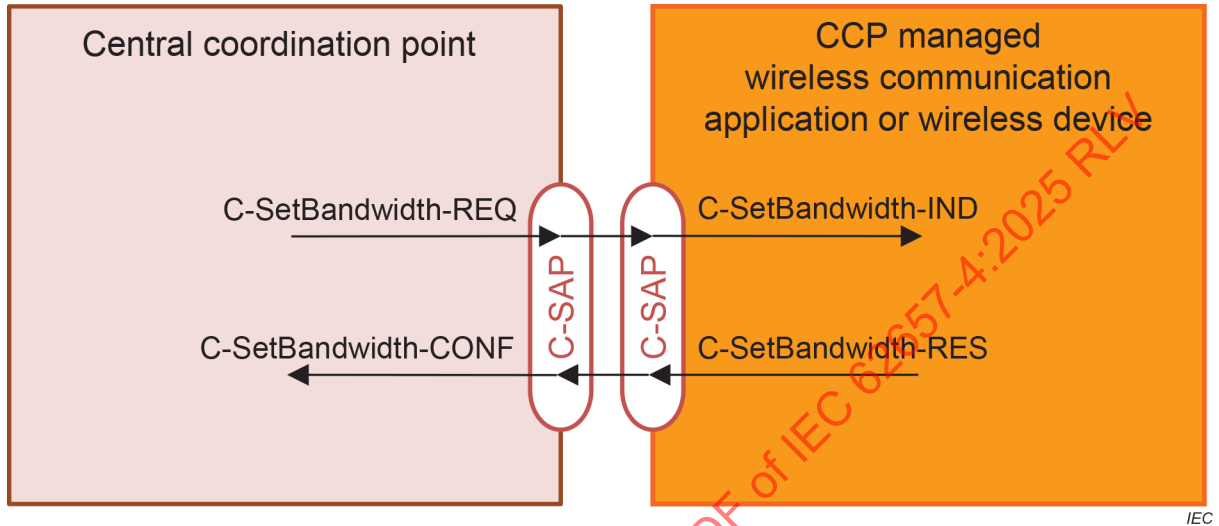


Figure 38 – Primitive flow of SetBandwidth service

8.4.4.2 Service primitives

The structure of the service primitives is shown in Table 32.

Table 32 – SetBandwidth service parameter

Parameter name	Request	Indication	Response	Confirm
Argument				
Destination address	M	M(=)		
System or Device ID	M	M(=)		
Frequency Bandwidth	M	M(=)		
Result (+)			S	S(=)
			-	-
Result (-)			S	S(=)
Service status			M	M(=)

Argument

The argument contains the parameters of the service request.

Destination address

This parameter specifies the destination address to which the service request is to be sent.

System or Device ID

This parameter specifies the identifier of the CMWCA or CMWD entity ID.

Frequency Bandwidth

This parameter specifies the bandwidth.

Result (+)

This selection type parameter indicates that the service request succeeded.

Result (-)

This selection type parameter indicates that the service request failed.

8.4.4.3 Service procedure

The SetBandwidth request shall send a message from the CCP to the CMWCA or CMWD. When the message arrives at the target wireless device, this shall result in a SetBandwidth indication at the CMWCA or CMWD. The CCP shall forward the message to the appropriate target object.

8.4.4.4 Service sequence

The service sequence of SetBandwidth service is shown in Figure 39.

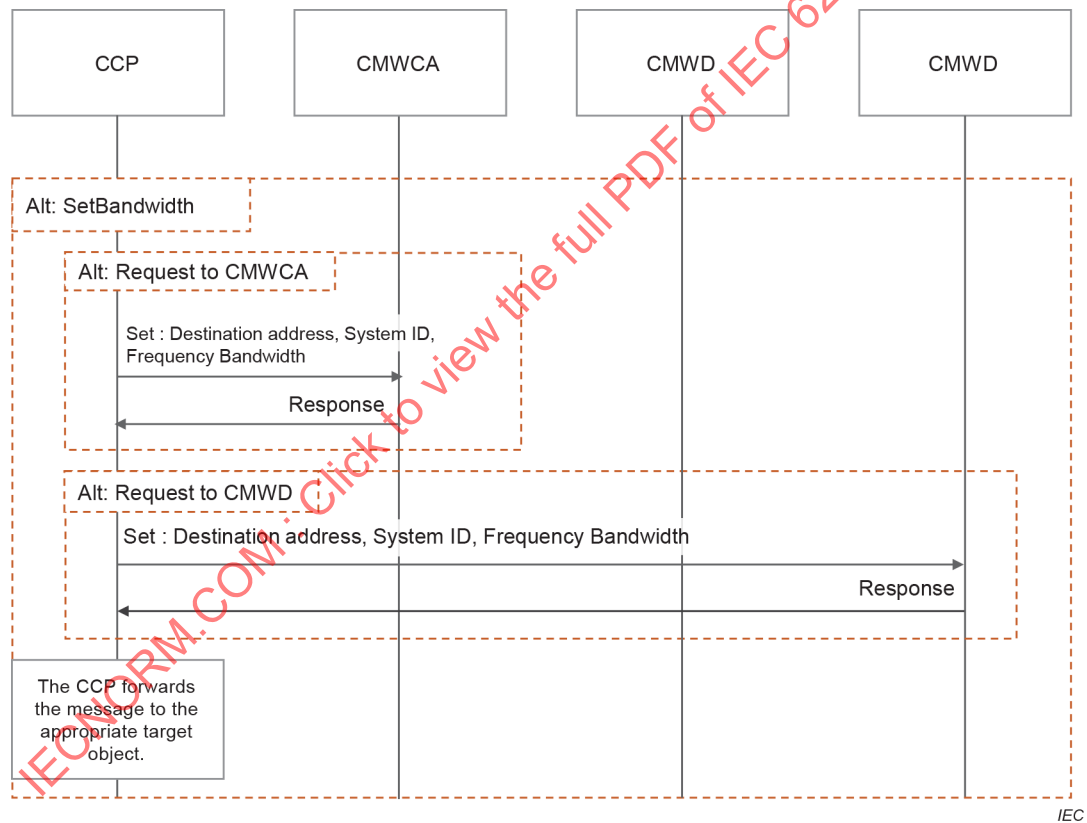


Figure 39 – Sequence diagram (SetBandwidth)

8.4.4.5 Service message format

The message format of SetBandwidth service shall be according to Table 33.

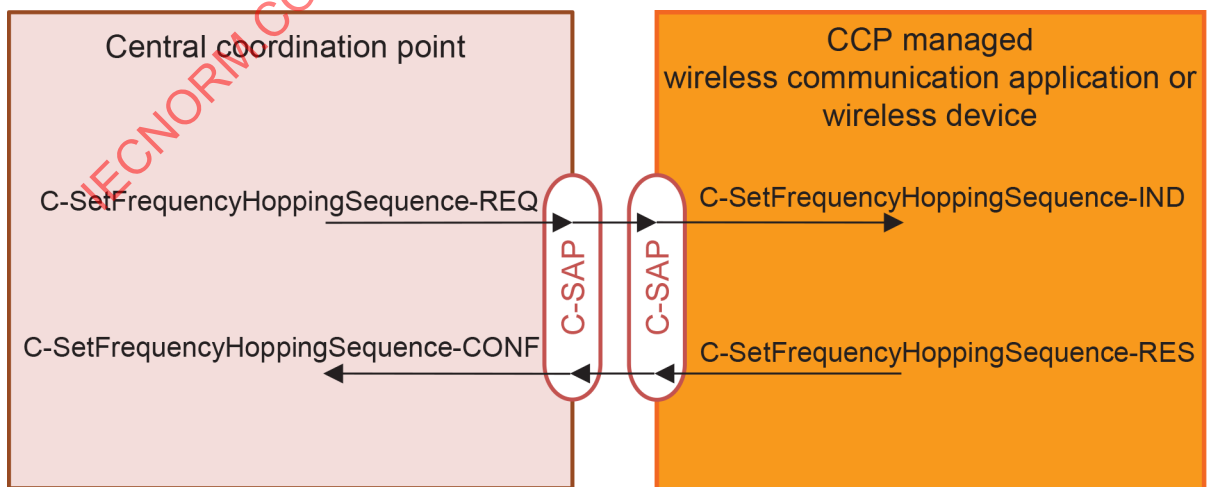
Table 33 – SetBandwidthservice message format

Message format	Explanation
<pre>{ "Argument": [{ "Destination address": "02004CAABBDD", "System or Device ID": "A3000", "Frequency Bandwidth": "429, 920" }], "Result (+)": "Result (-)": { "Service status": "aborted" } }</pre>	Parameters of the service request. Destination address to which the service request is to be Sent. Identifier of the CMWCA or CMWD entity ID. Bandwidth. Service request succeeded. Service request failed. Information on the result of service execution.

8.4.5 SetFrequencyHoppingSequence

8.4.5.1 Service overview

The SetFrequencyHoppingSequence service uses a set of primitives for supporting control of the CMWCA and CMWD from the CCP. SetFrequencyHoppingSequence service is a confirmed service and uses the C-SAP. The CCP sends the SetFrequencyHoppingSequence service request attempts to CMWD or CMWCA. The primitive flow of SetFrequencyHoppingSequence service is depicted in Figure 40.



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Figure 40 – Primitive flow of SetFrequencyHoppingSequence service

8.4.5.2 Service primitives

The structure of the service primitives is shown in Table 34.

Table 34 – SetFrequencyHoppingSequence service parameter

Parameter name	Request	Indication	Response	Confirm
Argument				
Destination address	M	M(=)		
System or Device ID	M	M(=)		
Frequency hopping sequence	M	M(=)		
Result (+)			S	S(=)
			-	-
Result (-)			S	S(=)
Service status			M	M(=)

Argument

The argument contains the parameters of the service request.

Destination address

This parameter specifies the destination address to which the service request is to be sent.

System or device ID

This parameter specifies the identifier of the CMWCA or CMWD entity ID.

Frequency hopping sequence

This parameter specifies the frequency hopping sequence for frequency hopping systems.

Result (+)

This selection type parameter indicates that the service request succeeded.

Result (-)

This selection type parameter indicates that the service request failed.

8.4.5.3 Service procedure

The SetFrequencyHoppingSequence request shall send a message from the CCP to the CMWCA or CMWD. When the message arrives at the target wireless device, this shall result in a SetFrequencyHoppingSequence indication at the CMWCA or CMWD. The CCP shall forward the message to the appropriate target object.

8.4.5.4 Service sequence

The service sequence of SetFrequencyHoppingSequence service is shown in Figure 41.

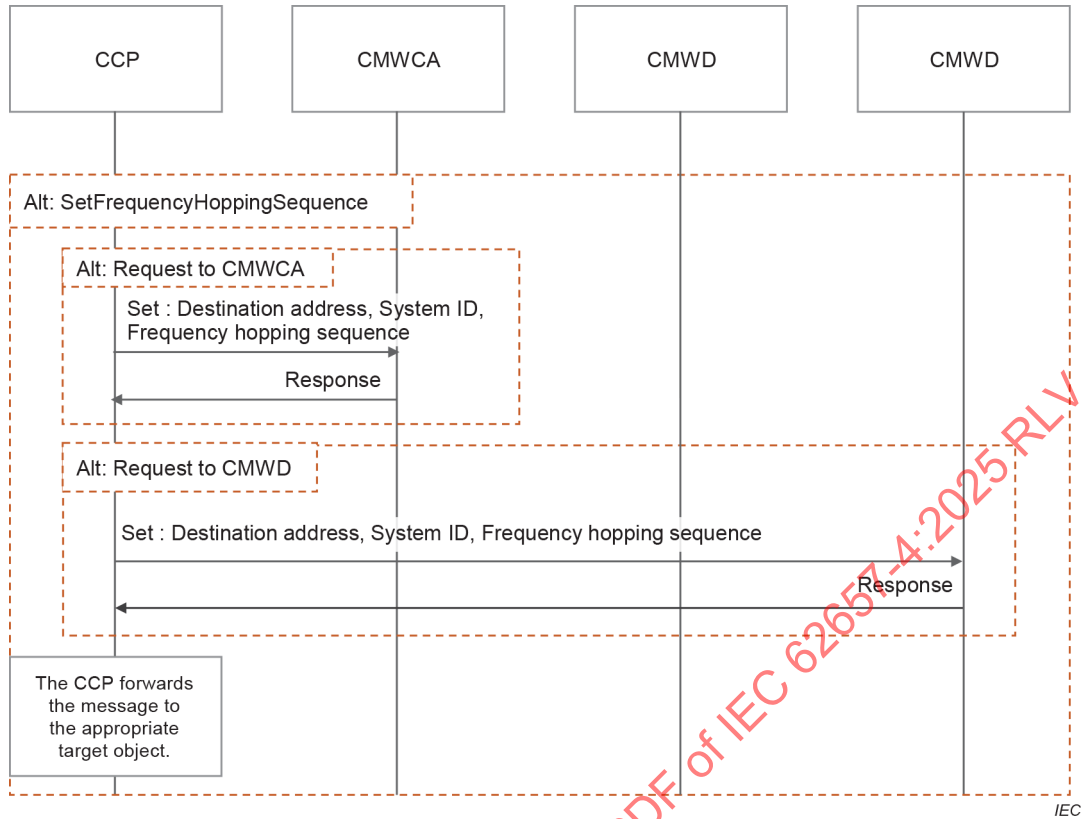


Figure 41 – Sequence diagram (SetBandwidth)

8.4.5.5 Service message format

The message format of SetFrequencyHoppingSequence service shall be according to Table 35.

Table 35 – SetFrequencyHoppingSequenceservice message format

Message format	Explanation
<pre> { "Argument": [{ "Destination address": "02004CAABDD", "System or Device ID": "A3000", "Frequency hopping sequence": "1, 0.4" }], "Result (+)": "Result (-)": { "Service status": "aborted", } } </pre>	Parameters of the service request. Destination address to which the service request is to be sent. Identifier of the CMWCA or CMWD entity ID. Frequency hopping sequence for frequency hopping systems. Service request succeeded. Service request failed. Information on the result of service execution.

8.4.6 SetBlockedFrequencyList

8.4.6.1 Service overview

The SetBlockedFrequencyList service uses a set of primitives for supporting control of the CMWCA and CMWD from the CCP. SetBlockedFrequencyList service is a confirmed service and uses the C-SAP. The CCP sends the SetBlockedFrequencyList service request attempts to CMWD or CMWCA. The primitive flow of SetBlockedFrequencyList service is depicted in Figure 42.

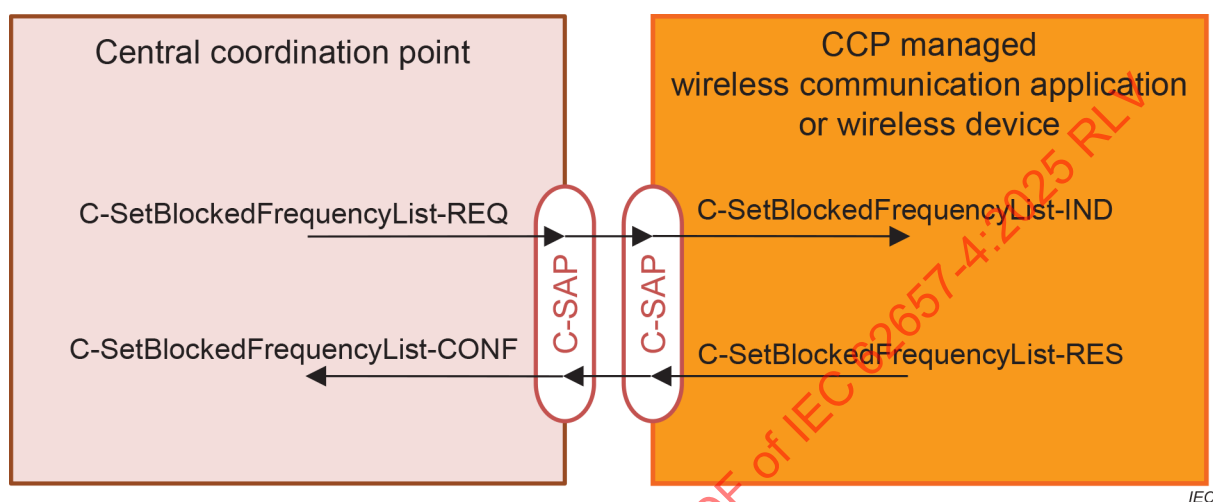


Figure 42 – Primitive flow of SetBlockedFrequencyList service

8.4.6.2 Service primitives

The structure of the service primitives is shown in Table 36.

Table 36 – SetBlockedFrequencyList service parameter

Parameter name	Request	Indication	Response	Confirm
Argument				
Destination address	M	M(=)		
System or Device ID	M	M(=)		
Blocked frequency list	M	M(=)		
Result (+)			S	S(=)
			-	-
Result (-)			S	S(=)
Service status			M	M(=)

Argument

The argument contains the parameters of the service request.

Destination address

This parameter specifies the destination address to which the service request is to be sent.

System or device ID

This parameter specifies the identifier of the CMWCA or CMWD entity ID.

Blocked frequency list

This parameter specifies the blocked frequency channels.

Result (+)

This selection type parameter indicates that the service request succeeded.

Result (-)

This selection type parameter indicates that the service request failed.

8.4.6.3 Service procedure

The SetBlockedFrequencyList request shall send a message from the CCP to the CMWCA or CMWD. When the message arrives at the target wireless device, this shall result in a SetBlockedFrequencyList indication at the CMWCA or CMWD. The CCP shall forward the message to the appropriate target object.

8.4.6.4 Service sequence

The service sequence of SetBlockedFrequencyList service is shown in Figure 43.

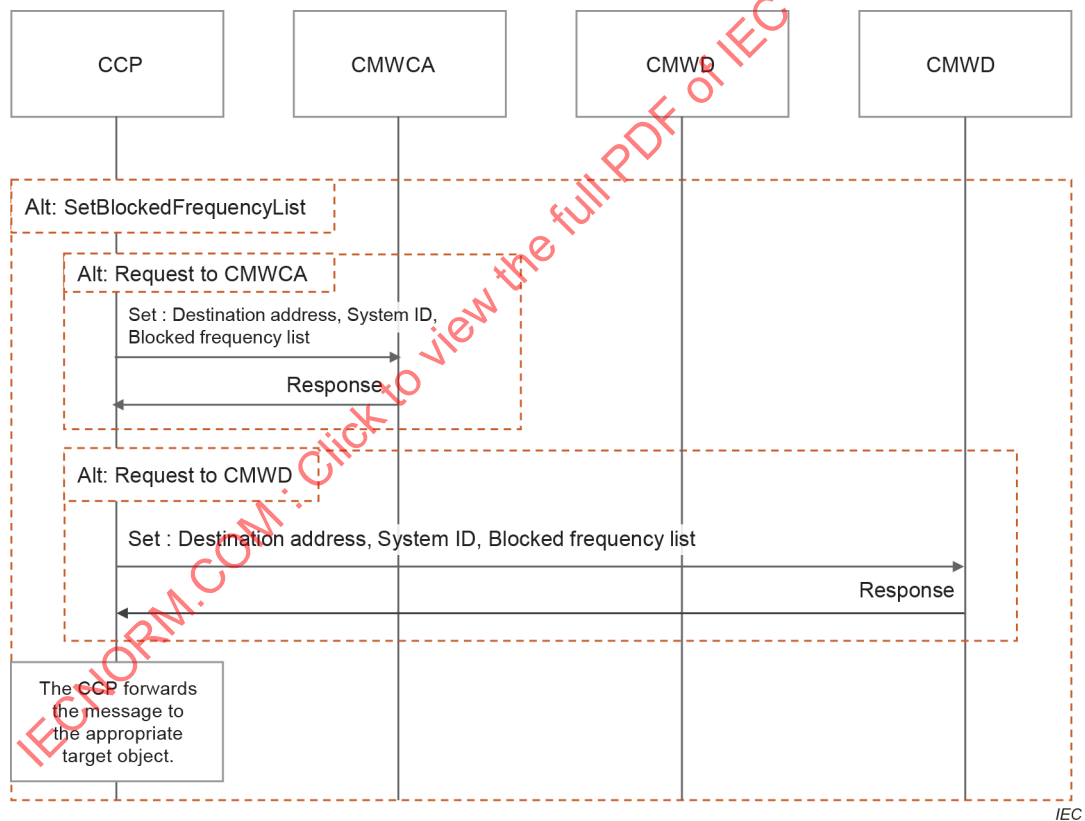


Figure 43 – Sequence diagram (SetBlockedFrequencyList)

8.4.6.5 Service message format

The message format of SetBlockedFrequencyList service shall be according to Table 37.

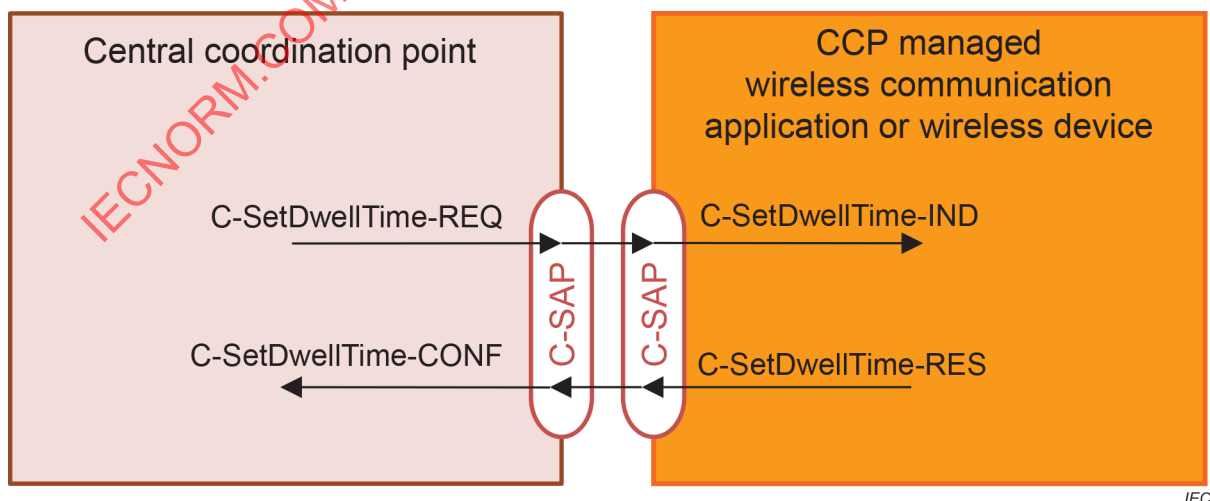
Table 37 – SetBlockedFrequencyListservice message format

Message format	Explanation
<pre>{ "Argument": [{ "Destination address": "02004CAABBDD", "System or Device ID": "A3000", "Blocked frequency list": "4, 5" }], "Result (+)": "Result (-)": { "Service status": "aborted" } }</pre>	Parameters of the service request. Destination address to which the service request is to be sent. Identifier of the CMWCA or CMWD entity ID. Blocked frequency channels. Service request succeeded. Service request failed. Information on the result of service execution.

8.4.7 SetDwellTime

8.4.7.1 Service overview

The SetDwellTime service uses a set of primitives for supporting control of the CMWCA and CMWD from the CCP. SetDwellTime service is a confirmed service and uses the C-SAP. The CCP sends the SetDwellTime service request attempts to CMWD or CMWCA. The primitive flow of SetDwellTime service is depicted in Figure 44.



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Figure 44 – Primitive flow of SetDwellTime service

8.4.7.2 Service primitives

The structure of the service primitives is shown in Table 38.

Table 38 – SetDwellTime service parameter

Parameter name	Request	Indication	Response	Confirm
Argument				
Destination address	M	M(=)		
System or Device ID	M	M(=)		
Dwell time	M	M(=)		
Result (+)			S	S(=)
			-	-
Result (-)			S	S(=)
Service status			M	M(=)

Argument

The argument contains the parameters of the service request.

Destination address

This parameter specifies the destination address to which the service request is to be sent.

System or device ID

This parameter specifies the identifier of the CMWCA or CMWD entity ID.

Dwell time

This parameter specifies the dwell time.

Result (+)

This selection type parameter indicates that the service request succeeded.

Result (-)

This selection type parameter indicates that the service request failed.

8.4.7.3 Service procedure

The SetDwellTime request shall send a message from the CCP to the CMWCA or CMWD. When the message arrives at the target wireless device, this shall result in a SetDwellTime indication at the CMWCA or CMWD. The CCP shall forward the message to the appropriate target object.

8.4.7.4 Service sequence

The service sequence of SetDwellTime service is shown in Figure 45.

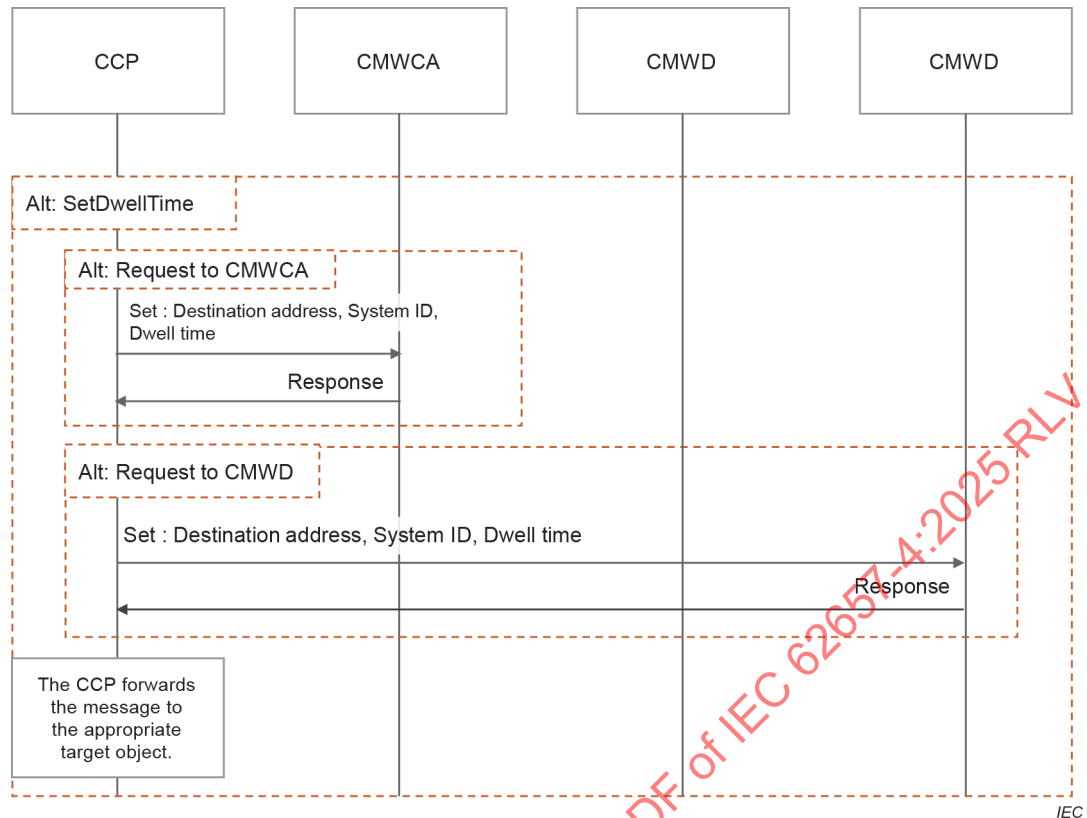


Figure 45 – Sequence diagram (SetDwellTime)

8.4.7.5 Service message format

The message format of SetDwellTime service shall be according to Table 39.

Table 39 – SetDwellTimeservice message format

Message format	Explanation
<pre> { "Argument": [{ "Destination address": "02004CAABBDD", "System or Device ID": "A3000", "Dwell time": "0.4" }], "Result (+)": "Result (-)": { "Service status": "aborted" } } </pre>	Parameters of the service request. Destination address to which the service request is to be sent. Identifier of the CMWCA or CMWD entity ID. Dwell time. Service request succeeded. Service request failed. Information on the result of service execution.

8.4.8 SetMediumAccessControlMechanism

8.4.8.1 Service overview

The SetMediumAccessControlMechanism service uses a set of primitives for supporting control of the CMWCA and CMWD from the CCP. SetMediumAccessControlMechanism service is a confirmed service and uses the C-SAP. The CCP sends the SetMediumAccessControlMechanism service request attempts to CMWD or CMWCA. The primitive flow of SetMediumAccessControlMechanism service is depicted in Figure 46.

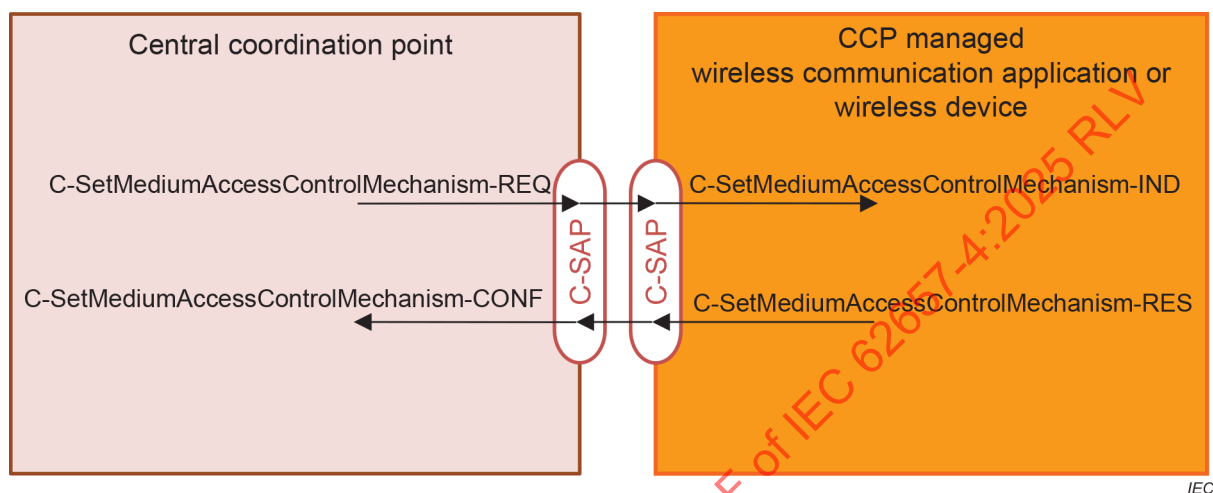


Figure 46 – Primitive flow of SetMediumAccessControlMechanism service

8.4.8.2 Service primitives

The structure of the service primitives is shown in Table 40 .

Table 40 – SetMediumAccessControlMechanism service parameter

Parameter name	Request	Indication	Response	Confirm
Argument				
Destination address	M	M(=)		
System or Device ID	M	M(=)		
Medium access control mechanism	M	M(=)		
Result (+)			S	S(=)
			-	-
Result (-)			S	S(=)
Service status			M	M(=)

Argument

The argument contains the parameters of the service request.

Destination address

This parameter specifies the destination address to which the service request is to be sent.

System or Device ID

This parameter specifies the identifier of the CMWCA or CMWD entity ID.

Medium access control mechanism

This parameter specifies the type of medium access control mechanism. Allowed values are: CCP, DAA, DAR, DAS using data type CHAR.

Result (+)

This selection type parameter indicates that the service request succeeded.

Result (-)

This selection type parameter indicates that the service request failed.

8.4.8.3 Service procedure

The SetMediumAccessControlMechanism request shall send a message from the CCP to the CMWCA or CMWD. When the message arrives at the target wireless device, this shall result in a SetMediumAccessControlMechanism indication at the CMWCA or CMWD. The CCP shall forward the message to the appropriate target object.

8.4.8.4 Service sequence

The service sequence of SetMediumAccessControlMechanism service is shown in Figure 47.

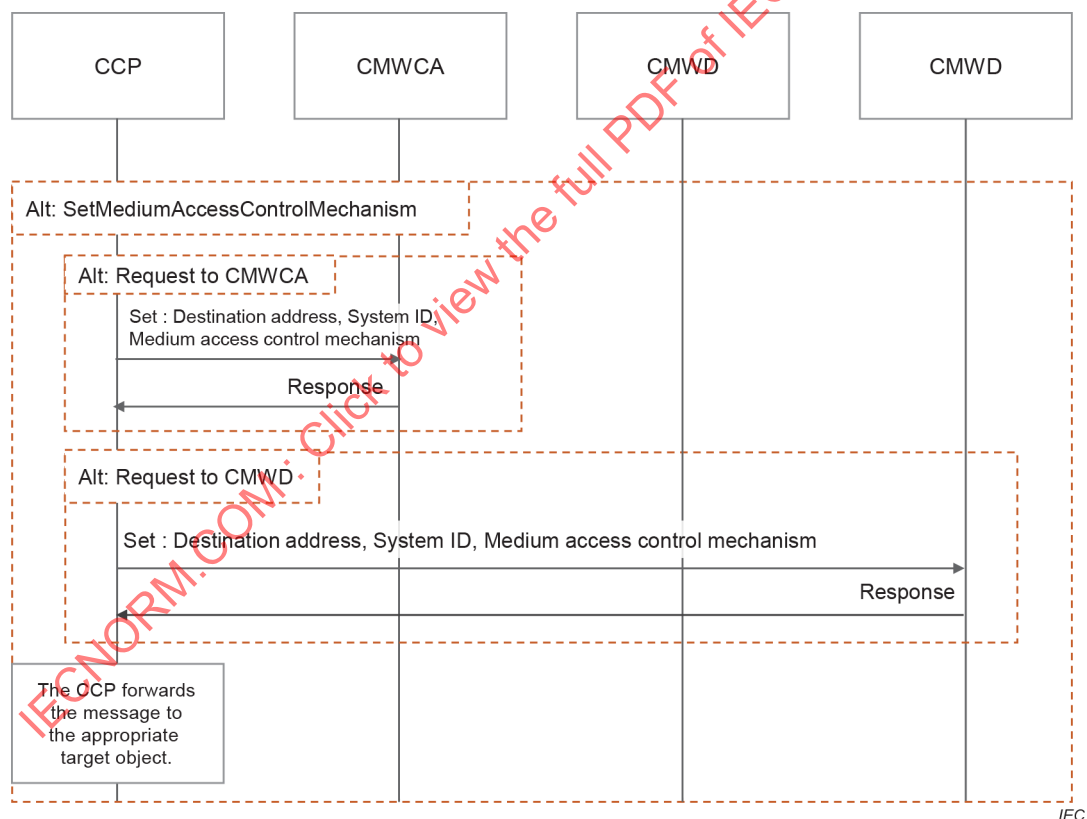


Figure 47 – Sequence diagram (SetMediumAccessControlMechanism)

8.4.8.5 Service message format

The message format of SetMediumAccessControlMechanism service shall be according to Table 41.

Table 41 – SetMediumAccessControlMechanism service message format

Message format	Explanation
<pre>{ "Argument": [{ "Destination address": "02004CAABBDD", "System or Device ID": "A3000", "Medium access control mechanism": "CSMA" }], "Result (+)": "Result (-)": { "Service status": "aborted" } }</pre>	Parameters of the service request. Destination address to which the service request is to be sent. Identifier of the CMWCA or CMWD entity ID. Type of medium access control mechanism. Service request succeeded. Service request failed. Information on the result of service execution.

8.4.9 SetDeviceStatus

8.4.9.1 Service overview

The SetDeviceStatus service uses a set of primitives for supporting control of the CMWCA and CMWD from the CCP. SetDeviceStatus service is a confirmed service and uses the C-SAP. The CCP sends the SetDeviceStatus service request attempts to CMWD or CMWCA. The primitive flow of SetDeviceStatus service is depicted in Figure 48.

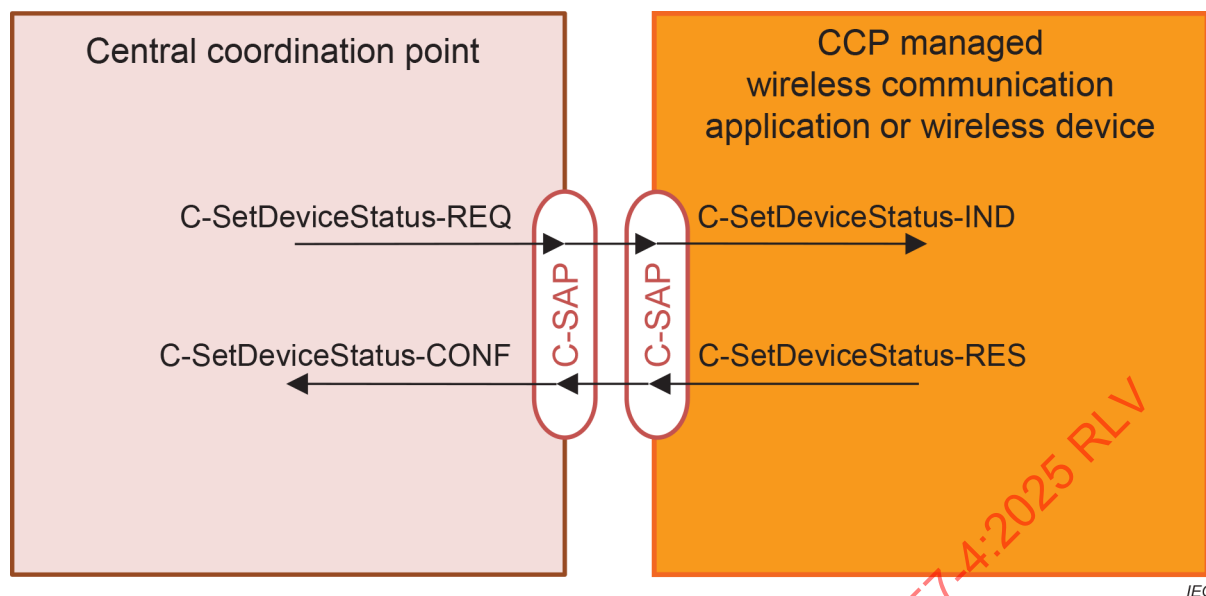


Figure 48 – Primitive flow of SetDeviceStatus service

8.4.9.2 Service primitives

The structure of the service primitives is shown in Table 42.

Table 42 – SetDeviceStatus service parameter

Parameter name	Request	Indication	Response	Confirm
Argument				
Destination address	M	M(=)		
System or Device ID	M	M(=)		
Device status	M	M(=)		
Result (+)			S	S(=)
			-	-
Result (-)			S	S(=)
Service status			M	M(=)

Argument

The argument contains the parameters of the service request.

Destination address

This parameter specifies the destination address to which the service request is to be sent.

System or Device ID

This parameter specifies the identifier of the CMWCA or CMWD entity ID.

Device status

This parameter specifies the type (RUN, IDLE, START_SSF, STOP_SSF, STOP) of system or device status.

Result (+)

This selection type parameter indicates that the service request succeeded.

Result (-)

This selection type parameter indicates that the service request failed.

8.4.9.3 Service procedure

The SetDeviceStatus request shall send a message from the CCP to the CMWCA or CMWD. When the message arrives at the target wireless device, this shall result in a SetDeviceStatus indication at the CMWCA or CMWD. The CCP shall forward the message to the appropriate target object.

8.4.9.4 Service sequence

The service sequence of SetDeviceStatus service is shown in Figure 49.

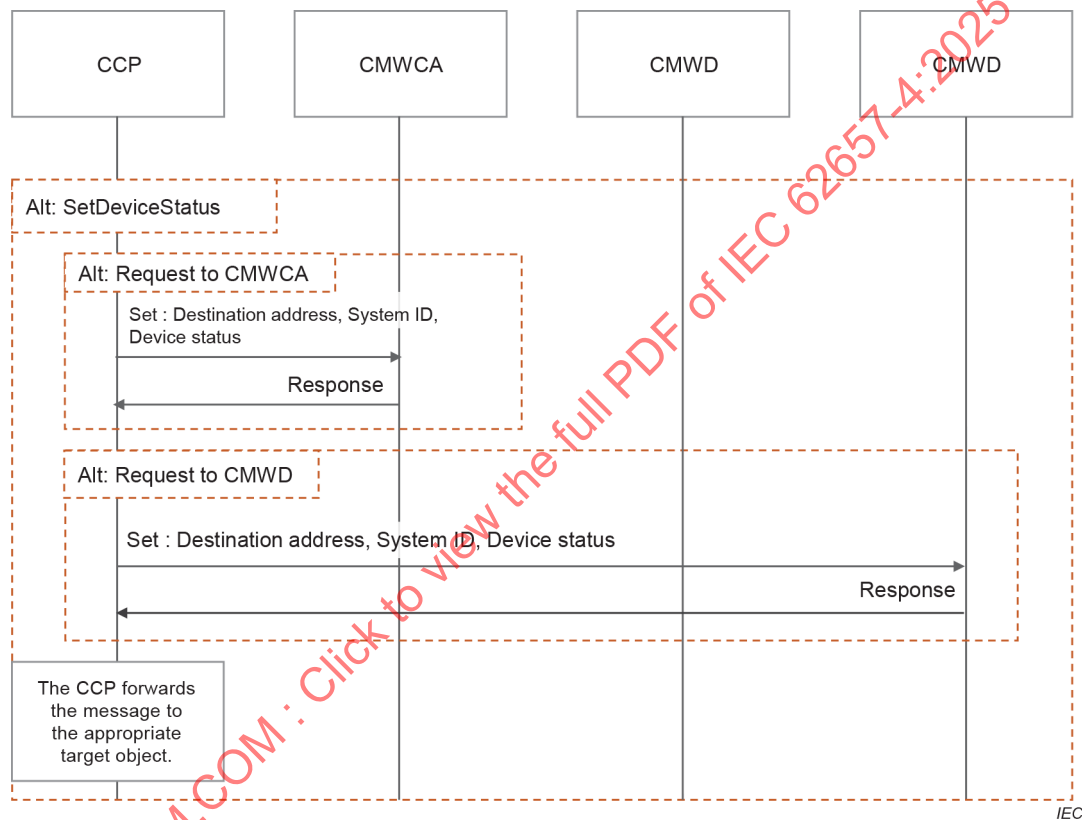


Figure 49 – Sequence diagram (SetDeviceStatus)

8.4.9.5 Service message format

The message format of SetDeviceStatus service shall be according to Table 43.

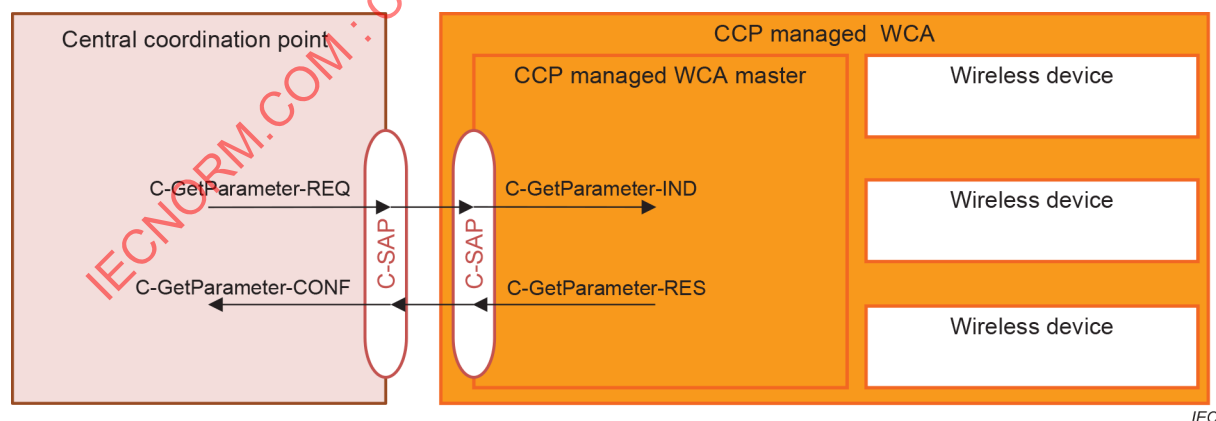
Table 43 – SetDeviceStatusservice message format

Message format	Explanation
<pre> { "Argument": [{ "Destination address": "02004CAABBDD", "System or Device ID": "A3000", "Device status": "run" }], "Result (+)": "Result (-)": { "Service status": "aborted" } } </pre>	Parameters of the service request. Destination address to which the service request is to be sent. Identifier of the CMWCA or CMWD entity ID. Type (RUN, IDLE, START_SSF, STOP_SSF, STOP) of system or device status. Service request succeeded. Service request failed. Information on the result of service execution.

8.4.10 GetParameter

8.4.10.1 Service overview

The GetParameter service uses a set of primitives to be used by the CCP for querying technology specific or vendor specific parameter values from CMWCA or CMWD. GetParameter service is a confirmed service and uses the C-SAP. The CCP sends the GetParameter service request attempts to CMWCA or CMWD. The primitive flow of GetParameter service is depicted in Figure 50 for CMWCA and in Figure 51 for CMWD.

**Figure 50 – Primitive flow of GetParameter service for CMWCA**

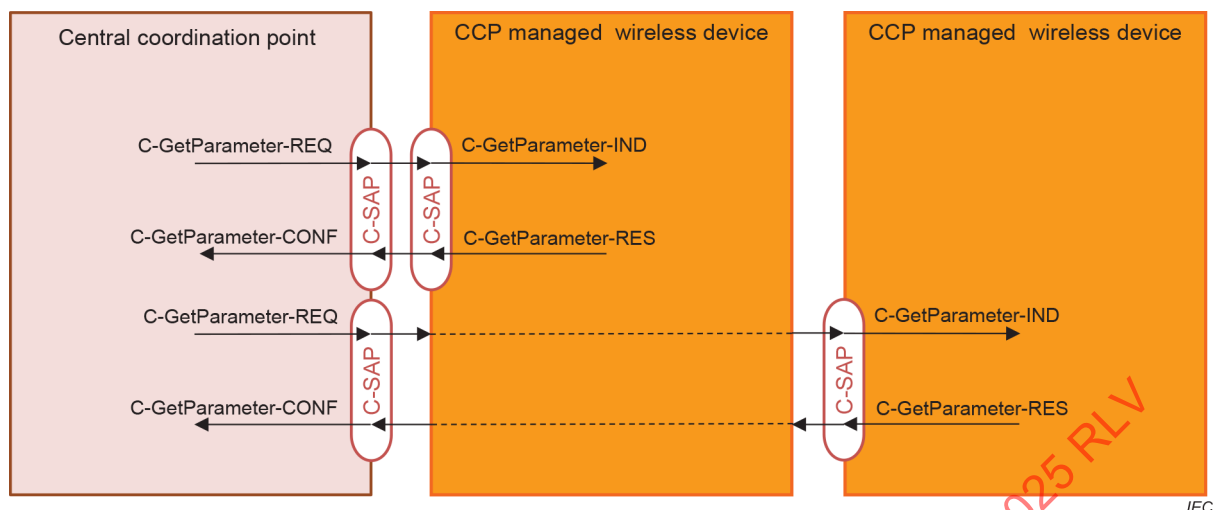


Figure 51 – Primitive flow of GetParameter service for CMWD

8.4.10.2 Service primitives

The structure of the service primitives is shown in Table 44.

Table 44 – GetParameter service parameter

Parameter name	Request	Indication	Response	Confirm
Argument				
Destination address	M	M(=)		
Parameter ID	M	M(=)		
Result (+)			S	S(=)
Source address			M	M(=)
Parameter ID			M	M(=)
Parameter values			M	M(=)
Result (-)			S	S(=)
Service status			M	M(=)

Argument

The argument contains the parameters of the service request.

Destination address

This parameter specifies the destination address to which the service request is to be sent.

Parameter ID

This parameter is specified by a standard or vendor and identifies the parameter whose value is to be returned.

Result (+)

This selection type parameter indicates that the service request succeeded.

Destination address

This parameter specifies the source address of the response.

Parameter ID

This parameter is specified by a standard or vendor and identifies the parameter whose value is returned.

Parameter value

This parameter contains the value of the parameter to be returned.

Result (-)

This selection type parameter indicates that the service request failed.

Service status

This parameter provides information on the result of service execution. It shall be one of ABORTED or TIMEOUT.

8.4.10.3 Service procedure

The CCP may use this primitive to request technology specific or vendor specific parameter values from the CMWCA or CMWD. The GetParameter request shall send a message to the CMWCA or CMWD. When the message arrives at the target wireless device (CMWCA or CMWD), this shall result in a GetParameter indication at the CMWCA or CMWD. The CMWCA or CMWD, in turn, shall forward the message to the appropriate target object. When the object responds, the CMWCA or CMWD shall forward the response via the GetParameter response primitive. When the response arrives at the device which originated the request, a GetParameter confirmation shall be returned to the application object which sent the request.

8.4.10.4 Service sequence

The service sequence of GetParameter service is shown in Figure 52.

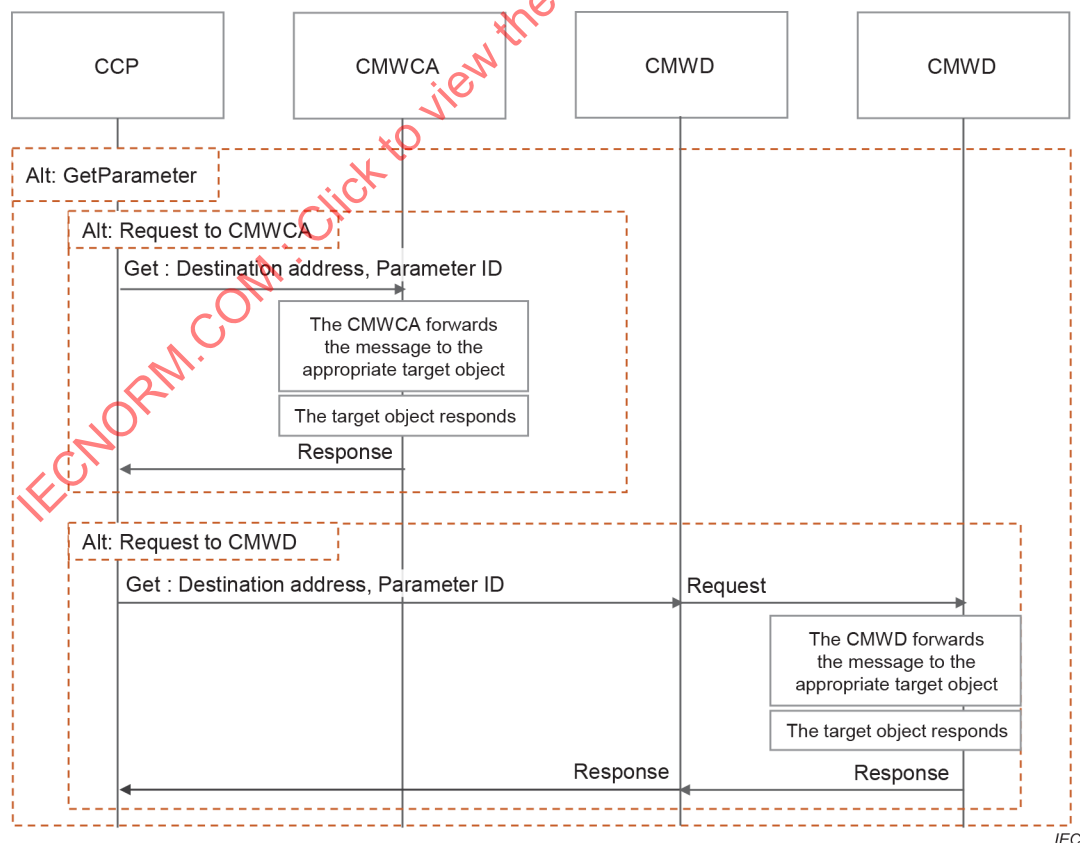


Figure 52 – Sequence diagram (GetParameter)

8.4.10.5 Service message format

The message format of GetParameter service shall be according to Table 45.

Table 45 – GetParameterservice message format

Message format	Explanation
<pre>{ "Argument": [{ "Destination address": "02004CAABBDD", "Parameter ID ": "UAA306" }], "Result (+)": [{ "Source address": "02004CAABBDD", "Parameter ID": "UAA306", "Parameter values": "0.1" }], "Result (-)": { "Service status": "aborted" } }</pre>	Parameters of the service request. Destination address to which the service request is to be sent. Specified by a standard or vendor and identifies the parameter whose value is to be returned. Service request succeeded. Source address of the response. Specified by a standard or vendor and identifies the parameter whose value is returned. Value of the parameter to be returned. Service request failed. Information on the result of service execution.

8.4.11 SetParameter

8.4.11.1 Service overview

The SetParameter service uses a set of primitives for setting technology specific or vendor specific parameters in CMWCA and CMWD from the CCP. SetParameter service is a confirmed service and uses the C-SAP. The CCP sends the SetParameter service request attempts to CMWCA or CMWD. The primitive flow of SetParameter service is depicted in Figure 53 for CMWCA and Figure 54 for CMWD.

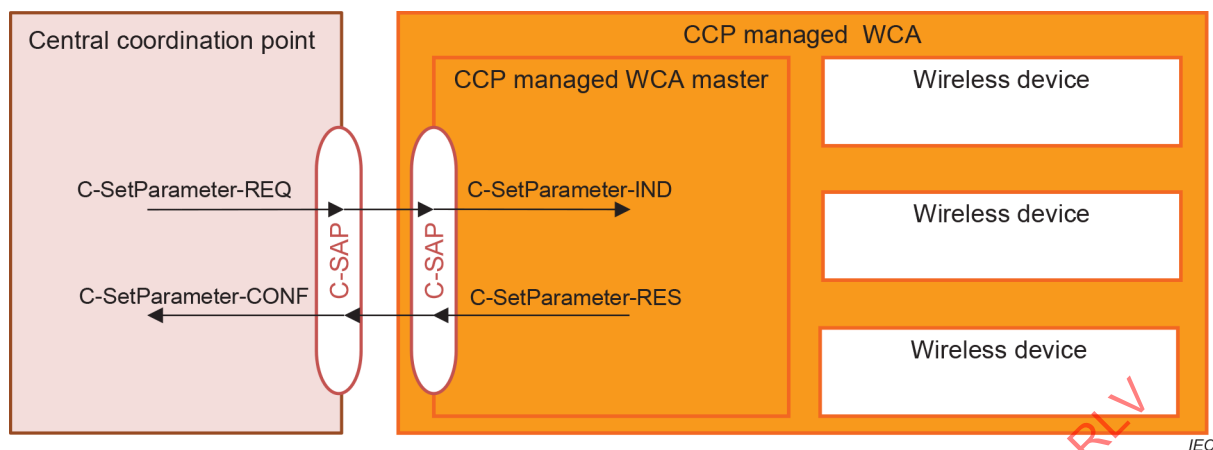


Figure 53 – Primitive flow of SetParameter service for CMWCA

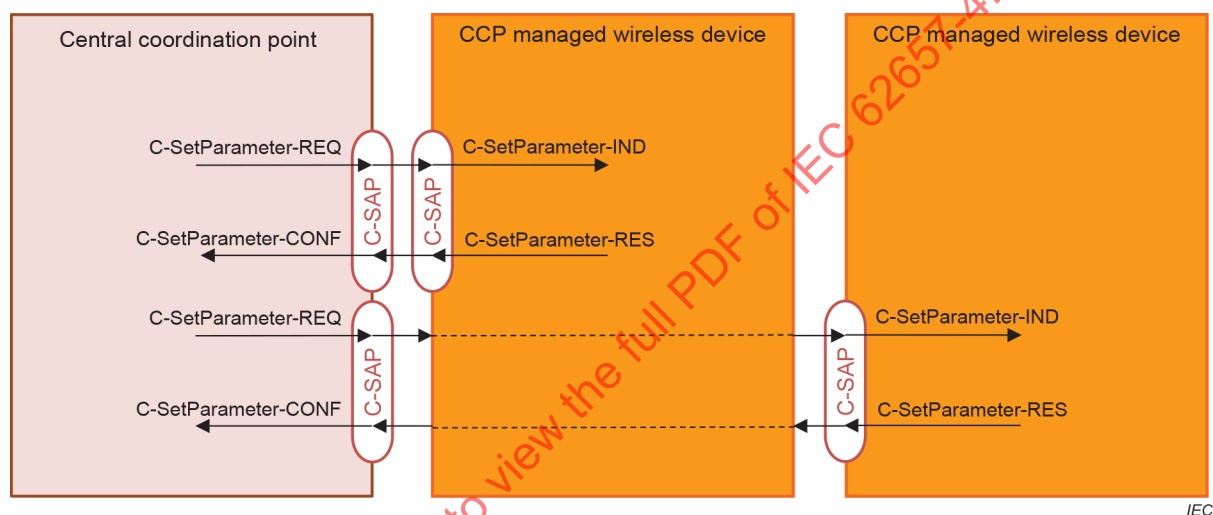


Figure 54 – Primitive flow of SetParameter service for CMWD

8.4.11.2 Service primitives

The structure of the service primitives is shown in Table 46.

Table 46 – SetParameter service parameter

Parameter name	Request	Indication	Response	Confirm
Argument				
Destination address	M	M(=)		
Parameter ID	M	M(=)		
Parameter value	M	M(=)		
Result (+)			S	S(=)
			-	-
Result (-)			S	S(=)
Service status			M	M(=)

Argument

The argument contains the parameters of the service request.

Destination address

This parameter specifies the destination address to which the service request is to be sent.

Parameter ID

This parameter is specified by a standard or a vendor and identifies the parameter to be set.

Parameter value

This parameter contains the value of the parameter to be set.

Result (+)

This selection type parameter indicates that the service request succeeded.

Result (-)

This selection type parameter indicates that the service request failed.

8.4.11.3 Service procedure

The SetParameter request shall send a message from the CCP to the CMWCA or CMWD. When the message arrives at the target wireless device, this shall result in a SetParameter indication at the CMWCA or CMWD. The CMWCA or CMWD shall forward the message to the appropriate target object. When the object responds, the CMWCA or CMWD shall forward the response via the SetParameter response primitive. When the response arrives at the user interface which originated the request, a SetParameter confirmation shall be returned to the application object which sent the request.

8.4.11.4 Service sequence

The service sequence of SetParameter is shown in Figure 55.

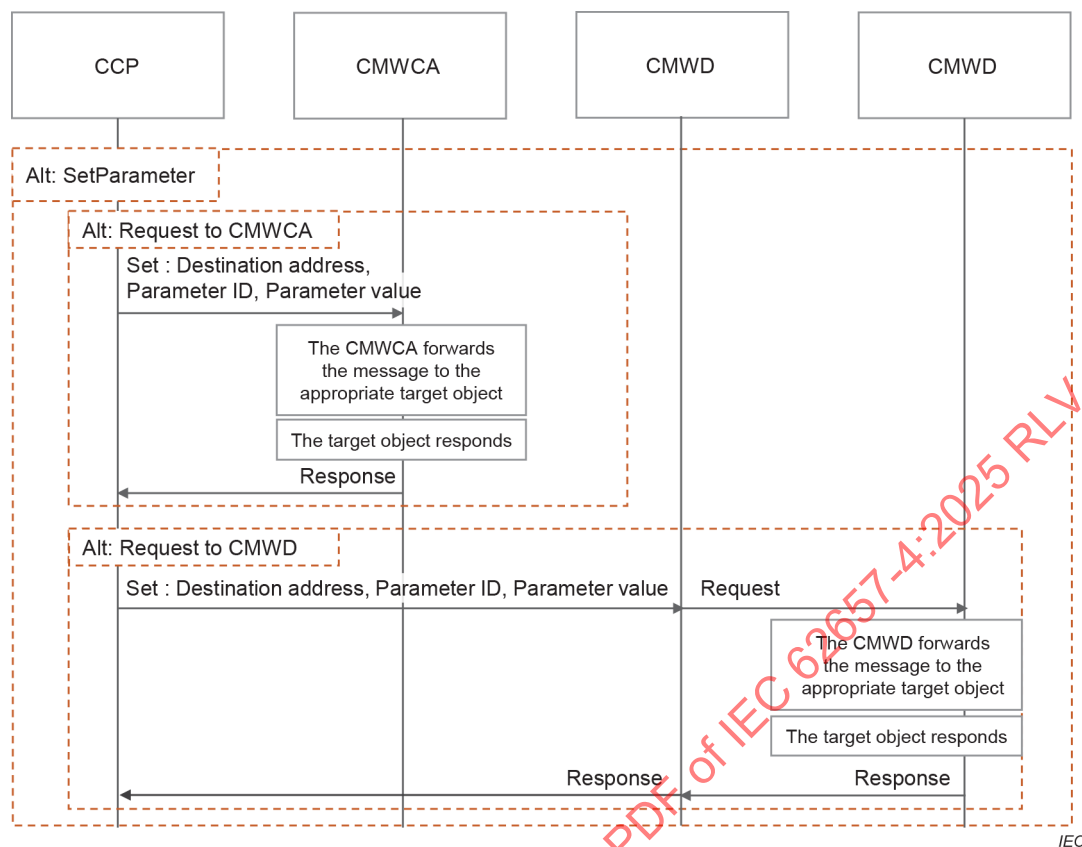


Figure 55 – Sequence diagram (SetParameter)

8.4.11.5 Service message format

The message format of SetParameter, SetMediumSensingResult service shall be according to Table 47.

Table 47 – SetParameterservice message format

Message format	Explanation
<pre> { "Argument": [{ "Destination address": "02004CAABDD", "Parameter ID": "UAA306", "Parameter values": "0,1" }], "Result (+)": "Result (-)": { "Service status": "aborted" } } </pre>	Parameters of the service request. Destination address to which the service request is to be sent. Specified by a standard or vendor and identifies the parameter whose value is provided for example Transmitter output power. Value of the parameter provided for example 100 mW. Service request succeeded. Service request failed. Information on the result of service execution.

8.5 Medium resource management services

8.5.1 Supported services

This Subclause 8.5 contains the definition of services that are unique to the medium resource management (MRM) service. The services defined for this MRM are:

- GetMediumResourceReport, see 8.5.2;
- SetMediumResourceReport, see 8.5.3;
- NotifyMediumResource, see 8.5.4;
- SetMediumSensingReport, see 8.5.5;
- NotifyMediumSensingResults, see 8.5.6.

8.5.2 GetMediumResourceReport

8.5.2.1 Service overview

The GetMediumResourceReport service uses a set of primitives for supporting management resource reports procedures between CCP and CMWCA or CMWD. GetMediumResourceReport service is a confirmed service and uses the C-SAP. The CCP sends the GetMediumResourceReport service request attempts to CMWCA or CMWD. The primitive flow of GetMediumResourceReport service is depicted in Figure 56 for CMWCA and in Figure 57 for CMWD.

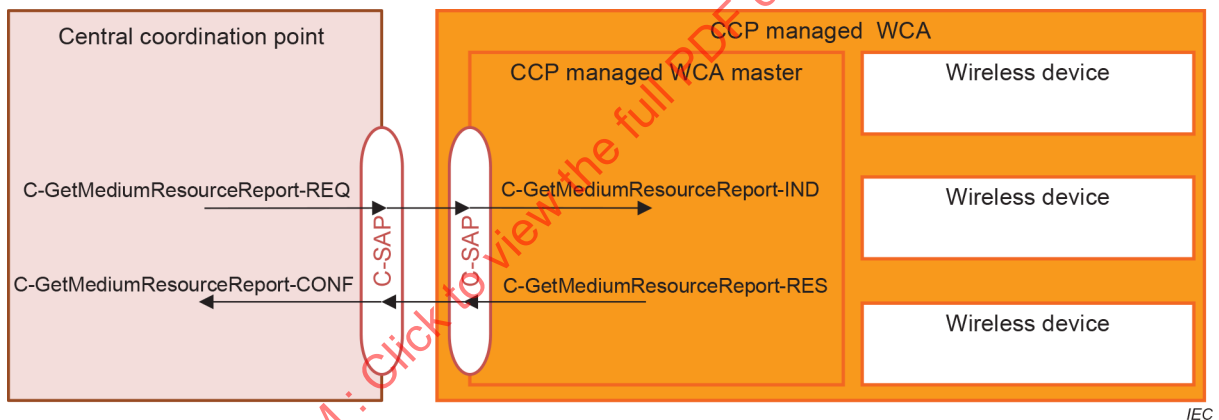


Figure 56 – Primitive flow of GetMediumResourceReport service for CMWCA

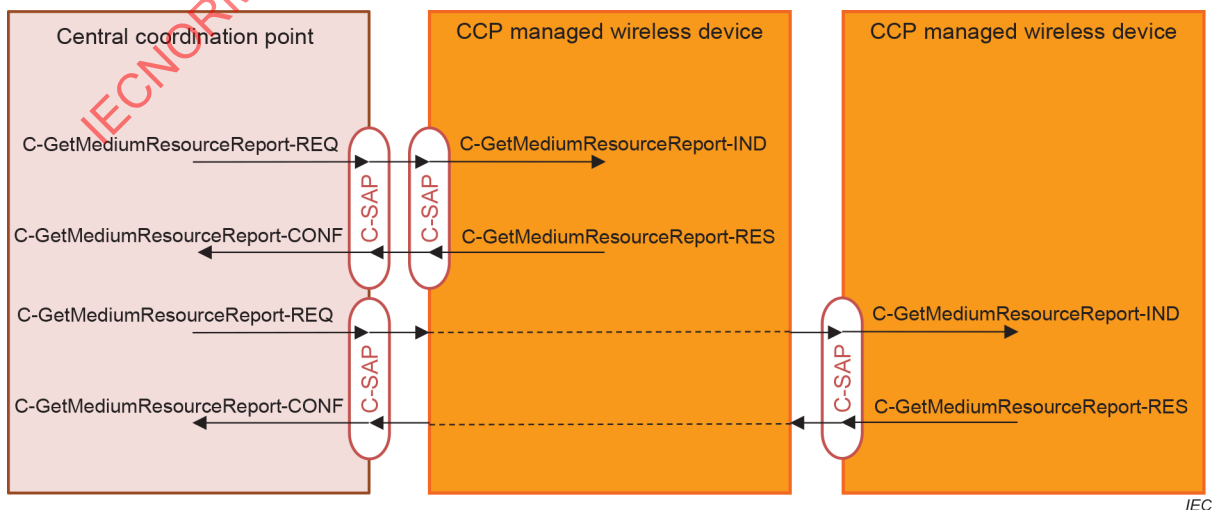


Figure 57 – Primitive flow of GetMediumResourceReport service for CMWD

8.5.2.2 Service primitives

The structure of the service primitives is shown in Table 48.

Table 48 – GetMediumResourceReport service parameter

Parameter name	Request	Indication	Response	Confirm
Argument				
Destination address	M	M(=)		
Communication link ID	M	M(=)		
Wireless ID	M	M(=)		
Result (+)			S	S(=)
CCP address			M	M(=)
Wireless ID			M	M(=)
Attribute data			M	M(=)
Duty cycle			M	M(=)
RSSI mean			M	M(=)
RSSI standard deviation			M	M(=)
SINR mean			M	M(=)
SINR standard deviation			M	M(=)
Data throughput			M	M(=)
Message loss ratio			M	M(=)
Result (-)			S	S(=)
Service status			M	M(=)

Argument

The argument contains the parameters of the service request.

Destination address

This parameter specifies the destination address to which the service request is to be sent.

Communication link ID

This parameter specifies the identifier of the communication link. It is present in the request primitive.

Wireless ID

This parameter specifies the identifier of requested wireless system or wireless device.

Result (+)

This selection type parameter indicates that the service request succeeded.

CCP address

This parameter specifies the address of the requested CCP. It is present in the response primitive.

Wireless ID

This parameter specifies the identifier of the wireless system or wireless device.

Attribute data

This parameter returns a stream of information containing all the attributes.

- duty cycle;
- RSSI mean;
- RSSI standard deviation;
- SINR mean;
- SINR standard deviation;
- Data throughput;
- Message loss ratio.

Result (-)

This selection type parameter indicates that the service request failed.

Service status

This parameter provides information on the result of service execution. It shall be one of ABORTED or TIMEOUT.

8.5.2.3 Service procedure

The CCP may use this primitive to request medium resource information from the CMWCA or CMWD. The GetMediumResourceReport request shall send a message to the CMWCA or CMWD. When the message arrives at the target wireless device (CMWCA or CMWD), this shall result in a GetMediumResourceReport indication at the CMWCA or CMWD. The CMWCA or CMWD, in turn, shall forward the message to the appropriate target object. When the object responds, the CMWCA or CMWD shall forward the response via the GetMediumResourceReport response primitive. When the response arrives at the device which originated the request, a GetMediumResourceReport confirmation shall be returned to the application object which sent the request.

8.5.2.4 Service sequence

The service sequence of GetMediumResourceReport service is shown in Figure 58.

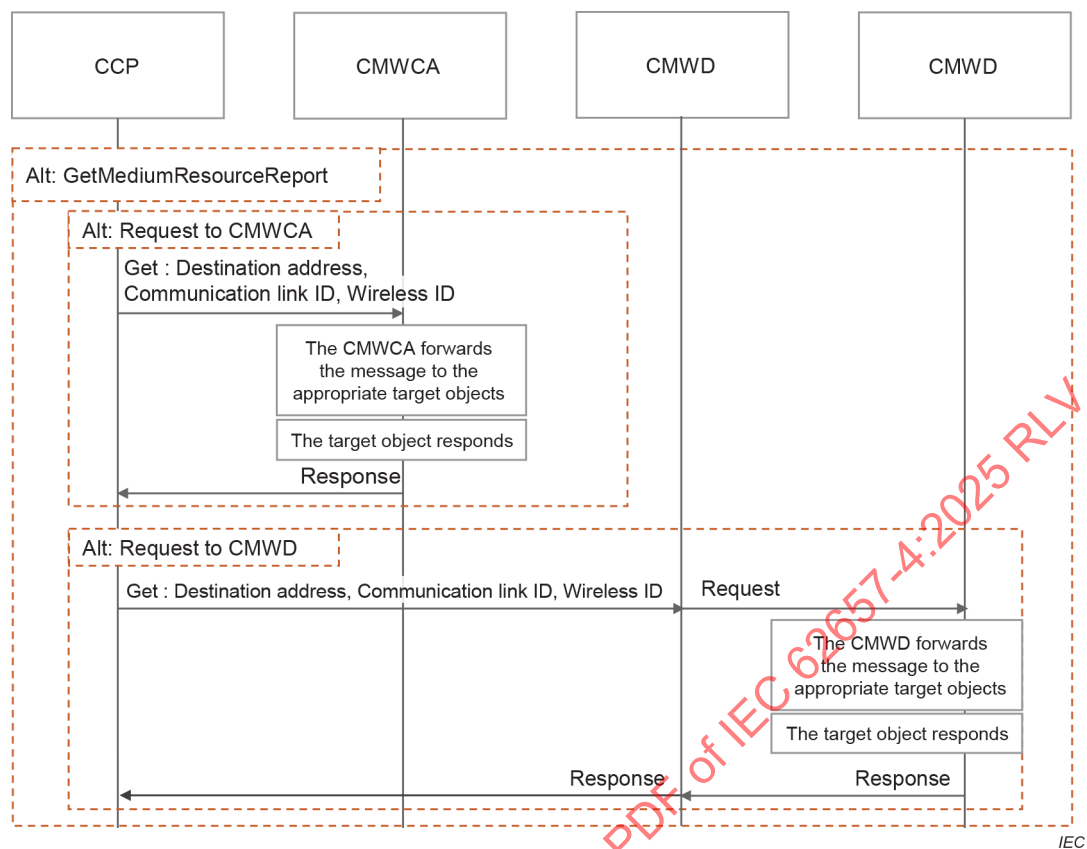


Figure 58 – Sequence diagram (GetMediumResourceReport)

8.5.2.5 Service message format

The message format of `GetMediumResourceReport` service shall be according to Table 49.

Table 49 – GetMediumResourceReport service message format

Message format	Explanation
<pre> { "Argument": [{ "Destination address": "02004CAABBDD", "Communication link ID": "A1000", "Wireless ID": "A1111" }], "Result (+)": [{ "CCP address": "02004CAABBFF", "Wireless ID": "A1111", "Attribute data": [{ "Duty cycle": 80, "RSSI mean": -50, "RSSI standard deviation": 10, "SINR mean": 9.0, "SINR standard deviation": 10 }], }], "Result (-)": { "Service status": "aborted" } } </pre>	Parameters of the service request. Destination address to which the service request is to be sent. Identifier of the communication link. Identifier of requested wireless system or wireless device. Service request succeeded. Address of the requested CCP. It is present in the response primitive. Identifier of requested wireless system or wireless device. Duty cycle per communication link. Received signal strength indication mean. Received signal strength indication standard deviation. Signal to interference and noise ratio mean. Signal to interference and noise ratio standard deviation. Service request failed. Information on the result of service execution.

8.5.3 SetMediumResourceReport

8.5.3.1 Service overview

The SetMediumResourceReport service uses a set of primitives for setting periodically or event driven management resource reports procedures at CMWCA or CMWD. SetMediumResourceReport service is a confirmed service and uses the M-SAP. The CCP sends the SetMediumResourceReport service request attempts to CMWCA or CMWD. The primitive flow of SetMediumResourceReport service is depicted in Figure 59 for CMWCA and in Figure 60 for CMWD.

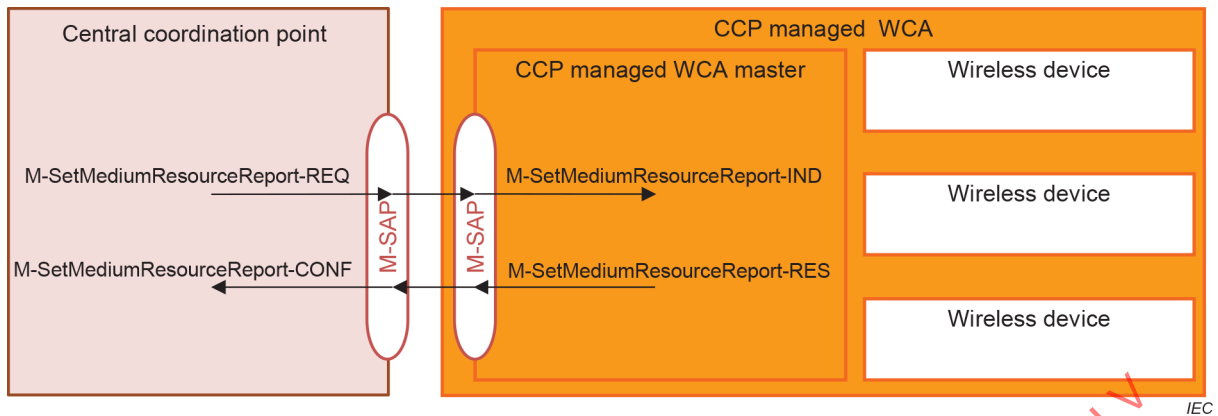


Figure 59 – Primitive flow of SetMediumResourceReport service for CMWCA

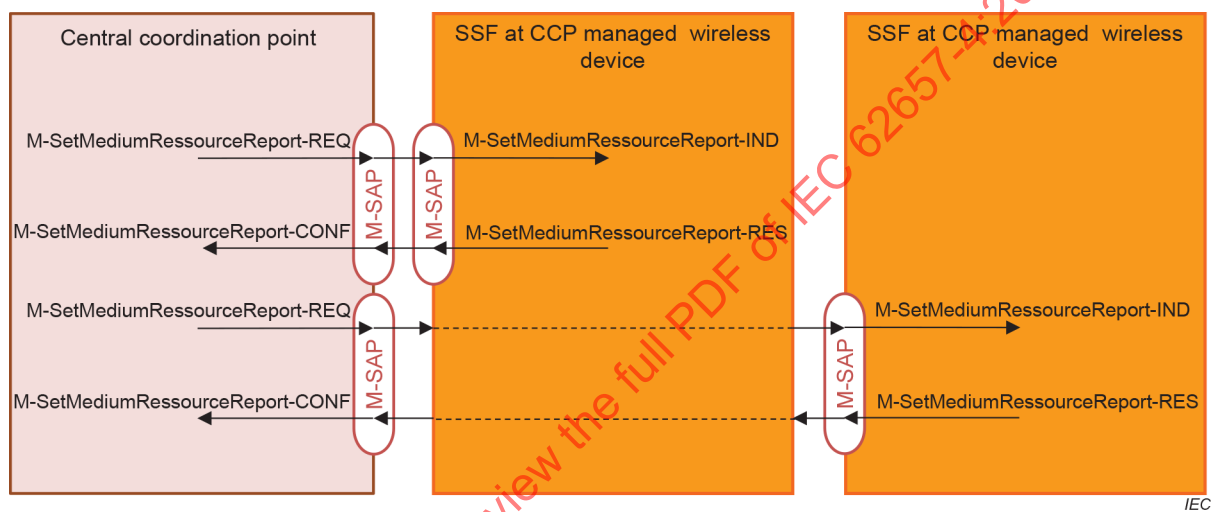


Figure 60 – Primitive flow of SetMediumResourceReport service for CMWD

8.5.3.2 Service primitives

The structure of the service primitives is shown in Table 50.

Table 50 – SetMediumResourceReport service parameter

Parameter name	Request	Indication	Response	Confirm
Argument				
Destination address	M	M(=)		
Communication link ID	M	M(=)		
Wireless ID	M	M(=)		
Report type	M	M(=)		
Report interval	M	M(=)		
Report threshold	M	M(=)		
Result (+)			S	S(=)
CCP address			M	M(=)
Wireless ID			M	M(=)
Report status			M	M(=)
Result (-)			S	S(=)
Service status			M	M(=)

Argument

The argument contains the parameters of the service request.

Destination address

This parameter specifies the destination address to which the service request is to be sent.

Communication link ID

This parameter specifies the identifier of the communication link. It is present in the request primitive.

Wireless ID

This parameter specifies the identifier of requested wireless system or wireless device.

Report type

This parameter specifies the generation type of medium resource report (NotifyMediumResource). The report types are event driven, cyclic or requested. It is present in the request primitive.

Report interval

This parameter specifies the interval time of cyclic reports.

Report threshold

This parameter specifies the threshold ~~of parameter~~ λ_{Thr} of the coexistence state for event generation.

Result (+)

This selection type parameter indicates that the service request succeeded.

CCP address

This parameter specifies the address of the requested CCP. It is present in the response primitive.

Wireless ID

This parameter specifies the identifier of the wireless system or wireless device.

Result (-)

This selection type parameter indicates that the service request failed.

Service status

This parameter provides information on the result of service execution. It shall be one of ABORTED or TIMEOUT.

8.5.3.3 Service procedure

The CCP may use this primitive to set the medium resource report at the CMWCA or CMWD.

The SetMediumResourceReport request shall send a message to the CMWCA or CMWD. When the message arrives at the target wireless device (CMWCA or CMWD), this shall result in a SetMediumResourceReport indication at the CMWCA or CMWD. The CMWCA or CMWD, in turn, shall forward the message to the appropriate target object. When the object responds, the CMWCA or CMWD shall forward the response via the SetMediumResourceReport response primitive. When the response arrives at the device which originated the request, a SetMediumResourceReport confirmation shall be returned to the application object which sent the request.

8.5.3.4 Service sequence

The service sequence of SetMediumResourceReport service is shown in Figure 61.

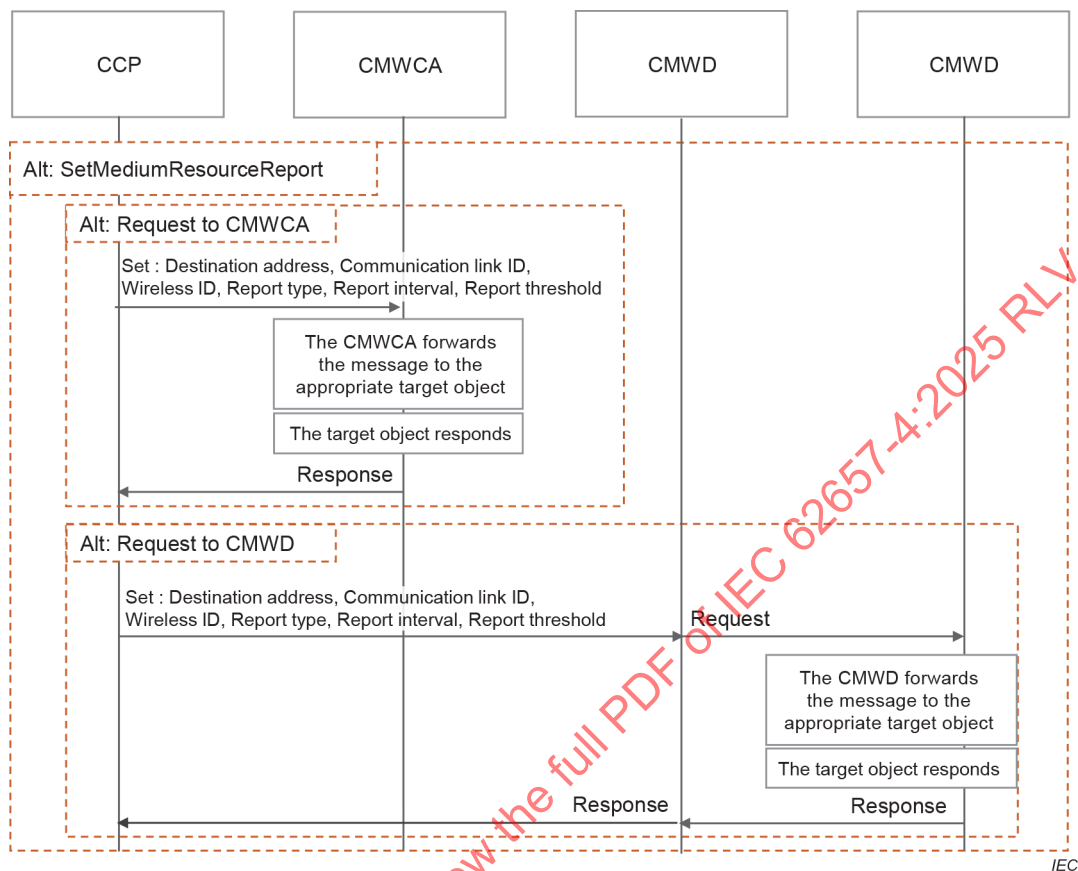


Figure 61 – Sequence diagram (SetMediumResourceReport)

8.5.3.5 Service message format

The message format of SetMediumResourceReport service shall be according to Table 51.

Table 51 – SetMediumResourceReport service message format

Message format	Explanation
<pre> { "Argument": [{ "Destination address": "02004CAABBDD", "Communication link ID": "A1000", "Wireless ID": "A1111", "Report type": "cyclic", "Report interval": "45.0", "Report threshold": "0,4" }], "Result (+)": [{ "CCP address": "02004CAABBFF", "Wireless ID": "A1111" }], "Result (-)": { "Service status": "aborted", } } </pre>	Parameters of the service request. Destination address to which the service request is to be sent. Identifier of the communication link. Identifier of requested wireless system or wireless device. Generation type of medium resource report. Interval time of cyclic reports. Threshold of parameter for event generation. Service request succeeded. Address of the requested CCP. It is present in the response primitive. Identifier of the wireless system or wireless device. Service request failed. Information on the result of service execution.

8.5.4 NotifyMediumResource

8.5.4.1 Service overview

The NotifyMediumResource service uses a set of primitives for providing control resource reports from a logical link of a CMWCA or CMWD to CCP. NotifyMediumResource service is an unconfirmed service and uses the C-SAP. The CMWCA or CMWD sends the NotifyMediumResource service request attempts to CCP. The primitive flow of NotifyMediumResource service is depicted in Figure 62 for CMWCA and in Figure 63 for CMWD.

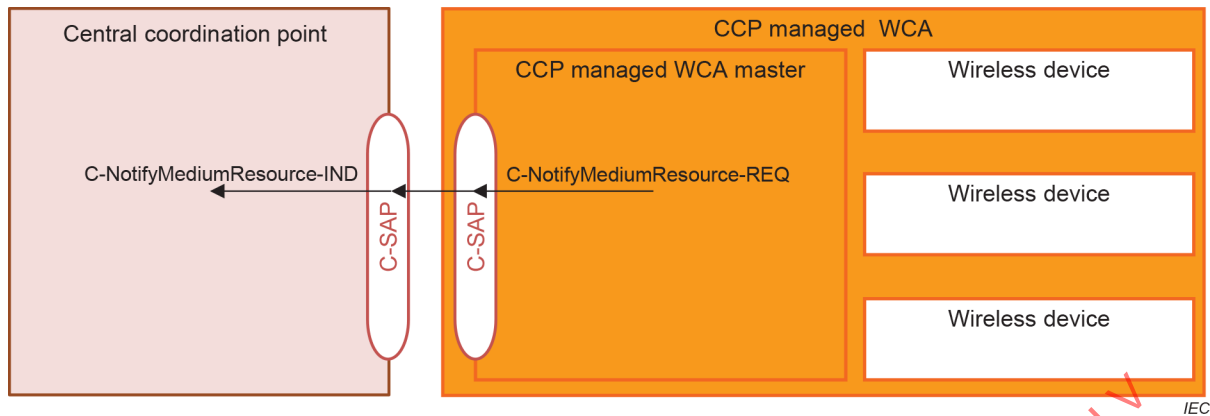


Figure 62 – Primitive flow of NotifyMediumResource service for CMWCA

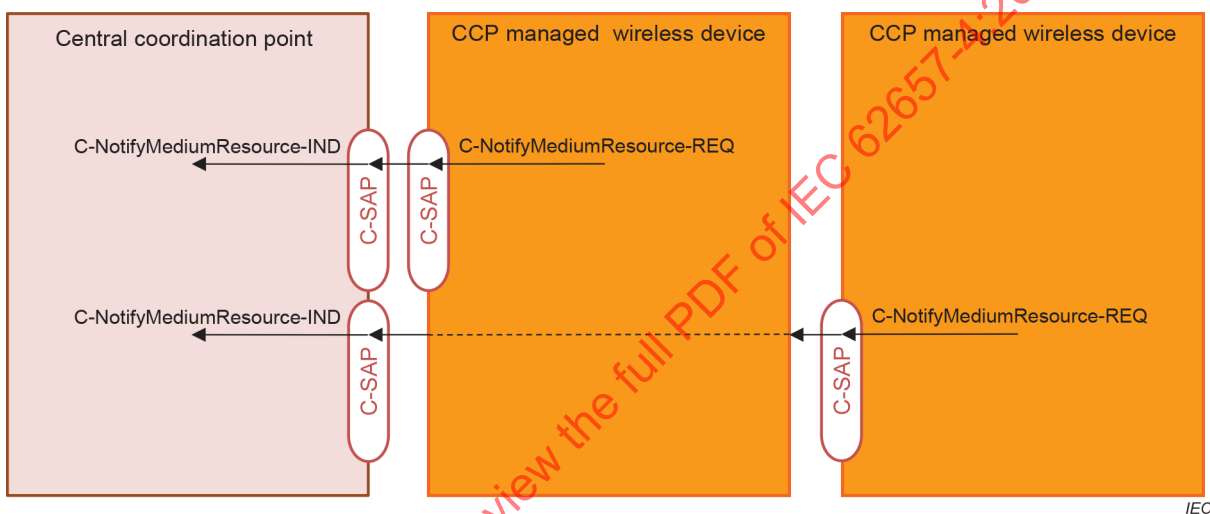


Figure 63 – Primitive flow of NotifyMediumResource service for CMWD

8.5.4.2 Service primitives

The structure of the service primitives is shown in Table 52.

Table 52 – NotifyMediumResource service parameter

Parameter name	Request	Indication	Response	Confirm
Argument				
CCP address	M	M(=)		
Wireless ID	M	M(=)		
Attribute data	M	M(=)		
Duty cycle	M	M(=)		
RSSI mean	M	M(=)		
RSSI standard deviation	M	M(=)		
SINR mean	M	M(=)		
SINR standard deviation	M	M(=)		
Data throughput	M	M(=)		
Message loss ratio	M	M(=)		

Argument

The argument contains the parameters of the service request.

CCP address

This parameter specifies the address of the requested CCP. It is present in the response primitive.

Wireless ID

This parameter specifies the identifier of requested wireless system or wireless device.

Attribute data

This parameter returns a stream of information containing all the attributes.

- duty cycle;
- RSSI mean;
- RSSI standard deviation;
- SINR mean;
- SINR standard deviation;
- data throughput;
- message loss ratio.

8.5.4.3 Service procedure

The CCP may configure the NotifyMediumResource service with the SetMediumResourceReport service primitive. The NotifyMediumResource request shall send a message from the CMWCA or CMWD to the CCP. When the message arrives at the target device (CCP), this shall result in a NotifyMediumResource indication at the CCP. The CCP shall forward the message to the appropriate target object.

8.5.4.4 Service sequence

The service sequence of NotifyMediumResource service is shown in Figure 64.

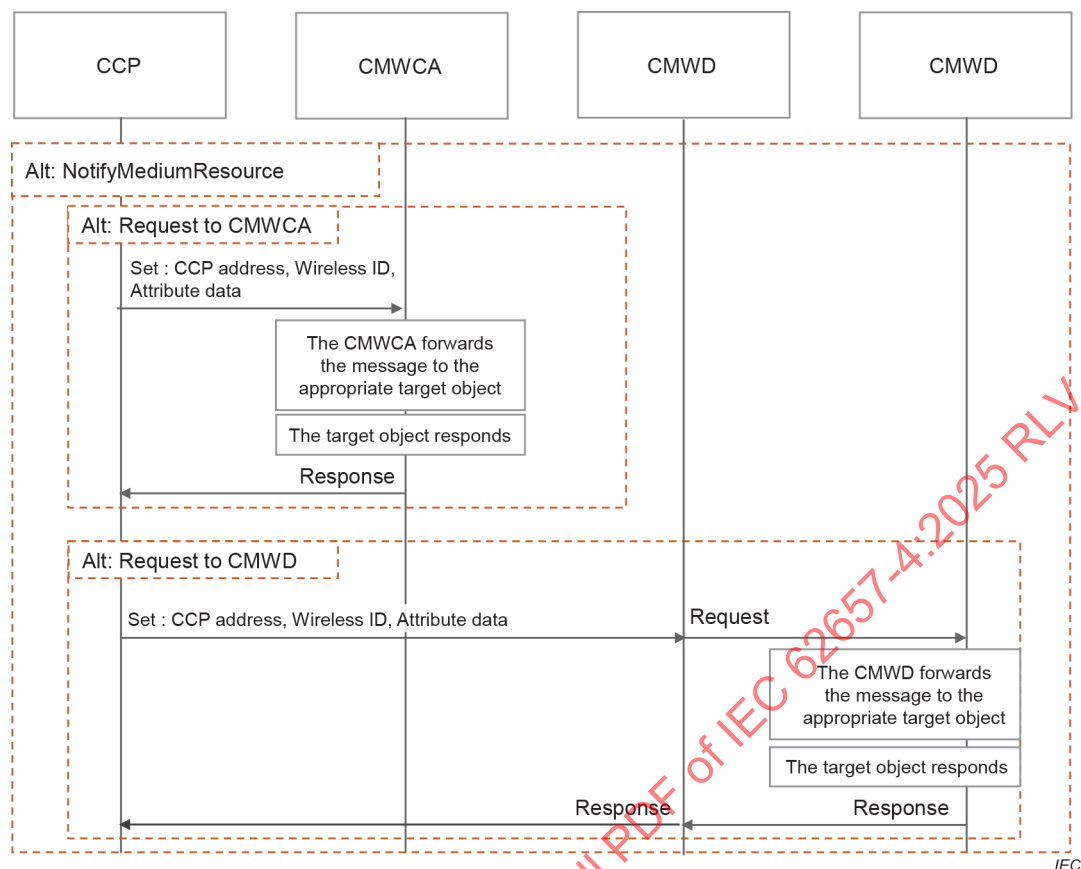


Figure 64 – Sequence diagram (NotifyMediumResource)

The message format of `NotifyMediumResource` service shall be according to Table 53 .

Table 53 – NotifyMediumResourceservice message format

Message format	Explanation
<pre> { "Argument": [{ "CCP address": "02004CAABBFF", "Wireless ID": "A1111", "Attribute data": [{ "Duty cycle": 80, "RSSI mean": -50, "RSSI standard deviation": 10, "SINR mean": 9.0, "SINR standard deviation": 10, "Data throughput": 1000000, "Message loss ratio": 0.1 }], }], } </pre>	Parameters of the service request. CCP address to which the service request is to be sent. Identifier of requested wireless system or wireless device. Duty cycle per communication link. Received signal strength indication mean. Received signal strength indication standard deviation. Signal to interference and noise ratio mean. Signal to interference and noise ratio standard deviation. Ratio between the number of user data transferred to the application at the target reference. Ratio of number of packets of messages, transferred from the Application at the reference interface within the producer, and the number of messages, transferred at the reference interface to the application within the consumer.

8.5.5 SetMediumSensingReport

8.5.5.1 Service overview

The SetMediumSensingReport service uses a set of primitives for setting periodically or ~~event driven~~ by request control resource reports procedures at SSF in CMWD or SSN.

SetMediumSensingReport service is a confirmed service and uses the M-SAP. The CCP sends the SetMediumSensingReport service request attempts to SSF in CMWD or SSN. The primitive flow of SetMediumSensingReport service is depicted in Figure 65 for SSN and in Figure 66 for SSF in CMWD.

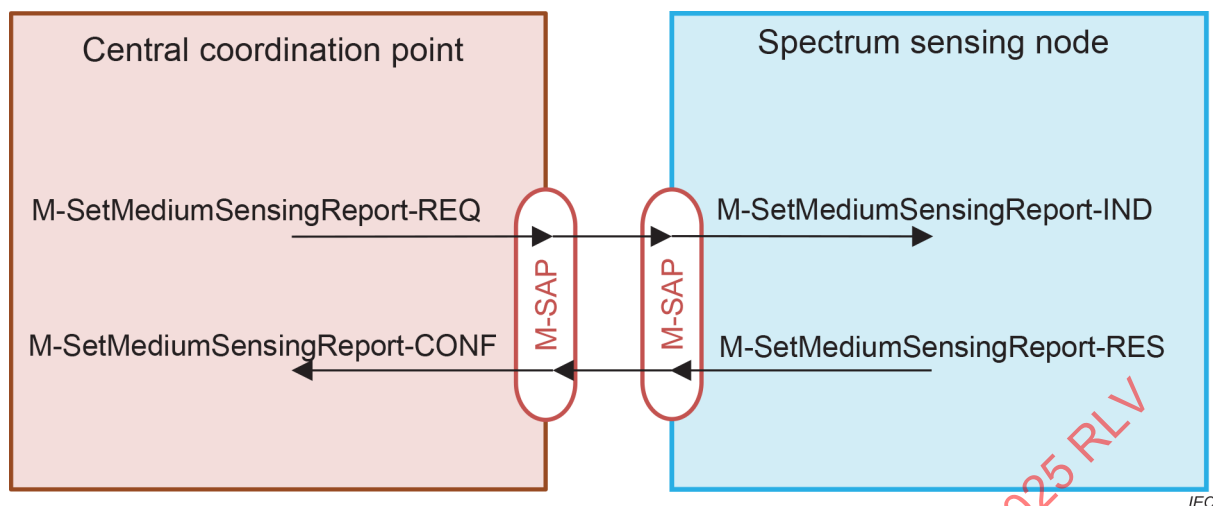


Figure 65 – Primitive flow of SetMediumSensingReport service for SSN

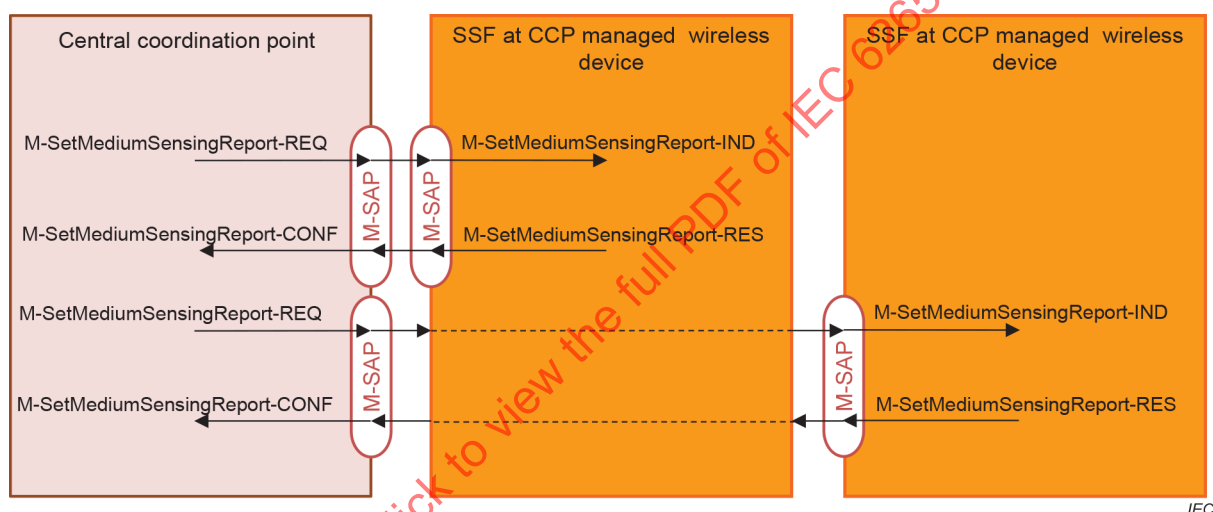


Figure 66 – Primitive flow of SetMediumSensingReport service for SSF in CMWD

8.5.5.2 Service primitives

The structure of the service primitives is shown in Table 54.

Table 54 – SetMediumSensingReport service parameter

Parameter name	Request	Indication	Response	Confirm
Argument				
Destination address	M	M(=)		
Medium sensing report type	M	M(=)		
Report interval	M	M(=)		
Sensing start frequency	M	M(=)		
Sensing end frequency	M	M(=)		
Sensing interval	M	M(=)		
Signal duration	M	M(=)		
Result (+)			S	S(=)
CCP address			M	M(=)
Spectrum sensing entity ID			M	M(=)
Result (-)			S	S(=)
Service status			M	M(=)

Argument

The argument contains the parameters of the service request.

Destination address

This parameter specifies the destination address to which the service request is to be sent.

Medium sensing report type

This parameter specifies the generation type of medium resource report (NotifyMediumResource). The report types are ~~event driven~~, cyclic or requested. It is present in the request primitive.

Report interval

This parameter specifies the interval time of cyclic reports, if the medium sensing report type is cyclic.

Sensing start frequency

This parameter specifies the start frequency of sensing.

Sensing end frequency

This parameter specifies the stop frequency of sensing.

Sensing interval

This parameter specifies the interval between sensing processes.

Sensing duration

This parameter specifies the duration of a sensing process.

Result (+)

This selection type parameter indicates that the service request succeeded.

CCP address

This parameter specifies the address of the requested CCP. It is present in the response primitive.

Spectrum sensing entity ID

This parameter specifies the identifier of the spectrum sensing entity ID either SSN or SSF.

Result (-)

This selection type parameter indicates that the service request failed.

Service status

This parameter provides information on the result of service execution. It shall be one of ABORTED or TIMEOUT.

8.5.5.3 Service procedure

The CCP may use this primitive to set the medium sensing report at the SSF in CMWD and SSN.

The SetMediumSensingReport request shall send a message to the SSF in CMWD or SSN. When the message arrives at the target device (CMWD or SSN), this shall result in a SetMediumSensingReport indication at the SSF in CMWD or SSN. The SSF in CMWD or SSN shall forward the message to the appropriate target objects. When the object responds, the SSF in CMWD or SSN shall forward the response via the SetMediumSensingReport response primitive. When the response arrives at the device which originated the request, a SetMediumSensingReport confirmation shall be returned to the application object which sent the request.

8.5.5.4 Service sequence

The service sequence of SetMediumSensingReport service is shown in Figure 67.

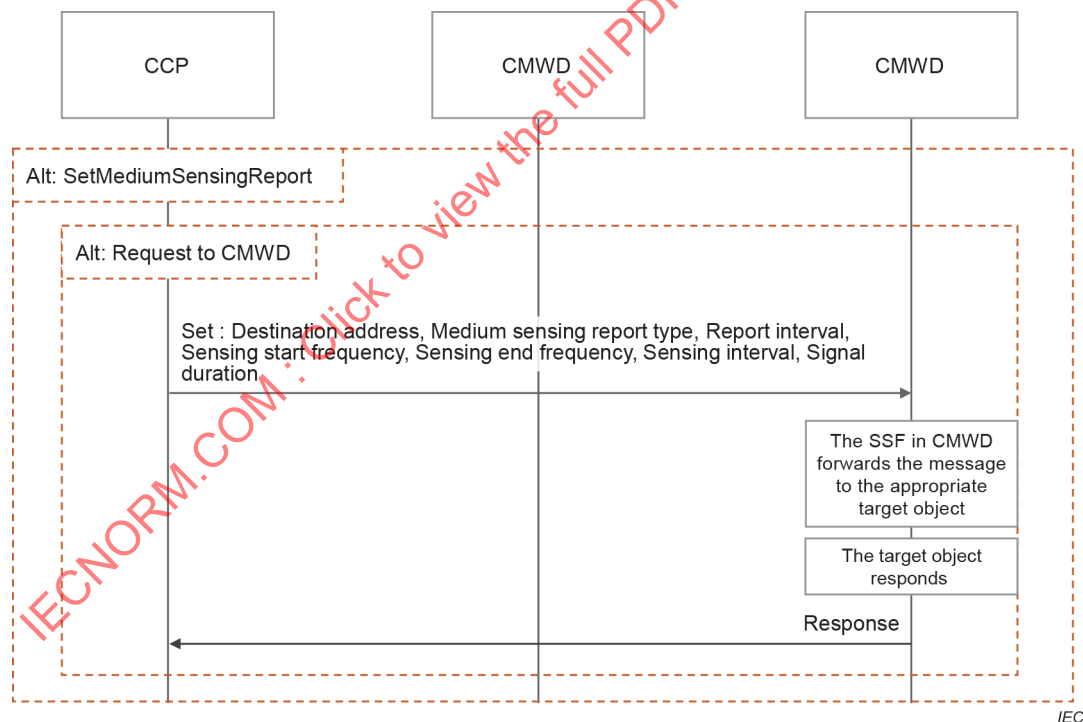


Figure 67 – Sequence diagram (SetMediumSensingReport)

8.5.5.5 Service message format

The message format of SetMediumSensingReport service shall be according to Table 55.

Table 55 – SetMediumSensingReportservice message format

Message format	Explanation
<pre> { "Argument": [{ "Destination address": "02004CAABBDD", "Medium sensing report type": "cyclic", "Report interval": 45, "Sensing start frequency": 2412, "Sensing end frequency": 2484, "Sensing interval": 0.1, "Signal duration": 1 }], "Result (+)": [{ "CCP address": 02004CAABBFF, "Spectrum sensing entity ID": 2222 }], "Result (-)": { "Service status": aborted } } </pre>	Parameters of the service request. Destination address to which the service request is to be sent. Generation type of medium resource report. Interval time of cyclic reports. Start frequency of sensing. Start frequency of sensing. Interval between sensing processes. Duration of a sensing process. Service request succeeded. CCP address to which the service request is to be sent. Identifier of the spectrum sensing entity ID either SSN or SSF. Service request failed. Information on the result of service execution.

8.5.6 NotifyMediumSensingResults

8.5.6.1 Service overview

The NotifyMediumSensingResults service uses a set of primitives for supporting control resource reports from SSN or SSF in CMWD to CCP. NotifyMediumSensingResults service is an unconfirmed service and uses the C-SAP. The SSN or SSF in CMWD sends the NotifyMediumSensingResults service request attempts to CCP. The primitive flow of NotifyMediumSensingResults service is depicted in Figure 68 for SSN and in Figure 69 for SSF in CMWD.

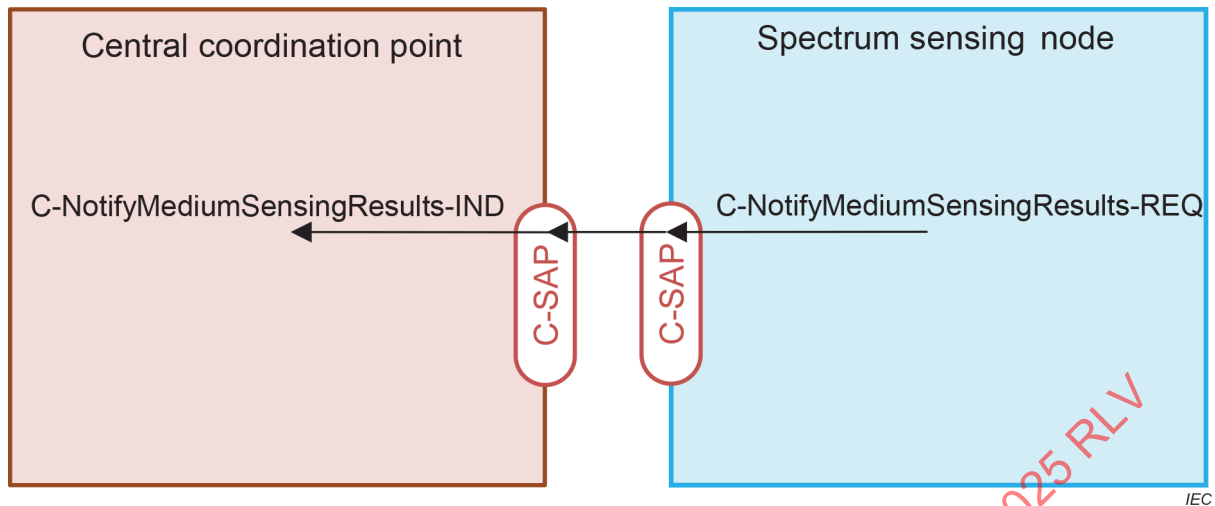


Figure 68 – Primitive flow of NotifyMediumSensingResults service for SSN

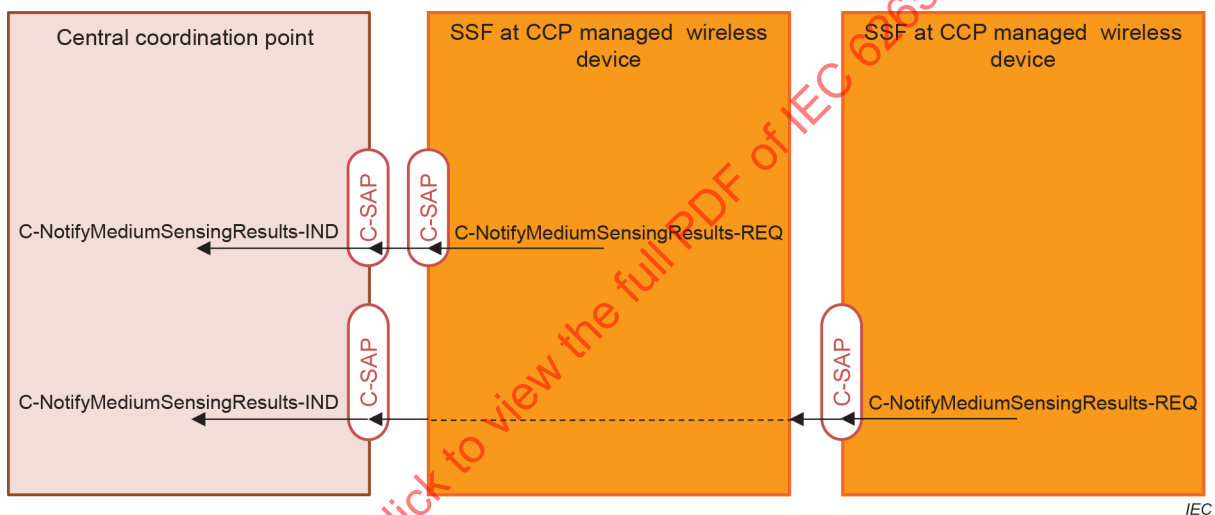


Figure 69 – Primitive flow of NotifyMediumSensingResults service for SSF in CMWD

8.5.6.2 Service primitives

The structure of the service primitives is shown in Table 56.

Table 56 – NotifyMediumSensingResults service parameter

Parameter name	Request	Indication	Response	Confirm
Argument				
CCP address			M	M(=)
Spectrum sensing entity ID	M	M(=)		
Attribute data	M	M(=)		
Timestamp	M	M(=)		
Array of frequency	M	M(=)		
Array of power spectral density	M	M(=)		

Argument

The argument contains the parameters of the service request.

CCP address

This parameter specifies the address of the requested CCP. It is present in the response primitive.

Spectrum sensing entity ID

This parameter specifies the identifier of the spectrum sensing entity ID either SSN or SSF.

Attribute data

This parameter returns a stream of information containing all the attributes.

- Timestamp;
- array of frequency;
- array of power spectral density.

8.5.6.3 Service procedure

The CCP may configure the NotifyMediumSensingResults service with the SetMediumSensingReport service primitive. The NotifyMediumSensingResults request shall send a message from the SSF in CMWD or SSN to the CCP. When the message arrives at the target device (CCP), this shall result in a NotifyMediumSensingResults indication at the CCP. The CCP shall forward the message to the appropriate target object.

8.5.6.4 Service sequence

The service sequence of NotifyMediumSensingResults service is shown in Figure 70.

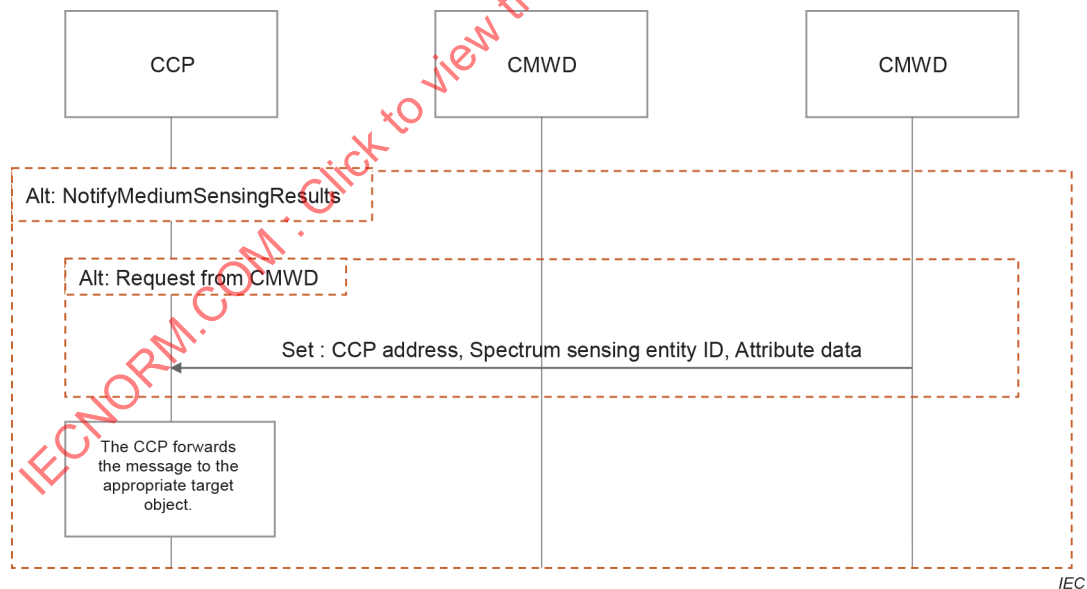


Figure 70 – Sequence diagram (NotifyMediumSensingResults)

8.5.6.5 Service message format

The message format of NotifyMediumSensingResults service shall be according to Table 57.

Table 57 – NotifyMediumSensingResults service message format

Message format	Explanation
<pre> { "Argument": [{ "CCP address": "02004CAABBFF", "Spectrum sensing entity ID": "2222", "Attribute data": [{ "Timestamp": "1569855600", "Array of frequency": , [2401, 2412,2406,2417...,2495], "Array of power spectral density": [-83-83-75..., -45..., -83] }], }], } </pre>	Parameters of the service request. CCP address to which the service request is to be sent. Identifier of the spectrum sensing entity ID either SSN or SSF. Information concerning time of collected attribute data. Collected values from sensing start frequency to sensing end frequency during the sensing process. Collected values of power spectral density from sensing start frequency to sensing end frequency during the sensing process.

8.6 Database access services

8.6.1 Supported service

This Subclause 8.6 contains the definition of a service that is unique to the data base access.

8.6.2 GetRadioRegulation

8.6.2.1 Service overview

The GetRadioRegulation service uses a set of primitives for getting radio regulation parameters from the radio regulation database. The GetRadioRegulation service is a confirmed service and uses the M-SAP. The CCP sends the GetRadioRegulation service request attempts to the radio regulation database. The primitive flow of GetRadioRegulation service is depicted in Figure 71.

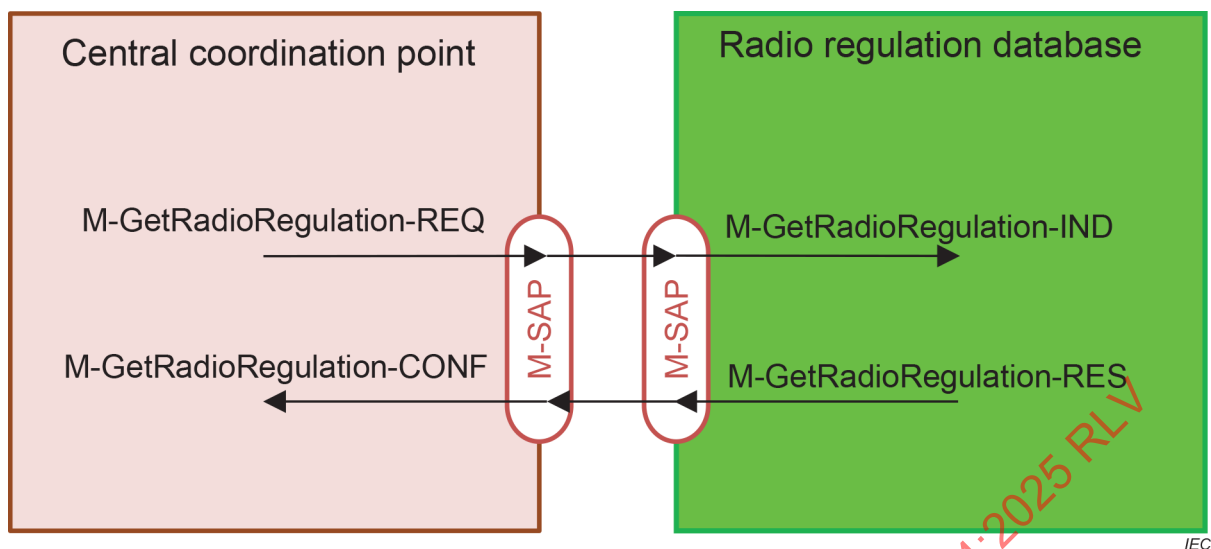


Figure 71 – Primitive flow of GetRadioRegulation service

8.6.2.2 Service primitives

The structure of the service primitives is shown in Table 58.

Table 58 – GetRadioRegulation service parameter

Parameter name	Request	Indication	Response	Confirm
Argument				
Destination address	M	M(=)		
Radio regulation database ID	M	M(=)		
Start frequency	M	M(=)		
Stop frequency	M	M(=)		
Location	M	M(=)		
Result (+)			S	S(=)
CCP address			M	M(=)
Radio regulation database ID			M	M(=)
Attribute data			M	M(=)
Frequency band			M	M(=)
Allocation			M	M(=)
Application(s)			M	M(=)
Result (-)			S	S(=)
Service status			M	M(=)

Argument

The argument contains the parameters of the service request.

Destination address

This parameter specifies the destination address to which the service request is to be sent.

Radio regulation database ID

This parameter specifies the ID of requested radio regulation database.

Start frequency

This parameter specifies the start frequency of used frequency range.

Stop frequency

This parameter specifies the stop frequency of used frequency range.

Location

~~This parameter specifies the location of CMWCA and CMWD.~~

Position

This parameter specifies the position of CMWCA and CMWD specified in a three-dimensional space.

Result (+)

This selection type parameter indicates that the service request succeeded.

CCP address

This parameter specifies the address of the requested CCP. It is present in the response primitive.

Radio regulation database ID

This parameter specifies the ID of radio regulation database.

Attribute data

This parameter returns a stream of information containing all the attributes.

- frequency band;
- allocation;
- application(s).

Result (-)

This selection type parameter indicates that the service request failed.

Service status

This parameter provides information on the result of service execution. It shall be one of ABORTED or TIMEOUT.

8.6.2.3 Service procedure

The CCP may use this primitive to get radio regulation parameters from the radio regulation database. The GetRadioRegulation request shall send a message to the radio regulation database. When the message arrives at the target device, this shall result in a GetRadioRegulation indication at the radio regulation database. The radio regulation database shall forward the message to the appropriate target objects. When the object responds, the radio regulation database shall forward the response via the GetRadioRegulation response primitive. When the response arrives at the device which originated the request, a GetRadioRegulation confirmation shall be returned to the application object which sent the request.

8.6.2.4 Service sequence

The service sequence of GetRadioRegulation service is shown in Figure 72.

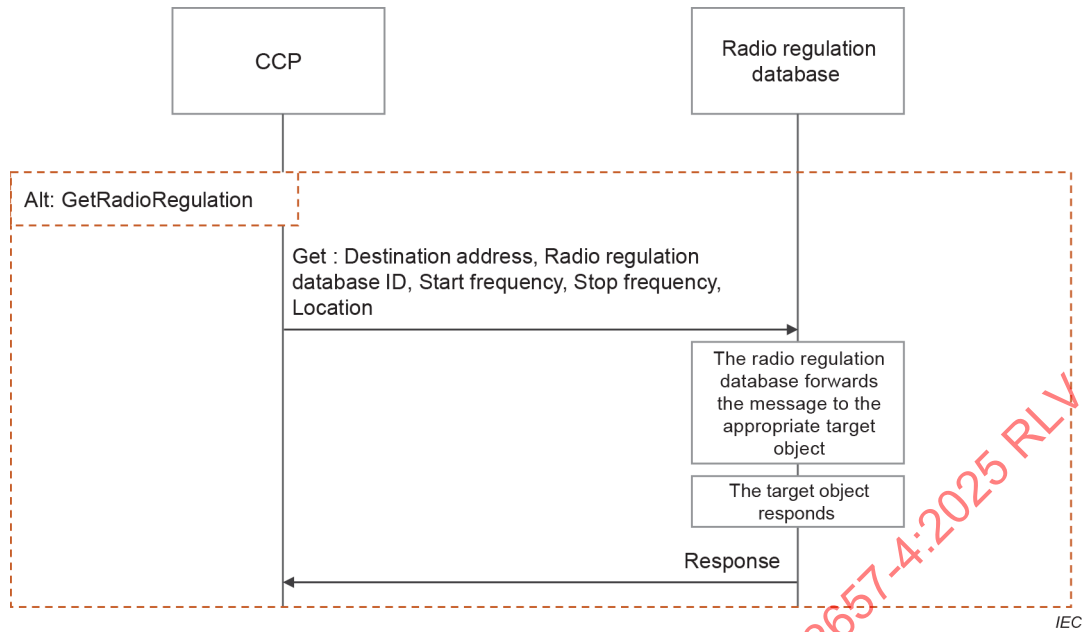


Figure 72 – Sequence diagram (GetRadioRegulation)

8.6.2.5 Service message format

The message format of GetRadioRegulation service shall be according to Table 59.

Table 59 – GetRadioRegulation service message format

Message format	Explanation
<pre> { "Argument": [{ "Destination address": "02004CAABBDD", "Radio regulation database ID": "ETSI EN 300 328", "Start frequency": "429.2500", "Stop frequency": "429.6500", "Position": "120, 45, 10" }], "Result (+)": [{ "CCP address": "02004CAABBFF", "Radio regulation database ID": "ETSI EN 300 328", "Attribute data": [{ "Frequency band": "429, 920xxxxxx", "Allocation": "429.2500", "Application(s)": "Control of machine and production cell local" }], }], "Result (-)": { "Service status": "aborted", } } </pre>	Parameters of the service request. Destination address to which the service request is to be sent. ID of requested radio regulation database. Start frequency of used frequency range. Stop frequency of used frequency range. Position of CMWCA and CMWD. Service request succeeded. CCP address to which the service request is to be sent. ID of requested radio regulation database. Range in the frequency spectrum that is assigned by regulatory organizations for use for specific applications or a group of applications. Entry in the table of frequency allocations of a given frequency band for the purpose of its use by one or more radio communication services or the radio astronomy service under specified conditions. Service request failed. Information on the result of service execution.

Annex A (informative)

Example of a CCP controlled WCA and incumbent services/applications within the 5,8 GHz band

CCP controlled WCA and incumbent services/applications within the 5,8 GHz WIA band, such as radiolocation, transportation system and BFWA are depicted in Figure A.1, as examples.

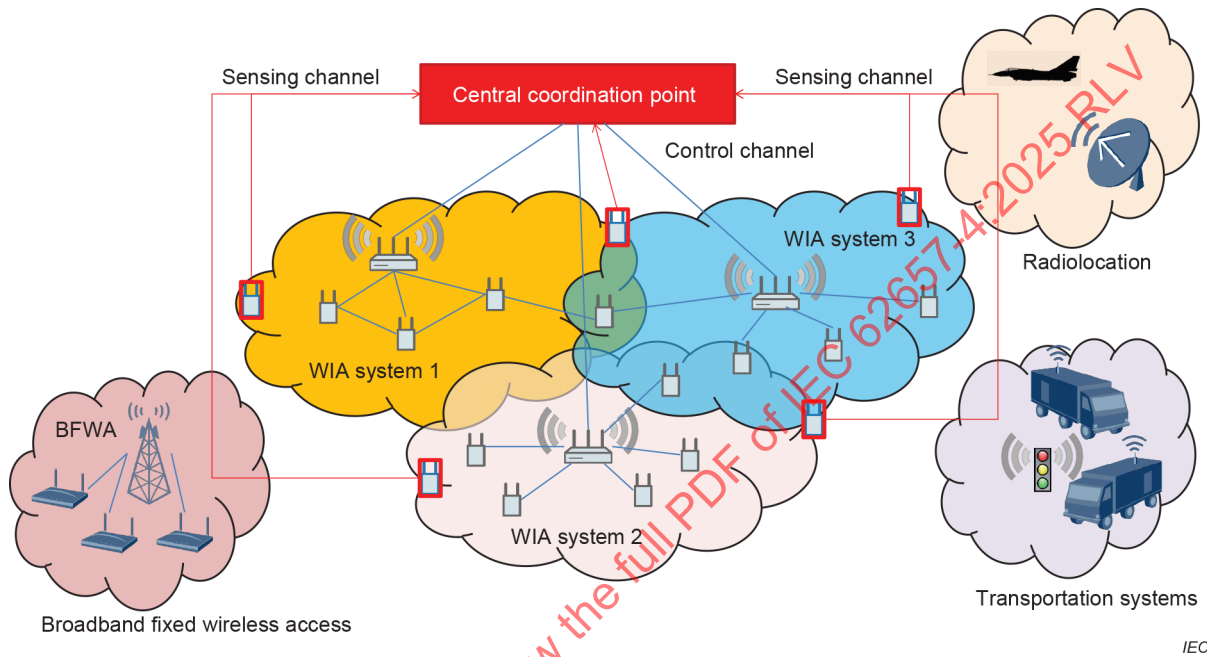


Figure A.1 – CCP controlled WCA and incumbent services and applications

Figure A.2 shows an example of the incumbent services and applications using the 5,8 GHz WIA band. The incumbent services and applications with high regulatory involvement are the following: radiolocation, fixed satellite services (FSS), transportation systems like transport and traffic telematics (TTT), ITS non-safety and broadband fixed wireless access (BFWA).

Table A.1 shows an example of typical parameters for some incumbent services and applications in the 5,8 GHz WIA band (see ECC Report 206).

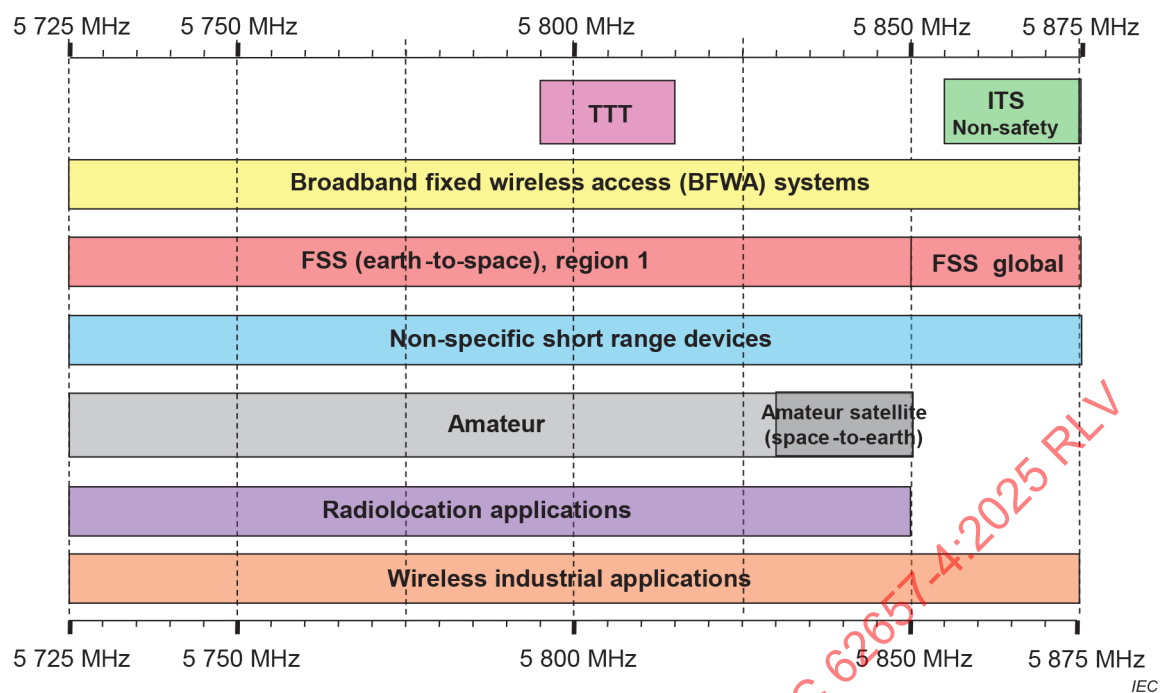


Figure A.2 – Overview of incumbent service/applications

Table A.1 – Incumbent services and applications

Incumbent service application	Frequency band MHz	Type	Application characteristic	Transmit power (EIRP)
Radiolocation	5 725 to 5 850	Defense	Dynamic in time and location	25 kW to 2 800 kW
BFWA	5 725 to 5 875	Fixed service	Static	4 W
TTT	5 795 to 5 815	Transport and traffic telematics	Static	2 W to 8 W
ITS non-safety	5 855 to 5 875	Transportation	Dynamic in time	1 mW to 200 mW

Annex B (informative)

Use of IEC CDD

Coexistence management is an example of network-encompassing property.

For any planning to work, all communication aspects ~~need to~~ can be described in a comprehensive format.

- network model;
- devices;
- coexistence management.

Figure B.1 shows the fostering wireless coexistence management according to IEC 62657-2 using IEC common data dictionary (IEC CDD) in two different ways.

The first way is to specify all needed value lists, properties and item classes (e.g. list of properties, block of properties, activities) to be able to describe the behaviour of a wireless interface and the network behaviour.

The second way is to use defined dictionary concepts for wireless interface and the network behaviour to specify the allowed values and ranges based on the existing wireless communication network standards, for example IEC 62591, IEC 62601, IEC 62734, and IEC 62948. For this purpose, specific values for sets of properties ~~need to~~ can be defined (e.g. specific combination of protocol name, radio frequency, baud rate and reaction times).

The IEC 62657 series provides templates which can be mapped to a database standard. This database standard can be based on the IEC 61360 series (IEC CDD).

Wireless device vendors can use the template in the IEC CDD named AGA ###, for example

- AGA 000 defines the coexistence management information,
- AGA 107 defines the communication load,

to provide the content of the templates with the values etc. as built.

If a vendor decides to use a wireless protocol specified by the IEC, ~~then for these wireless protocols it is planned to~~ that have a pre-filled-out version of the IEC CDD templates with the capabilities and options of this wireless protocol ~~to, then the vendor can~~ select the subset and define the superset of ~~this these~~ capabilities ~~according to the device as built by the vendor~~.

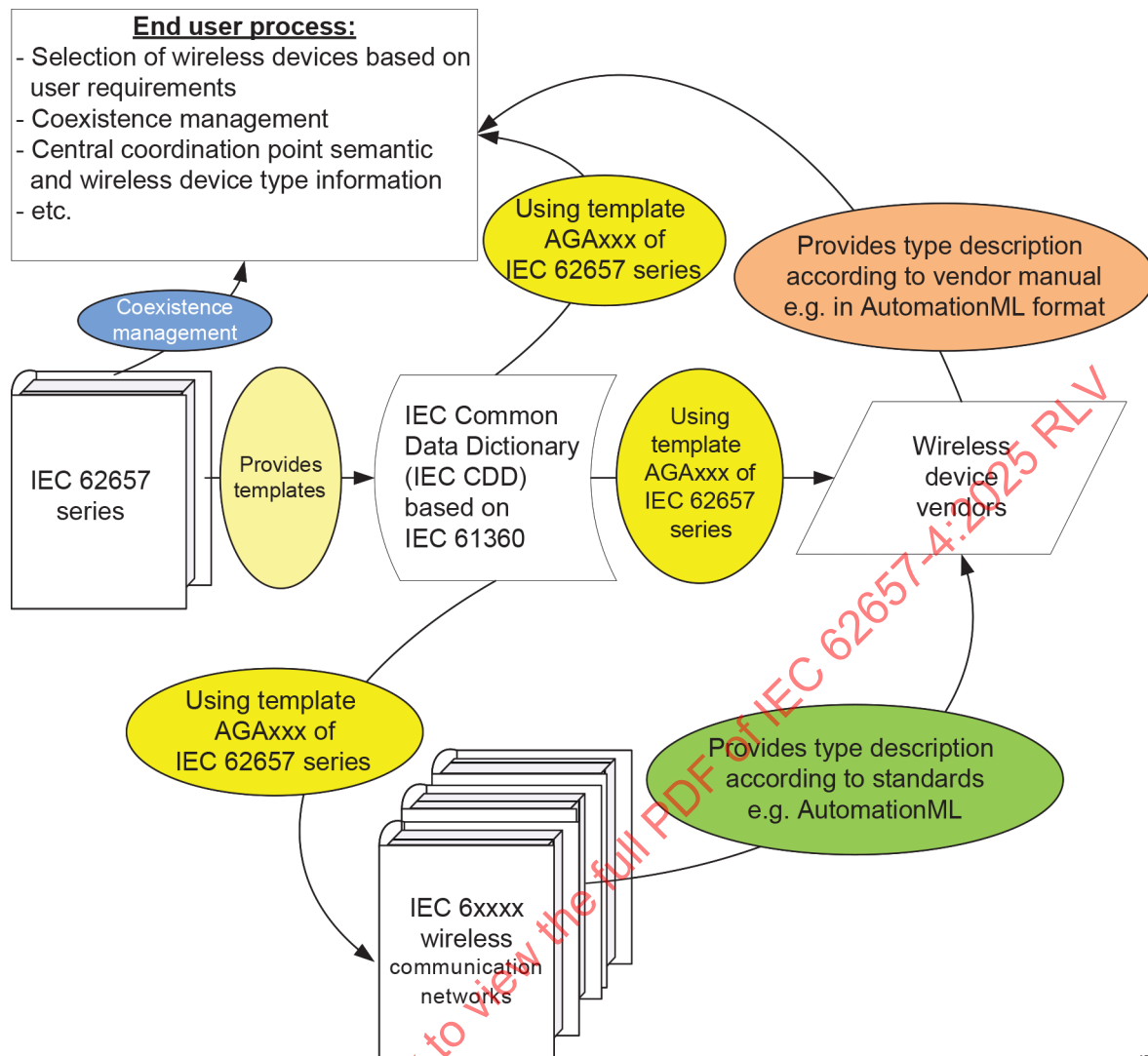


Figure B.1 – Fostering wireless coexistence management

Annex C (informative)

Mapping of the services to templates

C.1 General

The templates in IEC 62657-2 are generic and ~~may~~ can be mapped to the IEC CDD. The content of the IEC CDD can be used to develop implementations of CCPs and their components, wireless devices with spectrum sensing functions, and spectrum sensing devices that are interoperable with each other. The central coordinated coexistence management system, see Figure 6, needs database services with standardized classes and properties.

In Figure B.1, the box with the "Wireless device vendors" is the step where the device types ~~will be described~~ describe the classes and properties according to the vendor manuals. The resulting electronic description, using the "catalogue data" representation of IEC CDD, can be imported by the CCP, see box "End-user process".

For the coexistence management according to this document, the templates in IEC 62657-2 are not sufficient. These templates are extended in this Annex C with functions and attributes to facilitate the end-user process (see in Figure B.1 the blue box named "Coexistence management"). These extended templates ~~may~~ can also be used in the IEC CDD.

The added functions are the services of the CCP, specified in Clause 8. The attributes are the parameter of the service, grouped in:

- a) Argument, parameters of the service request;
- b) Result (+), if applicable for the service and conditional if successful;
- c) Result (-), conditional if not successful.

NOTE The columns in the tables of Annex C named "IEC 62657-2 reference" provide the reference to the parameter or template in IEC 62657-2:2025. A character "—" in a cell means that this is a specific attribute of this document.

C.2 Templates of the management services

The management services are specified in 8.2.

The service GetGeneralPlantCharacteristic ~~should~~ can use the template in Table C.1.

Table C.1 – GetGeneralPlantCharacteristic service parameter template

Parameter name	Value	Unit	Usage	Remark	IEC 62657-2:2025 reference
Argument					
Destination address					—
Result (+)					
Communication address					
CCP address					—
General plant characteristics					
Regional radio regulations					Table 5, 5.51
Future expansion plan					Table 5, 5.24
Passive environmental influences					
Area of operation					Table 6, 5.11
Object movement					Table 6, 5.42
Geographical dimension of the plant					Table 6, 5.25
Natural environmental condition					Table 6, 5.39
Intervisibility					Table 6, 5.29
Frequency band					Table 6, 5.20
Active environmental influences					
Wireless communication solution density					Table 7, 5.69
Interference type					Table 7, 5.28
Limitation from neighbours of the plant					Table 7, 5.32
Result (-)					
Service status					—

The service SetGeneralPlantCharacteristic ~~should~~ can use the template in Table C.2.

Table C.2 – SetGeneralPlantCharacteristic service parameter template

Parameter name	Value	Unit	Usage	Remark	IEC 62657-2:2025 reference
Argument					
Destination address					—
Attribute data					
General plant characteristics					
Regional radio regulations					Table 5, 5.51
Future expansion plan					Table 5, 5.24
Passive environmental influences					
Area of operation					Table 6, 5.11
Object movement					Table 6, 5.42
Geographical dimension of the plant					Table 6, 5.25
Natural environmental condition					Table 6, 5.39
Intervisibility					Table 6, 5.29
Frequency band					Table 6, 5.20
Active environmental influences					
Wireless communication solution density					Table 7, 5.69
Interference type					Table 7, 5.28
Limitation from neighbours of the plant					Table 7, 5.32
Result (-)					
Service status					—

The service GetApplicationCommunicationRequirements ~~should~~ can use the template in Table C.3.

Table C.3 – GetApplicationCommunicationRequirements service parameter template

Parameter name	Value	Unit	Usage	Remark	IEC 62657-2:2025 reference
Argument					
Destination address					—
Communication link ID					—
Result (+)					
CCP address					—
Communication link ID					—
Performance parameter type					—
Limits of performance parameter					—
Result (-)					
Service status					—

C.3 Templates of the subscription services

The wireless communication system and device subscription services are specified in 8.3.

The service SubscribeDevice ~~should~~ can use the template in Table C.4.

Table C.4 – SubscribeDevice service parameter template

Parameter name	Value	Unit	Usage	Remark	IEC 62657-2:2025 reference
Argument					
Destination address					—
Device type					—
Result (+)					
Device ID					—
Status					—
Device type					—
Device address					—
Result (-)					
Service status					—

The service UnsubscribeDevice ~~should~~ can use the template in Table C.5.

Table C.5 – UnsubscribeDevice service parameter template

Parameter name	Value	Unit	Usage	Remark	IEC 62657-2:2025 reference
Argument					
Destination address					—
Device type					—
Device ID					—
Result (+)					
Device ID					—
Status					—
Device address					—
Result (-)					
Service status					—

The service SubscribeSystem ~~should~~ can use the template in Table C.6.

Table C.6 – SubscribeSystem service parameter template

Parameter name	Value	Unit	Usage	Remark	IEC 62657-2:2025 reference
Argument					
Destination address					—
Wireless system type					—
Result (+)					
Wireless system ID					—
Status					—
Wireless system type					—
System address					—
Result (-)					
Service status					—

The service UnsubscribeSystem ~~should~~ can use the template in Table C.7.

Table C.7 – UnsubscribeSystem service parameter template

Parameter name	Value	Unit	Usage	Remark	IEC 62657-2:2025 reference
Argument					
Destination address					—
Wireless system type					—
Wireless system ID					—
Result (+)					
Wireless system ID					—
Status					—
System address					—
Result (-)					
Service status					—

The service GetDeviceAttributes ~~should~~ can use the template in Table C.8.

Table C.8 – GetDeviceAttributes service parameter template

Parameter name	Value	Unit	Usage	Remark	IEC 62657-2:2025 reference
Argument					
Destination address					—
Device ID					—
Result (+)					
CCP address					—
Device ID					—
Status					—
Attribute data					
Regional radio regulation					Table 23, 5,51
Transmitter					
Antenna type					Table 23, 5.5
Antenna gain					Table 23, 5.3
Antenna radiation pattern					Table 23, 5.4
Equivalent radiated power					Table 23, 5.19
Equivalent isotropic radiated power					Table 23, 5.18
Total radiated power					Table 23, 5.59
Transmitter output power					Table 23, 5,63
Power spectral density					Table 23, 5.46
Frequency channel					Table 23, 5.22
Medium access control mechanism					Table 23, 5.35
Frequency hopping sequence					Table 23, 5.23
Communication reliability					Table 23, 5.7
Transfer interval					Table 23, 5.60
Transmission gap					Table 23, 5.61
Transmitter sequence					Table 23, 5.64
Duty cycle					Table 23, 5.16
Dwell time					Table 23, 5.17
Medium utilization factor					Table 23, 5,36
Receiver					
Adjacent channel selectivity					Table 23, 5.2
Receiver sensitivity					Table 23, 5.50
Receiver maximum input level					Table 23, 5.49
Receiver blocking					Table 23, 5.48
Spurious response					Table 23, 5.57
Result (-)					
Service status					—

C.4 Templates of the Wireless communication system and device configuration and control services

The wireless communication system and device configuration and control services are specified in 8.4.

The service SetTransmitPower ~~should~~ can use the template in Table C.9.

Table C.9 – SetTransmitPower service parameter template

Parameter name	Value	Unit	Usage	Remark	IEC 62657-2:2025 reference
Argument					
Destination address					—
System or Device ID					—
Transmitter output power					5.63
Result (+)					
Result (-)					
Service status					—

The service SetFrequencyChannel ~~should~~ can use the template in Table C.10.

Table C.10 – SetFrequencyChannel service parameter template

Parameter name	Value	Unit	Usage	Remark	IEC 62657-2:2025 reference
Argument					
Destination address					—
System or Device ID					—
Frequency channel					5.22
Result (+)					
Result (-)					
Service status					—

The service SetBandwidth ~~should~~ can use the template in Table C.11.

Table C.11 – SetBandwidth service parameter template

Parameter name	Value	Unit	Usage	Remark	IEC 62657-2:2025 reference
Argument					
Destination address					—
System or Device ID					—
Frequency Bandwidth					5.21
Result (+)					
Result (-)					
Service status					—

The service SetFrequencyHoppingSequence ~~should~~ can use the template in Table C.12.

Table C.12 – SetFrequencyHoppingSequence service parameter template

Parameter name	Value	Unit	Usage	Remark	IEC 62657-2:2025 reference
Argument					
Destination address					—
System or Device ID					—
Frequency hopping sequence					5.23
Result (+)					
Result (-)					
Service status					—

The service SetBlockedFrequencyList ~~should~~ can use the template in Table C.13.

Table C.13 – SetBlockedFrequencyList service parameter template

Parameter name	Value	Unit	Usage	Remark	IEC 62657-2:2025 reference
Argument					
Destination address					—
System or Device ID					—
Blocked frequency list					5.9
Result (+)					
Result (-)					
Service status					—

The service SetDwellTime ~~should~~ can use the template in Table C.14.

Table C.14 – SetDwellTime service parameter template

Parameter name	Value	Unit	Usage	Remark	IEC 62657-2:2025 reference
Argument					
Destination address					—
System or Device ID					—
Dwell time					5.17
Result (+)					
Result (-)					
Service status					—

The service SetMediumAccessControlMechanism ~~should~~ can use the template in Table C.15.

Table C.15 – SetMediumAccessControlMechanism service parameter template

Parameter name	Value	Unit	Usage	Remark	IEC 62657-2:2025 reference
Argument					
Destination address					—
System or Device ID					—
Medium access control mechanism					5.35
Result (+)					
Result (-)					
Service status					—

The service SetDeviceStatus ~~should~~ can use the template in Table C.16.

Table C.16 – SetDeviceStatus service parameter template

Parameter name	Value	Unit	Usage	Remark	IEC 62657-2:2025 reference
Argument					
Destination address					—
System or Device ID					—
Device status					—
Result (+)					
Result (-)					
Service status					—

The service GetParameter ~~should~~ can use the template in Table C.17.

Table C.17 – GetParameter service parameter template

Parameter name	Value	Unit	Usage	Remark	IEC 62657-2:2025 reference
Argument					
Destination address					—
Parameter ID					—
Result (+)					
Destination address					—
Parameter ID					—
Parameter values					—
Result (-)					
Service status					—

The service SetParameter ~~should~~ can use the template in Table C.18.

Table C.18 – SetParameter service parameter template

Parameter name	Value	Unit	Usage	Remark	IEC 62657-2:2025 reference
Argument					
Destination address					—
Parameter ID					—
Parameter value					—
Result (+)					
Result (-)					
Service status					—

C.5 Templates of the Medium resource management services

The Medium resource management services are specified in 8.5.

The service GetMediumResourceReport ~~should~~ can use the template in Table C.19.

Table C.19 – GetMediumResourceReport service parameter template

Parameter name	Value	Unit	Usage	Remark	IEC 62657-2:2025 reference
Argument					
Destination address					—
Communication link ID					—
Wireless ID					—
Result (+)					
Result (-)					
Service status					—

The service SetMediumResourceReport ~~should~~ can use the template in Table C.20.

Table C.20 – SetMediumResourceReport service parameter template

Parameter name	Value	Unit	Usage	Remark	IEC 62657-2:2025 reference
Argument					
Destination address					—
Communication link ID					—
Wireless ID					—
Report type					—
Report interval					—
Report threshold					—
Result (+)					
CCP address					—
Wireless ID					—
Report status					
Result (-)					
Service status					—

The service NotifyMediumResource ~~should~~ can use the template in Table C.21.

Table C.21 – NotifyMediumResource service parameter template

Parameter name	Value	Unit	Usage	Remark	IEC 62657-2:2025 reference
Argument					
CCP address					—
Wireless ID					—
Attribute data					
Duty cycle					5.16
RSSI mean					—
RSSI standard deviation					—
SINR mean					—
SINR standard deviation					—
Data throughput					5.14
Message loss ratio					5.44
Result (+)					
Result (-)					
Service status					—

The service SetMediumSensingReport ~~should~~ can use the template in Table C.22.

Table C.22 – SetMediumSensingReport service parameter template

Parameter name	Value	Unit	Usage	Remark	IEC 62657-2:2025 reference
Argument					
Destination address					—
Medium sensing report type					—
Report interval					—
Sensing start frequency					—
Sensing end frequency					—
Sensing interval					—
Signal duration					—
Result (+)					
CCP address					—
Spectrum sensing entity ID					—
Result (-)					
Service status					—

The service NotifyMediumSensingResults ~~should~~ can use the template in Table C.23.

Table C.23 – NotifyMediumSensingResults service parameter template

Parameter name	Value	Unit	Usage	Remark	IEC 62657-2:2025 reference
Argument					
CCP address					—
Spectrum sensing entity ID					—
Attribute data					
Timestamp					—
Array of frequency					—
Array of power spectral density					—
Result (-)					
Service status					—

C.6 Templates of the Database access services

The Database access services are specified in 8.6.

The service GetRadioRegulation ~~should~~ can use the template in Table C.24.

Table C.24 – GetRadioRegulation service parameter template

Parameter name	Value	Unit	Usage	Remark	IEC 62657-2:2025 reference
Argument					
Destination address					—
Radio regulation database ID					—
Start frequency					—
Stop frequency					—
Location					—
Result (+)					
CCP address					—
Radio regulation database ID					—
Attribute data					
Frequency band					5.20
Allocation					—
Automation application(s)					—
Result (-)					
Service status					—

Annex D

(informative)

Wireless coexistence management with SRF Wireless Platform

D.1 General

IEC 62657-4 describes the concept and services of the automated coexistence management system. On the other hand, to implement it in an existing factory, more detailed functions and settings are required. Therefore, this annex exemplifies smart resource flow (SRF)² wireless platform (named SRF Wireless Platform), which is based on IEC 62657-4 and explains the verification effects (effectiveness of coexistence management).

D.2 Overview of SRF Wireless Platform

The SRF Wireless Platform is a coordination control technology to ensure stable communications in an environment where various wireless systems coexist for industrial applications. SRF Wireless Platform aims at accommodating existing and future available wireless technologies.

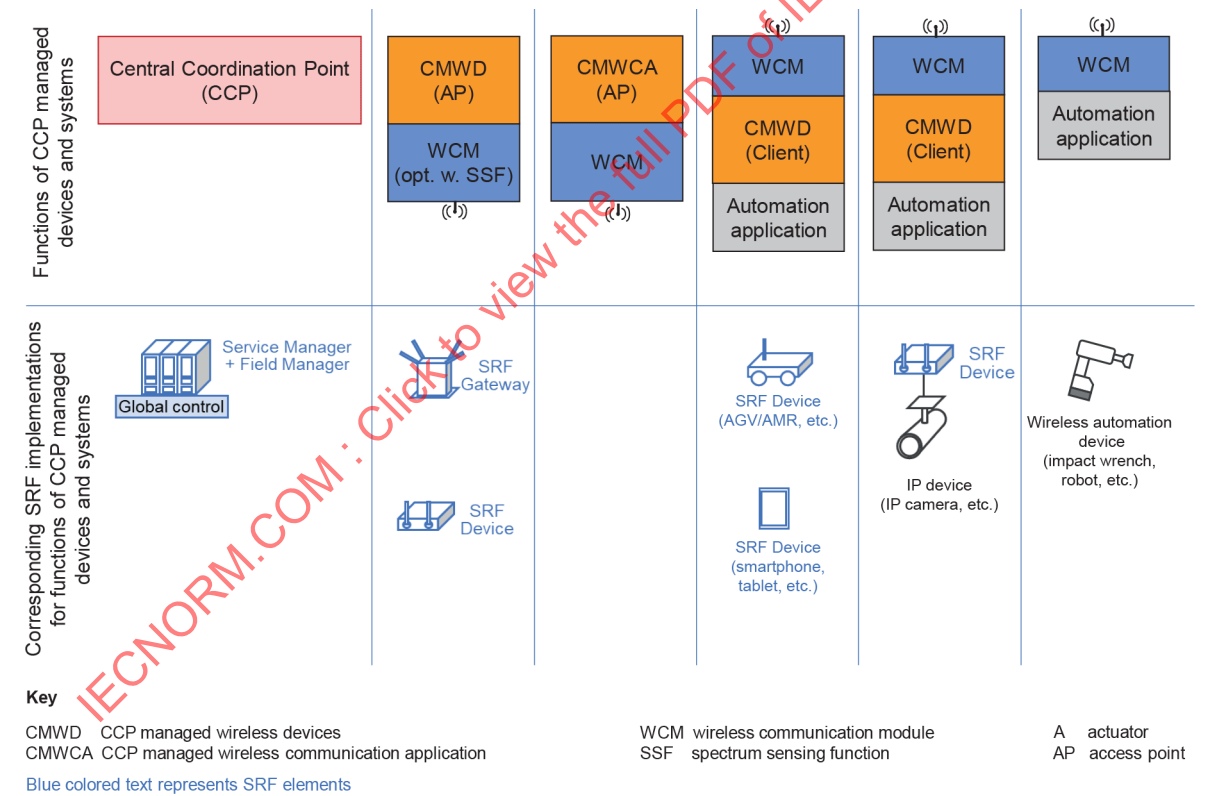
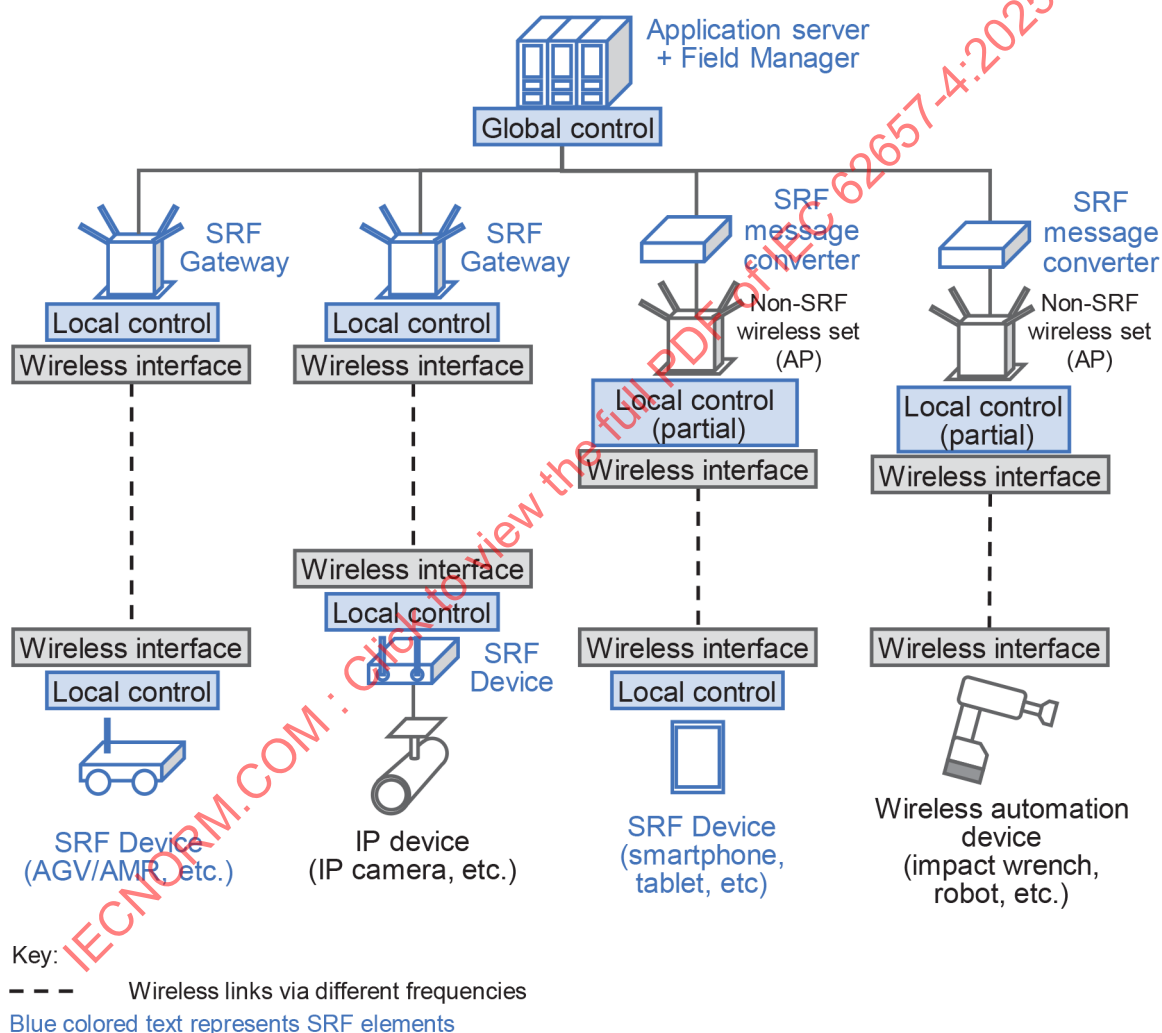


Figure D.1 – CCP system elements of SRF Wireless Platform

² Smart resource flow is an example of a suitable product available commercially. This information is given for the convenience of users of IEC 62657-4 and does not constitute an endorsement by IEC of this product.

The SRF Wireless Platform implements the system architecture elements for wireless coexistence management described in 5.2 as shown in Figure D.1. The central coordination point functions described in 5.2.2 are implemented in the SRF Service Managers and the SRF Field Manager. An SRF Gateway implements functions of a CCP managed wireless device in accordance with 5.2.1.2 in addition to the functions of a standard access point. SRF Devices implement functions of a CCP managed wireless device according to 5.2.1.2. SRF Devices can implement an automation application or only an interface to a separate automation device. The SRF Sensor corresponds to the spectrum sensing node described in 5.2.4.

SRF Wireless Platform provides hierarchical radio resource control consisting of global control and local control, see Figure D.2. Global control is the coordination control of radio resources to satisfy requirements of factory applications. Local control is the autonomous fine control of radio resources according to Radio Resource Control Policy to adapt promptly to rapid changes locally of radio environment.



IEC

SOURCE: SRF Wireless Platform Technical Specifications Version 2.0.0. Reproduced with the permission of Flexible Factory Partner Alliance (FFPA).

Figure D.2 – Overview of SRF Wireless Platform

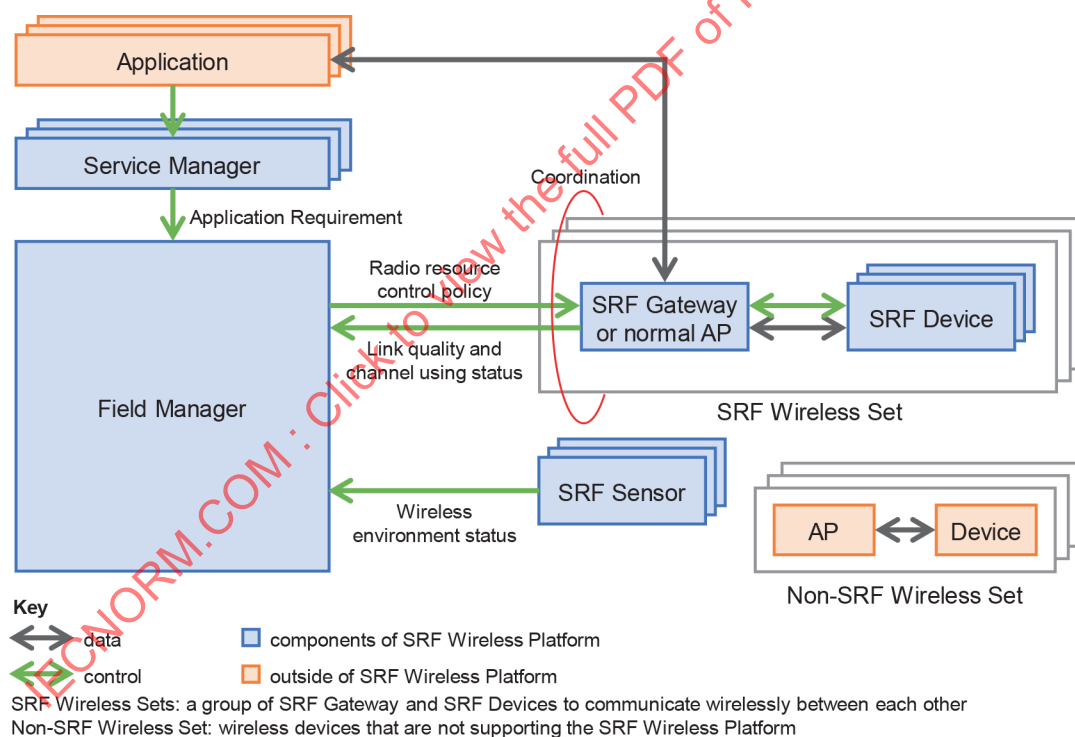
The functional structure described by the SRF Wireless Platform is shown in Figure D.3.

The service manager implements the resource engine functionality of a CCP excluding maintaining and monitoring QoS information of the communication links (see 5.2.2.3). It calculates application-specific requirements (transmission quality such as transmission time, packet loss ratio, congestion, etc.). Furthermore, the service manager includes the information and configuration data base of a CCP (see 5.2.3.1). Each wireless communication application has its own service manager.

The field manager implements the functionality of the spectrum engine and the interfaces to the CCP managed wireless applications and/or devices. It also has a function of resource engine in terms of maintaining and monitoring QoS information of the communication links. It coordinates radio resources to meet quality requirements of each application and to avoid radio frequency interference. It also allocates spectrum resources by providing control policies to each wireless communication system. One field manager coordinates all relevant wireless communication applications.

The SRF Sensor corresponds to the Spectrum Sensing Node (SSN). It monitors radio environment of a factory and collects information for coexistence management.

In short, the architecture and components are almost the same between IEC 62657-4 and SRF Wireless Platform. On the other hand, some terms are differently used. Table D.1 provides the translation. SRF Wireless Platform has functions applicable to IEC 62657-4, except communications with Wireless Sensor Actuator Network (WSAN).



IEC

Figure D.3 – Architecture of SRF Wireless Platform

Table D.1 – Comparison between IEC 62657-4 and SRF Wireless Platform

Functions of SRF Wireless Platform	Equivalent service name of IEC 62657-4
Service manager	Resource engine functionality, and information and configuration data base of a CCP
Application server	Automation application
Field Manager	Spectrum engine of a CCP and interfaces to the CCP managed wireless applications and/or devices
SRF Sensor	Spectrum Sensing Node (SSN)

The SRF Wireless Platform can be implemented without changing the existing MAC/PHY by building a variety of communication devices of different standards and generations on the platform, see Figure D.4.

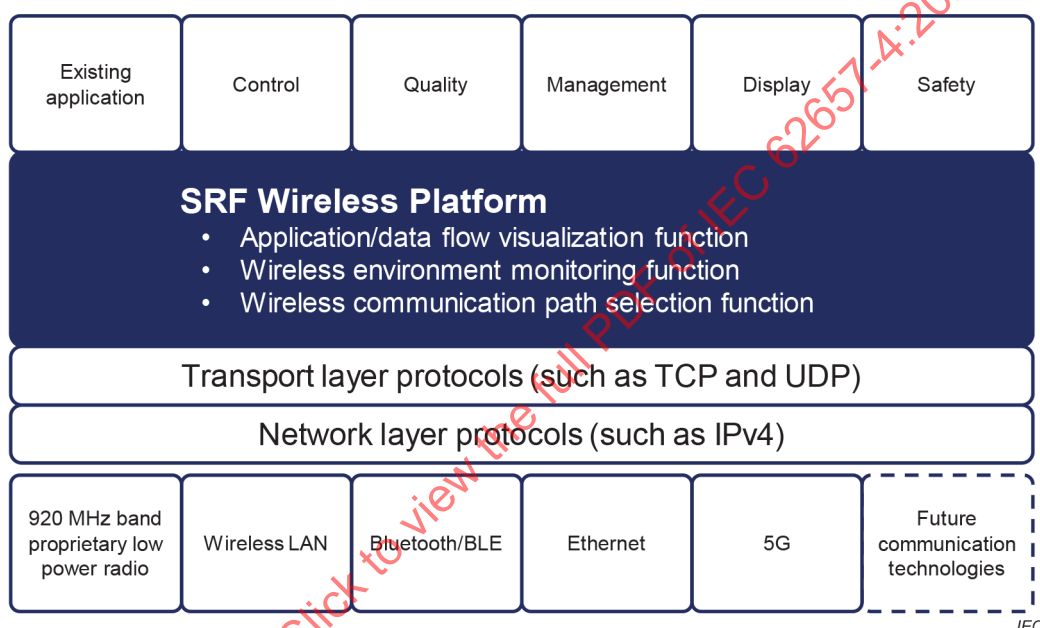
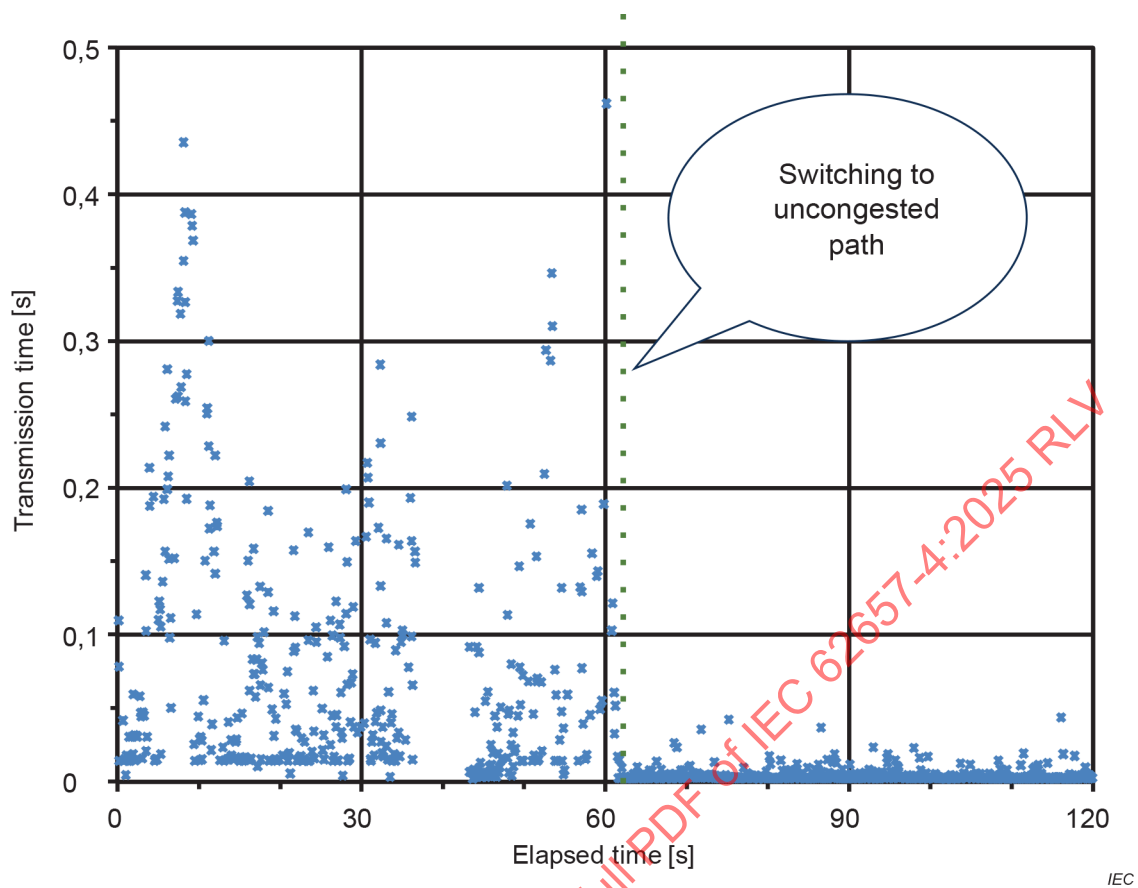


Figure D.4 – Overview of SRF Wireless Platform layer structure

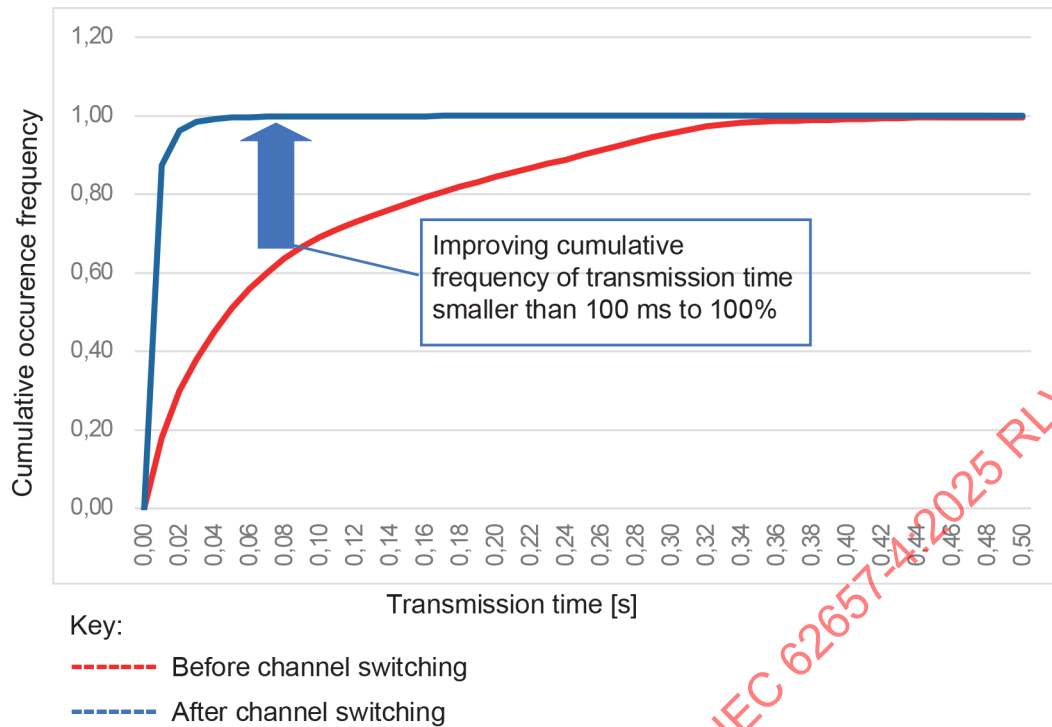
D.3 Effects of SRF Wireless Platform implementation

In 2020, National Institute of Information and Communications Technology (NICT), Japan conducted a demonstration of the SRF Wireless Platform at machine assembly factory. In the demonstration, test communication in the same frequency band as that used in the production line was conducted, and the latency of this test communication was evaluated. As a result, it was confirmed that by switching to an appropriate communication path under the control of the Field Manager (management server), the latency and its jitter significantly decreased, see Figure D.5. Also, the ratio of latency less than 100 ms increased to 100 %, see Figure D.6.



SOURCE: Successful Experiment with Stabilization Technology for Wireless Communications for Manufacturing Systems. Reproduced with the permission of NICT.

Figure D.5 – Experimental results of the SRF Wireless Platform demonstration (time variation of transmission time)



SOURCE: Successful Experiment with Stabilization Technology for Wireless Communications for Manufacturing Systems. Reproduced with the permission of NICT.

Figure D.6 – Experimental results of the SRF Wireless Platform demonstration (frequency of transmission time)

D.4 Functions of SRF Wireless Platform

D.4.1 Messages

In the SRF Wireless Platform, the messages below are exchanged between the Field Manager, Gateway, Device, and SRF Sensor as described in Table D.2.

Table D.2 – Correspondence list of messages of SRF Wireless Platform and services in IEC 62657-4

SRF			IEC 62657-4		
Interface	Message	Description of message	Service	Primitive	Reasons for matching/not-matching
Between Service Manager and Field Manager	srfSystemControllIndicator	This message is used by Service Manager or an application to give SRF System Control Indicator to Field Manager.	GetApplicationCommunicationRequirements	M- GetApplicationCommunicationRequirements-REQ	Match. srfSystem ControllIndicator in SRF is a message transmitting application requirement from Service Manager to Field Manager. GetApplicationCommunicationRequirements in IEC 62657-4 are similar in terms of transmitting requirements set by applications.
Between Field Manager and SRF Gateway or SRF Device	capability	This message is used by SRF Gateway to register Capability Information with its identification to Field Manager.	GetDeviceAttributes	M-GetDeviceAttributes-CONF	Match. Capability in SRF is a message transmitting I/F type, bandwidths, antenna type, signal strength. GetDeviceAttributes in IEC 62657-4 transmits bandwidths, antenna type and signal strength from CMWD to CCP so it has a similar function to grasp the ability of the target object.
	policy/Info	This message is used by SRF Gateway to get policy information from Field Manager.	- SetTransmitPower - SetFrequencyChannel - SetBandwidth - SetFrequencyHoppingSequence - SetBlockedFrequencyList - SetDwellTime - SetMediumAccessControlMechanism - SetDeviceStatus - SetParameter - SetMediumResourceReport	- C-SetTransmitPower-REQ - C-SetFrequencyChannel-REQ - C-SetBandwidth-REQ - SetFrequencyHopping-REQSequence - SetBlockedFrequencyList-REQ - SetDwellTime-REQ - SetMediumAccessControlMechanism-REQ - SetDeviceStatus-REQ - SetParameter-REQ - M-SetMediumResourceReport-REQ	Match. PolicyInfo in SRF is a message transmitting identification of SRF Gateway and Device, each SRF Service Policy and transmit output from Field Manager to SRF Gateway. SetTransmitPower in IEC 62657-4 is similar in terms of transmitting transmit output from CCP to CMWD and CMWCA. SetFrequencyChannel in IEC 62657-4 is similar in terms of transmitting channel priority from CCP to CMWD and CMWCA. SetBandwidth in IEC 62657-4 is similar in terms of transmitting priority bandwidths from CCP to CMWD and CMWCA.

SRF			IEC 62657-4		
Interface	Message	Description of message	Service	Primitive	Reasons for matching/not-matching
					SetFrequencyHoppingSequence in IEC 62657-4 is similar in terms of transmitting frequency hopping sequence from CCP to CMWD and CMWCA. SetBlockedFrequencyList in IEC 62657-4 is similar in terms of transmitting blocked frequency list from CCP to CMWD and CMWCA. SetDwellTime in IEC 62657-4 is similar in terms of transmitting dwell time from CCP to CMWD and CMWCA. SetMediumAccessControlMechanism in IEC 62657-4 is similar in terms of transmitting medium access control mechanism from CCP to CMWD and CMWCA. SetDeviceStatus in IEC 62657-4 is similar in terms of transmitting device status from CCP to CMWD and CMWCA. SetParameter in IEC 62657-4 is similar in terms of transmitting parameter value from CCP to CMWD and CMWCA. SetMediumResourceReport in IEC 62657-4 is similar in terms of transmitting report interval from CCP to CMWD and CMWCA.
	dataAttribute	This message is used by SRF Gateway to get Data Attributes of an application from Field Manager.	None	None	No match dataAttribute in SRF is a message transmitting application requirement from Field Manager to SRF Gateway. There are no parameters matched in IEC side.

SRF			IEC 62657-4		
Interface	Message	Description of message	Service	Primitive	Reasons for matching/not-matching
	wlanInfo	This message is used by SRF Gateway to transfer wireless link information to Field Manager.	- GetMediumResourceReport - NotifyMediumResource	- C-GetMediumResourceReport-CONF - C-NotifyMediumResource-IND	Match. wlanInfo of SRF is a message transmitting wireless link information from SRF Gateway to Field Manager. GetMediumResourceReport in IEC is similar in terms of transmitting RSSI from CMWD and CMWCA to CCP. NotifyMediumResource in IEC is similar in terms of transmitting RSSI from CMWD and CMWCA to CCP.
	doalInfo	This message is used for Radio Link Monitoring for DoA procedure.	GetRadioRegulation	M-GetRadioRegulation-IND	Match. DoalInfo in SRF is a message transmitting to monitor signals direction of arrival. GetRadioRegulation in SRF is similar in terms of transmitting location of CMWD and CMWCA from CCP to Database.
	streamInfo	This message is used by SRF Gateway to transfer Application Stream Information from Field Manager.	None	None	Not match. StreamInfo in SRF is a message transmitting latency and loss ration from Field Manager to applications. There are no parameters matched in IEC side.

SRF			IEC 62657-4		
Interface	Message	Description of message	Service	Primitive	Reasons for matching/not-matching
Between Field Manager and SRF Sensor	channelUsageInfo	This message is used by SRF Sensor to report Radio Channel Usage Efficiency to Field Manager. Field Manager does not indicate the interval for channelUsageInfo to SRF Sensor. SRF Sensor determines the interval by itself.	NotifyMediumSensingResults	C-NotifyMediumSensingResults-REQ	Match. channelUsageInfo in SRF is a message transmitting channel use efficiency from SRF Sensor to Field Manager. NotifyMediumSensingResults in IEC is similar in terms of transmitting frequency sensing results from Spectrum Sensing Node or Spectrum Sensing Function to CCP. The following parameters correspond to parameters of NotifyMediumSensingResults. - srfsensorId (Identification of each SRF Sensor)→Spectrum sensing entity ID - timestamp (Timestamp [sec])→Timestamp - lowerLimit (Lowest frequency [MHz])→Array of frequency - frequencyResolution (Frequency resolution [kHz])→Array of frequency - bandwidth (Bandwidths [kHz])→Array of frequency - count (RSSI counted number)→Array of frequency

SOURCE: Parts of this table are reproduced from SRF Wireless Platform Technical Specifications Version 2.0.0 with the permission of Flexible Factory Partner Alliance (FFPA).

D.4.2 Functions

The SRF Wireless Platform describes the following functions which work between the Filed Manager, Gateway, Device, and SRF Sensor, see Table D.3.

Table D.3 – Correspondence list of functions of SRF Wireless Platform and IEC 62657-4

SRF				IEC 62657-4	
ID	Function classification	Function name	Detail function name	Description of function	Reasons for matching/not-matching
100	Association	Capability Information Exchange	—	The function shares Capability Information (supported functions and capability of each function) of SRF Gateway and SRF Device and shares types of radio interface (e.g. IEEE Std 802.11n) of SRF Gateway and SRF Device. None	Match. Capability Information Exchange in SRF shares information related to SRF Gateway and SRF Device capability (supported functions and each function's capability) and types of wireless interfaces. GetDeviceAttributes in IEC 62657-4 is similar in terms of bandwidth, antenna type and signal strength from CMWD to CCP.

SRF					IEC 62657-4	
ID	Function classification	Function name	Detail function name	Description of function	Function name	Description of function
201	Dynamic Communication Control	Dynamic Communication Control Decision for Field Manager	—	The function is to output necessary information to generate Radio Resource Control Policy in Radio Resource Coordination Control. It can change Radio Resource Control Policy depending on the state of the communication environment.	Database Service	Dynamic Communication Control corresponds to Database Service on the following italicized points. The central coordinated coexistence management system has three entities, as shown in Figure 5: – central coordination point (CCP); – spectrum sensing system (SSS), which is a combination of spectrum sensing nodes (SSN) and spectrum sensing functions (SSF), see 5.2.4; – <i>database services with information and configuration database and regulation database.</i> Figure 6 shows the data exchange between the elements in a central coordinated coexistence management system. The central coordination point (CCP) is the key element of the coexistence management system. <i>The CCP makes coexistence management decisions based on engineering baseline data, information from databases and current measurements of application behaviour and spectrum.</i> Current measured values of application behaviour and spectrum can be collected for wireless systems via their central device, for example a base station, or directly from wireless devices. In the first case, there is only one connection between the CCP and the central component, as with WSAN in Figure 6. Then the application using the WSAN is a CCP managed wireless communication application (CMWCA). In the other case, there are connections from the CCP to the wireless devices, as with the wireless system 1 and 2. These are then called CCP managed wireless devices (CMWD). The exchange of
						Reasons for matching/not-matching Match: Dynamic Communication Control outputs information to make Radio Resource Control Policy to Radio Resource Coordination Control in Field Manager. IEC 62657-4 transmits Engineering and configuration data from Information and configuration database to CCP and transmits Regulation data from Regulation database and CCP decides coexistence management.

SRF					IEC 62657-4	
ID	Function classification	Function name	Detail function name	Description of function	Function name	Description of function
						coexistence data can take place directly between CCP and CMWD or via the central device of the WCS. Current measured values of spectrum are also provided by the spectrum sensing node (SSN). (See Figure 6.)
300	Radio Resource Coordination Control	Interference Coordination Control	—	The function is to perform scheduling control among multiple wireless systems to mitigate interferences.	CCP	Interface Coordination Control corresponds to CCP on the following italicized points. The control plane shall be comprised of the spectrum sensing system (SSS) function and central coordination point (CCP) function. The SSS shall implement spectrum sensing algorithms and the RE shall provide the information to determine the location of the CMWCA and CMWD. <i>The CCP shall maintain medium availability information, manage channel lists, manage quiet periods, scheduling and implement coexistence mechanisms.</i> The CCP shall also take requests from the MAC and PHY. For example, the MAC shall inform the CCP if an interference situation has been detected during normal operation in the channel. The CCP shall then take appropriate actions to resolve the issue such as moving to another channel. For this purpose, the CCP first requests sufficient idle time from the wireless communication application to perform an in-band sensing. It shall update the list of backup and candidate channels in a prioritized order. The CCP then ensures that the wireless communication application has sufficient idle time to select a sufficient number of backup channels. If an incumbent is found during in-
						Match. Interference Coordination Control in SRF is implemented in Field Manager and schedule control among multiple wireless systems. IEC 62657-4 has a similar function to manage channel and scheduling for CCP to avoid interferences.

SRF					IEC 62657-4		
ID	Function classification	Function name	Detail function name	Description of function	Function name	Description of function	Reasons for matching/not-matching
310		Frequency Control	Manual Channel Setting	The function is to set Channels manually at the initial stage and determine the Channel used in SRF Gateway for initial communications.	IEC 62657-2	band sensing, the MAC uses the corresponding service to inform the CCP to perform the switching operation. (See 5.3.3.)	
						Manual Channel Setting corresponds to spectrum engine of CCP on the following italicized point. Manual coexistence management In the case of manual coexistence management, <i>the coexistence manager shall define a fixed planning of the wireless solutions intended to prevent transmission overlaps. The manager shall implement manual measures to react to modifications that change the wireless coexistence state.</i> This is the simplest management method, especially if multiple wireless solutions of different technologies and from several vendors are involved, or if several frequency bands have to be managed. This method can be used if there are non-manageable radio emitters in the same bands as used by wireless solutions. However, the manual coexistence management capabilities are limited if some coexistence management parameters cannot be configured. (See IEC 62657-2:2025, 4.7.1.)	Match. Manual Channel Setting in SRF is implemented in SRF Gateway and set Channels manually at the initial stage and determine the Channel used in SRF Gateway for initial communications. IEC 62657-2 has the concept of manual coexistence management.

SRF					IEC 62657-4	
ID	Function classification	Function name	Detail function name	Description of function	Function name	Description of function
311			Auto Channel Control	The function is to select Channels automatically at the initial stage and determine the target Channel from the available Channel list and enables for SRF Gateways to select Channels of wireless connectivity	CCP	Auto Channel Control corresponds to spectrum engine of CCP on the following italicized points. The spectrum engine (SE) is a management and control function and an entity of the CCP. The SE centralizes all medium usage decisions for various wireless communication applications, taking into account medium availability information and location-specific medium utilization. In summary, the SE shall be responsible for: - maintaining medium availability and medium utilization information; <i>channel classification and selection</i>; - association control; <i>channel set management</i>; - accessing the database service; - scheduling spectrum sensing operation; - making channel move decisions for one or more CCP managed wireless systems or wireless devices for the automation application; - supporting coexistence of wireless communication applications; - considering incumbent radio systems and other wireless applications; - establishing a wired or wireless connection to all CCP managed wireless communication applications and devices; - establishing a connection to the resource engine. (See 5.2.2.)
						Reasons for matching/not-matching Partial match. Auto Channel Control in SRF is implemented in SRF Gateway and select Channels automatically at the initial stage. In IEC 62657-4, Spectrum Engine, implemented in CCP has a function to categorize and select channel but if the function is "automatic" is not clearly stated.

SRF					IEC 62657-4		
ID	Function classification	Function name	Detail function name	Description of function	Function name	Description of function	Reasons for matching/not-matching
312			Dynamic Channel Selection	The function is to switch one Channel to another Channel according to radio link quality. It switches to a new Channel among other Channels available between the SRF Gateway and the SRF Devices based on radio link quality when the radio link quality of the currently used Channel is estimated to be degrading.	CCP	Dynamic Channel Selection corresponds to spectrum engine of CCP on the following italicized point. The spectrum engine (SE) is a management and control function and an entity of the CCP. The SE centralizes all medium usage decisions for various wireless communication applications, taking into account medium availability information and location-specific medium utilization. In summary, the SE shall be responsible for: • maintaining medium availability and medium utilization information; • channel classification and selection; • association control; • channel set management; • accessing the database service; • scheduling spectrum sensing operation; • supporting coexistence of wireless communication applications; • considering incumbent radio systems and other wireless applications; • establishing a wired or wireless connection to all CCP managed wireless communication applications and devices; • establishing a connection to the resource engine. (See 5.2.2.)	Match. Dynamic Channel Selection in SRF is implemented in SRF Gateway and switches one Channel to another Channel according to radio link quality. In IEC 62657-4, Spectrum Engine, implemented in CCP makes channel move decisions for one or more CCP managed wireless systems or wireless devices for the automation application.
313			Path Control	The function is to switch between multiple wireless Paths according to wireless quality	None	None	Not match. There is no explanation about Path.

SRF					IEC 62657-4	
ID	Function classification	Function name	Detail function name	Description of function	Function name	Description of function
314			Licensed Band Selection	The function is to suppress interference with existing wireless system by using a licensed band.	CCP	Licensed Band Selection corresponds to spectrum engine of CCP on the following italicized point. The spectrum engine (SE) is a management and control function and an entity of the CCP. The SE centralizes all medium usage decisions for various wireless communication applications, taking into account medium availability information and location-specific medium utilization. In summary, the SE shall be responsible for: • maintaining medium availability and medium utilization information; • channel classification and selection; association control; • channel set management; • accessing the database service; • scheduling spectrum sensing operation; • making channel move decisions for one or more CCP managed wireless systems or wireless devices for the automation application; • supporting coexistence of wireless communication applications; • considering incumbent radio systems and other wireless applications; • establishing a wired or wireless connection to all CCP managed wireless communication applications and devices; • establishing a connection to the resource engine. (See 5.2.2.2.)
						Reasons for matching/not-matching Partial match. Licensed Band Selection in SRF is implemented in SRF Gateway and mitigates interference among wireless systems operating in the unlicensed bands by using a wireless system in the licensed band. It selects a Path among available Paths in the licensed band between the SRF Gateway and the SRF Devices based on radio link quality when radio link quality of currently used Path is estimated to be degrading. In IEC 62657-4, Spectrum Engine, implemented in CCP schedules spectrum sensing operation but whether it selects license band is not clearly stated.

SRF				IEC 62657-4			
ID	Function classification	Function name	Detail function name	Description of function	Function name	Description of function	Reasons for matching/not-matching
331			Sectorization Control	The function is to enable SRF Gateway/Devices to conduct adjustment of transmission timing for every sector based on Radio Resource Control Policy. It starts operation process after making sure that synchronization is indicated in the status from Time Synchronization.	None	None	Not match. Sectorization Control in SRF is implemented in Spatial Control in SRF Gateway and conducts adjustment of transmission timing for every sector based on Radio Resource Control Policy. There is no explanation in IEC 62657-4.
332			Power Control	The function is to enable SRF Gateway to adjust the transmission power based on Radio Resource Control Policy. It obtains TX Power from Radio Resource Coordination Control in Field Manager.	CMWCA/CMWD	Power Control corresponds to CMWCA/CMWD on the following italicized points. The SetTransmitPower service primitive is a set of primitives for supporting control CMWCA and CMWD from the CCP. Table 22 SetTransmitPower service parameter Argument: The argument contains the parameters of the service request. Destination address: This parameter specifies the destination address to which the service request is to be sent. System or Device ID: This parameter specifies the identifier of the CMWCA or CMWD entity ID. <i>Transmit power value: This parameter specifies the value of transmit power.</i> (See 8.4.2.1.)	Match. Power Control is implemented in Spatial Control in SRF Gateway and adjust the transmission power based on Radio Resource Control Policy. In IEC 62657-4, SetTransmitPower has Transmit power value, a parameter to set transmit power.

SRF					IEC 62657-4	
ID	Function classification	Function name	Detail function name	Description of function	Function name	Description of function
340	Radio Resource Coordination Control	Bandwidth Coordination Control	—	The function is to coordinately control parameters related to frequency radio resources for Paths/Channels among multiple wireless systems to guarantee required bandwidth.	CMWCA/CMWD	Bandwidth Coordination Control corresponds to CMWCA/CMWD on the following italicized points. The SetBandwidth service primitive is a set of primitives for supporting control CMWCA and CMWD from the CCP. Table 26 SetBandwidth service parameter Argument: The argument contains the parameters of the service request. Destination address: This parameter specifies the destination address to which the service request is to be sent. System or Device ID: This parameter specifies the identifier of the CMWCA or CMWD entity ID. <i>Frequency Bandwidth: This parameter specifies the bandwidth.</i> (See 8.4.4.1.)
						Reasons for matching/not-matching Match: Bandwidth Coordination Control in SRF is implemented in Radio Resource Coordination Control in Field Manager and control parameters related to frequency radio resources for Paths/Channels among multiple wireless systems to guarantee required bandwidth. In IEC 62657-4, SetBandwidth has Frequency Bandwidth, a parameter to set frequencies.

SRF				IEC 62657-4	
ID	Function classification	Function name	Detail function name	Description of function	Function name
350	Radio Resource Coordination Control	Multi-radio Integration Control	Channel Aggregation Control	The function is to aggregate multiple Channels according to the radio link quality or the amount of data to be transmitted. It selects and sets an additional aggregation Channel to the currently used Channels from available Channels indicated by Bandwidth Coordination Control. A packet is then sent over a Channel selected from the aggregated Channels.	IEC 62657-1 Availability and reliability
				Channel Aggregation Control corresponds to Availability and reliability on the following italicized points. <i>The reliability of a wireless communication network can be increased by channel hopping to provide a level of immunity against interference from other RF devices operating in the same band, as well as robustness to mitigate multipath interference effects. In addition, the use of selective channel utilization facilitates coexistence with other RF systems by detecting and avoiding using occupied channels within the spectrum. Selective channel utilization can also enhance reliability by avoiding the use of channels with consistently poor performance.</i> (IEC 62657-1:2017, 5.3.9.)	Not match.
351			Path Aggregation Control	The function is to aggregate multiple Paths according to radio link quality or amount of data to be transmitted. It selects and sets an additional Path aggregated to the currently used Paths from available Paths indicated by Bandwidth Coordination Control. It sends a packet over a selected Path from available Paths.	None
				Path Aggregation Control in SRF aggregates multiple Paths according to radio link quality or amount of data to be transmitted. It selects and sets an additional Path aggregated to the currently used Paths from available Paths indicated by Bandwidth Coordination Control. There is no explanation on Path in IEC 62657-4.	Not match.

SRF					IEC 62657-4	
ID	Function classification	Function name	Detail function name	Description of function	Function name	Description of function
352			Channel Mirroring Control	The function is to send duplicated copies of a packet over multiple Channels. It selects available Channels indicated by Bandwidth Coordination Control. Channel Mirroring Control on the other side of communication network (the receiver) receives identical packets via different Channels. The receiver forwards only one packet to the destination from the identical packets and drops the others. When the sender copies the packets, it attaches sequence numbers to the packets so that the receiver can identify them.	None	None
						Reasons for matching/not-matching Not match. Channel Mirroring Control in SRF sends duplicated copies of a packet over multiple Channels. There is no explanation on monitoring in IEC 62657-4.
353			Path Mirroring Control	The function is to communicate the same packets over multiple paths.	IEC 62657-1	Path Mirroring Control corresponds to Availability and reliability on the following italicized point. <i>In the parallel operation, messages are transmitted via all available redundant paths. The receiving end node selects one of the received messages.</i> (See IEC 62657-1: 2017, 5.3.9.)
						Not match. Path Mirroring Control in SRF sends duplicated copies of a packet over multiple Paths. It selects Paths from the available Paths indicated by Bandwidth Coordination Control. The concept is provided in IEC 62657-1 but not in the architecture of IEC 62657-4.

SRF				IEC 62657-4		
ID	Function classification	Function name	Detail function name	Description of function	Function name	Description of function
354			Channel Combining Control	The function is to communicate encoded packets over multiple Channels. (error correction)	None	Not match. Channel Combining Control in SRF encodes some packets for error correction and distributes the encoded packets to multiple Channels. There is no explanation in IEC 62657-4.
355			Path Combining Control	The function is to communicate encoded packets over multiple paths. (error correction)	None	Not match. Path Combining Control in SRF encodes some packets for error correction and distributes the encoded packets to multiple Paths. There is no explanation in IEC 62657-4.
361	Radio Resource Coordination Control	Flow Control	Ingress Rate Control	The function is to measure radio link quality and current performance of each data flow. Then it determines data flow. Then it determines data receiving speed of each data flow based on Queue length in Radio Resource Control Policy. Subsequently, it controls data receiving speed of each data flow.	None	Not match. Ingress Rate Control in SRF measures radio link quality and current performance of each data flow. Then it determines data receiving speed of each data flow based on Queue length in Radio Resource Control Policy. In IEC 62657-4, the unit of data throughput in performance parameter type (see 3.3.11) is bit/s so it can be said that it manages the values on the speed. However, whether it controls or not cannot be confirmed.
362			Adaptive Packet Aggregation	The function is to guarantee tolerable delay by changing frame aggregation settings.	None	Not match. In SRF, Adaptive Packet Aggregation guarantees tolerable delay by changing frame aggregation settings. There is no explanation in IEC 62657-4.

SRF					IEC 62657-4		
ID	Function classification	Function name	Detail function name	Description of function	Function name	Description of function	Reasons for matching/not-matching
370	Radio Resource Coordination Control	Delay Coordination Control	—	The function is to perform delay control among multiple wireless systems to guarantee tolerable delay.	CMWCA/CMWD	Radio Resource Coordination Control corresponds to CMWCA/CMWD on the following italicized points. <i>The SetDwellTime service primitive is a set of primitives for supporting control CMWCA and CMWD from the CCP.</i> Table 32 SetDwellTime service parameter Argument: The argument contains the parameters of the service request. Destination address: This parameter specifies the destination address to which the service request is to be sent. System or device ID: This parameter specifies the identifier of the CMWCA or CMWD entity ID. <i>Dwell time: This parameter specifies the dwell time.</i> (See 8.4.7.1.)	Match. In SRF, Delay Coordination Control performs delay control among multiple wireless systems to guarantee tolerable delay. In IEC 62657-4, SetDwellTime has a similar function as Dwell Time in SRF. In SRF, a parameter indicates Dwell Time.
380	Radio Resource Coordination Control	Retransmission Control	—	The function is to control the number of frame retransmission in accordance with wireless communication environment.	CCP	Retransmission Control corresponds to CCP on the following italicized point. The CCP can control the radio parameters for coexistence control in Table 5. <i>Parameter name: Maximum number of retransmissions</i> Description: Maximum number of retransmissions per wireless device (See 7.3.)	Match. In SRF, Retransmission Control has a function to control the number of frame retransmissions in accordance with wireless communication environment. This receives the maximum number of retransmissions from Delay Coordination Control in Field Manager. In IEC 62657-4, CCP's coexistence management has a similar function as maximum number of retransmissions. In SRF, a parameter is used to set a maximum number of retransmissions.

SRF					IEC 62657-4	
ID	Function classification	Function name	Detail function name	Description of function	Function name	Description of function
390	Radio Resource Coordination Control	Rate Control	—	The function is to enable SRF Gateway and SRF Devices to conduct adjustment of adaptive rate based on maximum rate in Radio Resource Control Policy. It restricts adaptive rate to reduce retransmission.	None	—
						Not match. In SRF, Rate Control is a function for SRF Gateway and SRF Device to conduct adjustment of adaptive rate based on maximum rate in Radio Resource Control Policy. In IEC 62657-1 "Use case 1 – Safety of workers around transporting machines" has some requirements as below. However, these are generalized requirements so there are no functions matched. In order to meet the required safety levels, such as the SIL levels specified in the IEC 61508 series, the bit error rate should be less than a certain level depending on the residual error rate of the error detection mechanism. Enough immunity against EMI is necessary for the communication system to keep the bit error rate below the acceptable level.

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SRF					IEC 62657-4	
ID	Function classification	Function name	Detail function name	Description of function	Function name	Description of function
400	Data Attributes Control	Data Attributes Control	—	The function is to change Data Attributes dynamically.	IEC 62657-2	Data Attributes Control corresponds to Mechanism for adaptivity on the following italicized point. <i>One or more mechanisms for adaptivity can be used to modify one or more of a system's operational parameters in order to improve a system's robustness against interferences and to minimize medium utilization factor. Adaptive communication mechanisms can use automatically feedback information obtained from a system itself or from the signals carried by a system to modify dynamically a system's operational parameter. It is also possible to plan the operational parameters in advance and configure the systems appropriately.</i> Mechanisms for adaptivity are as follows: • detect and avoid (DAA): if the channel is occupied, change the channel (for example AFH); • detect and suppress (DAS): if the channel is occupied, don't transmit (for example listen before talk); • detect and reduce (DAR): if the channel is occupied, reduce the output power and/or channel usage. <i>Depending on how many systems are using mechanisms for adaptivity and which parameter they adapt, these measures can help improving coexistence or can lead to unstable and unreliable system behaviour.</i> (IEC 62657-2:2025, 5.34)
						Reasons for matching/not-matching Match: In SRF, in Data Attributes Control, SRF Gateway and SRF Devices requires the new Data Attributes to Field Manager, then, Field Manager notifies SRF Gateway and SRF Devices of Data Attributes. After that, SRF Gateway and SRF Devices updates Data Attributes as requested by Field Manager. In IEC 62657-4, CCP's coexistence management has a similar function since mechanism for adaptivity has a function to change parameters in order to improve coexistence.

SRF					IEC 62657-4		
ID	Function classification	Function name	Detail function name	Description of function	Function name	Description of function	Reasons for matching/not-matching
500	Radio Monitoring	Radio Link Quality Monitoring	—	The function is to generate SRF Wireless Set Information consisting of communication information on wireless systems and quality information of the radio link at SRF Gateway and SRF Devices. It obtains SRF Wireless Set Information from SRF Gateway and SRF Devices. The command issue cycle can be changed by Field Manager.	CCP	Radio Link Quality Monitoring corresponds to CCP on the following italicized points. <i>The CCP can provide assistance for radio network coexistence via the transmission of context information such as quality of service, priority of service, etc. and measurement results. The CCP also can enable control for multiple WCA. (See 5.4.3.)</i>	Match. In SRF, Radio Link Quality Monitoring generates SRF Wireless Set Information consisting of communication information on wireless systems and quality information of the radio link at SRF Gateway and SRF Devices. In IEC 62657-4, CCP has a similar function since it provides assistance for radio network coexistence via the transmission of context information such as quality of service, priority of service, etc. and measurement results.
502	Radio Monitoring	Radio Channel Usage Efficiency Monitoring	—	The function is to generate frequency utilization efficiency for all various wireless systems based on information from SRF Sensors.	Spectrum sensing system	The spectrum sensing system (SSS) is a combination of dedicated spectrum sensing nodes (SSN) and embedded spectrum sensing functions (SSF) integrated into the wireless devices for automation applications. The SSS shall continuously provide medium utilization information to the CCP. The SSS observes the relevant frequency bands in and around the environment of the local industrial premises to determine the occurrence of wireless applications including incumbent radio systems. This process is called sensing and takes into account parameters of the radio channel, of the known wireless applications, of the automation application, and of the environment.	Match. Radio Channel Usage Efficiency Monitoring in SRF generates frequency utilization efficiency for all various wireless systems based on information from SRF Sensors. In IEC 62657-4, Spectrum Sensing System (SSS) has a similar function in terms of monitoring channel use status.

SRF					IEC 62657-4		
ID	Function classification	Function name	Detail function name	Description of function	Function name	Description of function	Reasons for matching/not-matching
503	Radio Monitoring	Radio Link Monitoring for DoA	—	The function is to generate DoA Estimation Information that indicates the location of wireless equipment and direction of arrival of radio waves.	CCP	Radio Link Monitoring for DoA corresponds to CCP on the following italicized points. "The policy engine (PE) is a management function and an entity of CCP. The PE centralizes all location-dependent radio regulation restrictions and limitations about the used frequency ranges. The PE shall be responsible for: • maintaining regulatory requirements, restrictions, and limits regarding the geographical location, as well as the range of frequencies used by the wireless systems and wireless devices for automation applications; • establishing a wired or wireless communication to the regulation database containing geolocation limit of radio spectrum regulation. (See 5.2.2.4.)"	Match. Radio Link Monitoring for DoA (Direction of Arrival) in SRF generates DoA Estimation Information that indicates the location of wireless equipment and direction of arrival of radio waves. IEC 62657-4 has a similar function since it maintains regulatory requirements, restrictions and limits regarding the geographical location, as well as the range of frequencies used by the wireless systems and wireless devices for automation applications.
504	Radio Monitoring	Application Stream Information Monitoring	—	The function is to monitor the measured values of rate, delay and loss for each Application Stream, which are reported to Field Manager for updating.	None	None	Not match. Application Stream Information Monitoring in SRF monitors the measured values of rate, delay and loss rate for each Application Stream, which are reported to Field Manager for updating. There is no explanation in IEC 62657-4.
700	Mobility Control	Handover	—	The function is to transmit data to high quality wireless Path when connecting with multiple APs simultaneously.	None	—	Not match. The general handover changes associated SRF Gateway to keep the wireless link with higher quality. The seamless handover changes associated SRF Gateway while keeping the background wireless link with higher quality when SRF Device establishes links with multiple SRF Gateways. There is no explanation in IEC 62657-4.

SRF					IEC 62657-4	
ID	Function classification	Function name	Detail function name	Description of function	Function name	Description of function
701	Mobility Control	Setting Parameters Control for Handover	—	The function is for dynamic change of switching policy of various handover parameters.	None	—
Reasons for matching/not-matching						
					Not match.	Setting Parameters Control for Handover in SRF changes handover parameters adapting to radio link quality and a communication environment. It determines the handover parameters based on quality information of the wireless links and an RSSI threshold. There is no explanation in IEC 62657-4.
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D.4.3 Parameters

The SRF Wireless Platform uses more parameters than those described in IEC 62657-2 or IEC 62657-4. For the implementation of wireless coexistence management, the parameters given in Table D.4 could be the reference.

Table D.4 – Correspondence list of parameters of SRF Wireless Platform and IEC 62657-4

Services described in IEC 62657-4	SRF			IEC 62657-4		Reasons for matching/not-matching
	Message	Parameters	Description	Parameters	Description	
	wlanInfo	srfgwld	Identification of SRF Gateway	Wireless ID	Identifier of requested wireless system or wireless device.	Matched in terms of identifying the target object
NotifyMediumResource		timestamp	UNIX timestamp [sec]	—	—	No parameters matched in IEC side
		measurmentDuration	Duration how long the SRF Gateway or Device measure cumulative parameters, e.g. number of packets [sec]	—	—	No parameters matched in IEC side
		communicationInterfaces	I/F type: "IEEE802.11a", "IEEE802.11b", "IEEE802.11g", "IEEE802.11n", "IEEE802.11ac", "IEEE802.11ax", "Bluetooth", "ble", "subghz", "licensedBand"	—	—	No parameters indicating certain communication standards in IEC side

Services described in IEC 62657-4	SRF			IEC 62657-4		Reasons for matching/not-matching
	Message	Parameters		Description	Parameters	
			name	Physical I/F name	—	No parameters indicating I/F type in IEC side
		mode		Operation mode: "AP" or "STA"	—	No parameters requiring AP or STA
		ssid		BSSID [HEX]	—	No parameters indicating Service Set Identifier
		essid		ESSID	—	No parameters indicating Service Set Identifier
		address		MAC address to communicate this interface [HEX]	—	No parameters indicating MAC address
		deviceName		Device name	—	No parameters indicating device name
		companyID		Bluetooth company ID	—	No parameters matched
		afh		Channel Map	—	No parameters indicating Channel map
		channel		Current Channel number	—	No parameters indicating Channel
		occupancy		Channel occupancy rate [%]	—	No parameters indicating Channel occupancy rate
		bssColor		BSS color	—	No parameters indicating Service Set Identifier
		linkInfos	address	MAC address to communicate this interface [HEX]	—	No parameters indicating MAC address
			phyType	Link phy type (only AP)	—	No parameters indicating phyType
			bandwidth	Channel bandwidth	—	No parameters indicating bandwidth
			currentRate	Current transmission data rate of modulation and coding [kbps]	—	No parameters indicating MAX communication speed in current wireless conditions (RSSI, wireless standards)
			rssi	RSSI [dBm]	RSSI mean	Both indicating received signal's strength
					Received signal strength indication mean.	

Services described in IEC 62657-4	SRF			IEC 62657-4		Reasons for matching/not-matching
	Message	Parameters	Description	Parameters	Description	
				RSSI standard	Received signal strength indication standard deviation.	
				—	—	Both indicating received signal's strength
		State	Connection status	—	—	No parameters indicating connection status
		txPacket	Number of packets sent	—	—	No parameters indicating txPacket
		txByte	Number of bytes sent	—	—	No parameters indicating txByte
		rxPacket	Number of packets received	—	—	No parameters indicating rxPacket
		rxByte	Number of bytes received [Byte]	—	—	No parameters indicating rxByte
		txFailed	Number of transmission failures	—	—	No parameters indicating txFailed
		txError	Tx error rate [%]	Message loss ratio	Ratio of number of packets of messages, transferred from the Application at the reference interface within the producer, and the number of messages, transferred at the reference interface to the application within the consumer.	Both indicating ratio of packets that fail to be transmitted
		txRetry	Number of retry packets	—	—	No parameters indicating txRetry
		vendorKey	Vendor option	—	—	No parameters indicating Vendor key
		vendor	Vendor name	—	—	No parameters indicating vendor name
		syncFlag	Time synchronization status	—	—	No parameters indicating time synchronization

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D.4.4 Message format

The parameters are described in the message body using the Java Script Object Notation (JSON) format.

"Interface between field manager and SRF Device" is the main communication between "Field Manager" and "SRF Device" to realise wireless coexistence management. The following Table D.5 shows the message structure in case parameter is "capability" as a concrete example.

Table D.5 – Examples of JSON Format

JSON format	Description
<pre>{ "srfgwld": "YourSrfGwld", "timestamp": 1569855600, "activeFlag": "Active", "capability": { "srfVersion": 1, "srfSupportVersions": [1, 2], "communicationInterfaces": [{ "ifInfo": { "ifType": "IEEE802.11n", "name": "wlan0" }, "address": "02004CAABBFF", "channels2ghz": [1, ..., 14], "channels5ghz": [36, 40, ..., 140], "channelsSubghz": [1, ..., 5, 24, ..., 61], "antennaSpec": { "antType": "planar-2x2", "space": 5, "theta3db": 30, "direction": 0 }, "txPower": { "max": 20, "min": 1, "step": 1 }, "multiStreamsUplink": 4, "multiStreamsDownlink": 4, "bandwidths": ["20", "40", "80", "160", "26tone", "52tone", "106tone", "242tone", "484tone", "996tone"], </pre>	Identification of SRF Gateway/Device. UNIX timestamp [sec] Active Flag: "Active" or "Deactive". Capability of SRF Gateway/Device. Lowest supported SRF Wireless Platform specification version. All of supported SRF Wireless Platform specification versions (*9). Physical I/F type: "IEEE802.11a", "IEEE802.11b", "IEEE802.11g", "IEEE802.11n", "IEEE802.11ac", "IEEE802.11ax", "Bluetooth", "ble", "subghz", "licensedBand" or "5G". Physical I/F name MAC address [HEX] Available Channels of 2 GHz Available Channels of 5 GHz Available Channels of subghz Antenna type: "linear-Na" or "planar-Na × Nb" (*2). Antenna element spacing [cm]. 3 dB beamwidth of antenna element in horizontal plane [deg] Antenna orientation in horizontal plane [deg] (*3). Maximum transmission power [dBm]. Minimum transmission power [dBm] Setting step [dB] Maximum number of MIMO streams for uplink (*4). Maximum number of MIMO streams for downlink (*4). Frequency Bandwidths [MHz] (*5).

JSON format	Description
<pre> "giTypes": [0.4, 0.8, 1.6, 3.2], "tdmaSlot": 100000, "aggregations": ["A-MPDU"] "bssColor": true }, { "ifInfo": { "ifType": "Bluetooth", "name": "hci0" }, "version": "2.1+EDR", "class": 1, "profile": ["SPP", "PAN"] } { "ifInfo": { "ifType": "Ethernet", "name": "ethernet0" }, "address": "02004CAABBFF", }], "controlFunctions": { "dynamicChannelSelection": true, "pathControl": true, "licensedBandSelection": true, "5gControl": true, "scheduling": true, "timeSynchronization": true, "contentionWindowControl": true, "antennaDirectivityControl": true, "sectorizationControl": true, "powerControl": true, "multiHopControl": true, "channelAggregationControl": true, "pathAggregationControl": true, "channelMirroringControl": true, "pathMirroringControl": true, "channelCombining": true, "pathCombining": true, "adaptiveFlowControl": true, "ingressRateControl": true, "adaptivePacketAggregation": true, "retransmissionControl": true, </pre>	Guard intervals (*6) TDMA timeslot for Scheduling control [μsec] Frame aggregation: "A-MPDU", "A-MSDU" BSS color: true or false Physical I/F type: "Bluetooth" or "ble" Physical I/F name Bluetooth version: "1.0b", "1.1", "1.2", "2.0+EDR", "2.1+EDR", "3.0+HS", "4.0LE" or "5.0" Bluetooth class: 1, 1.5, 2 or 3 Bluetooth profile. Any profile defined for Bluetooth can be specified. Physical I/F type: "Ethernet" (*10) Physical I/F name (*10) MAC address [HEX] (*10) Control function compatibilities true or false (*7) true or false true or false true or false (*10) true or false true or false true or false (*9) true or false true or false true or false (*7) true or false (*10) true or false true or false true or false true or false true or false true or false (*1) true or false true or false

JSON format	Description
<pre> "rateControl": true, "dataAttributesControl": true, "radioLinkQualityMonitoring": true, "radioLinkQualityMonitoringLte": true, "radioLinkQualityMonitoringNr": true, "applicationStreamInformationMonitoring": true, "radioLinkMonitoringForDoA": true, "handover": true, "settingParametersControlForHandover": true }, "timeSyncMethods": ["NTP", "PTP"], "optDataAttrCntrlTypes": ["L2", "L3"], "maxDevice": 100, "numberOfServiceType": 1, "vendorOption": { "vendorKey": "example", "vendor": { "key": "example" } } } </pre>	true or false true or false true or false (*8) true or false (*1) true or false (*10) true or false (*10) true or false true or false true or false true or false Supported synchronization method: "NTP" and/or "PTP" (*11) Supported optional type of Data Attributes Control for U-Plane: "L2" and/or "L3" (*11) Maximum number of SRF Devices associated to one SRF Gateway The number of kinds of SRF Service Type: N is 1, 2, ..., 32 Vendor option Example of vendor option. "vendor" in the key should be a vendor name.
Key: (*1) "false" shall not be specified because of mandatory functions. However, "false" may be specified by U-plane anchor. (*2) "linear-Na" means linear array antenna with Na antenna elements and "planar-Na×Nb" means planar array antenna with Na×Nb antenna elements. (*3) The direction of zero in SRF Gateways/SRF Devices should be same with the direction in Field Manager in advance. (How to set the axes of space coordinates is out of the scope of the specifications.) (*4) Applied to IEEE Std 802.11n, IEEE Std 802.11ac and IEEE Std 802.11ax. (*5) "Tone" may be used for OFDMA of IEEE Std 802.11ax. (*6) The number 0.4 is used only for IEEE Std 802.11ac. (*7) "false" shall not be specified by SRF Gateway because of mandatory functions. However, "false" may be specified by U-plane anchor. (*8) "false" shall not be specified because of mandatory functions. However, "false" may be specified either when U-plane anchor is used, or when "ifType" is "Bluetooth", "ble", and "subghz". (*9) "false" shall not be specified by SRF Gateway because of mandatory functions. However, "false" may be specified either when U-plane anchor is used, or when "ifType" is "Bluetooth", "ble", and "subghz". (*10) In case of "srfVersion" is 1, they are not notified. (*11) If the functions are not supported, fill "null".	

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INTERNATIONAL STANDARD

NORME INTERNATIONALE

**Industrial networks – Coexistence of wireless systems –
Part 4: Coexistence management with central coordination of wireless
applications**

**Réseaux industriels – Coexistence des systèmes sans fil –
Partie 4: Gestion de coexistence avec coordination centralisée des applications
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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**INDUSTRIAL NETWORKS –
COEXISTENCE OF WIRELESS SYSTEMS –****Part 4: Coexistence management with central coordination
of wireless applications****FOREWORD**

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IEC 62657-4 has been prepared by subcommittee 65C: Industrial networks, of IEC technical committee 65: Industrial-process measurement, control and automation. It is an International Standard.

This second edition cancels and replaces the first edition published in 2022. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition.

- a) The data item (parameter) to be exchanged between CCP and CMWCA and CMWD to ensure interoperability between CCP providers and device providers.
- b) The sequence of services conducted between CCP and CMWCA and CMWD are now defined. When the CCP providers and the device providers implement similar process, clearly defined sequence and unified execution specifications ensure interoperability as expected.
- c) The message formats of sequence diagram to be exchanged between CCP and CMWCA and CMWD are defined. By defining the message formats, the hierarchical structure of each data (parameter), and implementing the same message format by the CCP provider and the device provider, enables to exchange data correctly and ensure interoperability.

The text of this International Standard is based on the following documents:

Draft	Report on voting
65C/1330/FDIS	65C/1338/RVD

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

A list of all parts in the IEC 62657 series, published under the general title *Industrial networks – Coexistence of wireless systems*, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn, or
- revised.

INTRODUCTION

The IEC 62657 series provides background, foundations, process and examples to achieve wireless coexistence. With a coexistence management process according to IEC 62657-2, a predictable assuredness of coexistence can be achieved for a given spectrum while ensuring that application requirements continue to be met. The present document provides an automated coexistence management.

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INDUSTRIAL NETWORKS – COEXISTENCE OF WIRELESS SYSTEMS –

Part 4: Coexistence management with central coordination of wireless applications

1 Scope

This part of IEC 62657 specifies a concept and methods for central coordination (CC) of automation applications using wireless communications to extend the coexistence management according to IEC 62657-2. It establishes system elements, interfaces and relationships for a central coordination. Functions, data, and data exchange for assessing and maintaining the coexistence state are specified.

This document specifies the central coordination point (CCP) approach as one example of the usage of the formal description given in IEC 62657-3.

This document is applicable to develop, implement, or modify procedures or solutions.

This document provides requirements for automated coexistence management systems.

This document provides requirements for:

- determination of the coexistence state,
- automated coexistence management procedures,
- CC amendments for existing wireless communication solutions,
- CC functions that coordinate legacy and new wireless communication systems,
- CC sequences and message formats for data exchange.

This document is not restricted to a specific radio frequency range nor is it restricted to a specific wireless communication technology.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes the requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 62657-2:2025, *Industrial networks – Coexistence of wireless systems – Part 2: Coexistence management*¹

ISO/IEC 10731, *Information technology – Open Systems Interconnection – Basic Reference Model – Conventions for the definition of OSI services*

IETF RFC 8259, Tim Bray, *The JavaScript Object Notation (JSON) Data Interchange Format*, available at [RFC 8259 – The JavaScript Object Notation \(JSON\) Data Interchange Format \(ietf.org\)](https://www.rfc-editor.org/rfc/rfc8259) [viewed 2024-09-03]

¹ Under preparation. Stage at the time of publication: IEC/FDIS 62657-2:2024.

3 Terms, definitions, abbreviated terms and conventions

3.1 General

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- IEC Electropedia: available at <https://www.electropedia.org/>
- ISO Online browsing platform: available at <https://www.iso.org/obp>

3.2 Terms and definitions specific for this document

3.2.1

allocation

entry in the table of frequency allocations of a given frequency band for the purpose of its use by one or more radio communication services or the radio astronomy service under specified conditions

3.2.2

antenna

device designed to transmit or receive electromagnetic waves

3.2.3

coexistence distance

difference between the threshold value for the coexistence state and the actual value of the coexistence state function expressing the distance before reaching the coexistence state

3.2.4

coexistence margin

difference between the actual value of the coexistence state function and the threshold for the coexistence state expressing the reserve before leaving the coexistence state

3.2.5

database service

service officially operated under the rules of the local regulatory authority that provides a list of available channels and possibly the maximum EIRP allowable on these channels based on queries containing the geolocation of the wireless regional area network (WRAN) devices

3.2.6

geolocation

process of acquiring the location data of a device, determining its latitude and longitude

3.2.7

harmful interference

any emission, radiation or induction that endangers the functioning of a radio navigation service or of other safety services or seriously degrades, obstructs, or repeatedly interrupts a radiocommunications service operating in accordance with the ITU and local regulations

3.2.8

incumbent radio system

wireless communication system that is not under the control of, and is not affected by, the coexistence manager

3.2.9

master station

data station that has been designated by the control station to ensure data transfer to one or more slave stations

Note 1 to entry: At a given instant, there can be only one master station on a data link.

[SOURCE: IEC 60050-721:1991, 721-19-12]

3.2.10

service flow

QoS parameters for the PDUs that are exchanged on a connection, and provide a mechanism for upstream and downstream QoS management

3.2.11

service flow identifier

SFID

unique identifier for a service flow dealing with how higher layer packets/application sessions are mapped to their QoS requirements and scheduling constraints

3.2.12

slave station

data station that is selected by a master station to receive data

3.2.13

spectrum sensing system

SSS

combination of dedicated spectrum sensing nodes (SSN) and embedded spectrum sensing functions (SSF) integrated into the wireless devices for automation applications

3.3 Additional terms and definitions for the templates

3.3.1

array of frequency

collected values from sensing start frequency to sensing end frequency during the sensing process

3.3.2

array of power spectral density

collected values of power spectral density from sensing start frequency to sensing end frequency during the sensing process

3.3.3

CCP address

communication partner identification of the central coordination point for a service

3.3.4

coexistence assessment

process of evaluating wireless communication coexistence

3.3.5

communication link ID

identifier (ID) as part of the response of a service execution related to the communication link

3.3.6

destination address

communication partner identification for a service

3.3.7**limits of performance parameter**

value returned with the limit for a performance parameter

3.3.8**medium sensing report type**

requested type of information related to the generation type of medium resource report

Note 1 to entry: The type is represented by a number with the following code: 1: Event driven; 2: Cyclic; 3: Requested.

3.3.9**parameter ID**

identifier (ID) of a parameter that is specified by a standard or vendor and identifies the parameter whose value is returned

3.3.10**parameter value**

value of the parameter to be returned

3.3.11**performance parameter type**

requested type of information related to a communication link ID

Note 1 to entry: The type is represented by a number with the following code: 1: Transmission time; 2: Update time; 3: Response time; 4: Data throughput; 5: Communication availability.

3.3.12**radio regulation database ID**

identifier (ID) of the radio regulation database

3.3.13**received signal strength indication****RSSI**

value of the power present in a received radio signal

3.3.14**received signal strength indication mean****RSSI mean**

mean value of the power present in a received radio signal

3.3.15**received signal strength indication standard deviation****RSSI standard deviation**

standard deviation value of the power present in a received radio signal

3.3.16**report interval**

interval time of cyclic reports

Note 1 to entry: This belongs to the cyclic "medium sensing report type".

3.3.17**sensing duration**

parameter specifying the duration of a sensing process

3.3.18**sensing end frequency**

parameter specifying the stop frequency of sensing

3.3.19

sensing interval

parameter specifying the interval between sensing processes

3.3.20

sensing start frequency

parameter specifying the start frequency of sensing

3.3.21

service status

parameter that provides information on the result of service execution

Note 1 to entry: The service status can be either ABORTED or TIMEOUT.

3.3.22

SINR

signal to interference plus noise ratio

value of the power of a certain signal of interest divided by the sum of the interference power from all the other interfering signals and the power of some background noise

3.3.23

spectrum sensing entity ID

identifier (ID) of the spectrum sensing entity containing either SSN or SSF

3.3.24

status

parameter that specifies the behaviour of the wireless device concerning configuration by a code

Note 1 to entry: The status is represented by a number with the following code: 0: No address assigned; 1: Unconfigured; 2: Configured.

3.3.25

system address

communication partner identification of the system for a service

3.3.26

Timestamp

information concerning time of collected attribute data

3.3.27

wireless system ID

identifier (ID) as part of a service execution related to the concerned wireless system

3.3.28

wireless ID

identifier (ID) as part of a service execution related to the model of a wireless system or a wireless device

3.4 Terms and definitions given in IEC 62657-2

For ease of understanding, the most important terms from IEC 62657-2 used within this document are listed but the definitions are not repeated in the list.

- antenna type,
- antenna gain,
- antenna radiation pattern
- automation application,

- bandwidth,
- centre frequency,
- coexistence (wireless communication coexistence),
- coexistence planning,
- coexistence management,
- communication load,
- device,
- device type,
- duty cycle,
- dwell time,
- frequency band,
- frequency channel,
- logical link
- lower cut-off frequency,
- mechanisms for adaptivity,
- medium utilization factor
- message,
- number of consecutive lost messages,
- plant,
- power spectral density,
- radio channel,
- signal to interference and noise ratio,
- received signal strength indication,
- receiver sensitivity,
- transfer interval,
- wireless application,
- wireless communication,
- wireless communication application,
- wireless communication solution,
- wireless communication system,
- wireless device,
- wireless network,
- wireless system type,
- total radiated power,
- upper cut-off frequency.

3.5 SRF specific definitions

3.5.1

SRF Wireless Platform

specification of hardware and software architecture for coexistence management

3.5.2

SRF Gateway

managed gateway used for SRF Wireless Platform

3.5.3

SRF Device

managed wireless device used for SRF Wireless Platform

3.5.4

SRF Sensor

sensing node used for SRF Wireless Platform to monitor the radio environment

3.5.5

SRF Wireless Set

group consisting of SRF Gateway and SRF Devices to communicate wirelessly between each other

3.5.6

Non-SRF Wireless Set

wireless devices that are not supporting the SRF Wireless Platform

3.6 Abbreviated terms

ACRM	application communication requirements management
AFH	adaptive frequency hopping
AL	application layer
AP	access point
ble	Bluetooth low energy
CC	central coordination
CCP	central coordination point
CDD	common data dictionary
CMWCA	CCP managed wireless communication application
CMWD	CCP managed wireless device
CONF	confirmation
CS	convergence sublayer
C-SAP	control service access point
DAA	detect and avoid
DAR	detect and reduce
DAS	detect and suppress
DoA	direction of arrival
EIRP	equivalent isotropic radiated power
HMI	human machine interface
ID	identifier
IETF	Internet engineering task force
IND	event notification
IP	Internet protocol
ISM	industrial, scientific and medical
JSON	JavaScript object notation
LAN	local area network
MAC	medium access
MLME	medium access layer management entity
MRM	medium resource management

M-SAP	management service access point
PE	policy engine
PHY	physical layer
PLC	programmable logic controller
PLME	physical layer management entity
PSD	power spectral density
QoS	quality of service
REQ	request
RES	response to the request message
RF	radio frequency
RSSI	received signal strength indication
SAP	service access point
SDU	service data units
SFID	service flow identifier
SINR	signal to interference plus noise ratio
SSF	spectrum sensing function
SSN	spectrum sensing node
SSS	spectrum sensing system
STA	station
WCA	wireless communication application
WCD	wireless communication device
WCS	wireless communication system
WCSDCC	wireless communication system and device configuration and control
WCSDS	wireless communication system and device subscription
WIA	wireless industrial automation
WSAN	wireless sensor actuator network

3.7 Conventions used for service descriptions

This document uses the descriptive conventions given in ISO/IEC 10731.

The service model and service primitives used are entirely abstract descriptions; they do not represent a specification for implementation.

Service primitives, used to represent service user/service provider interactions (see ISO/IEC 10731), convey parameters that indicate information available in the user/provider interaction.

The parameters that apply to each group of primitives are set out in tables throughout the remainder of this document. Each table consists of five columns, containing the name of the service parameter, and a column each for those primitives and parameter-transfer directions used by the service:

- the request primitive's input parameters;
- the indication primitive's output parameters;
- the response primitive's input parameters, and
- the confirm primitive's output parameters.

One parameter (or part of it) is listed in each row of each table. Under the appropriate service primitive columns, a code is used to specify the type of usage of the parameter on the primitive and parameter direction specified in the column:

M	parameter is mandatory for the primitive.
U	parameter is a user option and may or may not be provided depending on the dynamic usage of the service user. When not provided, a default value for the parameter is assumed.
S	only one parameter in a group of parameters using this code is required.
C	parameter is conditional upon other parameters or upon the environment of the service user.
CU	parameter is a conditional user option, and may or may not be permitted depending upon other parameters or upon the environment of the service user. When permitted, it may or may not be provided depending on the dynamic usage of the service user. When permitted and not provided, a default value for the parameter is assumed.
(blank)	parameter is never present.

In this document the service message formats are described using JSON notation according to IETF RFC 8259.

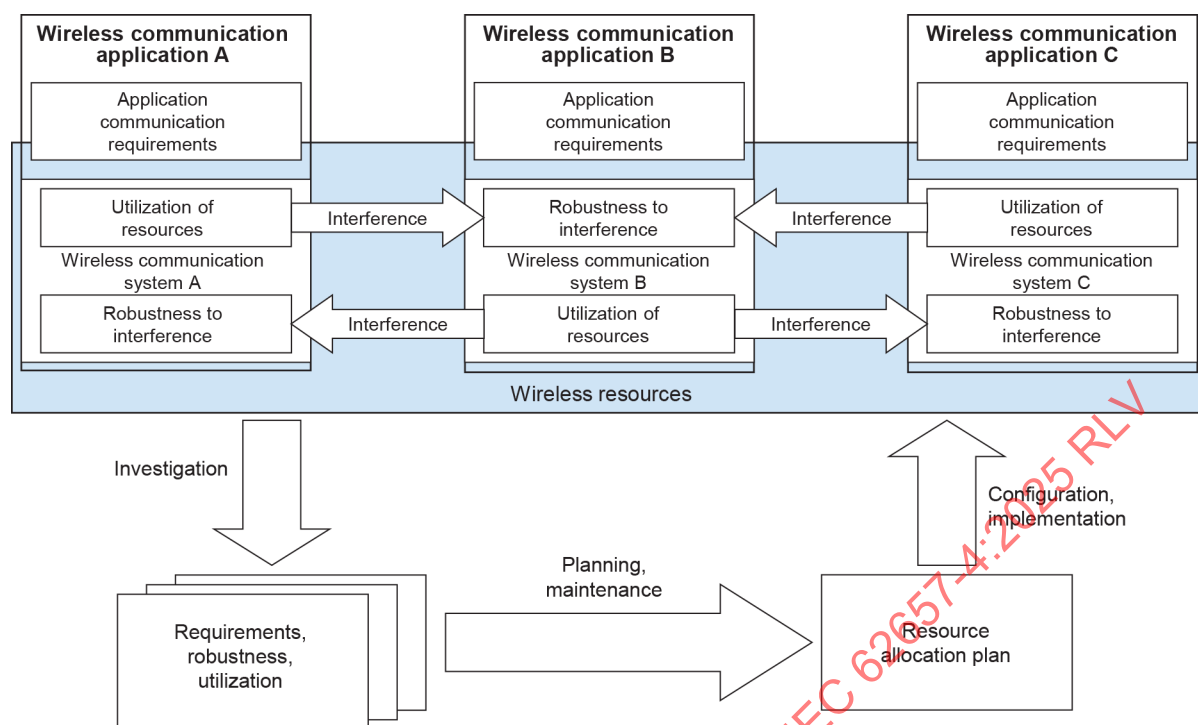
4 Area of consideration

4.1 Coexistence conceptual model

In Figure 1, the coexistence conceptual model, described in IEC 62657-2, is shown. In this example, three wireless communication applications – A, B and C are assumed. According to the definition of wireless coexistence, all three wireless communication applications shall fulfill their application communication requirements. One part of the wireless communication application (WCA) A is a selected wireless communication system (WCS) A. It uses the wireless resources for communication and can interfere with other WCS, e.g. WCS B. WCS B can be of the same wireless technology or of another one. Each WCS is characterized by a certain robustness against interference. Thus, not every interference leads to errors in communication or to application failures.

Coexistence management requires the investigation of the coexistence state throughout the entire life cycle of the system. This requires that measurements be taken to determine whether all wireless communications applications are fulfilling their application communications requirements.

An investigation of the application communication requirements and the characteristics of the wireless system (immunity and utilization) shall be reported in an inventory. The resulting coexistence planning shall be reported in a resource allocation plan. This shall be the basis for implementing the radio resources and their utilization.



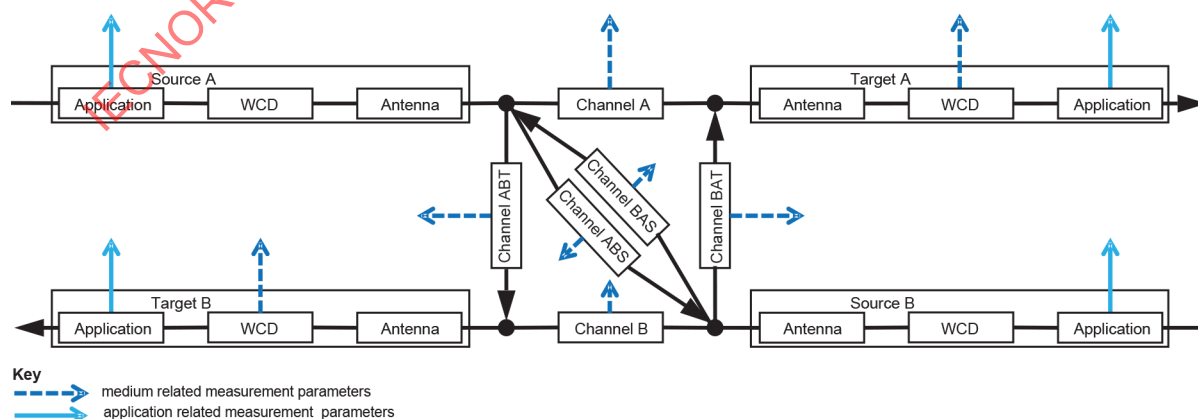
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Figure 1 – Wireless coexistence conceptual model according to IEC 62657-2

4.2 Investigation of coexistence state

An essential task for coexistence management is to calculate and to evaluate the coexistence state. With respect to the definition of the term coexistence, in addition to spectrum parameters (e.g. frequency channel or power spectral density), application related characteristic parameters (e.g. transmission time) are also required to calculate the coexistence state.

Figure 2 is intended to show where relevant parameters can be determined. The figure shows a scenario with two WCA (A and B) with one logical link per WCA. Messages of a distributed application are transferred via the source device, transmitter antenna, radio channel, receiver antenna, and target device to the target of the distributed application. Interferences can occur from the source antenna of one WCS to the antennas of the other WCS. These interferences are influenced by the radio channel characteristic between the relevant antennas. Table 1 lists the relevant radio channels of the scenario shown in Figure 2.



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Figure 2 – Sources to determine parameters for coexistence state calculation

Table 1 – Explanations of radio channels

Radio channel	Explanation
Channel A	Active environmental influences for transmissions from source A to target A
Channel ABT	Active environmental influences for interferences from source A to target B
Channel ABS	Active environmental influences for interferences from source A to source B
Channel B	Active environmental influences for transmissions from source B to target B
Channel BAT	Active environmental influences for interferences from source B to target A
Channel BAS	Active environmental influences for interferences from source B to source A

Relevant parameters can be determined by:

- spectrum sensing function (e.g. frequency channel);
- source application (e.g. number of transferred messages);
- target wireless communication device (e.g. number of correct received messages);
- target application (e.g. transmission time).

Relevant parameters to determine and assess coexistence are specified in detail in Clause 6. In ECC Report 206, an approach is introduced to holistically assess the dependability of industrial communication. This approach is well-suited to derive a coexistence state function defined as follows.

$\sigma_i(t)$ is the normalized parameter of the characteristic parameter i , according to Clause 6, at time t . Index i with $i = 1 \dots n$ specifies one of n types of characteristic parameters. Factors for normalizing depend on the type of the characteristic parameter and are specified in Clause 6. The parameter $\sigma(t)$ expresses the quality of a logical connection of a WCS at time t .

A weighting factor $u_i(t)$ is introduced with a possible range of 0 to 1. This factor allows to adapt a parameter of type i according to the requirements. While, for example, the transmission time is more relevant for applications with event driven communication, the update time is important to applications with periodic traffic. This can be expressed with $u_i(t)$. The time dependence of this factor considers emerging flexible concepts of industrial automation that could require adaptations of the relevance of different parameter types.

The coexistence state function shall consider all known $k = 1 \dots p$ WCS. The priority of an application that uses WCS k is expressed with the weighting factor $w_k(t)$. Furthermore, the logical links $j = 1 \dots m$ of a WCS should be taken into account. The importance of a logical link is expressed by the weighting factor $v_j(t)$.

Thus, a coexistence state function $\chi(t)$ according to Formula (1) can be defined.

$$\chi(t) = \frac{1}{\sum_{k=1}^p w_k(t)} \times \left(\frac{1}{\sum_{j=1}^m v_j(t)} \times \left(\frac{1}{\sum_{i=1}^n u_i(t)} \times \sigma_i(t) \right) \right) \quad (1)$$

Assuming a threshold χ_{Thr} that specifies the state in which the application communication requirements of all wireless communication applications are fulfilled, the coexistence state can be specified as shown in Formula (2).

$$s(\chi(t) \geq \chi_{\text{Thr}}) = 1 \quad (2)$$

The complementary state of non-coexistence is defined according to Formula (3).

$$s(\chi(t) < \chi_{\text{Thr}}) = 0 \quad (3)$$

The difference of actual value $\chi(t)$ and threshold χ_{Thr} is called coexistence margin (see Formula (4)). The difference of threshold χ_{Thr} and actual value $\chi(t)$ is called coexistence distance (see Formula (5)).

$$\chi_M(t) = \chi(t) - \chi_{\text{Thr}} \quad (4)$$

$$\chi_D(t) = \chi_{\text{Thr}} - \chi(t) \quad (5)$$

A coexistence state function with its main values is shown as an example in Figure 3.

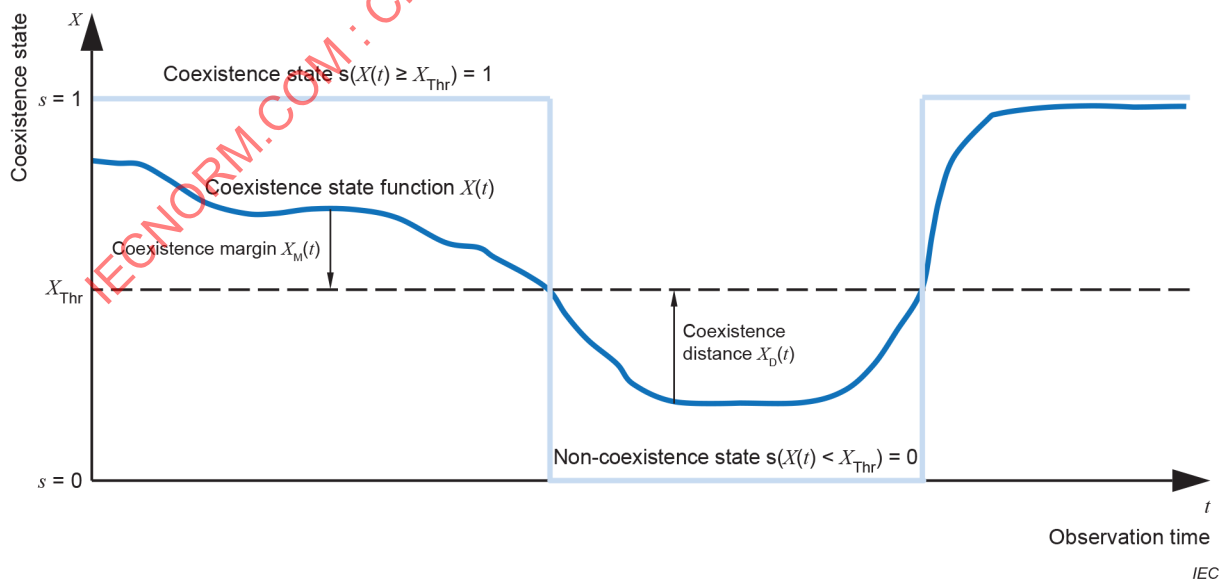


Figure 3 – Coexistence state function

The coexistence state function can be used to assess the level of coexistence and to derive measures to maintain coexistence. The characteristic parameters $\sigma_i(t)$ referred to WCS k and to logical link j offer the possibility to identify weak points within the area of consideration. Based on that algorithm, the central coordination approach is able to derive specific resource allocations.

4.3 Implementing radio resources and their utilization

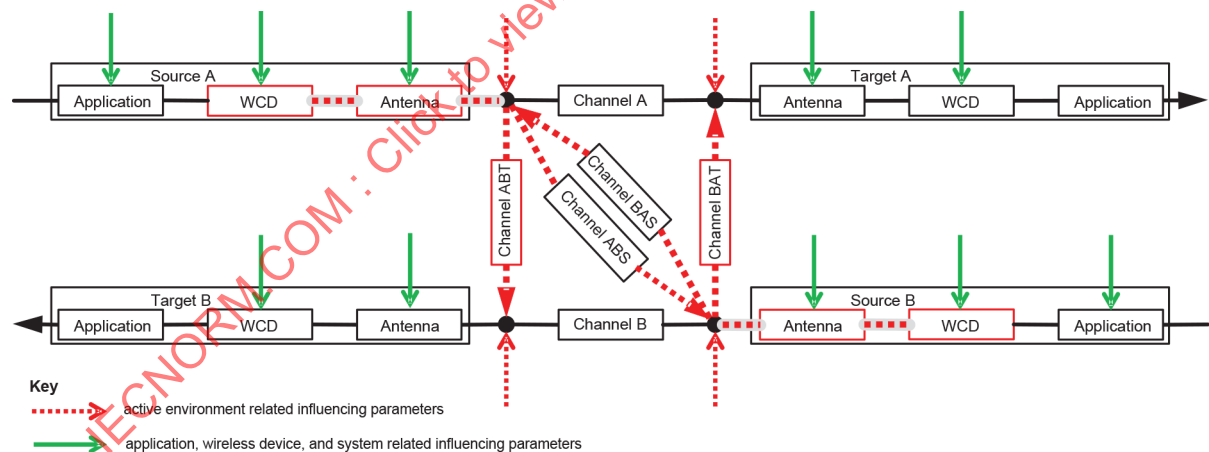
In Figure 4, active environmental influences and targets to control coexistence are depicted. The scenario is the same as in Figure 3. In addition to the mutual interference of both systems, external interferences that cannot be influenced are indicated by dotted arrows. The mutual interference is attenuated by the radio channels ABT, BAS, BAT and ABS (see also Table 1).

Relevant parameters can be controlled by:

- source application (e.g. transfer interval);
- source wireless communication device (e.g. frequency channel);
- antenna type (e.g. beam forming);
- target wireless communication device (e.g. buffer management).

Changing the values of the above-mentioned parameters affects not only the coexistence (fulfilment of the requirements of all applications) but also directly the fulfilment of the requirements of the controlled application. An extension of the transfer interval, for example, can be helpful for other applications, but critical for the controlled application. Controlling the parameters accordingly should therefore be considered.

Relevant parameters to control coexistence are specified in detail in Clause 7. To comply with this document, the WCD shall implement parameters and services that allow the control of coexistence.



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Figure 4 – Parameters describing active influences and control parameters used to manage coexistence

4.4 Coexistence management equipment

In compliance with the area of operation (industrial automation), coexistence management equipment shall be treated throughout the entire life cycle as automation equipment. This applies to the device description (for example field device integration according to the IEC 62769 series, the information exchange and management as well as questions of how much security, intrinsic safety, functional safety, high availability, etc. is needed). For example, a spectrum sensing function will be a vulnerability point in an automated coexistence management system by jamming radio waves. It is recommended to apply the IEC 62443 series for cyber security concerns like denial of service (wireless jamming). In an operational space, there are typically multiple control systems with separate wireless communication systems due to the separation of functionalities and concerns. The automated coexistence management system interacts with the devices of the wireless systems and the control system to receive information and to configure them.

5 Wireless coexistence management system architecture

5.1 General

This document deals with the basic idea of automated coexistence management of wireless communication systems for automation applications with central coordination (CC) of several wireless communication systems within industrial plants. This automated coexistence management with centralized coordination is an example implementation of the class `CoexistenceManagementSystem` described in IEC 62657-3:2022, 5.2. The wireless communication systems can use the same communication technology, called homogenous wireless communication infrastructure or different communication technologies, called heterogeneous wireless communication infrastructure. The aim is to further improve the efficient use of the radio resource. The main idea is to

- deal with wireless devices that can be controlled and take into account devices that cannot be controlled;
- consider available per device mitigation techniques in a central coordination approach;
- stop transmitting radio energy or to activate the per device mitigation technique if central coordination fails;
- ensure the compliance of wireless devices with local regulations by having a central coordination controlling and managing the use of the spectrum in the boundaries declared for the devices.

In general, the functional architecture for central coordination of wireless communication systems for automation applications shall fulfill the following basic requirements:

- provide coordination mechanisms to achieve and maintain coexistence between different wireless communication solutions in the same frequency range;
- avoid harmful interferences. Provide mechanisms for automatic spectrum access and utilization, with the aim of:
 - recognition of free and occupied spectrum;
 - detection and classification of wireless communication solutions including incumbent radio systems;
 - establishment of communication channels;
 - registration of wireless communication systems in the location(s) of interest in the plant;
 - inventorying wireless automation applications with the associated wireless communication system;
 - release or rejection of newly registered wireless communication systems for automation applications;
 - gathering the requirements for the use of wireless communication based on the agreed decisions of the internal procedure;

- providing mechanisms for continuous monitoring of
 - the frequency spectrum condition, and
 - the coexistence state.

The available medium resources can be organized by assigning resource blocks to different wireless systems and/or devices by the CC. The resource blocks represent a combination of resources from the time, frequency and space domains and the coding.

The CC shall include communication with wireless systems or with wireless devices by means of one or more communication channels and protocols. Therefore, the CC shall fulfill the following requirements:

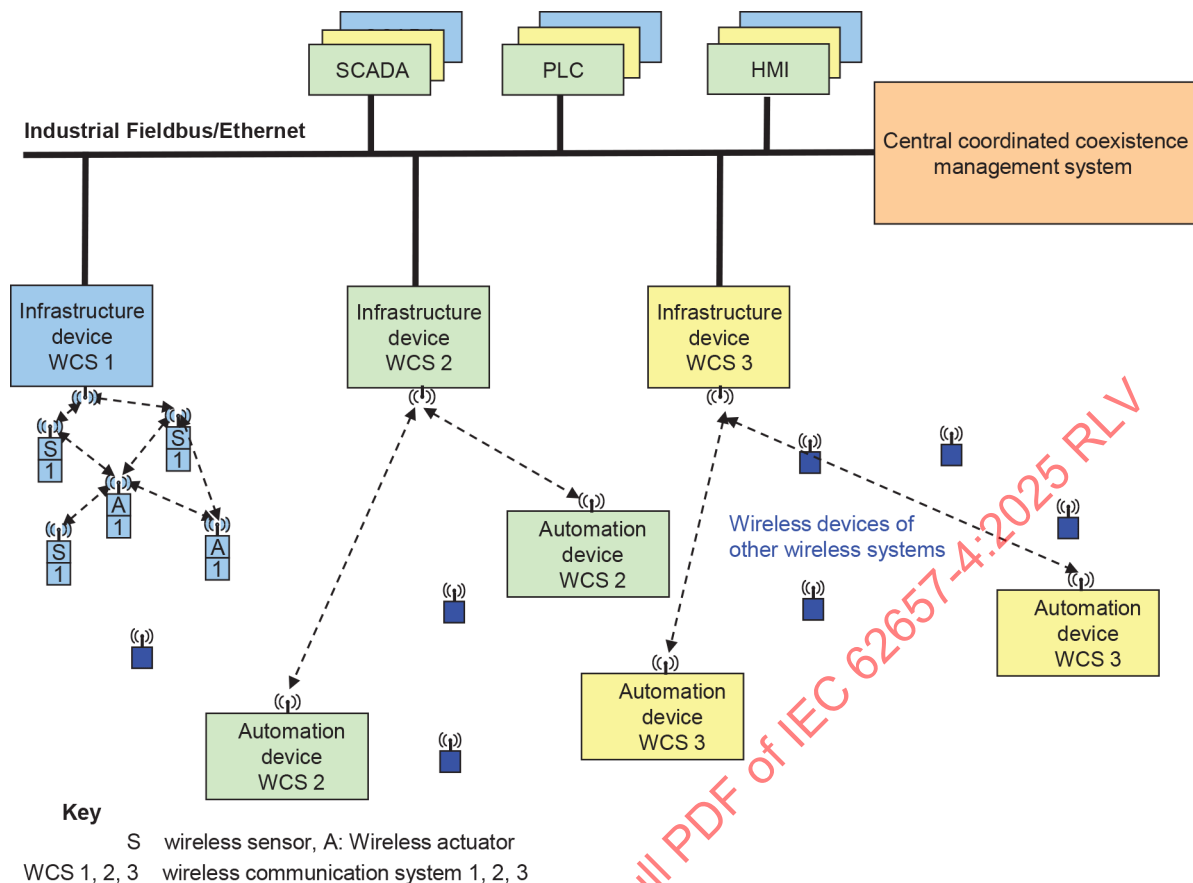
- support of different radio technologies;
- support of interface for coordination.

The coexistence management for intra-system coexistence can substitute manual coexistence management as defined by IEC 62657-2.

The CC is used to schedule resources to the different wireless communication solutions. This can include CC of single devices and CC of wireless systems. In the latter case, the wireless systems will then use the CC information to configure and control its own wireless network.

If the wireless communication applications are not controlled by CC and operate independently using the medium access control mechanisms of the wireless communication systems, then there is no coordination between them, and they rely on their own techniques for network formation, network discovery, service discovery and interference management, including the protection of incumbent radio systems.

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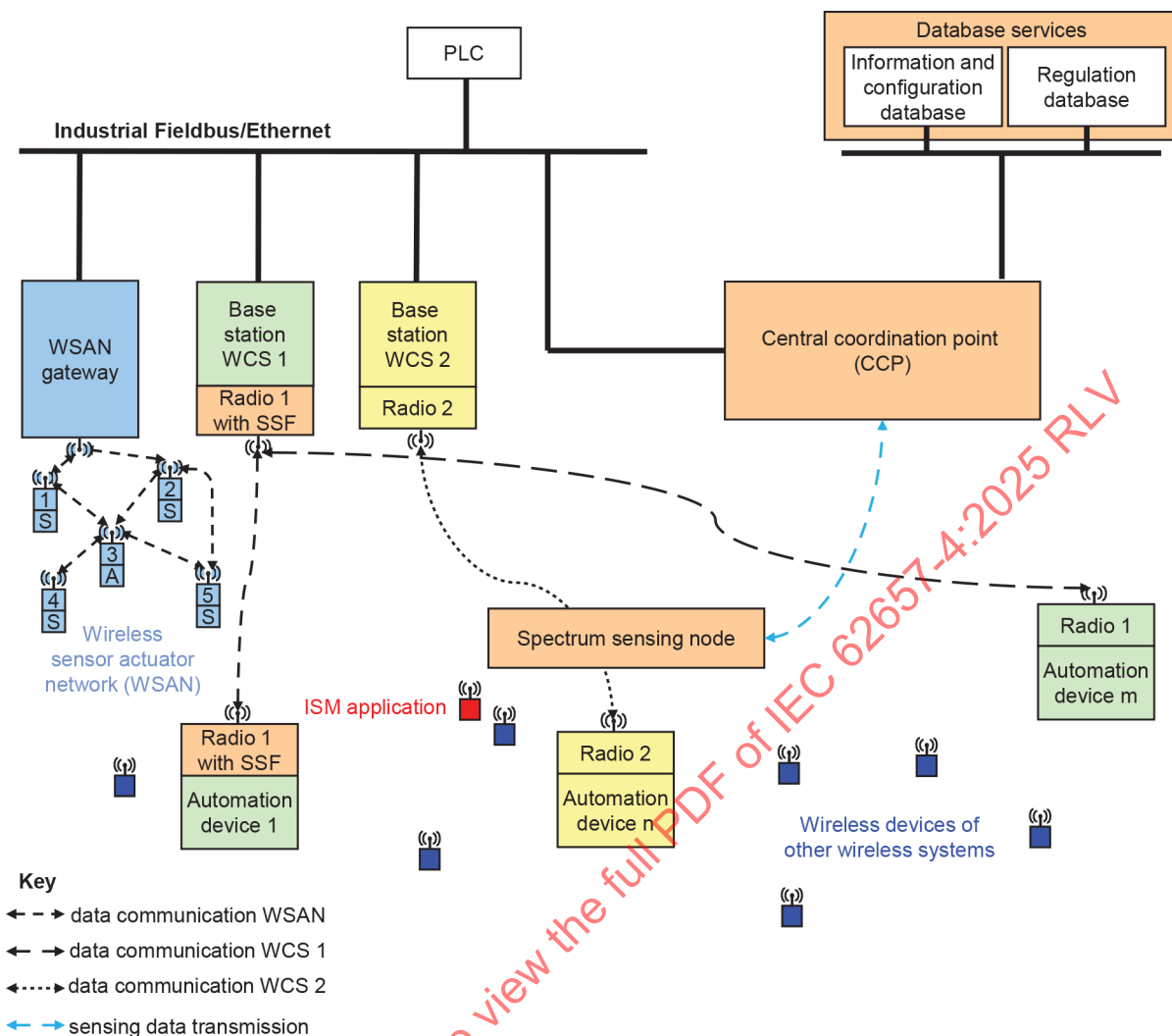
Figure 5 – Example instance of class CoexistenceSystem in accordance with IEC 62657-3

Figure 5 shows an example representation of the class model CoexistenceSystem from IEC 62657-3:2022, 5.2. The class DistributedAutomationSystem is represented by local automation functions implemented in Supervisory Control and Data Acquisition (SCADA), Programmable logic controller (PLC), Human Machine Interface (HMI), Sensor (S), Actuator (A), and the application component of the automation devices. The wireless communication components of the Wireless Communication Systems WCS 1 to WCS 3 are instances of the class WirelessCommunicationSystem. The wireless devices of other wireless systems are instances of the class ActiveEnvironmentalInfluence. The central coordinated coexistence management system is an instantiation of the class CoexistenceManagementSystem. In the following, the example representation of Figure 5 is used to describe the system elements, the architecture, the functions and the interfaces of a CCP system in more detail.

The central coordinated coexistence management system has three entities, as shown in Figure 6:

- central coordination point (CCP);
- spectrum sensing system (SSS), which is a combination of spectrum sensing nodes (SSN) and spectrum sensing functions (SSF), see 5.2.4;
- database services with information and configuration database and regulation database.

Each entity is defined by its functional roles and interaction with other entities.



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Figure 6 – Elements of central coordinated coexistence management system

Figure 6 shows three independent wireless communication systems that are subject to central coordination. A wireless sensor actor network (WSAN), a wireless communication system 1 (Radio 1) and a wireless communication system 2 (Radio 2). Furthermore, there are wireless devices of other wireless communication systems that are not under control of the CC (incumbent radio systems) and an ISM application that can interfere with the wireless applications of interest. A line-based industrial communication system is used as a backbone to connect the wireless communication systems and the CCP.

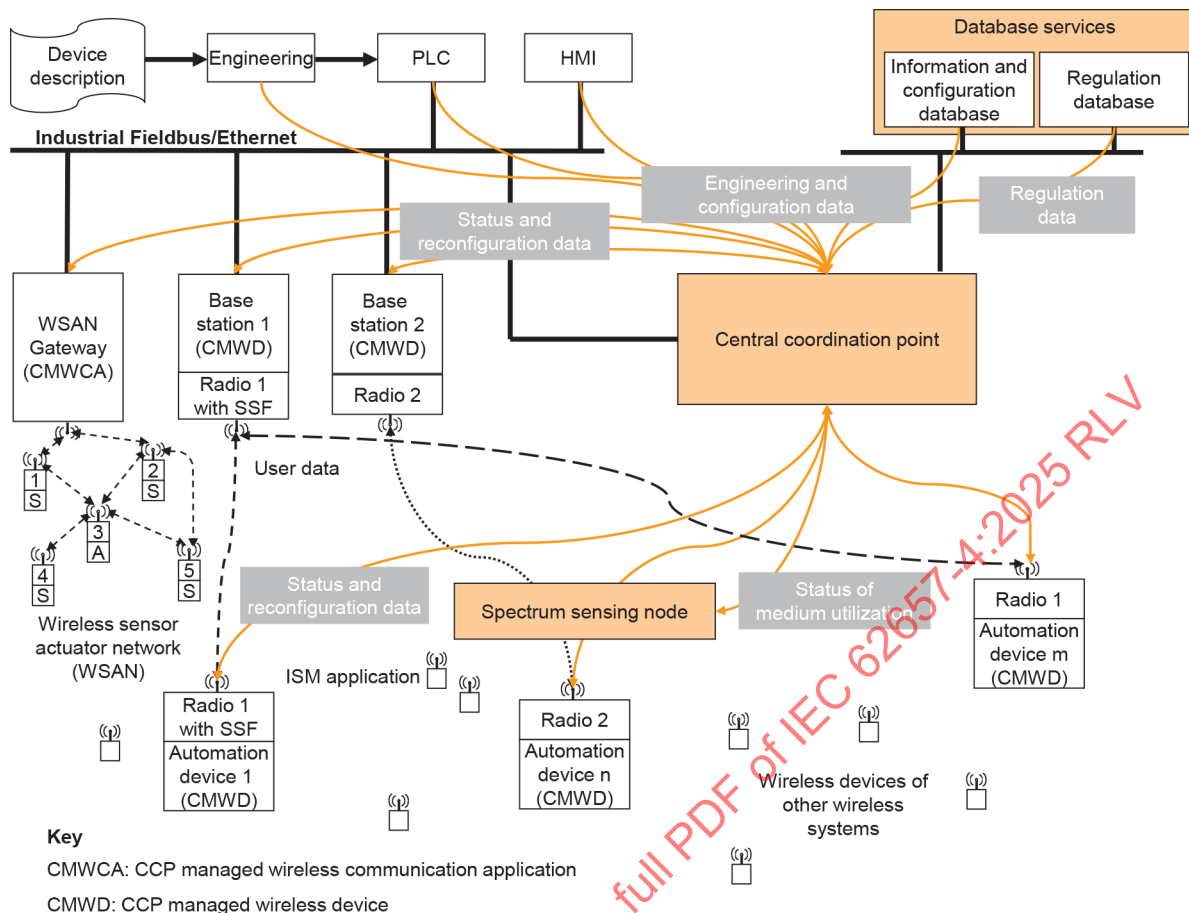


Figure 7 – Data exchange in central coordinated coexistence management system

Figure 7 shows the data exchange between the elements in a central coordinated coexistence management system. The central coordination point (CCP) is the key element of the coexistence management system. The CCP makes coexistence management decisions based on engineering baseline data, information from databases and current measurements of application behaviour and spectrum. Current measured values of application behaviour and spectrum can be collected for wireless systems via their central device, for example a base station, or directly from wireless devices. In the first case, there is only one connection between the CCP and the central component, as with WSAN in Figure 7. Then the application using the WSAN is a CCP managed wireless communication application (CMWCA). In the other case, there are connections from the CCP to the wireless devices, as with the wireless communication system 1 and wireless communication system 2. These are then called CCP managed wireless devices (CMWD). The exchange of coexistence data can take place directly between CCP and CMWD or via the central device of the WCS. Current measured values of spectrum are also provided by the spectrum sensing node (SSN).

The CCP manages the available resources spectrum, time and space and assigns the resources to the CMWCA and/or CMWD with respect to the requirements of the automation application. The central device of CMWCA receives the resource information and acts as master station and manages the registered and connected slave station of CMWCA. Therefore, the CMWCA uses available spectrum resources with additional knowledge about spectrum usage by its neighbour CMWCA and about incumbent radio systems.

5.2 System elements

5.2.1 Wireless systems and wireless devices for automation applications

5.2.1.1 Wireless device with per device mechanisms for adaptivity and medium access control

Wireless devices with per device mechanisms for adaptivity and medium access control mechanism shall provide the needed mechanisms for adaptivity and medium access control mechanism for the assigned frequency band, such as dynamic frequency selection and frequency agility mechanisms. Manual coexistence management according to IEC 62657-2 can be used for intra-system coexistence but cannot replace mandatory mechanisms to fulfill regulatory requirements (for example protect incumbent radio system). IEC 62657-2 should be established to improve the efficient use of the medium in an industrial environment if the device cannot participate in the CCP concept.

5.2.1.2 CCP managed wireless communication application and wireless device

The CCP managed wireless communication application (CMWCA) and/or the CCP managed wireless devices (CMWD) are supervised, managed and controlled by the CCP. The CCP managed wireless communication application combines all related functions in one wireless device. That is, the control functions (for example base station or access point functions) for the wireless communication system and the client functions for the CCP. The CCP managed wireless devices include the client functions for the CCP and the functions of a wireless communication module (WCM) or an infrastructure device in a wireless communication system, as depicted in Figure 8.

The CCP controlled wireless communication application and wireless device shall not transmit wireless data messages by itself. If the communication between CCP and CCP managed wireless device is established and the CCP enables the transmission, then the CCP managed wireless device can transmit wireless data messages with or without mechanisms for adaptivity and/or medium access control mechanism. If the communication between CCP and the CCP managed wireless device fails, the wireless transmission shall stop if, for example, the regulatory required mitigation is not in the device, or the device does not have access to the antenna. A heart-beat signal or similar mechanisms shall enable monitoring of the communication between CCP and CCP managed wireless communication application and wireless device.

CCP managed wireless devices can have implemented spectrum sensing functions. These can be integrated into the overall spectrum sensing system (see 5.2.4).

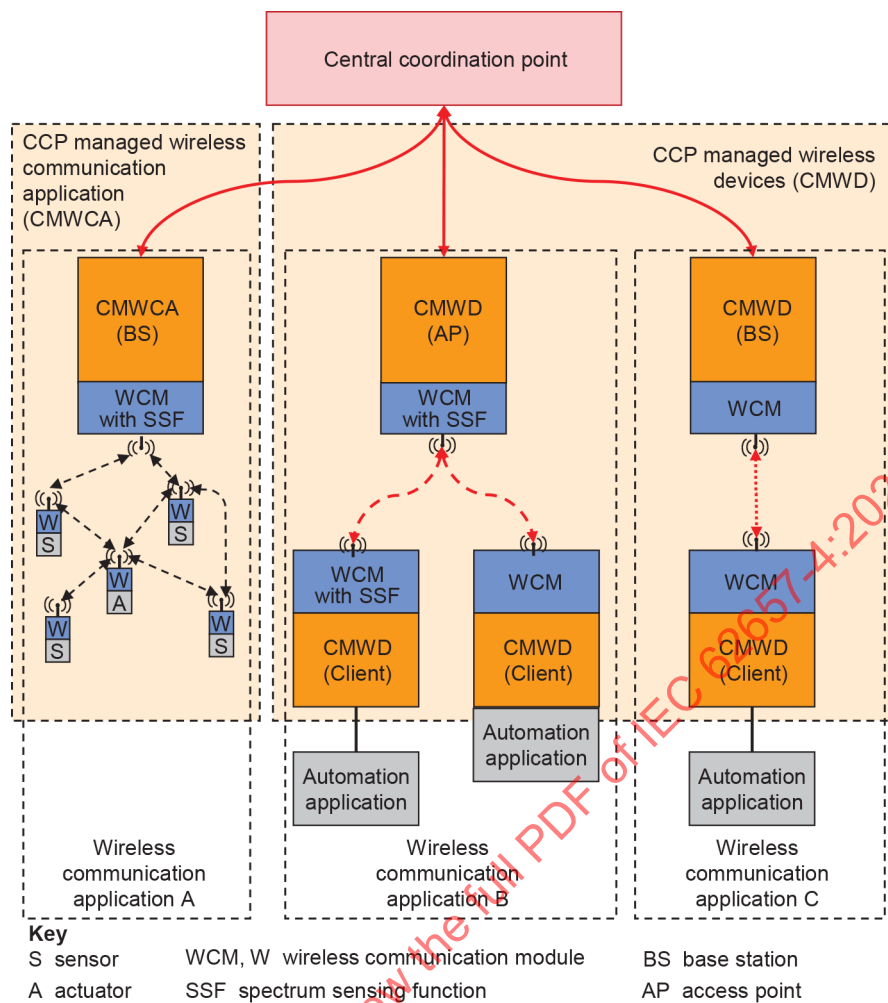


Figure 8 – CCP managed wireless devices and CCP managed wireless systems

Wireless devices of CMWCA that do not perform active spectrum sensing to save power have limited sensing capability and are therefore subject to dynamic interference. In that context, the spectrum sensing system can perform specific sensing measurements to support a wireless system consisting of such low-power wireless devices with limited sensing capability.

5.2.1.3 CCP managed wireless device with per device mechanisms for adaptivity and medium access control mechanism

Wireless devices with per device adaptivity and medium access control mechanisms which are also CCP controlled shall fulfill the requirements of 5.2.1.1.

If the communication between CCP and a CMWCA or a CMWD is established and the CCP enables the transmission, the wireless device or wireless system can transmit without adaptivity and medium access control mechanisms. If the communication between CCP and a CMWCA or a CMWD fails, the transmission shall be in line with adaptivity and medium access control mechanisms.

5.2.2 Central coordination point

5.2.2.1 General

The central coordination point (CCP) is a centralized coordination device or system for management of heterogeneous wireless infrastructures for spatially distributed automation applications. As shown in Figure 9, the CCP consists of an access to backplane(s) and an access to the RF channel, a spectrum engine, a resource engine and a policy engine.

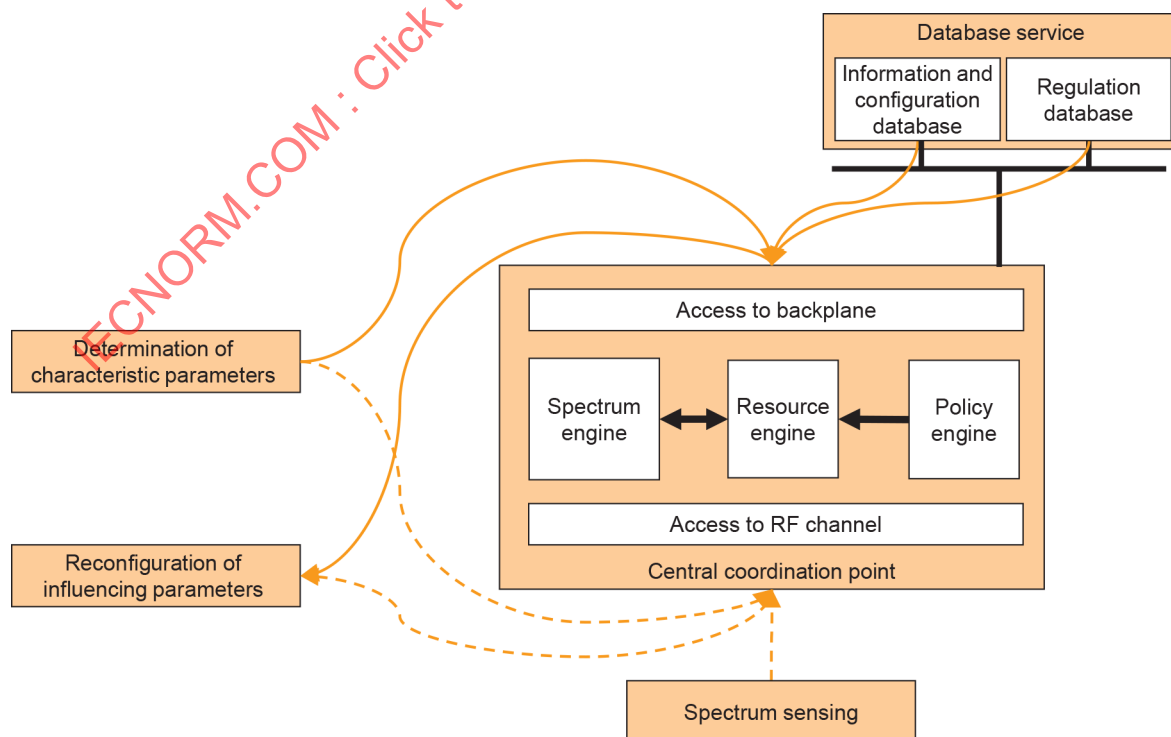
The tasks for the CCP are:

- management (control and coordination) of a heterogeneous wireless communication infrastructure for spatially distributed automation applications;
- establishment of automatic coexistence management within a heterogeneous wireless communication infrastructure for automation applications;
- consideration of the automation application requirements;
- detection and protection of wireless communication applications;
- consideration and fulfilment of regional regulatory requirements for wireless communication systems and wireless devices with support of geolocation.

The CCP shall:

- establish a wired or wireless communication to the information and configuration data base containing geolocation and medium usage information from wireless communication applications and incumbent radio systems;
- detect incumbent radio systems and select the appropriate mitigation technique to protect these systems;
- use application related characteristic parameters according to IEC 62657-2:2025, 6.6 to determine the coexistence state described in 4.2;
- obtain the requirements of the automation applications (see IEC 62657-2) and assign resources accordingly to the CMWCA and CMD;
- establish a wired or wireless connection to the CMWCA and CMD;
- establish a wired or wireless connection to the regulation database.
- reconfigure CCP managed wireless communication applications and wireless devices using influencing parameters defined in IEC 62657-2:2025, Clause 7.

If more than one CCP is in use in a certain configuration, then wired or wireless communication shall be established directly or indirectly between the CCPs. All requirements of a single CCP shall apply.



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Figure 9 – Overview of CCP

5.2.2.2 Spectrum engine

The spectrum engine (SE) is a management and control function and an entity of the CCP. The SE centralizes all medium usage decisions for various wireless communication applications, taking into account medium availability information and location-specific medium utilization.

In summary, the SE shall be responsible for:

- maintaining medium availability and medium utilization information;
- channel classification and selection;
- association control;
- channel set management;
- accessing the database service;
- scheduling spectrum sensing operation;
- making channel move decisions for one or more CCP managed wireless systems or wireless devices for the automation application;
- supporting coexistence of wireless communication applications;
- considering incumbent radio systems and other wireless applications;
- establishing a wired or wireless connection to all CCP managed wireless communication applications and devices;
- establishing a connection to the resource engine.

5.2.2.3 Resource engine

The resource engine (RE) is a management and control function and an entity of CCP. The RE centralizes all information about automation application, application communication requirements and general plant characteristics. This information shall be analysed and processed with respect to the use of the wireless medium by the wireless communication applications. Furthermore, the RE shall consider the radio regulation restrictions.

The resource engine (RE) within the CCP shall be responsible for:

- collection, analysing and processing of engineering and automation application data;
- providing coexistence control parameters to the SE with respect to the radio regulation restrictions and limitations;
- maintaining the requirements of the automation application;
- maintaining and monitoring QoS information of the communication links.

5.2.2.4 Policy engine

The policy engine (PE) is a management function and an entity of CCP. The PE centralizes all location-dependent radio regulation restrictions and limitations about the used frequency ranges. The PE shall be responsible for:

- maintaining regulatory requirements, restrictions and limits regarding the geographical location, as well as the range of frequencies used by the wireless systems and wireless devices for automation applications;
- establishing a wired or wireless communication to the regulation database containing geolocation limit of radio spectrum regulation.

It is impossible to get a general approval of administrations for the CC concept in general. To get an assuredness that vendors can start to invest in products compliant with this document, it is important to know that a vendor that put products on the market and put the product into service is responsible to comply with local and regional policies. There exist two principles on the worldwide markets:

- the process of self-declaration of conformity;
- type approval.

NOTE 1 In Europe, as a harmonized standard for this type of product does not exist, the process is to ask a notified body for its expert opinion.

NOTE 2 The responsibility for the product remains by the vendor.

The product description shall provide the needed information to describe the system:

- CCP;
- CCP managed wireless communication applications and devices,

with their CCP-service-interfaces to operate using a communication interface. The communication interface could be based for example on IEEE Std 802.11. The CCP-service-interfaces shall be according to this document.

Table 2 – Level of effectiveness of wireless automation

Scenario	Achievement of coexistence	Spectrum efficiency
Without coexistence management	Hardly	—
With coexistence management	Most likely	Not efficient
With CCP based coexistence management	Most likely	Efficient
With CCP based coexistence management and only controlled traffic	For sure	Efficient

As shown in Table 2, the CCP increases the achievement of the coexistence of wireless communication applications compared to not using a CCP concept. That means the policy engine shall contain all relevant restrictions to fulfil the regional and local requirements of regulations, policies and others.

5.2.3 Coordination database

5.2.3.1 Information and configuration database

The information and configuration database (ICD) stores information about automation application communication requirements, CCP managed wireless applications and CCP managed devices, wireless systems and wireless devices with per-device adaptivity and medium access control mechanisms, location-specific information, and radio-specific information. The ICD shall provide this information to the CCP. The radio-specific information shall include information on available radio frequencies and associated maximum EIRP values, implemented adaptivity mechanisms, and medium access control mechanisms used by the systems wireless and wireless devices under consideration. This enables the protection of incumbent radio systems. The information is derived from documentation of the wireless systems and wireless devices.

5.2.3.2 Regulation database

The regulation database (RD) contains regulation information about the used frequency band(s). The RD shall include information on radio regulation limits and information on incumbent radio systems and other wireless applications, as well as which frequency bands or parts of them can be used during operation.

Furthermore, the RD contains information on how wireless communication systems will respond when an incumbent radio system is detected. The CCP's policy uses the RD to configure wireless systems and wireless devices according to regulatory requirements. The incumbent radio systems are defined by:

- frequency band;
- incumbent type:
 - defense (radiolocation);
 - fixed service;
 - transportation;
- incumbent operation characteristic:
 - static;
 - dynamic by time;
 - dynamic by geography;
 - dynamic by time and geography.

Due to incumbent radio systems, a number of disadvantages can arise for wireless communication systems and thus for wireless communication applications (WCA), for example:

- reduced frequency band;
- reduced coverage;
- decreased capacity;
- decelerated access to spectrum.

5.2.4 Spectrum sensing system

The spectrum sensing system (SSS) is a combination of dedicated spectrum sensing nodes (SSN) and embedded spectrum sensing functions (SSF) integrated into the wireless devices for automation applications. The SSS shall continuously provide medium utilization information to the CCP. The SSS observes the relevant frequency bands in and around the environment of the local industrial premises to determine the occurrence of wireless applications including incumbent radio systems. This process is called sensing and takes into account parameters of the radio channel, of the known wireless applications, of the automation application, and of the environment. Furthermore, the determined spectrum values can provide information about the location of a transmitting wireless device.

Spectrum sensing is generally a passive process and shall not interfere with wireless applications. The sensed signals shall be detected from the SSS and the parameters shall be transferred to the SE function in CCP. The parameters indicate frequency range, energy level and occupation time. To assess the energy level, for example the received signal strength indication (RSSI) or the signal to interference plus noise ratio (SINR) are used as parameters. Based on this information, the SE can identify the radio pattern of the transmitter and can so characterize, catalog and classify incumbent radio systems, wireless communication systems and devices, ISM applications and other wireless applications.

The spectrum sensing nodes (SSN) independently implement specific procedures for sensing the radio frequency environment inside and outside the local automation environment. The SSN shall permanently sense the radio frequency environment and report to the CCP so that it can refresh the status of the medium resources.

The spectrum sensing function (SSF) is present at the CMWCA and CMWD. The SSF in CMWCA independently implement specific procedures for sensing the radio frequency environment at initialization of the master station and before the registration of a slave station with the master station and during operation.

The SSF in a CMWD shall contain essential features to allow proper operation when the device is not under the control of the WCS master station, for example, during initialization or during a channel change. When a CMWD is idle, the SSF shall conduct out-of-band sensing and report to the master station so that it can refresh the status of the channels in the backup/candidate channel list. At any other time, the SSFs in the CMWD are under the control of the CCP. When the master station is not transmitting, the SSF is active to conduct out-of-band sensing. The SSF can then also carry out sensing to clear channels.

CMWD may be subject to limitations in terms of processing capacity, memory resources or power requirements (battery powered). In these cases, the following measures can be applied:

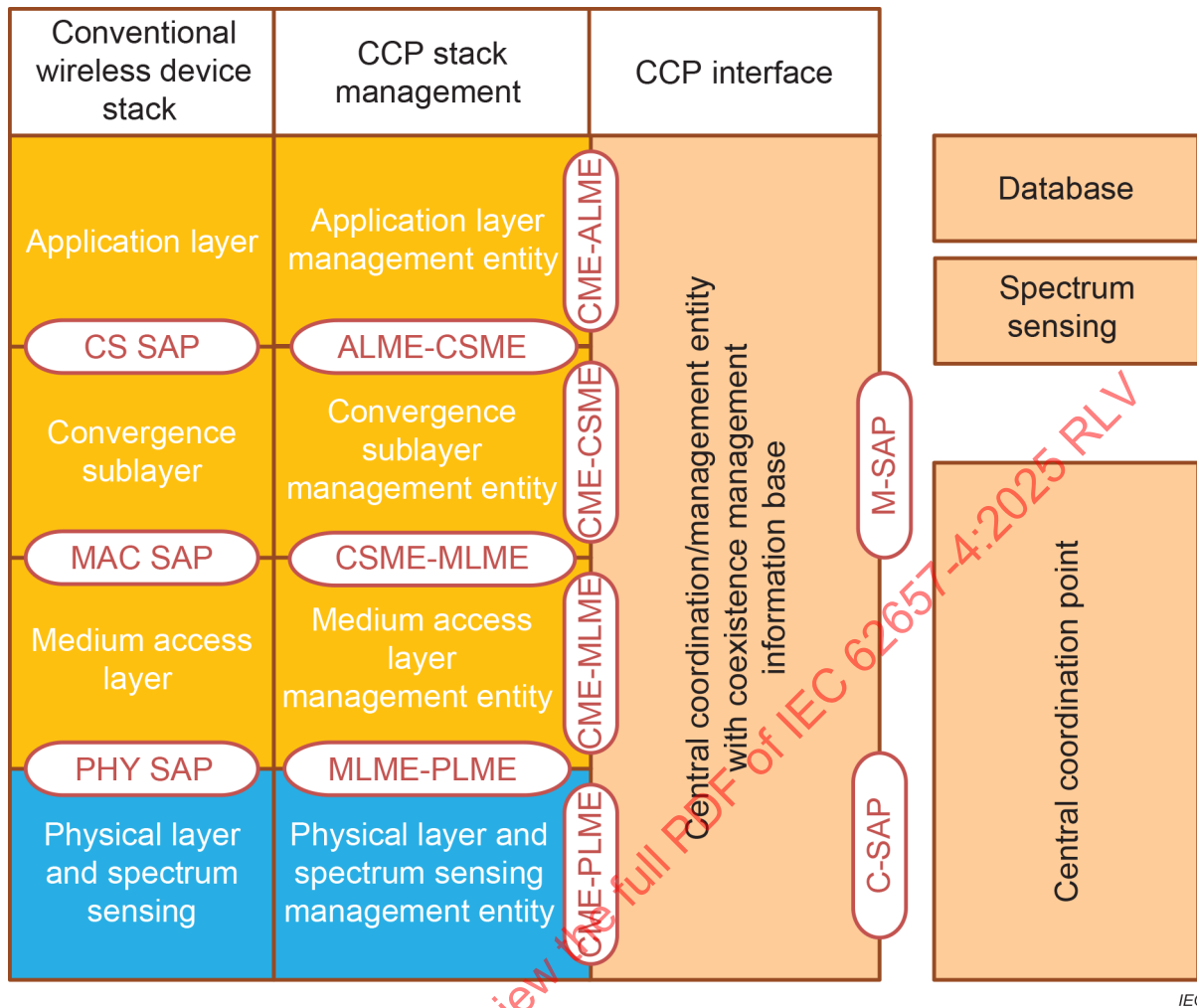
- The SSF is not started immediately after registration of the CMWD but on command of the CCP.
- The SSF senses only the frequency range that the wireless device can use operationally.
- The SSF can be suspended to conserve battery power.

These spectrum sensing limitations can be compensated by using information from the SSN and/or by selectively activating SSFs and performing sophisticated data analysis.

5.3 Protocol reference architecture

5.3.1 General

The protocol reference model (PRM) of CCP managed wireless automation applications and wireless devices, shown in Figure 10, is divided in three parts. The conventional wireless device stack transfers the user data. It is called user plane or data plane. The CCP stack management provides the CCP management and control services of the device according to Clause 8. The CCP interface contains the management/control plane functionality, creating a new coordination plane to support the central coordination capabilities.



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Figure 10 – Protocol reference model of CCP managed wireless device

5.3.2 Data plane

The data plane consists of the physical layer (PHY), the medium access control (MAC) layer, the convergence sublayer (CS) and application layer (AL). Service access points (SAPs) are added in between these layers to allow modularization of the system. An SAP is provided with a well-defined interface or a set of primitives to exchange information, by virtue of which these different components can talk to each other.

The service-specific CS shall provide transformation or mapping of external network data that is received through the CS SAP from AL, into MAC service data units (SDUs). This transformation or mapping shall include classifying external network SDUs and associating them to the proper MAC service flow identifier. Multiple CS specifications are provided for interfacing with various protocols.

The MAC shall provide the functionality of system access, connection establishment and connection maintenance. The data that the MAC layer receives from the various CSs through the MAC SAP shall be assigned to particular MAC connections. Quality of Service (QoS) is applied to the transmission and scheduling of data over the PHY. Data, PHY control, and monitoring statistics (spectrum sensing, RSSI, etc.) shall be transferred between the MAC and the PHY via the PHY SAP.

The parameter for coexistence assessment shall be determined from the message transfer in the data plane. The PHY, MAC, CS and AL shall provide the determined parameters to the central coordination/management entity with coexistence management information base, where these parameters are available for the CCP.

5.3.3 Management and control plane

5.3.3.1 General

The management and control plane shall consist of physical layer and spectrum sensing management entity (PLME), medium access layer management entity (MLME), convergence sublayer management entity (CLME), application layer management entity (ALME) and the central coordination entity (CCE) with a coexistence management information base (CMIB). Service primitives are used to communicate with the CMIB database and some of its primitives can be used to manage the wireless system and wireless device entities. The CMIB primitives shall be used for system configuration, monitoring statistics, notifications, triggers and session management, medium resources management, communication with the database, the spectrum sensing system and the CCP. The CMIB data can be obtained either from the wireless system, pre-defined within the system, or obtained from other devices after an exchange of information using the communication medium. The CCP has a key role in the overall architecture. It is the central coordinator for all CMWCA and CMWD, where all information about the availability of the spectrum is collected, resulting from the database and the spectrum sensing system. Based on this combined information, local regulations and predefined CCP policies, the CCP shall provide the needed configuration information to the MAC, which shall remotely configure all registered CMWCA and CMWD.

5.3.3.2 Management plane

The CCP shall reside in the management plane of the wireless communication application. The management SAP (M-SAP) may include, but is not limited to, primitives related to the following:

- general plant characterization;
- application communication requirements;
- communication system and device management;
- monitoring statistics;
- notifications/triggers;
- sensing management.

5.3.3.3 Control plane

The control plane shall be comprised of the spectrum sensing system (SSS) function and central coordination point (CCP) function. The SSS shall implement spectrum sensing algorithms and the RE shall provide the information to determine the location of the CMWCA and CMWD.

The CCP shall maintain medium availability information, manage channel lists, manage quiet periods, scheduling and implement coexistence mechanisms. The CCP shall also take requests from the MAC and PHY. For example, the MAC shall inform the CCP if an interference situation has been detected during normal operation in the channel. The CCP shall then take appropriate actions to resolve the issue such as moving to another channel. For this purpose, the CCP first requests sufficient idle time from the wireless communication application to perform an in-band sensing. It shall update the list of backup and candidate channels in a prioritized order. The CCP then ensures that the wireless communication application has sufficient idle time to select a sufficient number of backup channels. If an incumbent is found during in-band sensing, the MAC uses the corresponding service to inform the CCP to perform the switching operation.

C-SAP shall be used by the CCP to initiate channel move, to configure the spectrum sensing function at the wireless devices (backup or candidate channel list, specific channels to be sensed, etc.) as well as to gather information from the wireless devices (local sensing information, etc.).

The C-SAP may include, but is not limited to primitives related to the following:

- subscriber and session management;
- medium resource report;
- sensing result.

5.4 System of wireless communication applications

5.4.1 CCP concept for sharing with incumbent radio systems

The CCP concept is intended to reduce the effort required to implement the necessary mitigation techniques for the used spectrum in each device. Another advantage of this approach is that the CCP can detect incumbent radio systems at the edges of the plant with a higher receiver sensitivity than the wireless devices can. While the location of a wireless device in a building depends on the automation application, SSNs can be placed in positions with optimal receiving performance.

If the available frequency band not used by incumbent radio systems is identified by the CCP, then the CCP shall calculate the most efficient spectrum assignments that can be assigned to the CCP managed wireless communication applications and CCP managed wireless devices based on their automation application requirements on communication needs.

Wireless communication applications in a factory environment may operate exclusively over one or more network access technologies and many of these applications may be capable of operating simultaneously in a factory environment.

An example of a CCP controlled WCA and incumbent services/applications within the 5,8 GHz WIA band is provided in Annex A.

Another example of a CCP controlled WCA is provided in Annex D.

5.4.2 Protection of incumbent radio systems

CCP controlled WCA employ centralized coordination with centralized or distributed spectrum sensing to identify free and occupied frequency ranges. The spectrum sensing node (SSN) may have multiple radio interfaces or a universal radio interface for monitoring a number of channels or frequency ranges simultaneously. It determines the operation of incumbent services on certain channels or frequencies. If available, SSF of the devices of the CMWCA can be used to obtain a more accurate status of the utilization of the medium, especially with respect to the spatial distribution.

To protect incumbent services and applications, an automated non-collaborative metrics-based coexistence management shall be used, as WCA and incumbent services/applications are not capable of exchanging information. Since they are fully independent, WCA shall rely only on incumbent service/application detection and estimation. In other words, each potentially interfered WCA classifies the behaviour of the interfering incumbent services or applications and adapts its own behaviour to the new conditions.

5.4.3 CCP concept for intra-system coexistence

The intra-system coexistence, as achieved by the CCP concept, fulfils the viewpoint of an automatic adaptive coexistence management mechanism.

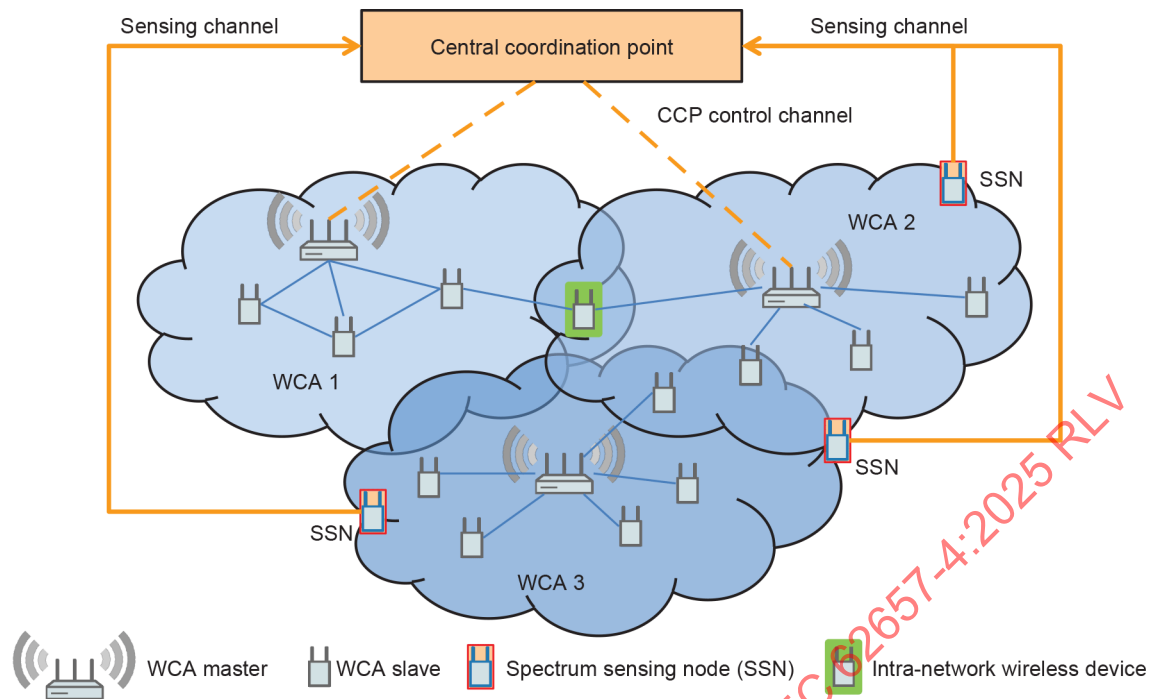
The CCP shall organize the spectrum access for multiple WCA within the frequency band. Currently many coexistence issues and mitigation techniques exist, because there is no coordination between WCA. Therefore, WCA should use new intra-system coexistence schemes in order to optimize radio resource usage. These coexistence schemes can be enabled by a CCP. The CCP can provide assistance for wireless coexistence via the transmission of context information such as quality of service, priority of service, etc. and measurement results. The CCP also can enable control for multiple WCA.

The CCP organizes the simultaneous operation of multiple WCA and wireless devices in industrial environments. Therefore, the CCP, CCP controlled WCA and CCP controlled wireless devices shall provide a control channel for information collection from WCA and wireless devices to the CCP as well as to carry control or assistance information from the CCP to the WCA and wireless devices. In order to provide control or assistance services, the CCP performs decision making via a control channel. In order to provide information collection services, the CCP shall provide information on available WCA and wireless devices via a control channel. The control channel can use

- line-bound connections between CCP and CCP controlled WCA;
- wireless connections between CCP and CCP controlled WCA or CCP controlled wireless devices;
- wireless connections between CCP controlled WCA and CCP controlled wireless devices;
- wireless connections between CCP controlled WCA;
- wireless connections between CCP controlled wireless devices.

The CCP shall provide multi radio technology capability and a line-bound network access.

WCA in an industrial environment may operate exclusively over a single radio technology, but wireless devices within these networks may be capable of operating on multiple different radio technologies simultaneously. Therefore, multiple WCA control shall use the ability of specific wireless devices to communicate on more than one WCA in order to provide advanced services to WCA on which that device is not active. A device with multi-radio access capability can be used to provide assistance to WCA in an effort to coordinate transmissions across WCA and to improve the performance within a WCA. Intra-network wireless devices can exist that are capable to communicate with WCA 1 and also capable to communicate with WCA 2. This wireless device can be seen as marked in green in Figure 11. WCA with single radio access capability need assistance from CCP. The CCP manages the medium utilization of WCA by coordinating their transmissions.



IEC

Figure 11 – CCP for intra-system coexistence

Conceptually, multi-radio access technology assistance or line-bound technology assistance helps to cooperate with coexistence issues not only by minimizing harmful interference, but also by expanding the services available to wireless devices and to include services from devices outside the local network. The services offered by every device are added to the CCP, but in order to access this CCP, a common control channel capable of WCA-agnostic communication is required.

WCA 1 (see Figure 11) or wireless devices belonging to WCA 1 can be requested to sense the operating channel of WCA 2 and report the results to a CCP. This could be useful for networks consisting of low-powered devices with limited sensing capability.

The CCP collects location information and operating characteristics of different WCA including the operating channel of the low complexity WCA. The CCP then instructs SSN or wireless devices to perform periodic sensing on the operating channel of the low complexity WCA with specific sensing algorithms applicable to detect low complexity WCA with low medium utilization. If harmful interference is detected, the CCP informs the low complexity WCA and instructs it to move to another operation channel provided no incumbent service is operating on that channel.

Optionally, the CCP can also instruct the SSN to monitor one or more alternative channels for the WCA. Once high interference is detected, the CCP can instruct the WCA to change the acting channels to a validated alternative channel. Hence, the service discontinuity, which occurs as a result of the harmful interference, is reduced at the WCA.

5.5 Interfaces

5.5.1 CCP

The CCP is interfaced to the AL, CS, MAC and PHY layer entities of the CCP managed wireless communication applications and devices through the two SAPs M-SAP and C-SAP. The M-SAP is used for less time sensitive management plane primitives and the C-SAP is used for more time-sensitive control plane primitives.

The CCP is interfaced to the SSN through the M-SAP and C-SAP. The M-SAP is used for the management plane primitives and the C-SAP is used for more control plane primitives.

The CCP is interfaced to the database via the M-SAP, which used the management plane primitives.

The CCP is interfaced to the automation application via the M-SAP, which used the management plane primitives.

The CCP provides a user interface for management, control and engineering.

5.5.2 CCP managed wireless communication application and wireless device

The CCP managed wireless communication applications and wireless devices shall include a control-SAP (C-SAP) and management-SAP (M-SAP) that provide CCP access to the control plane and management plane functions.

The CMWD shall provide an interface to the automation application.

5.5.3 Database

The coordination database shall provide an M-SAP that provides CCP access to the database content.

The database provides a user interface for management, control and engineering.

5.5.4 Spectrum sensing system

The SSN and SSF shall provide a C-SAP that provides CCP access to the spectrum sensing results.

6 Parameter for coexistence assessment

Characteristic parameters are used to describe and assess the behaviour of the media access mechanism and the performance of the complete communication of a wireless solution. In this Clause 6, the characteristic parameters are specified to assess wireless communication systems and especially media access mechanisms with respect to industrial automation applications. The parameters can be distinguished in the description of the time and error behaviour and in measures concerning all kinds of spectrum efficiency.

The assessment of coexistence shall be done by using the parameters listed in Table 3.

Table 3 – List of parameters for coexistence assessment

Parameter name	Symbol	Unit	Data type
Data throughput	T_D	bit/s	REAL_MEASURE_TYPE
Communication availability			
Message loss ratio	MLR	%	REAL_MEASURE_TYPE
Number of consecutive lost messages	N_{SML}	.	INT_TYPE
Transmission time	t_{TT}	s	REAL_MEASURE_TYPE
Update time	t_{UT}	s	REAL_MEASURE_TYPE
Response time	t_{RT}	s	REAL_MEASURE_TYPE

The specifications of the parameters are provided in IEC 62657-2.

7 Parameter for coexistence control

7.1 General

The values of the characteristic parameters are influenced by several parameters. That is why it is important to control and manage parameters and their values. The first set of influencing parameters is related to the application. This includes, for instance, the communication load. Another set of influencing parameters is related to the radio devices, e.g. the frequency band or transmission power. In 7.2 and 7.3, the relevant influencing parameters for the management and control of media utilization and coexistence are listed and declared.

This document describes general parameters for coexistence management. Depending on the specific radio technology, special resource allocation parameters could be available, for example, routing parameters of a mesh network. Other special parameters are available due to the evolution of radio technologies, for example parameters for frequency-time resource block assignments or for beamforming of smart antenna types.

NOTE The tools supporting the CCP can also be based on the catalogue data definitions and specifications given in the IEC 61360 series and the data base, called common data dictionary (IEC CDD), filled with the classes and properties of the IEC 62657 series. Annex B provides an overview of the processes by which the content of the IEC CDD can be filled and used in an application. Annex C provides templates as a possible basis to fill the IEC CDD with the parameters used in the services of this document.

7.2 Application parameter

The CCP can control the application parameters for coexistence control in Table 4. Especially in the context of smart manufacturing, there is the possibility to efficiently use communication resources according to the flexible changing requirements of the application.

Table 4 – List of application parameters for coexistence control

Parameter name	Symbol	Unit	Data type	Description
Communication load	A_{CL}	bit/s	REAL_MEASURE_TYPE	Communication load per communication link
Initiation of data transmission	A_{IDT}	-	ENUM_STRING_TYPE	Type of initiations of data transmission for each automation device for communication link
Length of user data per transfer interval	A_{LUD}	octet	INT_TYPE	Length of user data for each automation device for communication link
Transfer interval	A_{TI}	s	LEVEL(MAX) of REAL_MEASURE_TYPE	Transfer interval for each automation device for communication link

The specifications of the parameters are provided in IEC 62657-2.

7.3 Radio parameter

The CCP can control the radio parameters for coexistence control in Table 5.

Table 5 – List of radio parameters for coexistence control

Parameter name	Symbol	Unit	Data type	Description
Frequency band				
Lower cut-off frequency	f_{BL}	Hz	REAL_MEASURE_TYPE	Lower cut-off frequency of frequency band
Upper cut-off frequency	f_{BU}	Hz	REAL_MEASURE_TYPE	Upper cut-off frequency of frequency band
Frequency channel				
Centre frequency	f_C	Hz	REAL_MEASURE_TYPE	Centre frequency of frequency channel
Bandwidth	BW	Hz	REAL_MEASURE_TYPE	Bandwidth of frequency channel
Lower cut-off frequency	f_{CL}	Hz	REAL_MEASURE_TYPE	Lower cut-off frequency of frequency channel
Upper cut-off frequency	f_{CU}	Hz	REAL_MEASURE_TYPE	Upper cut-off frequency of frequency channel
Type of radio channel identification	Ch		ENUM_STRING_TYPE	Radio channel number or identification of frequency channel
Power spectral density	PSD	dBm/Hz	REAL_MEASURE_TYPE	PSD of frequency channel
Number of frequency hopping channels	N_{HC}	-	INT_TYPE	Number of frequency channels for frequency hopping
Dwell time	t_{dwell}	s	LEVEL(MAX)REAL_MEASURE_TYPE	Time period of frequency hopping
Operational frequency channel				
Type of frequency channel identification			ENUM_STRING_TYPE	Centre frequency of frequency channels for operation
Blocked frequency list				
Type of frequency channel identification			ENUM_STRING_TYPE	Centre frequency of blocked frequency channels
Transmit power				
Equivalent isotropic radiated power	EIRP	W	REAL_MEASURE_TYPE	EIRP of radio device
Equivalent radiated power	ERP	W	REAL_MEASURE_TYPE	ERP of radio device
Transmitter output power	P_{out}	W	REAL_MEASURE_TYPE	Transmit output power of radio device
Channel occupancy time				
Duty cycle	DC	%	LEVEL(MAX)REAL_MEASURE_TYPE	Duty cycle per communication link
Transmitter sequence	t_{seq}	s	LEVEL(MAX)REAL_MEASURE_TYPE	Transmitter sequence per wireless device
Maximum number of retransmissions	N_{RT}	-	LEVEL(MAX)INT_MEASURE_TYPE	Maximum number of retransmissions per wireless device
Mechanisms for adaptivity			ENUM_STRING_TYPE	Mechanisms for adaptivity per wireless system
CCP	-	-	Char	A central systems element controls the medium utilization.
DAA	-	-	Char	If the channel is occupied, change the channel (for example AFH).
DAR	-	-	Char	If the channel is occupied, reduce the output power.
DAS	-	-	Char	If the channel is occupied, don't transmit (for example listen before talk). The Clear Channel Assessment might be an equivalent term but is a precondition.

The specifications of the parameters are provided in IEC 62657-2.

8 Management and control services

8.1 General

The primitive name defined on the SAP consists of three fields – SAP, Function, and Operation:

a) SAP

- C-SAP: Control plane SAP;
- M-SAP: Management plane SAP;

b) Function

- Application communication requirements management;
- Wireless communication system and device subscription;
- Wireless communication system and device configuration and control;
- Medium resource management;
- Database access;

c) Operation

- REQ – Request;
- RES – Response to the REQ message;
- CONF – Confirmation;
- IND – Event notification.

The CCP, CCP managed wireless communication applications (CMWCA) and CCP managed wireless devices (CMWD), the SSN and the database can send these primitives depending on the functional behaviour defined for M-SAP and C-SAP.

- A service primitive of type REQ is used whenever a response to the primitive is solicited. If there is an REQ message, it is generally mapped to a REQ on C-SAP/M-SAP.
- A service primitive of type RSP is used in response to a REQ primitive. Moreover, if there is an RSP message, it is generally mapped to an RSP on C-SAP/M-SAP.
- A service primitive of type IND is used at C-SAP or M-SAP for event notification if a response to this primitive is not solicited, and if the primitive is not sent in response to an REQ primitive.

The specific usage of these operation types for the respective control and management functions is specified in 8.2 to 8.6.

8.2 Application communication requirements management services

8.2.1 Supported services

This Subclause 8.2 contains the definition of services that are unique to this application communication requirements management (ACRM) service. The services defined for this ACRM are:

- GetGeneralPlantCharacteristic, see 8.2.2;
- SetGeneralPlantCharacteristic, see 8.2.3;
- GetApplicationCommunicationRequirements, see 8.2.4;
- GetApplicationCommunicationStatus, see 8.2.5;
- SetApplicationCommunicationReport, see 8.2.6 and
- NotificationApplicationCommunicationstatus, see 8.2.7.

8.2.2 GetGeneralPlantCharacteristic

8.2.2.1 Service overview

GetGeneralPlantCharacteristic service is a confirmed service and uses the M-SAP. The CCP sends the GetGeneralPlantCharacteristic service request attempts to the database. The primitive flow of GetGeneralPlantCharacteristic service is depicted in Figure 12. Legacy engineering and database implementation should be supplemented by a software module for this service.

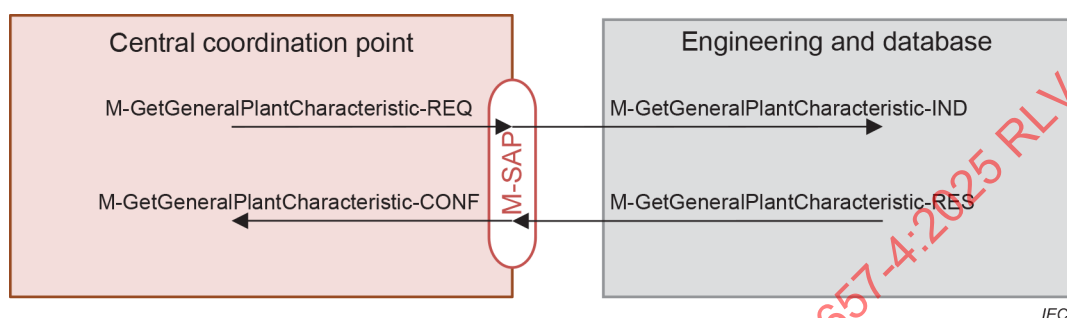


Figure 12 – Primitive flow of GetGeneralPlantCharacteristic

8.2.2.2 Service primitives

The service parameters for GetGeneralPlantCharacteristic service are shown in Table 6.

Table 6 – GetGeneralPlantCharacteristic service parameters

Parameter name	Request	Indication	Response	Confirm
Argument				
Destination address	M	M(=)		
Result (+)			S	S(=)
CCP address			M	M(=)
Attribute data			M	M(=)
Regional radio regulations			M	M(=)
Future expansion plan			M	M(=)
Area of operation			M	M(=)
Object movement			M	M(=)
Geographical dimension of the plant			M	M(=)
Natural environmental condition			M	M(=)
Intervisibility			U	U(=)
Frequency band			M	M(=)
Wireless communication solution density			M	M(=)
Interference type			M	M(=)
Limitation from neighbours of the plant			M	M(=)
Result (-)			S	S(=)
Service status			M	M(=)

Argument

The argument contains the parameters of the service request.

Destination address

This parameter specifies the destination address to which the service request is to be sent.

Result (+)

This selection type parameter indicates that the service request succeeded.

CCP address

This parameter specifies the address of the requested CCP. It is present in the response primitive.

Attribute data

This parameter returns a stream of information containing all the attributes.

- regional radio regulations;
- future expansion plan;
- area of operation;
- object movement;
- geographical dimension of the plant;
- natural environmental condition;
- intervisibility;
- frequency band;
- wireless communication solution density;
- interference type;
- limitation from neighbours of the plant.

Result (-)

This selection type parameter indicates that the service request failed.

Service status

This parameter provides information on the result of service execution. It shall be one of ABORTED or TIMEOUT.

8.2.2.3 Service procedure

The GetGeneralPlantCharacteristic request shall send a message to the database, which contains the general plant characteristic from the engineering. When the message arrives at the target device (database), this shall result in a GetGeneralPlantCharacteristic indication at the database. The database, in turn, shall forward the message to the appropriate target object. When the object responds, the database shall forward the response via the GetGeneralPlantCharacteristic response primitive. When the response arrives at the CCP which originated the request, a GetGeneralPlantCharacteristic confirmation shall be returned to the application object which sent the request. The application delivers the requested attributes for plant characterization.

8.2.2.4 Service sequence

The service sequence of GetGeneralPlantCharacteristic service is shown in Figure 13. Alt in the figure means a conditional branch on the service sequence.

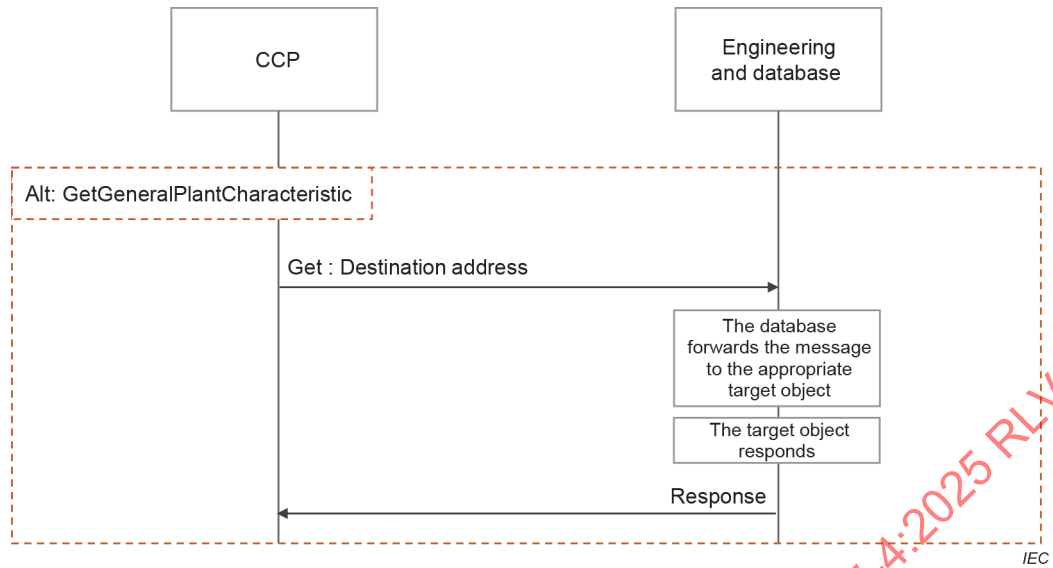


Figure 13 – Sequence diagram (GetGeneralPlantCharacteristic)

8.2.2.5 Service message format

The message format of GetGeneralPlantCharacteristic service shall be according to Table 7.

Table 7 – GetGeneralPlantCharacteristic service message format

Message format	Explanation
<pre> { "Argument": { "Destination address": "02004CAABBDD", "Result (+)": [{ "CCP address": "02004CAABBFF ", "Attribute data": [{ "Regional radio regulations ": "ETSI EN 300 328", "Future expansion plan": " phase 3", "Area of operation": "over the entire factory", "Object movement": "1600", "Geographical dimension of the plant": "[20, 20, 5]" "Natural environmental condition": " temperature, humidity air pressure ", "Intervisibility": "los", "Frequency band": "429, 920", "Wireless communication solution density": "10", "Interference type": "electromagnetic interfering sources", "Limitation from neighbours of the plant": "high power radio source" }], }], "Result (-)": { "Service status": "aborted", } } </pre>	Parameters of the service request. Destination address to which the service request is to be sent. Service request succeeded. CCP address to which the service request is to be sent. Regulation of important coexistence parameters such as frequency band and output power 868 related to the region where the wireless application is intended to be used. Possible installation of new wireless communication solutions and buildings that can affect coexistence. Distinguishing properties of the area where the wireless communication system is operated. Specification of the trajectory of mobile assets that can significantly influence the radio propagation conditions. Length, width and height of the intended space of the wireless system. Condition that surrounds the wireless device and wireless system. Property of a logical link that describes a possible influence on radio signal propagation by obstruction, refraction or reflection. Ratio of the number of wireless communication solutions and the spatial coverage of the plant. Kind of unwanted energy caused by a certain source or Application. Description of the neighbours of the plant that are likely to cause limitations for wireless communication. Service request failed. Information on the result of service execution.

8.2.3 SetGeneralPlantCharacteristic

8.2.3.1 Service overview

SetGeneralPlantCharacteristic service is a confirmed service and uses the M-SAP. The user sends via user interface a SetGeneralPlantCharacteristic service request to CCP. The primitive flow of SetGeneralPlantCharacteristic service is depicted in Figure 14.

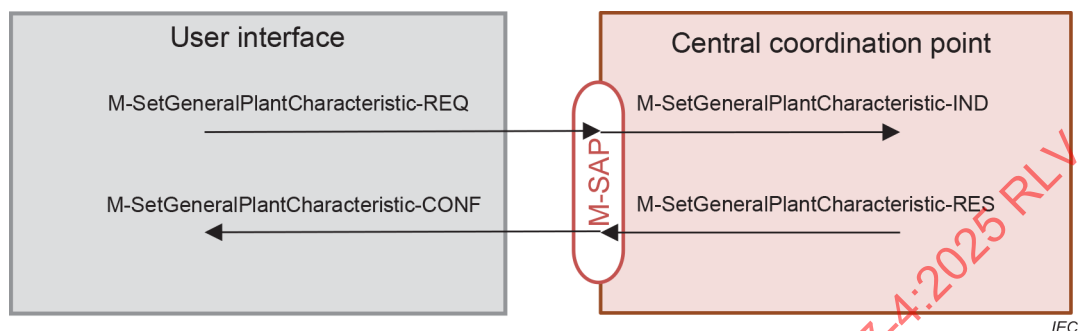


Figure 14 – Primitive flow of SetGeneralPlantCharacteristic

8.2.3.2 Service primitives

The service parameters for SetGeneralPlantCharacteristic service are shown in Table 8.

Table 8 – SetGeneralPlantCharacteristic service parameters

Parameter name	Request	Indication	Response	Confirm
Argument				
Destination address	M	M(=)		
Attribute data			M	M(=)
Regional radio regulations			M	M(=)
Future expansion plan			M	M(=)
Area of operation			M	M(=)
Object movement			M	M(=)
Geographical dimension of the plant			M	M(=)
Natural environmental condition			M	M(=)
Intervisibility			U	U(=)
Frequency band			M	M(=)
Wireless communication solution density			M	M(=)
Interference type			M	M(=)
Limitation from neighbours of the plant			M	M(=)
Result (+)			S	S(=)
			-	-
Result (-)			S	S(=)
Service status			M	M(=)

Argument

The argument contains the parameters of the service request.

Destination address

This parameter specifies the destination address to which the service request is to be sent.

Attribute data

This parameter returns a stream of information containing all the attributes.

- regional radio regulations;
- future expansion plan;
- area of operation;
- object movement;
- geographical dimension of the plant;
- natural environmental condition;
- intervisibility;
- frequency band;
- wireless communication solution density;
- interference type;
- limitation from neighbours of the plant.

Result (+)

This selection type parameter indicates that the service request succeeded.

Result (-)

This selection type parameter indicates that the service request failed.

Service status

This parameter provides information on the result of service execution. It shall be one of ABORTED or TIMEOUT.

8.2.3.3 Service procedure

The SetGeneralPlantCharacteristic request shall send a message to the CCP, which contains the general plant characteristic from the engineering. When the message arrives at the target device (CCP), this shall result in a SetGeneralPlantCharacteristic indication at the CCP. The CCP, in turn, shall forward the message to the appropriate target object. When the object responds, the CCP shall forward the response via the SetGeneralPlantCharacteristic response primitive. When the response arrives at the user interface which originated the request, a SetGeneralPlantCharacteristic confirmation shall be returned to the application object which sent the request.

8.2.3.4 Service sequence

The service sequence of SetGeneralPlantCharacteristic service is shown in Figure 15.

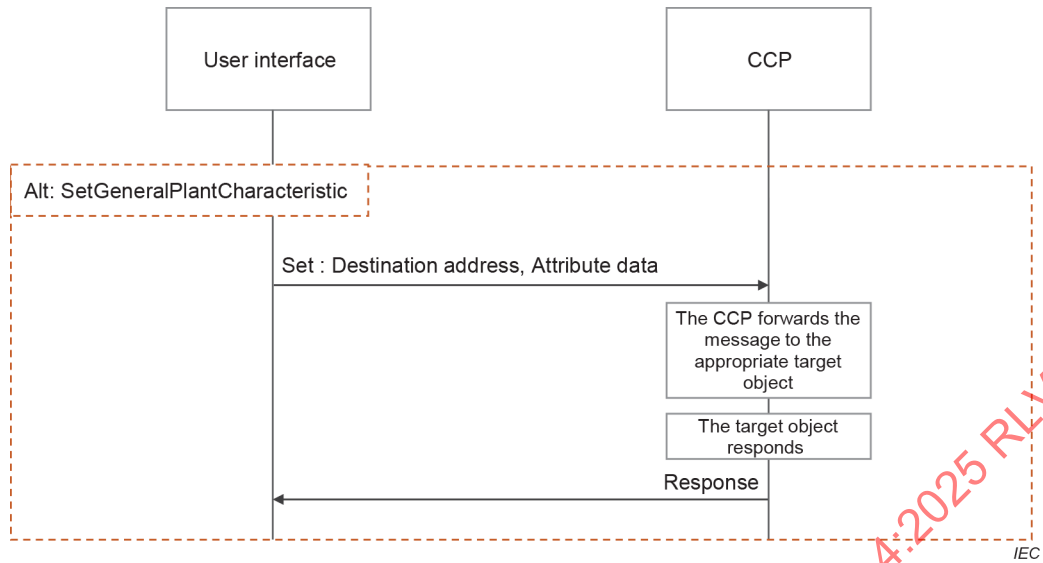


Figure 15 – Sequence diagram (SetGeneralPlantCharacteristic)

8.2.3.5 Service message format

The message format of `SetGeneralPlantCharacteristic`. service shall be according to Table 9.

Table 9 – SetGeneralPlantCharacteristic service message format

Message format	Explanation
<pre> { "Argument": [{ "Destination address": "02004CAABBDD", "Attribute data": [{ "Regional radio regulations": "xxxxxxx", "Future expansion plan": "ETSI EN 300 328", "Area of operation": "all over the entire factory", "Object movement": "1600", "Geographical dimension of the plant": "[20, 20, 5]" "Natural environmental condition ": "temperature, humidity air pressure", "Intervisibility": "los", "Frequency band": "429, 920", "Wireless communication solution density": "10", "Interference type": "electromagnetic interfering sources", "Limitation from neighbours of the plant": "high power radio source" }], }], "Result (+)": "Result (-)": { "Service status": "aborted", }, } </pre>	Parameters of the service request. Destination address to which the service request is to be sent. Regulation of important coexistence parameters such as frequency band and output power related to the region where the wireless application is intended to be used. Possible installation of new wireless communication solutions and buildings that can affect coexistence. Distinguishing properties of the area where the wireless communication system is operated. Specification of the trajectory of mobile assets that can significantly influence the radio propagation conditions. Length, width and height of the intended space of the wireless system. Condition that surrounds the wireless device and wireless system. Property of a logical link that describes a possible influence on radio signal propagation by obstruction, refraction or reflection. Ratio of the number of wireless communication solutions and the spatial coverage of the plant. Kind of unwanted energy caused by a certain source or application. Description of the neighbours of the plant that are likely to cause limitations for wireless communication. Service request succeeded. Service request failed. Information on the result of service execution.

8.2.4 GetApplicationCommunicationRequirements

8.2.4.1 Service overview

GetApplicationCommunicationRequirements service is a confirmed service and uses the M-SAP. The CCP sends a GetApplicationCommunicationRequirements service request to the automation application. The primitive flow of GetApplicationCommunicationRequirements service is depicted in Figure 16. Legacy application implementation should be supplemented by a software module for this service.

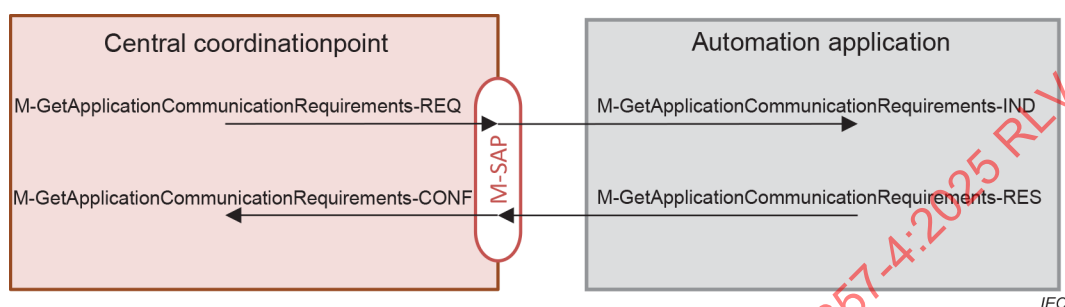


Figure 16 – Primitive flow of GetApplicationCommunicationRequirements

8.2.4.2 Service primitives

The service parameters for GetApplicationCommunicationRequirements service are shown in Table 10.

Table 10 – GetApplicationCommunicationRequirements service parameters

Parameter name	Request	Indication	Response	Confirm
Argument				
Destination address	M	M(=)		
Communication link ID	M	M(=)		
Result (+)			S	S(=)
CCP address			M	M(=)
Communication link ID			M	M(=)
Performance parameter type			M	M(=)
Limits of performance parameter			M	M(=)
Result (-)			S	S(=)
Service status			M	M(=)

Argument

The argument contains the parameters of the service request.

Destination address

This parameter specifies the destination address to which the service request is to be sent. Depending on the destination address, the values of a logical link or average values of a device are provided.

Communication link ID

This parameter specifies the identifier of the communication link. It is present in the request primitive and in the response primitive.

Result (+)

This selection type parameter indicates that the service request succeeded.

CCP address

This parameter specifies the address of the requested CCP. It is present in the response primitive.

Communication link ID

This parameter specifies the identifier of the communication link. It is present in the response primitive.

Performance parameter type

This parameter specifies the type of performance parameter related to communication link ID:

- 1: Transmission time
- 2: Update time
- 3: Response time
- 4: Data throughput
- 5: Communication availability

It is present in the response primitive.

Limits of performance parameter

This parameter specifies the limit value for a performance parameter. It is present in the response primitive.

Result (-)

This selection type parameter indicates that the service request failed.

Service status

This parameter provides information on the result of service execution. It shall be one of ABORTED or TIMEOUT.

8.2.4.3 Service procedure

The GetApplicationCommunicationRequirements request shall send a message to the automation application, which contains the requested communication link ID. When the message arrives at the target device (automation application), this shall result in a GetApplicationCommunicationRequirements indication at the automation application. The automation application, in turn, shall forward the message to the appropriate target object. When the object responds, the automation application shall forward the response via the GetApplicationCommunicationRequirements response primitive. When the response arrives at the CCP which originated the request, a GetApplicationCommunicationRequirements confirmation shall be returned to the object which sent the request.

8.2.4.4 Service sequence

The service sequence of GetApplicationCommunicationRequirements service is shown in Figure 17.

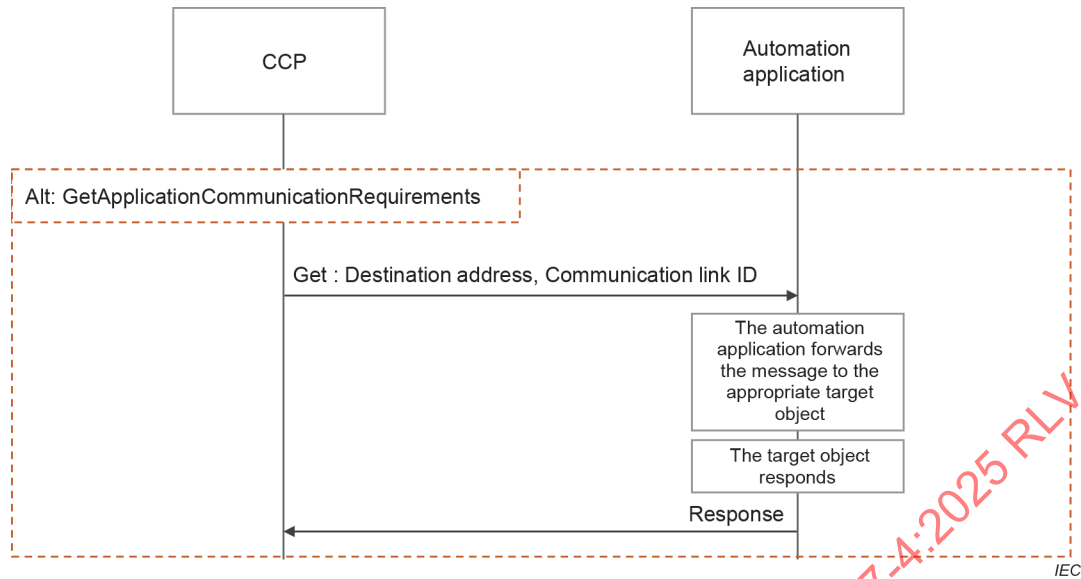


Figure 17 – Sequence diagram (GetApplicationCommunicationRequirements)

8.2.4.5 Service message format

The message format of GetApplicationCommunicationRequirements service shall be according to Table 11.

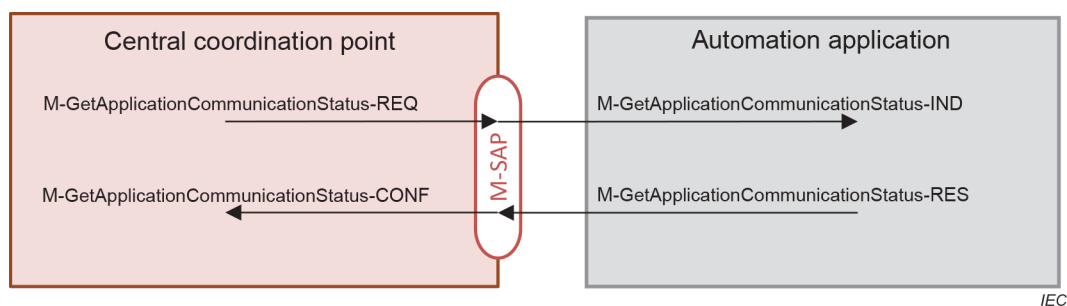
Table 11 – GetApplicationCommunicationRequirements service message format

Message format	Explanation
<pre> { "Argument": [{ "Destination address": "02004CAABBDD", "Communication link ID": "1000" }] "Result (+)": [{ "CCP address": "02004CAABBFF ", "Communication link ID": "1000", "Performance parameter type": 1, "Limits of performance parameter": 0.015 }] "Result (-)": { "Service status": "aborted", } } </pre>	Parameters of the service request. Destination address to which the service request is to be sent. Identifier of the communication link. Service request succeeded. CCP address to which the service request is to be sent. Identifier of the communication link. Type of performance parameter related to communication link ID. Limit value for a performance parameter. Service request failed. Information on the result of service execution.

8.2.5 GetApplicationCommunicationStatus

8.2.5.1 Service overview

GetApplicationCommunicationStatus service is a confirmed service and uses the M-SAP. The CCP sends a GetApplicationCommunicationStatus service request to the automation application. The primitive flow of GetApplicationCommunicationStatus service is depicted in Figure 18. Legacy application implementation should be supplemented by a software module for this service.

**Figure 18 – Primitive flow of GetApplicationCommunicationStatus**

8.2.5.2 Service primitives

The service parameters for GetApplicationCommunicationStatus service are shown in Table 12.

Table 12 – GetApplicationCommunicationStatus service parameters

Parameter name	Request	Indication	Response	Confirm
Argument				
Destination address	M	M(=)		
Communication link ID	M	M(=)		
Result (+)			S	S(=)
CCP address			M	M(=)
Communication link ID			M	M(=)
Performance parameter type			M	M(=)
Statistical values of parameter			M	M(=)
Result (-)			S	S(=)
Service status			M	M(=)

Argument

The argument contains the parameters of the service request.

Destination address

This parameter specifies the destination address to which the service request is to be sent. Depending on the destination address, the values of a logical link or average values of a device are provided.

Communication link ID

This parameter specifies the identifier of the communication link. It is present in the request primitive and in the response primitive.

Result (+)

This selection type parameter indicates that the service request succeeded.

CCP address

This parameter specifies the address of the requested CCP. It is present in the response primitive.

Communication link ID

This parameter specifies the identifier of the communication link. It is present in the response primitive.

Performance parameter type

This parameter specifies the type of performance parameter related to communication link ID:

- 1: Transmission time
- 2: Update time
- 3: Response time
- 4: Data throughput
- 5: Communication availability

It is present in the response primitive.

Statistical values of parameter

This parameter specifies the statistical values of the performance parameter. It is present in the response primitive.

Result (-)

This selection type parameter indicates that the service request failed.

Service status

This parameter provides information on the result of service execution. It shall be one of ABORTED or TIMEOUT.

8.2.5.3 Service procedure

The GetApplicationCommunicationStatus request shall send a message to the automation application, which contains the requested communication link ID. When the message arrives at the target device (automation application), this shall result in a GetApplicationCommunicationStatus indication at the automation application. The automation application, in turn, shall forward the message to the appropriate target object. When the object responds, the automation application shall forward the response via the GetApplicationCommunicationStatus response primitive. When the response arrives at the CCP which originated the request, a GetApplicationCommunicationStatus confirmation shall be returned to the object which sent the request.

8.2.5.4 Service sequence

The service sequence of GetApplicationCommunicationStatus service is shown in Figure 19.

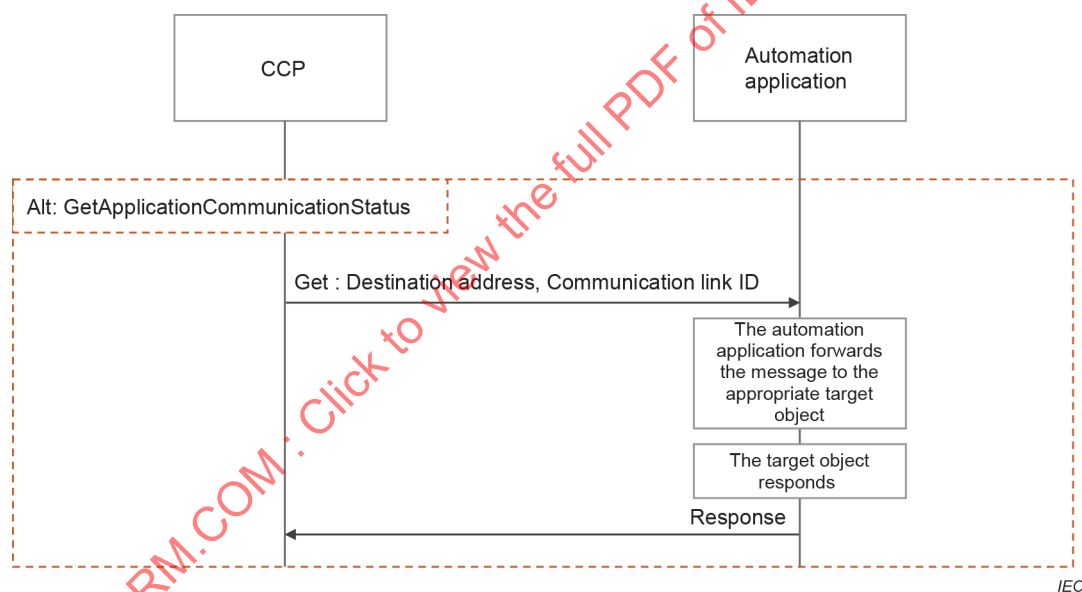


Figure 19 – Sequence diagram (GetApplicationCommunicationStatus)

8.2.5.5 Service message format

The message format of GetApplicationCommunicationStatus service shall be according to Table 13.

Table 13 – GetApplicationCommunicationStatus service message format

Message format	Explanation
<pre>{ "Argument": [{ "Destination address": "02004CAABBDD", "Communication link ID": "1000" }] "Result (+)": [{ "CCP address": "02004CAABBFF", "Communication link ID": "1000", "Performance parameter type": 1, "Statistical values of parameter": 0.8 }] "Result (-)": { "Service status": "aborted", } }</pre>	Parameters of the service request. Destination address to which the service request is to be sent. Identifier of the communication link. Service request succeeded. CCP address to which the service request is to be sent. Identifier of the communication link. Type of performance parameter related to communication link ID. Statistical values of the performance parameter. Service request failed. Information on the result of service execution.

8.2.6 SetApplicationCommunicationReport

8.2.6.1 Service overview

SetApplicationCommunicationReport service a set of primitives for setting periodically or event driven management resource reports procedures at automation application.

SetApplicationCommunicationReport service is a confirmed service and uses the M-SAP.

The CCP sends the Set application Communication Report service request attempts to automation application.

The primitive flow of SetApplicationCommunicationReport service is depicted in Figure 20.

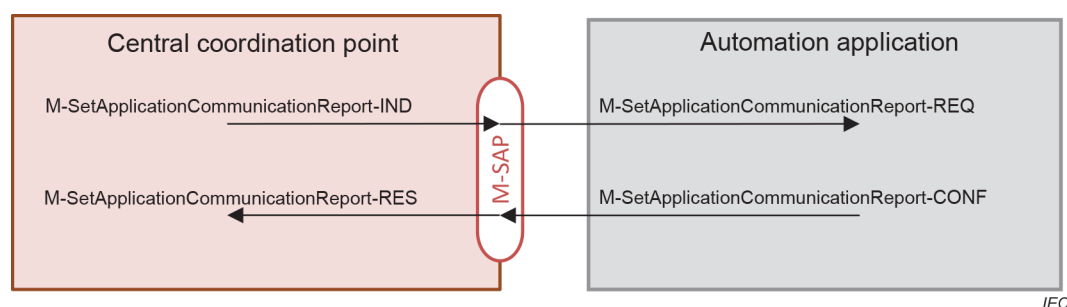


Figure 20 – Primitive flow of SetApplicationCommunicationReport

8.2.6.2 Service primitives

The service parameters for SetApplicationCommunicationReport service are shown in Table 14.

Table 14 – SetApplicationCommunicationReport service parameters

Parameter name	Request	Indication	Response	Confirm
Argument				
Destination address	M	M(=)		
Performance report type	M	M(=)		
Report interval	M	M(=)		
Assessment interval	M	M(=)		
Result (+)			S	S(=)
CCP address			M	M(=)
Performance Assessment entity ID			M	M(=)
Result (-)			S	S(=)
Service status			M	M(=)

Argument

The argument contains the parameters of the service request.

Destination address

This parameter specifies the destination address to which the service request is to be sent.

Performance report type

This parameter specifies the generation type of Performance report (Notification Application Communication status). The report types are event driven, cyclic or requested. It is present in the request primitive.

- 1: Transmission time
- 2: Update time
- 3: Response time
- 4: Data throughput
- 5: Communication availability

Report interval

This parameter specifies the interval time of cyclic reports, if the performance report type is cyclic.

Assessment interval

This parameter specifies the interval between performance assessment processes.

Result (+)

This selection type parameter indicates that the service request succeeded.

CCP address

This parameter specifies the address of the requested CCP. It is present in the response primitive.

Performance Assessment entity ID

This parameter specifies the identifier of the Performance Assessment entity ID either automation application.

Result (-)

This selection type parameter indicates that the service request failed.

Service status

This parameter provides information on the result of service execution. It shall be one of ABORTED or TIMEOUT.

8.2.6.3 Service procedure

The CCP may use this primitive to SetApplicationCommunicationReport at the automation application. The SetApplicationCommunicationReport request shall send a message to the automation application. When the message arrives at the target automation application, this shall result in a SetApplicationCommunicationReport indication at the automation application. The automation application shall forward the message to the appropriate target objects. When the object responds, the automation application shall forward the response via the SetApplicationCommunicationReport response primitive. When the response arrives at the device which originated the request, a SetApplicationCommunicationReport confirmation shall be returned to the application object which sent the request.

8.2.6.4 Service sequence

The service sequence of SetApplicationCommunicationStatus service is shown in Figure 21.

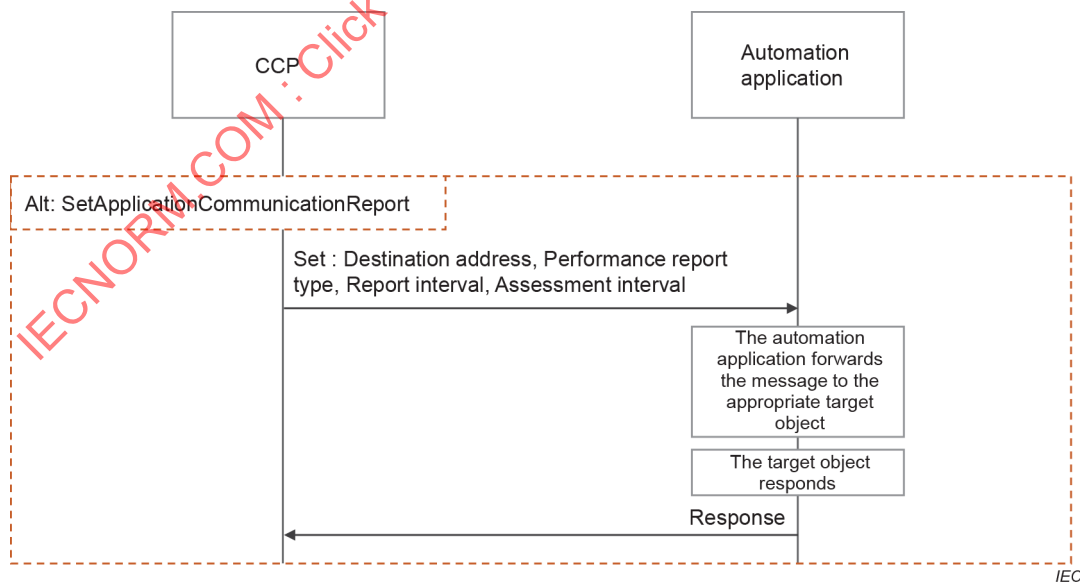


Figure 21 – Sequence diagram (SetApplicationCommunicationReport service parameters)

8.2.6.5 Service message format

The message format of SetApplicationCommunicationStatus service shall be according to Table 15.

Table 15 – SetApplicationCommunicationReport service message format

Message format	Explanation
<pre>{ "Argument": [{ "Destination address": "02004CAABBDD", "Communication link ID": "1000" }] "Result (+)": [{ "CCP address": "02004CAABBDD", "Performance Assessment entity ID": "A6000", }] "Result (-)": { "Service status": "aborted", } }</pre>	Parameters of the service request. Destination address to which the service request is to be sent. Identifier of the communication link. Service request succeeded. CCP address to which the service request is to be sent. Identifier of the Performance Assessment entity ID either automation application. Service request failed. Information on the result of service execution.

8.2.7 NotificationApplicationCommunicationstatus

8.2.7.1 Service overview

NotificationApplicationCommunicationstatus service uses a primitive for supporting coexistence assessment reports from automation application to CCP.

NotificationApplicationCommunicationstatus service is an unconfirmed service and uses the M-SAP. The automation application sends the Application Communication status service attempts to CCP.

The primitive flow of NotificationApplicationCommunicationstatus service is depicted in Figure 22.

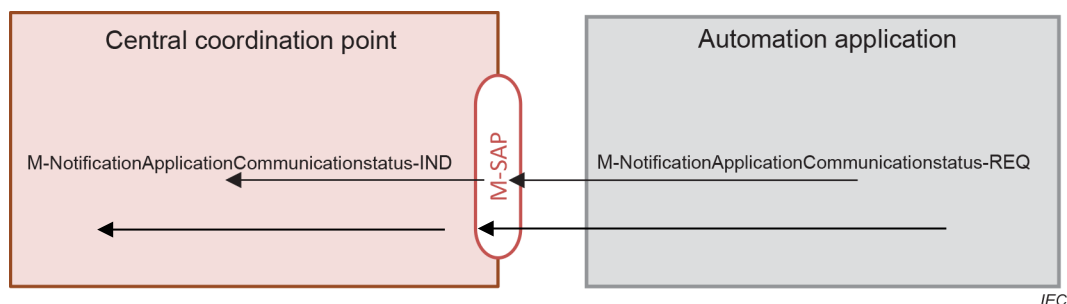


Figure 22 – Primitive flow of NotificationApplicationCommunicationstatus

8.2.7.2 Service primitives

The service parameters for NotificationApplicationCommunicationstatus service are shown in Table 16.

Table 16 – NotificationApplicationCommunicationstatus service parameters

Parameter name	Request	Indication	Response	Confirm
Argument				
CCP address	M	M(=)		
Communication link ID	M	M(=)		
Attribute data	M	M(=)		
Timestamp	M	M(=)		
Performance parameter type	M	M(=)		
Statistical values of parameter	M	M(=)		

Argument

The argument contains the parameters of the service request.

CCP address

This parameter specifies the address of the requested CCP. It is present in the response primitive.

Communication link ID

This parameter specifies the identifier of the communication link. It is present in the request primitive and in the response primitive.

Attribute data

This parameter returns a stream of information containing all the attributes.

Timestamp

Information concerning time of collected attribute data.

Performance parameter type

This parameter specifies the type of performance parameter related to communication link ID:

- 1: Transmission time
- 2: Update time
- 3: Response time
- 4: Data throughput
- 5: Communication availability

Statistical values of parameter

This parameter specifies the statistical values of the performance parameter.

8.2.7.3 Service procedure

The CCP may configure the NotificationApplicationCommunicationstatus service with the SetApplicationCommunicationstatus service primitive.

The NotificationApplicationCommunicationstatus request shall send a message from the automation application to the CCP. When the message arrives at the target device (CCP), this shall result in a NotificationApplicationCommunicationstatus indication at the CCP. The CCP shall forward the message to the appropriate target object.

8.2.7.4 Service sequence

The service sequence of NotificationApplicationCommunicationstatus service is shown in Figure 23.

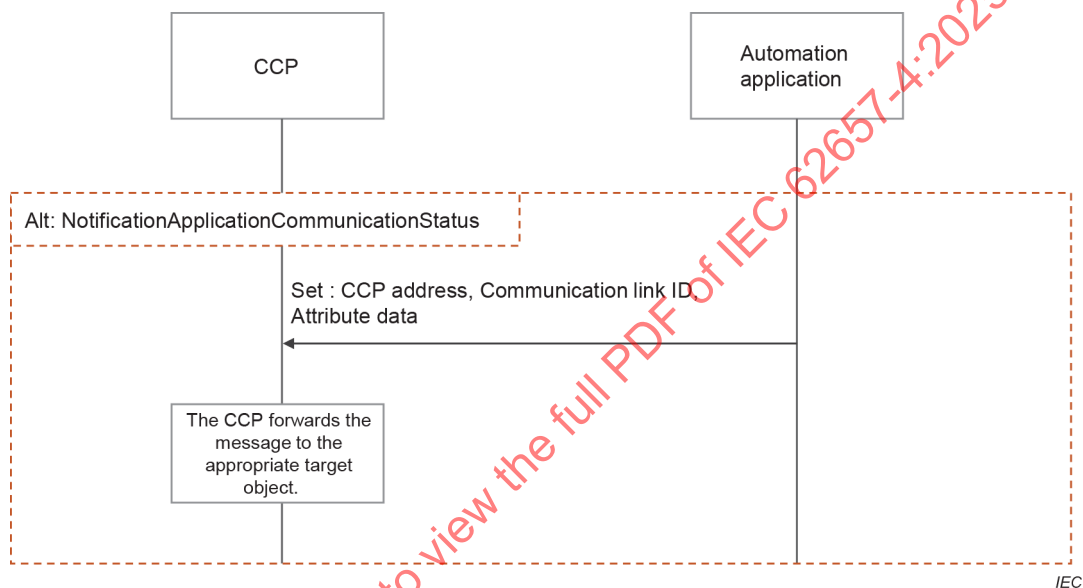


Figure 23 – Sequence diagram (NotificationApplicationCommunicationstatus)

8.2.7.5 Service message format

The message format of NotificationApplicationCommunicationstatus service shall be according to Table 17.

Table 17 – NotificationApplicationCommunicationstatus service message format

Message format	Explanation
<pre> { "Argument": [{ "CCP address": "02004CAABBDD", "Communication link ID": "1000", "Attribute data": [{ "Timestamp": "1569855600", "Performance parameter type": 1, "Statistical values of parameter": 0.8, }], }], } </pre>	Parameters of the service request. CCP address to which the service request is to be sent. Identifier of the communication link. Information concerning time of collected attribute data. Type of performance parameter related to communication link ID. Statistical values of the performance parameter.

8.3 Wireless communication system and device subscription services

8.3.1 Supported services

This Subclause 8.3 contains the definition of services that are unique to this wireless communication system and device subscription (WCSDS). The services defined for this WCSDS are:

- SubscribeDevice, see 8.3.2;
- UnsubscribeDevice, see 8.3.3;
- SubscribeSystem, see 8.3.4;
- UnsubscribeSystem, see 8.3.5;
- GetDeviceAttributes, see 8.3.6.

8.3.2 SubscribeDevice

8.3.2.1 Service overview

SubscribeDevice service is a confirmed service and uses the M-SAP. The CMWD sends the SubscribeDevice service request attempts to CCP. The primitive flow of SubscribeDevice service is depicted in Figure 24.

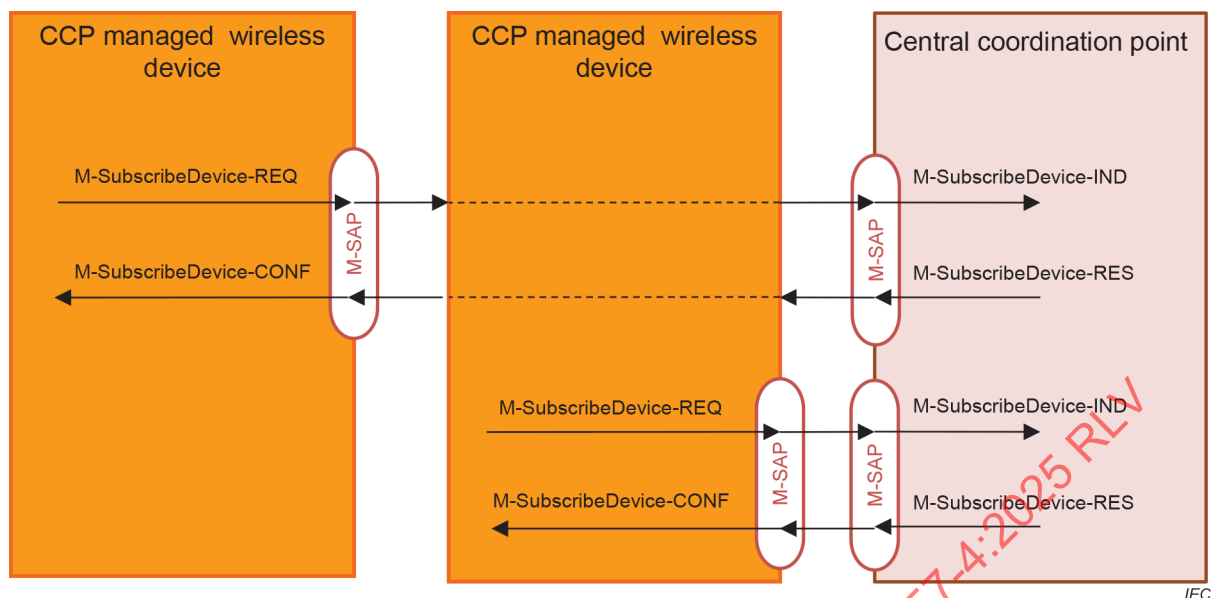


Figure 24 – Primitive flow of SubscribeDevice

8.3.2.2 Service primitives

The service parameters for SubscribeDevice service are shown in Table 18.

Table 18 – SubscribeDevice service parameters

Parameter name	Request	Indication	Response	Confirm
Argument				
Destination address	M	M(=)		
Device type	M	M(=)		
Result (+)			S	S(=)
Device ID			M	M(=)
Status			M	M(=)
Device type			M	M(=)
Device address			M	M(=)
Result (-)			S	S(=)
Service status			M	M(=)

Argument

The argument contains the parameters of the service request.

Destination address

This parameter specifies the destination address to which the service request is to be sent.

Device type

This parameter specifies the type of the requested wireless device. It is present in the request primitive.

Result (+)

This selection type parameter indicates that the service request succeeded.

Device ID

This parameter specifies the identifier of the wireless device.

Status

This parameter specifies the following status of the wireless device.

- 0: no address
- 1: unconfigured
- 2: configured

Device type

This parameter specifies the type of the wireless device. It is present in the response primitive.

Device address

This parameter specifies the address of the requested wireless device. It is present in the response primitive.

Result (-)

This selection type parameter indicates that the service request failed.

Service status

This parameter provides information on the result of service execution. It shall be one of ABORTED or TIMEOUT.

8.3.2.3 Service procedure

The SubscribeDevice request shall send a message to the CCP. When the message arrives at the target device (CCP), this shall result in a SubscribeDevice indication at the CCP. The CCP, in turn, shall forward the message to the appropriate target object. When the object responds, the CCP shall forward the response via the SubscribeDevice response primitive. When the response arrives at the device which originated the request, a SubscribeDevice confirmation shall be returned to the application object which sent the request.

8.3.2.4 Service sequence

The service sequence of SubscribeDevice service is shown in Figure 25.

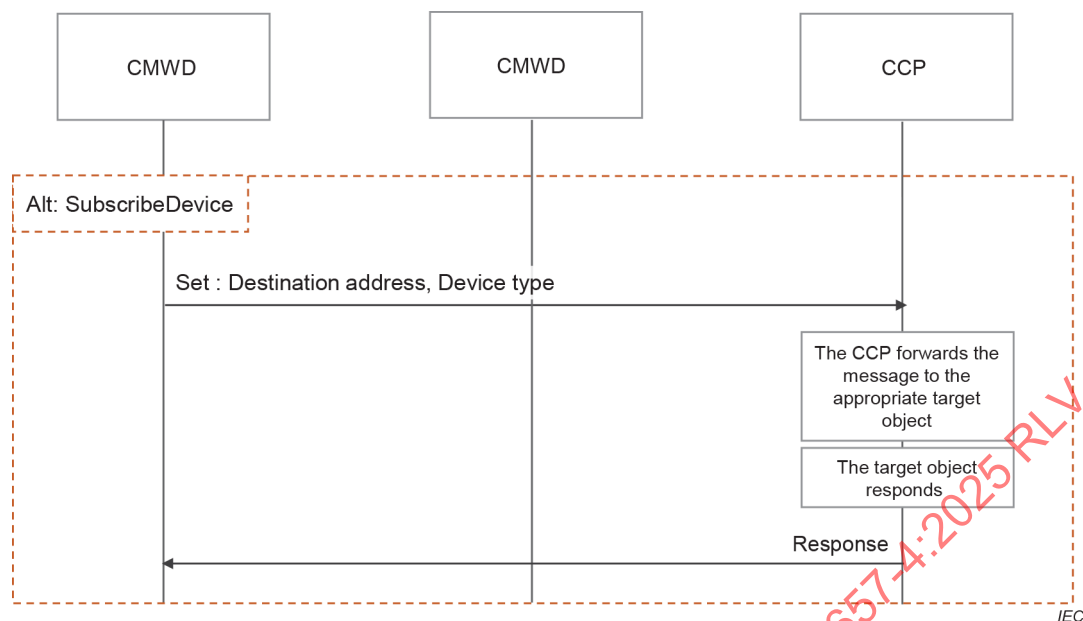


Figure 25 – Sequence diagram (SubscribeDevice)

8.3.2.5 Service message format

The message format of SubscribeDevice service shall be according to Table 19.

Table 19 – SubscribeDevice service message format

Message format	Explanation
<pre> { "Argument": [{ "Destination address": "02004CAABBDD", "Device type": "ABC 36, ABC company, version 3.0" }] "Result (+)": [{ "Device ID": "A3000", "Status": "connect", "Device type": "ABC 36, ABC company, version 3.0", "Device address": "02004CAABBGG" }] "Result (-)": { "Service status": "aborted", } } </pre>	Parameters of the service request. Destination address to which the service request is to be sent. Type of the requested wireless device. Service request succeeded. Identifier of the wireless device. Status of the wireless device. Type of the wireless device. Address of the requested wireless device. Service request failed. Information on the result of service execution.

8.3.3 UnsubscribeDevice

8.3.3.1 Service overview

UnsubscribeDevice service is a confirmed service and uses the M-SAP. The CCP sends the UnsubscribeDevice service request attempts to CMWD. The primitive flow of UnsubscribeDevice service is depicted in Figure 26.

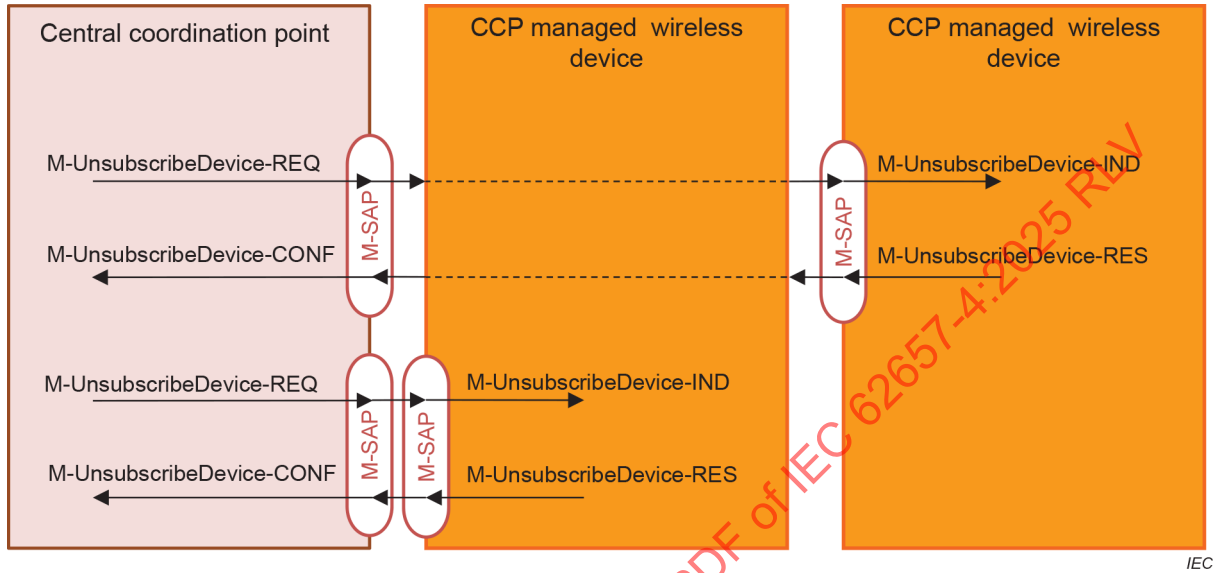


Figure 26 – Primitive flow of UnsubscribeDevice

8.3.3.2 Service primitives

The service parameters for UnsubscribeDevice service are shown in Table 20.

Table 20 – UnsubscribeDevice service parameters

Parameter name	Request	Indication	Response	Confirm
Argument				
Destination address	M	M(=)		
Device type	M	M(=)		
Device ID	M	M(=)		
Result (+)			S	S(=)
Device ID			M	M(=)
Status			M	M(=)
Device address			M	M(=)

Argument

The argument contains the parameters of the service request.

Destination address

This parameter specifies the destination address to which the service request is to be sent.

Device type

This parameter specifies the type of the destination wireless device. It is present in the request primitive.

Device ID

This parameter specifies the identifier of the wireless device.

Result (+)

This selection type parameter indicates that the service request succeeded.

Device ID

This parameter specifies the identifier of the wireless device.

Status

This parameter specifies the unsubscribe status of the wireless device.

Device address

This parameter specifies the address of the requested wireless device. It is present in the response primitive.

Result (-)

This selection type parameter indicates that the service request failed.

Service status

This parameter provides information on the result of service execution. It shall be one of ABORTED or TIMEOUT.

8.3.3.3 Service procedure

The UnsubscribeDevice request shall send a message to the CMWD. When the message arrives at the target device (CMWD), this shall result in an UnsubscribeDevice indication at the CMWD. The CMWD, in turn, shall forward the message to the appropriate target object. When the object responds, the CCP shall forward the response via the UnsubscribeDevice response primitive. When the response arrives at the device which originated the request, an UnsubscribeDevice confirmation shall be returned to the application object which sent the request.

8.3.3.4 Service sequence

The service sequence of UnsubscribeDevice service is shown in Figure 27.

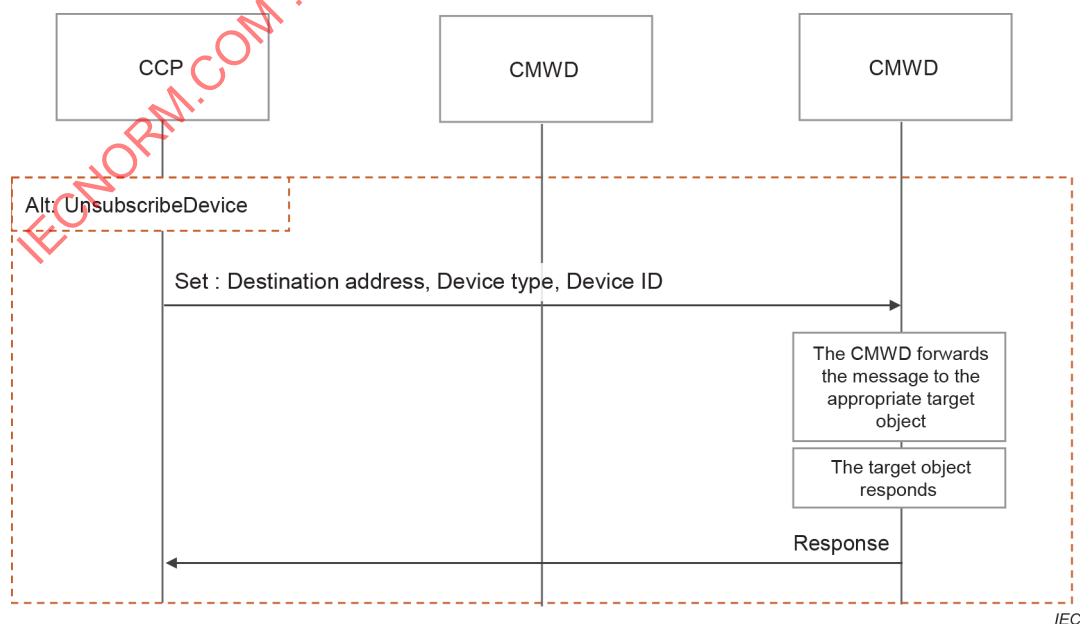


Figure 27 – Sequence diagram (UnsubscribeDevice)

8.3.3.5 Service message format

The message format of UnsubscribeDevice service shall be according to Table 21.

Table 21 – UnsubscribeDeviceservice message format

Message format	Explanation
<pre>{ "Argument": [{ "Destination address": "02004CAABBDD", "Device type": "ABC 36, ABC company, version 3.0", "Device ID": "A3000", }] "Result (+)": [{ "Device ID": "A3000", "Status": "connect", "Device address": "02004CAABBG" }] "Result (-)": { "Service status": "aborted" } }</pre>	Parameters of the service request. Destination address to which the service request is to be sent. Type of the destination wireless device. Identifier of the wireless device. Service request succeeded. Identifier of the wireless device. Unsubscribe status of the wireless device. Address of the requested wireless device. Service request failed. Information on the result of service execution.

8.3.4 SubscribeSystem

8.3.4.1 Service overview

SubscribeSystem service is a confirmed service and uses the M-SAP. The CMWCA sends the SubscribeSystem service request attempts to CCP. The primitive flow of SubscribeSystem service is depicted in Figure 28.

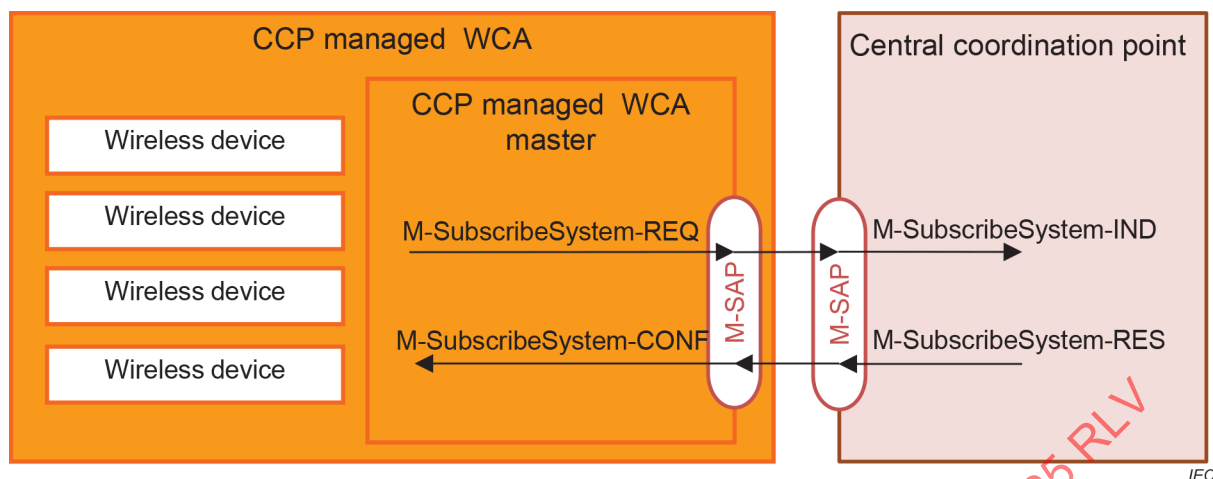


Figure 28 – Primitive flow of SubscribeSystem

8.3.4.2 Service primitives

The service parameters for SubscribeSystem service are shown in Table 22.

Table 22 – SubscribeSystem service parameters

Parameter name	Request	Indication	Response	Confirm
Argument				
Destination address	M	M(=)		
Wireless system type	M	M(=)		
Result (+)			S	S(=)
Wireless system ID			M	M(=)
Status			M	M(=)
Wireless system type			M	M(=)
System address			M	M(=)
Result (-)			S	S(=)
Service status			M	M(=)

Argument

The argument contains the parameters of the service request.

Destination address

This parameter specifies the destination address to which the service request is to be sent.

Wireless system type

This parameter specifies the type of the requested wireless system. It is present in the request primitive.

Result (+)

This selection type parameter indicates that the service request succeeded.

Wireless system ID

This parameter specifies the identifier of the wireless system.

Status

This parameter specifies the following status of the wireless system.

- 0: no address
- 1: unconfigured
- 2: configured

Wireless system type

This parameter specifies the type of the wireless device. It is present in the response primitive.

System address

This parameter specifies the address of the requested wireless device (master station of wireless system). It is present in the response primitive.

Result (-)

This selection type parameter indicates that the service request failed.

Service status

This parameter provides information on the result of service execution. It shall be one of ABORTED or TIMEOUT.

8.3.4.3 Service procedure

The SubscribeSystem request shall send a message to the CCP. When the message arrives at the target device (CCP), this shall result in a SubscribeSystem indication at the CCP. The CCP, in turn, shall forward the message to the appropriate target object. When the object responds, the CCP shall forward the response via the SubscribeSystem response primitive. When the response arrives at the device which originated the request, a SubscribeSystem confirmation shall be returned to the application object which sent the request.

8.3.4.4 Service sequence

The service sequence of SubscribeSystem service is shown in Figure 29.

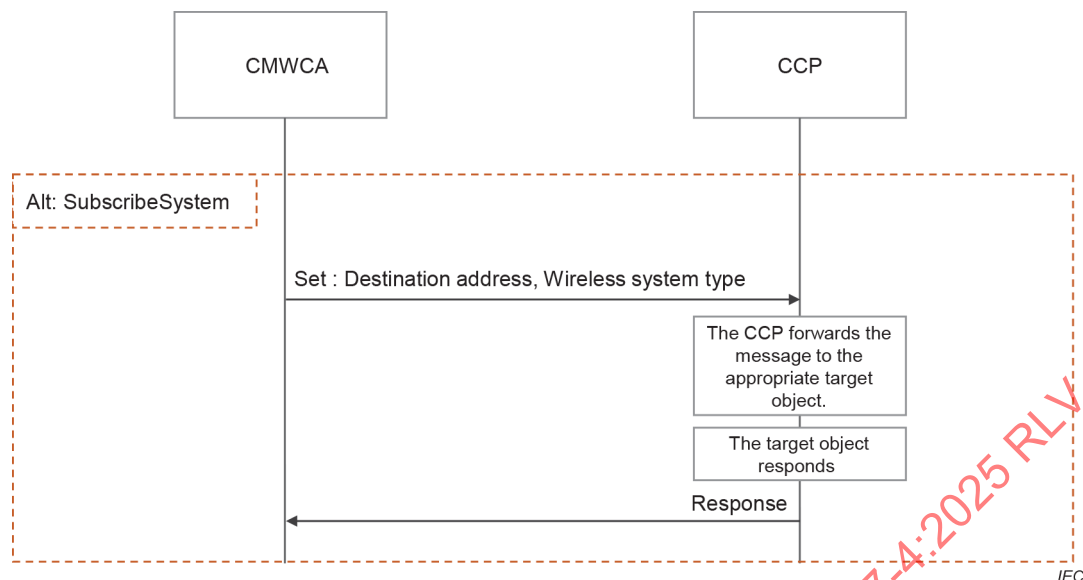


Figure 29 – Sequence diagram (SubscribeSystem)

8.3.4.5 Service message format

The message format of SubscribeSystem service shall be according to Table 23.

Table 23 – SubscribeSystem service message format

Message format	Explanation
<pre> { "Argument": [{ "Destination address": "02004CAABBDD" }, { "Wireless system type": "IEC 62591" }] } </pre>	Parameters of the service request. Destination address to which the service request is to be sent. Type of the requested wireless system.
<pre> "Result (+)": [{ "Wireless system ID": "5555", "Status": "connect", "Wireless system type": "IEC 62591", "System address": "02004CAABBHH" }] </pre>	Service request succeeded. Identifier of the wireless system. Status of the wireless system. Type of the wireless device. Address of the requested wireless device (master station of wireless system).
<pre> "Result (-)": { "Service status": "aborted", } </pre>	Service request failed. Information on the result of service execution.

8.3.5 UnsubscribeSystem

8.3.5.1 Service overview

UnsubscribeSystem service is a confirmed service and uses the M-SAP. The CCP sends the UnsubscribeSystem service request attempts to CMWCA. The primitive flow of UnsubscribeSystem service is depicted in Figure 30.

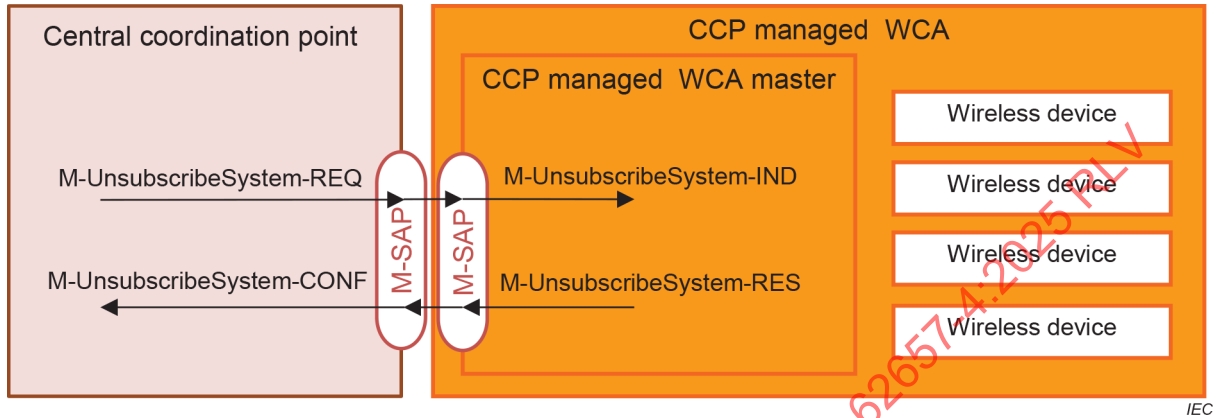


Figure 30 – Primitive flow of UnsubscribeSystem

8.3.5.2 Service primitives

The service parameters for UnsubscribeSystem service are shown in Table 24.

Table 24 – UnsubscribeSystem service parameters

Parameter name	Request	Indication	Response	Confirm
Argument				
Destination address	M	M(=)		
Wireless system type	M	M(=)		
Wireless system ID	M	M(=)		
Result (+)			S	S(=)
Wireless system ID			M	M(=)
Status			M	M(=)
System address			M	M(=)
Result (-)			S	S(=)
Service status			M	M(=)

Argument

The argument contains the parameters of the service request.

Destination address

This parameter specifies the destination address to which the service request is to be sent.

Wireless system type

This parameter specifies the type of the destination wireless system. It is present in the request primitive.

Wireless system ID

This parameter specifies the identifier of the wireless system.

Result (+)

This selection type parameter indicates that the service request succeeded.

Wireless system ID

This parameter specifies the identifier of the wireless system.

Status

This parameter specifies the unsubscribe status of the wireless device.

System address

This parameter specifies the address of the requested wireless device (master station of wireless system). It is present in the response primitive.

Result (-)

This selection type parameter indicates that the service request failed.

Service status

This parameter provides information on the result of service execution. It shall be one of ABORTED or TIMEOUT.

8.3.5.3 Service procedure

The UnsubscribeSystem request shall send a message to the CMWCA. When the message arrives at the target device (master station of CMWCA), this shall result in an UnsubscribeSystem indication at the CMWCS. The CMWCA, in turn, shall forward the message to the appropriate target object. When the object responds, the CCP shall forward the response via the UnsubscribeSystem response primitive. When the response arrives at the device which originated the request, an UnsubscribeSystem confirmation shall be returned to the application object which sent the request.

8.3.5.4 Service sequence

The service sequence of UnsubscribeSystem service is shown in Figure 31.

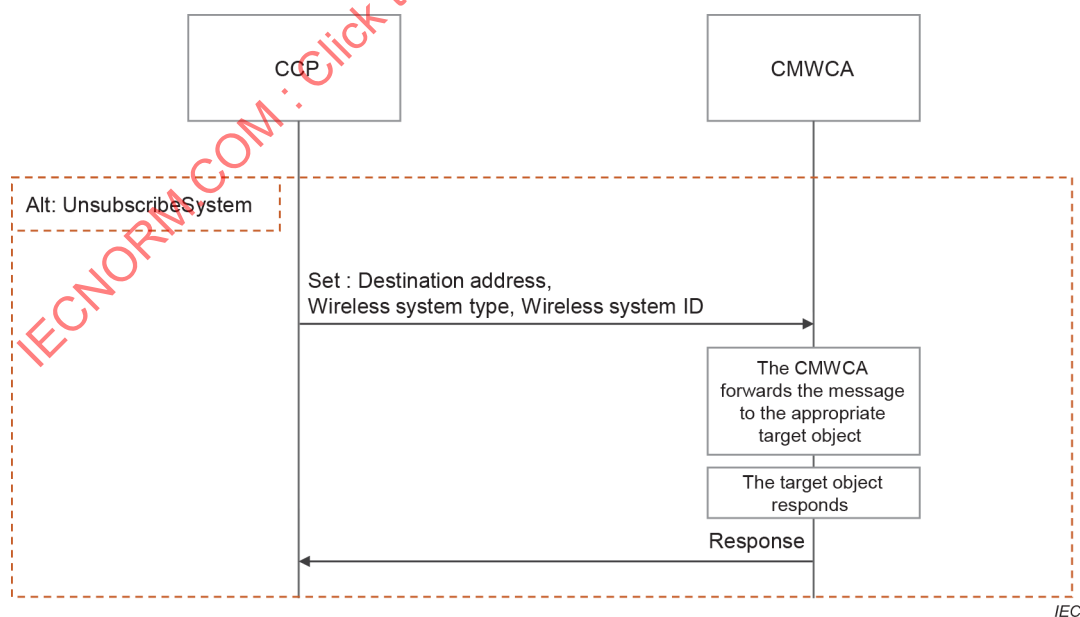


Figure 31 – Sequence diagram (UnsubscribeSystem)

8.3.5.5 Service message format

The message format of UnsubscribeSystem service shall be according to Table 25.

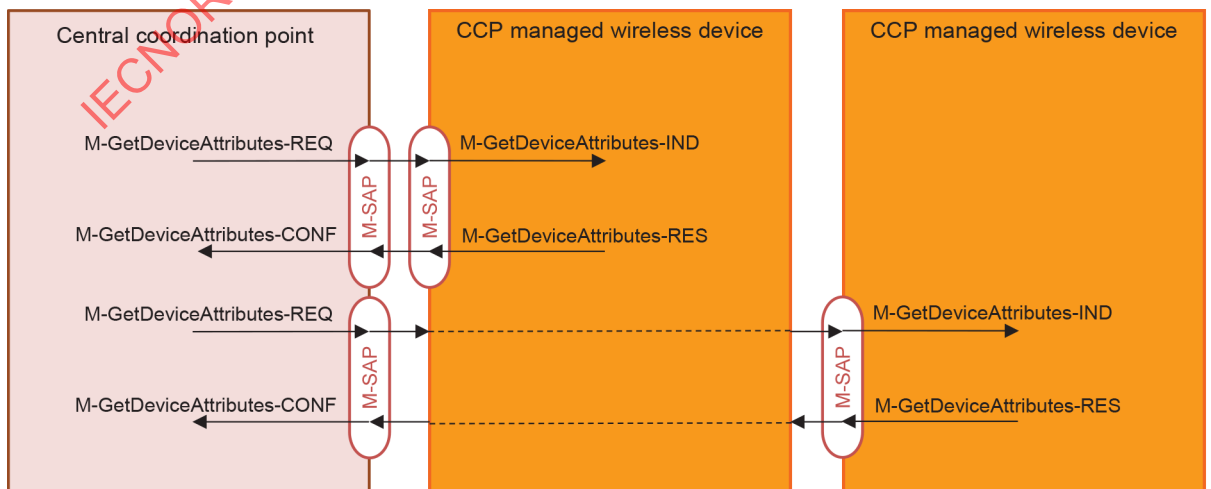
Table 25 – UnsubscribeSystemservice message format

Message format	Explanation
<pre>{ "Argument": [{ "Destination address": "02004CAABDD", "Wireless system type": "IEC 62591", "Wireless system ID": "5555" }] "Result (+)": [{ "Wireless system ID": "5555", "Status": "connect", "System address": "02004CAABHH" }] "Result (-)": { "Service status": "aborted", } }</pre>	Parameters of the service request. Destination address to which the service request is to be sent. Type of the destination wireless system. Identifier of the wireless system. Service request succeeded. Identifier of the wireless system. Unsubscribe status of the wireless device. Address of the requested wireless device (master station of wireless system). Service request failed. Information on the result of service execution.

8.3.6 GetDeviceAttributes

8.3.6.1 Service overview

GetDeviceAttributes service is a confirmed service and returns the content of all attributes. GetDeviceAttributes service uses the M-SAP. The CCP sends the GetDeviceAttributes service request to CMWD. The primitive flow of GetDeviceAttributes service is depicted in Figure 32.



IEC

Figure 32 – Primitive flow of GetDeviceAttributes

8.3.6.2 Service primitives

The service parameters for GetDeviceAttributes service are shown in Table 26.

Table 26 – GetDeviceAttributes service parameters

Parameter name	Request	Indication	Response	Confirm
Argument				
Destination address	M	M(=)		
Device ID	M	M(=)		
Result (+)			S	S(=)
CCP address			M	M
Device ID			M	M(=)
Status			M	M(=)
Attribute data			M	M(=)
Regional radio regulation			M	M(=)
Antenna type			M	M(=)
Antenna gain			U	U(=)
Antenna radiation pattern			U	U(=)
Equivalent radiated power			S	S(=)
Equivalent isotropic radiated power			S	S(=)
Total radiated power			S	S(=)
Transmitter output power			S	S(=)
Power spectral density			U	U(=)
Frequency channel			M	M(=)
Medium access control mechanism			M	M(=)
Frequency hopping sequence			M	M(=)
Communication reliability			U	U(=)
Transfer interval			M	M(=)
Transmission gap			U	U(=)
Transmitter sequence			U	U(=)
Duty cycle			M	M(=)
Dwell time			U	U(=)
Medium Utilization factor			U	U(=)
Adjacent channel selectivity			U	U(=)
Receiver sensitivity			M	M(=)
Receiver maximum input level			U	U(=)
Receiver blocking			U	U(=)
Spurious response			U	U(=)
Result (-)			S	S(=)
Service status			M	M(=)

Argument

The argument contains the parameters of the service request.

Destination address

This parameter specifies the destination address to which the service request is to be sent.

Device ID

This parameter specifies the identifier of the wireless device.

Result (+)

This selection type parameter indicates that the service request succeeded.

CCP address

This parameter specifies the address of the requested CCP. It is present in the response primitive.

Device ID

This parameter specifies the identifier of the wireless device.

Status

This parameter specifies the following status of the wireless device.

Attribute data

This parameter returns a stream of information containing all the relevant attributes of the wireless device.

Result (-)

This selection type parameter indicates that the service request failed.

Service status

This parameter provides information on the result of service execution. It shall be one of ABORTED or TIMEOUT.

8.3.6.3 Service procedure

The GetDeviceAttributes request shall send a message to the CMWD. When the message arrives at the target wireless device (CMWD), this shall result in a GetDeviceAttributes indication at the CMWD. The CMWD, in turn, shall forward the message to the appropriate target object. When the object responds, the CMWD shall forward the response via the GetDeviceAttributes response primitive. When the response arrives at the device which originated the request, a GetDeviceAttributes confirmation shall be returned to the application object which sent the request.

8.3.6.4 Service sequence

The service sequence of GetDeviceAttributes service is shown in Figure 33.

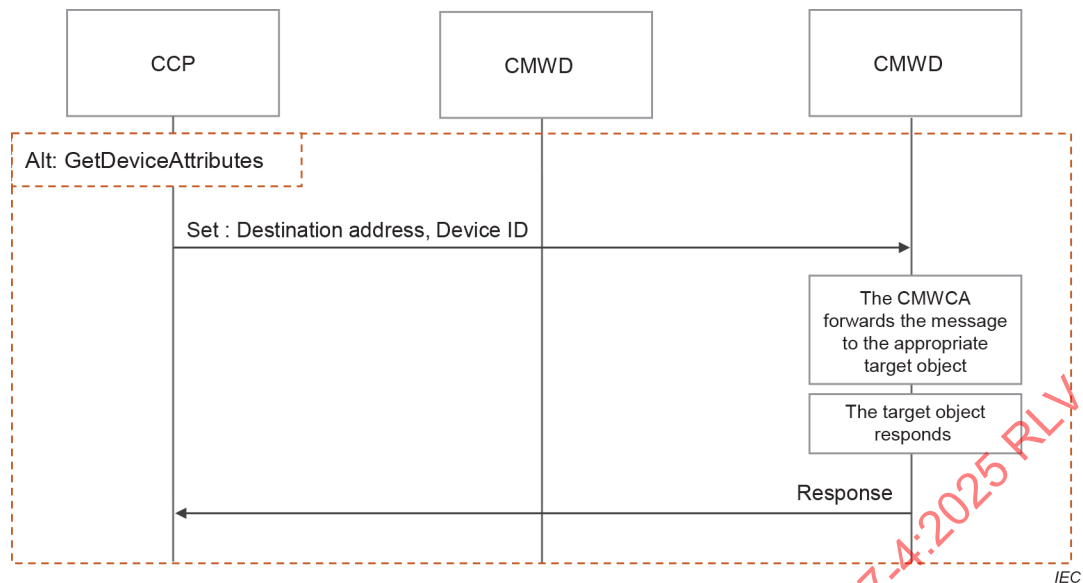


Figure 33 – Sequence diagram (GetDeviceAttributes)

8.3.6.5 Service message format

The message format of GetDeviceAttributes service shall be according to Table 27.

Table 27 – GetDeviceAttributes service message format

Message format	Explanation
<pre> { "Argument": [{ "Destination address": "02004CAABBD", "Device ID": "3000" }], "Result (+)": [{ "CCP address": "02004CAABBFF", "Device ID": "3000", "Status": "connect" "Attribute data": [{ "Regional radio regulation": "ETSI EN 300 328", "Antenna type": "omni-directional", }] }] } </pre>	Parameters of the service request. Destination address to which the service request is to be sent. Identifier of the wireless device. Service request succeeded. Address of the requested CCP. Identifier of the wireless device. Status of the wireless device. Regulation of important coexistence parameters such as frequency band and output power related to the region where the wireless application is intended to be used. Kind of part of a radio transmitting or receiving system which is designed to provide the required coupling between a transmitter or a receiver and the medium in which the radio wave propagates.

Message format	Explanation
"Antenna gain": 2, "Antenna radiation pattern": { "minPhi":0, "phiResolution": 30, "maxPhi": 360, "count": 12, "gain": [1,1,2....2] }, "Equivalent radiated power": "0.07676", "Equivalent isotropic radiated power": "0.126", "Total radiated power": "0.0794", "Transmitter output power": 0.1", "Power spectral density":, { "Array of frequency": [2401, 2412,2406,2417....,2495], "Array of power spectral density": [-83- 83-75....,-45....,-83] } "Frequency channel": "01", "Medium access control mechanism": "CSMA", "Frequency hopping sequence": "1, 04", "Communication reliability": 400, "Transfer interval": 4 "Transmission gap": 0.1, "Transmitter sequence": 0.4,	Ratio of the power required at the input of a reference antenna to the power supplied to the input of the given antenna to produce, in a given direction, the same field strength at the same distance. Variation of the field intensity of an antenna as an angular function with respect to the axis. Product of the power supplied to the antenna and its gain relative to a half-wave dipole in given direction. Product of the power supplied to the antenna and the antenna gain in a given direction relative to an isotropic antenna (absolute or isotropic gain). Spatial power density integrated across the surface of the Sphere. Indicator for transmission range. Distribution as a function of frequency of the power per unit bandwidth of the spectral components of a signal or a noise having a continuous spectrum and a finite mean power. Span of the frequency spectrum which is characterized by lower cut-off frequency and upper cut-off frequency or by centre frequency and frequency Bandwidth. Transmission technique how to access the medium. Sequence of frequency channels used for transmission (hopping sequence) and dwell time. Ability of a physical link and the related nodes to perform communication services under given conditions for a given time interval. Time difference between two consecutive transfers of user data from the automation application via the reference interface to the wireless communication function. Gap between two successive channel usages by a transmitter. Time that a transmitter uses a frequency channel without the

Message format	Explanation
<pre> "Duty cycle": 80, "Dwell time": 0.4, "Medium Utilization factor": 10, "Adjacent channel selectivity": -1, "Receiver sensitivity": -65, "Receiver maximum input level": 20, "Receiver blocking": -34, "Spurious response": 30 }], }], "Result (-)": { "Service status": aborted, } } </pre>	possibility to be interrupted by a wireless device of the same system. Duty cycle per communication link. Period spent at a particular frequency during any single hop of a frequency hopping system. Measure to quantify the amount of resources (power and time) used by non-adaptive equipment. Ability of a radio receiver to respond to the desired signal and to reject signals in adjacent frequency channels. Minimal signal power to receive data with a defined bit error ratio. Maximum signal power that the system can tolerate without distortion of the signal. Effect of a strong interfering signal on the receiver's ability to detect a low-level wanted signal. Receiver output due to unwanted signals Service request failed. Information on the result of service execution.

8.4 Wireless communication system and device configuration and control services

8.4.1 Supported services

This Subclause 8.4 contains the definition of services that are unique to the wireless communication system and device configuration and control (WCSDCC) service. The services defined for this WCSDCC are:

- SetTransmitPower, see 8.4.2;
- SetFrequencyChannel, see 8.4.3;
- SetBandwidth, see 8.4.4;
- SetFrequencyHoppingSequence, see 8.4.5;
- SetBlockedFrequencyList, see 8.4.6;
- SetDwellTime, see 8.4.7;
- SetMediumAccessControlMechanism, see 8.4.8;
- SetDeviceStatus, see 8.4.9;
- GetParameter, see 8.4.10;
- SetParameter, see 8.4.11.

8.4.2 SetTransmitPower

8.4.2.1 Service overview

The SetTransmitPower service uses a set of primitives for supporting control of the CMWCA and CMWD from the CCP. SetTransmitPower service is a confirmed service and uses the C-SAP. The CCP sends the SetTransmitPower service request attempts to CMWD or CMWCA. The primitive flow of SetTransmitPower service is depicted in Figure 34.

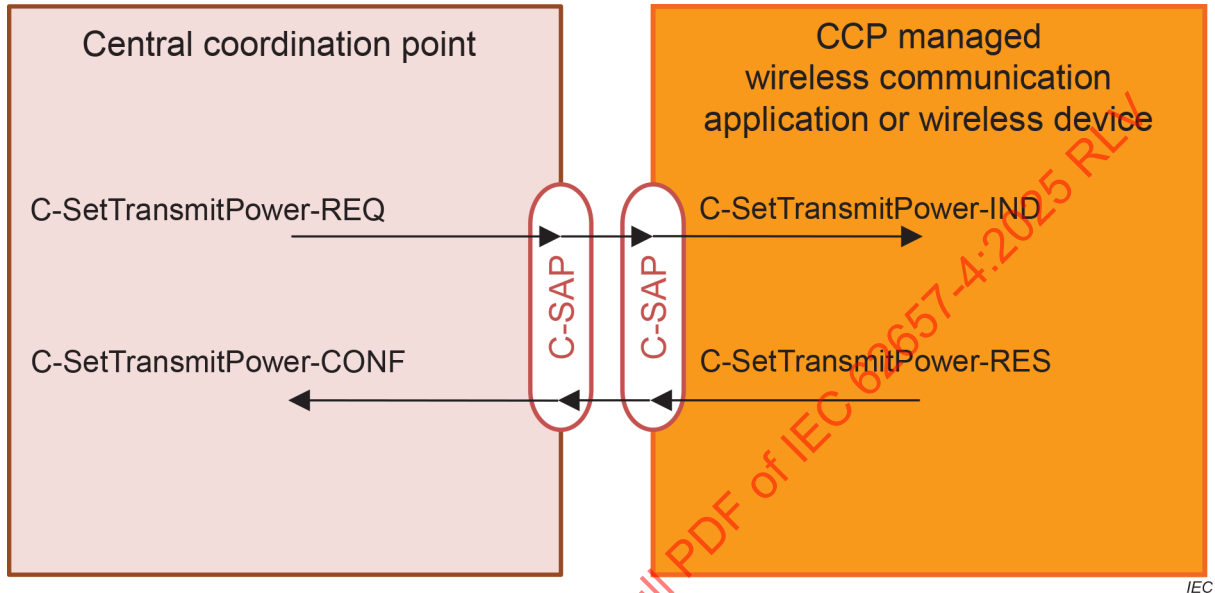


Figure 34 – Primitive flow of SetTransmitPower service

8.4.2.2 Service primitives

The structure of the service primitives is shown in Table 28.

Table 28 – SetTransmitPower service parameter

Parameter name	Request	Indication	Response	Confirm
Argument				
Destination address	M	M(=)		
System or Device ID	M	M(=)		
Transmitter output power	M	M(=)		
Result (+)			S	S(=)
Result (-)			S	S(=)
Service status			M	M(=)

Argument

The argument contains the parameters of the service request.

Destination address

This parameter specifies the destination address to which the service request is to be sent.

System or Device ID

This parameter specifies the identifier of the CMWCA or CMWD entity ID.

Transmit power value

This parameter specifies the value of transmit power.

Result (+)

This selection type parameter indicates that the service request succeeded.

Result (-)

This selection type parameter indicates that the service request failed.

8.4.2.3 Service procedure

The SetTransmitPower request shall send a message from the CCP to the CMWCA or CMWD. When the message arrives at the target wireless device, this shall result in a SetTransmitPower indication at the CMWCA or CMWD. The CCP shall forward the message to the appropriate target object.

8.4.2.4 Service sequence

The service sequence of SetTransmitPower service is shown in Figure 35.

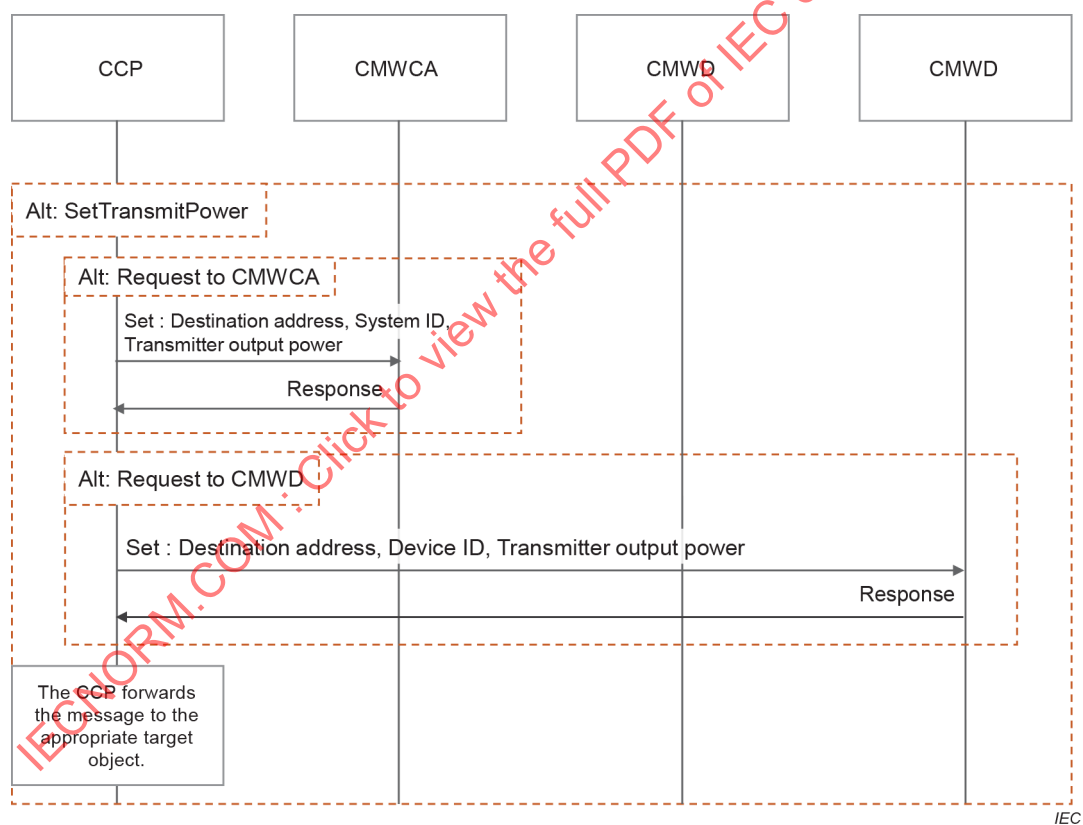


Figure 35 – Sequence diagram (SetTransmitPower)

8.4.2.5 Service message format

The message format of SetTransmitPower service shall be according to Table 29.

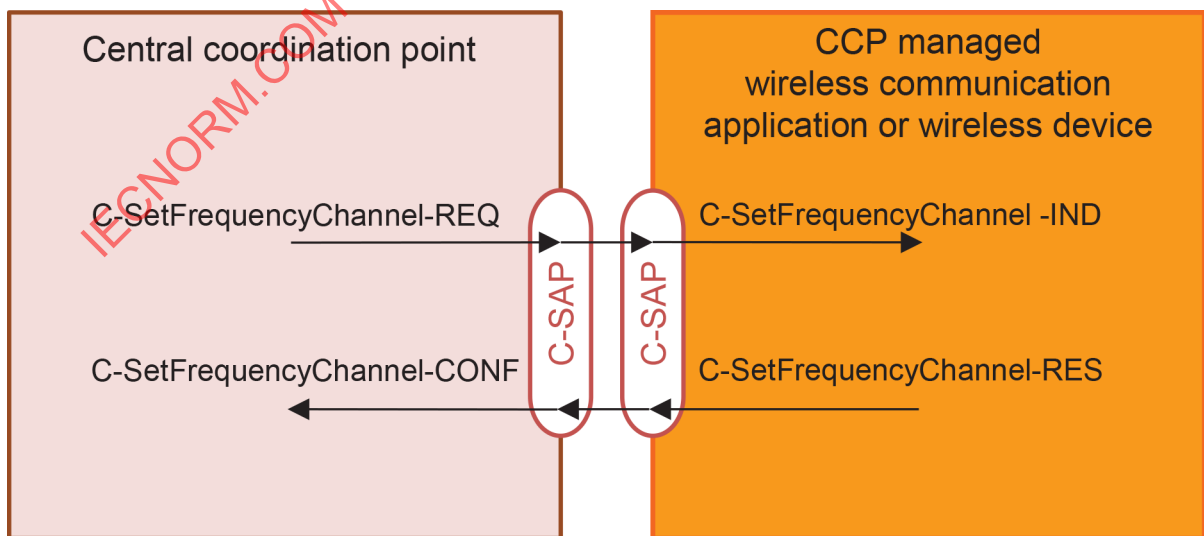
Table 29 – SetTransmitPowerservice message format

Message format	Explanation
<pre>{ "Argument": [{ "Destination address": "02004CAABBDD", "System or Device ID": "A3000", "Transmitter output power": 0.01 }], "Result (+)": "Result (-)": { "Service status": "aborted", } }</pre>	Parameters of the service request. Destination address to which the service request is to be sent. Identifier of the CMWCA or CMWD entity ID. Value of transmit power. Service request succeeded. Service request failed. Information on the result of service execution.

8.4.3 SetFrequencyChannel

8.4.3.1 Service overview

The SetFrequencyChannel service uses a set of primitives for supporting control of the CMWCA and CMWD from the CCP. SetFrequencyChannel service is a confirmed service and uses the C-SAP. The CCP sends the SetFrequencyChannel service request attempts to CMWD or CMWCA. The primitive flow of SetFrequencyChannel service is depicted in Figure 36.



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Figure 36 – Primitive flow of SetFrequencyChannel service

8.4.3.2 Service primitives

The structure of the service primitives is shown in Table 30.

Table 30 – SetFrequencyChannel service parameter

Parameter name	Request	Indication	Response	Confirm
Argument				
Destination address	M	M(=)		
System or Device ID	M	M(=)		
Frequency channel	M	M(=)		
Result (+)			S	S(=)
Result (-)			S	S(=)
Service status			M	M(=)

Argument

The argument contains the parameters of the service request.

Destination address

This parameter specifies the destination address to which the service request is to be sent.

System or Device ID

This parameter specifies the identifier of the CMWCA or CMWD entity ID.

Frequency channel centre frequency

This parameter specifies the centre frequency of the frequency channel.

Result (+)

This selection type parameter indicates that the service request succeeded.

Result (-)

This selection type parameter indicates that the service request failed.

8.4.3.3 Service procedure

The SetFrequencyChannel request shall send a message from the CCP to the CMWCA or CMWD. When the message arrives at the target wireless device, this shall result in a SetFrequencyChannel indication at the CMWCA or CMWD. The CCP shall forward the message to the appropriate target object.

8.4.3.4 Service sequence

The service sequence of SetFrequencyChannel service is shown in Figure 37.

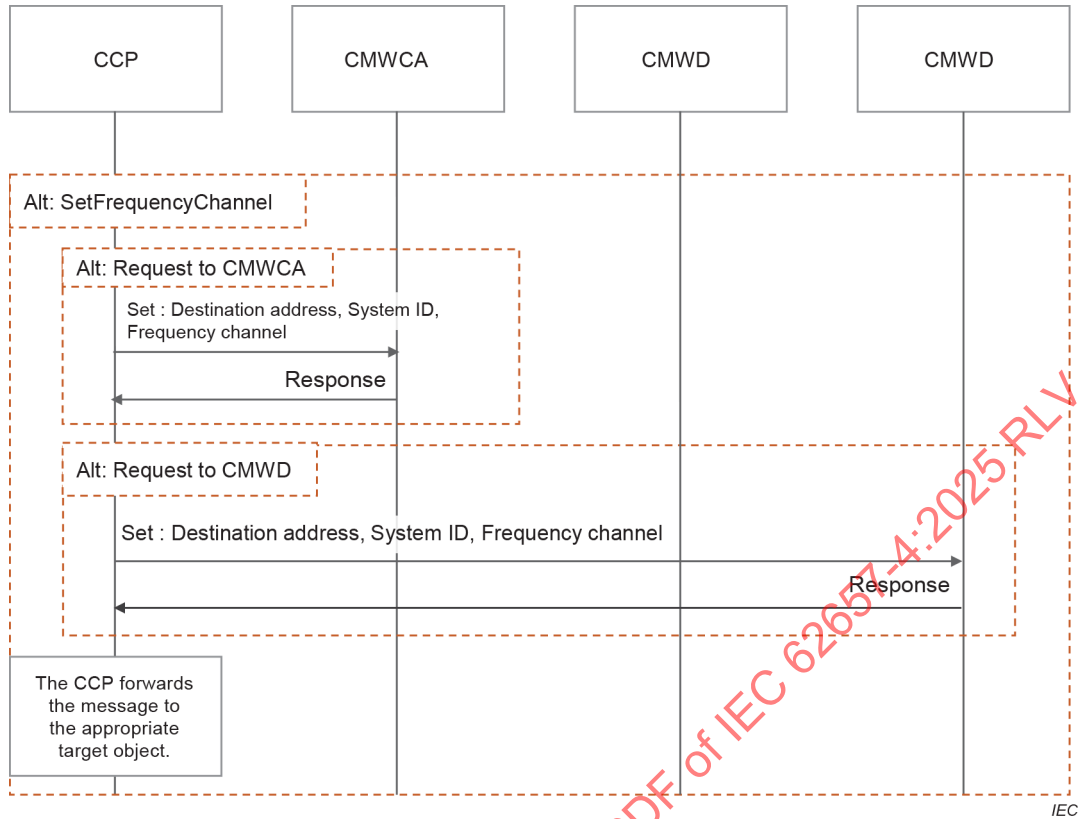


Figure 37 – Sequence diagram (SetFrequencyChannel)

8.4.3.5 Service message format

The message format of SetFrequencyChannel service shall be according to Table 31.

Table 31 – SetFrequencyChannel service message format

Message format	Explanation
<pre> { "Argument": [{ "Destination address": "02004CAABBDD", "System or Device ID": "A3000", "Frequency channel": "01" }], "Result (+)": "Result (-)": { "Service status": "aborted" } } </pre>	Parameters of the service request. Destination address to which the service request is to be sent. Identifier of the CMWCA or CMWD entity ID. Centre frequency of the frequency channel. Service request succeeded. Service request failed. Information on the result of service execution.

8.4.4 SetBandwidth

8.4.4.1 Service overview

The SetBandwidth service uses a set of primitives for supporting control of the CMWCA and CMWD from the CCP. SetBandwidth service is a confirmed service and uses the C-SAP. The CCP sends the SetBandwidth service request attempts to CMWD or CMWCA. The primitive flow of SetBandwidth service is depicted in Figure 38.

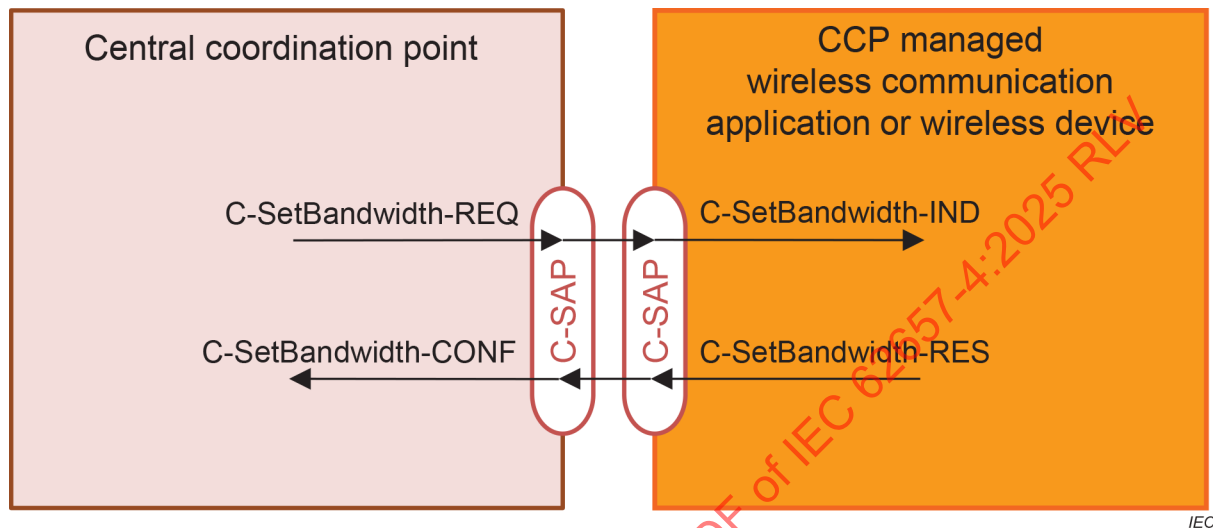


Figure 38 – Primitive flow of SetBandwidth service

8.4.4.2 Service primitives

The structure of the service primitives is shown in Table 32.

Table 32 – SetBandwidth service parameter

Parameter name	Request	Indication	Response	Confirm
Argument				
Destination address	M	M(=)		
System or Device ID	M	M(=)		
Frequency Bandwidth	M	M(=)		
Result (+)			S	S(=)
			-	-
Result (-)			S	S(=)
Service status			M	M(=)

Argument

The argument contains the parameters of the service request.

Destination address

This parameter specifies the destination address to which the service request is to be sent.

System or Device ID

This parameter specifies the identifier of the CMWCA or CMWD entity ID.

Frequency Bandwidth

This parameter specifies the bandwidth.

Result (+)

This selection type parameter indicates that the service request succeeded.

Result (-)

This selection type parameter indicates that the service request failed.

8.4.4.3 Service procedure

The SetBandwidth request shall send a message from the CCP to the CMWCA or CMWD. When the message arrives at the target wireless device, this shall result in a SetBandwidth indication at the CMWCA or CMWD. The CCP shall forward the message to the appropriate target object.

8.4.4.4 Service sequence

The service sequence of SetBandwidth service is shown in Figure 39.

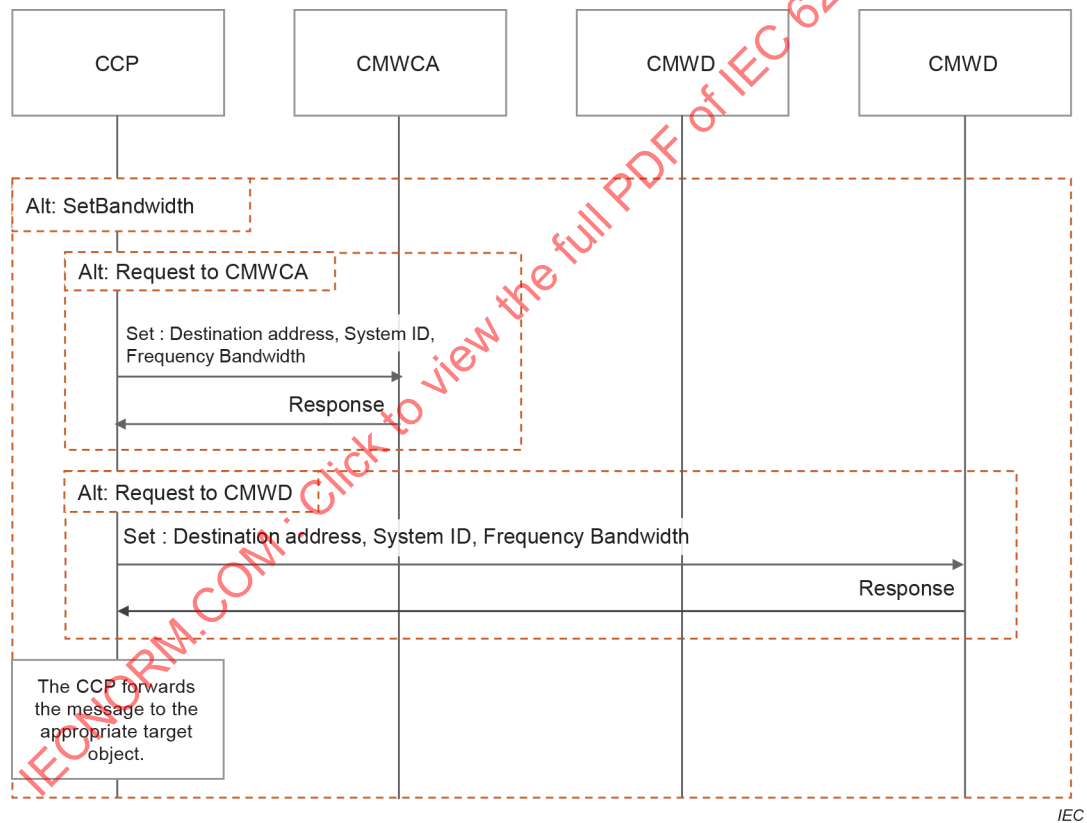


Figure 39 – Sequence diagram (SetBandwidth)

8.4.4.5 Service message format

The message format of SetBandwidth service shall be according to Table 33.

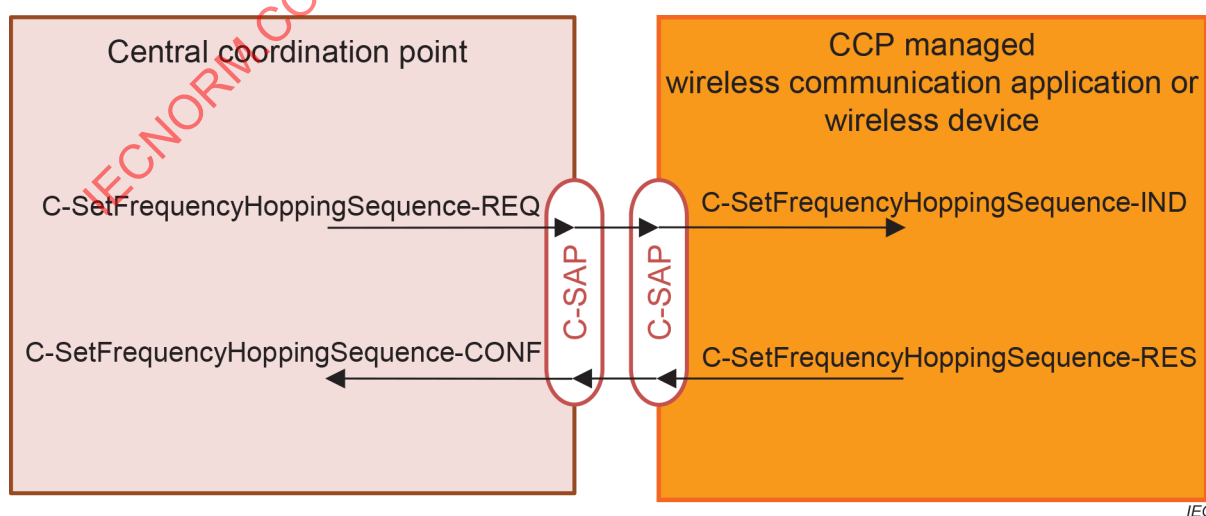
Table 33 – SetBandwidthservice message format

Message format	Explanation
<pre>{ "Argument": [{ "Destination address": "02004CAABBDD", "System or Device ID": "A3000", "Frequency Bandwidth": "429, 920" }], "Result (+)": "Result (-)": { "Service status": "aborted" } }</pre>	Parameters of the service request. Destination address to which the service request is to be Sent. Identifier of the CMWCA or CMWD entity ID. Bandwidth. Service request succeeded. Service request failed. Information on the result of service execution.

8.4.5 SetFrequencyHoppingSequence

8.4.5.1 Service overview

The SetFrequencyHoppingSequence service uses a set of primitives for supporting control of the CMWCA and CMWD from the CCP. SetFrequencyHoppingSequence service is a confirmed service and uses the C-SAP. The CCP sends the SetFrequencyHoppingSequence service request attempts to CMWD or CMWCA. The primitive flow of SetFrequencyHoppingSequence service is depicted in Figure 40.



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Figure 40 – Primitive flow of SetFrequencyHoppingSequence service

8.4.5.2 Service primitives

The structure of the service primitives is shown in Table 34.

Table 34 – SetFrequencyHoppingSequence service parameter

Parameter name	Request	Indication	Response	Confirm
Argument				
Destination address	M	M(=)		
System or Device ID	M	M(=)		
Frequency hopping sequence	M	M(=)		
Result (+)			S	S(=)
			-	-
Result (-)			S	S(=)
Service status			M	M(=)

Argument

The argument contains the parameters of the service request.

Destination address

This parameter specifies the destination address to which the service request is to be sent.

System or device ID

This parameter specifies the identifier of the CMWCA or CMWD entity ID.

Frequency hopping sequence

This parameter specifies the frequency hopping sequence for frequency hopping systems.

Result (+)

This selection type parameter indicates that the service request succeeded.

Result (-)

This selection type parameter indicates that the service request failed.

8.4.5.3 Service procedure

The SetFrequencyHoppingSequence request shall send a message from the CCP to the CMWCA or CMWD. When the message arrives at the target wireless device, this shall result in a SetFrequencyHoppingSequence indication at the CMWCA or CMWD. The CCP shall forward the message to the appropriate target object.

8.4.5.4 Service sequence

The service sequence of SetFrequencyHoppingSequence service is shown in Figure 41.

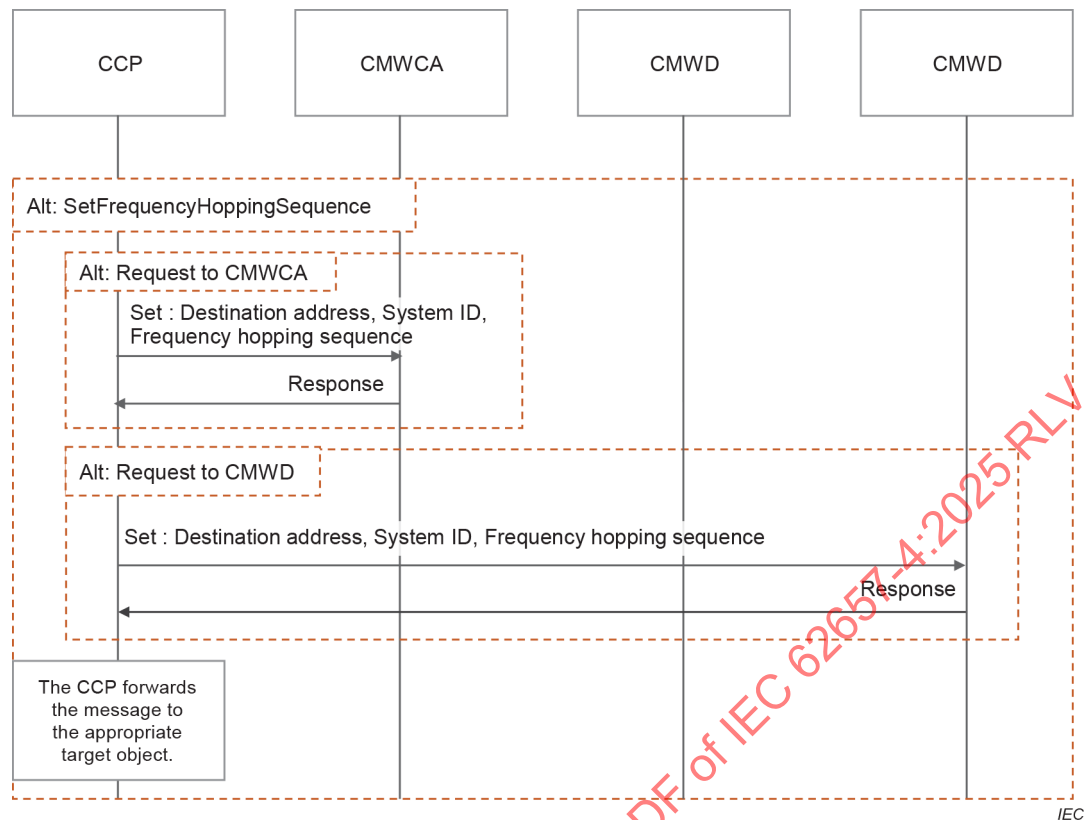


Figure 41 – Sequence diagram (SetBandwidth)

8.4.5.5 Service message format

The message format of SetFrequencyHoppingSequence service shall be according to Table 35.

Table 35 – SetFrequencyHoppingSequenceservice message format

Message format	Explanation
<pre> { "Argument": [{ "Destination address": "02004CAABBDD", "System or Device ID": "A3000", "Frequency hopping sequence": "1, 0.4" }], "Result (+)": "Result (-)": { "Service status": "aborted", } } </pre>	Parameters of the service request. Destination address to which the service request is to be sent. Identifier of the CMWCA or CMWD entity ID. Frequency hopping sequence for frequency hopping systems. Service request succeeded. Service request failed. Information on the result of service execution.

8.4.6 SetBlockedFrequencyList

8.4.6.1 Service overview

The SetBlockedFrequencyList service uses a set of primitives for supporting control of the CMWCA and CMWD from the CCP. SetBlockedFrequencyList service is a confirmed service and uses the C-SAP. The CCP sends the SetBlockedFrequencyList service request attempts to CMWD or CMWCA. The primitive flow of SetBlockedFrequencyList service is depicted in Figure 42.

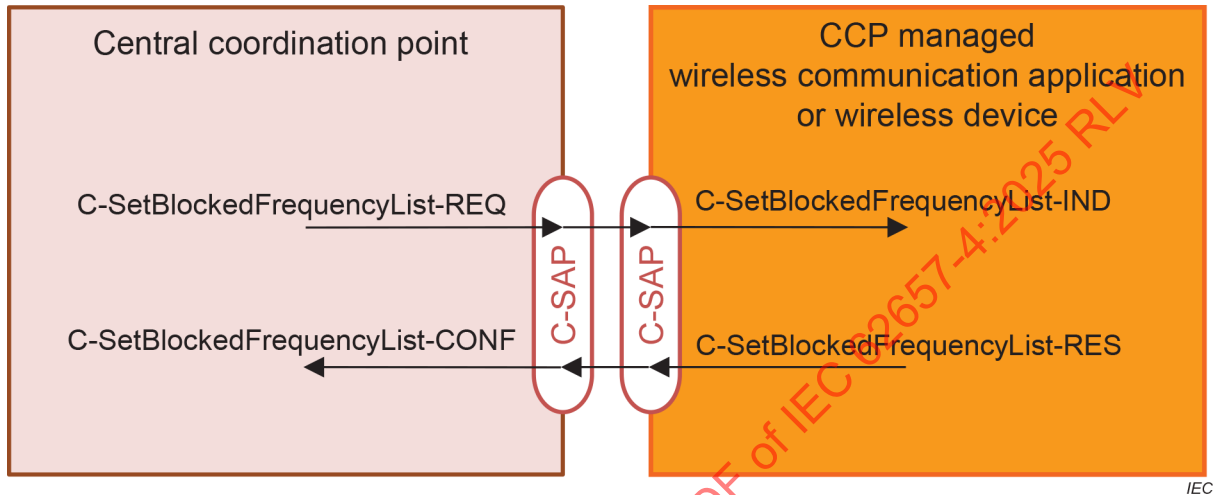


Figure 42 – Primitive flow of SetBlockedFrequencyList service

8.4.6.2 Service primitives

The structure of the service primitives is shown in Table 36.

Table 36 – SetBlockedFrequencyList service parameter

Parameter name	Request	Indication	Response	Confirm
Argument				
Destination address	M	M(=)		
System or Device ID	M	M(=)		
Blocked frequency list	M	M(=)		
Result (+)			S	S(=)
			-	-
Result (-)			S	S(=)
Service status			M	M(=)

Argument

The argument contains the parameters of the service request.

Destination address

This parameter specifies the destination address to which the service request is to be sent.

System or device ID

This parameter specifies the identifier of the CMWCA or CMWD entity ID.

Blocked frequency list

This parameter specifies the blocked frequency channels.

Result (+)

This selection type parameter indicates that the service request succeeded.

Result (-)

This selection type parameter indicates that the service request failed.

8.4.6.3 Service procedure

The SetBlockedFrequencyList request shall send a message from the CCP to the CMWCA or CMWD. When the message arrives at the target wireless device, this shall result in a SetBlockedFrequencyList indication at the CMWCA or CMWD. The CCP shall forward the message to the appropriate target object.

8.4.6.4 Service sequence

The service sequence of SetBlockedFrequencyList service is shown in Figure 43.

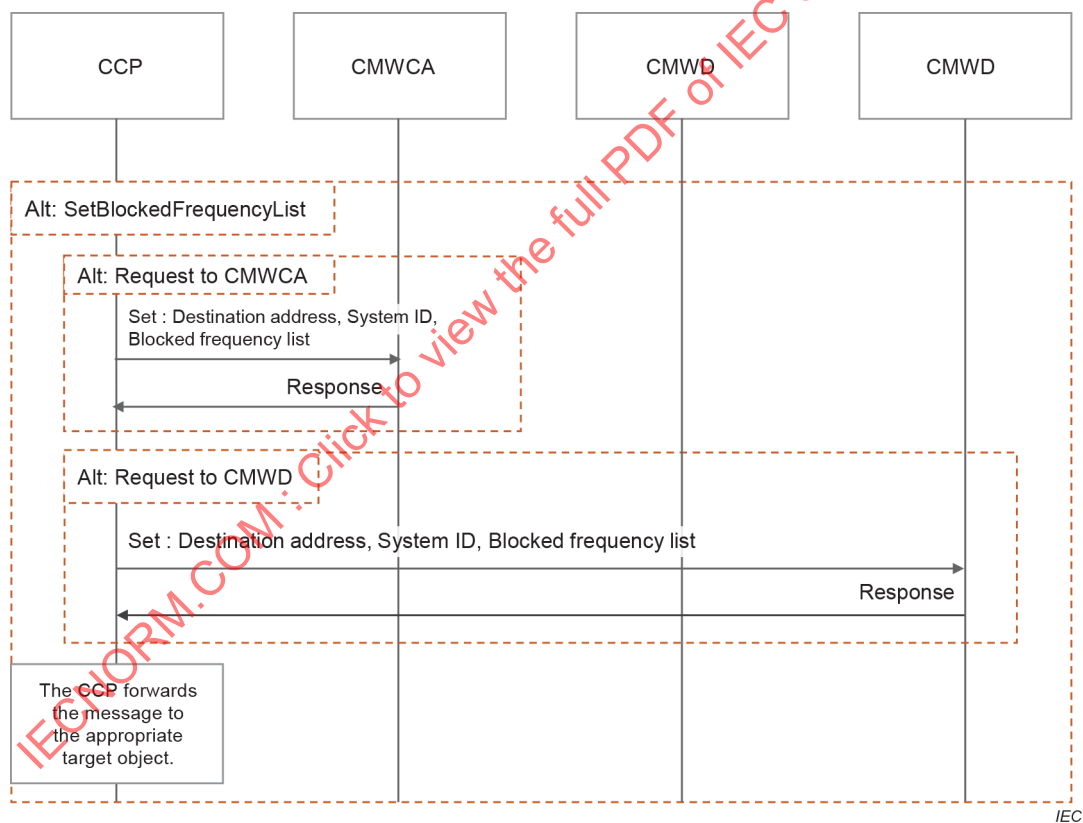


Figure 43 – Sequence diagram (SetBlockedFrequencyList)

8.4.6.5 Service message format

The message format of SetBlockedFrequencyList service shall be according to Table 37.

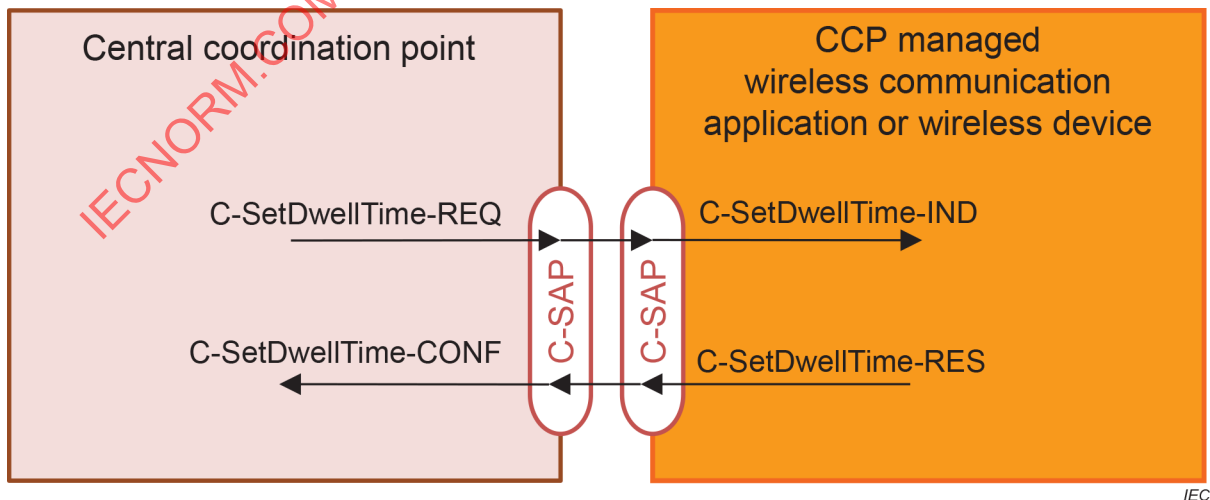
Table 37 – SetBlockedFrequencyListservice message format

Message format	Explanation
<pre>{ "Argument": [{ "Destination address": "02004CAABBDD", "System or Device ID": "A3000", "Blocked frequency list": "4, 5" }], "Result (+)": "Result (-)": { "Service status": "aborted" } }</pre>	Parameters of the service request. Destination address to which the service request is to be sent. Identifier of the CMWCA or CMWD entity ID. Blocked frequency channels. Service request succeeded. Service request failed. Information on the result of service execution.

8.4.7 SetDwellTime

8.4.7.1 Service overview

The SetDwellTime service uses a set of primitives for supporting control of the CMWCA and CMWD from the CCP. SetDwellTime service is a confirmed service and uses the C-SAP. The CCP sends the SetDwellTime service request attempts to CMWD or CMWCA. The primitive flow of SetDwellTime service is depicted in Figure 44.



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Figure 44 – Primitive flow of SetDwellTime service

8.4.7.2 Service primitives

The structure of the service primitives is shown in Table 38.

Table 38 – SetDwellTime service parameter

Parameter name	Request	Indication	Response	Confirm
Argument				
Destination address	M	M(=)		
System or Device ID	M	M(=)		
Dwell time	M	M(=)		
Result (+)			S	S(=)
			-	-
Result (-)			S	S(=)
Service status			M	M(=)

Argument

The argument contains the parameters of the service request.

Destination address

This parameter specifies the destination address to which the service request is to be sent.

System or device ID

This parameter specifies the identifier of the CMWCA or CMWD entity ID.

Dwell time

This parameter specifies the dwell time.

Result (+)

This selection type parameter indicates that the service request succeeded.

Result (-)

This selection type parameter indicates that the service request failed.

8.4.7.3 Service procedure

The SetDwellTime request shall send a message from the CCP to the CMWCA or CMWD. When the message arrives at the target wireless device, this shall result in a SetDwellTime indication at the CMWCA or CMWD. The CCP shall forward the message to the appropriate target object.

8.4.7.4 Service sequence

The service sequence of SetDwellTime service is shown in Figure 45.

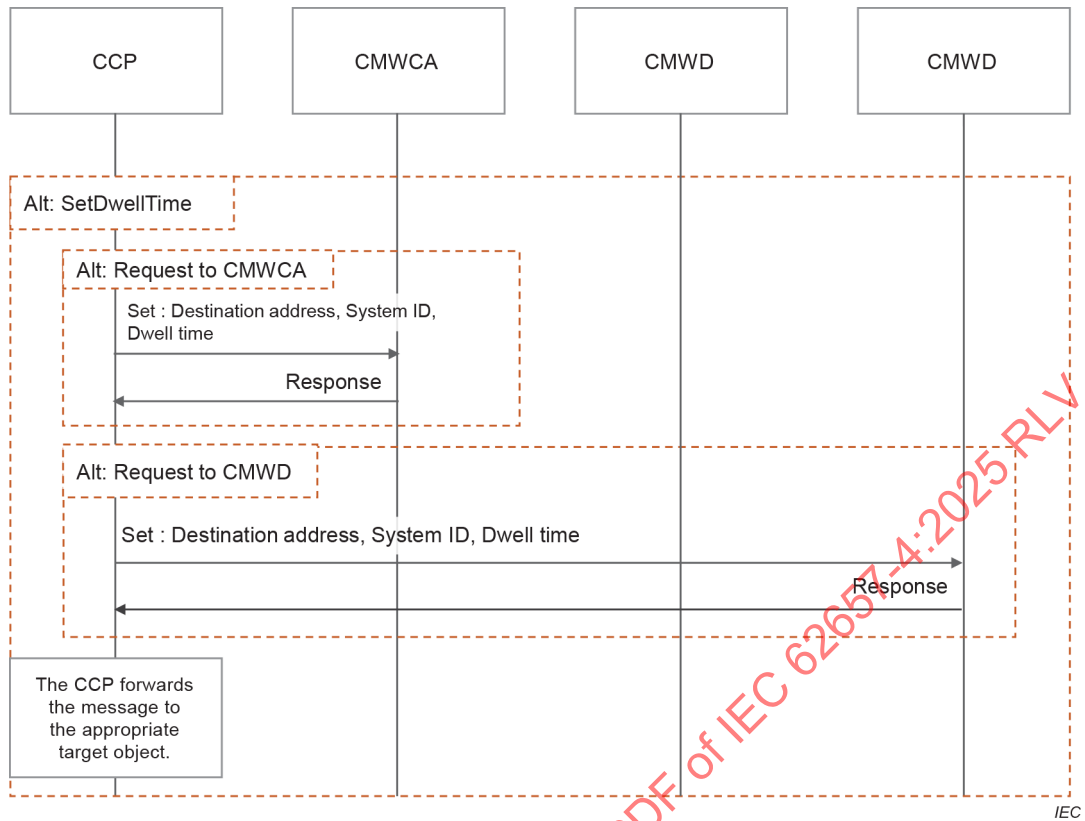


Figure 45 – Sequence diagram (SetDwellTime)

8.4.7.5 Service message format

The message format of SetDwellTime service shall be according to Table 39.

Table 39 – SetDwellTimeservice message format

Message format	Explanation
<pre> { "Argument": [{ "Destination address": "02004CAABBDD", "System or Device ID": "A3000", "Dwell time": "0.4" }], "Result (+)": "Result (-)": { "Service status": "aborted" } } </pre>	Parameters of the service request. Destination address to which the service request is to be sent. Identifier of the CMWCA or CMWD entity ID. Dwell time. Service request succeeded. Service request failed. Information on the result of service execution.

8.4.8 SetMediumAccessControlMechanism

8.4.8.1 Service overview

The SetMediumAccessControlMechanism service uses a set of primitives for supporting control of the CMWCA and CMWD from the CCP. SetMediumAccessControlMechanism service is a confirmed service and uses the C-SAP. The CCP sends the SetMediumAccessControlMechanism service request attempts to CMWD or CMWCA. The primitive flow of SetMediumAccessControlMechanism service is depicted in Figure 46.

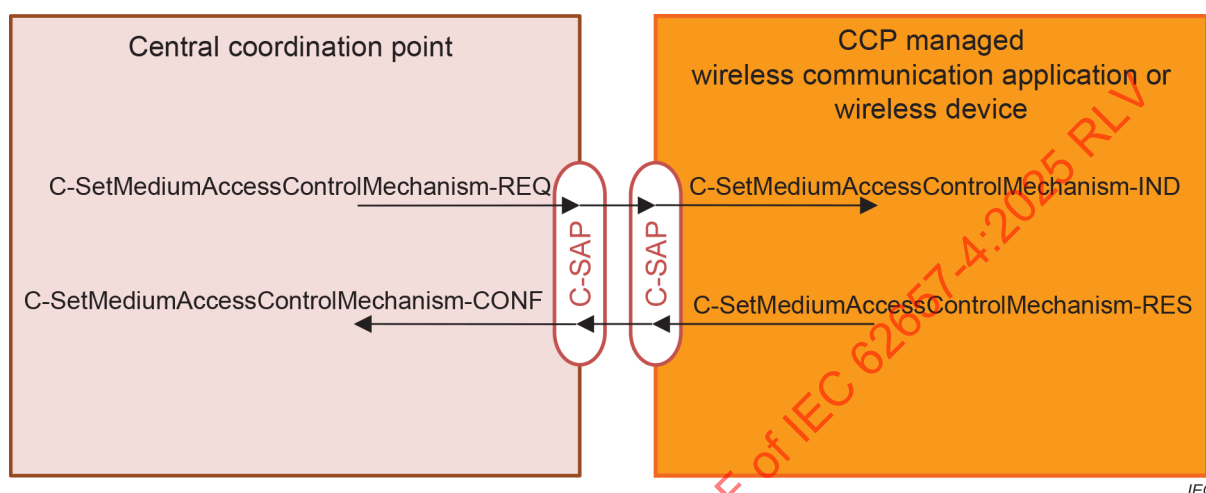


Figure 46 – Primitive flow of SetMediumAccessControlMechanism service

8.4.8.2 Service primitives

The structure of the service primitives is shown in Table 40 .

Table 40 – SetMediumAccessControlMechanism service parameter

Parameter name	Request	Indication	Response	Confirm
Argument				
Destination address	M	M(=)		
System or Device ID	M	M(=)		
Medium access control mechanism	M	M(=)		
Result (+)			S	S(=)
			-	-
Result (-)			S	S(=)
Service status			M	M(=)

Argument

The argument contains the parameters of the service request.

Destination address

This parameter specifies the destination address to which the service request is to be sent.

System or Device ID

This parameter specifies the identifier of the CMWCA or CMWD entity ID.

Medium access control mechanism

This parameter specifies the type of medium access control mechanism. Allowed values are: CCP, DAA, DAR, DAS using data type CHAR.

Result (+)

This selection type parameter indicates that the service request succeeded.

Result (-)

This selection type parameter indicates that the service request failed.

8.4.8.3 Service procedure

The SetMediumAccessControlMechanism request shall send a message from the CCP to the CMWCA or CMWD. When the message arrives at the target wireless device, this shall result in a SetMediumAccessControlMechanism indication at the CMWCA or CMWD. The CCP shall forward the message to the appropriate target object.

8.4.8.4 Service sequence

The service sequence of SetMediumAccessControlMechanism service is shown in Figure 47.

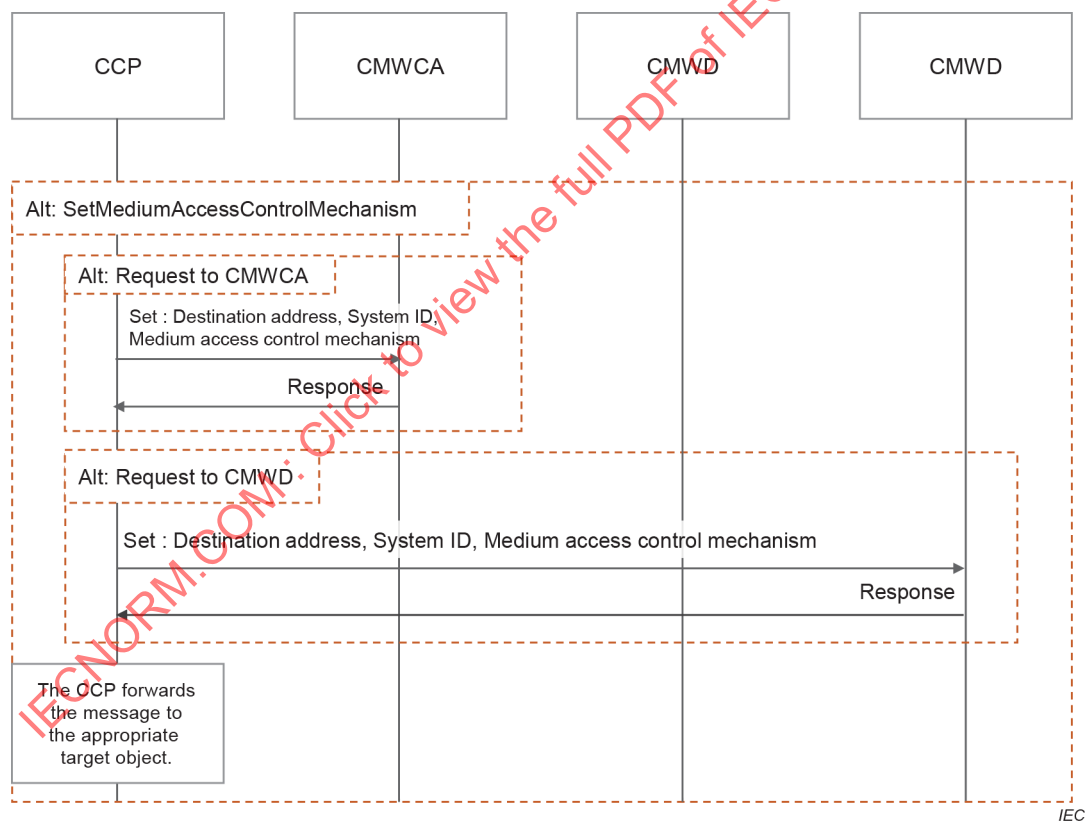


Figure 47 – Sequence diagram (SetMediumAccessControlMechanism)

8.4.8.5 Service message format

The message format of SetMediumAccessControlMechanism service shall be according to Table 41.

Table 41 – SetMediumAccessControlMechanism service message format

Message format	Explanation
<pre>{ "Argument": [{ "Destination address": "02004CAABDD", "System or Device ID": "A3000", "Medium access control mechanism": "CSMA" }], "Result (+)": "Result (-)": { "Service status": "aborted" } }</pre>	Parameters of the service request. Destination address to which the service request is to be sent. Identifier of the CMWCA or CMWD entity ID. Type of medium access control mechanism. Service request succeeded. Service request failed. Information on the result of service execution.

8.4.9 SetDeviceStatus

8.4.9.1 Service overview

The SetDeviceStatus service uses a set of primitives for supporting control of the CMWCA and CMWD from the CCP. SetDeviceStatus service is a confirmed service and uses the C-SAP. The CCP sends the SetDeviceStatus service request attempts to CMWD or CMWCA. The primitive flow of SetDeviceStatus service is depicted in Figure 48.

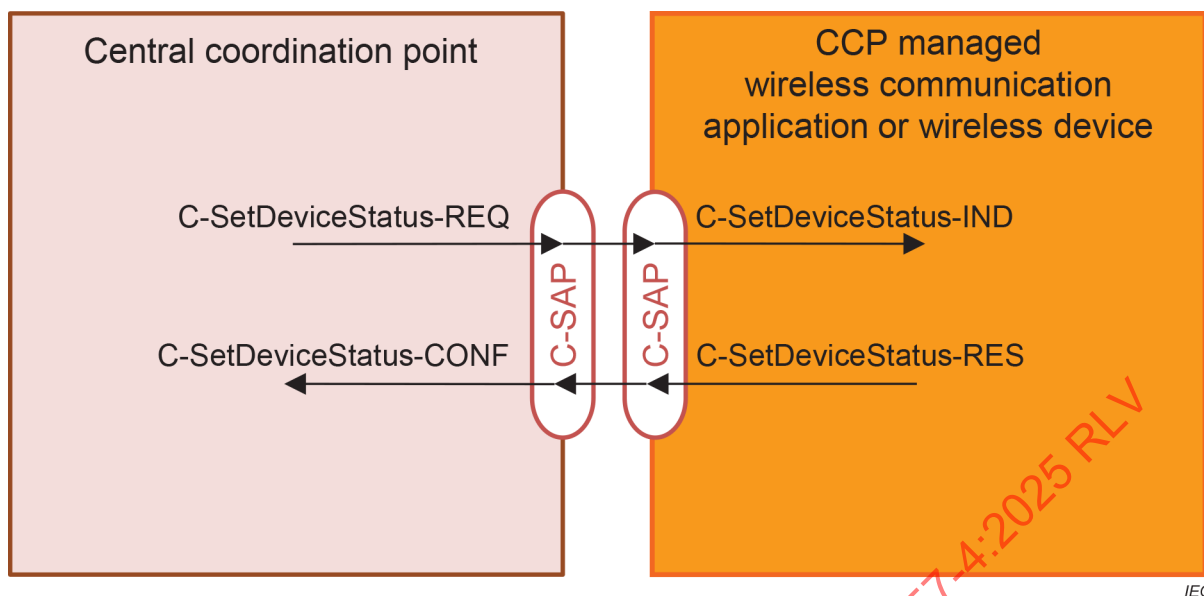


Figure 48 – Primitive flow of SetDeviceStatus service

8.4.9.2 Service primitives

The structure of the service primitives is shown in Table 42.

Table 42 – SetDeviceStatus service parameter

Parameter name	Request	Indication	Response	Confirm
Argument				
Destination address	M	M(=)		
System or Device ID	M	M(=)		
Device status	M	M(=)		
Result (+)			S	S(=)
			-	-
Result (-)			S	S(=)
Service status			M	M(=)

Argument

The argument contains the parameters of the service request.

Destination address

This parameter specifies the destination address to which the service request is to be sent.

System or Device ID

This parameter specifies the identifier of the CMWCA or CMWD entity ID.

Device status

This parameter specifies the type (RUN, IDLE, START_SSF, STOP_SSF, STOP) of system or device status.

Result (+)

This selection type parameter indicates that the service request succeeded.

Result (-)

This selection type parameter indicates that the service request failed.

8.4.9.3 Service procedure

The SetDeviceStatus request shall send a message from the CCP to the CMWCA or CMWD. When the message arrives at the target wireless device, this shall result in a SetDeviceStatus indication at the CMWCA or CMWD. The CCP shall forward the message to the appropriate target object.

8.4.9.4 Service sequence

The service sequence of SetDeviceStatus service is shown in Figure 49.

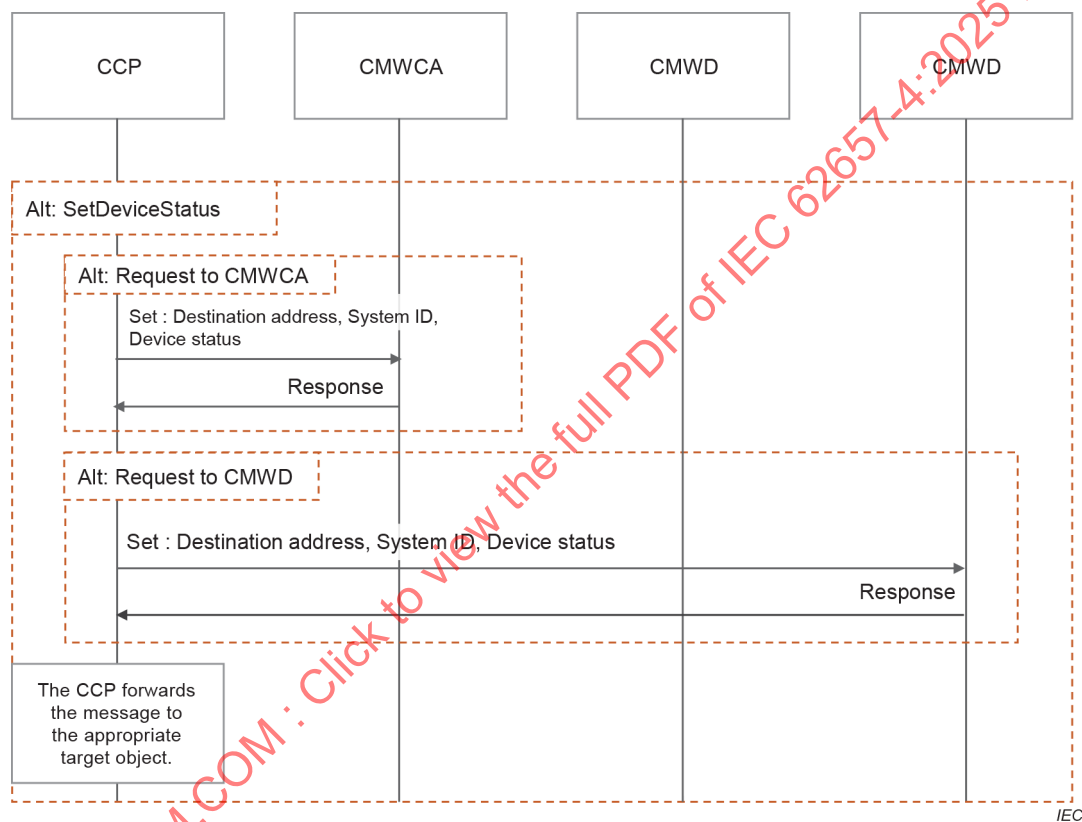


Figure 49 – Sequence diagram (SetDeviceStatus)

8.4.9.5 Service message format

The message format of SetDeviceStatus service shall be according to Table 43.

Table 43 – SetDeviceStatusservice message format

Message format	Explanation
<pre>{ "Argument": [{ "Destination address": "02004CAABBDD", "System or Device ID": "A3000", "Device status": "run" }], "Result (+)": "Result (-)": { "Service status": "aborted" } }</pre>	Parameters of the service request. Destination address to which the service request is to be sent. Identifier of the CMWCA or CMWD entity ID. Type (RUN, IDLE, START_SSF, STOP_SSF, STOP) of system or device status. Service request succeeded. Service request failed. Information on the result of service execution.

8.4.10 GetParameter

8.4.10.1 Service overview

The GetParameter service uses a set of primitives to be used by the CCP for querying technology specific or vendor specific parameter values from CMWCA or CMWD. GetParameter service is a confirmed service and uses the C-SAP. The CCP sends the GetParameter service request attempts to CMWCA or CMWD. The primitive flow of GetParameter service is depicted in Figure 50 for CMWCA and in Figure 51 for CMWD.

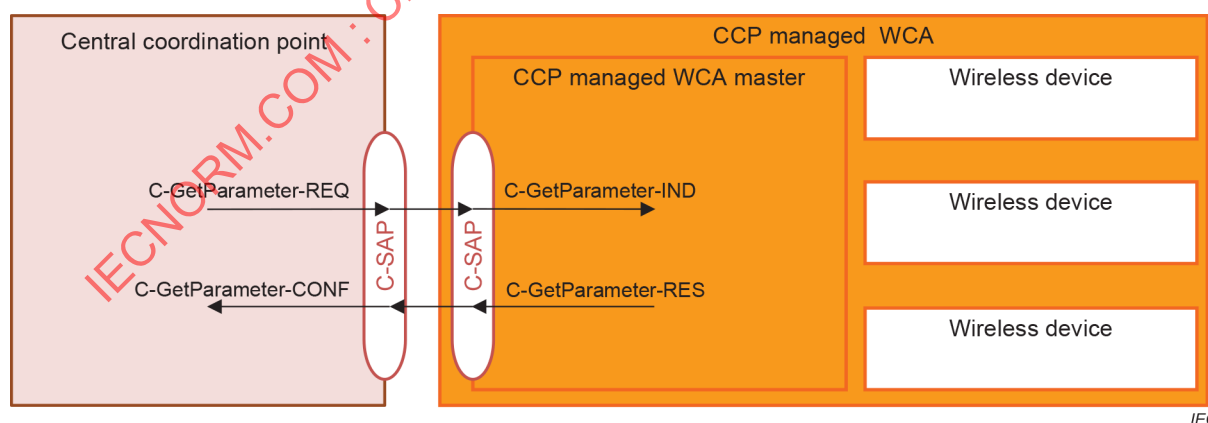


Figure 50 – Primitive flow of GetParameter service for CMWCA

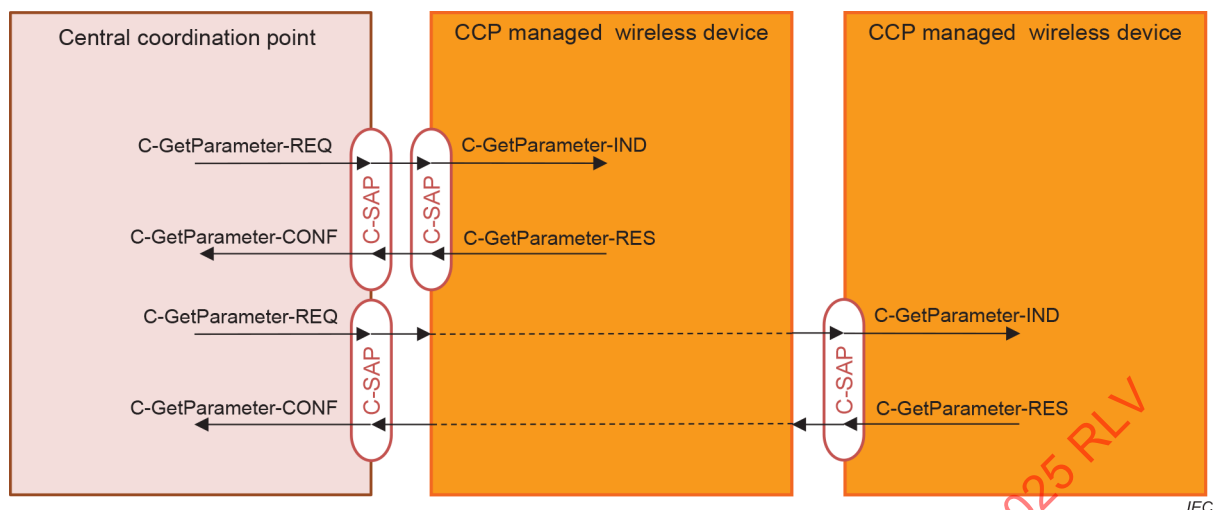


Figure 51 – Primitive flow of GetParameter service for CMWD

8.4.10.2 Service primitives

The structure of the service primitives is shown in Table 44.

Table 44 – GetParameter service parameter

Parameter name	Request	Indication	Response	Confirm
Argument				
Destination address	M	M(=)		
Parameter ID	M	M(=)		
Result (+)			S	S(=)
Source address			M	M(=)
Parameter ID			M	M(=)
Parameter values			M	M(=)
Result (-)			S	S(=)
Service status			M	M(=)

Argument

The argument contains the parameters of the service request.

Destination address

This parameter specifies the destination address to which the service request is to be sent.

Parameter ID

This parameter is specified by a standard or vendor and identifies the parameter whose value is to be returned.

Result (+)

This selection type parameter indicates that the service request succeeded.

Destination address

This parameter specifies the source address of the response.

Parameter ID

This parameter is specified by a standard or vendor and identifies the parameter whose value is returned.

Parameter value

This parameter contains the value of the parameter to be returned.

Result (-)

This selection type parameter indicates that the service request failed.

Service status

This parameter provides information on the result of service execution. It shall be one of ABORTED or TIMEOUT.

8.4.10.3 Service procedure

The CCP may use this primitive to request technology specific or vendor specific parameter values from the CMWCA or CMWD. The GetParameter request shall send a message to the CMWCA or CMWD. When the message arrives at the target wireless device (CMWCA or CMWD), this shall result in a GetParameter indication at the CMWCA or CMWD. The CMWCA or CMWD, in turn, shall forward the message to the appropriate target object. When the object responds, the CMWCA or CMWD shall forward the response via the GetParameter response primitive. When the response arrives at the device which originated the request, a GetParameter confirmation shall be returned to the application object which sent the request.

8.4.10.4 Service sequence

The service sequence of GetParameter service is shown in Figure 52.

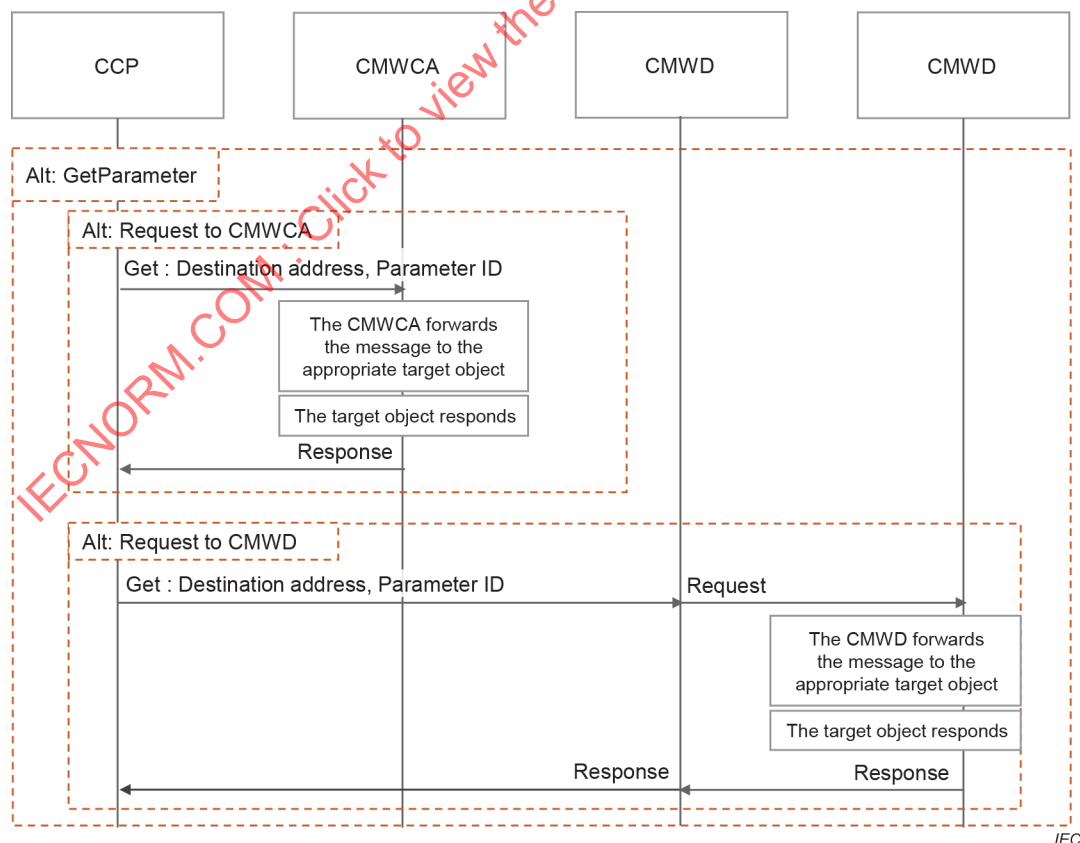


Figure 52 – Sequence diagram (GetParameter)

8.4.10.5 Service message format

The message format of GetParameter service shall be according to Table 45.

Table 45 – GetParameterservice message format

Message format	Explanation
<pre>{ "Argument": [{ "Destination address": "02004CAABBDD", "Parameter ID ": "UAA306" }], "Result (+)": [{ "Source address": "02004CAABBDD", "Parameter ID": "UAA306", "Parameter values": "0.1" }], "Result (-)": { "Service status": "aborted" } }</pre>	Parameters of the service request. Destination address to which the service request is to be sent. Specified by a standard or vendor and identifies the parameter whose value is to be returned. Service request succeeded. Source address of the response. Specified by a standard or vendor and identifies the parameter whose value is returned. Value of the parameter to be returned. Service request failed. Information on the result of service execution.

8.4.11 SetParameter

8.4.11.1 Service overview

The SetParameter service uses a set of primitives for setting technology specific or vendor specific parameters in CMWCA and CMWD from the CCP. SetParameter service is a confirmed service and uses the C-SAP. The CCP sends the SetParameter service request attempts to CMWCA or CMWD. The primitive flow of SetParameter service is depicted in Figure 53 for CMWCA and Figure 54 for CMWD.

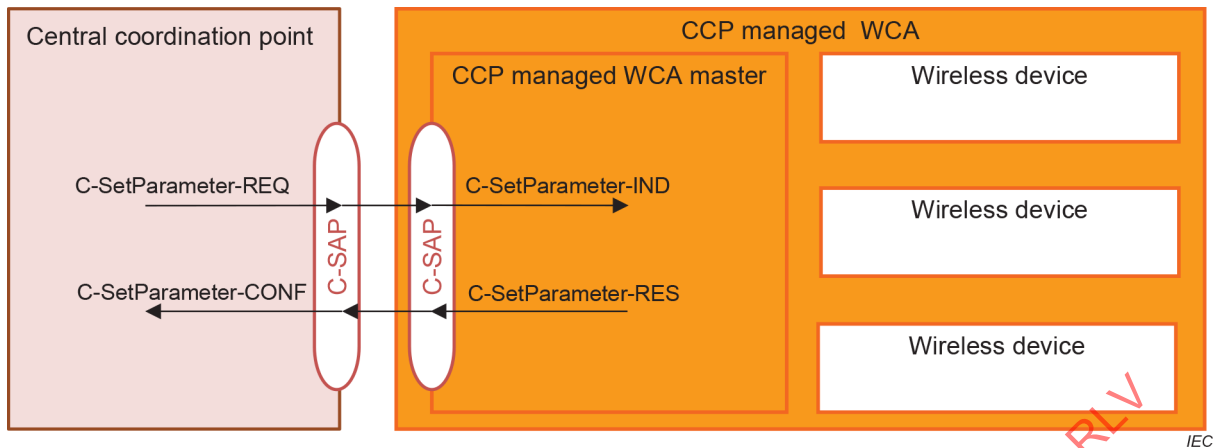


Figure 53 – Primitive flow of SetParameter service for CMWCA

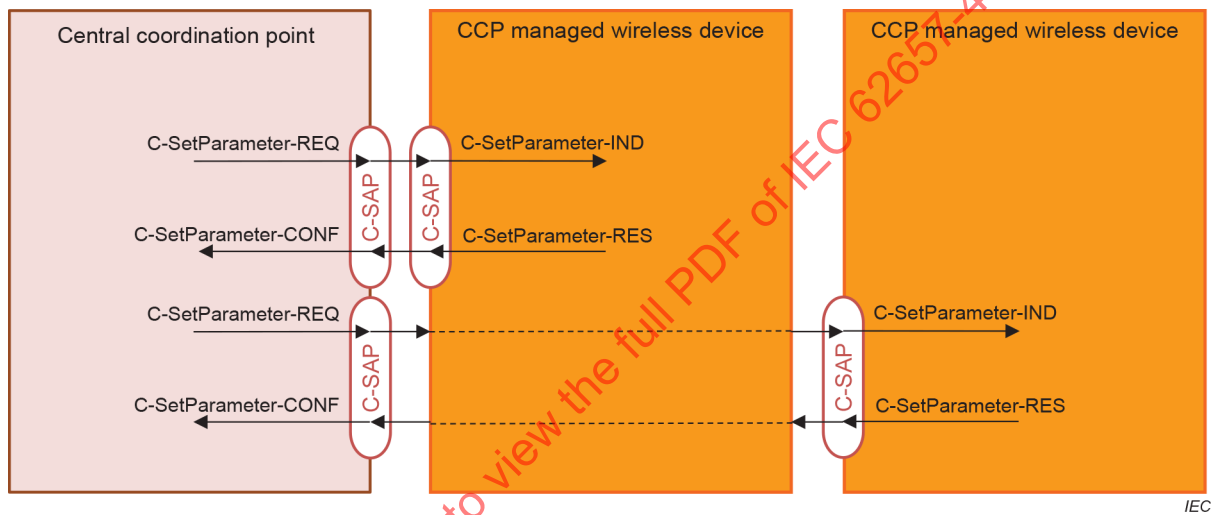


Figure 54 – Primitive flow of SetParameter service for CMWD

8.4.11.2 Service primitives

The structure of the service primitives is shown in Table 46.

Table 46 – SetParameter service parameter

Parameter name	Request	Indication	Response	Confirm
Argument				
Destination address	M	M(=)		
Parameter ID	M	M(=)		
Parameter value	M	M(=)		
Result (+)			S	S(=)
			-	-
Result (-)			S	S(=)
Service status			M	M(=)

Argument

The argument contains the parameters of the service request.

Destination address

This parameter specifies the destination address to which the service request is to be sent.

Parameter ID

This parameter is specified by a standard or a vendor and identifies the parameter to be set.

Parameter value

This parameter contains the value of the parameter to be set.

Result (+)

This selection type parameter indicates that the service request succeeded.

Result (-)

This selection type parameter indicates that the service request failed.

8.4.11.3 Service procedure

The SetParameter request shall send a message from the CCP to the CMWCA or CMWD. When the message arrives at the target wireless device, this shall result in a SetParameter indication at the CMWCA or CMWD. The CMWCA or CMWD shall forward the message to the appropriate target object. When the object responds, the CMWCA or CMWD shall forward the response via the SetParameter response primitive. When the response arrives at the user interface which originated the request, a SetParameter confirmation shall be returned to the application object which sent the request.

8.4.11.4 Service sequence

The service sequence of SetParameter is shown in Figure 55.

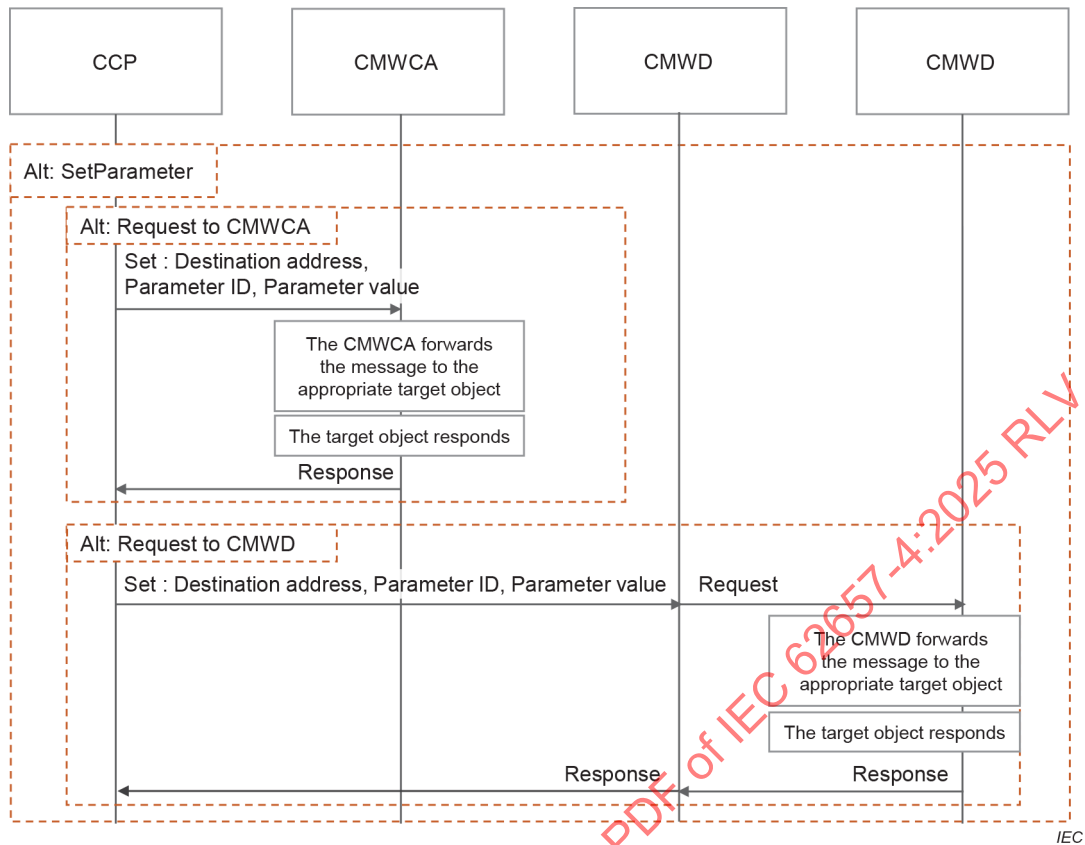


Figure 55 – Sequence diagram (SetParameter)

8.4.11.5 Service message format

The message format of SetParameter SetMediumSensingResult service shall be according to Table 47.

Table 47 – SetParameterservice message format

Message format	Explanation
<pre> { "Argument": [{ "Destination address": "02004CAABBDD", "Parameter ID": "UAA306", "Parameter values": "0,1" }], "Result (+)": "Result (-)": { "Service status": "aborted" } } </pre>	Parameters of the service request. Destination address to which the service request is to be sent. Specified by a standard or vendor and identifies the parameter whose value is provided for example Transmitter output power. Value of the parameter provided for example 100 mW. Service request succeeded. Service request failed. Information on the result of service execution.

8.5 Medium resource management services

8.5.1 Supported services

This Subclause 8.5 contains the definition of services that are unique to the medium resource management (MRM) service. The services defined for this MRM are:

- GetMediumResourceReport, see 8.5.2;
- SetMediumResourceReport, see 8.5.3;
- NotifyMediumResource, see 8.5.4;
- SetMediumSensingReport, see 8.5.5;
- NotifyMediumSensingResults, see 8.5.6.

8.5.2 GetMediumResourceReport

8.5.2.1 Service overview

The GetMediumResourceReport service uses a set of primitives for supporting management resource reports procedures between CCP and CMWCA or CMWD. GetMediumResourceReport service is a confirmed service and uses the C-SAP. The CCP sends the GetMediumResourceReport service request attempts to CMWCA or CMWD. The primitive flow of GetMediumResourceReport service is depicted in Figure 56 for CMWCA and in Figure 57 for CMWD.

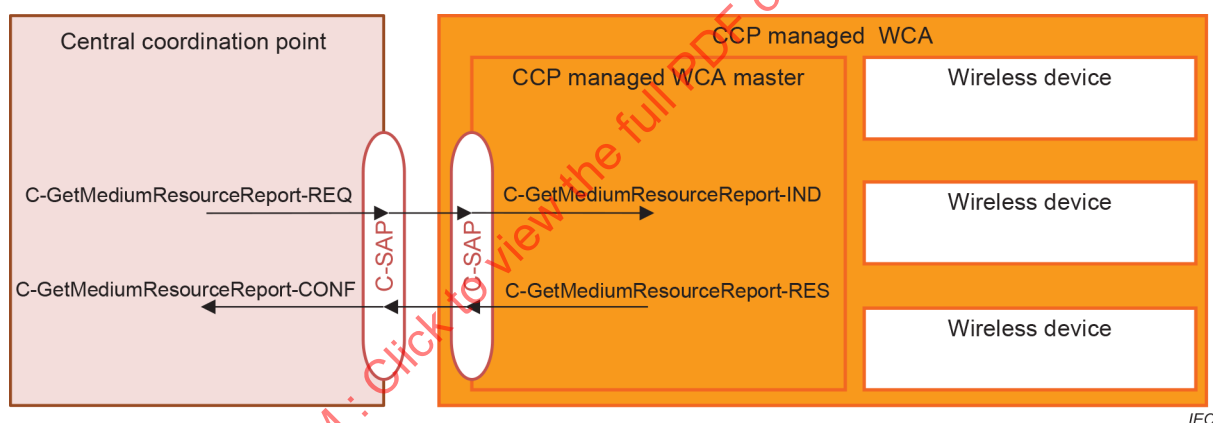


Figure 56 – Primitive flow of GetMediumResourceReport service for CMWCA

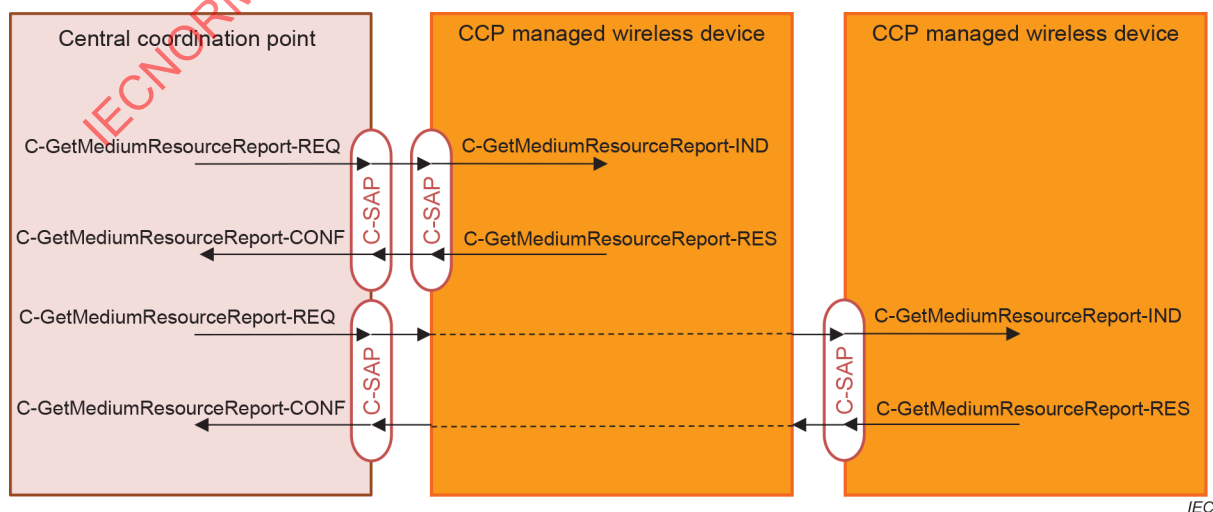


Figure 57 – Primitive flow of GetMediumResourceReport service for CMWD

8.5.2.2 Service primitives

The structure of the service primitives is shown in Table 48.

Table 48 – GetMediumResourceReport service parameter

Parameter name	Request	Indication	Response	Confirm
Argument				
Destination address	M	M(=)		
Communication link ID	M	M(=)		
Wireless ID	M	M(=)		
Result (+)			S	S(=)
CCP address			M	M(=)
Wireless ID			M	M(=)
Attribute data			M	M(=)
Duty cycle			M	M(=)
RSSI mean			M	M(=)
RSSI standard deviation			M	M(=)
SINR mean			M	M(=)
SINR standard deviation			M	M(=)
Data throughput			M	M(=)
Message loss ratio			M	M(=)
Result (-)			S	S(=)
Service status			M	M(=)

Argument

The argument contains the parameters of the service request.

Destination address

This parameter specifies the destination address to which the service request is to be sent.

Communication link ID

This parameter specifies the identifier of the communication link. It is present in the request primitive.

Wireless ID

This parameter specifies the identifier of requested wireless system or wireless device.

Result (+)

This selection type parameter indicates that the service request succeeded.

CCP address

This parameter specifies the address of the requested CCP. It is present in the response primitive.

Wireless ID

This parameter specifies the identifier of the wireless system or wireless device.

Attribute data

This parameter returns a stream of information containing all the attributes.

- duty cycle;
- RSSI mean;
- RSSI standard deviation;
- SINR mean;
- SINR standard deviation;
- Data throughput;
- Message loss ratio.

Result (-)

This selection type parameter indicates that the service request failed.

Service status

This parameter provides information on the result of service execution. It shall be one of ABORTED or TIMEOUT.

8.5.2.3 Service procedure

The CCP may use this primitive to request medium resource information from the CMWCA or CMWD. The GetMediumResourceReport request shall send a message to the CMWCA or CMWD. When the message arrives at the target wireless device (CMWCA or CMWD), this shall result in a GetMediumResourceReport indication at the CMWCA or CMWD. The CMWCA or CMWD, in turn, shall forward the message to the appropriate target object. When the object responds, the CMWCA or CMWD shall forward the response via the GetMediumResourceReport response primitive. When the response arrives at the device which originated the request, a GetMediumResourceReport confirmation shall be returned to the application object which sent the request.

8.5.2.4 Service sequence

The service sequence of GetMediumResourceReport service is shown in Figure 58.

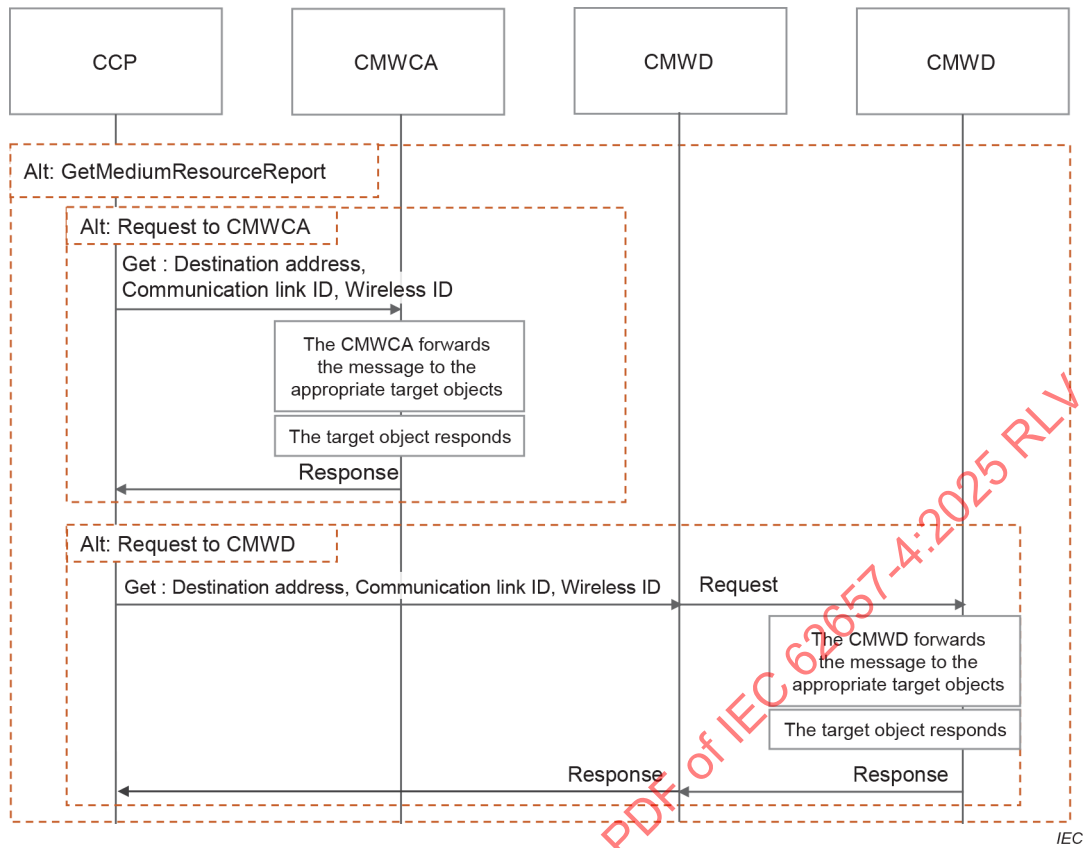


Figure 58 – Sequence diagram (GetMediumResourceReport)

8.5.2.5 Service message format

The message format of `GetMediumResourceReport` service shall be according to Table 49.

Table 49 – GetMediumResourceReport service message format

Message format	Explanation
<pre> { "Argument": [{ "Destination address": "02004CAABBDD", "Communication link ID": "A1000", "Wireless ID": "A1111" }], "Result (+)": [{ "CCP address": "02004CAABBFF", "Wireless ID": "A1111", "Attribute data": [{ "Duty cycle": 80, "RSSI mean": -50, "RSSI standard deviation": 10, "SINR mean": 9.0, "SINR standard deviation": 10 }], }], "Result (-)": { "Service status": "aborted" } } </pre>	Parameters of the service request. Destination address to which the service request is to be sent. Identifier of the communication link. Identifier of requested wireless system or wireless device. Service request succeeded. Address of the requested CCP. It is present in the response primitive. Identifier of requested wireless system or wireless device. Duty cycle per communication link. Received signal strength indication mean. Received signal strength indication standard deviation. Signal to interference and noise ratio mean. Signal to interference and noise ratio standard deviation. Service request failed. Information on the result of service execution.

8.5.3 SetMediumResourceReport

8.5.3.1 Service overview

The SetMediumResourceReport service uses a set of primitives for setting periodically or event driven management resource reports procedures at CMWCA or CMWD. SetMediumResourceReport service is a confirmed service and uses the M-SAP. The CCP sends the SetMediumResourceReport service request attempts to CMWCA or CMWD. The primitive flow of SetMediumResourceReport service is depicted in Figure 59 for CMWCA and in Figure 60 for CMWD.

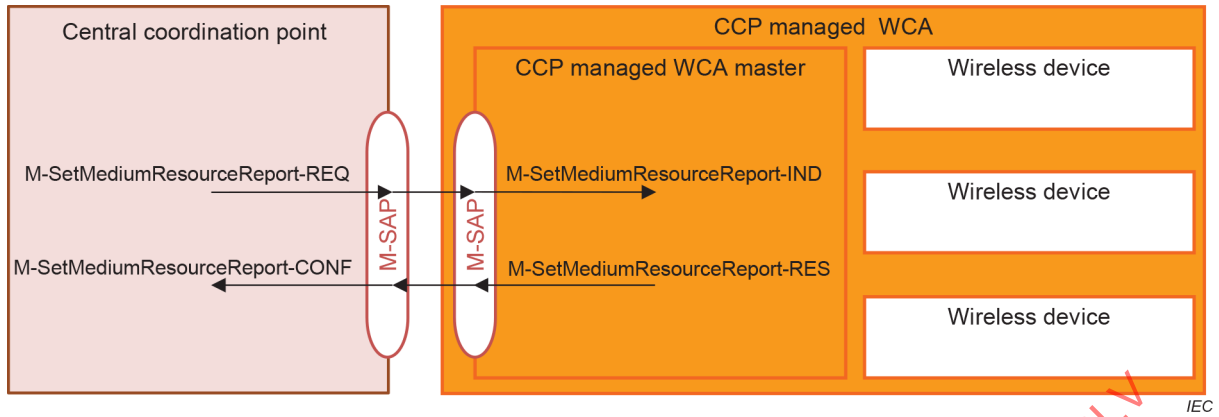


Figure 59 – Primitive flow of SetMediumResourceReport service for CMWCA

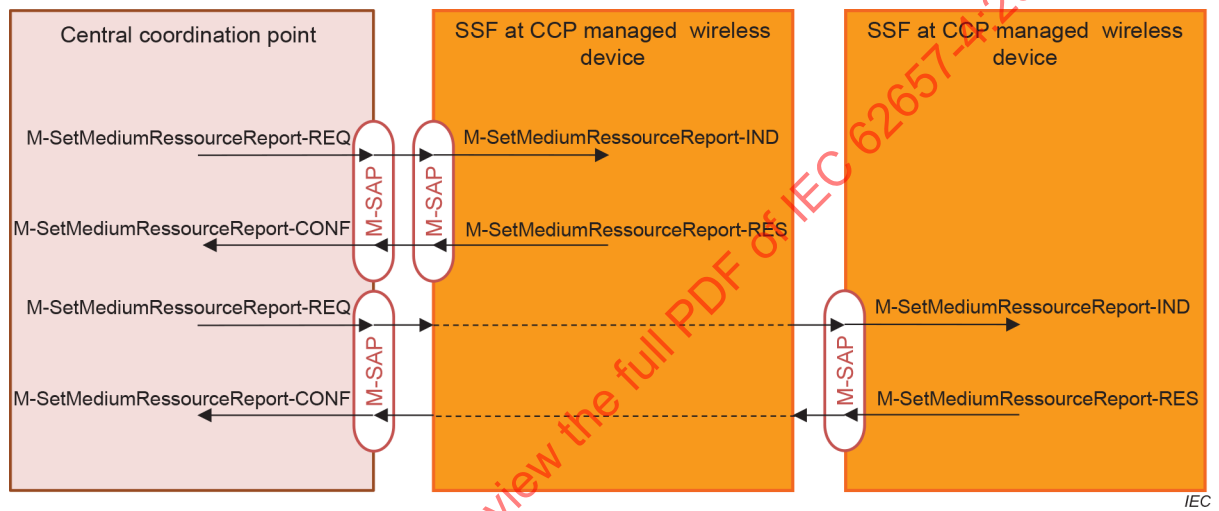


Figure 60 – Primitive flow of SetMediumResourceReport service for CMWD

8.5.3.2 Service primitives

The structure of the service primitives is shown in Table 50.

Table 50 – SetMediumResourceReport service parameter

Parameter name	Request	Indication	Response	Confirm
Argument				
Destination address	M	M(=)		
Communication link ID	M	M(=)		
Wireless ID	M	M(=)		
Report type	M	M(=)		
Report interval	M	M(=)		
Report threshold	M	M(=)		
Result (+)			S	S(=)
CCP address			M	M(=)
Wireless ID			M	M(=)
Report status			M	M(=)
Result (-)			S	S(=)
Service status			M	M(=)

Argument

The argument contains the parameters of the service request.

Destination address

This parameter specifies the destination address to which the service request is to be sent.

Communication link ID

This parameter specifies the identifier of the communication link. It is present in the request primitive.

Wireless ID

This parameter specifies the identifier of requested wireless system or wireless device.

Report type

This parameter specifies the generation type of medium resource report (NotifyMediumResource). The report types are event driven, cyclic or requested. It is present in the request primitive.

Report interval

This parameter specifies the interval time of cyclic reports.

Report threshold

This parameter specifies the threshold χ_{Thr} of the coexistence state for event generation.

Result (+)

This selection type parameter indicates that the service request succeeded.

CCP address

This parameter specifies the address of the requested CCP. It is present in the response primitive.

Wireless ID

This parameter specifies the identifier of the wireless system or wireless device.

Result (-)

This selection type parameter indicates that the service request failed.

Service status

This parameter provides information on the result of service execution. It shall be one of ABORTED or TIMEOUT.

8.5.3.3 Service procedure

The CCP may use this primitive to set the medium resource report at the CMWCA or CMWD.

The SetMediumResourceReport request shall send a message to the CMWCA or CMWD. When the message arrives at the target wireless device (CMWCA or CMWD), this shall result in a SetMediumResourceReport indication at the CMWCA or CMWD. The CMWCA or CMWD, in turn, shall forward the message to the appropriate target object. When the object responds, the CMWCA or CMWD shall forward the response via the SetMediumResourceReport response primitive. When the response arrives at the device which originated the request, a SetMediumResourceReport confirmation shall be returned to the application object which sent the request.

8.5.3.4 Service sequence

The service sequence of SetMediumResourceReport service is shown in Figure 61.

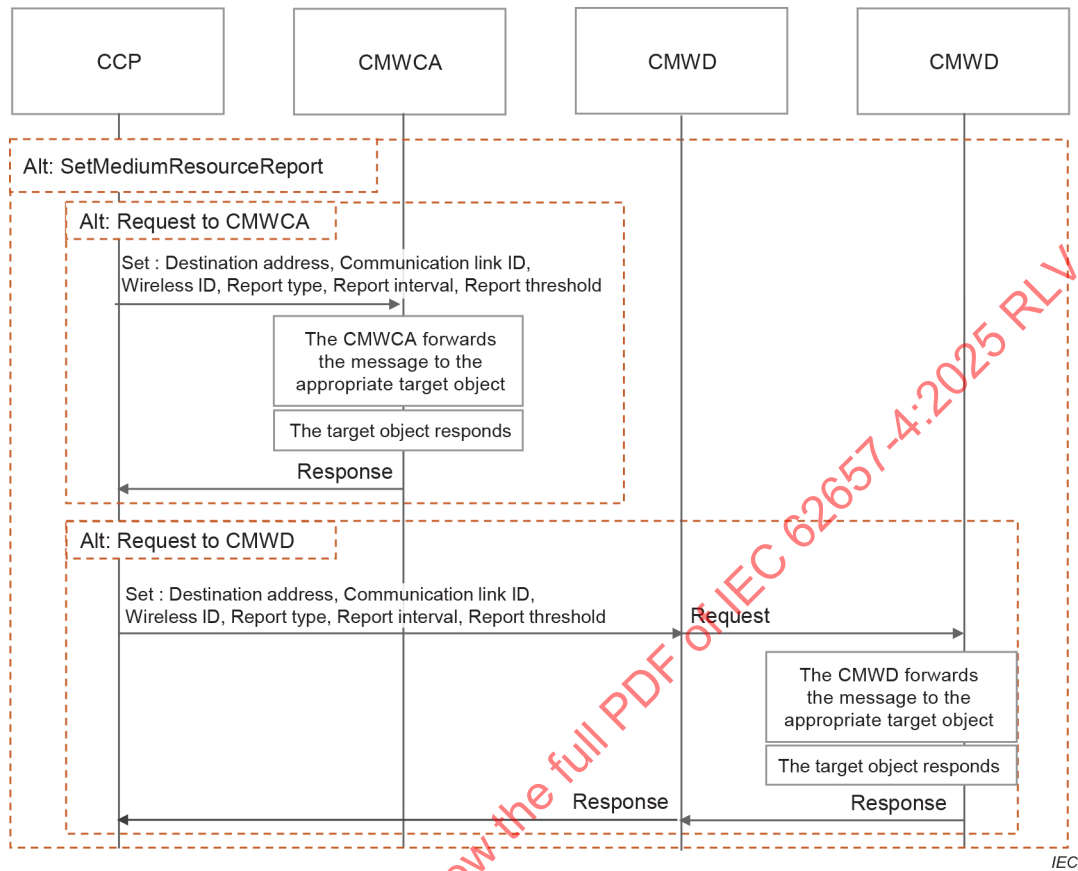


Figure 61 – Sequence diagram (SetMediumResourceReport)

8.5.3.5 Service message format

The message format of SetMediumResourceReport service shall be according to Table 51.

Table 51 – SetMediumResourceReport service message format

Message format	Explanation
<pre> { "Argument": [{ "Destination address": "02004CAABBDD", "Communication link ID": "A1000", "Wireless ID": "A1111", "Report type": "cyclic", "Report interval": "45.0", "Report threshold": "0,4" }], "Result (+)": [{ "CCP address": "02004CAABBFF", "Wireless ID": "A1111" }], "Result (-)": { "Service status": "aborted", } } </pre>	Parameters of the service request. Destination address to which the service request is to be sent. Identifier of the communication link. Identifier of requested wireless system or wireless device. Generation type of medium resource report. Interval time of cyclic reports. Threshold of parameter for event generation. Service request succeeded. Address of the requested CCP. It is present in the response primitive. Identifier of the wireless system or wireless device. Service request failed. Information on the result of service execution.

8.5.4 NotifyMediumResource

8.5.4.1 Service overview

The NotifyMediumResource service uses a set of primitives for providing control resource reports from a logical link of a CMWCA or CMWD to CCP. NotifyMediumResource service is an unconfirmed service and uses the C-SAP. The CMWCA or CMWD sends the NotifyMediumResource service request attempts to CCP. The primitive flow of NotifyMediumResource service is depicted in Figure 62 for CMWCA and in Figure 63 for CMWD.

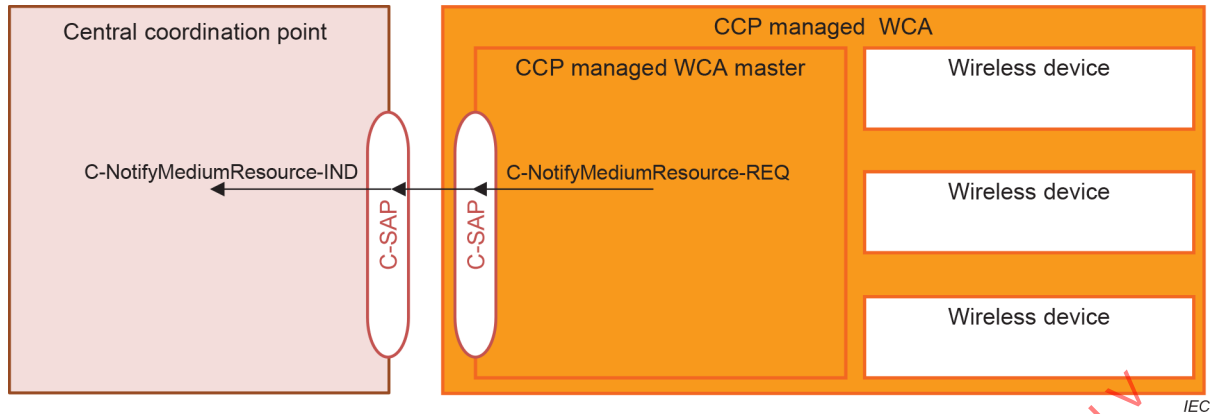


Figure 62 – Primitive flow of NotifyMediumResource service for CMWCA

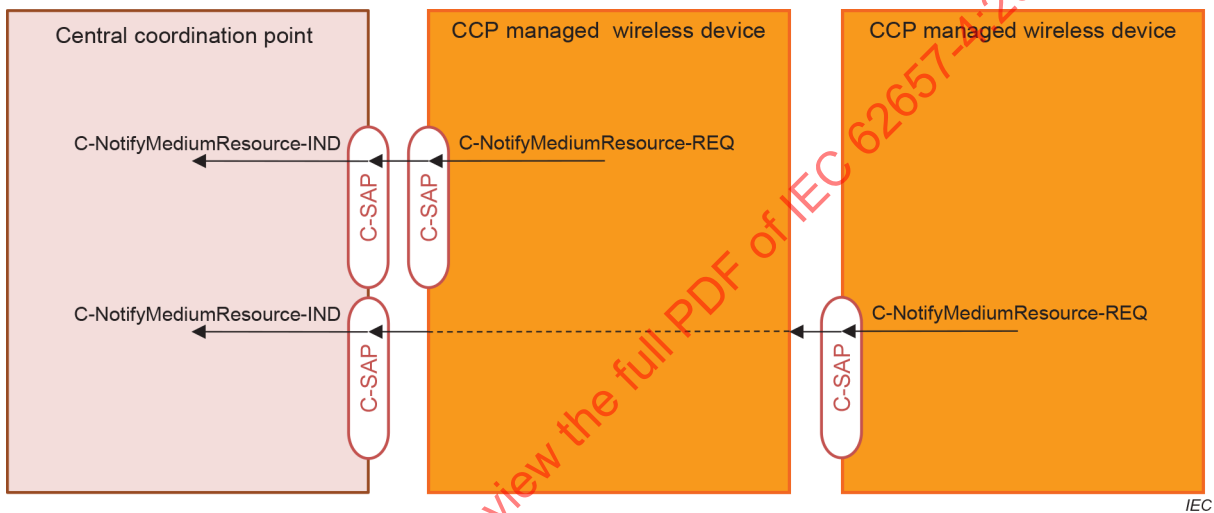


Figure 63 – Primitive flow of NotifyMediumResource service for CMWD

8.5.4.2 Service primitives

The structure of the service primitives is shown in Table 52.

Table 52 – NotifyMediumResource service parameter

Parameter name	Request	Indication	Response	Confirm
Argument				
CCP address	M	M(=)		
Wireless ID	M	M(=)		
Attribute data	M	M(=)		
Duty cycle	M	M(=)		
RSSI mean	M	M(=)		
RSSI standard deviation	M	M(=)		
SINR mean	M	M(=)		
SINR standard deviation	M	M(=)		
Data throughput	M	M(=)		
Message loss ratio	M	M(=)		

Argument

The argument contains the parameters of the service request.

CCP address

This parameter specifies the address of the requested CCP. It is present in the response primitive.

Wireless ID

This parameter specifies the identifier of requested wireless system or wireless device.

Attribute data

This parameter returns a stream of information containing all the attributes.

- duty cycle;
- RSSI mean;
- RSSI standard deviation;
- SINR mean;
- SINR standard deviation;
- data throughput;
- message loss ratio.

8.5.4.3 Service procedure

The CCP may configure the NotifyMediumResource service with the SetMediumResourceReport service primitive. The NotifyMediumResource request shall send a message from the CMWCA or CMWD to the CCP. When the message arrives at the target device (CCP), this shall result in a NotifyMediumResource indication at the CCP. The CCP shall forward the message to the appropriate target object.

8.5.4.4 Service sequence

The service sequence of NotifyMediumResource service is shown in Figure 64.

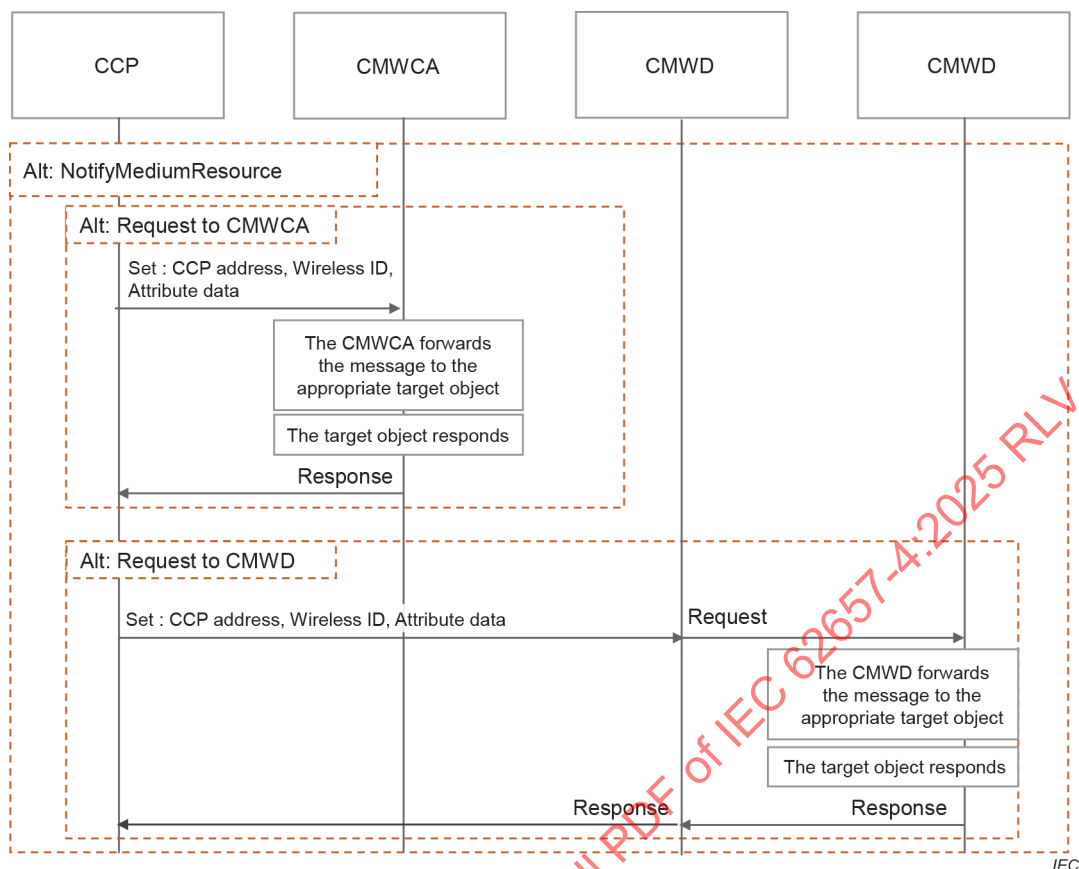


Figure 64 – Sequence diagram (NotifyMediumResource)

The message format of `NotifyMediumResource` service shall be according to Table 53 .

Table 53 – NotifyMediumResourceservice message format

Message format	Explanation
<pre> { "Argument": [{ "CCP address": "02004CAABBFF", "Wireless ID": "A1111", "Attribute data": [{ "Duty cycle": 80, "RSSI mean": -50, "RSSI standard deviation": 10, "SINR mean": 9.0, "SINR standard deviation": 10, "Data throughput": 1000000, "Message loss ratio": 0.1 }], }], } </pre>	Parameters of the service request. CCP address to which the service request is to be sent. Identifier of requested wireless system or wireless device. Duty cycle per communication link. Received signal strength indication mean. Received signal strength indication standard deviation. Signal to interference and noise ratio mean. Signal to interference and noise ratio standard deviation. Ratio between the number of user data transferred to the application at the target reference. Ratio of number of packets of messages, transferred from the Application at the reference interface within the producer, and the number of messages, transferred at the reference interface to the application within the consumer.

8.5.5 SetMediumSensingReport

8.5.5.1 Service overview

The SetMediumSensingReport service uses a set of primitives for setting periodically or by request control resource reports procedures at SSF in CMWD or SSN.

SetMediumSensingReport service is a confirmed service and uses the M-SAP. The CCP sends the SetMediumSensingReport service request attempts to SSF in CMWD or SSN. The primitive flow of SetMediumSensingReport service is depicted in Figure 65 for SSN and in Figure 66 for SSF in CMWD.

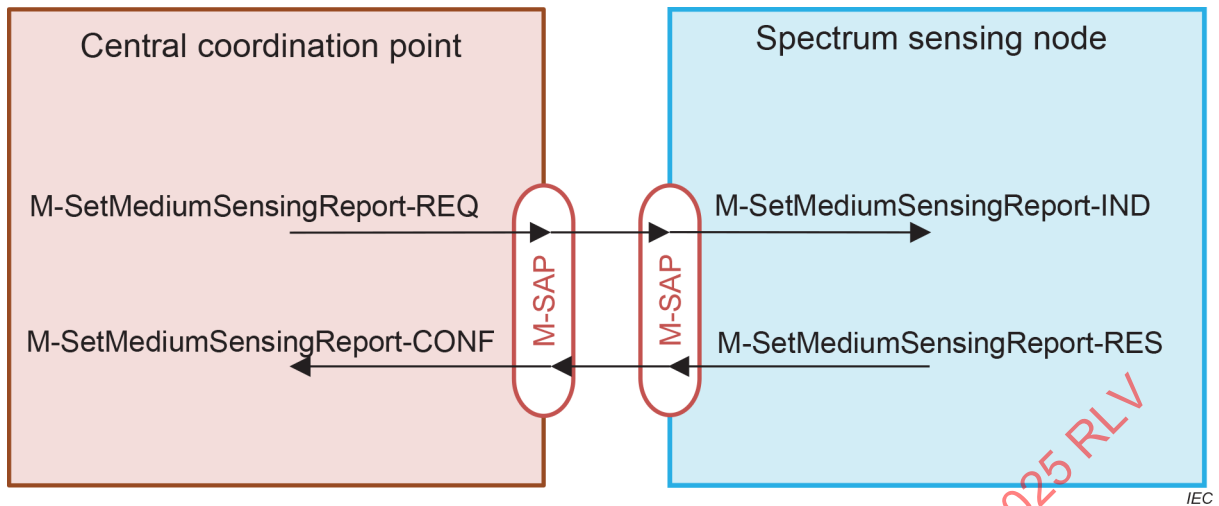


Figure 65 – Primitive flow of SetMediumSensingReport service for SSN

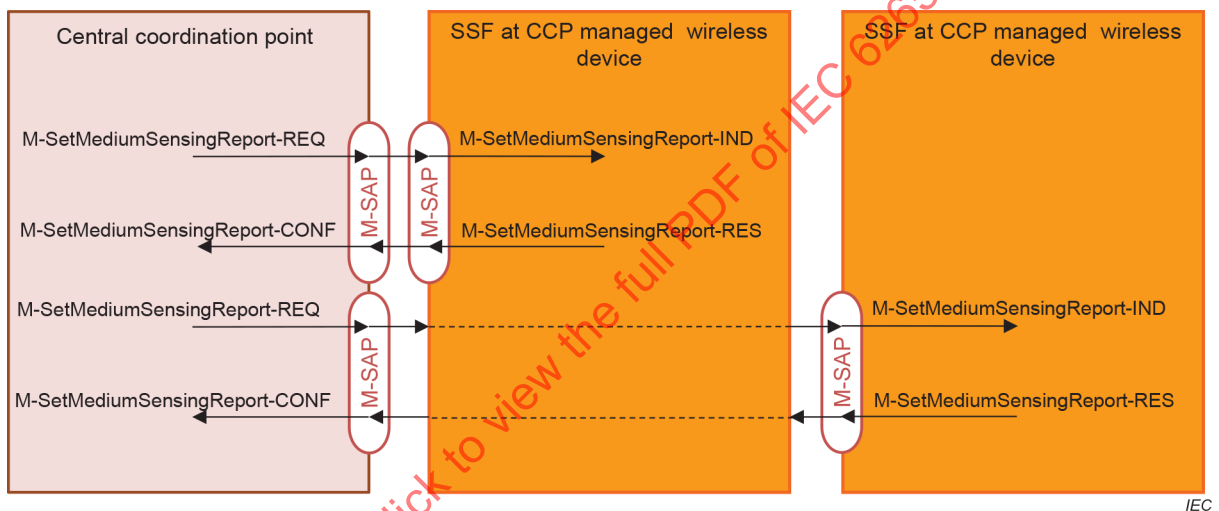


Figure 66 – Primitive flow of SetMediumSensingReport service for SSF in CMWD

8.5.5.2 Service primitives

The structure of the service primitives is shown in Table 54.

Table 54 – SetMediumSensingReport service parameter

Parameter name	Request	Indication	Response	Confirm
Argument				
Destination address	M	M(=)		
Medium sensing report type	M	M(=)		
Report interval	M	M(=)		
Sensing start frequency	M	M(=)		
Sensing end frequency	M	M(=)		
Sensing interval	M	M(=)		
Signal duration	M	M(=)		
Result (+)			S	S(=)
CCP address			M	M(=)
Spectrum sensing entity ID			M	M(=)
Result (-)			S	S(=)
Service status			M	M(=)

Argument

The argument contains the parameters of the service request.

Destination address

This parameter specifies the destination address to which the service request is to be sent.

Medium sensing report type

This parameter specifies the generation type of medium resource report (NotifyMediumResource). The report types are cyclic or requested. It is present in the request primitive.

Report interval

This parameter specifies the interval time of cyclic reports, if the medium sensing report type is cyclic.

Sensing start frequency

This parameter specifies the start frequency of sensing.

Sensing end frequency

This parameter specifies the stop frequency of sensing.

Sensing interval

This parameter specifies the interval between sensing processes.

Sensing duration

This parameter specifies the duration of a sensing process.

Result (+)

This selection type parameter indicates that the service request succeeded.

CCP address

This parameter specifies the address of the requested CCP. It is present in the response primitive.

Spectrum sensing entity ID

This parameter specifies the identifier of the spectrum sensing entity ID either SSN or SSF.

Result (-)

This selection type parameter indicates that the service request failed.

Service status

This parameter provides information on the result of service execution. It shall be one of ABORTED or TIMEOUT.

8.5.5.3 Service procedure

The CCP may use this primitive to set the medium sensing report at the SSF in CMWD and SSN.

The SetMediumSensingReport request shall send a message to the SSF in CMWD or SSN. When the message arrives at the target device (CMWD or SSN), this shall result in a SetMediumSensingReport indication at the SSF in CMWD or SSN. The SSF in CMWD or SSN shall forward the message to the appropriate target objects. When the object responds, the SSF in CMWD or SSN shall forward the response via the SetMediumSensingReport response primitive. When the response arrives at the device which originated the request, a SetMediumSensingReport confirmation shall be returned to the application object which sent the request.

8.5.5.4 Service sequence

The service sequence of SetMediumSensingReport service is shown in Figure 67.

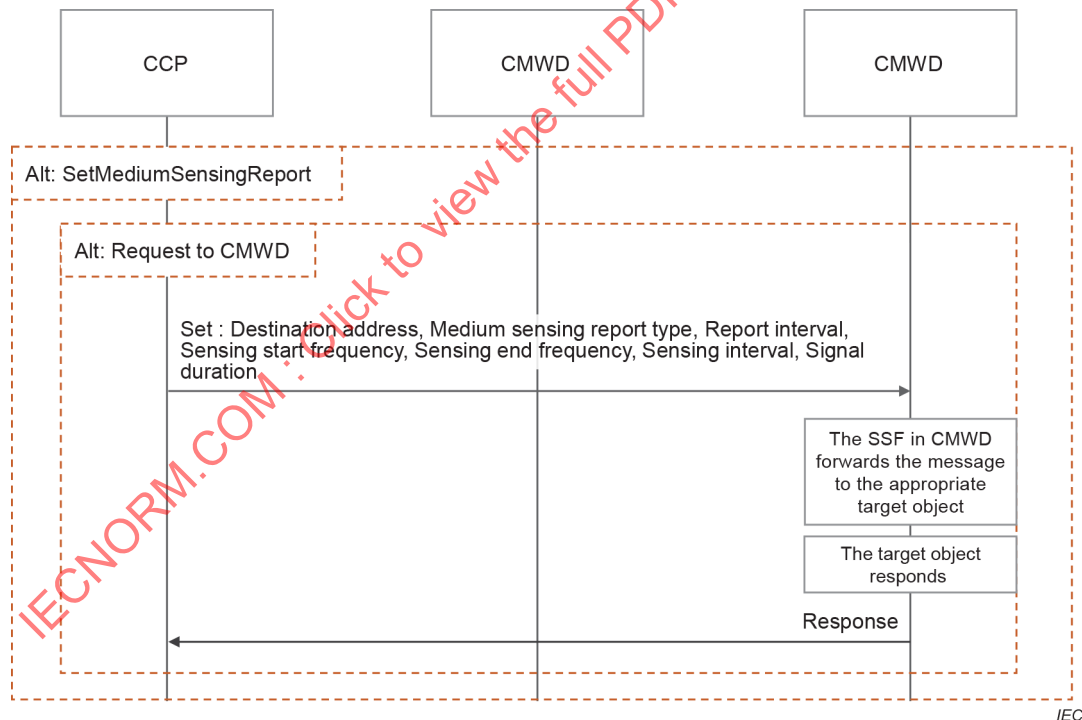


Figure 67 – Sequence diagram (SetMediumSensingReport)

8.5.5.5 Service message format

The message format of SetMediumSensingReport service shall be according to Table 55.

Table 55 – SetMediumSensingReportservice message format

Message format	Explanation
<pre> { "Argument": [{ "Destination address": "02004CAABBDD", "Medium sensing report type": "cyclic", "Report interval": 45, "Sensing start frequency": 2412, "Sensing end frequency": 2484, "Sensing interval": 0.1, "Signal duration": 1 }], "Result (+)": [{ "CCP address": 02004CAABBFF, "Spectrum sensing entity ID": 2222 }], "Result (-)": { "Service status": aborted } } </pre>	Parameters of the service request. Destination address to which the service request is to be sent. Generation type of medium resource report. Interval time of cyclic reports. Start frequency of sensing. Start frequency of sensing. Interval between sensing processes. Duration of a sensing process. Service request succeeded. CCP address to which the service request is to be sent. Identifier of the spectrum sensing entity ID either SSN or SSF. Service request failed. Information on the result of service execution.

8.5.6 NotifyMediumSensingResults

8.5.6.1 Service overview

The NotifyMediumSensingResults service uses a set of primitives for supporting control resource reports from SSN or SSF in CMWD to CCP. NotifyMediumSensingResults service is an unconfirmed service and uses the C-SAP. The SSN or SSF in CMWD sends the NotifyMediumSensingResults service request attempts to CCP. The primitive flow of NotifyMediumSensingResults service is depicted in Figure 68 for SSN and in Figure 69 for SSF in CMWD.

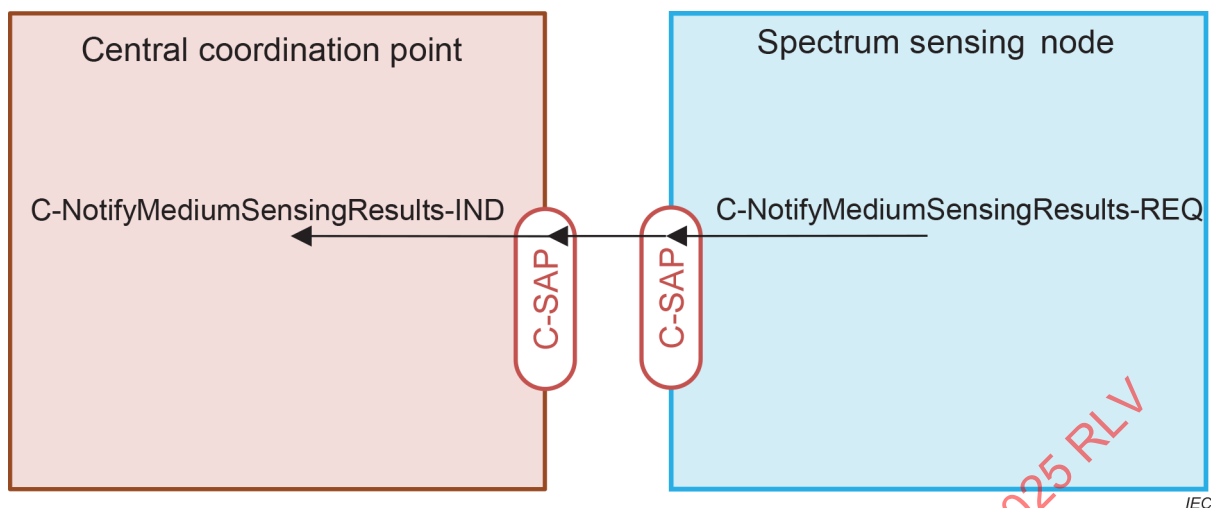


Figure 68 – Primitive flow of NotifyMediumSensingResults service for SSN

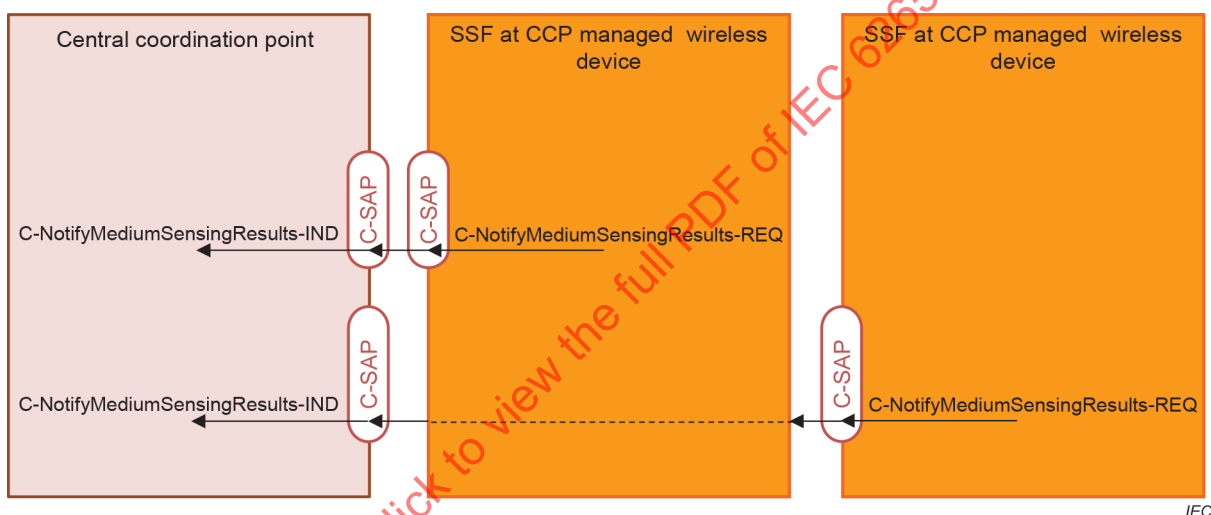


Figure 69 – Primitive flow of NotifyMediumSensingResults service for SSF in CMWD

8.5.6.2 Service primitives

The structure of the service primitives is shown in Table 56.

Table 56 – NotifyMediumSensingResults service parameter

Parameter name	Request	Indication	Response	Confirm
Argument				
CCP address			M	M(=)
Spectrum sensing entity ID	M	M(=)		
Attribute data	M	M(=)		
Timestamp	M	M(=)		
Array of frequency	M	M(=)		
Array of power spectral density	M	M(=)		

Argument

The argument contains the parameters of the service request.

CCP address

This parameter specifies the address of the requested CCP. It is present in the response primitive.

Spectrum sensing entity ID

This parameter specifies the identifier of the spectrum sensing entity ID either SSN or SSF.

Attribute data

This parameter returns a stream of information containing all the attributes.

- Timestamp;
- array of frequency;
- array of power spectral density.

8.5.6.3 Service procedure

The CCP may configure the NotifyMediumSensingResults service with the SetMediumSensingReport service primitive. The NotifyMediumSensingResults request shall send a message from the SSF in CMWD or SSN to the CCP. When the message arrives at the target device (CCP), this shall result in a NotifyMediumSensingResults indication at the CCP. The CCP shall forward the message to the appropriate target object.

8.5.6.4 Service sequence

The service sequence of NotifyMediumSensingResults service is shown in Figure 70.

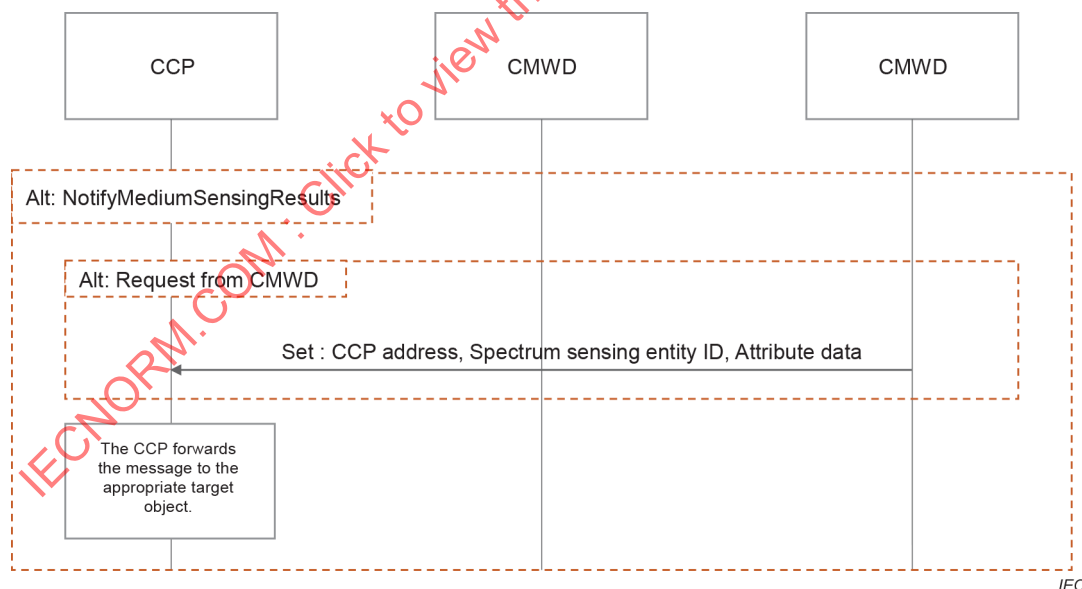


Figure 70 – Sequence diagram (NotifyMediumSensingResults)

8.5.6.5 Service message format

The message format of NotifyMediumSensingResults service shall be according to Table 57.

Table 57 – NotifyMediumSensingResults service message format

Message format	Explanation
<pre>{ "Argument": [{ "CCP address": "02004CAABBFF", "Spectrum sensing entity ID": "2222", "Attribute data": [{ "Timestamp": "1569855600", "Array of frequency": , [2401, 2412,2406,2417...,2495], "Array of power spectral density": [-83-83-75..., -45..., -83] }], }], }</pre>	Parameters of the service request. CCP address to which the service request is to be sent. Identifier of the spectrum sensing entity ID either SSN or SSF. Information concerning time of collected attribute data. Collected values from sensing start frequency to sensing end frequency during the sensing process. Collected values of power spectral density from sensing start frequency to sensing end frequency during the sensing process.

8.6 Database access services

8.6.1 Supported service

This Subclause 8.6 contains the definition of a service that is unique to the data base access.

8.6.2 GetRadioRegulation

8.6.2.1 Service overview

The GetRadioRegulation service uses a set of primitives for getting radio regulation parameters from the radio regulation database. The GetRadioRegulation service is a confirmed service and uses the M-SAP. The CCP sends the GetRadioRegulation service request attempts to the radio regulation database. The primitive flow of GetRadioRegulation service is depicted in Figure 71.

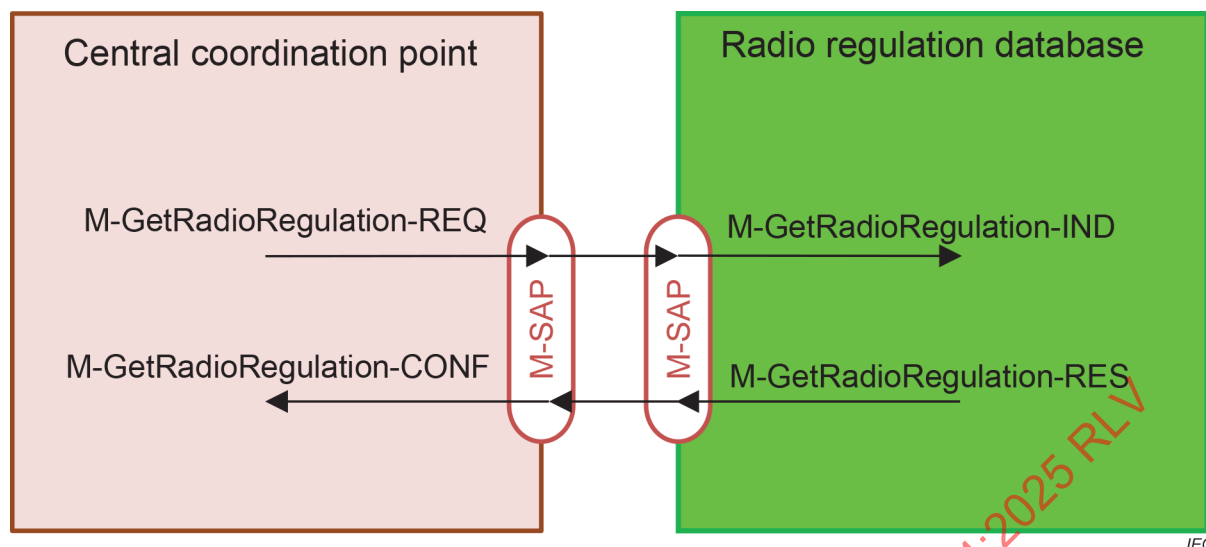


Figure 71 – Primitive flow of GetRadioRegulation service

8.6.2.2 Service primitives

The structure of the service primitives is shown in Table 58.

Table 58 – GetRadioRegulation service parameter

Parameter name	Request	Indication	Response	Confirm
Argument				
Destination address	M	M(=)		
Radio regulation database ID	M	M(=)		
Start frequency	M	M(=)		
Stop frequency	M	M(=)		
Location	M	M(=)		
Result (+)			S	S(=)
CCP address			M	M(=)
Radio regulation database ID			M	M(=)
Attribute data			M	M(=)
Frequency band			M	M(=)
Allocation			M	M(=)
Application(s)			M	M(=)
Result (-)			S	S(=)
Service status			M	M(=)

Argument

The argument contains the parameters of the service request.

Destination address

This parameter specifies the destination address to which the service request is to be sent.

Radio regulation database ID

This parameter specifies the ID of requested radio regulation database.

Start frequency

This parameter specifies the start frequency of used frequency range.

Stop frequency

This parameter specifies the stop frequency of used frequency range.

Position

This parameter specifies the position of CMWCA and CMWD specified in a three-dimensional space.

Result (+)

This selection type parameter indicates that the service request succeeded.

CCP address

This parameter specifies the address of the requested CCP. It is present in the response primitive.

Radio regulation database ID

This parameter specifies the ID of radio regulation database.

Attribute data

This parameter returns a stream of information containing all the attributes.

- frequency band;
- allocation;
- application(s).

Result (-)

This selection type parameter indicates that the service request failed.

Service status

This parameter provides information on the result of service execution. It shall be one of ABORTED or TIMEOUT.

8.6.2.3 Service procedure

The CCP may use this primitive to get radio regulation parameters from the radio regulation database. The GetRadioRegulation request shall send a message to the radio regulation database. When the message arrives at the target device, this shall result in a GetRadioRegulation indication at the radio regulation database. The radio regulation database shall forward the message to the appropriate target objects. When the object responds, the radio regulation database shall forward the response via the GetRadioRegulation response primitive. When the response arrives at the device which originated the request, a GetRadioRegulation confirmation shall be returned to the application object which sent the request.

8.6.2.4 Service sequence

The service sequence of GetRadioRegulation service is shown in Figure 72.

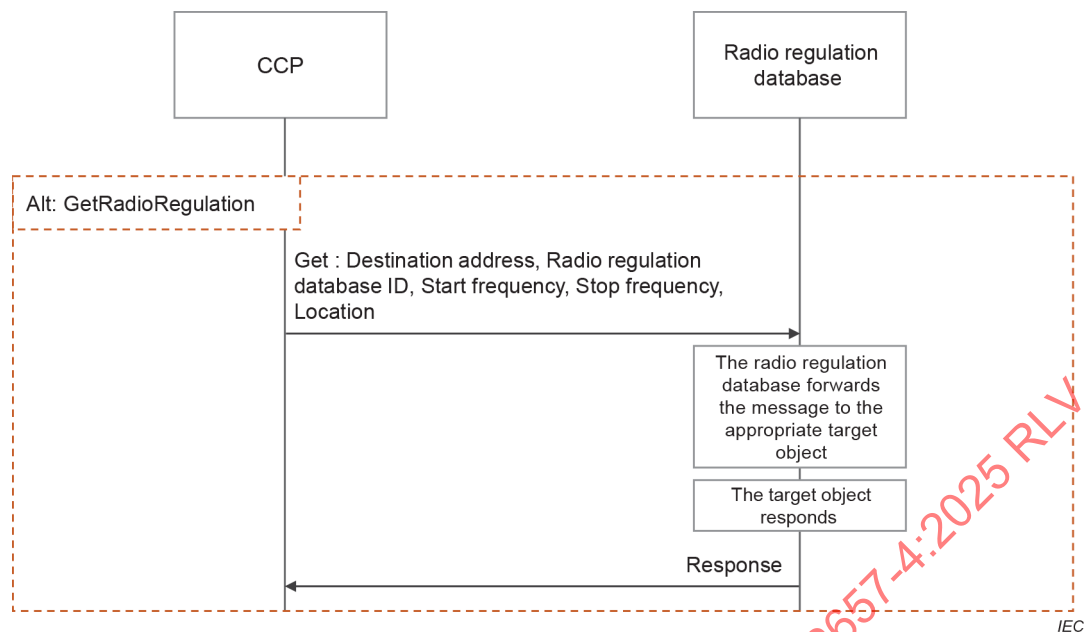


Figure 72 – Sequence diagram (GetRadioRegulation)

8.6.2.5 Service message format

The message format of GetRadioRegulation service shall be according to Table 59.

Table 59 – GetRadioRegulation service message format

Message format	Explanation
<pre> { "Argument": [{ "Destination address": "02004CAABBDD", "Radio regulation database ID": "ETSI EN 300 328", "Start frequency": "429.2500", "Stop frequency": "429.6500", "Position": "120, 45, 10" }], "Result (+)": [{ "CCP address": "02004CAABBFF", "Radio regulation database ID": "ETSI EN 300 328", "Attribute data": [{ "Frequency band": "429, 920xxxxxx", "Allocation": "429.2500", "Application(s)": "Control of machine and production cell local" }], }], "Result (-)": { "Service status": "aborted", } } </pre>	Parameters of the service request. Destination address to which the service request is to be sent. ID of requested radio regulation database. Start frequency of used frequency range. Stop frequency of used frequency range. Position of CMWCA and CMWD. Service request succeeded. CCP address to which the service request is to be sent. ID of requested radio regulation database. Range in the frequency spectrum that is assigned by regulatory organizations for use for specific applications or a group of applications. Entry in the table of frequency allocations of a given frequency band for the purpose of its use by one or more radio communication services or the radio astronomy service under specified conditions. Service request failed. Information on the result of service execution.

Annex A (informative)

Example of a CCP controlled WCA and incumbent services/applications within the 5,8 GHz band

CCP controlled WCA and incumbent services/applications within the 5,8 GHz WIA band, such as radiolocation, transportation system and BFWA are depicted in Figure A.1, as examples.

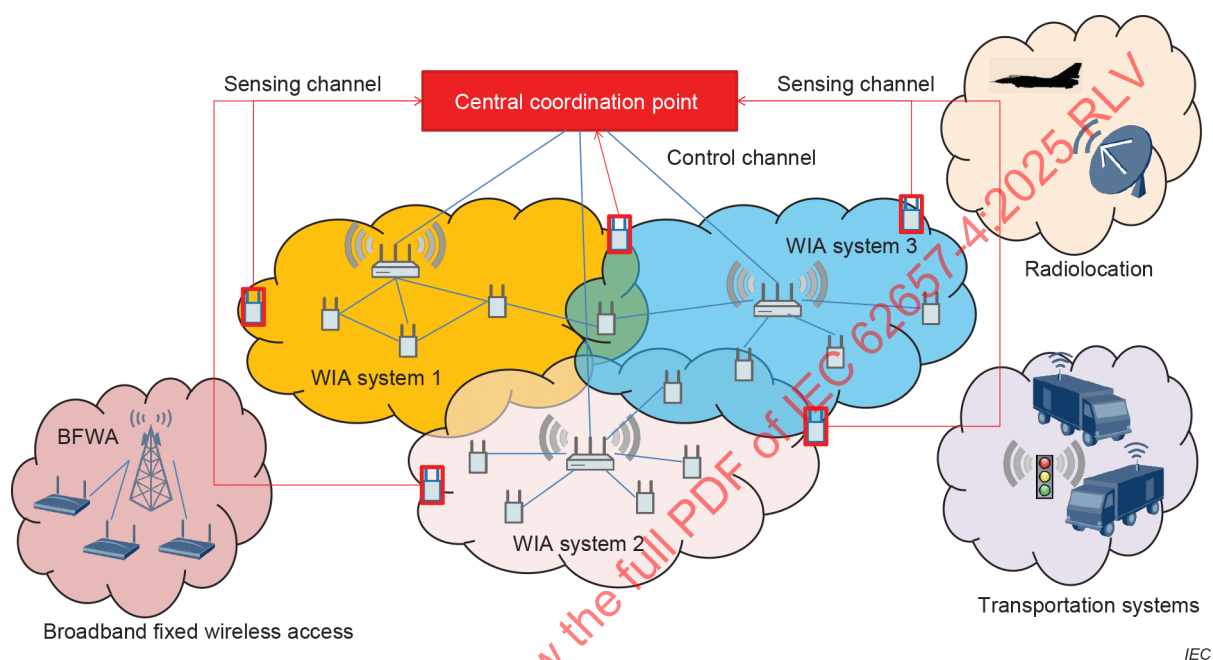


Figure A.1 – CCP controlled WCA and incumbent services and applications

Figure A.2 shows an example of the incumbent services and applications using the 5,8 GHz WIA band. The incumbent services and applications with high regulatory involvement are the following: radiolocation, fixed satellite services (FSS), transportation systems like transport and traffic telematics (TTT), ITS non-safety and broadband fixed wireless access (BFWA).

Table A.1 shows an example of typical parameters for some incumbent services and applications in the 5,8 GHz WIA band (see ECC Report 206).

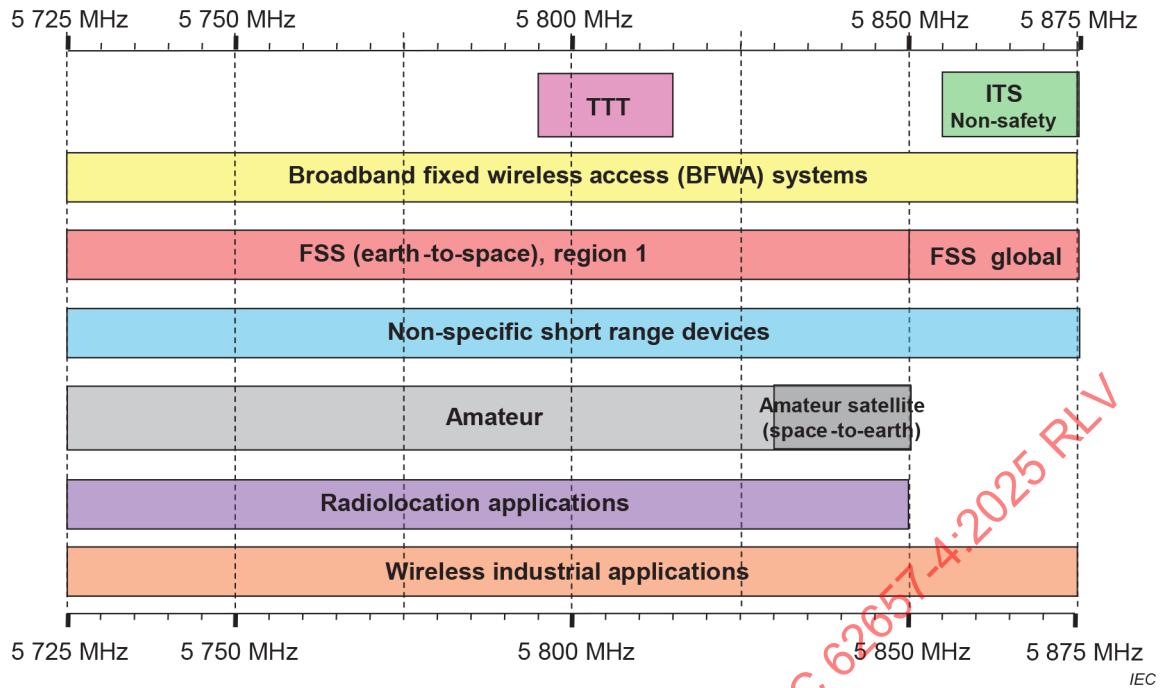


Figure A.2 – Overview of incumbent service/applications

Table A.1 – Incumbent services and applications

Incumbent service application	Frequency band MHz	Type	Application characteristic	Transmit power (EIRP)
Radiolocation	5 725 to 5 850	Defense	Dynamic in time and location	25 kW to 2 800 kW
BFWA	5 725 to 5 875	Fixed service	Static	4 W
TTT	5 795 to 5 815	Transport and traffic telematics	Static	2 W to 8 W
ITS non-safety	5 855 to 5 875	Transportation	Dynamic in time	1 mW to 200 mW

Annex B (informative)

Use of IEC CDD

Coexistence management is an example of network-encompassing property.

For any planning to work, all communication aspects can be described in a comprehensive format.

- network model;
- devices;
- coexistence management.

Figure B.1 shows the fostering wireless coexistence management according to IEC 62657-2 using IEC common data dictionary (IEC CDD) in two different ways.

The first way is to specify all needed value lists, properties and item classes (e.g. list of properties, block of properties, activities) to be able to describe the behaviour of a wireless interface and the network behaviour.

The second way is to use defined dictionary concepts for wireless interface and the network behaviour to specify the allowed values and ranges based on the existing wireless communication network standards, for example IEC 62591, IEC 62601, IEC 62734, and IEC 62948. For this purpose, specific values for sets of properties can be defined (e.g. specific combination of protocol name, radio frequency, baud rate and reaction times).

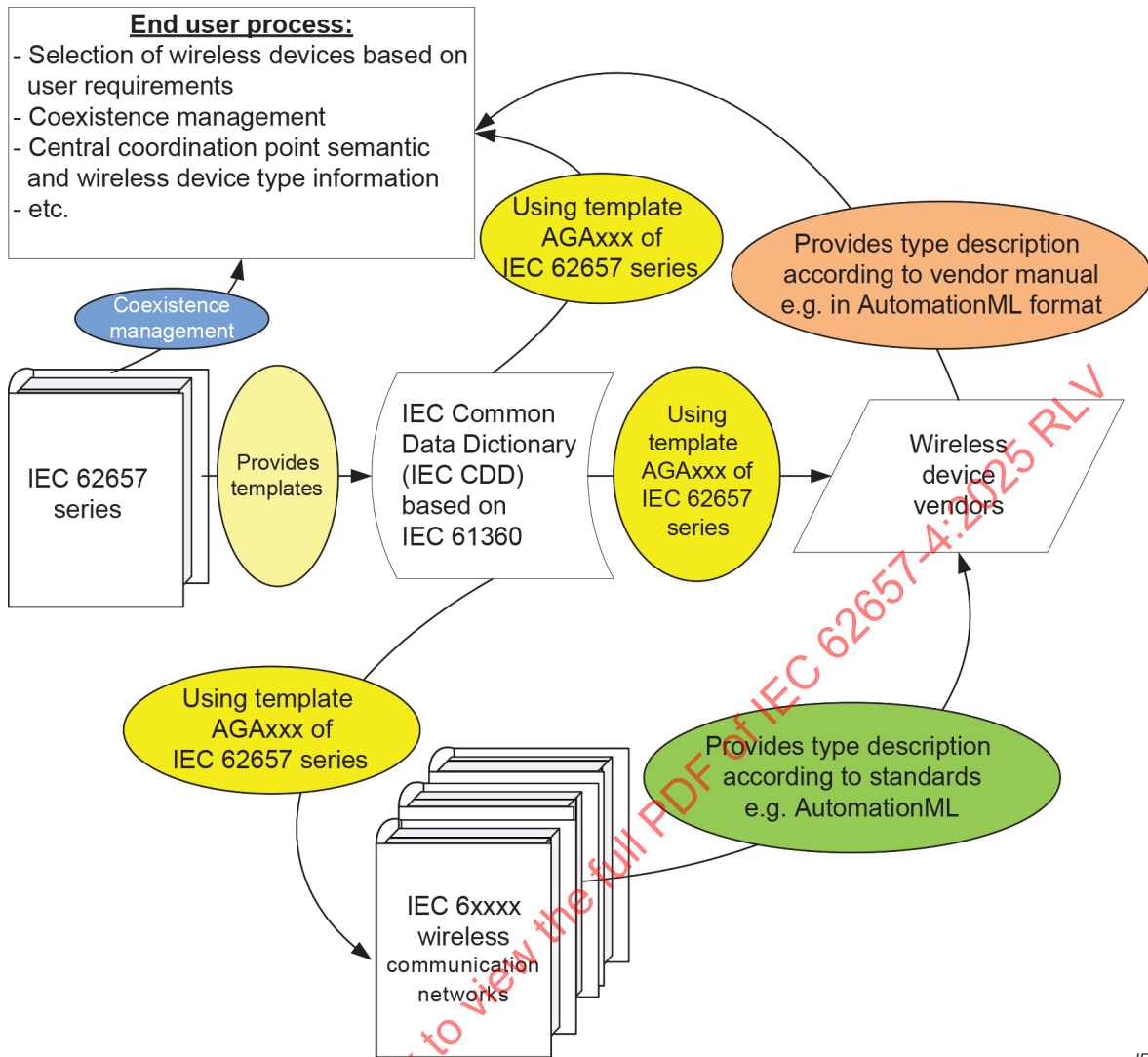
The IEC 62657 series provides templates which can be mapped to a database standard. This database standard can be based on the IEC 61360 series (IEC CDD).

Wireless device vendors can use the template in the IEC CDD named AGA ###, for example

- AGA 000 defines the coexistence management information,
- AGA 107 defines the communication load,

to provide the content of the templates with the values etc. as built.

If a vendor decides to use a wireless protocol specified by the IEC wireless protocols that have a pre-filled-out version of the IEC CDD templates with the capabilities and options of this wireless protocol, then the vendor can select the subset and define the superset of these capabilities.



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Figure B.1 – Fostering wireless coexistence management

Annex C (informative)

Mapping of the services to templates

C.1 General

The templates in IEC 62657-2 are generic and can be mapped to the IEC CDD. The content of the IEC CDD can be used to develop implementations of CCPs and their components, wireless devices with spectrum sensing functions, and spectrum sensing devices that are interoperable with each other. The central coordinated coexistence management system, see Figure 6, needs database services with standardized classes and properties.

In Figure B.1, the box with the "Wireless device vendors" is the step where the device types describe the classes and properties according to the vendor manuals. The resulting electronic description, using the "catalogue data" representation of IEC CDD, can be imported by the CCP, see box "End-user process".

For the coexistence management according to this document, the templates in IEC 62657-2 are not sufficient. These templates are extended in this Annex C with functions and attributes to facilitate the end-user process (see in Figure B.1 the blue box named "Coexistence management"). These extended templates can also be used in the IEC CDD.

The added functions are the services of the CCP, specified in Clause 8. The attributes are the parameter of the service, grouped in:

- a) Argument, parameters of the service request;
- b) Result (+), if applicable for the service and conditional if successful;
- c) Result (-), conditional if not successful.

NOTE The columns in the tables of Annex C named "IEC 62657-2 reference" provide the reference to the parameter or template in IEC 62657-2:2025. A character "—" in a cell means that this is a specific attribute of this document.

C.2 Templates of the management services

The management services are specified in 8.2.

The service GetGeneralPlantCharacteristic can use the template in Table C.1.

Table C.1 – GetGeneralPlantCharacteristic service parameter template

Parameter name	Value	Unit	Usage	Remark	IEC 62657-2:2025 reference
Argument					
Destination address					—
Result (+)					
Communication address					
CCP address					—
General plant characteristics					
Regional radio regulations					Table 5, 5.51
Future expansion plan					Table 5, 5.24
Passive environmental influences					
Area of operation					Table 6, 5.11
Object movement					Table 6, 5.42
Geographical dimension of the plant					Table 6, 5.25
Natural environmental condition					Table 6, 5.39
Intervisibility					Table 6, 5.29
Frequency band					Table 6, 5.20
Active environmental influences					
Wireless communication solution density					Table 7, 5.69
Interference type					Table 7, 5.28
Limitation from neighbours of the plant					Table 7, 5.32
Result (-)					
Service status					—

The service SetGeneralPlantCharacteristic can use the template in Table C.2.

Table C.2 – SetGeneralPlantCharacteristic service parameter template

Parameter name	Value	Unit	Usage	Remark	IEC 62657-2:2025 reference
Argument					
Destination address					—
Attribute data					
General plant characteristics					
Regional radio regulations					Table 5, 5.51
Future expansion plan					Table 5, 5.24
Passive environmental influences					
Area of operation					Table 6, 5.11
Object movement					Table 6, 5.42
Geographical dimension of the plant					Table 6, 5.25
Natural environmental condition					Table 6, 5.39
Intervisibility					Table 6, 5.29
Frequency band					Table 6, 5.20
Active environmental influences					
Wireless communication solution density					Table 7, 5.69
Interference type					Table 7, 5.28
Limitation from neighbours of the plant					Table 7, 5.32
Result (-)					
Service status					—

The service GetApplicationCommunicationRequirements can use the template in Table C.3.

Table C.3 – GetApplicationCommunicationRequirements service parameter template

Parameter name	Value	Unit	Usage	Remark	IEC 62657-2:2025 reference
Argument					
Destination address					—
Communication link ID					—
Result (+)					
CCP address					—
Communication link ID					—
Performance parameter type					—
Limits of performance parameter					—
Result (-)					
Service status					—

C.3 Templates of the subscription services

The wireless communication system and device subscription services are specified in 8.3.

The service SubscribeDevice can use the template in Table C.4.

Table C.4 – SubscribeDevice service parameter template

Parameter name	Value	Unit	Usage	Remark	IEC 62657-2:2025 reference
Argument					
Destination address					—
Device type					—
Result (+)					
Device ID					—
Status					—
Device type					—
Device address					—
Result (-)					
Service status					—

The service UnsubscribeDevice can use the template in Table C.5.

Table C.5 – UnsubscribeDevice service parameter template

Parameter name	Value	Unit	Usage	Remark	IEC 62657-2:2025 reference
Argument					
Destination address					—
Device type					—
Device ID					—
Result (+)					
Device ID					—
Status					—
Device address					—
Result (-)					
Service status					—

The service SubscribeSystem can use the template in Table C.6.

Table C.6 – SubscribeSystem service parameter template

Parameter name	Value	Unit	Usage	Remark	IEC 62657-2:2025 reference
Argument					
Destination address					—
Wireless system type					—
Result (+)					
Wireless system ID					—
Status					—
Wireless system type					—
System address					—
Result (-)					
Service status					—

The service UnsubscribeSystem can use the template in Table C.7.

Table C.7 – UnsubscribeSystem service parameter template

Parameter name	Value	Unit	Usage	Remark	IEC 62657-2:2025 reference
Argument					
Destination address					—
Wireless system type					—
Wireless system ID					—
Result (+)					
Wireless system ID					—
Status					—
System address					—
Result (-)					
Service status					—

The service GetDeviceAttributes can use the template in Table C.8.

Table C.8 – GetDeviceAttributes service parameter template

Parameter name	Value	Unit	Usage	Remark	IEC 62657-2:2025 reference
Argument					
Destination address					—
Device ID					—
Result (+)					
CCP address					—
Device ID					—
Status					—
Attribute data					
Regional radio regulation					Table 23, 5,51
Transmitter					
Antenna type					Table 23, 5.5
Antenna gain					Table 23, 5.3
Antenna radiation pattern					Table 23, 5.4
Equivalent radiated power					Table 23, 5.19
Equivalent isotropic radiated power					Table 23, 5.18
Total radiated power					Table 23, 5.59
Transmitter output power					Table 23, 5,63
Power spectral density					Table 23, 5.46
Frequency channel					Table 23, 5.22
Medium access control mechanism					Table 23, 5.35
Frequency hopping sequence					Table 23, 5.23
Communication reliability					Table 23, 5.7
Transfer interval					Table 23, 5.60
Transmission gap					Table 23, 5.61

Parameter name	Value	Unit	Usage	Remark	IEC 62657-2:2025 reference
Transmitter sequence					Table 23, 5.64
Duty cycle					Table 23, 5.16
Dwell time					Table 23, 5.17
Medium utilization factor					Table 23, 5,36
Receiver					
Adjacent channel selectivity					Table 23, 5.2
Receiver sensitivity					Table 23, 5.50
Receiver maximum input level					Table 23, 5.49
Receiver blocking					Table 23, 5.48
Spurious response					Table 23, 5.57
Result (-)					
Service status					—

C.4 Templates of the Wireless communication system and device configuration and control services

The wireless communication system and device configuration and control services are specified in 8.4.

The service SetTransmitPower can use the template in Table C.9.

Table C.9 – SetTransmitPower service parameter template

Parameter name	Value	Unit	Usage	Remark	IEC 62657-2:2025 reference
Argument					
Destination address					—
System or Device ID					—
Transmitter output power					5.63
Result (+)					
Result (-)					
Service status					—

The service SetFrequencyChannel can use the template in Table C.10.

Table C.10 – SetFrequencyChannel service parameter template

Parameter name	Value	Unit	Usage	Remark	IEC 62657-2:2025 reference
Argument					
Destination address					—
System or Device ID					—
Frequency channel					5.22
Result (+)					
Result (-)					
Service status					—

The service SetBandwidth can use the template in Table C.11.

Table C.11 – SetBandwidth service parameter template

Parameter name	Value	Unit	Usage	Remark	IEC 62657-2:2025 reference
Argument					
Destination address					—
System or Device ID					—
Frequency Bandwidth					5.21
Result (+)					
Result (-)					
Service status					—

The service SetFrequencyHoppingSequence can use the template in Table C.12.

Table C.12 – SetFrequencyHoppingSequence service parameter template

Parameter name	Value	Unit	Usage	Remark	IEC 62657-2:2025 reference
Argument					
Destination address					—
System or Device ID					—
Frequency hopping sequence					5.23
Result (+)					
Result (-)					
Service status					—

The service SetBlockedFrequencyList can use the template in Table C.13.

Table C.13 – SetBlockedFrequencyList service parameter template

Parameter name	Value	Unit	Usage	Remark	IEC 62657-2:2025 reference
Argument					
Destination address					—
System or Device ID					—
Blocked frequency list					5.9
Result (+)					
Result (-)					
Service status					—

The service SetDwellTime can use the template in Table C.14.

Table C.14 – SetDwellTime service parameter template

Parameter name	Value	Unit	Usage	Remark	IEC 62657-2:2025 reference
Argument					
Destination address					—
System or Device ID					—
Dwell time					5.17
Result (+)					
Result (-)					
Service status					—

The service SetMediumAccessControlMechanism can use the template in Table C.15.

Table C.15 – SetMediumAccessControlMechanism service parameter template

Parameter name	Value	Unit	Usage	Remark	IEC 62657-2:2025 reference
Argument					
Destination address					—
System or Device ID					—
Medium access control mechanism					5.35
Result (+)					
Result (-)					
Service status					—

The service SetDeviceStatus can use the template in Table C.16.

Table C.16 – SetDeviceStatus service parameter template

Parameter name	Value	Unit	Usage	Remark	IEC 62657-2:2025 reference
Argument					
Destination address					—
System or Device ID					—
Device status					—
Result (+)					
Result (-)					
Service status					—

The service GetParameter can use the template in Table C.17.

Table C.17 – GetParameter service parameter template

Parameter name	Value	Unit	Usage	Remark	IEC 62657-2:2025 reference
Argument					
Destination address					—
Parameter ID					—
Result (+)					
Destination address					—
Parameter ID					—
Parameter values					—
Result (-)					
Service status					—

The service SetParameter can use the template in Table C.18.

Table C.18 – SetParameter service parameter template

Parameter name	Value	Unit	Usage	Remark	IEC 62657-2:2025 reference
Argument					
Destination address					—
Parameter ID					—
Parameter value					—
Result (+)					
Result (-)					
Service status					—

C.5 Templates of the Medium resource management services

The Medium resource management services are specified in 8.5.

The service GetMediumResourceReport can use the template in Table C.19.

Table C.19 – GetMediumResourceReport service parameter template

Parameter name	Value	Unit	Usage	Remark	IEC 62657-2:2025 reference
Argument					
Destination address					—
Communication link ID					—
Wireless ID					—
Result (+)					
Result (-)					
Service status					—

The service SetMediumResourceReport can use the template in Table C.20.

Table C.20 – SetMediumResourceReport service parameter template

Parameter name	Value	Unit	Usage	Remark	IEC 62657-2:2025 reference
Argument					
Destination address					—
Communication link ID					—
Wireless ID					—
Report type					—
Report interval					—
Report threshold					—
Result (+)					
CCP address					—
Wireless ID					—
Report status					
Result (-)					
Service status					—

The service NotifyMediumResource can use the template in Table C.21.

Table C.21 – NotifyMediumResource service parameter template

Parameter name	Value	Unit	Usage	Remark	IEC 62657-2:2025 reference
Argument					
CCP address					—
Wireless ID					—
Attribute data					
Duty cycle					5.16
RSSI mean					—
RSSI standard deviation					—
SINR mean					—
SINR standard deviation					—
Data throughput					5.14
Message loss ratio					5.44
Result (+)					
Result (-)					
Service status					—

The service SetMediumSensingReport can use the template in Table C.22.

Table C.22 – SetMediumSensingReport service parameter template

Parameter name	Value	Unit	Usage	Remark	IEC 62657-2:2025 reference
Argument					
Destination address					—
Medium sensing report type					—
Report interval					—
Sensing start frequency					—
Sensing end frequency					—
Sensing interval					—
Signal duration					—
Result (+)					
CCP address					—
Spectrum sensing entity ID					—
Result (-)					
Service status					—

The service NotifyMediumSensingResults can use the template in Table C.23.

Table C.23 – NotifyMediumSensingResults service parameter template

Parameter name	Value	Unit	Usage	Remark	IEC 62657-2:2025 reference
Argument					
CCP address					—
Spectrum sensing entity ID					—
Attribute data					
Timestamp					—
Array of frequency					—
Array of power spectral density					—
Result (-)					
Service status					—

C.6 Templates of the Database access services

The Database access services are specified in 8.6.

The service GetRadioRegulation can use the template in Table C.24.

Table C.24 – GetRadioRegulation service parameter template

Parameter name	Value	Unit	Usage	Remark	IEC 62657-2:2025 reference
Argument					
Destination address					—
Radio regulation database ID					—
Start frequency					—
Stop frequency					—
Location					—
Result (+)					
CCP address					—
Radio regulation database ID					—
Attribute data					
Frequency band					5.20
Allocation					—
Automation application(s)					—
Result (-)					
Service status					—

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Annex D (informative)

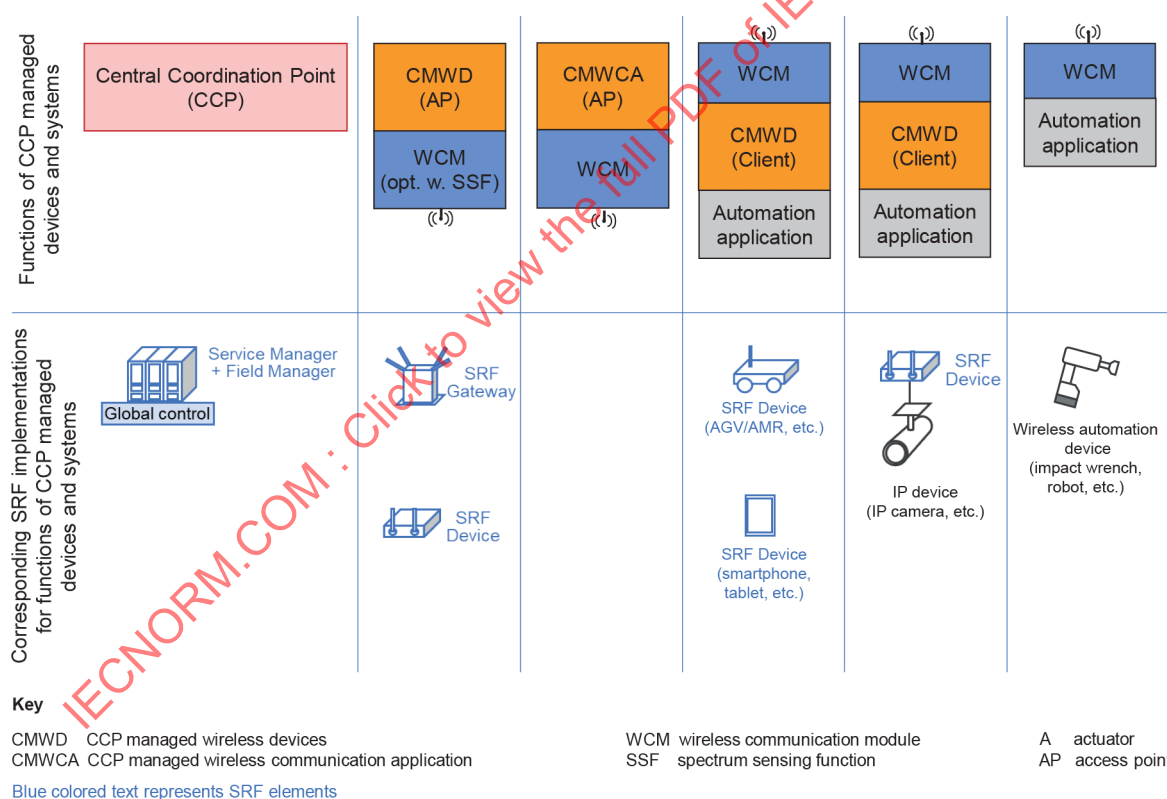
Wireless coexistence management with SRF Wireless Platform

D.1 General

IEC 62657-4 describes the concept and services of the automated coexistence management system. On the other hand, to implement it in an existing factory, more detailed functions and settings are required. Therefore, this annex exemplifies smart resource flow (SRF)² wireless platform (named SRF Wireless Platform), which is based on IEC 62657-4 and explains the verification effects (effectiveness of coexistence management).

D.2 Overview of SRF Wireless Platform

The SRF Wireless Platform is a coordination control technology to ensure stable communications in an environment where various wireless systems coexist for industrial applications. SRF Wireless Platform aims at accommodating existing and future available wireless technologies.



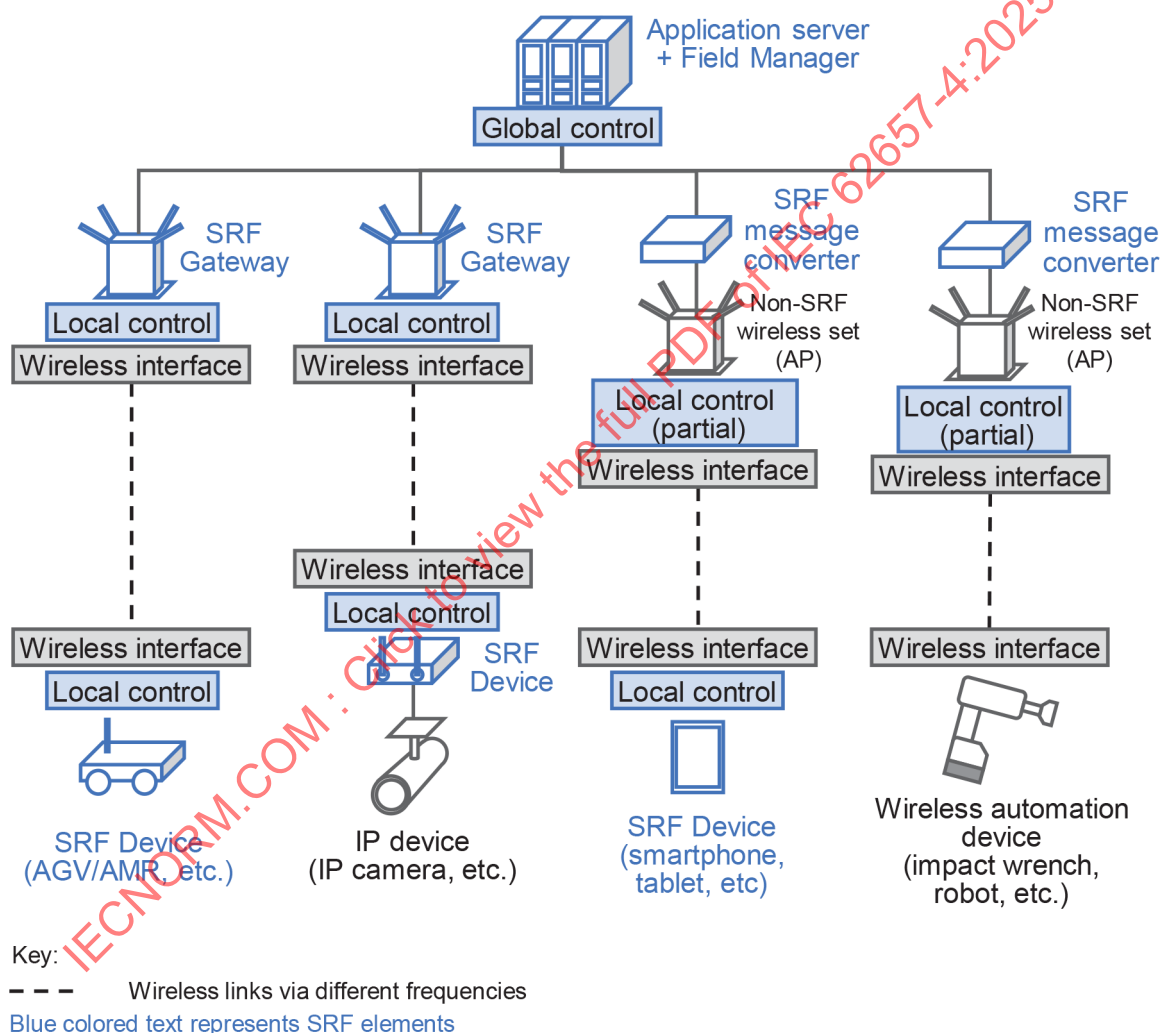
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Figure D.1 – CCP system elements of SRF Wireless Platform

² Smart resource flow is an example of a suitable product available commercially. This information is given for the convenience of users of IEC 62657-4 and does not constitute an endorsement by IEC of this product.

The SRF Wireless Platform implements the system architecture elements for wireless coexistence management described in 5.2 as shown in Figure D.1. The central coordination point functions described in 5.2.2 are implemented in the SRF Service Managers and the SRF Field Manager. An SRF Gateway implements functions of a CCP managed wireless device in accordance with 5.2.1.2 in addition to the functions of a standard access point. SRF Devices implement functions of a CCP managed wireless device according to 5.2.1.2. SRF Devices can implement an automation application or only an interface to a separate automation device. The SRF Sensor corresponds to the spectrum sensing node described in 5.2.4.

SRF Wireless Platform provides hierarchical radio resource control consisting of global control and local control, see Figure D.2. Global control is the coordination control of radio resources to satisfy requirements of factory applications. Local control is the autonomous fine control of radio resources according to Radio Resource Control Policy to adapt promptly to rapid changes locally of radio environment.



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SOURCE: SRF Wireless Platform Technical Specifications Version 2.0.0. Reproduced with the permission of Flexible Factory Partner Alliance (FFPA).

Figure D.2 – Overview of SRF Wireless Platform

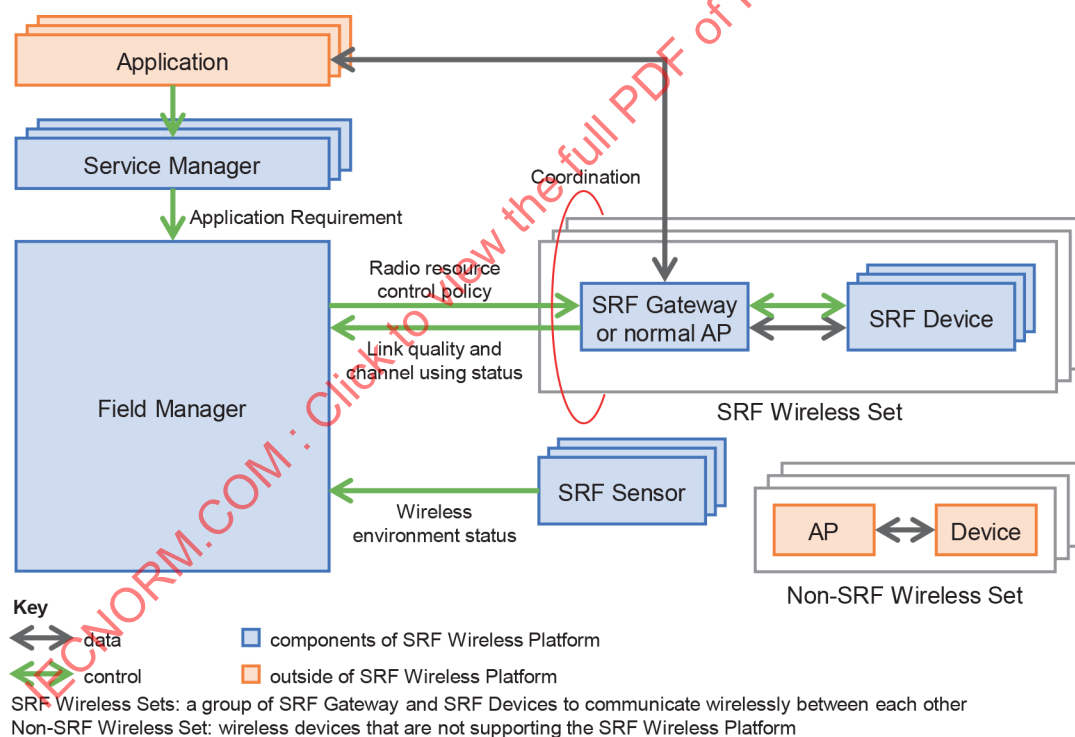
The functional structure described by the SRF Wireless Platform is shown in Figure D.3.

The service manager implements the resource engine functionality of a CCP excluding maintaining and monitoring QoS information of the communication links (see 5.2.2.3). It calculates application-specific requirements (transmission quality such as transmission time, packet loss ratio, congestion, etc.). Furthermore, the service manager includes the information and configuration data base of a CCP (see 5.2.3.1). Each wireless communication application has its own service manager.

The field manager implements the functionality of the spectrum engine and the interfaces to the CCP managed wireless applications and/or devices. It also has a function of resource engine in terms of maintaining and monitoring QoS information of the communication links. It coordinates radio resources to meet quality requirements of each application and to avoid radio frequency interference. It also allocates spectrum resources by providing control policies to each wireless communication system. One field manager coordinates all relevant wireless communication applications.

The SRF Sensor corresponds to the Spectrum Sensing Node (SSN). It monitors radio environment of a factory and collects information for coexistence management.

In short, the architecture and components are almost the same between IEC 62657-4 and SRF Wireless Platform. On the other hand, some terms are differently used. Table D.1 provides the translation. SRF Wireless Platform has functions applicable to IEC 62657-4, except communications with Wireless Sensor Actuator Network (WSAN).



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Figure D.3 – Architecture of SRF Wireless Platform

Table D.1 – Comparison between IEC 62657-4 and SRF Wireless Platform

Functions of SRF Wireless Platform	Equivalent service name of IEC 62657-4
Service manager	Resource engine functionality, and information and configuration data base of a CCP
Application server	Automation application
Field Manager	Spectrum engine of a CCP and interfaces to the CCP managed wireless applications and/or devices
SRF Sensor	Spectrum Sensing Node (SSN)

The SRF Wireless Platform can be implemented without changing the existing MAC/PHY by building a variety of communication devices of different standards and generations on the platform, see Figure D.4.

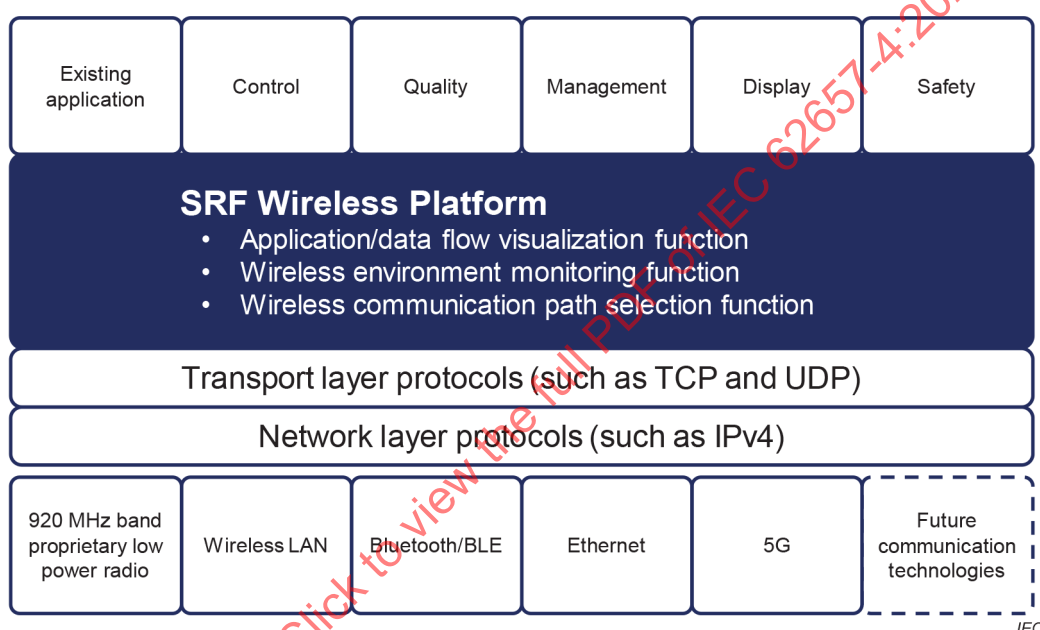
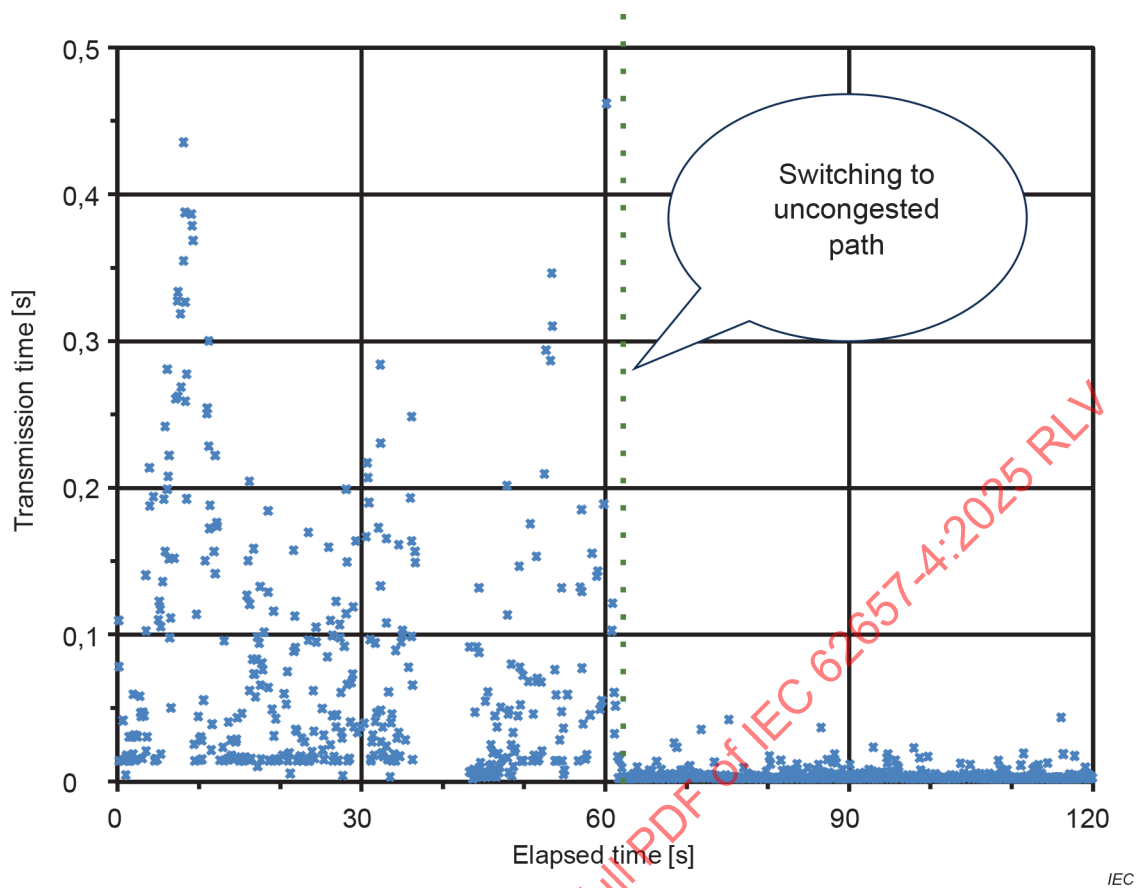


Figure D.4 – Overview of SRF Wireless Platform layer structure

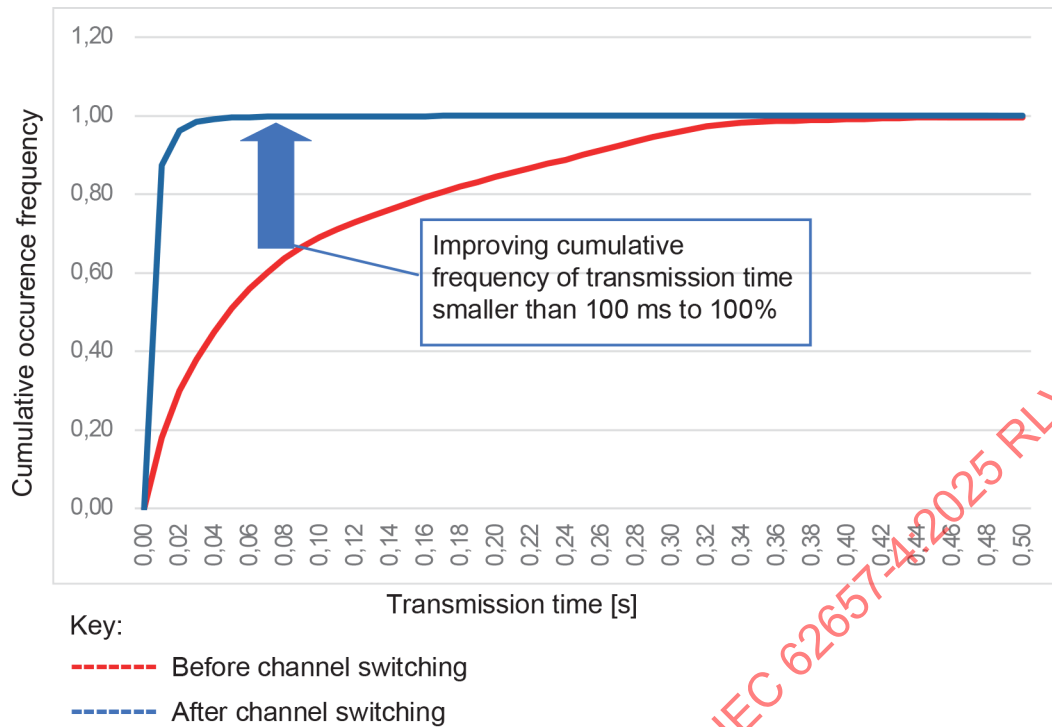
D.3 Effects of SRF Wireless Platform implementation

In 2020, National Institute of Information and Communications Technology (NICT), Japan conducted a demonstration of the SRF Wireless Platform at machine assembly factory. In the demonstration, test communication in the same frequency band as that used in the production line was conducted, and the latency of this test communication was evaluated. As a result, it was confirmed that by switching to an appropriate communication path under the control of the Field Manager (management server), the latency and its jitter significantly decreased, see Figure D.5. Also, the ratio of latency less than 100 ms increased to 100 %, see Figure D.6.



SOURCE: Successful Experiment with Stabilization Technology for Wireless Communications for Manufacturing Systems. Reproduced with the permission of NICT.

**Figure D.5 – Experimental results of the SRF Wireless Platform demonstration
(time variation of transmission time)**



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Figure D.6 – Experimental results of the SRF Wireless Platform demonstration (frequency of transmission time)

D.4 Functions of SRF Wireless Platform

D.4.1 Messages

In the SRF Wireless Platform, the messages below are exchanged between the Field Manager, Gateway, Device, and SRF Sensor as described in Table D.2.

Table D.2 – Correspondence list of messages of SRF Wireless Platform and services in IEC 62657-4

SRF			IEC 62657-4		
Interface	Message	Description of message	Service	Primitive	Reasons for matching/not-matching
Between Service Manager and Field Manager	srfSystemControllIndicator	This message is used by Service Manager or an application to give SRF System Control Indicator to Field Manager.	GetApplicationCommunicationRequirements	M- GetApplicationCommunicationRequirements-REQ	Match. srfSystemControllIndicator in SRF is a message transmitting application requirement from Service Manager to Field Manager.
	capability	This message is used by SRF Gateway to register Capability Information with its identification to Field Manager.	GetDeviceAttributes	M-GetDeviceAttributes-CONF	Match. Capability in SRF is a message transmitting I/F type, bandwidths, antenna type, signal strength. GetDeviceAttributes in IEC 62657-4 transmits bandwidths, antenna type and signal strength from CMWD to CCP so it has a similar function to grasp the ability of the target object.
	policy/Info	This message is used by SRF Gateway to get policy information from Field Manager.	- SetTransmitPower - SetFrequencyChannel - SetBandwidth - SetFrequencyHopping - Sequence - SetBlockedFrequencyList - SetDwellTime - SetMediumAccessControl - Mechanism - SetDeviceStatus - SetParameter - SetMediumResourceReport	- C-SetTransmitPower-REQ - C-SetFrequencyChannel-REQ - C-SetBandwidth-REQ - SetFrequencyHopping-REQ - Sequence - SetBlockedFrequencyList-REQ - SetDwellTime-REQ - SetMediumAccessControl - Mechanism-REQ - SetDeviceStatus-REQ - SetParameter-REQ - M-SetMediumResourceReport-REQ	Match. PolicyInfo in SRF is a message transmitting identification of SRF Gateway and Device, each SRF Service Policy and transmit output from Field Manager to SRF Gateway. SetTransmitPower in IEC 62657-4 is similar in terms of transmitting transmit output from CCP to CMWD and CMWCA. SetFrequencyChannel in IEC 62657-4 is similar in terms of transmitting channel priority from CCP to CMWD and CMWCA. SetBandwidth in IEC 62657-4 is similar in terms of transmitting priority bandwidths from CCP to CMWD and CMWCA.

SRF			IEC 62657-4	
Interface	Message	Description of message	Service	Primitive
				SetFrequencyHoppingSequence in IEC 62657-4 is similar in terms of transmitting frequency hopping sequence from CCP to CMWD and CMWCA. SetBlockedFrequencyList in IEC 62657-4 is similar in terms of transmitting blocked frequency list from CCP to CMWD and CMWCA. SetDwellTime in IEC 62657-4 is similar in terms of transmitting dwell time from CCP to CMWD and CMWCA. SetMediumAccessControlMechanism in IEC 62657-4 is similar in terms of transmitting medium access control mechanism from CCP to CMWD and CMWCA. SetDeviceStatus in IEC 62657-4 is similar in terms of transmitting device status from CCP to CMWD and CMWCA. SetParameter in IEC 62657-4 is similar in terms of transmitting parameter value from CCP to CMWD and CMWCA. SetMediumResourceReport in IEC 62657-4 is similar in terms of transmitting report interval from CCP to CMWD and CMWCA.
	dataAttribute	This message is used by SRF Gateway to get Data Attributes of an application from Field Manager.	None	None No match dataAttribute in SRF is a message transmitting application requirement from Field Manager to SRF Gateway. There are no parameters matched in IEC side.

SRF			IEC 62657-4		
Interface	Message	Description of message	Service	Primitive	Reasons for matching/not-matching
	wlanInfo	This message is used by SRF Gateway to transfer wireless link information to Field Manager.	- GetMediumResourceReport - NotifyMediumResource	- C-GetMediumResourceReport-CONF - C-NotifyMediumResource-IND	Match. wlanInfo of SRF is a message transmitting wireless link information from SRF Gateway to Field Manager. GetMediumResourceReport in IEC is similar in terms of transmitting RSSI from CMWD and CMWCA to CCP. NotifyMediumResource in IEC is similar in terms of transmitting RSSI from CMWD and CMWCA to CCP.
	doalInfo	This message is used for Radio Link Monitoring for DoA procedure.	GetRadioRegulation	M-GetRadioRegulation-IND	Match. DoalInfo in SRF is a message transmitting to monitor signals direction of arrival. GetRadioRegulation in SRF is similar in terms of transmitting location of CMWD and CMWCA from CCP to Database.
	streamInfo	This message is used by SRF Gateway to transfer Application Stream Information from Field Manager.	None	None	Not match. StreamInfo in SRF is a message transmitting latency and loss ration from Field Manager to applications. There are no parameters matched in IEC side.

SRF			IEC 62657-4		
Interface	Message	Description of message	Service	Primitive	Reasons for matching/not-matching
Between Field Manager and SRF Sensor	channelUsageInfo	This message is used by SRF Sensor to report Radio Channel Usage Efficiency to Field Manager. Field Manager does not indicate the interval for channelUsageInfo to SRF Sensor. SRF Sensor determines the interval by itself.	NotifyMediumSensingResults	C-NotifyMediumSensingResults-REQ	Match. channelUsageInfo in SRF is a message transmitting channel use efficiency from SRF Sensor to Field Manager. NotifyMediumSensingResults in IEC is similar in terms of transmitting frequency sensing results from Spectrum Sensing Node or Spectrum Sensing Function to CCP. The following parameters correspond to parameters of NotifyMediumSensingResults. - srfsensorId (Identification of each SRF Sensor)→Spectrum sensing entity ID - timestamp (Timestamp [sec])→Timestamp - lowerLimit (Lowest frequency [MHz])→Array of frequency - frequencyResolution (Frequency resolution [kHz])→Array of frequency - bandwidth (Bandwidths [kHz])→Array of frequency - count (RSSI counted number)→Array of frequency

SOURCE: Parts of this table are reproduced from SRF Wireless Platform Technical Specifications Version 2.0.0 with the permission of Flexible Factory Partner Alliance (FFPA).

D.4.2 Functions

The SRF Wireless Platform describes the following functions which work between the Filed Manager, Gateway, Device, and SRF Sensor, see Table D.3.

Table D.3 – Correspondence list of functions of SRF Wireless Platform and IEC 62657-4

SRF				IEC 62657-4	
ID	Function classification	Function name	Detail function name	Description of function	Reasons for matching/not-matching
100	Association	Capability Information Exchange	—	The function shares Capability Information (supported functions and capability of each function) of SRF Gateway and SRF Device and shares types of radio interface (e.g. IEEE Std 802.11n) of SRF Gateway and SRF Device. None	Match. Capability Information Exchange in SRF shares information related to SRF Gateway and SRF Device capability (supported functions and each function's capability) and types of wireless interfaces. GetDeviceAttributes in IEC 62657-4 is similar in terms of bandwidth, antenna type and signal strength from CMWD to CCP.

SRF					IEC 62657-4		
ID	Function classification	Function name	Detail function name	Description of function	Function name	Description of function	Reasons for matching/not-matching
201	Dynamic Communication Control	Dynamic Communication Control Decision for Field Manager	—	The function is to output necessary information to generate Radio Resource Control Policy in Radio Resource Coordination Control. It can change Radio Resource Control Policy depending on the state of the communication environment.	Database Service	Dynamic Communication Control corresponds to Database Service on the following italicized points. The central coordinated coexistence management system has three entities, as shown in Figure 5: – central coordination point (CCP); – spectrum sensing system (SSS), which is a combination of spectrum sensing nodes (SSN) and spectrum sensing functions (SSF), see 5.2.4; – <i>database services with information and configuration database and regulation database.</i> Figure 6 shows the data exchange between the elements in a central coordinated coexistence management system. The central coordination point (CCP) is the key element of the coexistence management system. <i>The CCP makes coexistence management decisions based on engineering baseline data, information from databases and current measurements of application behaviour and spectrum.</i> Current measured values of application behaviour and spectrum can be collected for wireless systems via their central device, for example a base station, or directly from wireless devices. In the first case, there is only one connection between the CCP and the central component, as with WSAN in Figure 6. Then the application using the WSAN is a CCP managed wireless communication application (CMWCA). In the other case, there are connections from the CCP to the wireless devices, as with the wireless system 1 and 2. These are then called CCP managed wireless devices (CMWD). The exchange of	Match. Dynamic Communication Control outputs information to make Radio Resource Control Policy to Radio Resource Coordination Control in Field Manager. IEC 62657-4 transmits Engineering and configuration data from Information and configuration database to CCP and transmits Regulation data from Regulation database and CCP decides coexistence management.

SRF					IEC 62657-4	
ID	Function classification	Function name	Detail function name	Description of function	Function name	Description of function
						coexistence data can take place directly between CCP and CMWD or via the central device of the WCS. Current measured values of spectrum are also provided by the spectrum sensing node (SSN). (See Figure 6.)
300	Radio Resource Coordination Control	Interference Coordination Control	—	The function is to perform scheduling control among multiple wireless systems to mitigate interferences.	CCP	Interface Coordination Control corresponds to CCP on the following italicized points. The control plane shall be comprised of the spectrum sensing system (SSS) function and central coordination point (CCP) function. The SSS shall implement spectrum sensing algorithms and the RE shall provide the information to determine the location of the CMWCA and CMWD. <i>The CCP shall maintain medium availability information, manage channel lists, manage quiet periods, scheduling and implement coexistence mechanisms.</i> The CCP shall also take requests from the MAC and PHY. For example, the MAC shall inform the CCP if an interference situation has been detected during normal operation in the channel. The CCP shall then take appropriate actions to resolve the issue such as moving to another channel. For this purpose, the CCP first requests sufficient idle time from the wireless communication application to perform an in-band sensing. It shall update the list of backup and candidate channels in a prioritized order. The CCP then ensures that the wireless communication application has sufficient idle time to select a sufficient number of backup channels. If an incumbent is found during in-
						Match. Interference Coordination Control in SRF is implemented in Field Manager and schedule control among multiple wireless systems. IEC 62657-4 has a similar function to manage channel and scheduling for CCP to avoid interferences.

SRF					IEC 62657-4		
ID	Function classification	Function name	Detail function name	Description of function	Function name	Description of function	Reasons for matching/not-matching
310		Frequency Control	Manual Channel Setting	The function is to set Channels manually at the initial stage and determine the Channel used in SRF Gateway for initial communications.	IEC 62657-2	band sensing, the MAC uses the corresponding service to inform the CCP to perform the switching operation. (See 5.3.3.)	
						Manual Channel Setting corresponds to spectrum engine of CCP on the following italicized point. Manual coexistence management In the case of manual coexistence management, <i>the coexistence manager shall define a fixed planning of the wireless solutions intended to prevent transmission overlaps. The manager shall implement manual measures to react to modifications that change the wireless coexistence state.</i> This is the simplest management method, especially if multiple wireless solutions of different technologies and from several vendors are involved, or if several frequency bands have to be managed. This method can be used if there are non-manageable radio emitters in the same bands as used by wireless solutions. However, the manual coexistence management capabilities are limited if some coexistence management parameters cannot be configured. (See IEC 62657-2:2025, 4.7.1.)	Match. Manual Channel Setting in SRF is implemented in SRF Gateway and set Channels manually at the initial stage and determine the Channel used in SRF Gateway for initial communications. IEC 62657-2 has the concept of manual coexistence management.

SRF					IEC 62657-4	
ID	Function classification	Function name	Detail function name	Description of function	Function name	Description of function
311			Auto Channel Control	The function is to select Channels automatically at the initial stage and determine the target Channel from the available Channel list and enables for SRF Gateways to select Channels of wireless connectivity	CCP	Auto Channel Control corresponds to spectrum engine of CCP on the following italicized points. The spectrum engine (SE) is a management and control function and an entity of the CCP. The SE centralizes all medium usage decisions for various wireless communication applications, taking into account medium availability information and location-specific medium utilization. In summary, the SE shall be responsible for: - maintaining medium availability and medium utilization information; <i>channel classification and selection</i>; - association control; <i>channel set management</i>; - accessing the database service; - scheduling spectrum sensing operation; - making channel move decisions for one or more CCP managed wireless systems or wireless devices for the automation application; - supporting coexistence of wireless communication applications; - considering incumbent radio systems and other wireless applications; - establishing a wired or wireless connection to all CCP managed wireless communication applications and devices; - establishing a connection to the resource engine. (See 5.2.2.)
						Reasons for matching/not-matching Partial match. Auto Channel Control in SRF is implemented in SRF Gateway and select Channels automatically at the initial stage. In IEC 62657-4, Spectrum Engine, implemented in CCP has a function to categorize and select channel but if the function is "automatic" is not clearly stated.

SRF					IEC 62657-4		
ID	Function classification	Function name	Detail function name	Description of function	Function name	Description of function	Reasons for matching/not-matching
312			Dynamic Channel Selection	The function is to switch one Channel to another Channel according to radio link quality. It switches to a new Channel among other Channels available between the SRF Gateway and the SRF Devices based on radio link quality when the radio link quality of the currently used Channel is estimated to be degrading.	CCP	Dynamic Channel Selection corresponds to spectrum engine of CCP on the following italicized point. The spectrum engine (SE) is a management and control function and an entity of the CCP. The SE centralizes all medium usage decisions for various wireless communication applications, taking into account medium availability information and location-specific medium utilization. In summary, the SE shall be responsible for: - maintaining medium availability and medium utilization information; - channel classification and selection; - association control; - channel set management; - accessing the database service; - scheduling spectrum sensing operation; - supporting coexistence of wireless communication applications; - considering incumbent radio systems and other wireless applications; - establishing a wired or wireless connection to all CCP managed wireless communication applications and devices; - establishing a connection to the resource engine. (See 5.2.2.)	Match. Dynamic Channel Selection in SRF is implemented in SRF Gateway and switches one Channel to another Channel according to radio link quality. In IEC 62657-4, Spectrum Engine, implemented in CCP makes channel move decisions for one or more CCP managed wireless systems or wireless devices for the automation application.
313			Path Control	The function is to switch between multiple wireless Paths according to wireless quality	None	None	Not match. There is no explanation about Path.

SRF					IEC 62657-4		
ID	Function classification	Function name	Detail function name	Description of function	Function name	Description of function	Reasons for matching/not-matching
314			Licensed Band Selection	The function is to suppress interference with existing wireless system by using a licensed band.	CCP	Licensed Band Selection corresponds to spectrum engine of CCP on the following italicized point. The spectrum engine (SE) is a management and control function and an entity of the CCP. The SE centralizes all medium usage decisions for various wireless communication applications, taking into account medium availability information and location-specific medium utilization. In summary, the SE shall be responsible for: • maintaining medium availability and medium utilization information; • channel classification and selection; association control; • channel set management; • accessing the database service; • scheduling spectrum sensing operation; • making channel move decisions for one or more CCP managed wireless systems or wireless devices for the automation application; • supporting coexistence of wireless communication applications; • considering incumbent radio systems and other wireless applications; • establishing a wired or wireless connection to all CCP managed wireless communication applications and devices; • establishing a connection to the resource engine. (See 5.2.2.2.)	Partial match. Licensed Band Selection in SRF is implemented in SRF Gateway and mitigates interference among wireless systems operating in the unlicensed bands by using a wireless system in the licensed band. It selects a Path among available Paths in the licensed band between the SRF Gateway and the SRF Devices based on radio link quality when radio link quality of currently used Path is estimated to be degrading. In IEC 62657-4, Spectrum Engine, implemented in CCP schedules spectrum sensing operation but whether it selects license band is not clearly stated.

SRF					IEC 62657-4		
ID	Function classification	Function name	Detail function name	Description of function	Function name	Description of function	Reasons for matching/not-matching
331			Sectorization Control	The function is to enable SRF Gateway/SRF Devices to conduct adjustment of transmission timing for every sector based on Radio Resource Control Policy. It starts operation process after making sure that synchronization is indicated in the status from Time Synchronization.	None	None	Not match. Sectorization Control in SRF is implemented in Spatial Control in SRF Gateway and conducts adjustment of transmission timing for every sector based on Radio Resource Control Policy. There is no explanation in IEC 62657-4.
332			Power Control	The function is to enable SRF Gateway to adjust the transmission power based on Radio Resource Control Policy. It obtains TX Power from Radio Resource Coordination Control in Field Manager.	CMWCA/CMWD	Power Control corresponds to CMWCA/CMWD on the following italicized points. The SetTransmitPower service primitive is a set of primitives for supporting control CMWCA and CMWD from the CCP. Table 22 SetTransmitPower service parameter Argument: The argument contains the parameters of the service request. Destination address: This parameter specifies the destination address to which the service request is to be sent. System or Device ID: This parameter specifies the identifier of the CMWCA or CMWD entity ID. Transmit power value: This parameter specifies the value of transmit power. (See 8.4.2.1.)	Match. Power Control is implemented in Spatial Control in SRF Gateway and adjust the transmission power based on Radio Resource Control Policy. In IEC 62657-4, SetTransmitPower has Transmit power value, a parameter to set transmit power.

SRF					IEC 62657-4		
ID	Function classification	Function name	Detail function name	Description of function	Function name	Description of function	Reasons for matching/not-matching
340	Radio Resource Coordination Control	Bandwidth Coordination Control	—	The function is to coordinately control parameters related to frequency radio resources for Paths/Channels among multiple wireless systems to guarantee required bandwidth.	CMWCA/CMWD	Bandwidth Coordination Control corresponds to CMWCA/CMWD on the following italicized points. The SetBandwidth service primitive is a set of primitives for supporting control CMWCA and CMWD from the CCP. Table 26 SetBandwidth service parameter Argument: The argument contains the parameters of the service request. Destination address: This parameter specifies the destination address to which the service request is to be sent. System or Device ID: This parameter specifies the identifier of the CMWCA or CMWD entity ID. <i>Frequency Bandwidth: This parameter specifies the bandwidth.</i> (See 8.4.4.1.)	Match. Bandwidth Coordination Control in SRF is implemented in Radio Resource Coordination Control in Field Manager and control parameters related to frequency radio resources for Paths/Channels among multiple wireless systems to guarantee required bandwidth. In IEC 62657-4, SetBandwidth has Frequency Bandwidth, a parameter to set frequencies.

SRF			IEC 62657-4		
ID	Function classification	Function name	Detail function name	Description of function	Function name
350	Radio Resource Coordination Control	Multi-radio Integration Control	Channel Aggregation Control	The function is to aggregate multiple Channels according to the radio link quality of data to be transmitted. It selects and sets an additional aggregation Channel to the currently used Channels from available Channels indicated by Bandwidth Coordination Control. A packet is then sent over a Channel selected from the aggregated Channels.	IEC 62657-1 Availability and reliability
				Channel Aggregation Control corresponds to Availability and reliability on the following italicized points. <i>The reliability of a wireless communication network can be increased by channel hopping to provide a level of immunity against interference from other RF devices operating in the same band, as well as robustness to mitigate multipath interference effects. In addition, the use of selective channel utilization facilitates coexistence with other RF systems by detecting and avoiding using occupied channels within the spectrum. Selective channel utilization can also enhance reliability by avoiding the use of channels with consistently poor performance.</i> (IEC 62657-1:2017, 5.3.9.)	Not match.
351			Path Aggregation Control	The function is to aggregate multiple Paths according to radio link quality or amount of data to be transmitted. It selects an additional Path aggregated to the currently used Paths from available Paths indicated by Bandwidth Coordination Control. It sends a packet over a selected Path from available Paths.	None
				Path Aggregation Control in SRF aggregates multiple Paths according to radio link quality or amount of data to be transmitted. It selects and sets an additional Path aggregated to the currently used Paths from available Paths indicated by Bandwidth Coordination Control. There is no explanation on Path in IEC 62657-4.	Not match.

SRF					IEC 62657-4		
ID	Function classification	Function name	Detail function name	Description of function	Function name	Description of function	Reasons for matching/not-matching
352			Channel Mirroring Control	The function is to send duplicated copies of a packet over multiple Channels. It selects Channels from the available Channels indicated by Bandwidth Coordination Control. Channel Mirroring Control on the other side of communication network (the receiver) receives identical packets via different Channels. The receiver forwards only one packet to the destination from the identical packets and drops the others. When the sender copies the packets, it attaches sequence numbers to the packets so that the receiver can identify them.	None	None	Not match. Channel Mirroring Control in SRF sends duplicated copies of a packet over multiple Channels. There is no explanation on monitoring in IEC 62657-4.
353			Path Mirroring Control	The function is to communicate the same packets over multiple paths.	IEC 62657-1	Path Mirroring Control corresponds to Availability and reliability on the following italicized point. <i>In the parallel operation, messages are transmitted via all available redundant paths. The receiving end node selects one of the received messages.</i> (See IEC 62657-1: 2017, 5.3.9.)	Not match. Path Mirroring Control in SRF sends duplicated copies of a packet over multiple Paths. It selects Paths from the available Paths indicated by Bandwidth Coordination Control. The concept is provided in IEC 62657-1 but not in the architecture of IEC 62657-4.

SRF				IEC 62657-4	
ID	Function classification	Function name	Detail function name	Description of function	Function name
354			Channel Combining Control	The function is to communicate encoded packets over multiple Channels. (error correction)	None
				Not match. Channel Combining Control in SRF encodes some packets for error correction and distributes the encoded packets to multiple Channels. There is no explanation in IEC 62657-4.	
355			Path Combining Control	The function is to communicate encoded packets over multiple paths. (error correction)	None
				Not match. Path Combining Control in SRF encodes some packets for error correction and distributes the encoded packets to multiple Paths. There is no explanation in IEC 62657-4.	
361	Radio Resource Coordination Control	Flow Control	Ingress Rate Control	The function is to measure radio link quality and current performance of each data flow. Then it determines data receiving speed of each data flow based on Queue length in Radio Resource Control Policy. Subsequently, it controls data receiving speed of each data flow.	None
				Not match. Ingress Rate Control in SRF measures radio link quality and current performance of each data flow. Then it determines data receiving speed of each data flow based on Queue length in Radio Resource Control Policy. In IEC 62657-4, the unit of data throughput in performance parameter type (see 3.3.11) is bit/s so it can be said that it manages the values on the speed. However, whether it controls or not cannot be confirmed.	
362			Adaptive Packet Aggregation	The function is to guarantee tolerable delay by changing frame aggregation settings.	None
				Not match. In SRF, Adaptive Packet Aggregation guarantees tolerable delay by changing frame aggregation settings. There is no explanation in IEC 62657-4.	

SRF					IEC 62657-4		
ID	Function classification	Function name	Detail function name	Description of function	Function name	Description of function	Reasons for matching/not-matching
370	Radio Resource Coordination Control	Delay Coordination Control	—	The function is to perform delay control among multiple wireless systems to guarantee tolerable delay.	CMWCA/CMWD	Radio Resource Coordination Control corresponds to CMWCA/CMWD on the following italicized points. <i>The SetDwellTime service primitive is a set of primitives for supporting control CMWCA and CMWD from the CCP.</i> Table 32 SetDwellTime service parameter Argument: The argument contains the parameters of the service request. Destination address: This parameter specifies the destination address to which the service request is to be sent. System or device ID: This parameter specifies the identifier of the CMWCA or CMWD entity ID. <i>Dwell time: This parameter specifies the dwell time.</i> (See 8.4.7.1.)	Match. In SRF, Delay Coordination Control performs delay control among multiple wireless systems to guarantee tolerable delay. In IEC 62657-4, SetDwellTime has a similar function as Dwell Time in SRF. In SRF, a parameter indicates Dwell Time.
380	Radio Resource Coordination Control	Retransmission Control	—	The function is to control the number of frame retransmission in accordance with wireless communication environment.	CCP	Retransmission Control corresponds to CCP on the following italicized point. The CCP can control the radio parameters for coexistence control in Table 5. <i>Parameter name: Maximum number of retransmissions</i> Description: Maximum number of retransmissions per wireless device (See 7.3.)	Match. In SRF, Retransmission Control has a function to control the number of frame retransmissions in accordance with wireless communication environment. This receives the maximum number of retransmissions from Delay Coordination Control in Field Manager. In IEC 62657-4, CCP's coexistence management has a similar function as maximum number of retransmissions. In SRF, a parameter is used to set a maximum number of retransmissions.

SRF					IEC 62657-4	
ID	Function classification	Function name	Detail function name	Description of function	Function name	Description of function
390	Radio Resource Coordination Control	Rate Control	—	The function is to enable SRF Gateway and SRF Devices to conduct adjustment of adaptive rate based on maximum rate in Radio Resource Control Policy. It restricts adaptive rate to reduce retransmission.	None	—
						Not match. In SRF, Rate Control is a function for SRF Gateway and SRF Device to conduct adjustment of adaptive rate based on maximum rate in Radio Resource Control Policy. In IEC 62657-1 "Use case 1 – Safety of workers around transporting machines" has some requirements as below. However, these are generalized requirements so there are no functions matched. In order to meet the required safety levels, such as the SIL levels specified in the IEC 61508 series, the bit error rate should be less than a certain level depending on the residual error rate of the error detection mechanism. Enough immunity against EMI is necessary for the communication system to keep the bit error rate below the acceptable level.

SRF					IEC 62657-4	
ID	Function classification	Function name	Detail function name	Description of function	Function name	Description of function
400	Data Attributes Control	Data Attributes Control	—	The function is to change Data Attributes dynamically.	IEC 62657-2	Data Attributes Control corresponds to Mechanism for adaptivity on the following italicized point. <i>One or more mechanisms for adaptivity can be used to modify one or more of a system's operational parameters in order to improve a system's robustness against interferences and to minimize medium utilization factor. Adaptive communication mechanisms can use automatically feedback information obtained from a system itself or from the signals carried by a system to modify dynamically a system's operational parameter. It is also possible to plan the operational parameters in advance and configure the systems appropriately.</i> Mechanisms for adaptivity are as follows: • detect and avoid (DAA): if the channel is occupied, change the channel (for example AFH); • detect and suppress (DAS): if the channel is occupied, don't transmit (for example listen before talk); • detect and reduce (DAR): if the channel is occupied, reduce the output power and/or channel usage. <i>Depending on how many systems are using mechanisms for adaptivity and which parameter they adapt, these measures can help improving coexistence or can lead to unstable and unreliable system behaviour.</i> (IEC 62657-2:2025, 5.34)
						Reasons for matching/not-matching Match. In SRF, in Data Attributes Control, SRF Gateway and SRF Devices requires the new Data Attributes to Field Manager, then, Field Manager notifies SRF Gateway and SRF Devices of Data Attributes. After that, SRF Gateway and SRF Devices updates Data Attributes as requested by Field Manager. In IEC 62657-4, CCP's coexistence management has a similar function since mechanism for adaptivity has a function to change parameters in order to improve coexistence.

SRF				IEC 62657-4	
ID	Function classification	Function name	Detail function name	Description of function	Function name
500	Radio Monitoring	Radio Link Quality Monitoring	—	The function is to generate SRF Wireless Set Information consisting of communication information on wireless systems and quality information of the radio link at SRF Gateway and SRF Devices. It obtains SRF Wireless Set Information from SRF Gateway and SRF Devices. The command issue cycle can be changed by Field Manager.	CCP
				Radio Link Quality Monitoring corresponds to CCP on the following italicized points. <i>The CCP can provide assistance for radio network coexistence via the transmission of context information such as quality of service, priority of service, etc. and measurement results. The CCP also can enable control for multiple WCA. (See 5.4.3.)</i>	Match. In SRF, Radio Link Quality Monitoring generates SRF Wireless Set Information on wireless systems and quality information of the radio link at SRF Gateway and SRF Devices. In IEC 62657-4, CCP has a similar function since it provides assistance for radio network coexistence via the transmission of context information such as quality of service, priority of service, etc. and measurement results.
502	Radio Monitoring	Radio Channel Usage Efficiency Monitoring	—	The function is to generate frequency utilization efficiency for all various wireless systems based on information from SRF Sensors.	Spectrum sensing system
				The spectrum sensing system (SSS) is a combination of dedicated spectrum sensing nodes (SSN) and embedded spectrum sensing functions (SSF) integrated into the wireless devices for automation applications. The SSS shall continuously provide medium utilization information to the CCP. The SSS observes the relevant frequency bands in and around the environment of the local industrial premises to determine the occurrence of wireless applications including incumbent radio systems. This process is called sensing and takes into account parameters of the radio channel, of the known wireless applications, of the automation application, and of the environment.	Match. Radio Channel Usage Efficiency Monitoring in SRF generates frequency utilization efficiency for all various wireless systems based on information from SRF Sensors. In IEC 62657-4, Spectrum Sensing System (SSS) has a similar function in terms of monitoring channel use status.

SRF					IEC 62657-4		
ID	Function classification	Function name	Detail function name	Description of function	Function name	Description of function	Reasons for matching/not-matching
503	Radio Monitoring	Radio Link Monitoring for DoA	—	The function is to generate DoA Estimation Information that indicates the location of wireless equipment and direction of arrival of radio waves.	CCP	Radio Link Monitoring for DoA corresponds to CCP on the following italicized points. "The policy engine (PE) is a management function and an entity of CCP. The PE centralizes all location-dependent radio regulation restrictions and limitations about the used frequency ranges. The PE shall be responsible for: - maintaining regulatory requirements, restrictions, and limits regarding the geographical location, as well as the range of frequencies used by the wireless systems and wireless devices for automation applications; - establishing a wired or wireless communication to the regulation database containing geolocation limit of radio spectrum regulation. (See 5.2.2.4.)	Match. Radio Link Monitoring for DoA (Direction of Arrival) in SRF generates DoA Estimation Information that indicates the location of wireless equipment and direction of arrival of radio waves. IEC 62657-4 has a similar function since it maintains regulatory requirements, restrictions and limits regarding the geographical location, as well as the range of frequencies used by the wireless systems and wireless devices for automation applications.
504	Radio Monitoring	Application Stream Information Monitoring	—	The function is to monitor the measured values of rate, delay and loss for each Application Stream, which are reported to Field Manager for updating.	None	None	Not match. Application Stream Information Monitoring in SRF monitors the measured values of rate, delay and loss rate for each Application Stream, which are reported to Field Manager for updating. There is no explanation in IEC 62657-4.
700	Mobility Control	Handover	—	The function is to transmit data to high quality wireless Path when connecting with multiple APs simultaneously.	None	—	Not match. The general handover changes associated SRF Gateway to keep the wireless link with higher quality. The seamless handover changes associated SRF Gateway while keeping the background wireless link with higher quality when SRF Device establishes links with multiple SRF Gateways. There is no explanation in IEC 62657-4.

SRF					IEC 62657-4	
ID	Function classification	Function name	Detail function name	Description of function	Function name	Description of function
701	Mobility Control	Setting Parameters Control for Handover	—	The function is for dynamic change of switching policy of various handover parameters.	None	—
Reasons for matching/not-matching						
					Not match.	Setting Parameters Control for Handover in SRF changes handover parameters adapting to radio link quality and a communication environment. It determines the handover parameters based on quality information of the wireless links and an RSSI threshold. There is no explanation in IEC 62657-4.
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D.4.3 Parameters

The SRF Wireless Platform uses more parameters than those described in IEC 62657-2 or IEC 62657-4. For the implementation of wireless coexistence management, the parameters given in Table D.4 could be the reference.

Table D.4 – Correspondence list of parameters of SRF Wireless Platform and IEC 62657-4

Services described in IEC 62657-4	SRF			IEC 62657-4		Reasons for matching/not-matching
	Message	Parameters	Description	Parameters	Description	
	wlanInfo	srfgwld	Identification of SRF Gateway	Wireless ID	Identifier of requested wireless system or wireless device.	Matched in terms of identifying the target object
NotifyMediumResource		timestamp	UNIX timestamp [sec]	—	—	No parameters matched in IEC side
		measurmentDuration	Duration how long the SRF Gateway or Device measure cumulative parameters, e.g. number of packets [sec]	—	—	No parameters matched in IEC side
		communicationInterfaces	I/F type: "IEEE802.11a", "IEEE802.11b", "IEEE802.11g", "IEEE802.11n", "IEEE802.11ac", "IEEE802.11ax", "Bluetooth", "ble", "subghz", "licensedBand"	—	—	No parameters indicating certain communication standards in IEC side

Services described in IEC 62657-4	SRF				IEC 62657-4		Reasons for matching/not-matching
	Message	Parameters		Description	Parameters	Description	
			name	Physical I/F name	—	—	No parameters indicating I/F type in IEC side
		mode		Operation mode: "AP" or "STA"	—	—	No parameters requiring AP or STA
		ssid		BSSID [HEX]	—	—	No parameters indicating Service Set Identifier
		essid		ESSID	—	—	No parameters indicating Service Set Identifier
		address		MAC address to communicate this interface [HEX]	—	—	No parameters indicating MAC address
		deviceName		Device name	—	—	No parameters indicating device name
		companyID		Bluetooth company ID	—	—	No parameters matched
		afh		Channel Map	—	—	No parameters indicating Channel map
		channel		Current Channel number	—	—	No parameters indicating Channel
		occupancy		Channel occupancy rate [%]	—	—	No parameters indicating Channel occupancy rate
		bssColor		BSS color	—	—	No parameters indicating Service Set Identifier
		linkInfos	address	MAC address to communicate this interface [HEX]	—	—	No parameters indicating MAC address
			phyType	Link phy type (only AP)	—	—	No parameters indicating phyType
			bandwidth	Channel bandwidth	—	—	No parameters indicating bandwidth
			currentRate	Current transmission data rate of modulation and coding [kbps]	—	—	No parameters indicating MAX communication speed in current wireless conditions (RSSI, wireless standards)
		rssi	RSSI [dBm]	RSSI mean	Received signal strength indication mean.	Both indicating received signal's strength	

Services described in IEC 62657-4	SRF			IEC 62657-4		Reasons for matching/not-matching
	Message	Parameters	Description	Parameters	Description	
				RSSI standard	Received signal strength indication standard deviation.	
			State	—	—	No parameters indicating connection status
			txPacket	—	—	No parameters indicating txPacket
			txByte	—	—	No parameters indicating txByte
			rxPacket	—	—	No parameters indicating rxPacket
			rxByte	—	—	No parameters indicating rxByte
			txFailed	—	—	No parameters indicating txFailed
			txError	Message loss ratio	Ratio of number of packets of messages, transferred from the Application at the reference interface within the producer, and the number of messages, transferred at the reference interface to the application within the consumer.	Both indicating ratio of packets that fail to be transmitted
			txRetry	Number of retry packets	—	No parameters indicating txRetry
	syncFlag	Vendor Option	vendorKey	—	—	No parameters indicating Vendor key
			vendor	—	—	No parameters indicating vendor name
			Time synchronization status	—	—	No parameters indicating time synchronization

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D.4.4 Message format

The parameters are described in the message body using the Java Script Object Notation (JSON) format.

"Interface between field manager and SRF Device" is the main communication between "Field Manager" and "SRF Device" to realise wireless coexistence management. The following Table D.5 shows the message structure in case parameter is "capability" as a concrete example.

Table D.5 – Examples of JSON Format

JSON format	Description
<pre>{ "srfgwld": "YourSrfGwld", "timestamp": 1569855600, "activeFlag": "Active", "capability": { "srfVersion": 1, "srfSupportVersions": [1, 2], "communicationInterfaces": [{ "ifInfo": { "ifType": "IEEE802.11n", "name": "wlan0" }, "address": "02004CAABBFF", "channels2ghz": [1, ..., 14], "channels5ghz": [36, 40, ..., 140], "channelsSubghz": [1, ..., 5, 24, ..., 61], "antennaSpec": { "antType": "planar-2x2", "space": 5, "theta3db": 30, "direction": 0 }, "txPower": { "max": 20, "min": 1, "step": 1 }, "multiStreamsUplink": 4, "multiStreamsDownlink": 4, "bandwidths": ["20", "40", "80", "160", "26tone", "52tone", "106tone", "242tone", "484tone", "996tone"], </pre>	Identification of SRF Gateway/Device. UNIX timestamp [sec] Active Flag: "Active" or "Deactive". Capability of SRF Gateway/Device. Lowest supported SRF Wireless Platform specification version. All of supported SRF Wireless Platform specification versions (*9). Physical I/F type: "IEEE802.11a", "IEEE802.11b", "IEEE802.11g", "IEEE802.11n", "IEEE802.11ac", "IEEE802.11ax", "Bluetooth", "ble", "subghz", "licensedBand" or "5G". Physical I/F name MAC address [HEX] Available Channels of 2 GHz Available Channels of 5 GHz Available Channels of subghz Antenna type: "linear-Na" or "planar-Na × Nb" (*2). Antenna element spacing [cm]. 3 dB beamwidth of antenna element in horizontal plane [deg] Antenna orientation in horizontal plane [deg] (*3). Maximum transmission power [dBm]. Minimum transmission power [dBm] Setting step [dB] Maximum number of MIMO streams for uplink (*4). Maximum number of MIMO streams for downlink (*4). Frequency Bandwidths [MHz] (*5).

JSON format	Description
<pre> "giTypes": [0.4, 0.8, 1.6, 3.2], "tdmaSlot": 100000, "aggregations": ["A-MPDU"] "bssColor": true }, { "ifInfo": { "ifType": "Bluetooth", "name": "hci0" }, "version": "2.1+EDR", "class": 1, "profile": ["SPP", "PAN"] } { "ifInfo": { "ifType": "Ethernet", "name": "ethernet0" }, "address": "02004CAABBF", }], "controlFunctions": { "dynamicChannelSelection": true, "pathControl": true, "licensedBandSelection": true, "5gControl": true, "scheduling": true, "timeSynchronization": true, "contentionWindowControl": true, "antennaDirectivityControl": true, "sectorizationControl": true, "powerControl": true, "multiHopControl": true, "channelAggregationControl": true, "pathAggregationControl": true, "channelMirroringControl": true, "pathMirroringControl": true, "channelCombining": true, "pathCombining": true, "adaptiveFlowControl": true, "ingressRateControl": true, "adaptivePacketAggregation": true, "retransmissionControl": true, </pre>	Guard intervals (*6) TDMA timeslot for Scheduling control [µsec] Frame aggregation: "A-MPDU", "A-MSDU" BSS color: true or false Physical I/F type: "Bluetooth" or "ble" Physical I/F name Bluetooth version: "1.0b", "1.1", "1.2", "2.0+EDR", "2.1+EDR", "3.0+HS", "4.0LE" or "5.0" Bluetooth class: 1, 1.5, 2 or 3 Bluetooth profile. Any profile defined for Bluetooth can be specified. Physical I/F type: "Ethernet" (*10) Physical I/F name (*10) MAC address [HEX] (*10) Control function compatibilities true or false (*7) true or false true or false true or false (*10) true or false true or false true or false (*9) true or false true or false true or false (*7) true or false (*10) true or false true or false true or false true or false true or false true or false (*1) true or false true or false

JSON format	Description
<pre> "rateControl": true, "dataAttributesControl": true, "radioLinkQualityMonitoring": true, "radioLinkQualityMonitoringLte": true, "radioLinkQualityMonitoringNr": true, "applicationStreamInformationMonitoring": true, "radioLinkMonitoringForDoA": true, "handover": true, "settingParametersControlForHandover": true }, "timeSyncMethods": ["NTP", "PTP"], "optDataAttrCntrlTypes": ["L2", "L3"], "maxDevice": 100, "numberOfServiceType": 1, "vendorOption": { "vendorKey": "example", "vendor": { "key": "example" } } } </pre>	true or false true or false true or false (*8) true or false (*1) true or false (*10) true or false (*10) true or false true or false true or false true or false Supported synchronization method: "NTP" and/or "PTP" (*11) Supported optional type of Data Attributes Control for U-Plane: "L2" and/or "L3" (*11) Maximum number of SRF Devices associated to one SRF Gateway The number of kinds of SRF Service Type: N is 1, 2, ..., 32 Vendor option Example of vendor option. "vendor" in the key should be a vendor name.
Key: (*1) "false" shall not be specified because of mandatory functions. However, "false" may be specified by U-plane anchor. (*2) "linear-Na" means linear array antenna with Na antenna elements and "planar-Na×Nb" means planar array antenna with Na×Nb antenna elements. (*3) The direction of zero in SRF Gateways/SRF Devices should be same with the direction in Field Manager in advance. (How to set the axes of space coordinates is out of the scope of the specifications.) (*4) Applied to IEEE Std 802.11n, IEEE Std 802.11ac and IEEE Std 802.11ax. (*5) "Tone" may be used for OFDMA of IEEE Std 802.11ax. (*6) The number 0.4 is used only for IEEE Std 802.11ac. (*7) "false" shall not be specified by SRF Gateway because of mandatory functions. However, "false" may be specified by U-plane anchor. (*8) "false" shall not be specified because of mandatory functions. However, "false" may be specified either when U-plane anchor is used, or when "ifType" is "Bluetooth", "ble", and "subghz". (*9) "false" shall not be specified by SRF Gateway because of mandatory functions. However, "false" may be specified either when U-plane anchor is used, or when "ifType" is "Bluetooth", "ble", and "subghz". (*10) In case of "srfVersion" is 1, they are not notified. (*11) If the functions are not supported, fill "null".	

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COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

**RÉSEAUX INDUSTRIELS –
COEXISTENCE DES SYSTÈMES SANS FIL –****Partie 4: Gestion de coexistence avec
coordination centralisée des applications sans fil****AVANT-PROPOS**

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Cette deuxième édition annule et remplace la première édition parue en 2022. Cette édition constitue une révision technique.

Cette édition inclut les modifications techniques majeures suivantes par rapport à l'édition précédente:

- a) l'élément de données (paramètre) à échanger entre le CCP et la CMWCA et le CMWD pour assurer l'interopérabilité entre les fournisseurs de CCP et les fournisseurs d'appareils;
- b) la séquence des services exécutés entre le CCP et la CMWCA et le CMWD est désormais définie. Lorsque les fournisseurs de CCP et les fournisseurs d'appareils mettent en œuvre un processus similaire, une séquence clairement définie et des spécifications d'exécution unifiées assurent l'interopérabilité comme prévu;
- c) les formats de messages du diagramme de séquence à échanger entre le CCP et la CMWCA et le CMWD sont définis. En définissant les formats de messages, la structure hiérarchique de chaque donnée (paramètre) et la mise en œuvre du même format de message par le fournisseur de CCP et le fournisseur d'appareil permettent d'échanger les données correctement et d'assurer l'interopérabilité.

Le texte de cette Norme internationale est issu des documents suivants:

Projet	Rapport de vote
65C/1330/FDIS	65C/1338/RVD

Le rapport de vote indiqué dans le tableau ci-dessus donne toute information sur le vote ayant abouti à son approbation.

La langue employée pour l'élaboration de cette Norme internationale est l'anglais.

Ce document a été rédigé selon les Directives ISO/IEC, Partie 2, il a été développé selon les Directives ISO/IEC, Partie 1 et les Directives ISO/IEC, Supplément IEC, disponibles sous www.iec.ch/members_experts/refdocs. Les principaux types de documents développés par l'IEC sont décrits plus en détail sous www.iec.ch/publications.

Une liste de toutes les parties de la série IEC 62657, publiées sous le titre général *Réseaux industriels – Coexistence des systèmes sans fil*, se trouve sur le site web de l'IEC.

Le comité a décidé que le contenu de ce document ne sera pas modifié avant la date de stabilité indiquée sur le site web de l'IEC sous webstore.iec.ch dans les données relatives au document recherché. À cette date, le document sera

- reconduit,
- supprimé, ou
- révisé.

INTRODUCTION

La série IEC 62657 donne des informations d'ordre général, des bases, des processus et des exemples permettant d'assurer la coexistence sans fil. Avec un processus de gestion de coexistence conforme à l'IEC 62657-2, une assurance prévisible de la coexistence peut être obtenue pour un spectre donné, tout en assurant le respect des exigences d'application. Le présent document fournit une gestion automatisée de la coexistence.

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RÉSEAUX INDUSTRIELS – COEXISTENCE DES SYSTÈMES SANS FIL –

Partie 4: Gestion de coexistence avec coordination centralisée des applications sans fil

1 Domaine d'application

La présente partie de l'IEC 62657 spécifie un concept et des méthodes de coordination centrale (CC) des applications d'automatisation à l'aide de communications sans fil, afin d'étendre la gestion de coexistence selon l'IEC 62657-2. Elle établit les éléments de système, les interfaces et les relations permettant d'assurer une coordination centrale. Les fonctions, les données et l'échange de données pour l'évaluation et le maintien de l'état de coexistence sont spécifiés.

Le présent document spécifie l'approche du point de coordination central (CCP, *Central Coordination Point*) comme exemple d'utilisation de la description formelle donnée dans l'IEC 62657-3.

Le présent document vise à développer, mettre en œuvre ou modifier des procédures ou solutions.

Le présent document fournit les exigences relatives aux systèmes de gestion automatisée de la coexistence.

Il fournit les exigences relatives:

- à la détermination de l'état de coexistence;
- aux procédures de gestion automatisée de la coexistence;
- aux amendements de la coordination centrale pour les solutions de communication sans fil existantes;
- aux fonctions de coordination centrale qui coordonnent les systèmes de communication sans fil existants et nouveaux;
- aux séquences de coordination centrale et aux formats de messages pour l'échange de données.

Le présent document ne se limite pas à une plage de radiofréquences particulière ni à une technologie de communication sans fil spécifique.

2 Références normatives

Les documents suivants sont cités dans le texte de sorte qu'ils constituent, pour tout ou partie de leur contenu, des exigences du présent document. Pour les références datées, seule l'édition citée s'applique. Pour les références non datées, la dernière édition du document de référence s'applique (y compris les éventuels amendements).

IEC 62657-2:2025, *Réseaux industriels – Coexistence des systèmes sans fil – Partie 2: Gestion de coexistence*

ISO/IEC 10731, *Technologies de l'information – Interconnexion de systèmes ouverts (OSI) – Modèle de référence de base – Conventions pour la définition des services OSI*

IETF RFC 8259, Tim Bray, *The JavaScript Object Notation (JSON) Data Interchange Format*, disponible à l'adresse [RFC 8259 – The JavaScript Object Notation \(JSON\) Data Interchange Format \(ietf.org\)](https://www.rfc-editor.org/rfc/rfc8259) [consulté le 2024-09-03]

3 Termes, définitions, abréviations et conventions

3.1 Généralités

Pour les besoins du présent document, les termes et définitions suivants s'appliquent.

L'ISO et l'IEC tiennent à jour des bases de données terminologiques destinées à être utilisées en normalisation, consultables aux adresses suivantes:

- IEC Electropedia: disponible à l'adresse <https://www.electropedia.org/>
- ISO Online browsing platform: disponible à l'adresse <https://www.iso.org/obp>

3.2 Termes et définitions spécifiques au présent document

3.2.1

allocation

entrée dans le tableau des allocations de fréquence d'une bande de fréquences donnée destinée à être utilisée par un ou plusieurs services de radiocommunication ou par le service de radioastronomie dans les conditions spécifiées

3.2.2

antenne

appareil conçu pour transmettre ou recevoir des ondes électromagnétiques

3.2.3

distance de coexistence

différence entre la valeur de seuil de l'état de coexistence et la valeur réelle de la fonction d'état de coexistence exprimant la distance avant d'atteindre l'état de coexistence

3.2.4

marge de coexistence

différence entre la valeur réelle de la fonction d'état de coexistence et le seuil de l'état de coexistence exprimant la réserve avant de quitter l'état de coexistence

3.2.5

service de base de données

service officiellement exploité dans le cadre des règles de l'autorité de réglementation locale qui fournit une liste des canaux disponibles et éventuellement la valeur PIRE maximale admissible sur ces canaux en fonction des demandes contenant la géolocalisation des appareils WRAN (*Wireless Regional Area Network*, réseau régional sans fil)

3.2.6

géolocalisation

processus d'acquisition des données de localisation d'un appareil, en déterminant sa latitude et sa longitude

3.2.7

brouillage préjudiciable

émissions, rayonnements ou induction qui mettent en danger le fonctionnement d'un service de radionavigation ou d'autres services de sécurité ou qui dégradent gravement, gênent ou interrompent de façon répétée un service de radiocommunication fonctionnant selon les règlements de l'UIT et les règlements locaux

3.2.8

système de radiocommunication titulaire

système de communication sans fil qui n'est pas sous le contrôle du gestionnaire de coexistence et n'est pas affecté par celui-ci

3.2.9

station maîtresse

station de données qui a été désignée par la station pilote pour assurer un transfert de données vers une ou plusieurs stations asservies

Note 1 à l'article: À un instant donné, il n'y a qu'une seule station maîtresse sur une liaison de données.

[SOURCE: IEC 60050-721:1991, 721-19-12]

3.2.10

flux de service

paramètres QoS pour les PDU qui sont échangés lors d'une connexion et qui offrent un mécanisme de gestion QoS en amont et en aval

3.2.11

identifiant de flux de service

SFID

identifiant unique d'un flux de service qui indiquent la manière dont les paquets/sessions d'application de couche supérieure sont mappés avec leurs exigences QoS et contraintes d'ordonnancement

Note 1 à l'article: L'abréviation "SFID" est dérivée du terme anglais développé correspondant "service flow identifier".

3.2.12

station asservie

station de données invitée par une station maîtresse à recevoir des données

3.2.13

système de détection de spectre

SSS

combinaison de nœuds de détection de spectre (SSN, *Spectrum Sensing Nodes*) dédiés et de fonctions de détection de spectre (SSF, *Spectrum Sensing Functions*) intégrées dans les appareils sans fil pour applications d'automatisation

Note 1 à l'article: L'abréviation "SSS" est dérivée du terme anglais développé correspondant "spectrum sensing system".

3.3 Termes et définitions supplémentaires pour les modèles

3.3.1

tableau de fréquences

valeurs collectées entre la fréquence de début de détection et la fréquence de fin de détection lors du processus de détection

3.3.2

tableau de densité spectrale de puissance

valeurs de densité spectrale de puissance collectées entre la fréquence de début de détection et la fréquence de fin de détection lors du processus de détection

3.3.3

adresse CCP

identification du partenaire de communication du point de coordination central pour un service

3.3.4**évaluation de coexistence**

processus visant à évaluer la coexistence de communications sans fil

3.3.5**ID de liaison de communication**

identifiant (ID) faisant partie intégrante de la réponse de l'exécution d'un service liée à la liaison de communication

3.3.6**adresse de destination**

identification du partenaire de communication pour un service

3.3.7**limites du paramètre de performance**

valeur renvoyée avec la limite d'un paramètre de performance

3.3.8**type de rapport de détection de support**

type d'informations demandé relatif au type de génération du rapport de détection de support

Note 1 à l'article: Le type est représenté par un nombre selon le code suivant: 1: Événementiel; 2: Cyclique; 3: Demandé.

3.3.9**ID de paramètre**

identifiant (ID) d'un paramètre qui est spécifié par une norme ou un fournisseur et qui identifie le paramètre dont la valeur est renvoyée

3.3.10**valeur de paramètre**

valeur du paramètre à renvoyer

3.3.11**type de paramètre de performance**

type d'information demandé relatif à un ID de liaison de communication

Note 1 à l'article: Le type est représenté par un nombre selon le code suivant: 1: Durée de transmission; 2: Temps d'actualisation; 3: Temps de réponse; 4: Débit de données; 5: Disponibilité de communication.

3.3.12**ID de base de données de réglementation de radiocommunication**

identifiant (ID) de la base de données de réglementation de radiocommunication

3.3.13**indication de puissance du signal reçu****RSSI**

valeur de la puissance présente dans un signal radiofréquence reçu

Note 1 à l'article: L'abréviation "RSSI" est dérivée du terme anglais développé correspondant "received signal strength indication".

3.3.14**moyenne de l'indication de puissance du signal reçu****moyenne RSSI**

valeur moyenne de la puissance présente dans un signal radiofréquence reçu

3.3.15

écart-type de l'indication de puissance du signal reçu

écart-type RSSI

écart-type de la valeur de la puissance présente dans un signal radiofréquence reçu

3.3.16

intervalle de rapport

intervalle entre les rapports cycliques

Note 1 à l'article: Appartient au "type de rapport de détection de support" cyclique.

3.3.17

durée de détection

paramètre qui spécifie la durée d'un processus de détection

3.3.18

fréquence de fin de détection

paramètre qui spécifie la fréquence de fin de la détection

3.3.19

intervalle de détection

paramètre qui spécifie l'intervalle entre les processus de détection

3.3.20

fréquence de début de détection

paramètre qui spécifie la fréquence de début de la détection

3.3.21

statut du service

paramètre qui donne des informations relatives au résultat de l'exécution du service

Note 1 à l'article: Le statut du service peut être ABORTED ou TIMEOUT.

3.3.22

SINR

rapport signal à l'interférence plus bruit

valeur de la puissance d'un certain signal d'intérêt divisée par la somme de la puissance perturbatrice provenant de tous les autres signaux perturbateurs et de la puissance d'un certain bruit de fond

Note 1 à l'article: L'abréviation "SINR" est dérivée du terme anglais développé correspondant "signal to interference plus noise ratio".

3.3.23

ID de l'entité de détection de spectre

identifiant (ID) de l'entité détection de spectre contenant un SSN ou une SSF

3.3.24

statut

paramètre qui spécifie le comportement de l'appareil sans fil en ce qui concerne la configuration par un code

Note 1 à l'article: Le statut est représenté par un nombre selon le code suivant: 0: Aucune adresse attribuée; 1: Non configuré; 2: Configuré.

3.3.25

adresse du système

identification du partenaire de communication du système pour un service

3.3.26**horodatage**

informations relatives à la durée des données d'attribut collectées

3.3.27**ID de système sans fil**

identifiant (ID) faisant partie intégrante de l'exécution d'un service en lien avec le système sans fil concerné

3.3.28**ID sans fil**

identifiant (ID) faisant partie intégrante de l'exécution d'un service en lien avec le modèle d'un système sans fil ou d'un appareil sans fil

3.4 Termes et définitions donnés dans l'IEC 62657-2

Afin de faciliter la compréhension, les termes les plus importants de l'IEC 62657-2 utilisés dans le présent document sont répertoriés, mais leurs définitions ne sont pas répétées dans la liste.

- type d'antenne,
- gain d'antenne,
- caractéristique de rayonnement de l'antenne,
- application d'automatisation,
- largeur de bande,
- fréquence centrale,
- coexistence (coexistence de communications sans fil),
- planification de coexistence,
- gestion de coexistence,
- charge de communication,
- appareil,
- type d'appareil,
- cycle de service,
- temps de tenue,
- bande de fréquences,
- canal de fréquences,
- liaison logique
- fréquence de coupure inférieure,
- mécanismes d'adaptabilité,
- facteur d'utilisation moyen,
- message,
- nombre de messages perdus consécutifs,
- installation,
- densité spectrale de puissance,
- canal radioélectrique,
- rapport signal à l'interférence plus bruit,
- indication de puissance du signal reçu,
- sensibilité de récepteur,
- intervalle de transfert,

- application sans fil,
- communication sans fil,
- application de communication sans fil,
- solution de communication sans fil,
- système de communication sans fil,
- appareil sans fil,
- réseau sans fil,
- type de système sans fil,
- puissance totale rayonnée,
- fréquence de coupure supérieure.

3.5 Définitions spécifiques à SRF

3.5.1

SRF Wireless Platform

spécification de l'architecture matérielle et logicielle pour la gestion de coexistence

3.5.2

passerelle SRF

passerelle gérée utilisée pour SRF Wireless Platform

3.5.3

appareil SRF

appareil sans fil géré utilisé pour SRF Wireless Platform

3.5.4

capteur SRF

nœud de détection utilisé pour SRF Wireless Platform afin de surveiller l'environnement radioélectrique

3.5.5

ensemble SRF Wireless

groupe constitué de la passerelle SRF et des appareils SRF pour la communication sans fil entre eux

3.5.6

ensemble non SRF Wireless

appareils sans fil qui ne prennent pas en charge SRF Wireless Platform

3.6 Abréviations

ACRM (Application Communication Requirements Management)	gestion des exigences de communication d'application
AFH (Adaptive Frequency Hopping)	saut de fréquence adaptatif
AL (Application Layer)	couche application
AP (Access point)	point d'accès
ble (Bluetooth low energy)	Bluetooth à basse énergie
CC	coordination centrale
CCP (Central Coordination Point)	point de coordination central
CDD (Common Data Dictionary)	dictionnaire de données communes
CMWCA (CCP Managed Wireless Communication Application)	application de communication sans fil gérée par CCP
CMWD (CCP Managed Wireless Device)	appareil sans fil géré par CCP
CONF	confirmation
CS (Convergence Sublayer)	sous-couche convergence
C-SAP (Control Service Access Point)	point d'accès au service de commande
DAA (Detect And Avoid)	détection et évitement
DAR (Detect And Reduce)	détection et réduction
DAS (Detect And Suppress)	détection et suppression
DoA (Direction of Arrival)	direction d'arrivée
PIRE	puissance isotrope rayonnée équivalente
IHM	interface homme/machine
ID	identifiant
IETF (Internet Engineering Task Force)	groupe de travail Internet Engineering Task Force
IND	notification d'événement
IP (Internet Protocol)	protocole Internet
ISM	industriel, scientifique et médical
JSON (JavaScript Object Notation)	notation objet issue de JavaScript
LAN (Local Area Network)	réseau local
MAC (Medium Access)	accès au support
MLME (Medium access Layer Management Entity)	entité de gestion de la couche d'accès au support
MRM (Medium Resource Management)	gestion des ressources du support
M-SAP (Management Service Access Point)	point d'accès au service de gestion
PE (Policy Engine)	moteur de politique
PHY (PHYsical layer)	couche physique
PLC (Programmable Logic Controller)	automate programmable
PLME (Physical Layer Management Entity)	entité de gestion de la couche physique
DSP	densité spectrale de puissance
QoS (Quality of Service)	qualité de service
REQ (REQuest)	demande
RES (RESponse to the request message)	réponse au message de demande
RF	radiofréquence

RSSI (Received Signal Strength Indication)	indication de puissance du signal reçu
SAP (Service Access Point)	point d'accès au service
SDU (Service Data Units)	unités de données de service
SFID (Service Flow IDentifier)	identifiant de flux de service
SINR (Signal to Interference plus Noise Ratio)	rapport signal à l'interférence plus bruit
SSF (Spectrum Sensing Function)	fonction de détection de spectre
SSN (Spectrum Sensing Node)	nœud de détection de spectre
SSS (Spectrum Sensing System)	système de détection de spectre
STA (Station)	poste
WCA (Wireless Communication Application)	application de communication sans fil
WCD (Wireless Communication Device)	appareil de communication sans fil
WCS (Wireless Communication System)	système de communication sans fil
WCSDCC (Wireless Communication System and Device Configuration and Control)	configuration et contrôle du système et des appareils de communication sans fil
WCSDS (Wireless Communication System and Device Subscription)	abonnement au système et aux appareils de communication sans fil
WIA (Wireless Industrial Automation)	automatisation industrielle sans fil
WSAN (Wireless Sensor Actuator Network)	réseau de capteurs et d'actionneurs sans fil

3.7 Conventions utilisées pour les descriptions de services

Le présent document utilise les conventions de description suivantes données dans l'ISO/IEC 10731.

Le modèle de service et les primitives de service utilisés sont des descriptions abstraites complètes. Ils ne représentent pas une spécification de mise en œuvre.

Les primitives de service, utilisées pour représenter les interactions entre l'utilisateur du service et le fournisseur de services (voir l'ISO/IEC 10731), acheminent les paramètres qui indiquent les informations disponibles dans l'interaction entre l'utilisateur et le fournisseur.

Les paramètres qui s'appliquent à chaque groupe de primitives sont définis dans les tableaux qui suivent dans le présent document. Chaque tableau est composé de cinq colonnes, qui contiennent le nom du paramètre de service, et d'une colonne pour chacune de ces primitives et chacune des directions de transfert de paramètre utilisées par le service:

- les paramètres d'entrée de la primitive de demande;
- les paramètres de sortie de la primitive d'indication;
- les paramètres d'entrée de la primitive de réponse; et
- les paramètres de sortie de la primitive de confirmation.

Un paramètre (ou une partie de celui-ci) figure dans chaque ligne de chaque tableau. Dans les colonnes de primitive de service appropriées, un code est utilisé pour préciser le type d'utilisation du paramètre sur la primitive et le sens du paramètre spécifiés dans la colonne:

- O** le paramètre est obligatoire pour la primitive.
- U** le paramètre est une option utilisateur et peut ne pas être fourni, selon l'usage dynamique de l'utilisateur du service. S'il n'est pas fourni, une valeur par défaut est admise par hypothèse pour le paramètre.
- S** un seul paramètre d'un groupe de paramètres utilisant ce code est exigé.

- C** le paramètre est conditionnel en fonction d'autres paramètres ou de l'environnement de l'utilisateur du service.
- CU** le paramètre est une option utilisateur conditionnelle et peut ne pas être admis, en fonction des autres paramètres ou de l'environnement de l'utilisateur du service. S'il est admis, il peut ne pas être fourni, selon l'usage dynamique de l'utilisateur du service. S'il est admis, mais n'est pas fourni, une valeur par défaut est admise par hypothèse pour le paramètre.
- (vierge)** le paramètre n'est jamais présent.

Dans le présent document, les formats de messages de services sont décrits à l'aide de la notation JSON conformément à l'IETF RFC 8259.

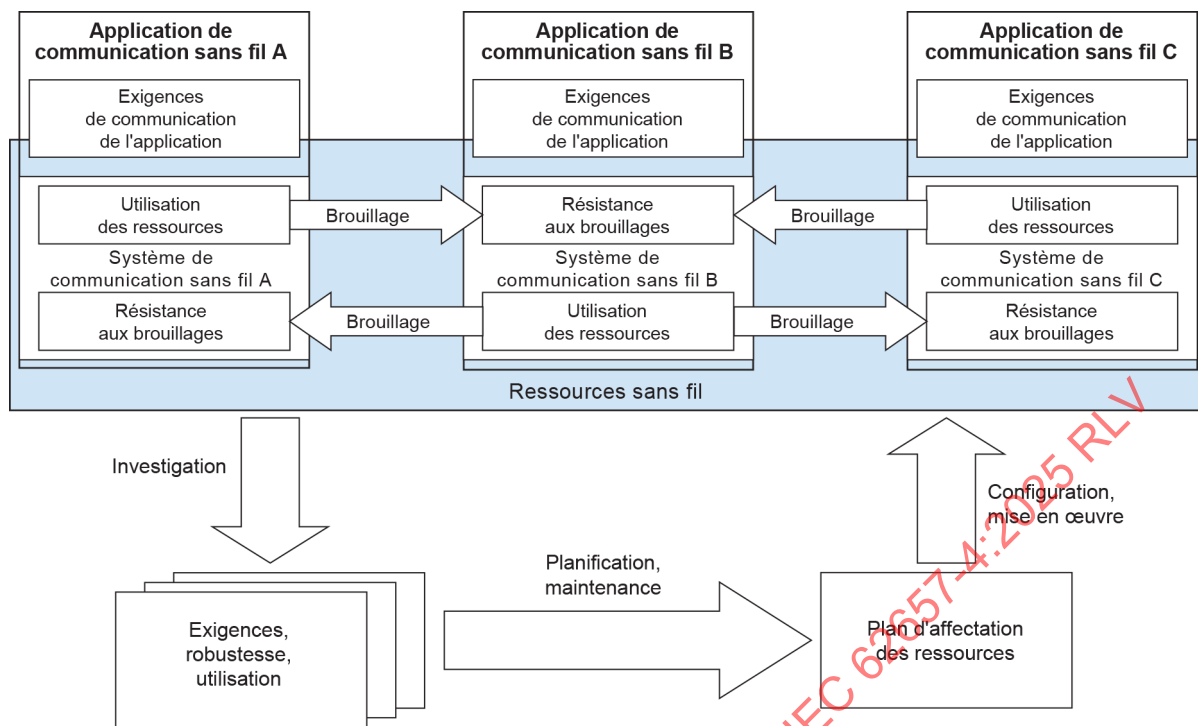
4 Domaine de considération

4.1 Modèle conceptuel de coexistence

Le modèle conceptuel de coexistence, décrit dans l'IEC 62657-2, est représenté à la Figure 1. Dans cet exemple, trois applications de communication sans fil (A, B et C) sont admises par hypothèse. Conformément à la définition de la coexistence sans fil, les trois applications de communication sans fil doivent respecter leurs exigences de communication respectives. Une partie de l'application de communication sans fil (WCA) A est un système de communication sans fil sélectionné (WCS) A. Il utilise les ressources sans fil pour la communication et peut interférer avec d'autres WCS (le WCS B, par exemple). La technologie sans fil du WCS B peut être la même ou être différente. Chaque WCS se caractérise par une certaine résistance aux brouillages. Par conséquent, tous les brouillages ne donnent pas lieu à des erreurs de communication ou à des défaillances de l'application.

La gestion de coexistence exige d'étudier l'état de coexistence tout au long du cycle de vie du système. Cela exige de procéder à des mesurages pour déterminer si toutes les applications de communication sans fil satisfont à leurs exigences relatives à la communication d'application.

Une étude des exigences de communication de l'application et des caractéristiques du système sans fil (immunité et utilisation) doit être consignée dans un inventaire. La planification de coexistence obtenue doit être consignée dans un plan d'allocation des ressources. Tout cela doit former la base de la mise en œuvre des ressources radioélectriques et de leur utilisation.



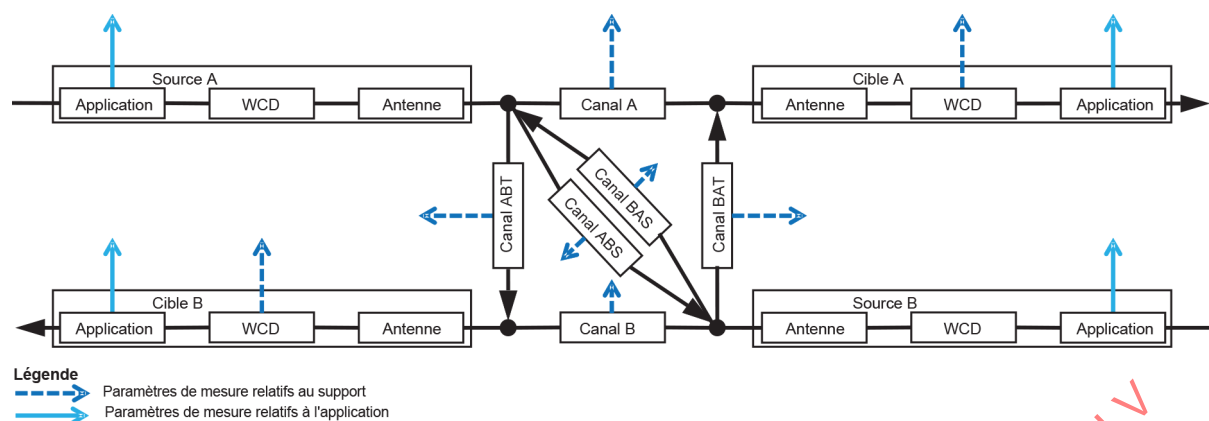
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Figure 1 – Modèle conceptuel de coexistence sans fil selon l'IEC 62657-2

4.2 Étude de l'état de coexistence

Une tâche essentielle liée à la gestion de coexistence consiste à calculer et évaluer l'état de coexistence. Selon la définition du terme "coexistence", outre les paramètres de spectre (le canal de fréquences ou la densité spectrale de puissance, par exemple), les paramètres caractéristiques relatifs à l'application (la durée de transmission, par exemple) sont également exigés pour calculer l'état de coexistence.

La Figure 2 montre dans quelle mesure les paramètres pertinents peuvent être déterminés. La figure représente un scénario avec deux WCA (A et B) et une liaison logique par WCA. Les messages d'une application répartie sont transférés vers la cible de l'application répartie par l'intermédiaire d'un appareil source, d'une antenne d'émetteur, d'un canal radioélectrique, d'une antenne de récepteur et d'un appareil cible. Des brouillages peuvent se produire entre l'antenne source d'un WCS et les antennes des autres WCS. Ces brouillages sont influencés par les caractéristiques du canal radioélectrique entre les antennes concernées. Le Tableau 1 énumère les canaux radioélectriques correspondants du scénario représenté à la Figure 2.



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Figure 2 – Sources permettant de déterminer les paramètres pour le calcul d'état de coexistence

Tableau 1 – Explications des canaux radioélectriques

Canal radioélectrique	Explication
Canal A	Influences environnementales actives pour les émissions entre la source A et la cible A
Canal ABT	Influences environnementales actives pour les brouillages entre la source A et la cible B
Canal ABS	Influences environnementales actives pour les brouillages entre la source A et la source B
Canal B	Influences environnementales actives pour les émissions entre la source B et la cible B
Canal BAT	Influences environnementales actives pour les brouillages entre la source B et la cible A
Canal BAS	Influences environnementales actives pour les brouillages entre la source B et la source A

Les paramètres correspondants peuvent être déterminés par:

- la fonction de détection de spectre (canal de fréquences, par exemple);
- l'application source (nombre de messages transférés, par exemple);
- l'appareil cible de communication sans fil (nombre de messages reçus corrects, par exemple);
- l'application cible (durée de transmission, par exemple).

Les paramètres pertinents permettant de déterminer et d'évaluer la coexistence sont spécifiés en détail à l'Article 6. L'ECC Report 206 décrit une approche d'évaluation holistique de la sûreté de fonctionnement de la communication industrielle. Cette approche permet de déduire une fonction d'état de coexistence définie comme suit.

$\sigma_i(t)$ est le paramètre normalisé du paramètre caractéristique i , conformément à l'Article 6, à l'instant t . L'indice i avec $i = 1 \dots n$ spécifie l'un des n types de paramètres caractéristiques. Les facteurs de normalisation dépendent du type de paramètres caractéristiques et sont spécifiés à l'Article 6. Le paramètre $\sigma(t)$ exprime la qualité d'une connexion logique d'un WCS à l'instant t .

Un facteur de pondération $u_i(t)$ est adopté avec une plage possible de 0 à 1. Ce facteur permet d'adapter un paramètre de type i conformément aux exigences. Si, par exemple, la durée de transmission se révèle être plus pertinente pour des applications à communication événementielle, la durée de mise à jour est un élément important pour les applications à trafic périodique. Cela peut être exprimé par $u_i(t)$. La dépendance temporelle de ce facteur prend en considération l'émergence de concepts souples en matière d'automatisation industrielle qui peuvent exiger l'adaptation de différents types de paramètres.

La fonction d'état de coexistence doit prendre en considération tous les WCS $k = 1 \dots p$ connus. La priorité d'une application qui utilise WCS k est exprimée par le facteur de pondération $w_k(t)$. De plus, il convient de tenir compte des liaisons logiques $j = 1 \dots m$ d'un WCS. L'importance d'une liaison logique est exprimée par le facteur de pondération $v_j(t)$.

Par conséquent, une fonction d'état de coexistence $\chi(t)$ selon la Formule (1) peut être définie.

$$\chi(t) = \frac{1}{\sum w_k(t)} \sum_{k=1}^p w_k(t) \times \left(\frac{1}{\sum v_j(t)} \sum_{j=1}^m v_j(t) \times \left(\frac{1}{\sum u_i(t)} \sum_{i=1}^n u_i(t) \times \sigma_i(t) \right) \right)_{j,k} \quad (1)$$

En prenant pour hypothèse un seuil χ_{Thr} qui spécifie l'état dans lequel les exigences relatives à la communication d'application de toutes les applications de communication sans fil sont respectées, l'état de coexistence peut être spécifié selon la Formule (2).

$$s(\chi(t) \geq \chi_{\text{Thr}}) = 1 \quad (2)$$

L'état complémentaire de non-coexistence est défini selon la Formule (3).

$$s(\chi(t) < \chi_{\text{Thr}}) = 0 \quad (3)$$

La différence entre la valeur réelle $\chi(t)$ et le seuil χ_{Thr} est la marge de coexistence (voir la Formule (4)). La différence entre le seuil χ_{Thr} et la valeur réelle $\chi(t)$ est la distance de coexistence (voir la Formule (5)).

$$\chi_M(t) = \chi(t) - \chi_{\text{Thr}} \quad (4)$$

$$\chi_D(t) = \chi_{\text{Thr}} - \chi(t) \quad (5)$$

Un exemple de fonction d'état de coexistence avec ses principales valeurs est représenté à la Figure 3.

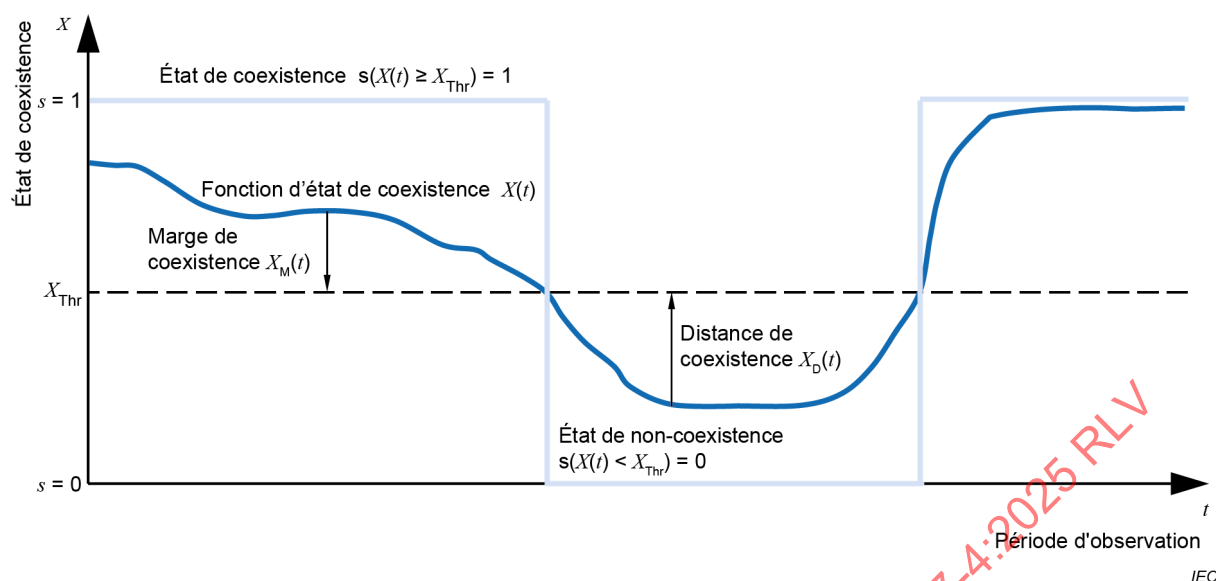


Figure 3 – Fonction d'état de coexistence

La fonction d'état de coexistence peut être utilisée pour évaluer le niveau de coexistence et déduire les mesures visant à maintenir la coexistence. Les paramètres caractéristiques $\sigma_i(t)$ liés à WCS k et à la liaison logique j offrent la possibilité d'identifier les points faibles à l'intérieur de la zone à l'étude. Selon cet algorithme, l'approche de coordination centrale peut déduire les allocations de ressources spécifiques.

4.3 Mise en œuvre et utilisation des ressources radioélectriques

La Figure 4 décrit les influences environnementales actives et les cibles de contrôle de coexistence. Le scénario est le même que celui de la Figure 3. Outre le brouillage mutuel des deux systèmes, les brouillages externes qui ne peuvent pas être influencés sont indiqués par des flèches en pointillés. Le brouillage mutuel est affaibli par les canaux radioélectriques ABT, BAS, BAT et ABS (voir également le Tableau 1).

Les paramètres correspondants peuvent être contrôlés par:

- l'application source (intervalle de transfert, par exemple);
- l'appareil source de communication sans fil (canal de fréquences, par exemple);
- le type d'antenne (formation de faisceau, par exemple);
- l'appareil cible de communication sans fil (gestion de mémoire tampon, par exemple).

La modification des valeurs des paramètres mentionnés ci-dessus a une incidence non seulement sur la coexistence (respect des exigences de toutes les applications), mais aussi directement sur le respect des exigences de l'application commandée. Une extension de l'intervalle de transfert, par exemple, peut s'avérer utile pour d'autres applications, mais cruciale pour l'application commandée. Il convient donc de prévoir un contrôle des paramètres en conséquence.

Les paramètres pertinents de contrôle de coexistence sont spécifiés en détail à l'Article 7. Pour satisfaire au présent document, le WCD doit mettre en œuvre les paramètres et services permettant de contrôler la coexistence.

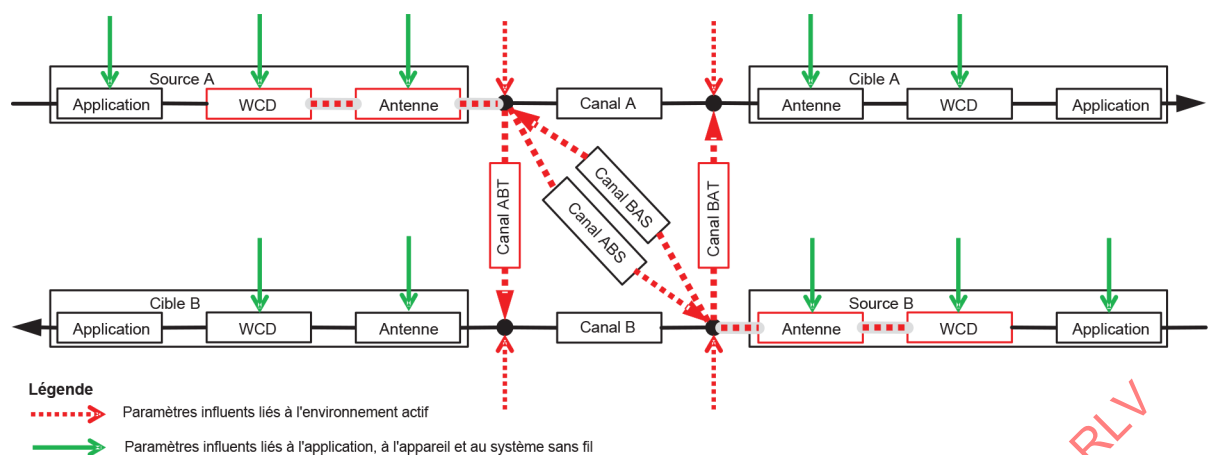


Figure 4 – Paramètres décrivant les influences actives et les paramètres de contrôle utilisés pour gérer la coexistence

4.4 Équipement de gestion de coexistence

Selon la zone de fonctionnement (automatisation industrielle), l'équipement de gestion de coexistence doit être traité, tout au long de son cycle de vie, comme un équipement d'automatisation. Cela s'applique à la description de l'appareil (intégration d'un appareil de terrain conformément à la série IEC 62769, par exemple, à l'échange et la gestion des informations, ainsi qu'aux questions relatives au niveau nécessaire de sécurité, de sûreté intrinsèque, de sécurité fonctionnelle, de haute disponibilité, etc.). Par exemple, une fonction de détection de spectre représente un point de vulnérabilité dans un système de gestion automatisée de la coexistence en brouillant volontairement les ondes radioélectriques. Il est recommandé d'appliquer la série IEC 62443 pour les questions liées à la cybersécurité telles que le déni de service (brouillage sans fil). Un espace opérationnel comporte en général plusieurs systèmes de commande avec des systèmes de communication sans fil séparés compte tenu de la séparation des fonctionnalités et des problèmes. Le système de gestion automatisée de la coexistence interagit avec les appareils des systèmes sans fil et du système de commande pour recevoir des informations et les configurer.

5 Architecture du système de gestion de coexistence sans fil

5.1 Généralités

Le présent document traite de la gestion automatisée de la coexistence des systèmes de communication sans fil destinés aux applications d'automatisation et repose sur l'idée fondamentale d'une coordination centralisée de plusieurs systèmes de communications sans fil à l'intérieur des installations industrielles. Cette gestion automatisée de la coexistence avec coordination centralisée constitue un exemple de mise en œuvre de la classe CoexistenceManagementSystem décrite dans l'IEC 62657-3:2022, 5.2. Les systèmes de communication sans fil peuvent utiliser la même technologie de communication (il s'agit alors d'une infrastructure de communication sans fil homogène) ou différentes technologies de communication (il s'agit alors d'une infrastructure de communication sans fil hétérogène). L'objectif est d'utiliser la ressource radioélectrique de manière plus efficace. L'idée principale est la suivante:

- traiter les appareils sans fil qui peuvent être commandés et tenir compte des appareils qui ne peuvent pas l'être;
- considérer les techniques d'atténuation par appareil comme étant disponibles dans une approche de coordination centrale;
- arrêter la transmission de l'énergie radioélectrique ou activer la technique d'atténuation par appareil si la coordination centrale échoue;

- assurer la conformité des appareils sans fil aux règlements locaux en commandant la coordination centrale et en gérant l'utilisation du spectre dans les limites déclarées pour les appareils.

En règle générale, l'architecture fonctionnelle de la coordination centrale des systèmes de communication sans fil destinés aux applications d'automatisation doit satisfaire aux exigences fondamentales suivantes:

- fournir les mécanismes de coordination pour obtenir et maintenir la coexistence entre les différentes solutions de communication sans fil dans la même plage de fréquences;
- éviter les brouillages préjudiciables. Fournir les mécanismes d'accès automatique au spectre et d'utilisation, avec pour objectif de:
 - reconnaître le spectre libre et le spectre occupé;
 - détecter et classer les solutions de communication sans fil, y compris les systèmes de radiocommunication titulaires;
 - établir des canaux de communication;
 - enregistrer les systèmes de communication sans fil aux endroits pertinents pour la centrale;
 - faire l'inventaire des applications d'automatisation sans fil avec le système de communication sans fil associé;
 - accepter ou refuser les systèmes de communication sans fil qui viennent d'être enregistrés pour les applications d'automatisation;
 - recueillir les exigences en matière d'utilisation de la communication sans fil à partir des décisions de la procédure interne;
- fournir les mécanismes de surveillance continue de:
 - l'état du spectre de fréquences; et
 - l'état de coexistence.

Les ressources de support disponibles peuvent être organisées en attribuant des blocs de ressources aux différents systèmes et/ou appareils sans fil par la CC. Les blocs de ressources représentent une combinaison de ressources provenant des domaines temporels, fréquentiels et spatiaux et du codage.

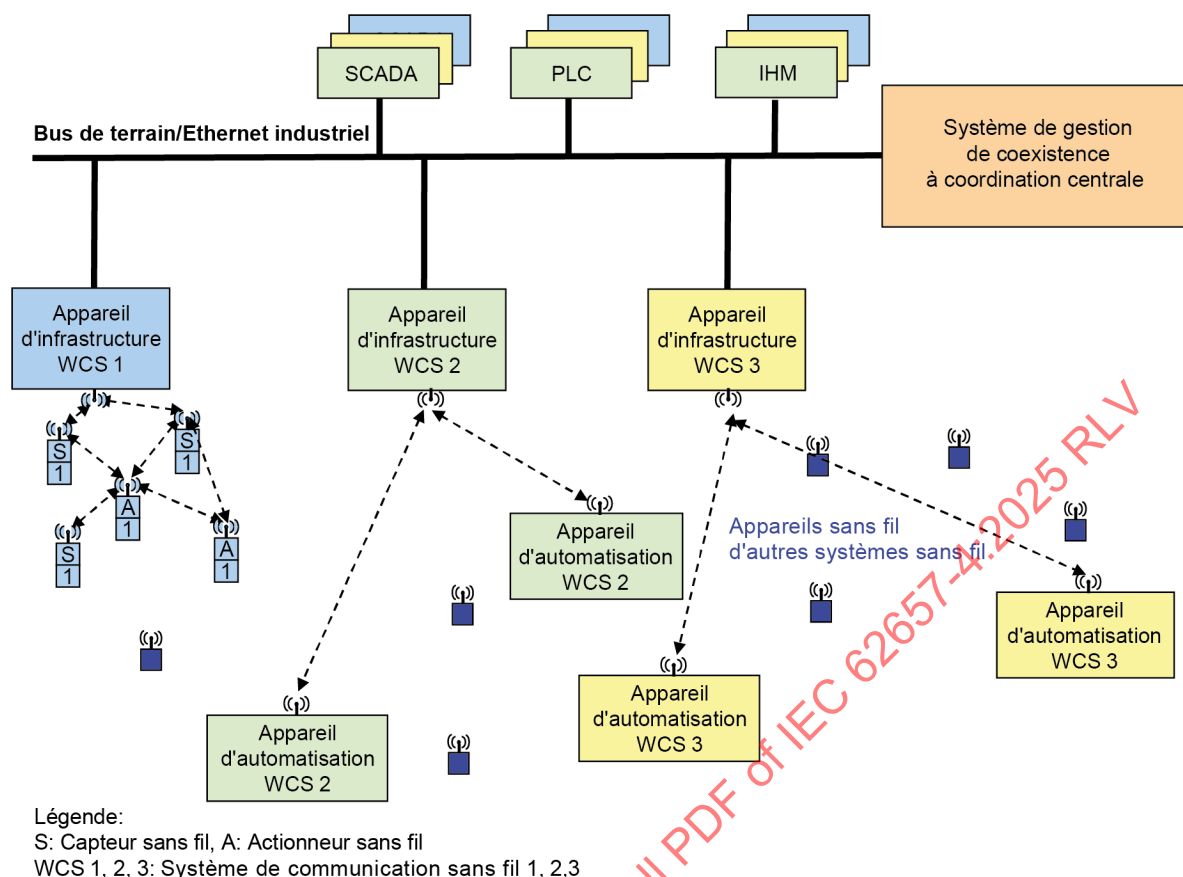
La CC doit inclure la communication avec les systèmes ou appareils sans fil au moyen d'un ou de plusieurs canaux et protocoles de communication. La CC doit donc satisfaire aux exigences suivantes:

- prise en charge des différentes technologies de radiocommunication;
- prise en charge de l'interface de coordination.

La gestion de coexistence interne au système peut remplacer la gestion de coexistence manuelle définie dans l'IEC 62657-2.

La CC permet d'ordonnancer les ressources attribuées aux différentes solutions de communication sans fil. Cela peut inclure la CC d'appareils isolés et la CC de systèmes sans fil. Dans ce dernier cas, les systèmes sans fil utilisent alors les informations CC pour configurer et commander leur propre réseau sans fil.

Si les applications de communication sans fil ne sont pas commandées par une CC et qu'elles fonctionnent de manière indépendante en utilisant les mécanismes de commande d'accès au support, il n'existe aucune coordination entre elles. Elles s'appuient alors sur leurs propres techniques de formation de réseau, de découverte de réseau, de découverte de service et de gestion du brouillage, y compris la protection des systèmes de radiocommunication titulaires.



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**Figure 5 – Exemple d'instance de classe
CoexistenceSystem conformément à l'IEC 62657-3**

La Figure 5 représente un exemple du modèle de classe CoexistenceSystem issu de l'IEC 62657-3:2022, 5.2. La classe DistributedAutomationSystem est représentée par des fonctions d'automatisation locales mises en œuvre dans la commande de surveillance et d'acquisition de données (SCADA, *Supervision Control and Data Acquisition*), l'automate logique programmable (PLC), l'interface homme-machine (IHM), le capteur (S, *Sensor*), l'actionneur (A) et le composant d'application des appareils d'automatisation. Les composants de communication sans fil des systèmes de communication sans fil WCS 1 à WCS 3 sont des instances de la classe WirelessCommunicationSystem. Les appareils sans fil d'autres systèmes sans fil sont des instances de la classe ActiveEnvironmentalInfluence. Le système de gestion de coexistence à coordination centrale est une instantiation de la classe CoexistenceManagementSystem. Ci-après, l'exemple représenté à la Figure 5 est utilisé pour décrire en détail les éléments du système, l'architecture, les fonctions et les interfaces d'un système CCP.

Le système de gestion de coexistence à coordination centrale comporte trois entités, comme cela est représenté à la Figure 6):

- point de coordination central (CCP);
- système de détection de spectre (SSS), qui est une combinaison de nœuds de détection de spectre (SSN) et de fonctions de détection de spectre (SSF), voir 5.2.4;
- services de base de données avec base de données d'informations et de configuration et base de données de réglementation.

Chaque entité est définie par ses rôles fonctionnels et son interaction avec d'autres entités.

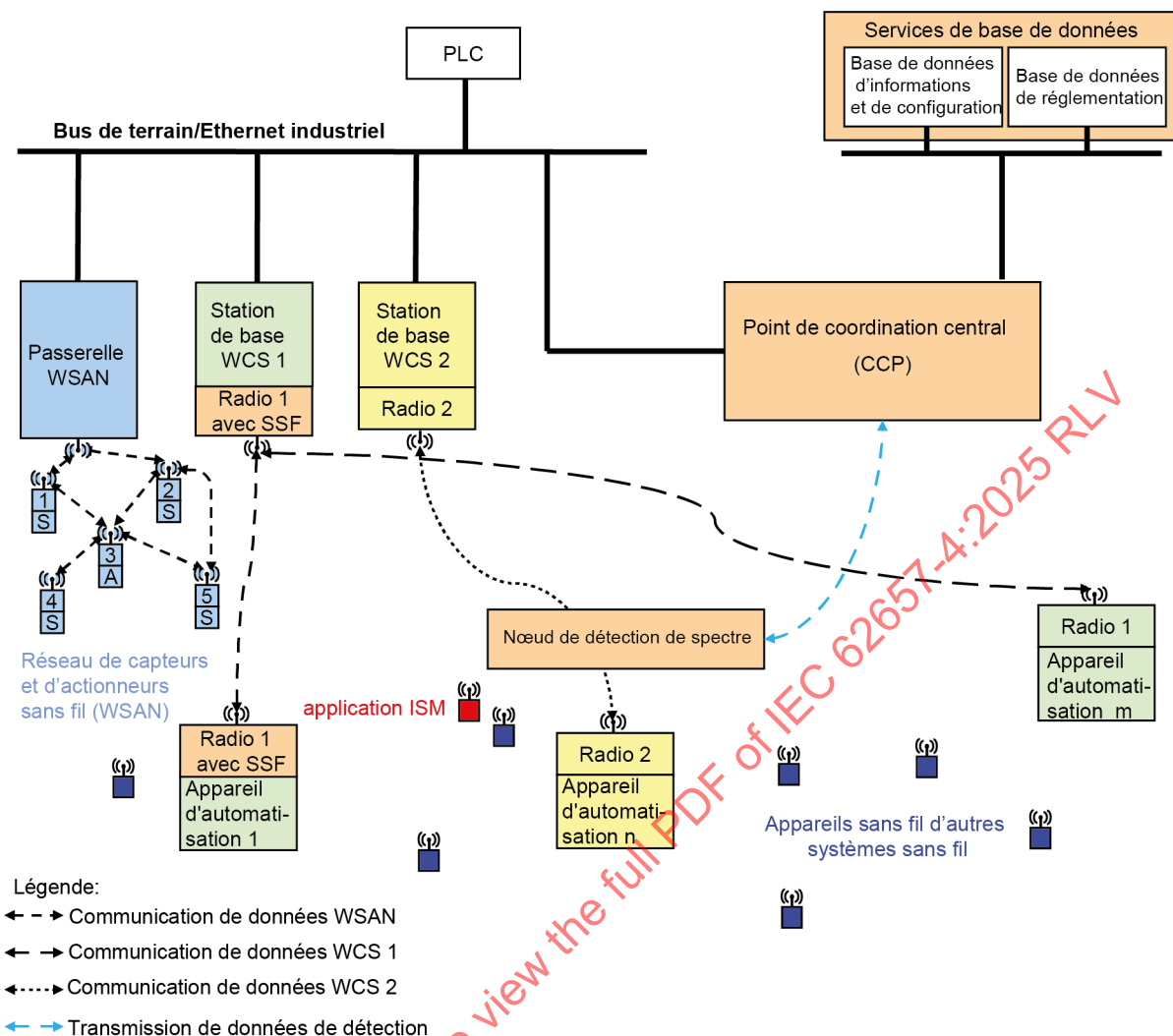
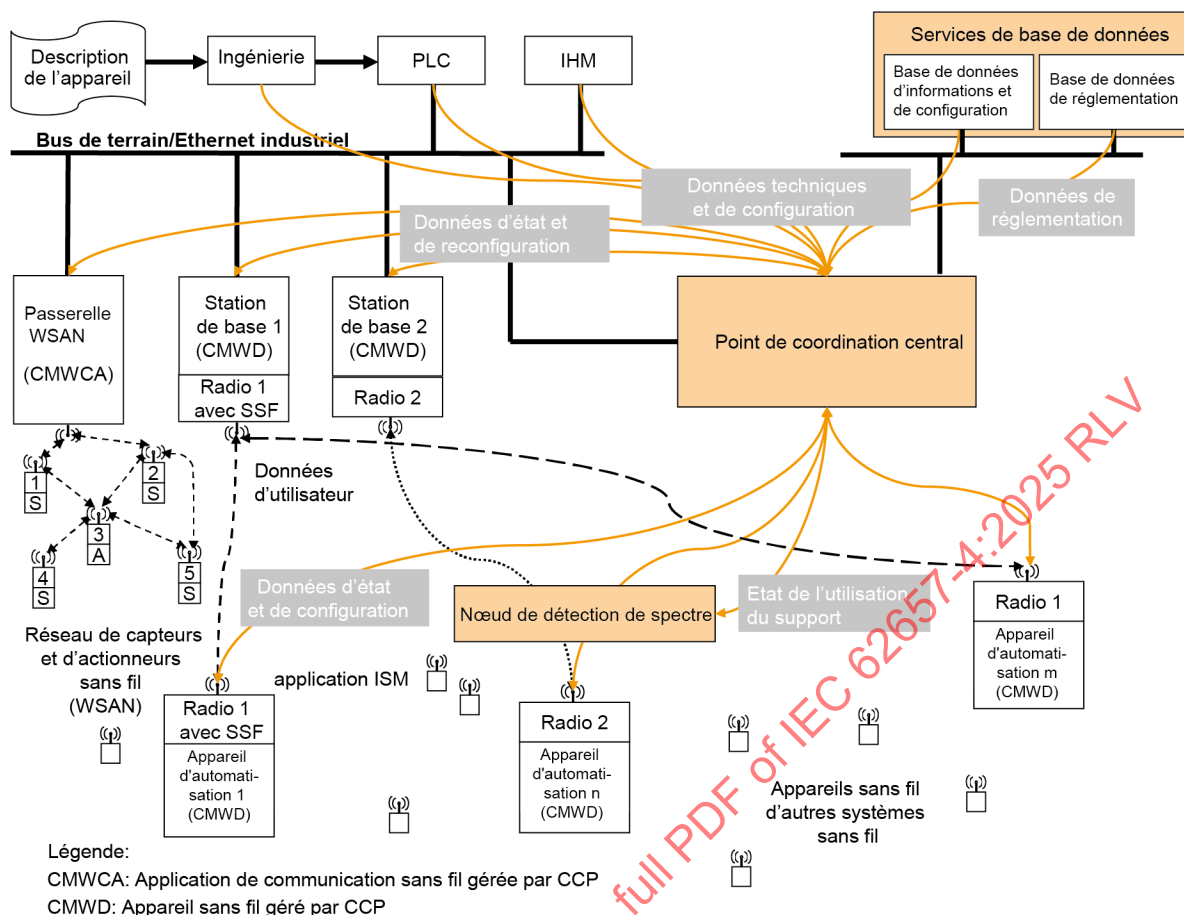


Figure 6 – Éléments du système de gestion de coexistence à coordination centrale

La Figure 6 représente trois systèmes de communication sans fil indépendants qui font l'objet d'une coordination centrale. Un réseau WSN, un système de communication sans fil 1 (Radio 1) et un système de communication sans fil 2 (Radio 2). De plus, des appareils sans fil d'autres systèmes de communication sans fil ne sont pas sous le contrôle de la CC (systèmes de radiocommunication titulaire) et d'une application ISM qui peut gêner les applications sans fil présentant un intérêt. Un système de communication industriel fondé sur le réseau est utilisé comme épine dorsale pour connecter les systèmes de communication sans fil et le CCP.



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Figure 7 – Échange de données dans le système de gestion de coexistence à coordination centrale

La Figure 7 représente l'échange de données entre les éléments dans un système de gestion de coexistence à coordination centrale. Le point de coordination central (CCP) est l'élément essentiel du système de gestion de coexistence. Le CCP prend des décisions en matière de gestion de coexistence en fonction des données techniques de base, des informations provenant des bases de données et des mesurages réels du comportement de l'application et du spectre. Les valeurs mesurées du comportement de l'application et du spectre peuvent être collectées pour les systèmes sans fil par l'intermédiaire de leur appareil central (une station de base, par exemple) ou directement à partir des appareils sans fil. Dans le premier cas, il n'y a qu'une seule connexion entre le CCP et le composant central, comme avec le réseau WSAN à la Figure 7. Ensuite, l'application qui utilise le réseau WSAN est une application de communication sans fil gérée par CCP (CMWCA). Dans l'autre cas, il existe des connexions entre le CCP et les appareils sans fil, comme avec le système de communication sans fil 1 et le système de communication sans fil 2. Il s'agit alors d'appareils sans fil gérés par CCP (CMWD). L'échange de données de coexistence peut avoir lieu directement entre le CCP et le CMWD ou par l'intermédiaire de l'appareil central du WCS. Les valeurs mesurées actuelles du spectre sont également fournies par le nœud de détection de spectre (SSN).

Le CCP gère le spectre de ressources disponible, le temps et l'espace, et attribue les ressources à la CMWCA et/ou au CMWD en fonction des exigences de l'application d'automatisation. L'appareil central de la CMWCA reçoit les informations de ressource et agit comme une station maîtresse, puis gère la station asservie enregistrée et connectée de la CMWCA. Par conséquent, la CMWCA utilise les ressources de spectre disponibles avec des connaissances supplémentaires concernant l'utilisation du spectre par sa CMWCA voisine et concernant les systèmes de radiocommunication titulaires.

5.2 Éléments du système

5.2.1 Systèmes sans fil et appareils sans fil pour applications d'automatisation

5.2.1.1 Appareil sans fil avec mécanismes d'adaptabilité et de contrôle d'accès au support par appareil

Les appareils sans fil avec mécanismes d'adaptabilité et de contrôle d'accès au support par appareil doivent fournir les mécanismes nécessaires pour l'adaptabilité et le contrôle d'accès au support de la bande de fréquences assignée (mécanismes dynamiques de sélection de fréquence et d'agilité de fréquence, par exemple). La gestion de coexistence manuelle conforme à l'IEC 62657-2 peut être utilisée pour la coexistence interne au système, mais elle ne peut pas remplacer les mécanismes obligatoires pour satisfaire aux exigences réglementaires (protéger le système de radiocommunication titulaire, par exemple). Il convient d'établir l'IEC 62657-2 pour améliorer l'efficacité d'utilisation du support en environnement industriel si l'appareil ne peut pas participer au concept CCP.

5.2.1.2 Applications de communication et appareils sans fil gérés par CCP

L'application de communication sans fil gérée par CCP (CMWCA) et/ou les appareils sans fil gérés par CCP (CMWD) sont supervisés, gérés et contrôlés par le CCP. L'application de communication sans fil gérée par CCP combine toutes les fonctions associées au sein d'un même appareil sans fil. Autrement dit, les fonctions de commande (fonctions de station de base ou de point d'accès, par exemple) pour le système de communication sans fil et les fonctions client pour le CCP. Les appareils sans fil gérés par CCP incluent les fonctions client du CCP et les fonctions d'un module de communication sans fil (WCM, *Wireless Communication Module*) ou d'un appareil d'infrastructure dans un système de communication sans fil (voir la Figure 8).

L'application de communication sans fil et l'appareil sans fil commandés par CCP ne doivent pas transmettre de messages de données sans fil. Si la communication entre le CCP et l'appareil sans fil géré par CCP est établie et que le CCP permet la transmission, l'appareil sans fil géré par CCP peut transmettre des messages de données sans fil avec ou sans les mécanismes d'adaptabilité et/ou le mécanisme de contrôle d'accès au support. Si la communication entre le CCP et l'appareil sans fil géré par CCP n'aboutit pas, la transmission sans fil doit s'arrêter si, par exemple, l'atténuation exigée par le règlement n'est pas dans l'appareil ou si l'appareil n'a pas accès à l'antenne. Un signal de détection de collision ou des mécanismes analogues doivent permettre de surveiller la communication entre le CCP et l'application de communication/l'appareil sans fil géré par CCP.

Les appareils sans fil gérés par CCP peuvent avoir mis en œuvre les fonctions de détection de spectre. Celles-ci peuvent être intégrées dans l'ensemble du système de détection de spectre (voir 5.2.4).

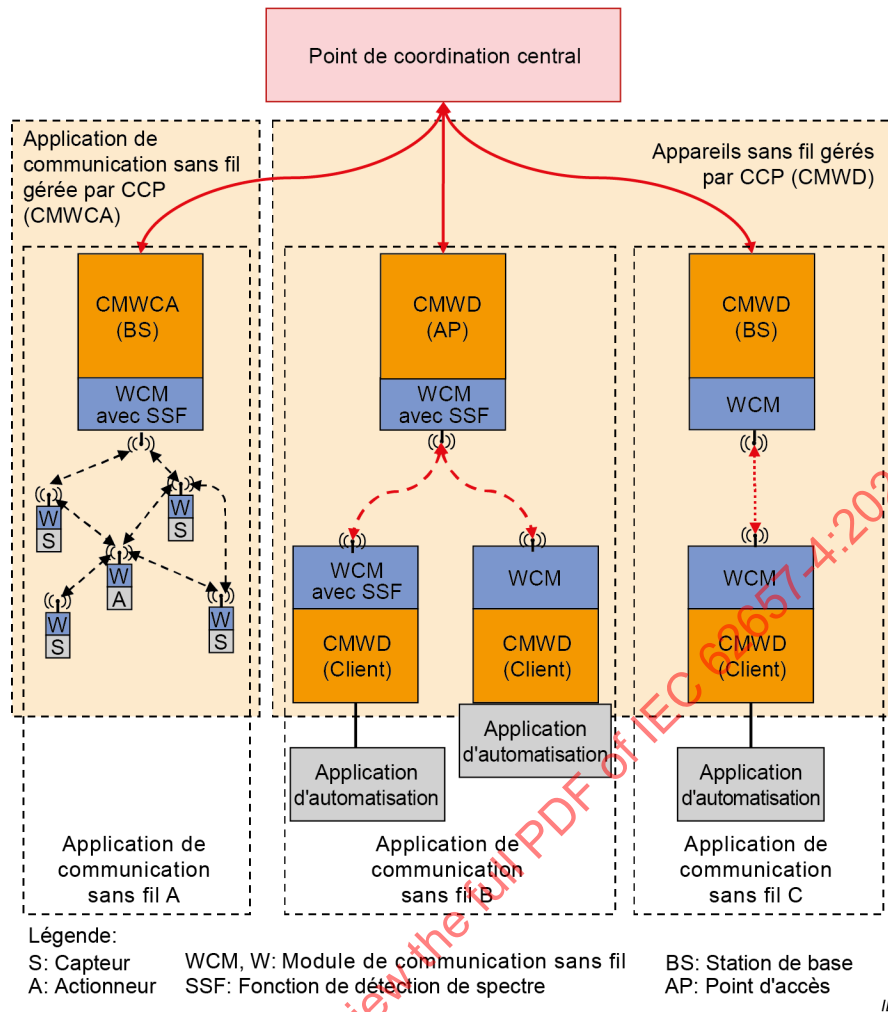


Figure 8 – Appareils sans fil gérés par CCP et systèmes sans fil gérés par CCP

Les appareils sans fil de la CMWCA qui ne procèdent pas à une détection active du spectre pour économiser de l'énergie présentent une capacité de détection limitée et sont donc soumis à un brouillage dynamique. Dans ce contexte, le système de détection de spectre peut procéder à des mesures de détection spécifiques afin de prendre en charge un système sans fil composé de ce type d'appareils sans fil basse puissance dont la capacité de détection est limitée.

5.2.1.3 Appareil sans fil géré par CCP avec mécanismes d'adaptabilité et mécanisme de contrôle d'accès au support par appareil

Les appareils sans fil avec mécanismes d'adaptabilité et de contrôle d'accès au support par appareil et qui sont également commandés par CCP doivent satisfaire aux exigences du 5.2.1.1.

Si la communication entre le CCP et une CMWCA ou un CMWD est établie et si le CCP permet la transmission, l'appareil ou système sans fil peut transmettre sans mécanisme d'adaptabilité et de contrôle d'accès au support. Si la communication entre le CCP et une CMWCA ou un CMWD n'aboutit pas, la transmission doit être conforme aux mécanismes d'adaptabilité et de contrôle d'accès au support.

5.2.2 Point de coordination central

5.2.2.1 Généralités

Le point de coordination central (CCP) est un appareil ou système de coordination centralisée permettant de gérer les infrastructures sans fil hétérogènes pour les applications d'automatisation réparties dans l'espace. Comme cela est représenté à la Figure 9, le CCP est composé d'un accès au(x) fond(s) de panier et d'un accès au canal RF, d'un moteur de spectre, d'un moteur de ressources et d'un moteur de politique.

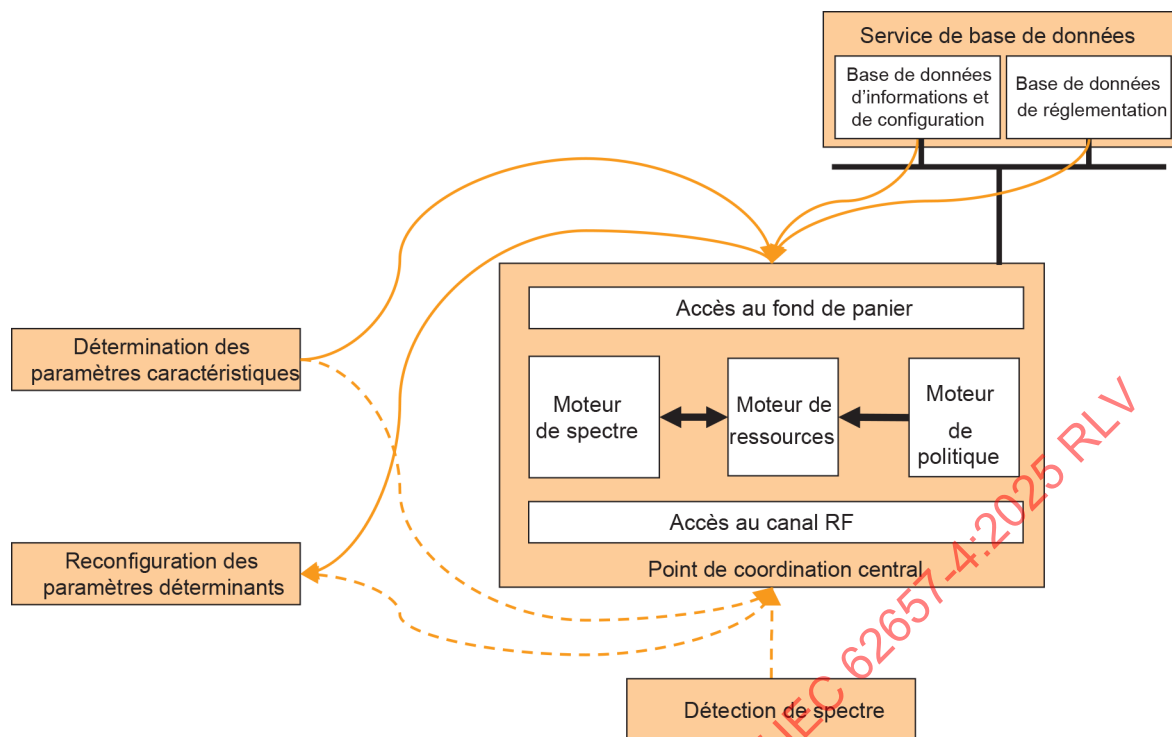
Les tâches du CCP sont les suivantes:

- gestion (commande et coordination) d'une infrastructure de communication sans fil hétérogène pour les applications d'automatisation réparties dans l'espace;
- établissement de coexistence automatique au sein d'une infrastructure de communication sans fil hétérogène pour les applications d'automatisation;
- prise en considération des exigences d'application d'automatisation;
- détection et protection des applications de communication sans fil;
- prise en considération et respect des exigences réglementaires régionales relatives aux systèmes de communication sans fil et aux appareils sans fil avec support de géolocalisation.

Le CCP doit:

- établir une communication filaire ou sans fil avec la base de données d'informations et de configuration contenant les informations de géolocalisation et d'utilisation du support provenant d'applications d'automatisation sans fil et de systèmes de radiocommunication titulaires;
- détecter les systèmes de radiocommunication titulaires et sélectionner la technique d'atténuation appropriée afin de protéger ces systèmes;
- utiliser les paramètres caractéristiques liés à l'application conformément à l'IEC 62657-2:2025, 6.6 pour déterminer l'état de coexistence décrit en 4.2;
- obtenir les exigences des applications d'automatisation (voir l'IEC 62657-2) et attribuer les ressources en conséquence à la CMWCA et au CMD;
- établir une connexion filaire ou sans fil à la CMWCA et au CMD;
- établir une connexion filaire ou sans fil à la base de données de réglementation;
- reconfigurer les applications de communication et appareils sans fil gérés par CCP en utilisant les paramètres influents définis dans l'IEC 62657-2:2025, Article 7.

Si plusieurs CCP sont utilisés dans une certaine configuration, la communication filaire ou sans fil doit être établie directement ou indirectement entre les CCP. Toutes les exigences d'un seul CCP doivent s'appliquer.



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Figure 9 – Vue d'ensemble du CCP

5.2.2.2 Moteur de spectre

Le moteur de spectre (SE, *Spectrum Engine*) est une fonction de gestion et de commande et une entité du CCP. Il centralise toutes les décisions d'utilisation du support pour différentes applications de communication sans fil, en tenant compte des informations de disponibilité du support et de l'utilisation du support en fonction de l'emplacement.

Pour récapituler, le SE doit être chargé:

- de la gestion des informations relatives à la disponibilité et à l'utilisation du support;
- de la classification et du choix du canal;
- du contrôle d'association;
- de la gestion de l'ensemble de canaux;
- de l'accès au service de base de données;
- de l'ordonnement des opérations de détection de spectre;
- de décider du déplacement de canal d'un ou de plusieurs systèmes ou appareils sans fil gérés par CCP pour application d'automatisation;
- de la prise en charge de la coexistence des applications de communication sans fil;
- de la prise en compte des systèmes de radiocommunication titulaires et d'autres applications sans fil;
- de l'établissement d'une connexion filaire ou sans fil aux applications et appareils de communication sans fil gérés par CCP;
- de l'établissement d'une connexion au moteur de ressources.

5.2.2.3 Moteur de ressources

Le moteur de ressources (RE, *Resource Engine*) est une fonction de gestion et de commande et une entité du CCP. Le RE centralise toutes les informations relatives à l'application d'automatisation, toutes les exigences de communication d'application et toutes les caractéristiques générales de la centrale. Ces informations doivent être analysées et traitées en fonction de l'utilisation du support sans fil par les applications de communication sans fil. De plus, le RE doit prendre en considération les restrictions de réglementation de radiocommunication.

Le moteur de ressources (RE) dans le CCP doit être chargé:

- de collecter, d'analyser et de traiter les données techniques et les données d'application d'automatisation;
- de fournir les paramètres de contrôle de coexistence au moteur de spectre (SE) en ce qui concerne les restrictions et limitations de réglementation de radiocommunication;
- de maintenir les exigences de l'application d'automatisation;
- de maintenir et de surveiller les informations QoS des liaisons de communication.

5.2.2.4 Moteur de politique

Le moteur de politique (PE) est une fonction de gestion et une entité du CCP. Il centralise toutes les restrictions et limitations de réglementation de radiocommunication en fonction de l'emplacement en ce qui concerne les plages de fréquences utilisées. Le PE doit être chargé:

- de maintenir les exigences, restrictions et limites réglementaires relatives à l'emplacement géographique, ainsi que la plage de fréquences utilisée par les systèmes et appareils sans fil pour applications d'automatisation;
- d'établir une communication filaire et sans fil avec la base de données de réglementation contenant la limite de géolocalisation de la réglementation du spectre radioélectrique.

Il est impossible d'obtenir une approbation générale du concept CC auprès des administrations. Pour s'assurer que les fournisseurs peuvent commencer à investir dans des produits conformes au présent document, il est important de savoir qu'un fournisseur qui lance un produit sur le marché et le met en service est responsable du respect des règles locales et régionales. Il existe deux principes sur les marchés mondiaux:

- le processus d'autodéclaration de conformité;
- l'agrément de type.

NOTE 1 En Europe, étant donné qu'il n'existe pas de norme harmonisée pour ce type de produits, le processus consiste à demander l'expertise d'un organisme certifié.

NOTE 2 La responsabilité du produit revient au fournisseur.

La description du produit doit donner les informations nécessaires pour décrire le système:

- CCP;
- applications et appareils de communication sans fil gérés par CCP,

avec leurs interfaces de maintenance CCP pour fonctionner à l'aide d'une interface de communication. L'interface de communication peut reposer, par exemple, sur l'IEEE Std 802.11. L'interface de maintenance CCP doit être conforme au présent document.

Tableau 2 – Niveau d'efficacité de l'automatisation sans fil

Scénario	Obtention de la coexistence	Efficacité du spectre
Sans gestion de coexistence	Difficilement	—
Avec gestion de coexistence	Plus probable	Non efficace
Avec gestion de coexistence fondée sur CCP	Plus probable	Efficace
Avec gestion de coexistence fondée sur CCP et trafic contrôlé uniquement	Sûr	Efficace

Comme cela est indiqué dans le Tableau 2, le CCP augmente les chances d'obtenir la coexistence des applications de communication sans fil comparées à celles obtenues en l'absence d'utilisation d'un concept CCP. Cela signifie que le moteur de politique doit contenir toutes les restrictions pertinentes pour satisfaire aux exigences régionales et locales des règlements, politiques et autres.

5.2.3 Base de données de coordination

5.2.3.1 Base de données d'informations et de configuration

La base de données d'informations et de configuration (ICD, *Information and Configuration Database*) contient les informations relatives aux exigences de communication de l'application d'automatisation, des applications sans fil gérées par CCP et appareils gérés par CCP, des appareils et systèmes sans fil avec mécanismes d'adaptabilité et de contrôle d'accès au support par appareil, avec des informations spécifiques à l'emplacement et à la radiocommunication. L'ICD doit donner ces informations au CCP. Les informations spécifiques à la radiocommunication doivent inclure des informations relatives aux radiofréquences disponibles et les valeurs PIRE maximales associées, les mécanismes d'adaptabilité et les mécanismes de contrôle d'accès au support mis en place utilisés par les systèmes et appareils sans fil considérés. Cela permet de protéger les systèmes de radiocommunication titulaires. Les informations sont tirées de la documentation des systèmes et appareils sans fil.

5.2.3.2 Base de données de réglementation

La base de données de réglementation (RD, *Regulation Database*) contient des informations réglementaires relatives à la ou aux bandes de fréquences utilisées. La RD doit contenir des informations relatives aux limites du règlement de radiocommunication et aux systèmes de radiocommunication titulaires et autres applications sans fil, ainsi que les bandes de fréquence ou parties de celles-ci qui peuvent être utilisées pendant le fonctionnement.

De plus, la base de données de réglementation contient des informations relatives à la manière dont les systèmes de communication sans fil répondent en cas de détection d'un système de radiocommunication titulaire. La politique du CCP utilise la base de données de réglementation pour configurer les systèmes et appareils sans fil en fonction des exigences réglementaires. Les systèmes de radiocommunication titulaires sont définis par:

- la bande de fréquences;
- le type titulaire:
 - la défense (radiolocalisation);
 - le service fixe;
 - le transport;

– la caractéristique de fonctionnement titulaire:

- statique;
- dynamique par le temps;
- dynamique par la géographie;
- dynamique par le temps et la géographie.

En raison des systèmes de radiocommunication titulaire, un certain nombre d'inconvénients peuvent apparaître pour les systèmes de communication sans fil et, de ce fait, pour les applications de communication sans fil (WCA), par exemple:

- bande de fréquences réduite;
- couverture réduite;
- capacité diminuée;
- accès au spectre ralenti.

5.2.4 Système de détection de spectre

Le système de détection de spectre (SSS) est une combinaison de nœuds de détection de spectre (SSN) dédiés et de fonctions de détection de spectre (SSF) intégrées dans les appareils sans fil pour application d'automatisation. Le SSS doit donner en permanence au CCP des informations relatives à l'utilisation du support. Le SSS observe les bandes de fréquences pertinentes dans et autour de l'environnement des locaux industriels, afin de déterminer l'occurrence d'applications sans fils, y compris les systèmes de radiocommunication titulaire. Ce processus est appelé "détection" et tient compte des paramètres du canal radioélectrique, des applications sans fil connues, de l'application d'automatisation et de l'environnement. De plus, les valeurs de spectre déterminées peuvent donner des informations relatives à l'emplacement d'un appareil sans fil émetteur.

En règle générale, la détection de spectre est un processus passif qui ne doit pas gêner les applications sans fil. Les signaux envoyés doivent être détectés depuis le SSS, et les paramètres doivent être transférés vers la fonction SE dans le CCP. Les paramètres indiquent la plage de fréquences, le niveau d'énergie et le temps d'occupation. Pour évaluer le niveau d'énergie, l'indication de puissance du signal reçu (RSSI) ou le rapport signal à l'interférence plus bruit (SINR) par exemple sont utilisés comme paramètres. En fonction de ces informations, le SE peut identifier les caractéristiques de radiocommunication de l'émetteur et peut ainsi caractériser, cataloguer et classer les systèmes de radiocommunication titulaires, les systèmes et appareils de communication sans fil, les applications ISM et d'autres applications sans fil.

Les nœuds de détection de spectre (SSN) mettent en œuvre indépendamment des procédures particulières de détection de l'environnement de radiofréquence à l'intérieur et à l'extérieur de l'environnement d'automatisation local. Le SSN doit détecter en permanence l'environnement de radiofréquence et le signaler au CCP de manière qu'il puisse actualiser le statut des ressources du support.

La fonction de détection de spectre (SSF) est présente au niveau de la CMWCA et du CMWD. Dans la CMWCA, la SSF met en œuvre indépendamment des procédures particulières de détection de l'environnement de radiofréquence à l'initialisation de la station maîtresse, avant l'enregistrement d'une station asservie et pendant le fonctionnement.

Dans un CMWD, la SSF doit inclure les caractéristiques essentielles au bon fonctionnement lorsque l'appareil n'est pas sous le contrôle de la station maîtresse WCS (lors de l'initialisation ou du changement de canal, par exemple). Si un CMWD est en veille, la SSF doit procéder à une détection hors bande et informer la station maîtresse de sorte qu'elle puisse actualiser le statut des canaux dans la liste des canaux de sauvegarde/candidats. À tout autre moment, les SSF dans le CMWD sont sous le contrôle du CCP. Lorsque la station maîtresse n'émet pas, la SSF est active pour procéder à une détection hors bande. La SSF peut également procéder à une détection pour libérer les canaux.

Le CMWD peut faire l'objet de limitations en ce qui concerne la capacité de traitement, les ressources de mémoire ou les exigences d'alimentation (batterie sous tension). Dans ces différents cas, les mesures suivantes peuvent s'appliquer:

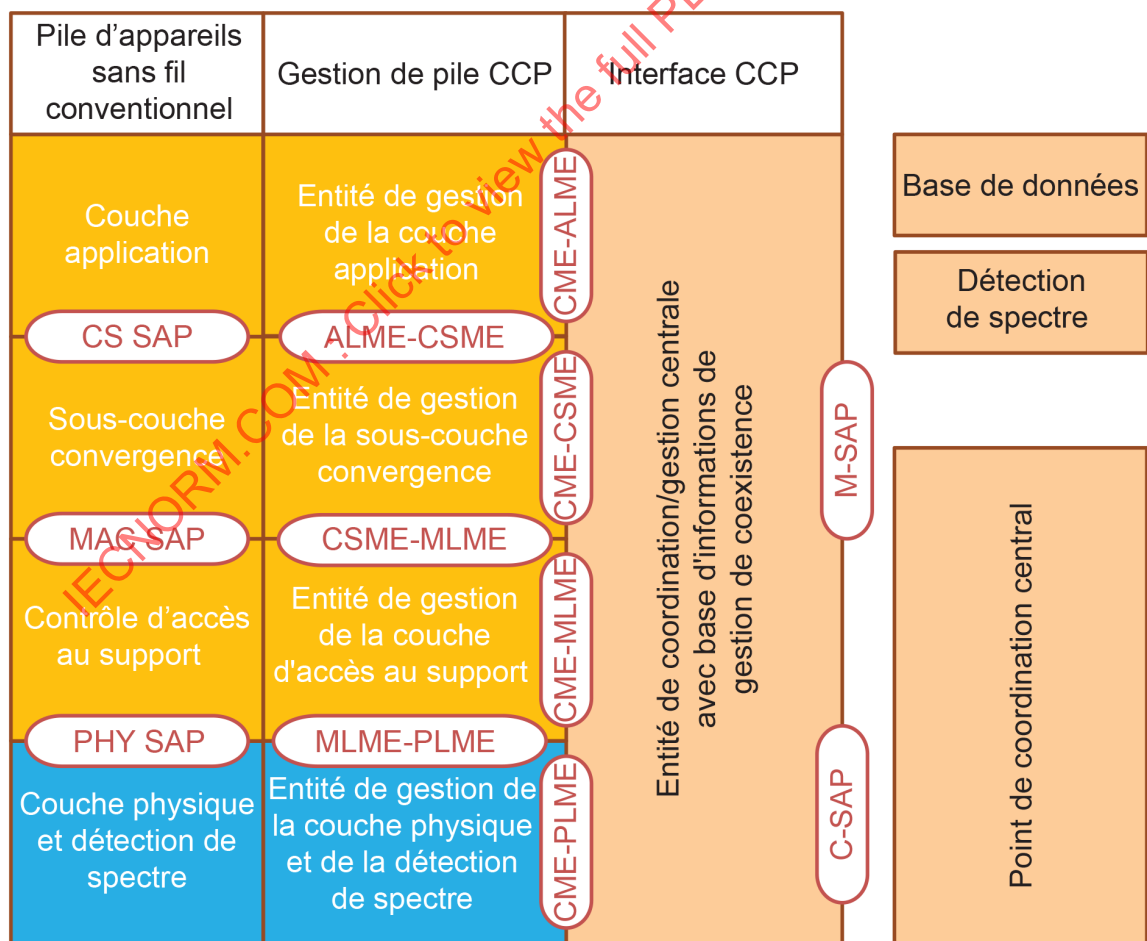
- La SSF n'est pas démarrée immédiatement après l'enregistrement du CMWD, mais sur commande du CCP.
- La SSF détecte uniquement la plage de fréquences que l'appareil sans fil peut utiliser de manière opérationnelle.
- La SSF peut être interrompue pour économiser la puissance de la batterie.

Ces limitations en matière de détection de spectre peuvent être compensées en utilisant les informations provenant du SSN et/ou en activant de manière sélective les SSF et en procédant à une analyse de données approfondie.

5.3 Architecture de référence de protocole

5.3.1 Généralités

Le modèle de référence de protocole (PRM) des applications d'automatisation et appareils sans fil gérés par CCP, représenté à la Figure 10, est divisé en trois parties. La pile d'appareils sans fil conventionnel transfère les données utilisateur. Elle est appelée "plan d'utilisateur" ou "plan de données". La gestion de pile CCP fournit les services de gestion et de contrôle CCP de l'appareil, conformément à l'Article 8. L'interface CCP contient la fonctionnalité du plan de gestion/contrôle, créant un plan de coordination pour prendre en charge les capacités de coordination centrales.



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Figure 10 – Modèle de référence de protocole de l'appareil sans fil géré par CCP

5.3.2 Plan de données

Le plan de données est composé de la couche physique (PHY), de la couche de contrôle d'accès au support (MAC), de la sous-couche Convergence (CS) et de la couche Application (AL). Des points d'accès au service (SAP) sont ajoutés entre ces couches pour assurer la modularisation du système. Un SAP est accompagné d'une interface bien définie ou d'un ensemble de primitives pour échanger des informations, à l'aide desquels ces différents composants peuvent communiquer.

Le CS spécifique au service doit assurer la transformation ou le mapping des données de réseau externe reçues par l'intermédiaire de CS-SAP depuis la couche Application (AL), en unités de données de service (SDU) MAC. Cette transformation ou ce mapping doit inclure des SDU de classification de réseau externe et leur association à un identifiant de flux de service MAC correct. Plusieurs spécifications CS sont fournies pour assurer l'interface avec différents protocoles.

Le MAC doit fournir la fonctionnalité d'accès au système, l'établissement de la connexion et le maintien de la connexion. Les données que la couche MAC reçoit de différentes CS par l'intermédiaire de MAC SAP doivent être attribuées selon les connexions MAC particulières. La qualité de service (QoS) est appliquée à la transmission et l'ordonnement des données sur la couche PHY. Les données, le contrôle PHY et les statistiques de surveillance (détection de spectre, RSSI, etc.) doivent être transférés entre la couche MAC et la couche PHY par l'intermédiaire de PHY SAP.

Le paramètre d'évaluation de coexistence doit être déterminé à partir du transfert de message dans le plan de données. PHY, MAC, CS et AL doivent fournir les paramètres déterminés à l'entité de coordination/gestion centrale avec la base d'informations de gestion de coexistence, dans laquelle ces paramètres sont disponibles pour le CCP.

5.3.3 Plan de gestion et de contrôle

5.3.3.1 Généralités

Le plan de gestion et de contrôle doit être composé de la couche physique et de l'entité de gestion de détection de spectre (PLME), de l'entité de gestion de la couche d'accès au support (MLME), de l'entité de gestion de la sous-couche Convergence (CLME), de l'entité de gestion de la couche Application (ALME) et de l'entité de coordination centrale (CCE) avec une base d'informations de gestion de coexistence (CMIB). Des primitives de service sont utilisées pour communiquer avec la base de données CMIB, et certaines d'entre elles peuvent être utilisées pour gérer les entités du système et de l'appareil sans fil. Les primitives CMIB doivent être utilisées pour la configuration du système, les statistiques de surveillance, les notifications, les déclencheurs et la gestion de session, la gestion des ressources de support, la communication avec la base de données, le système de détection de spectre et le CCP. Les données CMIB peuvent être obtenues auprès du système sans fil, être prédéfinies au sein du système ou obtenues auprès d'autres appareils après un échange d'informations à l'aide du support de communication. Le CCP joue un rôle essentiel dans l'architecture globale. Il s'agit du coordinateur central de toutes les CMWCA et tous les CMWD dans lesquels sont rassemblées toutes les informations relatives à la disponibilité du spectre résultant de la base de données et du système de détection de spectre. En fonction de ces informations combinées, des règlements locaux et des politiques CCP prédéfinies, le CCP doit donner les informations de configuration nécessaires au MAC, qui doit configurer à distance toutes les CMWCA et tous les CMWD enregistrés.

5.3.3.2 Plan de gestion

Le CCP doit résider dans le plan de gestion de l'application de communication sans fil. Le SAP de gestion (M-SAP) peut inclure entre autres les primitives liées aux éléments suivants:

- caractérisation générale de l'installation;
- exigences relatives à la communication d'application;
- système de communication et gestion de l'appareil;
- statistiques de surveillance;
- notifications/déclencheurs;
- gestion de détection.

5.3.3.3 Plan de contrôle

Le plan de contrôle doit être composé de la fonction du système de détection de spectre (SSS) et de la fonction du point de coordination central (CCP). Le SSS doit mettre en œuvre les algorithmes de détection de spectre et le RE doit donner les informations afin de déterminer l'emplacement de la CMWCA et du CMWD.

Le CCP doit maintenir les informations de disponibilité du support, gérer les listes de canaux, gérer les périodes calmes, ordonnancer et mettre en œuvre les mécanismes de coexistence. Le CCP doit également traiter les demandes du MAC et PHY. Par exemple, le MAC doit informer le CCP qu'une situation de brouillage a été détectée pendant le fonctionnement normal dans le canal. Le CCP doit alors réaliser les actions appropriées pour résoudre le problème (déplacement vers un autre canal, par exemple). À cet effet, le CCP demande en premier lieu une période de veille suffisante auprès de l'application de communication sans fil pour procéder à une détection hors bande. Il doit mettre à jour la liste des canaux de sauvegarde et candidats dans un ordre hiérarchique. Ensuite, le CCP vérifie que l'application de communication sans fil dispose d'une période de veille suffisante pour sélectionner un nombre suffisant de canaux de sauvegarde. Si un titulaire est détecté lors de la détection dans la bande, le MAC utilise le service correspondant pour demander au CCP de procéder à l'opération de commutation.

Le CCP doit utiliser C-SAP pour déplacer le canal, configurer la fonction de détection de spectre au niveau des appareils sans fil (liste de canaux de sauvegarde ou candidats, canaux spécifiques à détecter, etc.) et recueillir des informations auprès des appareils sans fil (informations de détection locale, etc.).

Le C-SAP peut inclure entre autres les primitives liées aux éléments suivants:

- gestion d'abonné et de session;
- rapport des ressources du support;
- résultat de détection.

5.4 Système d'applications de communication sans fil

5.4.1 Concept de point de coordination central pour le partage avec des systèmes de radiocommunication sans fil

Le concept de CCP a pour objet de réduire l'effort exigé pour la mise en œuvre des techniques d'atténuation nécessaires pour le spectre utilisé dans chaque appareil. Cette approche présente également l'avantage de permettre au CCP de détecter les systèmes de radiocommunication titulaires au bord de l'installation avec une meilleure sensibilité de réception que les appareils sans fil. Bien que l'emplacement d'un appareil sans fil dans un bâtiment dépende de l'application d'automatisation, les SSN peuvent être placés dans des endroits présentant des performances de réception optimales.

Si la bande de fréquences disponible non utilisée par les systèmes de radiocommunication titulaires est identifiée par le CCP, ce dernier doit calculer les attributions de spectre les plus efficaces qui peuvent être destinées aux applications de communication sans fil gérées par CCP en fonction des exigences de leur application d'automatisation relatives aux besoins de communication.

Les applications de communication sans fil en environnement industriel peuvent fonctionner exclusivement selon une ou plusieurs technologies d'accès au réseau, la plupart de ces applications pouvant même fonctionner simultanément dans ce type d'environnement.

Un exemple de WCA contrôlée par CCP et de services/applications titulaires dans la bande WIA de 5,8 GHz est donné à l'Annexe A.

Un autre exemple de WCA contrôlée par CCP est donné à l'Annexe D.

5.4.2 Protection des systèmes de radiocommunication titulaires

La WCA contrôlée par CCP utilise la coordination centralisée avec détection de spectre centralisée ou répartie afin d'identifier les plages de fréquences libres et occupées. Le nœud de détection de spectre (SSN) peut avoir plusieurs interfaces radioélectriques ou une interface radioélectrique universelle pour surveiller un certain nombre de canaux ou de plages de fréquences en même temps. Il détermine le fonctionnement des services titulaires sur certains canaux ou certaines fréquences. Le cas échéant, la SSF des appareils de la CMWCA peut être utilisée pour obtenir un statut plus précis de l'utilisation du support, en particulier en ce qui concerne la distribution spatiale.

Pour protéger les services et applications titulaires, une gestion de coexistence automatisée non collaborative reposant sur des indicateurs clés doit être utilisée, la WCA et les services/applications titulaires ne pouvant pas échanger d'informations. Étant donné qu'ils sont totalement indépendants, la WCA doit s'appuyer sur la détection et l'estimation du service/de l'application titulaire. En d'autres termes, chaque WCA potentiellement brouillée classe le comportement des services ou applications titulaires brouilleurs et adapte son comportement en fonction des nouvelles conditions.

5.4.3 Concept de point de coordination central pour la coexistence interne au système

La coexistence interne au système, telle qu'elle est obtenue selon le concept CCP, suit le point de vue d'un mécanisme automatique adaptatif de gestion de coexistence.

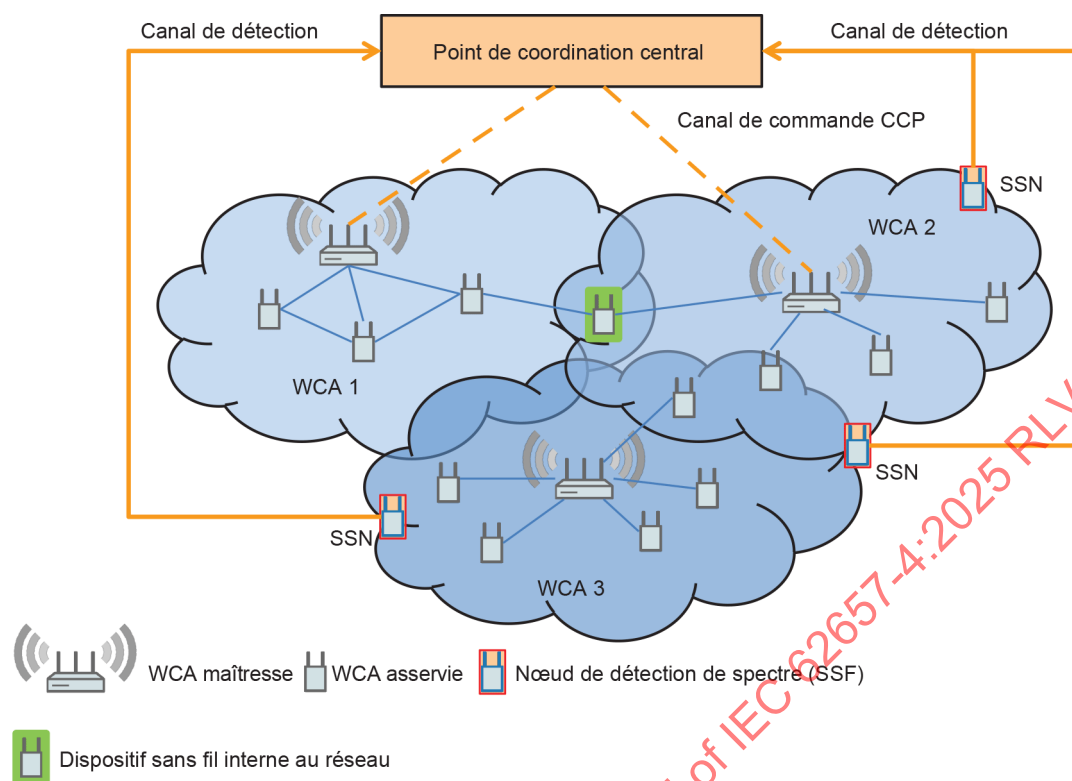
Le CCP doit organiser l'accès au spectre pour plusieurs WCA dans les limites de la bande de fréquences. Actuellement, il existe plusieurs problèmes de coexistence et techniques d'atténuation, car il n'y a aucune coordination entre les WCA. Par conséquent, il convient que la WCA utilise de nouveaux schémas de coexistence internes au système afin d'optimiser l'utilisation des ressources radioélectriques. Ces schémas de coexistence peuvent être activés par un CCP. Le CCP peut faciliter la coexistence sans fil en transmettant des informations contextuelles comme la qualité de service, la priorité de service, etc., et des résultats de mesure. Le CCP peut également activer le contrôle de plusieurs WCA.

Le CCP organise le fonctionnement simultané de plusieurs WCA et appareils sans fil dans des environnements industriels. Par conséquent, le CCP, la WCA contrôlée par CCP et les appareils sans fil contrôlés par CCP doivent fournir un canal de commande pour la collecte d'informations entre la WCA et les appareils sans fil et le CCP, et pour transporter les informations de contrôle ou d'assistance entre le CCP et la WCA et les appareils sans fil. Pour fournir des services de contrôle ou d'assistance, le CCP assure la prise de décision par l'intermédiaire d'un canal de commande. Pour assurer les services de collecte d'informations, le CCP doit donner des informations relatives à la WCA et aux appareils sans fil disponibles par l'intermédiaire d'un canal de commande. Le canal de commande peut utiliser:

- des connexions par liaison de ligne entre le CCP et la WCA contrôlée par CCP;
- des connexions sans fil entre le CCP et la WCA contrôlée par CCP ou les appareils sans fil contrôlés par CCP;
- des connexions sans fil entre la WCA contrôlée par CCP et les appareils sans fil contrôlés par CCP;
- des connexions sans fil entre les WCA contrôlées par CCP;
- des connexions sans fil entre les appareils sans fil contrôlés par CCP.

Le CCP doit fournir plusieurs capacités de technologie de radiocommunication et un accès au réseau par liaison de ligne.

Dans un environnement industriel, la WCA peut fonctionner exclusivement avec une seule technologie de radiocommunication, mais les appareils sans fil à l'intérieur de ces réseaux peuvent être capables de fonctionner sur plusieurs technologies de radiocommunication différentes en même temps. Par conséquent, un contrôleur à plusieurs WCA doit utiliser l'aptitude des appareils sans fil spécifiques à communiquer sur plusieurs WCA afin de fournir des services améliorés à la WCA sur laquelle cet appareil n'est pas actif. Un appareil avec capacité d'accès radioélectrique multiple peut être utilisé pour aider la WCA à coordonner les transmissions sur la WCA et à améliorer les performances à l'intérieur d'une WCA. Des appareils sans fil internes au réseau capables de communiquer avec WCA 1 et avec WCA 2 peuvent exister. Cet appareil sans fil peut être considéré comme étant celui marqué en vert à la Figure 11. La WCA avec une seule capacité d'accès radioélectrique a besoin d'aide de la part du CCP. Le CCP gère l'utilisation du support des WCA en coordonnant leurs transmissions.



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Figure 11 – Point de coordination central pour la coexistence interne au système

D'un point de vue conceptuel, l'aide technologique d'accès radioélectrique multiple ou l'aide technologique de liaison de ligne permet de gérer les problèmes de coexistence non seulement en réduisant le plus possible le brouillage préjudiciable, mais également en étendant les services disponibles aux appareils sans fil à partir d'appareils se trouvant à l'extérieur du réseau local. Les services offerts par chaque appareil sont ajoutés au CCP, mais pour accéder à ce CCP, un canal de commande commun capable d'assurer une communication agnostique avec la WCA est exigé.

Il peut être demandé à la WCA 1 (voir la Figure 11) ou aux appareils sans fil appartenant à la WCA 1 de détecter le canal de fonctionnement de la WCA 2 et de consigner les résultats dans un CCP. Cela peut s'avérer utile pour les réseaux composés d'appareils à faible puissance dont la capacité de détection est limitée.

Le CCP collecte des informations sur l'emplacement et les caractéristiques de fonctionnement des différentes WCA, y compris le canal de fonctionnement de la WCA de faible complexité. Ensuite, le CCP demande au SSN ou aux appareils sans fil de procéder à une détection régulière sur le canal de fonctionnement de la WCA de faible complexité, en utilisant les algorithmes de détection particuliers applicables pour détecter la WCA de faible complexité avec faible utilisation du support. Si un brouillage préjudiciable est détecté, le CCP informe la WCA de faible complexité et lui demande de se déplacer vers un autre canal de fonctionnement, à condition qu'aucun service titulaire ne fonctionne sur ce canal.

Éventuellement, le CCP peut également demander au SSN de surveiller d'autres canaux pour la WCA. Si un brouillage important est détecté, le CCP peut demander à la WCA de déplacer les canaux en activité vers un autre canal validé. Ainsi, la discontinuité de service, qui se produit en conséquence du brouillage préjudiciable, est réduite au niveau de la WCA.

5.5 Interfaces

5.5.1 CCP

Le CCP dispose d'une interface avec les entités de couche AL, CS, MAC et PHY des applications de communication et appareils sans fil gérés par CCP par l'intermédiaire des deux SAP M-SAP et C-SAP. Le M-SAP est utilisé pour les primitives de plan de gestion les moins urgentes, et le C-SAP pour les primitives de plan de gestion les plus urgentes.

Le CCP dispose d'une interface avec le SSN par l'intermédiaire de M-SAP et de C-SAP. Le M-SAP est utilisé pour les primitives de plan de gestion, et le C-SAP pour les primitives de plan de contrôle.

Le CCP dispose d'une interface avec la base de données par l'intermédiaire du M-SAP, qui utilise les primitives de plan de gestion.

Le CCP dispose d'une interface avec l'application d'automatisation par l'intermédiaire du M-SAP, qui utilise les primitives de plan de gestion.

Le CCP fournit une interface utilisateur pour la gestion, le contrôle et l'ingénierie.

5.5.2 Applications de communication et appareils sans fil gérés par CCP

Les applications de communication et appareils sans fil gérés par CCP doivent inclure un SAP de contrôle (C-SAP) et un SAP de gestion (M-SAP) qui assurent l'accès du CCP aux fonctions de plan de contrôle et de plan de gestion.

Le CMWD doit fournir une interface avec l'application d'automatisation.

5.5.3 Base de données

La base de données de coordination doit fournir un M-SAP qui permet au CCP d'accéder au contenu de la base de données.

La base de données fournit une interface utilisateur pour la gestion, le contrôle et l'ingénierie.

5.5.4 Système de détection de spectre

Le SSN et la SSF doivent fournir un C-SAP permettant au CCP d'accéder aux résultats de la détection de spectre.

6 Paramètre d'évaluation de coexistence

Les paramètres caractéristiques sont utilisés pour décrire et évaluer le comportement du mécanisme d'accès au support et les performances de l'ensemble de la communication d'une solution sans fil. Dans le présent Article 6, des paramètres caractéristiques sont spécifiés pour évaluer les systèmes de communication sans fil, et en particulier les mécanismes d'accès au support en fonction des applications d'automatisation industrielle. Les paramètres peuvent se distinguer par la description du comportement au temps et aux erreurs et par les mesures concernant tous les types d'efficacités du spectre.

La coexistence doit être évaluée à l'aide des paramètres du Tableau 3.

Tableau 3 – Liste des paramètres d'évaluation de coexistence

Nom du paramètre	Symbole	Unité	Type de données
Débit de données	T_D	bit/s	REAL_MEASURE_TYPE
Disponibilité de communication			
Facteur de pertes de messages	MLR	%	REAL_MEASURE_TYPE
Nombre de messages perdus successifs	N_{SML}	.	INT_TYPE
Durée de transmission	t_{TT}	s	REAL_MEASURE_TYPE
Temps d'actualisation	t_{UT}	s	REAL_MEASURE_TYPE
Temps de réponse	t_{RT}	s	REAL_MEASURE_TYPE

Les spécifications des paramètres sont fournies dans l'IEC 62657-2.

7 Paramètre de contrôle de coexistence

7.1 Généralités

Les valeurs des paramètres caractéristiques sont influencées par plusieurs paramètres. C'est la raison pour laquelle il est important de contrôler et de gérer les paramètres et leurs valeurs. Le premier ensemble de paramètres influents est lié à l'application. Il s'agit, par exemple, de la charge de communication. Un autre ensemble de paramètres influents est lié aux appareils de radiocommunication (bande de fréquences ou puissance de transmission, par exemple). Les paramètres influents pertinents pour la gestion et le contrôle de l'utilisation du support et de la coexistence sont répertoriés et déclarés en 7.2 et 7.3.

Le présent document décrit les paramètres généraux de gestion de la coexistence. En fonction de la technologie de radiocommunication spécifique, des paramètres d'allocation de ressources particuliers peuvent être disponibles (paramètres de routage d'un réseau maillé, par exemple). D'autres paramètres particuliers sont disponibles compte tenu de l'évolution des technologies de radiocommunication (les paramètres d'attribution de blocs de ressources fréquence-temps ou de formation de faisceau des types d'antennes intelligentes, par exemple).

NOTE Les outils prenant en charge le CCP peuvent également reposer sur les définitions de données de catalogue et les spécifications de la série IEC 61360 et sur la base de données, appelée dictionnaire de données communes (CDD de l'IEC), contenant les classes et propriétés de la série IEC 62657. L'Annexe B donne une vue d'ensemble des processus par lesquels le contenu du CDD de l'IEC peut être intégré et utilisé dans une application. L'Annexe C donne des modèles servant de base à l'intégration dans le CDD de l'IEC des paramètres utilisés dans les services du présent document.

7.2 Paramètre d'application

Le CCP peut contrôler les paramètres d'application pour le contrôle de coexistence répertoriés dans le Tableau 4. En particulier dans le contexte de la fabrication intelligente, il existe une possibilité d'utiliser de manière efficace les ressources de communication conformément aux exigences de souplesse de modification de l'application.

Tableau 4 – Liste des paramètres d'application pour le contrôle de coexistence

Nom du paramètre	Symbole	Unité	Type de données	Description
Charge de communication	A_{CL}	bit/s	REAL_MEASURE_TYPE	Charge de communication par liaison de communication
Initiation de la transmission de données	A_{IDT}	-	ENUM_STRING_TYPE	Type d'initiations de transmission de données pour chaque appareil d'automatisation pour liaison de communication
Longueur des données utilisateur par intervalle de transfert	A_{LUD}	octet	INT_TYPE	Longueur des données utilisateur de chaque appareil d'automatisation pour liaison de communication
Intervalle de transfert	A_{TI}	s	LEVEL(MAX) de REAL_MEASURE_TYPE	Intervalle de transfert pour chaque appareil d'automatisation pour liaison de communication

Les spécifications des paramètres sont fournies dans l'IEC 62657-2.

7.3 Paramètre de radiocommunication

Le CCP peut contrôler les paramètres de radiocommunication pour le contrôle de coexistence répertoriés dans le Tableau 5.

Tableau 5 – Liste des paramètres de radiocommunication pour le contrôle de coexistence

Nom du paramètre	Symbole	Unité	Type de données	Description
Bande de fréquences				
Fréquence de coupure inférieure	f_{BL}	Hz	REAL_MEASURE_TYPE	Fréquence de coupure inférieure de la bande de fréquences
Fréquence de coupure supérieure	f_{BU}	Hz	REAL_MEASURE_TYPE	Fréquence de coupure supérieure de la bande de fréquences
Canal de fréquences				
Fréquence centrale	f_c	Hz	REAL_MEASURE_TYPE	Fréquence centrale du canal de fréquences
Largeur de bande	BW	Hz	REAL_MEASURE_TYPE	Largeur de bande du canal de fréquences
Fréquence de coupure inférieure	f_{CL}	Hz	REAL_MEASURE_TYPE	Fréquence de coupure inférieure du canal de fréquence
Fréquence de coupure supérieure	f_{CU}	Hz	REAL_MEASURE_TYPE	Fréquence de coupure supérieure du canal de fréquences
Type d'identification de canal radioélectrique	Ch		ENUM_STRING_TYPE	Numéro de canal radioélectrique ou identification du canal de fréquences
Densité spectrale de puissance	DSP	dBm/Hz	REAL_MEASURE_TYPE	DSP du canal de fréquences
Nombre de canaux de saut de fréquence	N_{HC}	-	INT_TYPE	Nombre de canaux de fréquences pour le saut de fréquence
Temps de tenue	t_{dwell}	s	LEVEL(MAX) REAL_MEASURE_TYPE	Période de saut de fréquence
Canal de fréquences opérationnel				
Type d'identification de canal de fréquences			ENUM_STRING_TYPE	Fréquence centrale des canaux de fréquences pour fonctionnement
Liste de fréquences bloquées				
Type d'identification de canal de fréquences			ENUM_STRING_TYPE	Fréquence centrale des canaux de fréquences bloqués

Nom du paramètre	Symbole	Unité	Type de données	Description
Puissance transmise				
Puissance isotrope rayonnée équivalente	PIRE	W	REAL_MEASURE_TYPE	PIRE de l'appareil de radiocommunication
Puissance apparente rayonnée	PAR	W	REAL_MEASURE_TYPE	PAR de l'appareil de radiocommunication
Puissance de sortie de l'émetteur	P_{out}	W	REAL_MEASURE_TYPE	Puissance de sortie de transmission de l'appareil de radiocommunication
Temps d'occupation du canal				
Cycle de service	DC	%	LEVEL(MAX)REAL_MEASURE_TYPE	Cycle de service par liaison de communication
Séquence d'émetteur	t_{seq}	s	LEVEL(MAX)REAL_MEASURE_TYPE	Séquence d'émetteur par appareil sans fil
Nombre maximal de retransmissions	N_{RT}	-	LEVEL(MAX)INT_MEASURE_TYPE	Nombre maximal de retransmissions par appareil sans fil
Mécanismes d'adaptabilité			ENUM_STRING_TYPE	Mécanismes d'adaptabilité par système sans fil
CCP	-	-	Char	Un élément des systèmes centraux commande l'utilisation du support.
DAA	-	-	Char	Si le canal est occupé, changer de canal (AFH, par exemple).
DAR	-	-	Char	Si le canal est occupé, réduire la puissance de sortie.
DAS	-	-	Char	Si le canal est occupé, ne pas émettre (accès multiple avec écoute de porteuse, par exemple). Un terme équivalent peut être "Évaluation de canal libre", mais il s'agit d'une condition préalable.

Les spécifications des paramètres sont fournies dans l'IEC 62657-2.

8 Services de gestion et de contrôle

8.1 Généralités

Le nom de primitive défini sur le SAP est composé de trois champs: SAP, Fonction et Fonctionnement:

a) SAP

- C-SAP: SAP de plan de contrôle;
- M-SAP: SAP de plan de gestion;

b) Fonction

- Gestion des exigences de communication d'application;
- Abonnement au système et aux appareils de communication sans fil;
- Configuration et contrôle du système et des appareils de communication sans fil;
- Gestion des ressources du support;
- Accès à la base de données;

c) Fonctionnement

- REQ – Demande;
- RSP – Réponse au message REQ;
- CONF – Confirmation;
- IND – Notification d'événement.

Le CCP, les applications de communication sans fil gérées par CCP (CMWCA) et les appareils sans fil gérés par CCP (CMWD), le SSN et la base de données peuvent envoyer ces primitives selon le comportement fonctionnel pour M-SAP et C-SAP.

- Une primitive de service de type REQ est utilisée à chaque fois qu'une réponse à la primitive est demandée. En présence d'un message REQ, celui-ci est en général mappé à un REQ sur C-SAP/M-SAP.
- Une primitive de service de type RSP est utilisée en réponse à la primitive REQ. De plus, en présence d'un message RSP, celui-ci est en général mappé à un RSP sur C-SAP/M-SAP.
- Une primitive de service de type IND est utilisée au niveau de C-SAP ou de M-SAP pour la notification d'événement si une réponse à la primitive n'est pas demandée, et si la primitive n'est pas envoyée en réponse à une primitive REQ.

L'utilisation particulière de ces types d'opérations pour les fonctions de contrôle et de gestion respectives est spécifiée du 8.2 au 8.6.

8.2 Service de gestion des exigences de communication d'application

8.2.1 Services pris en charge

Le présent 8.2 contient la définition des services qui sont uniques à ce service de gestion des exigences de communication d'application (ACRM). Les services définis pour ACRM sont les suivants:

- GetGeneralPlantCharacteristic, voir 8.2.2;
- SetGeneralPlantCharacteristic, voir 8.2.3;
- GetApplicationCommunicationRequirements, voir 8.2.4;
- GetApplicationCommunicationStatus, voir 8.2.5;
- SetApplicationCommunicationReport, voir 8.2.6 et
- NotificationApplicationCommunicationstatus, voir 8.2.7.

8.2.2 GetGeneralPlantCharacteristic

8.2.2.1 Vue d'ensemble du service

Le service GetGeneralPlantCharacteristic est un service confirmé et utilise le M-SAP. Le CCP envoie les tentatives de demande de service GetGeneralPlantCharacteristic à la base de données. Le flux de primitives du service GetGeneralPlantCharacteristic est représenté à la Figure 12. Il convient de compléter la mise en œuvre de l'ingénierie et de la base de données existantes par un module logiciel pour ce service.

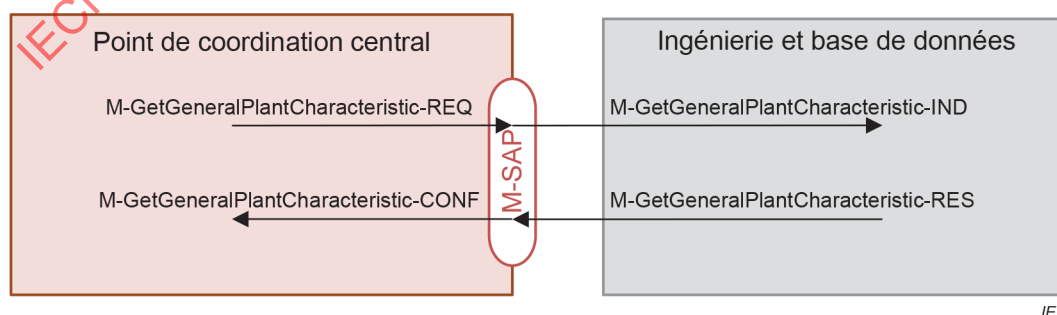


Figure 12 – Flux de primitives de GetGeneralPlantCharacteristic

8.2.2.2 Primitives de service

Les paramètres de service de GetGeneralPlantCharacteristic sont indiqués dans le Tableau 6.

Tableau 6 – Paramètres de service GetGeneralPlantCharacteristic

Nom du paramètre	Request	Indication	Response	Confirm
Argument				
Adresse de destination	M	M(=)		
Result (+)			S	S(=)
Adresse CCP			M	M(=)
Données d'attribut			M	M(=)
Règlements régionaux des radiocommunications			M	M(=)
Plan d'extension future			M	M(=)
Zone de fonctionnement			M	M(=)
Mouvement des objets			M	M(=)
Dimensions géographiques de l'installation			M	M(=)
Conditions environnementales naturelles			M	M(=)
Intervisibilité			U	U(=)
Bande de fréquences			M	M(=)
Densité de solutions de communication sans fil			M	M(=)
Type de brouillage			M	M(=)
Restrictions imposées par les voisins de l'installation			M	M(=)
Result (-)			S	S(=)
Statut du service			M	M(=)

Argument

L'argument contient les paramètres de la demande de service.

Adresse de destination

Ce paramètre spécifie l'adresse de destination à laquelle la demande de service doit être envoyée.

Result (+)

Ce paramètre de type de sélection indique que la demande de service a abouti.

Adresse CCP

Ce paramètre spécifie l'adresse du CCP demandé. Il est présent dans la primitive de réponse.

Données d'attribut

Ce paramètre renvoie un flux d'informations contenant la totalité des attributs.

- règlements régionaux des radiocommunications;
- plan d'extension future;
- zone de fonctionnement;
- mouvement des objets;
- dimensions géographiques de l'installation;
- conditions environnementales naturelles;
- intervisibilité;
- bande de fréquences;
- densité de solutions de communication sans fil;
- type de brouillage;
- restrictions imposées par les voisins de l'installation.

Result (-)

Ce paramètre de type de sélection indique que la demande de service n'a pas abouti.

Statut du service

Ce paramètre donne des informations relatives au résultat de l'exécution du service. Il doit prendre la valeur ABORTED ou TIMEOUT.

8.2.2.3 Procédure de service

La demande GetGeneralPlantCharacteristic doit envoyer un message à la base de données, qui contient les caractéristiques générales de l'installation du point de vue technique. Lorsque le message arrive à l'appareil cible (base de données), cela doit donner lieu à une indication GetGeneralPlantCharacteristic dans la base de données. En retour, la base de données doit transférer le message vers l'objet cible approprié. Si l'objet répond, la base de données doit transférer la réponse par l'intermédiaire de la primitive de réponse GetGeneralPlantCharacteristic. Lorsque la réponse arrive au CCP à l'origine de la demande, une confirmation GetGeneralPlantCharacteristic doit être renvoyée à l'objet d'application qui a envoyé la demande. L'application fournit les attributs demandés pour la caractérisation de l'installation.

8.2.2.4 Séquence de service

La séquence de service de GetGeneralPlantCharacteristic est représentée à la Figure 13. Sur la figure, Alt désigne une branche conditionnelle de la séquence de service.

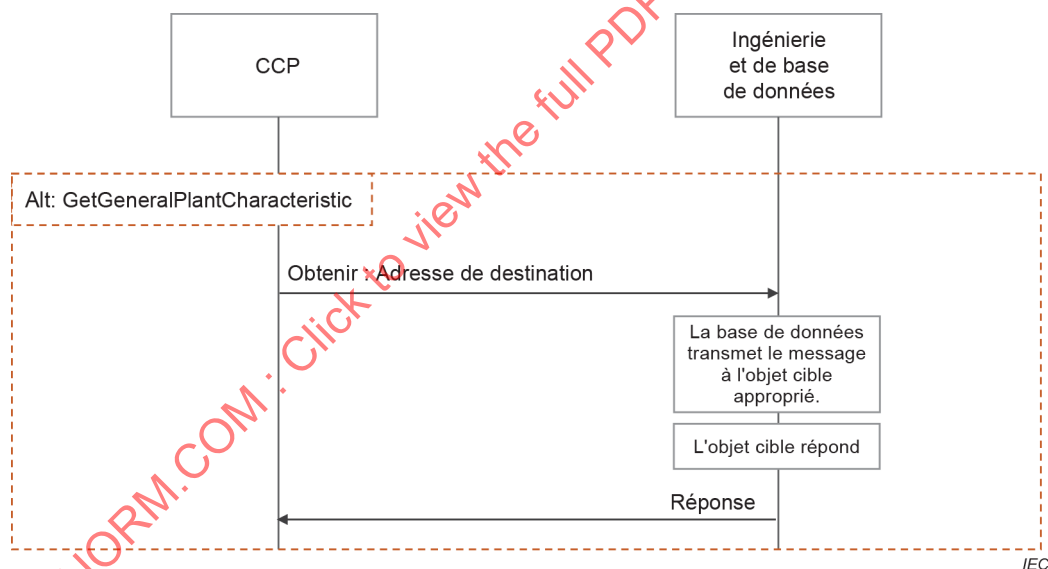


Figure 13 – Diagramme de séquence (GetGeneralPlantCharacteristic)

8.2.2.5 Format de message de service

Le format de message du service GetGeneralPlantCharacteristic doit être conforme au Tableau 7.

Tableau 7 – Format de message du service GetGeneralPlantCharacteristic

Format de message	Explication
<pre> { "Argument": { "Adresse de destination": "02004CAABBDD", "Result (+)": [{ "Adresse CCP": "02004CAABBFF", "Données d'attribut": [{ "Règlements régionaux des radiocommunications": "ETSI EN 300 328", "Plan d'extension future": "phase 3", "Zone de fonctionnement": "dans toute l'usine", "Mouvement des objets": "1600", "Dimensions géographiques de l'installation": "[20, 20, 5]" "Conditions environnementales naturelles": "température, humidité, pression atmosphérique", "Intervisibilité": "los", "Bande de fréquences": "429, 920", "Densité de solutions de communication sans fil": "10", "Type de brouillage": "sources de brouillages électromagnétiques", "Restrictions imposées par les voisins de l'installation": "radiosource à forte puissance" }], } "Result (-)": { "Statut du service": "abandonné", } } </pre>	Paramètres de la demande de service. Adresse de destination à laquelle la demande de service doit être envoyée. La demande de service a abouti. Adresse CCP à laquelle la demande de service doit être envoyée. Règlement relatif aux paramètres de coexistence importants, comme la bande de fréquences et la puissance de sortie, en fonction de la région dans laquelle il est prévu d'utiliser l'application sans fil. Installation possible de nouvelles solutions de communication sans fil et construction de nouveaux bâtiments qui peuvent avoir une incidence sur la coexistence. Propriétés distinctives de la zone dans laquelle le système de communication sans fil est en fonctionnement. Spécification de la trajectoire des biens mobiles qui peuvent avoir une influence significative sur les conditions de propagation radioélectrique. Longueur, largeur et hauteur de l'espace prévu du système sans fil. Condition d'environnement de l'appareil sans fil et du système sans fil. Propriété d'une liaison logique qui décrit une possible influence sur la propagation du signal radiofréquence par obstruction, réfraction ou réflexion. Rapport entre le nombre de solutions de communication sans fil et la couverture spatiale de l'installation. Type d'énergie indésirable causé par une certaine source ou application. Description des voisins de l'installation susceptibles d'imposer des limites à la communication sans fil. La demande de service n'a pas abouti. Informations relatives au résultat de l'exécution du service.

8.2.3 SetGeneralPlantCharacteristic

8.2.3.1 Vue d'ensemble du service

Le service SetGeneralPlantCharacteristic est un service confirmé et utilise le M-SAP. L'utilisateur envoie une demande de service SetGeneralPlantCharacteristic au CCP par l'intermédiaire de l'interface utilisateur. Le flux de primitives du service SetGeneralPlantCharacteristic est décrit à la Figure 14.

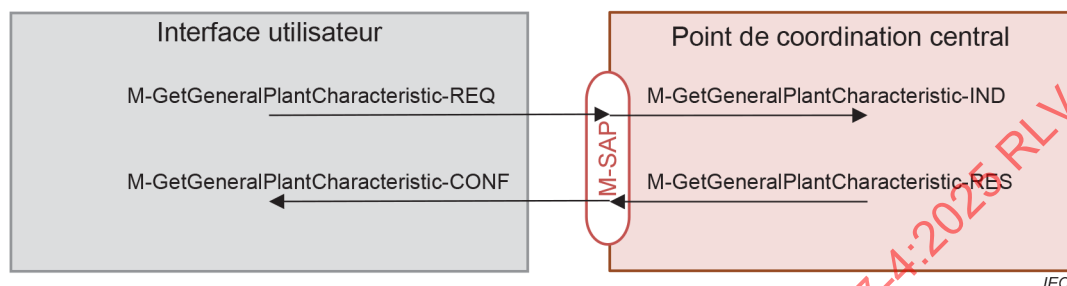


Figure 14 – Flux de primitives de SetGeneralPlantCharacteristic

8.2.3.2 Primitives de service

Les paramètres de service de SetGeneralPlantCharacteristic sont indiqués dans le Tableau 8.

Tableau 8 – Paramètres de service SetGeneralPlantCharacteristic

Nom du paramètre	Request	Indication	Response	Confirm
Argument				
Adresse de destination	M	M(=)		
Données d'attribut			M	M(=)
Règlements régionaux des radiocommunications			M	M(=)
Plan d'extension future			M	M(=)
Zone de fonctionnement			M	M(=)
Mouvement des objets			M	M(=)
Dimensions géographiques de l'installation			M	M(=)
Conditions environnementales naturelles			M	M(=)
Intervisibilité			U	U(=)
Bande de fréquences			M	M(=)
Densité de solutions de communication sans fil			M	M(=)
Type de brouillage			M	M(=)
Restrictions imposées par les voisins de l'installation			M	M(=)
Result (+)			S	S(=)
			-	-
Result (-)			S	S(=)
Statut du service			M	M(=)

Argument

L'argument contient les paramètres de la demande de service.

Adresse de destination

Ce paramètre spécifie l'adresse de destination à laquelle la demande de service doit être envoyée.

Données d'attribut

Ce paramètre renvoie un flux d'informations contenant la totalité des attributs.

- règlements régionaux des radiocommunications;
- plan d'extension future;
- zone de fonctionnement;
- mouvement des objets;
- dimensions géographiques de l'installation;
- conditions environnementales naturelles;
- intervisibilité;
- bande de fréquences;
- densité de solutions de communication sans fil;
- type de brouillage;
- restrictions imposées par les voisins de l'installation.

Result (+)

Ce paramètre de type de sélection indique que la demande de service a abouti.

Result (-)

Ce paramètre de type de sélection indique que la demande de service n'a pas abouti.

Statut du service

Ce paramètre donne des informations relatives au résultat de l'exécution du service. Il doit prendre la valeur ABORTED ou TIMEOUT.

8.2.3.3 Procédure de service

La demande SetGeneralPlantCharacteristic doit envoyer un message au CCP, qui contient les caractéristiques générales de l'installation du point de vue technique. Lorsque le message arrive à l'appareil cible (CCP), cela doit donner lieu à une indication SetGeneralPlantCharacteristic au niveau du CCP. En retour, le CCP doit transférer le message vers l'objet cible approprié. Si l'objet répond, le CCP doit transférer la réponse par l'intermédiaire de la primitive de réponse SetGeneralPlantCharacteristic. Lorsque la réponse arrive à l'interface utilisateur à l'origine de la demande, une confirmation SetGeneralPlantCharacteristic doit être renvoyée à l'objet d'application qui a envoyé la demande.

8.2.3.4 Séquence de service

La séquence de service de SetGeneralPlantCharacteristic est représentée à la Figure 15.

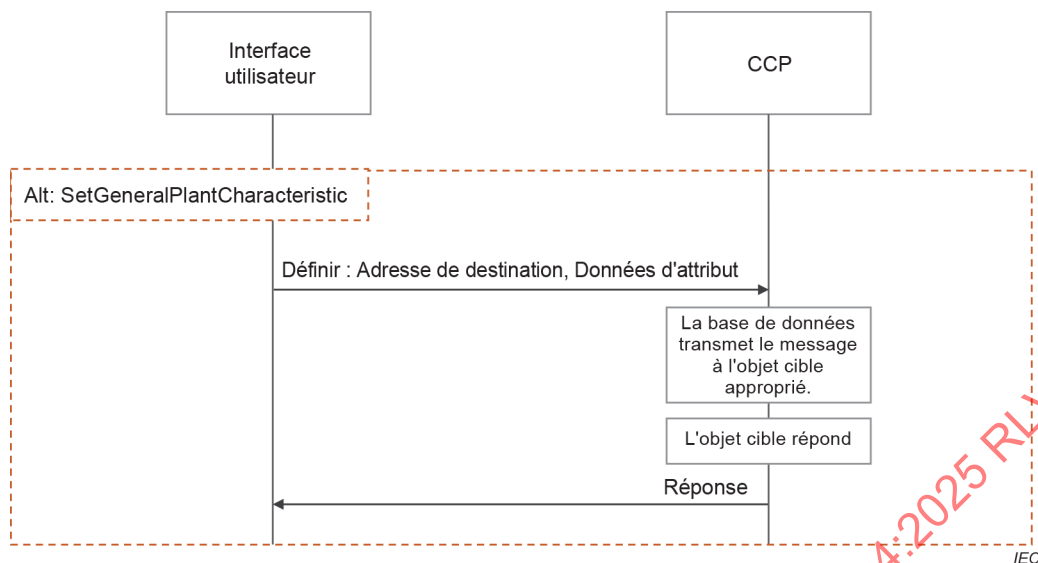


Figure 15 – Diagramme de séquence (SetGeneralPlantCharacteristic)

8.2.3.5 Format de message de service

Le format de message du service SetGeneralPlantCharacteristic doit être conforme au Tableau 9.

Tableau 9 – Format de message du service SetGeneralPlantCharacteristic

Format de message	Explication
<pre> { "Argument": [{ "Adresse de destination": "02004CAABDD", "Données d'attribut": [{ "Règlements régionaux des radiocommunications": "xxxxxx", "Plan d'extension future": "ETSI EN 300 328", "Zone de fonctionnement": "dans toute l'usine", "Mouvement des objets": "1600", "Dimensions géographiques de l'installation": "[20, 20, 5]" "Conditions environnementales naturelles": "température, humidité, pression atmosphérique", "Intervisibilité": "los", "Bande de fréquences": "429, 920", "Densité de solutions de communication sans fil": "10", "Type de brouillage": "sources de brouillages électromagnétiques", "Restrictions imposées par les voisins de l'installation": "radiosource à forte puissance" }], }], "Result (+)": "Result (-)": { "Statut du service": "abandonné", }, } </pre>	Paramètres de la demande de service. Adresse de destination à laquelle la demande de service doit être envoyée. Règlement relatif aux paramètres de coexistence importants, comme la bande de fréquences et la puissance de sortie, en fonction de la région dans laquelle il est prévu d'utiliser l'application sans fil. Installation possible de nouvelles solutions de communication sans fil et construction de nouveaux bâtiments qui peuvent avoir une incidence sur la coexistence. Propriétés distinctives de la zone dans laquelle le système de communication sans fil est en fonctionnement. Spécification de la trajectoire des biens mobiles qui peuvent avoir une influence significative sur les conditions de propagation radioélectrique. Longueur, largeur et hauteur de l'espace prévu du système sans fil. Condition d'environnement de l'appareil sans fil et du système sans fil. Propriété d'une liaison logique qui décrit une possible influence sur la propagation du signal radiofréquence par obstruction, réfraction ou réflexion. Rapport entre le nombre de solutions de communication sans fil et la couverture spatiale de l'installation. Type d'énergie indésirable causé par une certaine source ou application. Description des voisins de l'installation susceptibles d'imposer des limites à la communication sans fil. La demande de service a abouti. La demande de service n'a pas abouti. Informations relatives au résultat de l'exécution du service.

8.2.4 GetApplicationCommunicationRequirements

8.2.4.1 Vue d'ensemble du service

Le service GetApplicationCommunicationRequirements est un service confirmé et utilise le M-SAP. Le CCP envoie une demande de service GetApplicationCommunicationRequirements à l'application d'automatisation. Le flux de primitives du service GetApplicationCommunicationRequirements est décrit à la Figure 16. Il convient de compléter la mise en œuvre de l'application existante par un module logiciel pour ce service.

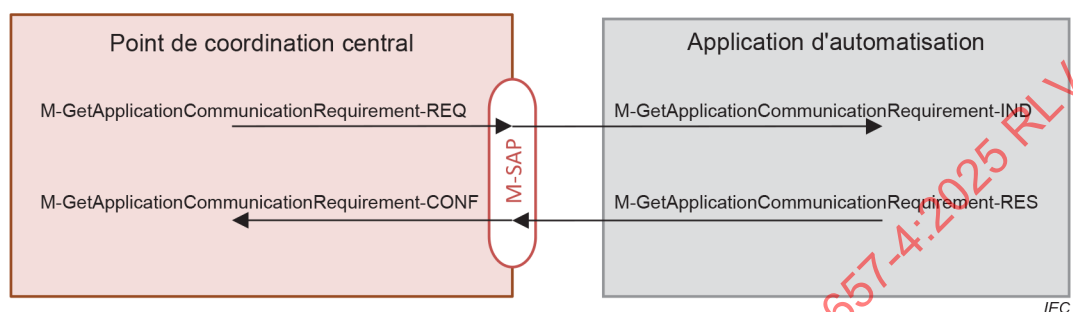


Figure 16 – Flux de primitives de GetApplicationCommunicationRequirements

8.2.4.2 Primitives de service

Les paramètres de service de GetApplicationCommunicationRequirements sont indiqués dans le Tableau 10.

Tableau 10 – Paramètres de service GetApplicationCommunicationRequirements

Nom du paramètre	Request	Indication	Response	Confirm
Argument				
Adresse de destination	M	M(=)		
ID de liaison de communication	M	M(=)		
Result (+)			S	S(=)
Adresse CCP			M	M(=)
ID de liaison de communication			M	M(=)
Type de paramètre de performance			M	M(=)
Limites du paramètre de performance			M	M(=)
Result (-)			S	S(=)
Statut du service			M	M(=)

Argument

L'argument contient les paramètres de la demande de service.

Adresse de destination

Ce paramètre spécifie l'adresse de destination à laquelle la demande de service doit être envoyée. Selon l'adresse de destination, les valeurs d'une liaison logique ou les valeurs moyennes d'un appareil sont fournies.

ID de liaison de communication

Ce paramètre spécifie l'identifiant de la liaison de communication. Il est présent dans la primitive de demande et dans la primitive de réponse.

Result (+)

Ce paramètre de type de sélection indique que la demande de service a abouti.

Adresse CCP

Ce paramètre spécifie l'adresse du CCP demandé. Il est présent dans la primitive de réponse.

ID de liaison de communication

Ce paramètre spécifie l'identifiant de la liaison de communication. Il est présent dans la primitive de réponse.

Type de paramètre de performance

Ce paramètre spécifie le type de paramètre de performance associé à l'ID de liaison de communication:

- 1: Durée de transmission
- 2: Temps d'actualisation
- 3: Temps de réponse
- 4: Débit de données
- 5: Disponibilité de communication

Il est présent dans la primitive de réponse.

Limites du paramètre de performance

Ce paramètre spécifie la valeur limite d'un paramètre de performance. Il est présent dans la primitive de réponse.

Result (-)

Ce paramètre de type de sélection indique que la demande de service n'a pas abouti.

Statut du service

Ce paramètre donne des informations relatives au résultat de l'exécution du service. Il doit prendre la valeur ABORTED ou TIMEOUT.

8.2.4.3 Procédure de service

La demande `GetApplicationCommunicationRequirements` doit envoyer un message à l'application d'automatisation, qui contient l'ID de liaison de communication demandé. Lorsque le message arrive à l'appareil cible (application d'automatisation), cela doit donner lieu à une indication `GetApplicationCommunicationRequirements` au niveau de l'application d'automatisation. En retour, l'application d'automatisation doit transférer le message vers l'objet cible approprié. Si l'objet répond, l'application d'automatisation doit transférer la réponse par l'intermédiaire de la primitive de réponse `GetApplicationCommunicationRequirements`. Lorsque la réponse arrive au CCP à l'origine de la demande, une confirmation `GetApplicationCommunicationRequirements` doit être renvoyée à l'objet qui a envoyé la demande.

8.2.4.4 Séquence de service

La séquence de service de `GetApplicationCommunicationRequirements` est représentée à la Figure 17.

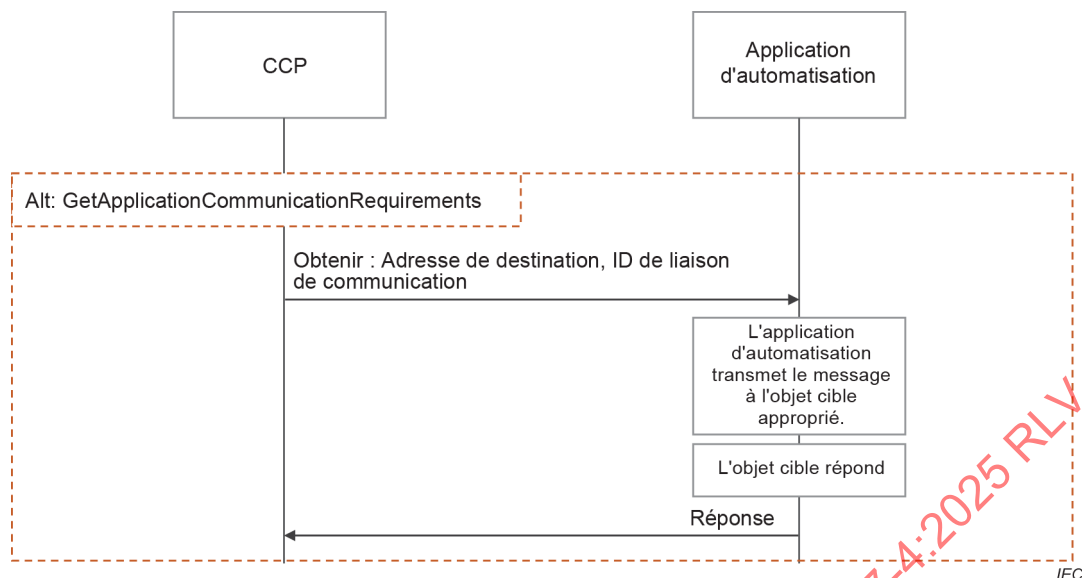


Figure 17 – Diagramme de séquence (GetApplicationCommunicationRequirements)

8.2.4.5 Format de message de service

Le format de message du service `GetApplicationCommunicationRequirements` doit être conforme au Tableau 11.

**Tableau 11 – Format de message du service
GetApplicationCommunicationRequirements**

Format de message	Explication
<pre>{ "Argument": [{ "Adresse de destination": "02004CAABBDD", "ID de liaison de communication": "1000" }] "Result (+)": [{ "Adresse CCP": "02004CAABBFF", "ID de liaison de communication": "1000", "Type de paramètre de performance": 1, "Limites du paramètre de performance": 0.015 }] "Result (-)": { "Statut du service": "abandonné", } }</pre>	Paramètres de la demande de service. Adresse de destination à laquelle la demande de service doit être envoyée. Identifiant de la liaison de communication. La demande de service a abouti. Adresse CCP à laquelle la demande de service doit être envoyée. Identifiant de la liaison de communication. Type de paramètre de performance associé à l'ID de liaison de communication. Valeur limite d'un paramètre de performance. La demande de service n'a pas abouti. Informations relatives au résultat de l'exécution du service.

8.2.5 GetApplicationCommunicationStatus

8.2.5.1 Vue d'ensemble du service

Le service GetApplicationCommunicationStatus est un service confirmé et utilise le M-SAP. Le CCP envoie une demande de service GetApplicationCommunicationStatus à l'application d'automatisation. Le flux de primitives du service GetApplicationCommunicationStatus est décrit à la Figure 18. Il convient de compléter la mise en œuvre de l'application existante par un module logiciel pour ce service.

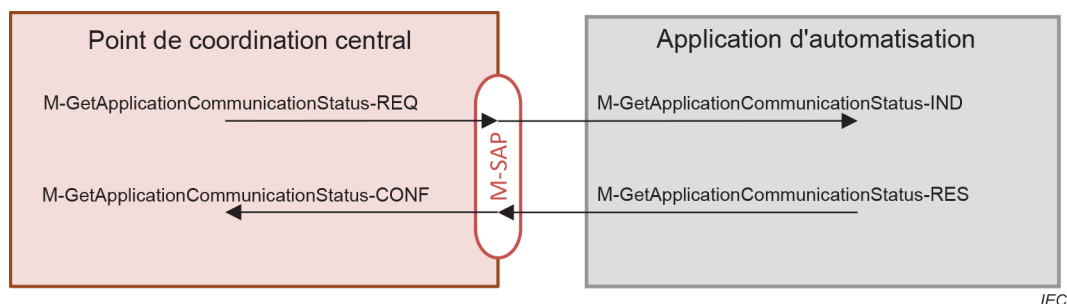


Figure 18 – Flux de primitives de GetApplicationCommunicationStatus

8.2.5.2 Primitives de service

Les paramètres de service de GetApplicationCommunicationStatus sont indiqués dans le Tableau 12.

Tableau 12 – Paramètres de service GetApplicationCommunicationStatus

Nom du paramètre	Request	Indication	Response	Confirm
Argument				
Adresse de destination	M	M(=)		
ID de liaison de communication	M	M(=)		
Result (+)			S	S(=)
Adresse CCP			M	M(=)
ID de liaison de communication			M	M(=)
Type de paramètre de performance			M	M(=)
Valeurs statistiques du paramètre			M	M(=)
Result (-)			S	S(=)
Statut du service			M	M(=)

Argument

L'argument contient les paramètres de la demande de service.

Adresse de destination

Ce paramètre spécifie l'adresse de destination à laquelle la demande de service doit être envoyée. Selon l'adresse de destination, les valeurs d'une liaison logique ou les valeurs moyennes d'un appareil sont fournies.

ID de liaison de communication

Ce paramètre spécifie l'identifiant de la liaison de communication. Il est présent dans la primitive de demande et dans la primitive de réponse.

Result (+)

Ce paramètre de type de sélection indique que la demande de service a abouti.

Adresse CCP

Ce paramètre spécifie l'adresse du CCP demandé. Il est présent dans la primitive de réponse.

ID de liaison de communication

Ce paramètre spécifie l'identifiant de la liaison de communication. Il est présent dans la primitive de réponse.

Type de paramètre de performance

Ce paramètre spécifie le type de paramètre de performance associé à l'ID de liaison de communication:

- 1: Durée de transmission
- 2: Temps d'actualisation
- 3: Temps de réponse
- 4: Débit de données
- 5: Disponibilité de communication

Il est présent dans la primitive de réponse.

Valeurs statistiques du paramètre

Ce paramètre spécifie les valeurs statistiques du paramètre de performance. Il est présent dans la primitive de réponse.

Result (-)

Ce paramètre de type de sélection indique que la demande de service n'a pas abouti.

Statut du service

Ce paramètre donne des informations relatives au résultat de l'exécution du service. Il doit prendre la valeur ABORTED ou TIMEOUT.

8.2.5.3 Procédure de service

La demande GetApplicationCommunicationStatus doit envoyer un message à l'application d'automatisation, qui contient l'ID de liaison de communication demandé. Lorsque le message arrive à l'appareil cible (application d'automatisation), cela doit donner lieu à une indication GetApplicationCommunicationStatus au niveau de l'application d'automatisation. En retour, l'application d'automatisation doit transférer le message vers l'objet cible approprié. Si l'objet répond, l'application d'automatisation doit transférer la réponse par l'intermédiaire de la primitive de réponse GetApplicationCommunicationStatus. Lorsque la réponse arrive au CCP à l'origine de la demande, une confirmation GetApplicationCommunicationStatus doit être renvoyée à l'objet qui a envoyé la demande.

8.2.5.4 Séquence de service

La séquence de service de GetApplicationCommunicationStatus est représentée à la Figure 19.

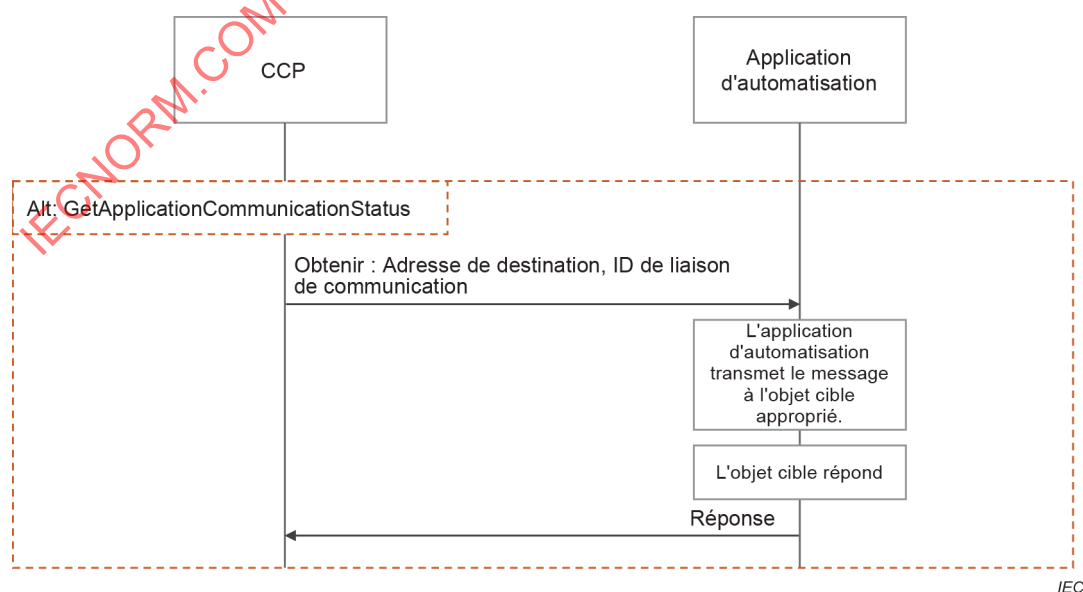


Figure 19 – Diagramme de séquence (GetApplicationCommunicationStatus)

8.2.5.5 Format de message de service

Le format de message du service GetApplicationCommunicationStatus doit être conforme au Tableau 13.

Tableau 13 – Format de message du service GetApplicationCommunicationStatus

Format de message	Explication
<pre>{ "Argument": [{ "Adresse de destination": "02004CAABBDD", "ID de liaison de communication": "1000" }] "Result (+)": [{ "Adresse CCP": "02004CAABBFF", "ID de liaison de communication": "1000", "Type de paramètre de performance": 1, "Valeurs statistiques du paramètre": 0.8 }] "Result (-)": { "Statut du service": "abandonné", } }</pre>	Paramètres de la demande de service. Adresse de destination à laquelle la demande de service doit être envoyée. Identifiant de la liaison de communication. La demande de service a abouti. Adresse CCP à laquelle la demande de service doit être envoyée. Identifiant de la liaison de communication. Type de paramètre de performance associé à l'ID de liaison de communication. Valeurs statistiques du paramètre de performance. La demande de service n'a pas abouti. Informations relatives au résultat de l'exécution du service.

8.2.6 SetApplicationCommunicationReport

8.2.6.1 Vue d'ensemble du service

Le service SetApplicationCommunicationReport utilise un ensemble de primitives de définition périodique ou événementielle des procédures de rapports de ressources de gestion au niveau de l'application d'automatisation.

Le service SetApplicationCommunicationReport est un service confirmé et utilise le M-SAP.

Le CCP envoie les tentatives de demande de service SetApplicationCommunicationReport à l'application d'automatisation.

Le flux de primitives du service SetApplicationCommunicationReport est décrit à la Figure 20.

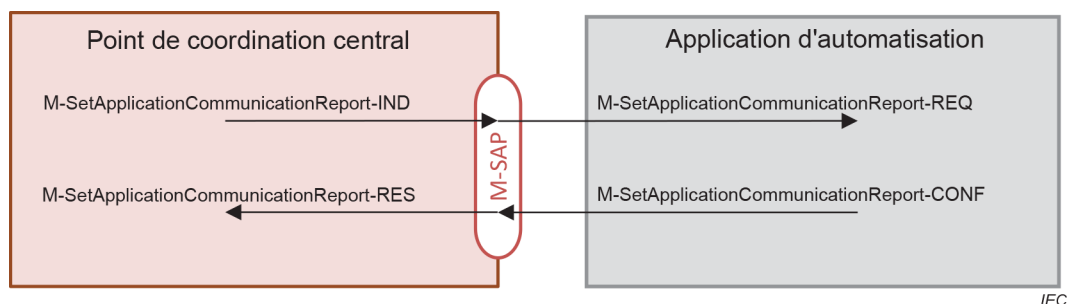


Figure 20 – Flux de primitives de SetApplicationCommunicationReport

8.2.6.2 Primitives de service

Les paramètres de service de SetApplicationCommunicationReport sont indiqués dans le Tableau 14.

Tableau 14 – Paramètres de service SetApplicationCommunicationReport

Nom du paramètre	Request	Indication	Response	Confirm
Argument				
Adresse de destination	M	M(=)		
Type de rapport de performance	M	M(=)		
Intervalle de rapport	M	M(=)		
Intervalle d'évaluation	M	M(=)		
Result (+)			S	S(=)
Adresse CCP			M	M(=)
ID de l'entité d'évaluation de performance			M	M(=)
Result (-)			S	S(=)
Statut du service			M	M(=)

Argument

L'argument contient les paramètres de la demande de service.

Adresse de destination

Ce paramètre spécifie l'adresse de destination à laquelle la demande de service doit être envoyée.

Type de rapport de performance

Ce paramètre spécifie le type de génération de rapport de performance (NotificationApplicationCommunicationstatus). Les types de rapports sont événementiels, cycliques ou demandés. Il est présent dans la primitive de demande.

- 1: Durée de transmission
- 2: Temps d'actualisation
- 3: Temps de réponse
- 4: Débit de données
- 5: Disponibilité de communication

Intervalle de rapport

Ce paramètre spécifie l'intervalle entre les rapports cycliques, si le type de rapport de performance est cyclique.

Intervalle d'évaluation

Ce paramètre spécifie l'intervalle entre les processus d'évaluation de performance.

Result (+)

Ce paramètre de type de sélection indique que la demande de service a abouti.

Adresse CCP

Ce paramètre spécifie l'adresse du CCP demandé. Il est présent dans la primitive de réponse.

ID de l'entité d'évaluation de performance

Ce paramètre spécifie l'identifiant de l'ID de l'entité d'évaluation de performance de l'application d'automatisation.

Result (-)

Ce paramètre de type de sélection indique que la demande de service n'a pas abouti.

Statut du service

Ce paramètre donne des informations relatives au résultat de l'exécution du service. Il doit prendre la valeur ABORTED ou TIMEOUT.

8.2.6.3 Procédure de service

Le CCP peut utiliser cette primitive de SetApplicationCommunicationReport au niveau de l'application d'automatisation. La demande SetApplicationCommunicationReport doit envoyer un message à l'application d'automatisation. Lorsque le message arrive à l'application d'automatisation cible, cela doit donner lieu à une indication SetApplicationCommunicationReport au niveau de l'application d'automatisation. L'application d'automatisation doit transférer le message vers les objets cibles appropriés. Si l'objet répond, l'application d'automatisation doit transférer la réponse par l'intermédiaire de la primitive de réponse SetApplicationCommunicationReport. Lorsque la réponse arrive à l'appareil à l'origine de la demande, une confirmation SetApplicationCommunicationReport doit être renvoyée à l'objet d'application qui a envoyé la demande.

8.2.6.4 Séquence de service

La séquence de service de SetApplicationCommunicationStatus est représentée à la Figure 21.

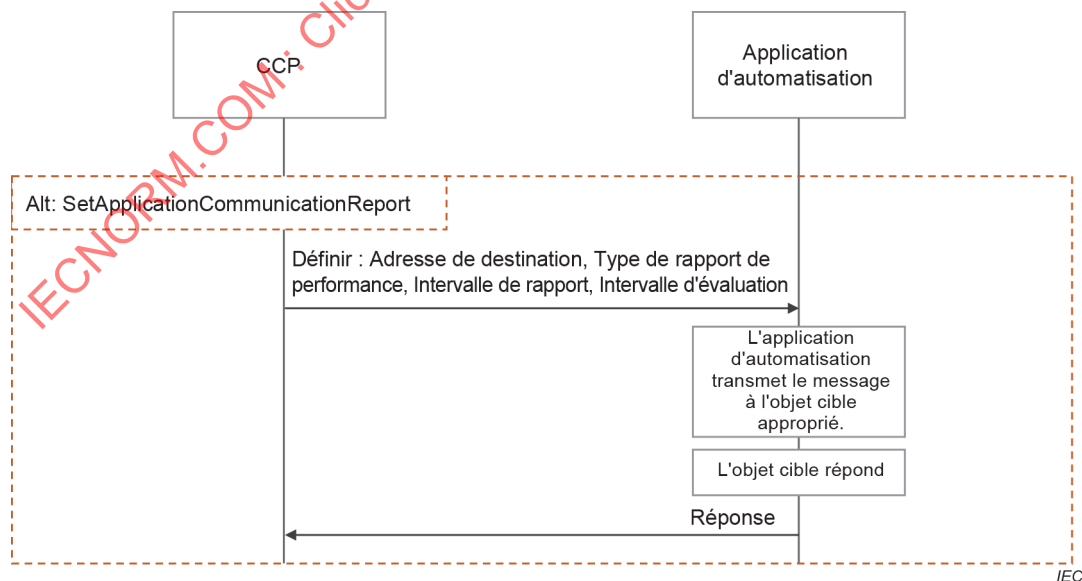


**Figure 21 – Diagramme de séquence
(paramètres de service SetApplicationCommunicationReport)**

8.2.6.5 Format de message de service

Le format de message du service SetApplicationCommunicationStatus doit être conforme au Tableau 15.

Tableau 15 – Format de message du service SetApplicationCommunicationReport

Format de message	Explication
<pre>{ "Argument": [{ "Adresse de destination": "02004CAABBDD", "ID de liaison de communication": "1000" }] "Result (+)": [{ "Adresse CCP": "02004CAABBDD", "ID de l'entité d'évaluation de performance": "A6000", }] "Result (-)": { "Statut du service": "abandonné", } }</pre>	Paramètres de la demande de service. Adresse de destination à laquelle la demande de service doit être envoyée. Identifiant de la liaison de communication. La demande de service a abouti. Adresse CCP à laquelle la demande de service doit être envoyée. Identifiant de l'ID de l'entité d'évaluation de performance de l'application d'automatisation. La demande de service n'a pas abouti. Informations relatives au résultat de l'exécution du service.

8.2.7 NotificationApplicationCommunicationstatus

8.2.7.1 Vue d'ensemble du service

Le service NotificationApplicationCommunicationstatus utilise une primitive pour prendre en charge les rapports d'évaluation de coexistence de l'application d'automatisation au CCP.

Le service NotificationApplicationCommunicationstatus est un service non confirmé et utilise le M-SAP. L'application d'automatisation envoie les tentatives de service ApplicationCommunicationstatus au CCP.

Le flux de primitives du service NotificationApplicationCommunicationstatus est décrit à la Figure 22.

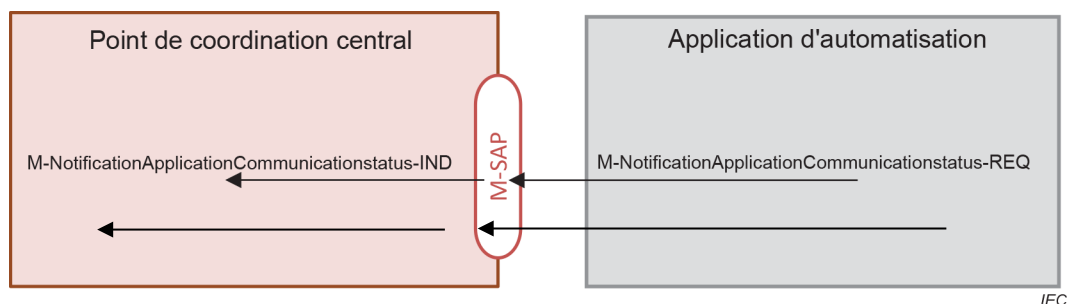


Figure 22 – Flux de primitives de NotificationApplicationCommunicationstatus

8.2.7.2 Primitives de service

Les paramètres de service de NotificationApplicationCommunicationstatus sont indiqués dans le Tableau 16.

Tableau 16 – Paramètres de service NotificationApplicationCommunicationstatus

Nom du paramètre	Request	Indication	Response	Confirm
Argument				
Adresse CCP	M	M(=)		
ID de liaison de communication	M	M(=)		
Données d'attribut	M	M(=)		
Horodatage	M	M(=)		
Type de paramètre de performance	M	M(=)		
Valeurs statistiques du paramètre	M	M(=)		

Argument

L'argument contient les paramètres de la demande de service.

Adresse CCP

Ce paramètre spécifie l'adresse du CCP demandé. Il est présent dans la primitive de réponse.

ID de liaison de communication

Ce paramètre spécifie l'identifiant de la liaison de communication. Il est présent dans la primitive de demande et dans la primitive de réponse.

Données d'attribut

Ce paramètre renvoie un flux d'informations contenant la totalité des attributs.

Horodatage

Informations relatives à la durée des données d'attribut collectées.

Type de paramètre de performance

Ce paramètre spécifie le type de paramètre de performance associé à l'ID de liaison de communication:

- 1: Durée de transmission
- 2: Temps d'actualisation
- 3: Temps de réponse
- 4: Débit de données
- 5: Disponibilité de communication

Valeurs statistiques du paramètre

Ce paramètre spécifie les valeurs statistiques du paramètre de performance.

8.2.7.3 Procédure de service

Le CCP peut configurer le service NotificationApplicationCommunicationstatus avec la primitive du service SetApplicationCommunicationstatus.

La demande NotificationApplicationCommunicationstatus doit envoyer un message de l'application d'automatisation au CCP. Lorsque le message arrive à l'appareil cible (CCP), cela doit donner lieu à une indication NotificationApplicationCommunicationstatus au niveau du CCP. Le CCP doit transférer le message vers l'objet cible approprié.

8.2.7.4 Séquence de service

La séquence de service de NotificationApplicationCommunicationstatus est représentée à la Figure 23.

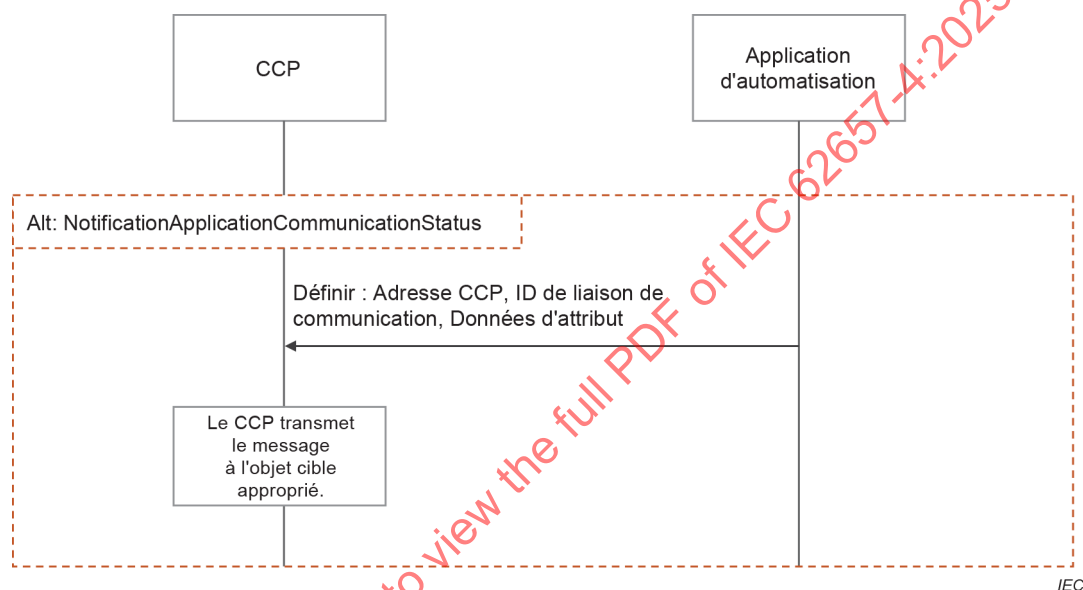


Figure 23 – Diagramme de séquence (NotificationApplicationCommunicationstatus)

8.2.7.5 Format de message de service

Le format de message du service NotificationApplicationCommunicationstatus doit être conforme au Tableau 17.

**Tableau 17 – Format de message du service
NotificationApplicationCommunicationstatus**

Format de message	Explication
<pre>{ "Argument": [{ "Adresse CCP": "02004CAABBDD", "ID de liaison de communication": "1000", "Données d'attribut": [{ "Horodatage": "1569855600", "Type de paramètre de performance": 1, "Valeurs statistiques du paramètre": 0,8, }], }], }</pre>	Paramètres de la demande de service. Adresse CCP à laquelle la demande de service doit être envoyée. Identifiant de la liaison de communication. Informations relatives à la durée des données d'attribut collectées. Type de paramètre de performance associé à l'ID de liaison de communication. Valeurs statistiques du paramètre de performance.

8.3 Service d'abonnement au système et aux appareils de communication sans fil

8.3.1 Services pris en charge

Le présent 8.3 contient la définition des services qui sont uniques à cet abonnement au système et aux appareils de communication sans fil (WCSDS). Les services définis pour WCSDS sont les suivants:

- SubscribeDevice, voir 8.3.2;
- UnsubscribeDevice, voir 8.3.3;
- SubscribeSystem, voir 8.3.4;
- UnsubscribeSystem, voir 8.3.5;
- GetDeviceAttributes, voir 8.3.6.

8.3.2 SubscribeDevice

8.3.2.1 Vue d'ensemble du service

Le service SubscribeDevice est un service confirmé et utilise le M-SAP. Le CMWD envoie les tentatives de demande de service SubscribeDevice au CCP. Le flux de primitives du service SubscribeDevice est décrit à la Figure 24.

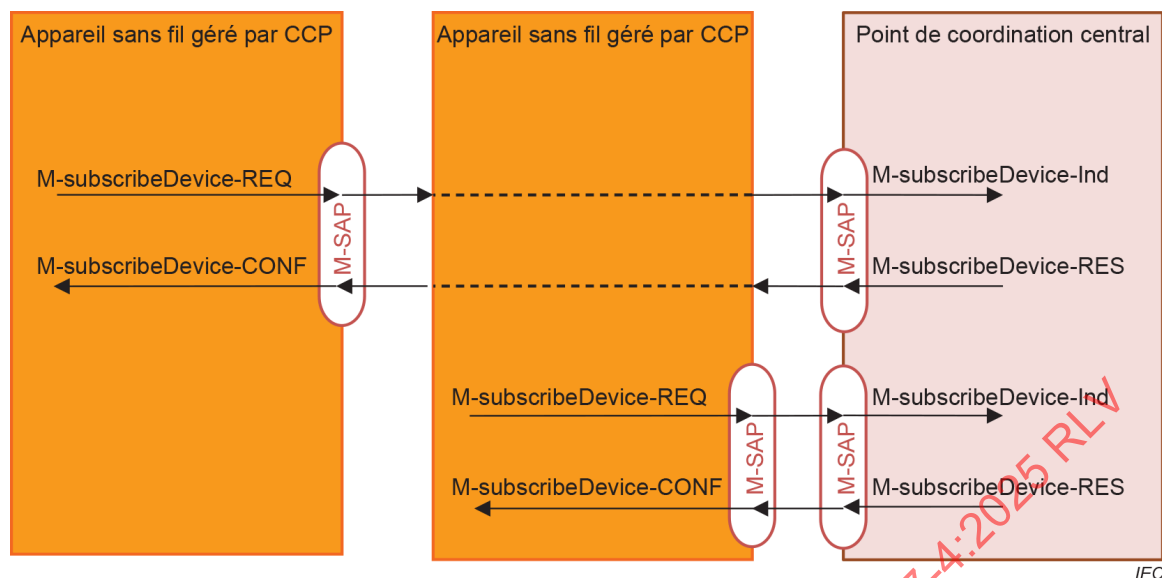


Figure 24 – Flux de primitives de SubscribeDevice

8.3.2.2 Primitives de service

Les paramètres de service de SubscribeDevice sont indiqués dans le Tableau 18.

Tableau 18 – Paramètres de service SubscribeDevice

Nom du paramètre	Request	Indication	Response	Confirm
Argument				
Adresse de destination	M	M(=)		
Type d'appareil	M	M(=)		
Result (+)			S	S(=)
ID de l'appareil			M	M(=)
Statut			M	M(=)
Type d'appareil			M	M(=)
Adresse d'appareil			M	M(=)
Result (-)			S	S(=)
Statut du service			M	M(=)

Argument

L'argument contient les paramètres de la demande de service.

Adresse de destination

Ce paramètre spécifie l'adresse de destination à laquelle la demande de service doit être envoyée.

Type d'appareil

Ce paramètre spécifie le type de l'appareil sans fil demandé. Il est présent dans la primitive de demande.

Result (+)

Ce paramètre de type de sélection indique que la demande de service a abouti.

ID de l'appareil

Ce paramètre spécifie l'identifiant de l'appareil sans fil.

Statut

Ce paramètre spécifie le statut suivant de l'appareil sans fil.

- 0: pas d'adresse
- 1: non configuré
- 2: configuré

Type d'appareil

Ce paramètre spécifie le type d'appareil sans fil. Il est présent dans la primitive de réponse.

Adresse d'appareil

Ce paramètre spécifie l'adresse de l'appareil sans fil demandé. Il est présent dans la primitive de réponse.

Result (-)

Ce paramètre de type de sélection indique que la demande de service n'a pas abouti.

Statut du service

Ce paramètre donne des informations relatives au résultat de l'exécution du service. Il doit prendre la valeur ABORTED ou TIMEOUT.

8.3.2.3 Procédure de service

La demande SubscribeDevice doit envoyer un message au CCP. Lorsque le message arrive à l'appareil cible (CCP), cela doit donner lieu à une indication SubscribeDevice au niveau du CCP. En retour, le CCP doit transférer le message vers l'objet cible approprié. Si l'objet répond, le CCP doit transférer la réponse par l'intermédiaire de la primitive de réponse SubscribeDevice. Lorsque la réponse arrive à l'appareil à l'origine de la demande, une confirmation SubscribeDevice doit être renvoyée à l'objet d'application qui a envoyé la demande.

8.3.2.4 Séquence de service

La séquence de service de SubscribeDevice est représentée à la Figure 25.

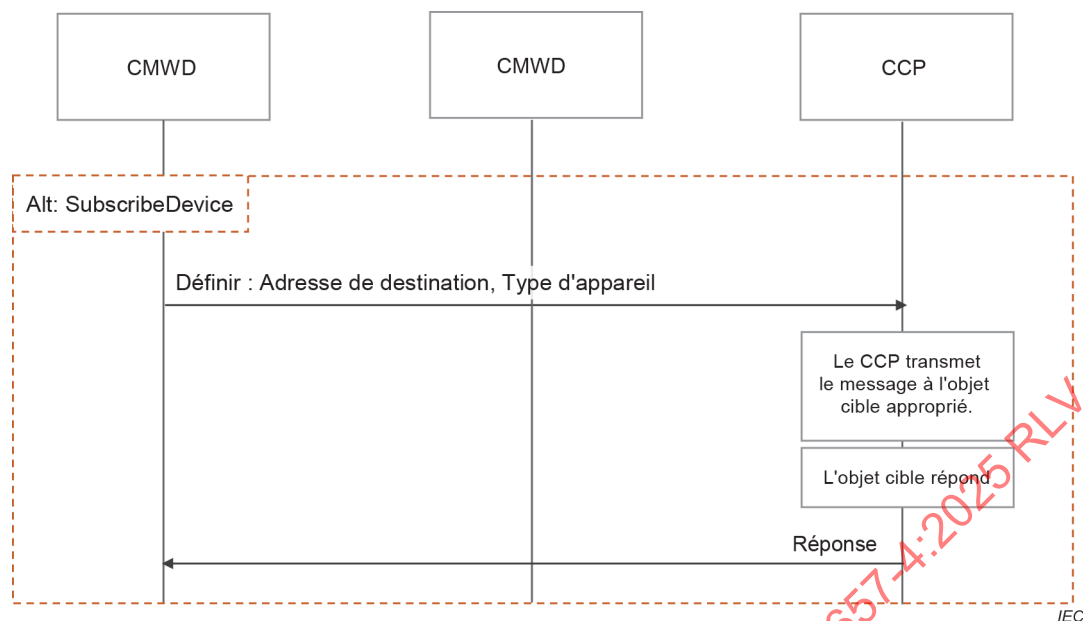


Figure 25 – Diagramme de séquence (SubscribeDevice)

8.3.2.5 Format de message de service

Le format de message du service SubscribeDevice doit être conforme au Tableau 19.

Tableau 19 – Format de message du service SubscribeDevice

Format de message	Explication
<pre> { "Argument": [{ "Adresse de destination": "02004CAABBDD", "Type d'appareil": "ABC 36, entreprise ABC, version 3.0" }] "Result (+)": [{ "ID de l'appareil": "A3000", "Statut": "connexion", "Type d'appareil": "ABC 36, entreprise ABC, version 3.0"; "Adresse d'appareil": "02004CAABBG" }] "Result (-)": { "Statut du service": "abandonné", } } </pre>	Paramètres de la demande de service. Adresse de destination à laquelle la demande de service doit être envoyée. Type de l'appareil sans fil demandé. La demande de service a abouti. Identifiant de l'appareil sans fil. Statut de l'appareil sans fil. Type de l'appareil sans fil. Adresse de l'appareil sans fil demandé. La demande de service n'a pas abouti. Informations relatives au résultat de l'exécution du service.

8.3.3 UnsubscribeDevice

8.3.3.1 Vue d'ensemble du service

Le service UnsubscribeDevice est un service confirmé et utilise le M-SAP. Le CCP envoie les tentatives de demande de service UnsubscribeDevice au CMWD. Le flux de primitives du service UnsubscribeDevice est décrit à la Figure 26.

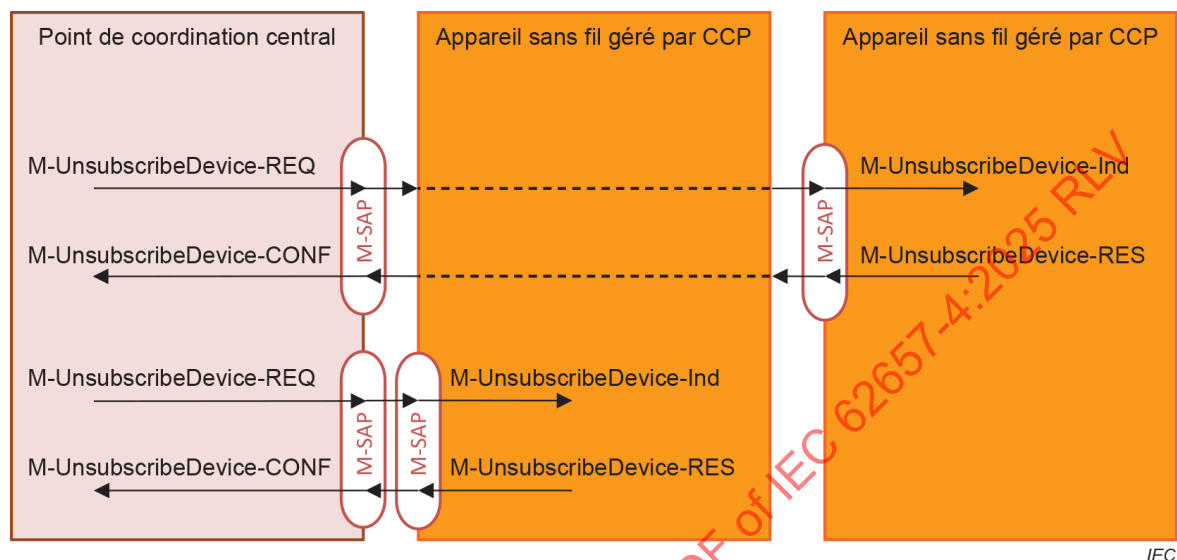


Figure 26 – Flux de primitives de UnsubscribeDevice

8.3.3.2 Primitives de service

Les paramètres de service de UnsubscribeDevice sont indiqués dans le Tableau 20.

Tableau 20 – Paramètres de service UnsubscribeDevice

Nom du paramètre	Request	Indication	Response	Confirm
Argument				
Adresse de destination	M	M(=)		
Type d'appareil	M	M(=)		
ID de l'appareil	M	M(=)		
Result (+)			S	S(=)
ID de l'appareil			M	M(=)
Statut			M	M(=)
Adresse d'appareil			M	M(=)

Argument

L'argument contient les paramètres de la demande de service.

Adresse de destination

Ce paramètre spécifie l'adresse de destination à laquelle la demande de service doit être envoyée.

Type d'appareil

Ce paramètre spécifie le type de l'appareil sans fil de destination. Il est présent dans la primitive de demande.

ID de l'appareil

Ce paramètre spécifie l'identifiant de l'appareil sans fil.

Result (+)

Ce paramètre de type de sélection indique que la demande de service a abouti.

ID de l'appareil

Ce paramètre spécifie l'identifiant de l'appareil sans fil.

Statut

Ce paramètre spécifie le statut désabonné de l'appareil sans fil.

Adresse d'appareil

Ce paramètre spécifie l'adresse de l'appareil sans fil demandé. Il est présent dans la primitive de réponse.

Result (-)

Ce paramètre de type de sélection indique que la demande de service n'a pas abouti.

Statut du service

Ce paramètre donne des informations relatives au résultat de l'exécution du service. Il doit prendre la valeur ABORTED ou TIMEOUT.

8.3.3.3 Procédure de service

La demande UnsubscribeDevice doit envoyer un message au CMWD. Lorsque le message arrive à l'appareil cible (CMWD), cela doit donner lieu à une indication UnsubscribeDevice au niveau du CMWD. En retour, le CMWD doit transférer le message vers l'objet cible approprié. Si l'objet répond, le CCP doit transférer la réponse par l'intermédiaire de la primitive de réponse UnsubscribeDevice. Lorsque la réponse arrive à l'appareil à l'origine de la demande, une confirmation UnsubscribeDevice doit être renvoyée à l'objet d'application qui a envoyé la demande.

8.3.3.4 Séquence de service

La séquence de service de UnsubscribeDevice est représentée à la Figure 27.

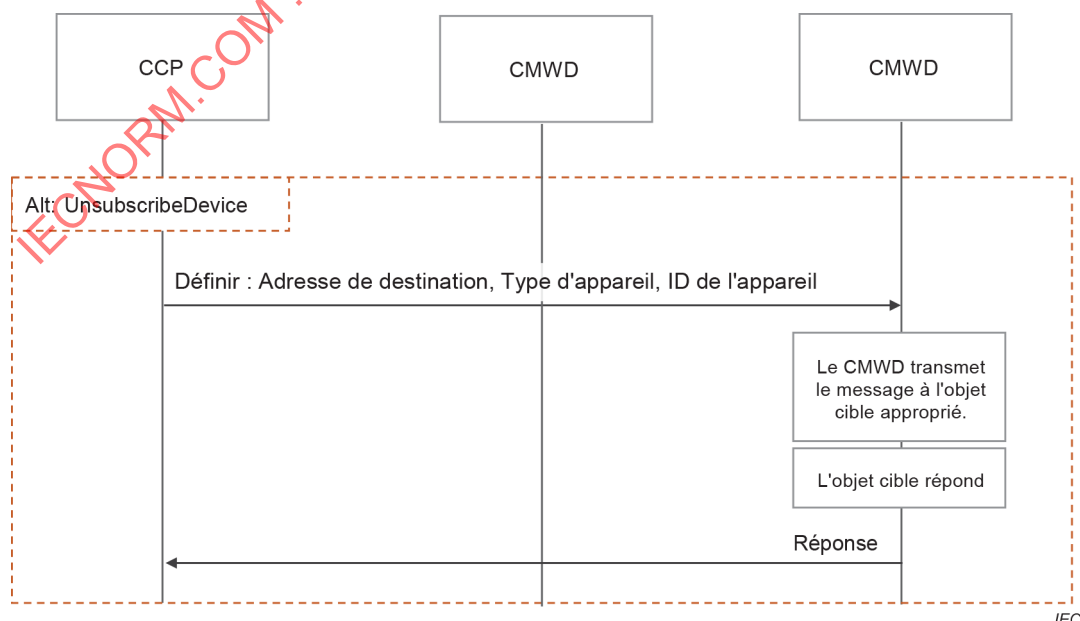


Figure 27 – Diagramme de séquence (UnsubscribeDevice)

8.3.3.5 Format de message de service

Le format de message du service UnsubscribeDevice doit être conforme au Tableau 21.

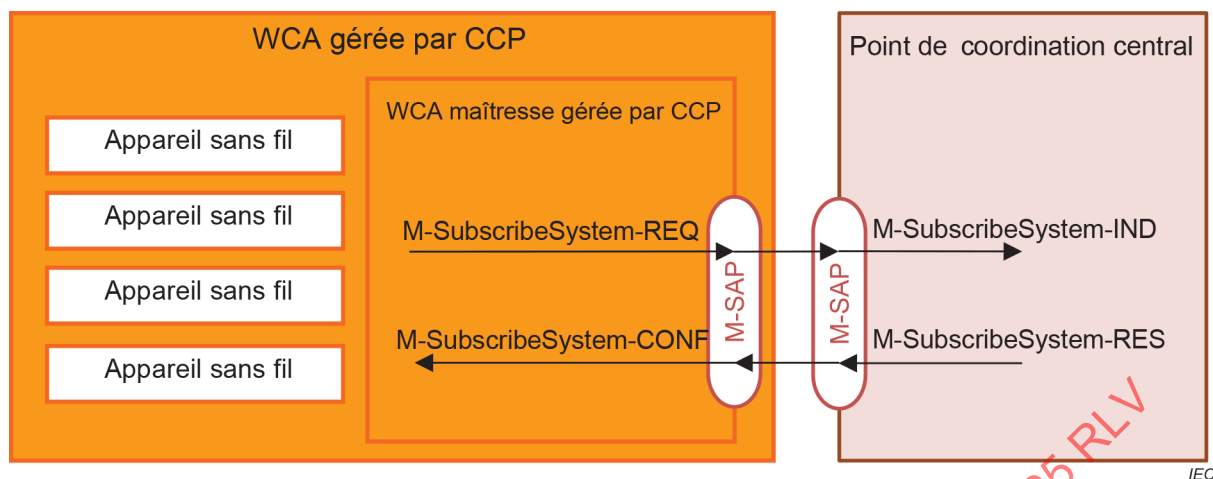
Tableau 21 – Format de message du service UnsubscribeDevice

Format de message	Explication
<pre>{ "Argument": [{ "Adresse de destination": "02004CAABBDD", "Type d'appareil": "ABC 36, entreprise ABC, version 3.0"; "ID de l'appareil": "A3000", }] "Result (+)": [{ "ID de l'appareil": "A3000", "Statut": "connexion", "Adresse d'appareil": "02004CAABBG" }] "Result (-)": { "Statut du service": "abandonné" } }</pre>	Paramètres de la demande de service. Adresse de destination à laquelle la demande de service doit être envoyée. Type de l'appareil sans fil de destination. Identifiant de l'appareil sans fil. La demande de service a abouti. Identifiant de l'appareil sans fil. Statut désabonné de l'appareil sans fil. Adresse de l'appareil sans fil demandé. La demande de service n'a pas abouti. Informations relatives au résultat de l'exécution du service.

8.3.4 SubscribeSystem

8.3.4.1 Vue d'ensemble du service

Le service SubscribeSystem est un service confirmé et utilise le M-SAP. La CMWA envoie les tentatives de demande de service SubscribeSystem au CCP. Le flux de primitives du service SubscribeSystem est décrit à la Figure 28.



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Figure 28 – Flux de primitives de SubscribeSystem

8.3.4.2 Primitives de service

Les paramètres de service de SubscribeSystem sont indiqués dans le Tableau 22.

Tableau 22 – Paramètres de service SubscribeSystem

Nom du paramètre	Request	Indication	Response	Confirm
Argument				
Adresse de destination	M	M(=)		
Type de système sans fil	M	M(=)		
Result (+)			S	S(=)
ID de système sans fil			M	M(=)
Statut			M	M(=)
Type de système sans fil			M	M(=)
Adresse du système			M	M(=)
Result (-)			S	S(=)
Statut du service			M	M(=)

Argument

L'argument contient les paramètres de la demande de service.

Adresse de destination

Ce paramètre spécifie l'adresse de destination à laquelle la demande de service doit être envoyée.

Type de système sans fil

Ce paramètre spécifie le type du système sans fil demandé. Il est présent dans la primitive de demande.

Result (+)

Ce paramètre de type de sélection indique que la demande de service a abouti.

ID de système sans fil

Ce paramètre spécifie l'identifiant du système sans fil.

Statut

Ce paramètre spécifie le statut suivant du système sans fil.

- 0: pas d'adresse
- 1: non configuré
- 2: configuré

Type de système sans fil

Ce paramètre spécifie le type d'appareil sans fil. Il est présent dans la primitive de réponse.

Adresse du système

Ce paramètre spécifie l'adresse de l'appareil sans fil demandé (station maîtresse du système sans fil). Il est présent dans la primitive de réponse.

Result (-)

Ce paramètre de type de sélection indique que la demande de service n'a pas abouti.

Statut du service

Ce paramètre donne des informations relatives au résultat de l'exécution du service. Il doit prendre la valeur ABORTED ou TIMEOUT.

8.3.4.3 Procédure de service

La demande SubscribeSystem doit envoyer un message au CCP. Lorsque le message arrive à l'appareil cible (CCP), cela doit donner lieu à une indication SubscribeSystem au niveau du CCP. En retour, le CCP doit transférer le message vers l'objet cible approprié. Si l'objet répond, le CCP doit transférer la réponse par l'intermédiaire de la primitive de réponse SubscribeSystem. Lorsque la réponse arrive à l'appareil à l'origine de la demande, une confirmation SubscribeSystem doit être renvoyée à l'objet d'application qui a envoyé la demande.

8.3.4.4 Séquence de service

La séquence de service de SubscribeSystem est représentée à la Figure 29.

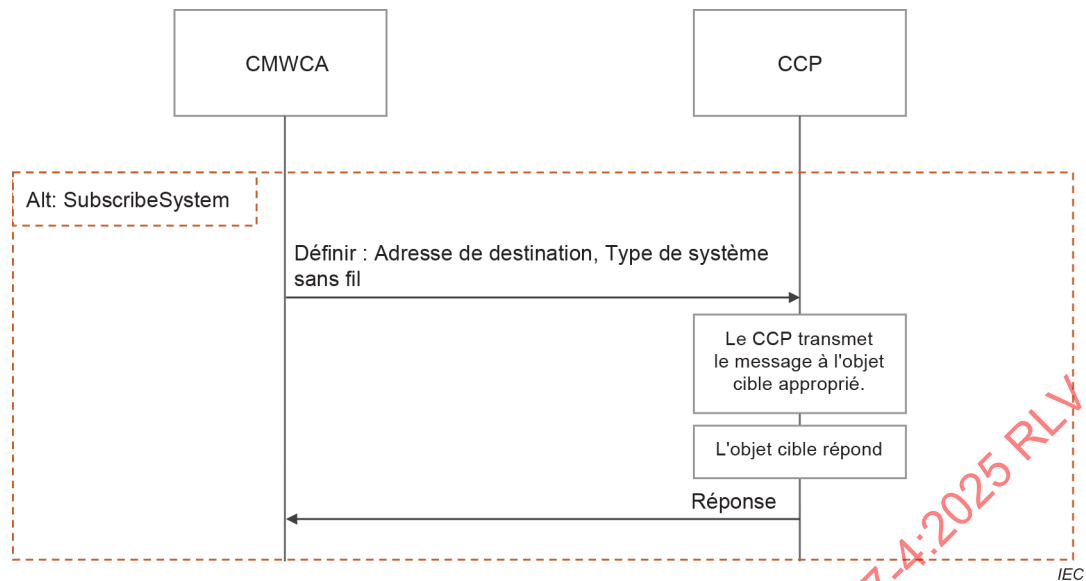


Figure 29 – Diagramme de séquence (SubscribeSystem)

8.3.4.5 Format de message de service

Le format de message du service `SubscribeSystem` doit être conforme au Tableau 23.

Tableau 23 – Format de message du service `SubscribeSystem`

Format de message	Explication
<pre>{ "Argument": [{ "Adresse de destination": "02004CAABBDD", "Type de système sans fil": "IEC 62591" }] "Result (+)": [{ "ID de système sans fil": "5555", "Statut": "connexion", "Type de système sans fil": "IEC 62591", "Adresse du système": "02004CAABBHH" }] "Result (-)": { "Statut du service": "abandonné", } }</pre>	Paramètres de la demande de service. Adresse de destination à laquelle la demande de service doit être envoyée. Type du système sans fil demandé. La demande de service a abouti. Identifiant du système sans fil. Statut du système sans fil. Type de l'appareil sans fil. Adresse de l'appareil sans fil demandé (station maîtresse du système sans fil). La demande de service n'a pas abouti. Informations relatives au résultat de l'exécution du service.

8.3.5 UnsubscribeSystem

8.3.5.1 Vue d'ensemble du service

Le service UnsubscribeSystem est un service confirmé et utilise le M-SAP. Le CCP envoie les tentatives de demande de service UnsubscribeSystem à la CMWCA. Le flux de primitives du service UnsubscribeSystem est décrit à la Figure 30.

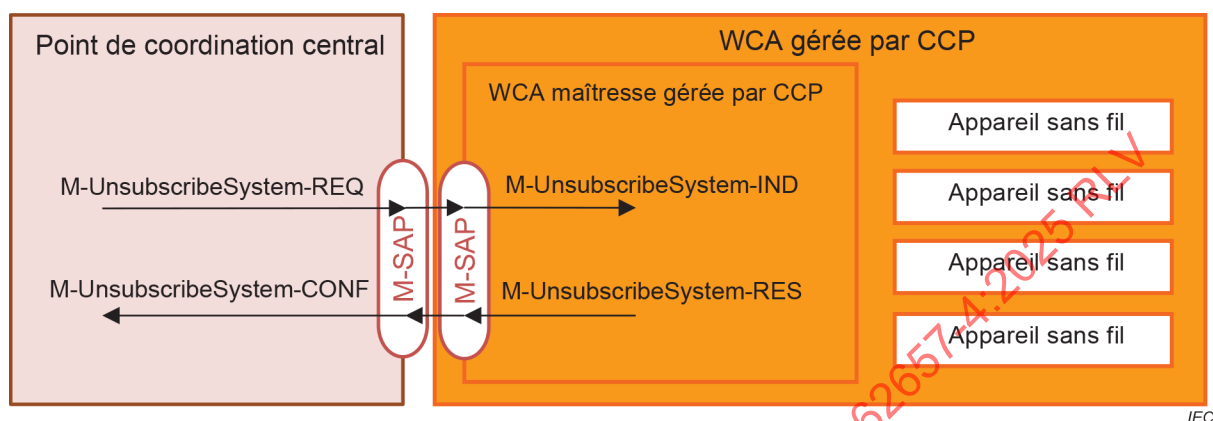


Figure 30 – Flux de primitives de UnsubscribeSystem

8.3.5.2 Primitives de service

Les paramètres de service de UnsubscribeSystem sont indiqués dans le Tableau 24.

Tableau 24 – Paramètres de service UnsubscribeSystem

Nom du paramètre	Request	Indication	Response	Confirm
Argument				
Adresse de destination	M	M(=)		
Type de système sans fil	M	M(=)		
ID de système sans fil	M	M(=)		
Result (+)			S	S(=)
ID de système sans fil			M	M(=)
Statut			M	M(=)
Adresse du système			M	M(=)
Result (-)			S	S(=)
Statut du service			M	M(=)

Argument

L'argument contient les paramètres de la demande de service.

Adresse de destination

Ce paramètre spécifie l'adresse de destination à laquelle la demande de service doit être envoyée.

Type de système sans fil

Ce paramètre spécifie le type de système sans fil de destination. Il est présent dans la primitive de demande.

ID de système sans fil

Ce paramètre spécifie l'identifiant du système sans fil.