SURFACE VEHICLE RECOMMENDED PRACTICE

J1939™-81 APR2025

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Superseding J1939-81 MAR2017

(R) Network Management

RATIONALE

Document is revised to add a section on wake and sleep, clarify address arbitration when using system integrator assigned addresses, remove content duplicated in ISO documents, update formatting to current conventions, and reorganize technical content.

FOREWORD

The set of SAE J1939 Recommended Practice documents define a high-speed ISO 11898 CAN protocol based communications network that can support real-time closed loop control functions, simple information exchanges, and diagnostic data exchanges between electronic control units (ECUs) physically distributed throughout the vehicle.

The SAE J1939 common communication architecture strives to offer an open interconnect system that allows the ECUs associated with different component manufacturers to communicate with each other.

The SAE J1939 communications network is intended for light-duty, medium-duty, and heavy-duty vehicles used on-road or off-road, and for appropriate stationary applications which use vehicle derived components (e.g., generator sets). Vehicles of interest include, but are not limited to, on-highway and off-highway trucks and their trailers, construction equipment, and agricultural equipment and implements.

This set of SAE Recommended Practices has been developed by the SAE Truck and Bus Control and Communications Network Committee of the SAE Truck and Bus Electrical and Electronics Steering Committee. The SAE J1939 communications network is defined using a collection of individual SAE J1939 documents based upon the layers of the Open System Interconnect (OSI) model for computer communications architecture. These SAE J1939 documents are intended as a guide toward standard practice and are subject to change to keep pace with experience and technical advances.

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1. SCOPE

SAE J1939-81 (“Network Management”) defines the processes and messages associated with managing the addresses of applications communicating on an SAE J1939 network. Network management is concerned with the management of addresses and the association of those addresses with an actual function and with the detection and reporting of network related errors. Due to the nature of management of addresses, network management also specifies address selection and address claiming processes, requirements for reaction to brief power outages, and minimum requirements for ECUs on the network.

2. REFERENCES

General information regarding this series of recommended practices is found in SAE J1939.

2.1 Applicable Documents

The following publications form a part of this specification to the extent specified herein. Unless otherwise indicated, the latest issue of SAE publications shall apply.

2.1.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

SAE J1939 Serial Control and Communications Heavy-Duty Vehicle Network - Top-Level Document

SAE J1939-21 Data Link Layer

SAE J1939-22 CAN FD Data Link Layer

SAE J1939-31 Network Layer

SAE J1939-71 Vehicle Application Layer

SAE J1939-73 Application Layer - Diagnostics

SAE J1939DA J1939 Digital Annex

2.1.2 ISO Publications

Copies of these documents are available online at https://webstore.ansi.org/.

ISO 11783-6:2018 Tractors and machinery for agriculture and forestry - Serial control and communications data network - Part 6: Virtual terminal

ISO 11783-7:2022 Tractors and machinery for agriculture and forestry - Serial control and communications data network - Part 7: Implement messages application layer

2.1.3 AUTOSAR Publications

Copies of these documents are available online at https://www.autosar.org/.

Document ID 013 Specification of CAN Network Management (Release 4.4.0)

3. DEFINITIONS AND ABBREVIATIONS

Refer to SAE J1939 for definition of terms not defined in this document.

3.1 Definitions

3.1.1 ADDRESS ARBITRATION

The logical operation of an address claim for resolving priority to an SAE J1939 address when multiple controller applications attempt to claim the same address.

3.1.2 ADDRESS CLAIMED MESSAGE

Alias for an instance of the Address Claimed PG (PGN 60928).

3.1.3 ADDRESS CLAIM PROTOCOL

The SAE J1939 protocol for Controller Applications (CAs) to acquire an SAE J1939 address on an SAE J1939 network segment and for CAs to identify the function of the CA associated with each claimed SAE J1939 address. Address claim consists of messaging communications and logical operations.

3.1.4 CANNOT CLAIM ADDRESS MESSAGE

Alias for a form of the Address Claimed PG (PGN 60928) that indicates the CA associated with the NAME in the PG data cannot claim a source address.

3.1.5 CONTENDING ADDRESS CLAIM

A received Address Claimed message with a source address matching the address the receiving CA has claimed or is claiming.

3.1.6 CONTROLLER APPLICATION (CA)

For the purposes of this document, a controller is made up of the software and the hardware within an Electronic Control Unit (ECU) that performs a particular control function. The software within a particular controller is the “Controller Application” (CA). An ECU may serve as one or more controllers and hence can contain one or more CAs.

3.1.7 CURRENT NAME

The NAME of a CA that is transmitted in its Address Claimed message. This term is used in association with the NAME Management capability to distinguish the NAME a CA is presently using from the new or pending NAME about to be adopted.

3.1.8 GLOBAL PREFERRED ADDRESS

A few SAE J1939 addresses are universally assigned to specific system functions, known as global preferred addresses, but most SAE J1939 addresses are neither static nor universally assigned.

3.1.9 GLOBAL REQUEST FOR ADDRESS CLAIMED (GRAC)

Alias for an instance of the Request for Address Claimed that is addressed to the global address (255).

3.1.10 NAME

An 8-byte value which shall uniquely identify the primary function of a CA and its instance on a given vehicle network.

3.1.11 PENDING NAME

The NAME that a particular CA has temporarily stored as a result of NAME Management messages received from a qualified source. This NAME can be requested and provided as part of the NAME management process. It does not become the current NAME of the CA until the CA receives a properly formatted and qualified “adopt” command as discussed in 5.11.2.10.8.

3.1.12 REQUEST FOR ADDRESS CLAIMED

Alias for an instance of the Request PG (PGN 59904) for the Address Claimed PG (PGN 60928). See 5.9.13.

3.1.13 TASK CONTROLLER

Electronic control unit on the mobile implement control system that is responsible for the sending, receiving, and logging of process data. Refer to ISO 11783-6:2018.

3.1.14 VIRTUAL TERMINAL

A Virtual Terminal (VT) is an electronic control unit consisting of a graphical display and input controls providing the capability to display information to and retrieve data from an operator for a connected implement or working set. Refer to ISO 11783-6:2018.

3.1.15 WORKING SET

Group of NAMEs for one or more CAs that collectively provide a control function or group of control functions. The source address of the working-set master is used to identify the working set and, for others, to communicate with the working set. The working-set master is identified by a specific control function within a specific electronic control unit. Refer to ISO 11783-7:2022.

3.1.16 WORKING SET MASTER

The one and only working set member that is the coordinator of the communications of a working set.

3.1.17 WORKING SET MEMBER

One of several CAs that collectively form the working set.

3.2 Abbreviations

CA	Controller Application
DA	Destination Address
ECU	Electronic Control Unit
GRAC	Global Request for Address Claimed
PDU	Protocol Data Unit
SA	Source Address

4. OPERATING PRINCIPLES/OVERVIEW

This document defines data objects, SAE J1939 PGs and procedures for address acquisition and management, partial networking, and network related errors.

4.1 Address Acquisition and Management

SAE J1939 NAME (NAME) is an 8-byte numeric value that describes a CA, such as its system function, system function instance, and manufacturer. Each CA that communicates SAE J1939 messages is required to have a NAME describing its system function, system function instance, manufacturer, and other properties. The NAME for a CA can be fully hardcoded in its software or partially hardcoded and fully resolved at run time or through service configuration.

An SAE J1939 address is a 1-byte numeric value used to identify a CA with SAE J1939 messages. Every SAE J1939 message includes a source address (SA) that identifies the CA that originated the message. Some SAE J1939 messages contain a destination address (DA) that identifies the CA that is the intended recipient of the message. SAE J1939 addresses are acquired by CAs (system functions) at network run time.

The SAE J1939 address claim protocol and NAME are the SAE J1939 network management solutions for a CA to acquire an SAE J1939 address, configure the system functions for permissible originators and intended recipients for SAE J1939 messages, and resolve the source addresses to use for SAE J1939 messages. Through the address claim protocol, a CA sends an Address Claimed message containing its NAME with the source address it intends to use. Once a CA has successfully claimed an address, it may begin transmitting other messages on the network using that source address. A special form of the Address Claimed message, referred to as a Cannot Claim Address message, is sent by a CA if it fails to successfully claim an address after attempting to claim all its allowable addresses.

Due to the dynamic nature of addresses, a CA should be programmed using a system function-based model instead of a source address-based model for its SAE J1939 communications. In a system function-based model, the CA is coded with the system functions (i.e., by NAME or subset of NAME) that are permissible originators for each message it can receive and coded with the system functions (i.e., by NAME or subset of NAME) that are recipients for each message it transmits. At run time, the CA can catalog the NAME and address relationships by monitoring the Address Claimed messages. When receiving an SAE J1939 message, the CA can use the cataloged data to identify the system function that sent the message, i.e., get the NAME associated with the SAE J1939 message source address. When needing to send an SAE J1939 message to a particular system function, the CA can use the cataloged data to get the address claimed with the matching system function and used that address as the destination address for the SAE J1939 message. Conversely, in an address-based model, a CA is coded with its own address, coded with the source addresses that are permissible originators for each message it can receive, and coded with the destination addresses that are recipients for each message it transmits. Because of the potentially dynamic nature of the addresses, the general CA should not be hardcoded with its own source address, should not be hardcoded with the source addresses for the system functions that are permissible originators for each message it can receive, and should not be hardcoded with the destination addresses for the system functions that are recipients for each message it transmits because those addresses are not known at software design time.

The Commanded Address message is used to set or alter the address claimed by a CA. Commanded Address messages can be sent by a service tool or an on-board CA to resolve situations where an address cannot be claimed or manage the addresses of CAs to a specific configuration of addresses for system functions. The Commanded Address message contains the NAME of the intended CA recipient and the address that CA should claim using the address claim protocol.

The NAME Management message is used to alter the value for some or all of the NAME properties for a CA. A common use of NAME Management is to change the values for the NAME instance properties for a CA, i.e., function instance, ECU instance or vehicle system instance, when there are multiple instances of the CA in a system and the CA cannot identify its system instance, e.g., no harness strapping.

4.2 Wake-Up and Sleep

The Wake-Up and Sleep message provides an SAE J1939 standard message and configuration parameters to implement the AUTOSAR network management service for wake-up, sleep, and partial networking.

4.3 Working Sets

Working sets are an address management service where multiple CAs, each with a distinct NAME, are acting as distributed processes for a single system function, as far as communication is concerned. Working set services support identifying the source addresses of CAs that form the working set and identifying the source address of the working set master, i.e., the CA that is the coordinator of the communications of a working set. Refer to ISO 11783-7:2022.

4.4 Network Error Management

Network error management are operational behaviors for detecting, resolving, and reporting related errors, such as a CA cannot claim a source address, duplicate use of a source address, duplicate NAMEs, and ECU power disturbances on claimed address.

5. TECHNICAL REQUIREMENTS

5.1 General

The Network Management layer provides the definitions and procedures to uniquely identify CAs on the network, manage the assignment of addresses, and manage network errors. Network management defines the allocation and permitted use of SAE J1939 addresses, a data object for identifying the system function performed by a CA, and classifications of CAs in regard to network management capabilities. Network management procedures define the logical actions taken by individual CAs to collectively manage the network such as claiming an address and associating an address to a system function. Some of these network management procedures are required to be supported by all CAs, while support of other procedures is optional. See Appendix B for a summary of requirements applicability.

5.2 Required Network Management Functionality

A CA that can communicate on an SAE J1939 network shall support the required behaviors and functions of the network management functionality.

1. A CA shall follow the address claim protocol (see 5.9) and network error management (see 5.13).
2. A CA shall support transmitting and receiving the Address Claimed message (see 5.9.2).
3. A CA shall respond to a Request for Address Claimed (see 5.9.13).
4. A CA shall successfully claim an address by following the address claim protocol prior to sending and receiving SAE J1939 messages on the network using that address (see 5.9). An exception is the Wake-up message (see 5.15.2).
5. Prior to claiming an address, a CA shall not transmit any SAE J1939 messages except for those specified in 5.9.3.
6. If a CA cannot claim an address, a CA shall not transmit any SAE J1939 messages except for those specified in 5.9.3.
7. A network interconnection device can forward SAE J1939 messages transmitted by other CAs before claiming its own address. (For further requirements for network interconnection devices, refer to SAE J1939-31.)
8. A CA shall be capable of providing its unique 64-bit NAME. The rules for creating this NAME, associating it with an address, and the ability or non-ability for the CA to change that address are presented in 5.5.
9. The inability to successfully claim an address according to the procedure shall be handled and reported to the network as specified in 5.9.11.
10. A CA shall support the minimum set of network management requirements, including required responses to power interruptions, are specified in 5.14.
11. A CA shall follow the address claim protocol after its NAME is modified, as specified in 5.5.6.

5.3 Optional Network Management Functionality

A CA that can communicate on an SAE J1939 network may support some or all of the following network management functions:

1. Commanded Address (see 5.10)
2. NAME Management (see 5.11)
3. Working Set (see 5.12)

A CA shall follow the address claim protocol if it's changing its source address in response to a Commanded Address message, as specified in 5.10.

A CA that commands NAME changes in a target CA shall assure the target CA follows the address claim protocol after its NAME is modified, as specified in 5.5.6.

Multiple ECUs and/or CAs can work together as working sets to perform functions but shall follow the rules in 5.12.

5.4 Network Management Messages

Network management messages have the same characteristics and requirements as other SAE J1939 messages with the exception of the use of the NULL address.

The Request for Address Claimed message is a standard Request PG message as described in SAE J1939-21 and SAE J1939-22. A Request for Address Claimed message may be sent using the NULL address as the message source address. See 5.9.13.

The Address Claimed message may be sent using the NULL address as the message source address. An Address Claimed message sent with the NULL source address is known as a Cannot Claim Address message. See 5.9.4.2.

The set of network management messages may be used to request addresses and NAMEs in use by other CAs on the network, claim an address for an ECU, announce the inability to claim an address, command another CA to assume a new address or change parts of a CA's NAME. Table 1 summarizes the network management messages.

Table 1 - Network management messages

Message Name	PGN	Source Address	Destination Address	PG Data Length (Bytes)	PG Data
Request for Address Claimed	59904 (refer to SAE J1939-21 and SAE J1939-22)	SA[1]	DA	3	60928 (PGN of Address Claimed PG)
Global Request for Address Claimed	59904 (refer to SAE J1939-21 and SAE J1939-22)	SA[1]	255	3	60928 (PGN of Address Claimed PG)
Address Claimed	60928	SA	255	8	NAME
Cannot Claim Address	60928	254	255	8	NAME
Commanded Address	65240	SA	N/A	9[2]	NAME, new SA
NAME Management	37632	SA	DA	8	NAME fields, qualifiers and mode

[1] Source address can be set to 254 (NULL address) if CA has not yet claimed an address.
[2] Sent using the Transport Protocol BAM when sent on SAE J1939-21 network (refer to SAE J1939-21).

5.5 SAE J1939 NAME (NAME)

The SAE J1939 NAME (NAME) identifies the primary system function of a controller application (CA). The NAME for a CA identifies the primary function performed by that CA on the network. NAME allows CAs to identify the functional role of the source of an SAE J1939 message. NAME also allows a CA to determine the CA with a particular functional role when needing to send an SAE J1939 message to that particular functional role.

NAME is required to be unique among all CAs on an SAE J1939 network. NAME includes fields for indicating the instance of the functionality so multiple CAs with the same primary function can coexist on the same network. The Function Instance, ECU Instance, and Identity Number fields in the NAME permit multiple CAs with similar functions to coexist on the same network and still have a unique NAME on an SAE J1939 network. Manufacturers of ECUs and integrators of networks shall ensure that the NAME for every CA on a network is unique.

With a length of 8 bytes, NAME is inconvenient to use in normal SAE J1939 messaging. SAE J1939 uses a 1-byte SAE J1939 address as part of the SAE J1939 message to identify the source CA, and conditionally destination CA, of the SAE J1939 message. Through the address claim protocol, a CA sends an Address Claimed message with its NAME and the source address it intends to use. NAME is communicated in the PG data of the Address Claimed PG, where NAME describes the system function of the CA associated to a claimed address. Cohesively reporting the CA's NAME with its address claim allows other CAs on the network to catalog the NAME and function associated with each claimed SA on the network.

NAME is used as the numerical value for determining priority to a claimed address when there are claims for the same address, known as address arbitration. NAME is also used with the Commanded Address PG to identify the particular CA, by its NAME, that is the intended recipient of the Commanded Address message.

5.5.1 NAME (SPN 2848)

NAME is composed of ten fields. Figure 1 specifies the structure and fields of the NAME. Table 2 summarizes the position of each field within the 8-byte numerical value. The definitions for each of the ten fields are provided in 5.5.1.1 through 5.5.1.10. The byte containing the Arbitrary Address Capable field is the most significant byte of the NAME value, and the byte containing the least significant 8 bits of the Identity Number field is the least significant byte of the NAME value.

Data Length:	8 Bytes
Resolution:	See individual field definitions (see 5.5.1.1 through 5.5.1.10)
Data Range:	0 to 18446744073709551615
Type:	Measured
Suspect Parameter Number:	2848
Reference:	5.9.4 and 5.10

The numeric value of NAME is used for comparing NAMEs to determine higher priority for a claim to the same address (see 5.9.6). Numeric NAME values are calculated from the structure shown in Figure 1. Figure 2 presents an example of the NAME with field values. The numeric value for the NAME illustrated in Figure 2 is the integer value B208801903A2990Eh.

When NAME is placed into the PG data of an SAE J1939 PG, the 8 bytes are arranged in least significant byte first ordering, in accordance with the SAE J1939-71 rules for data byte order for multiple-byte numerical values.

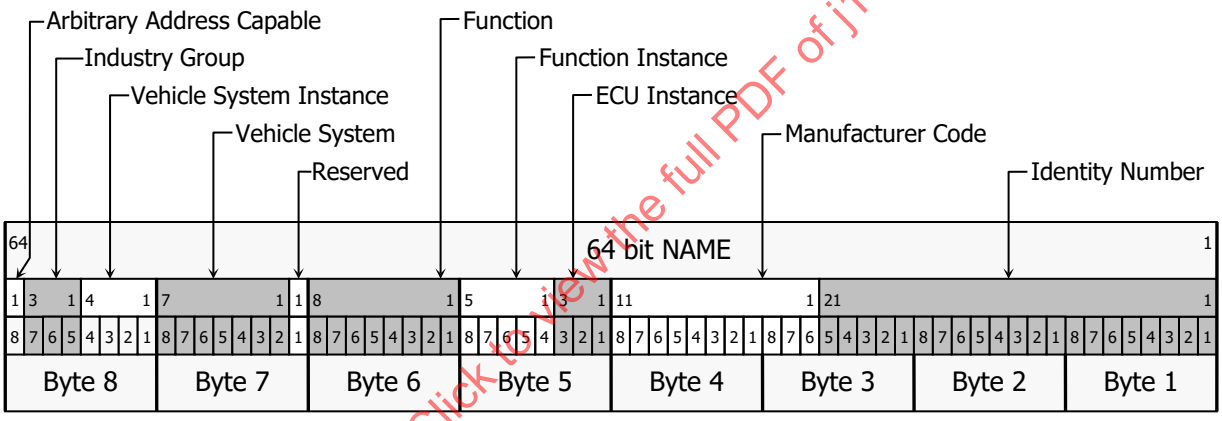


Figure 1 - Structure and fields of NAME

Table 2 - NAME fields information

Start Position	Length (bit)	Parameter Name	SPN	Ability to be set to "Not Available"	Reference
1-3.1	21	Identity Number	2837	No	5.5.1.10
3.6-4	11	Manufacturer Code	2838	No	5.5.1.9
5.1	3	ECU Instance	2840	No	5.5.1.8
5.4	5	Function Instance	2839	No	5.5.1.7
6	8	Function	2841	Yes	5.5.1.6
7.1	1	Reserved	N/A	N/A	5.5.1.5
7.2	7	Vehicle System	2842	Yes	5.5.1.4
8.1	4	Vehicle System Instance	2843	No	5.5.1.3
8.5	3	Industry Group	2846	No	5.5.1.2
8.8	1	Arbitrary Address Capable	2844	No	5.5.1.1

NAME fields	Arbitrary Address Capable	Industry Group	Vehicle System Instance	Vehicle System	Reserved	Function	Function Instance	ECU Instance	Manufacturer Code	Identity Number
# of bits	1	3	4	7	1	8	5	3	11	21
Field value EXAMPLE	yes	Construction Equipment	third one	Crawler	reserved	Blade Control	4th one	second one	Xxxx Motors, Inc	unique number, possibly the S/N
Field numerical value EXAMPLE (decimal)	1	3	2	4	0	128	3	1	29	170254
Field numerical value EXAMPLE (binary)	1	011	0010	0000100	0	10000000	00011	001	00000011101	00010100110010000111 0

combined into data bytes	64-bit NAME	msb								lsb
	hexadecimal values		B2	08	80	19	03	A2	99	0E
	data byte #		byte 8	byte 7	byte 6	byte 5	byte 4	byte 3	byte 2	byte 1

Note: NAME bytes are shown in the byte order representing the 64-bit NAME numeric value.
The NAME bytes, when placed into PG data, are in opposite order per SAE J1939-71 rules for data byte order for multiple byte numerical values.

Figure 2 - Example of NAME with field values

The values for the five NAME fields, listed below, are populated with a value assignment from the lists of standardized SAE J1939 values published in SAE J1939DA.

1. Industry Group
2. Vehicle System
3. Reserved
4. Function
5. Manufacturer Code

The values for the remaining five NAME fields, listed below, are either derived from characteristics of the network and vehicle architecture or under direct control of the manufacturer. Those fields are:

1. Arbitrary Address Capable
2. Vehicle System Instance
3. Function Instance
4. ECU Instance
5. Identity Number

5.5.1.1 Arbitrary Address Capable (SPN 2844)

This 1-bit field indicates whether the CA can use an arbitrary source address to resolve an address claim conflict. This bit is set to “1” when the CA can recursively select and claim any appropriate source address, including those in the range 128 to 247 inclusive, should it lose an address arbitration to another CA (see 5.7.1). This bit is set to “0” when the CA is single address capable (see 5.7.2). A self-configurable CA (see 5.7.2.4) is considered to be not arbitrary address capable. See 5.9 of this document for details of the Address Claim Protocol.

0 = This CA is not arbitrary address capable.

1 = CA is arbitrary address capable, i.e., capable of selecting alternate source addresses, by itself, if needed during address arbitration.

Data Length:	1 bit
Resolution:	2 states/1 bit, 0 offset
Data Range:	0 to 1
Type:	Status
Suspect Parameter Number:	2844
Supporting Information:	PGN 60928, 65240

5.5.1.2 Industry Group (SPN 2846)

The industry group is a 3-bit field used to identify the industry associated with the NAME Function, for example: On-Highway Equipment, or Agricultural Equipment. The industry group value shall only be one of the industry group values assigned and defined by SAE J1939. This list of defined industry group values is available on the “Industry Groups (B1)” worksheet in SAE J1939DA. The interpretation of the industry group field is independent of other NAME fields. The industry group value can affect the interpretation of the vehicle system field and the function field (see 5.5.2).

The selection of the industry group value is dictated by either the function value selection or the vehicle system selection, as described below.

1. If the function value is selected from the All Industry Groups NAME Functions (“Global NAME Functions [B11]” worksheet in SAE J1939DA), then the industry group field shall be set to either:

   a. Any defined industry group value from “Industry Groups (B1)” worksheet in SAE J1939DA.

   b. If using a vehicle system description from “IG Specific NAME Function (B12)” worksheet in SAE J1939DA, then the industry group value shall be set to one of the industry group values specified for that vehicle system.

2. If the function value is selected from the Industry Group Specific NAME Functions (i.e., from “IG Specific NAME Function [B12]” worksheet in SAE J1939DA), then the industry group field shall be set to the industry group value specified for that function.

Data Length:	3 bits
Resolution:	1 Industry Group/bit, no offset
Data Range:	0 to 7
Type:	Status
Suspect Parameter Number:	2846
Supporting Information:	PGN 60928, 65240

5.5.1.3 Vehicle System Instance (SPN 2843)

Vehicle system instance is a 4-bit field used to identify the occurrence of a particular vehicle system associated with the CA function. The vehicle system instance is a zero-based number where a value of 0 (zero) represents the first instance of that vehicle system. Note that in the case of a single instance of a vehicle system or the first instance of the vehicle system, the instance field shall be set to zero. Subsequent instances are assigned numbers in increasing numerical order. Users shall select the instance number that properly identifies the vehicle system by location, sequence, or arrangement in the overall system. Individual manufacturers and integrators are advised that some agreement in the interpretation and use of vehicle system instances may be necessary. For example, it can be important that the first instance refers to the forward most vehicle system or the leftmost vehicle system.

Data Length:	4 bits
Resolution:	1 Instance/bit, 1 offset
Data Range:	0 to 15
Type:	Status
Suspect Parameter Number:	2843
Supporting Information:	PGN 60928, 65240

5.5.1.4 Vehicle System (SPN 2842)

Vehicle system is a 7-bit field used to identify the vehicle system or system group associated with the CA function. The meaning of each of the vehicle system values is unique within and depends upon the industry group. The vehicle system value used in the NAME shall be one of the vehicle system values assigned and defined by SAE J1939. The list of defined vehicle system values for each of the industry groups is available on the “IG Specific NAME Function (B12)” worksheet in SAE J1939DA. The vehicle system provides a common name for a group of functions within a network. The interpretation of the vehicle system value depends on the industry group value (see 5.5.2).

Examples of vehicle systems for currently defined industry groups are “Trailer” in the On-Highway industry group, and “Planters/Seeders” in the Agricultural and Forestry Equipment industry group. Users shall select the vehicle system number that corresponds to the intended system on the “IG Specific NAME Function (B12)” worksheet in SAE J1939DA.

The vehicle system value 0 is defined as “Non-specific System” and applies to all industry groups. The “Non-specific System” value is appropriate to use if the interpretation of the CA function is not dependent upon the vehicle system. The vehicle system value 127 is defined as “Not Available” and applies to all industry groups. The “Not Available” value is appropriate to use if the vehicle system is not known by the CA or the vehicle system is not defined in the SAE J1939 assignments.

The interpretation of the vehicle system value is a matter of locating the combination of the vehicle system value and the industry group value on the “IG Specific NAME Function (B12)” worksheet in SAE J1939DA.

The selection of the vehicle system value shall be influenced by the function value selection, as describe below:

1. If the function value is selected from the All Industry NAME Functions (“Global NAME Functions [B11]” worksheet in SAE J1939DA), then the vehicle system field shall be set to either:

   a. The “Non-specific System” (value 0)

   b. The “Not Available” (value 127)

   c. A vehicle system description value from “IG Specific NAME Function (B12)” worksheet in SAE J1939DA.

2. If the function value is selected from the Industry Group Specific NAME Functions (“IG Specific NAME Function [B12]” worksheet in SAE J1939DA), then the vehicle system field shall be set to the vehicle system value specified for that function.

Data Length:	7 bits
Resolution:	127 states/7 bits, 0 offset
Data Range:	0 to 126
Type:	Status
Suspect Parameter Number:	2842
Supporting Information:	PGN 60928, 65240

5.5.1.5 Reserved Field

Reserved for future definition by SAE. The reserved bit shall be set to zero.

NOTE: This is different from the SAE J1939 convention of setting unused or reserved bits to 1.

5.5.1.6 Function (SPN 2841)

Function is an 8-bit field that identifies the function performed by the CA. A function is generally considered a basic functional component that controls part or all of a vehicle or vehicle system, such as an engine, transmission, or brakes. The function does not imply any specific capabilities.

The interpretation of the function value can depend on the industry group value and vehicle system value (see 5.5.2). The function values are divided into functions that apply across all industry groups and functions that are specific to an industry group and vehicle system. The function values of 0 to 127 are global functions that apply to all industries and the function definition is independent of any other NAME fields. The function values of 128 to 254 are industry group specific functions, and the function definition depends upon the industry group and the vehicle system values.

The function value shall only be one of the function values assigned and defined in SAE J1939DA. The list of defined global function values is available on “Global NAME Functions (B11)” worksheet in SAE J1939DA. The list of defined industry group specific function values is available on the “IG Specific NAME Function (B12)” worksheet in SAE J1939DA.

If the CA uses a function that is defined within the industry group specific function value range (“IG Specific NAME Function [B12]” worksheet in the SAE J1939DA), then the CA shall use the appropriate combination of industry group, vehicle system, and function within the NAME.

The function value 255 is defined as “Not Available” and applies to all combinations of industry group and vehicle system values. The “Not Available” value is appropriate to use if the function is not known by the CA (such as a blank ECU) or the function is not defined in the SAE J1939 assignments.

Data Length:	8 bits
Resolution:	254 states/8 bits, 0 offset
Data Range:	0 to 254
Type:	Status
Suspect Parameter Number:	2841
Supporting Information:	PGN 60928, 65240

5.5.1.7 Function Instance (SPN 2839)

The function instance is a 5-bit field that identifies the particular occurrence of a function on the same vehicle system that is associated with the CA. The function instance is a zero-based number where a vehicle system instance value of 0 (zero) represents the first instance of that vehicle system. Note that in the case of single instance of the function or the first instance of the function, the instance field shall be set to zero indicating the first instance. Users shall select the function instance number that properly identifies the function by location, sequence, or arrangement in the overall system.

Individual manufacturers and integrators are advised that some agreement in the interpretation and use of function instances can be necessary. As an example, consider an implementation consisting of two engines and two transmissions. It can be important that engine instance 0 is physically connected to transmission instance 0 and that engine instance 1 is physically connected to transmission instance 1.

Data Length:	5 bits
Resolution:	1 Instance/bit, 1 offset
Data Range:	0 to 31
Type:	Status
Suspect Parameter Number:	2839
Supporting Information:	PGN 60928, 65240

5.5.1.8 ECU Instance (SPN 2840)

The ECU instance is a 3-bit field that indicates which one of a group of electronic control modules associated with a given function is being referenced. For example, in the case where a single engine is managed by two separate control units, each of which is attached to the same SAE J1939 network, the ECU instance field shall be set to 0 for the first ECU and 1 for the second ECU. The ECU instance is a zero-based number where an ECU instance value of 0 (zero) represents the first instance of an ECU with that function on a vehicle system. Note that in the case of a single or first ECU for a particular CA, the instance field shall be set to zero indicating the first instance. Users shall select the ECU instance number that properly identifies the ECU by location, sequence, or arrangement in the overall system.

Data Length:	3 bits
Resolution:	1 Instance/bit, 1 offset
Data Range:	0 to 7
Type:	Status
Suspect Parameter Number:	2840
Supporting Information:	PGN 60928, 65240

5.5.1.9 Manufacturer Code (SPN 2838)

The manufacturer code is an 11-bit field that indicates the company associated with or responsible for the production of the CA or electronic control module for which this NAME is being referenced. The manufacturer code value shall only be one of the manufacturer code values assigned in SAE J1939DA. The list of defined manufacturer code values is available on the “Manufacturer IDs (B10)” worksheet in SAE J1939DA. The manufacturer code field is not dependent on any other field in the NAME. Users shall select the manufacturer code that corresponds to their company name (or possibly the OEM for which the ECU is intended).

The manufacturer code typically shall identify the company that is responsible for the final product, i.e., the company that someone would contact if they were having problems with the product in the field. This is usually the company that owns the application software running in the ECU. However, the manufacturer code value can reflect the company that owns the physical ECU design, it can reflect the company for which the specific ECU is branded, or it can reflect the company that actually manufactured/assembled the ECU.

Data Length:	11 bits
Resolution:	1 Manufacturer Code/bit, 0 offset
Data Range:	0 to 2047
Type:	Status
Suspect Parameter Number:	2838
Supporting Information:	PGN 60928, 65240

5.5.1.10 Identity Number (SPN 2837)

The identity number is a 21-bit field in the NAME assigned by the ECU manufacturer. The identity number is necessary in circumstances where it is possible that the NAME would not otherwise be unique among multiple instances of the ECU (i.e., could be identical). This field shall be unique and non-varying with removal of power. The manufacturer shall provide this uniqueness among products. It is the manufacturer’s choice to encode any other information into the identity number, for example, time/date of manufacture, serial number of the module, the vehicle the module is placed into, etc. Interpretation of the identity number is generally not relevant to the network management operations.

Data Length:	21 bits
Resolution:	1 number/bit, 0 offset
Data Range:	0 to 2097151
Type:	Status
Suspect Parameter Number:	2837
Supporting Information:	PGN 60928, 65240

5.5.2 Dependencies in the NAME Fields

Figure 3 shows the dependencies of the upper 128 functions on vehicle system and industry group. In addition, the dependency of identity number on manufacturer code is shown. The reserved field is independent of other fields. Functions 0 through 127 are independent of industry group or vehicle system. Functions 128 to 254 are dependent on both vehicle system and industry group.

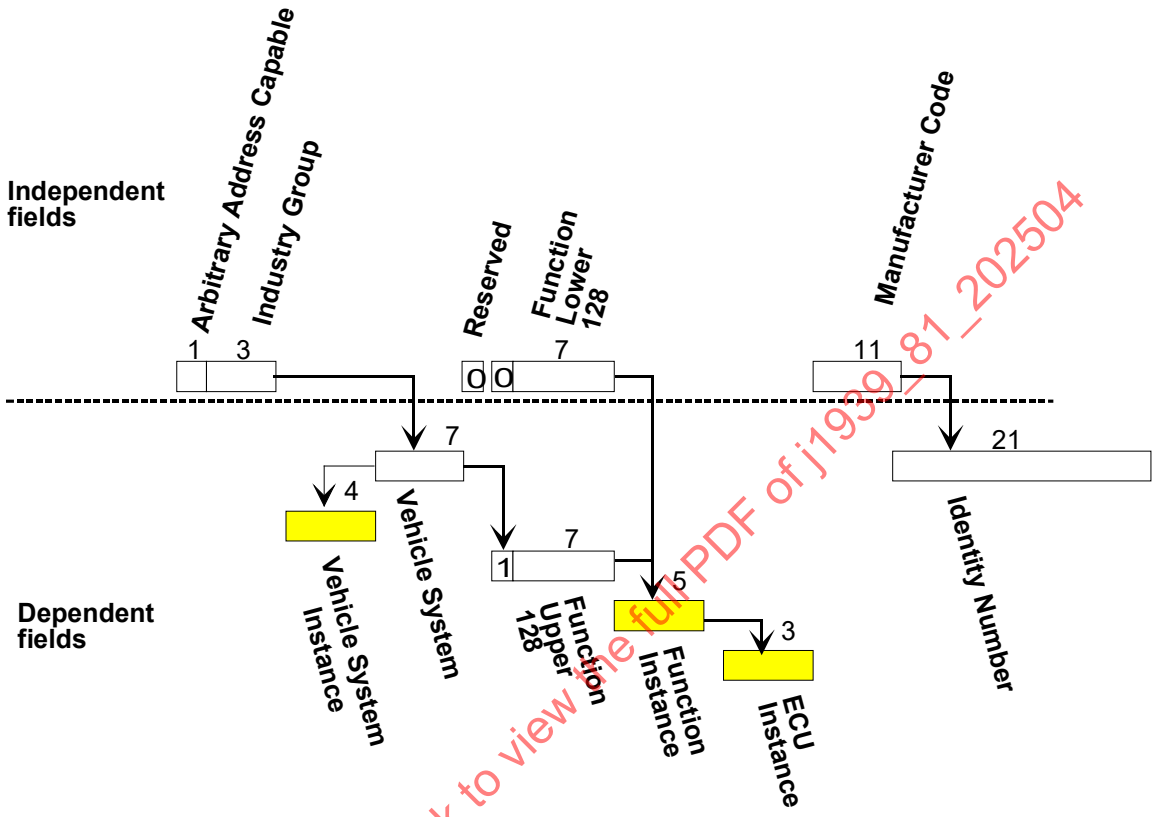


Figure 3 - Dependencies in the NAME fields

5.5.3 NAME Association to CA and ECU

NAME is an attribute of a CA executing within an ECU. Each ECU on the network shall contain at least one CA, and each CA that can transmit SAE J1939 messages on the network shall have its own NAME. NAME is associated to each CA and not with the physical ECU. In some cases, the ECU software performs only one primary control function, such as transmission control, so there is only one NAME for the only CA in the ECU; in this case, the NAME is sometimes informally stated as being the NAME of the ECU. In other instances, ECU software performs multiple controller applications, such as engine control and engine retarder control, where each CA needs to have its NAME and identity on the SAE J1939 network; in this case there are multiple NAMEs associated with the ECU.

The NAME reported from an ECU software can change when different CA software is loaded onto the ECU or the CA software configuration is changed. It is common for a blank ECU, i.e., an ECU running only basic operating system application, to have a NAME so the operating system CA can claim a network address and application software can be installed at the factory or in the field. The NAME used by a blank ECU, i.e., the basic operating system CA, can be different than the NAME used when the application software is loaded and executing on that same ECU.

5.5.4 NAME Usage

NAME, or a subset of NAME, can be used to hardcode the system function identity of permissible originators for each message a CA receives, and the intended recipients of each message a CA transmits. Using NAME in this manner is necessary due to the dynamic nature of source addresses. When a CA is programmed in this manner, at run time, the CA can monitor the address claim protocol to determine the source address claimed with a corresponding NAME. When a CA is programmed in this manner, usually only a subset of the NAME is hardcoded according to the specificity needed by the application. A combination of function, function instance, vehicle system, vehicle system instance, ECU instance, and industry group field values can be specified to identify the system function of an originator or recipient. If the CA needs to limit certain communications to an originator or recipient by a specific manufacturer, the value for the manufacturer code field can be specified. In general, the values for arbitrary address capable, identity number, and reserved fields of NAME will generally not be specified as these fields are primarily intended for address arbitration and NAME uniqueness.

For example, consider an engine CA that needs to send SAE J1939 messages to the transmission CA and to the fuel actuator CA. The engine CA can be hardcoded to identify the transmission CA, and its source address, as the address claimed with a NAME that has a function value of 3; industry group and vehicle system do not need to be specified because this NAME function value is global and not depended on industry group and vehicle system. The engine CA can be hardcoded to identify the fuel actuator CA, and its source address, as the address claimed with a NAME that has a function value of 146, an industry group value of 0, and a vehicle system value of 0; the combination of function, industry group, and vehicle system are needed because the function assigned is dependent industry group and vehicle system.

5.5.5 NAME Programmability

The NAME for a CA is commonly configured or established during software design. Depending on the CA function, the values for some NAME fields can be configured at installation or run time. Controller application designs are recommended to support SAE J1939 communications to alter some of the NAME fields during factory installation or field servicing. Some NAME fields, such as the instance fields, can identify CA characteristics that can depend on the characteristics of the network, vehicle architecture, or the ECU's installation location. Supporting field programmability of certain NAME fields allows for the proper configuration of the system function of the ECU (and its CAs), such as when a spare ECU is installed in the field, or multiple instances of an CA function (and ECU) exist on a vehicle. Field programmability of all NAME fields is recommended, but some NAME fields, such as function, can be tightly coupled to the CA software function and can be inappropriate to allow being changed.

There are two options for field programming NAME fields. A controller application with programmable NAME fields can support either or both of these options. These options do not prevent use of other solutions for configuring NAME fields at installation, such as harness pin codes.

One option is the NAME Management Message PG (see 5.11) for programming NAME fields. The NAME Management PG provides services for staging the NAME field changes and later adopting the updated NAME. These services are especially useful when the NAME for multiple CAs need to be altered and then adopted (implemented) at the same time or in a controlled sequence.

Another option is to use the Memory Access Protocol with Directed Spatial Addressing (refer to SAE J1939-73) to write the new NAME field values. The pointer extension shall be set to 0 indicating SPN space and the pointer shall be the NAME SPN (SPN 2848) or the SPN for the NAME field to be programmed.

5.5.6 NAME Changes at Run Time

If a CA's NAME is changed during run time through any of the methods mentioned in this document, the CA shall follow the address claim protocol to claim either the same source address or a different address. This allows other CAs to update their cataloged address to NAME associations with the new system function.

If the changed parts of a CA's NAME do not trigger the CA to perform an address claim with its revised NAME, the tool or CA responsible for making the change shall issue a Request for Address Claimed to assure the CA sends an Address Claimed message with its revised NAME.

5.6 SAE J1939 Address

An SAE J1939 address is a one-byte value used with SAE J1939 messages to identify the originating CA and the intended recipient CA (for destination specific messages). The SAE J1939 address used by a CA is often known as the “Source” Address (SA) of the CA.

The address claim protocol (see 5.9) is used by a CA to announce, arbitrate, and claim an SAE J1939 address on the network. After a CA successfully claims an SAE J1939 address, the CA uses that address as the source address for each SAE J1939 message it transmits, and uses that address when determining if a destination specific SAE J1939 message is addressed to the CA.

A controller application (CA) shall have successfully claimed an SAE J1939 source address before the CA transmits an SAE J1939 message on an SAE J1939 network. Every CA that communicates on an SAE J1939 network is required to have a unique SAE J1939 source address; the same source address cannot be used by two or more CAs on the same SAE J1939 network.

The address claim protocol is used by a CA to announce, arbitrate, and claim an SAE J1939 address on the network. The address claim protocol also allows a CA to identify the source address and function of other CAs on the network. The Address Claimed message, which contain both a source address and a NAME, associates a NAME with a particular address on the network. The association of an address with a unique NAME (see 5.5) enables a CA to associate an address with a CA with a specific function. Manufacturers of ECUs and integrators of networks shall ensure that the NAMEs of all CAs intended to transmit on a particular network are unique.

To facilitate the process of configuring the addresses to be claimed by CAs, commonly used devices have preferred addresses assigned by SAE J1939 (see 5.6.2). Configuring a CA to use a preferred address can minimize the frequency of multiple devices attempting to claim the same address.

5.6.1 Source Address Ranges

SAE J1939 source addresses are divided into two classes, Global preferred addresses (or fixed function addresses) and arbitrary addresses (or dynamic function addresses). Global preferred addresses range from 0 to 127 and 248 to 253 and can only be claimed by a CA performing the function assigned to that address by SAE J1939. Arbitrary addresses range from 128 to 247 and can be claimed by any CA performing any function. Source addresses 254 (NULL) and 255 (Global) are special SAE J1939 addresses with restricted usage.

5.6.1.1 Global Source Addresses (0 to 127 and 248 to 253)

The list of global source address assignments, also known as global preferred addresses, is on the “Global Source Addresses (B2)” worksheet in SAE J1939DA.

A global source address shall only be claimed and used by a CA that performs the described system function and function instance, when specified, that is assigned to that address by SAE J1939. Since there is a small finite set of global preferred addresses, SAE J1939 only assigns these addresses to system functions that are considered common across most industries (such as engine, transmission, service tool, or display) and usually only for the first instance of such a function.

5.6.1.2 Dynamic Addresses (128 to 247)

Dynamic addresses can be claimed and used by any CA performing any system function. The supplier of a CA may use any strategy for selecting the initial address to claim within the range of 128 to 247.

5.6.1.3 Global Address (255)

The SAE J1939 address 255 is the global address, also known as the global destination address. The global address indicates the SAE J1939 message is directed to all CAs on the network. The global address shall only be used as the destination address in an SAE J1939 message.

5.6.1.4 NULL Address (254)

The SAE J1939 address 254 is the NULL address. The NULL address shall only be used as the source (transmitter) address within an SAE J1939 message. There are only two permitted uses of the NULL address. The NULL address can be used with an Address Claimed PG when a CA is reporting it is unable to claim an SAE J1939 Address. The NULL address also can be used with a global Request for the Address Claimed when the Request PG is transmitted by a CA before it has claimed a source address.

5.6.2 Preferred Address

A preferred address is an SAE J1939 source address recommended to be the initial source address claimed by a CA that performs a particular system function. The objective of preferred address assignments is to minimize address arbitration during address claim. SAE J1939 has two classes of preferred addresses: global preferred addresses and industry group specific preferred addresses.

5.6.2.1 Global Preferred Addresses

Global preferred addresses specify the system function required to be performed by a CA to claim a source address in the global source address range, i.e., 0 to 127 and 248 to 253 (see 5.6.1.1). The CA that successfully claims the address shall have the system function and function instance identified by the address's system function assignment and shall declare the matching function in its NAME.

5.6.2.2 Industry Group Specific Preferred Addresses

Industry group specific preferred addresses specify the system function recommended to be performed by a CA to initially claim a source address in the dynamic address range, i.e., 128 to 247 (see 5.6.1.2). An industry group specific preferred address assignment is not a fixed or absolute assignment of a system function to that address. Since the industry group specific preferred address assignments are in the dynamic address range, the CA that successfully claims the address can have a system function that is different from the recommended system function assignment.

Historically, SAE J1939 had made industry group specific preferred address assignments in the dynamic address range. The industry group specific preferred addresses are intended as a means to minimize address arbitration on the SAE J1939 network by suggesting an initial (first) SAE J1939 address to claim for certain functions and instances. However, it became obvious it was not sustainable to uniquely issue preferred address assignments within most industry groups. In addition, too many components and systems had incorrectly treated these as fixed or absolute address assignments, often hard coding these addresses as the required address for certain system functions on the network. The lists of historical industry group specific preferred address assignments are on the "IG1 Source Addresses (B3)" through "IG5 Source Addresses (B7)" worksheets in SAE J1939DA.

5.6.3 Unique Addresses

A source address shall not be used by more than one CA on an SAE J1939 network or SAE J1939 network segment. Source addresses shall be unique on an SAE J1939 network or SAE J1939 network segment. The same source address may be used on different SAE J1939 network segments on the same system or vehicle if those SAE J1939 network segments are separated by a router or gateway. A particular source address can be associated with a different CA after each power up of the vehicle and can also vary from vehicle to vehicle.

5.6.4 Using an Address Not Claimed by a CA

A CA shall not send an SAE J1939 message with a source address that the CA has not claimed. A CA shall only send SAE J1939 messages using the source address that the CA has claimed. An exception is the NULL address, which a CA may use as the source address for the Address Claimed message and for a Global Request for Address Claimed prior to successfully claiming an address (see 5.6.1.4).

In some service modes, it can be necessary for a service tool or software programming tool to send SAE J1939 messages on behalf of a CA that is being serviced. For example, during ECU software reprogramming, an ECU can temporarily disable communication services. During such situations, a software programming tool can send Address Claimed messages using the CA's address to defend the CA's address while its communication services are disabled. This can be necessary so that the software programming can continue with the same CA address.

5.6.5 Address Imposters

An address imposter is a CA that sends SAE J1939 messages during normal system operation using a source address that was claimed by another CA on the same network. Devices acting as imposters can result in unexpected or damaging vehicle operation. Once a CA has successfully claimed and is using a given source address in normal operation, it is unacceptable for another CA on the same network segment to broadcast commands or data from that same given source address. Designers of a CA can take precautions to detect such imposters and take actions appropriate to the system under control.

For example, a CA that claimed an address can monitor the SAE J1939 network for messages sent using its own address but not sent by the CA. Appropriate actions can include setting a fault code as described in 5.13, or entering a default mode, etc.

5.7 Address Arbitration Capability

Address arbitration capability describes the capability of a CA to select an alternate source address if it loses address arbitration. For the purposes of the address claim protocol, there are two capability configurations: arbitrary address capable and single address capable. The address arbitration capability for a CA is indicated by the value in the arbitrary address capable field of its NAME.

5.7.1 Arbitrary Address Capable CA

An arbitrary address capable CA is a CA that is able to select and claim a source address from the dynamic address range, i.e., 128 to 247, and any applicable global preferred source address. If there is an applicable global source address for the CA function, this type of CA shall attempt to claim that address first before attempting to claim addresses in the dynamic address range.

An arbitrary address capable CA shall select and claim a different source address if it loses address arbitration for an address. An arbitrary address capable CA shall do this repeatedly, if necessary, until it successfully claims an address or until it has tried and failed to claim every one of those source addresses.

The Arbitrary Address Capable field in the NAME (see 5.5.1.1) shall be “1” (arbitrary address capable) for this type of CA. This Arbitrary Address Capable field value ensures that an Arbitrary Address Capable CA will lose address arbitration when a non-Arbitrary Address Capable CA is attempting to claim the same source address.

Arbitrary address capability is encouraged for all new CAs and devices. While arbitrary address capability is recommended for any CA, there are some types of CAs where this capability should be supported:

1. A CA where multiple instances can exist in a single vehicle or system, such as an engines, sensors, actuators, joysticks, window or door controllers, or network interconnect units.

2. A CA where it is can be normal for the CA to be moved from one vehicle or system to another, such as implements, data loggers, or calibration ECUs.

3. A CA where its function is not assigned to a global source address (see 5.6.1.1).

5.7.2 Single Address Capable CA

A single address capable CA is a CA that has only one source address that it will attempt to claim. This type of CA cannot select another source address if it loses address arbitration for an address.

The Arbitrary Address Capable field in the NAME (see 5.5.1.1) shall be 0 (zero) for this type of CA. This value ensures that a non-arbitrary address capable CA will win address arbitration when an arbitrary address capable CA is attempting to claim the same source address.

New CAs are recommended to be designed as arbitrary address capable. Single address capability has typically been used by a CA where the CA function has a global source address assignment (see 5.6.1.1). Use of single address capability for new CAs is discouraged due to the limited number of global source addresses.

There are four sub-classifications of single address capable CAs based upon the method for configuring the source address that the CA will claim. A single address capable CA is not limited to only one of these classifications. For example, a single address capable CA could be both a service configurable address CA and a command configurable address CA.

5.7.2.1 Non-Configurable Address CA

A non-configurable address CA is a single address capable CA that has one fixed source address value hardcoded in its software by its manufacturer. The source address value is not alterable by any means, including service procedures, other than replacing the software executing in the ECU with a CA that can claim a different source address.

5.7.2.2 Service Configurable Address CA

A service configurable address CA is a single address capable CA whose source address to claim can be changed in the field as part of a service procedure. The source address value to claim can be altered using the Commanded Address message while in a “service” mode of operation. The service procedure is likely performed by a service technician using a service tool.

5.7.2.3 Command Configurable Address CA

A command configurable address CA is a single address capable CA whose source address to claim can be changed during vehicle power up without the use of a service tool or without being in a special service mode of operation. The source address value to claim can be altered using the Commanded Address message sent from another CA on the vehicle. Command configurable address CA software should include functionality to recognize and authenticate the commanded address and its source.

5.7.2.4 Self-Configurable Address CA

A self-configurable address CA is a single address capable CA that can select one source address to claim from a predefined, limited set of source addresses, where each source address is associated to a specific configuration of the CA in a vehicle system. Like a non-configurable address CA, the set of source address values is not alterable by any means, including service procedures, other than replacing the software executing in the ECU with a CA that can claim a different source address. The CA should alter its NAME to coordinate with its specific configuration, such as its function instance, vehicle system instance, or ECU instance.

An example of this type of CA is a trailer bridge that could be in any position. In this example, the CA is programmed with a limited set of source addresses where each source address is specific to each possible position. When the trailer bridge CA determines it is Trailer 2 in a vehicle, the CA selects and claims the only source address designated for the Trailer 2 position, and it cannot select and claim any other source address while in this position. If that trailer is later moved to the Trailer 1 position, the CA selects and claims the only source address designated for the Trailer 1 position. There is only one address that is appropriate for use at each position; the CA first learns its position, updates its NAME for its position information, and finally selects and claims the appropriate address. Another example of this type of CA is a CA that uses information from a connector plug to determine whether it is controlling a function on the left or right side of the vehicle. The means by which the CA determines its position or system configuration is application specific.

5.7.3 Reprogrammable Preferred (Initial) Address

A CA’s initial address, the address the CA attempts to claim on first power-up, should be set by the manufacturer to match a preferred address wherever possible (see 5.6.2). A CA’s initial address is strongly recommended to be reprogrammable to permit an OEM to properly configure a vehicle. Although not always necessary for standard CAs (see 5.8.1), it provides flexibility for applications where multiple instances of a given CA (i.e., when there are two engines, etc.) can exist. This programmability feature is especially important for temporarily connected or aftermarket ECUs.

5.8 Types of CAs

For the purposes of network management, there are three types of CAs. Each type of CA has different behaviors and, therefore, different network management requirements. These differences are described in the following sections and the requirements are summarized in Table B1 in Appendix B.

5.8.1 Standard CA

A standard CA is a CA whose primary function is not that of network interconnection or of programming, diagnosing, or otherwise functioning as tools or network interconnection CAs. Standard CAs include those used for engines, transmissions, brakes, virtual terminals, instrument clusters, and vehicle navigation. Data loggers and recorders are also examples of standard CAs, but if these CAs assume diagnostic tool functions, then they shall meet requirements of diagnostic tool CAs (see 5.8.2). A standard CA does not have the ability to modify the source addresses of any other CAs except as a result of address arbitration as part of the address claim protocol.

A Standard CA can support any type of address arbitration capability (see 5.7).

Network management capabilities for a standard CA:

1. Shall support Address Claim Protocol.

2. Shall perform Address Claim Protocol and claim a source address before using the source address.

3. Shall transmit either an Address Claimed message or a Cannot Claim message upon receipt of any Request for Address Claimed message.

4. Shall retain its NAME and last claimed source address across power cycles unless it is capable of selecting an address or finding any available address.

5. Shall use the last source address it claimed on its previous power cycle when it transmits its first Address Claimed message after power up.

5.8.2 Diagnostic/Development Tool CA

A diagnostic or development tool CA is a CA which is connected to a particular SAE J1939 network or network segment for the purpose of analyzing, debugging, developing, or monitoring any CA on the network or the operation of the network itself. Although these tools are not expected to be permanently attached to a subnetwork, such a tool can be a permanent part of a particular vehicle or system. In either case, the capabilities of a diagnostic/development tool CA are more extensive than the capabilities of a standard CA. This type of CA is primarily designed to interact with other CAs on the network and have no other external functionality (a diagnostic tool, for example, is not expected to provide torque, plant beans, or control braking on a vehicle).

A diagnostic/development tool CA can be a general-purpose tool intended to interact with ECUs provided by any manufacturer. It can be a proprietary tool intended to interact with a specific manufacturer's CAs and ECUs or integrated into specific manufacturer's ECUs. Or it can be intended to work primarily on the network itself, providing network integration services for system integrators and OEM vehicle manufacturers.

Network management capabilities for a diagnostic/development tool CA:

1. Shall support all the network management capabilities of a standard CA, except for claiming last source address on power up.

2. Should support Commanded Address and NAME Management messages when needed by the system.

3. Should send a Request for Address Claimed before attempting to claim an address to identify addresses claimed by other tools in the system. This behavior facilitates multiple tools in a system without unnecessarily changing addresses due to address arbitration.

4. Should be able to have its address configured to avoid conflicts with other tools.

5. Should understand and support working sets if used in the system.

5.8.3 Network Interconnection CA

A network interconnection CA is a CA whose primary function is interconnecting networks or network segments. The four standard types of network interconnection devices are repeaters, bridges, routers, and gateways. In one manner or another, a network interconnection CA transfers frames, messages, and data from one network segment to another. These are sometimes known as Network Interface Units (NIUs). The network segments connected by a network interconnection CA can have the same data link layer protocol and address space; they can have the same data link layer protocol but different address spaces; or they can have different data link layer protocols. When network segments have the same address space, only one CA can use a source address among all the CAs connected to those network segments. When network segments have separate address spaces, the same address can be used by a different CAs on each network segment.

This document only applies to network interconnection CA connections to SAE J1939 network segments.

Network management capabilities for a network interconnection CA:

1. Shall support all the network management capabilities of a standard CA, except for claiming last source address on power up.

2. Should send a Request for Address Claimed before attempting to claim an address to identify addresses claimed by other network interconnect CAs in the system. This behavior facilitates multiple network interconnection CAs in a system without unnecessarily changing of addresses due to address arbitration.

3. Should support Commanded Address and NAME Management messages. This allows systems with multiple network segments and potentially multiple network interconnection CAs to be configured.

4. Should be able to have its address configured to avoid conflicts with other network interconnection CAs.

5. Can forward SAE J1939 messages between networks before the network interconnection CA has claimed an address.

6. Shall claim an address for CAs connected on another network, as required by the CA. Networks separated by a router or gateway can have different address spaces (router or gateway network interconnection CAs only).

5.9 Address Claim Protocol

The address claim protocol establishes a unique source address for each CA on an SAE J1939 network during run time. It is used by a CA to claim an SAE J1939 address, maintain claim to a source address, and arbitrate for a source address when the same address is claimed by multiple CAs. The address claim protocol is a set of CA behaviors associated with transmitted and received Address Claimed PG messages. A CA shall be able to transmit the Address Claimed PG and to receive the Address Claimed PG.

As part of the protocol, a CA transmits the Address Claimed PG to announce its claim to an SAE J1939 source address. A CA successfully claims a source address when there is no other Address Claimed PG for the same address (contending Address Claim) within a specific time period after sending the Address Claimed PG. If a CA has successfully claimed a source address, the CA retains claim to the source address until there is a contending Address Claim with higher priority to the address. The initial Address Claim PG transmitted by a CA may be transmitted unsolicited. All other Address Claimed messages shall transmitted either in response to a Request for Address Claimed, or in response to a contending address claim. If a CA is unable to claim any address due to contending Address Claim messages, then the CA transmits a special form of the Address Claimed message, called the Cannot Claim Address message, to announce the CA cannot claim an SAE J1939 source address.

As part of the protocol, a CA receives Address Claimed messages to monitor for a contending address claim. When a CA receives a contending address claim, the CA shall evaluate the NAME to determine the priority of the claim. A CA shall send an Address Claimed message in response to a contending Address Claim. If the CA has a higher priority NAME, the CA shall send an Address Claimed PG for that address – this reasserts the CA's claim to the address and will be received as a contending address claim by the other CA. If a CA has a higher priority claim but doesn't send an Address Claimed message for that address, then the CA is relinquishing its claim to that address. If the CA has a lower priority claim, the CA shall send either an Address Claimed message for a different address or a Cannot Claim Address message.

A CA shall follow the protocol, even if the CA can only send the Request message. A CA shall follow the protocol, regardless of whether the CA is attempting to claim a global preferred address or a dynamic address. A CA shall successfully claim an address before it transmits messages on an SAE J1939 network. A CA can transmit messages once it successfully claims an address. Prior to successfully claiming an address, a CA can send a Global Request for Address Claimed (GRAC) using the NULL source address to identify addresses claimed by other CAs.

A CA also receives Address Claimed messages to determine the address for specific system functions. The NAME (and system function) associated with an address is the NAME from the last (most recent) Address Claimed message for that address. A CA can send a GRAC message to solicit the Address Claimed PG from all CAs so the CA can discover each connected system function and its address.

5.9.1 Address Claim Requirement

A CA shall successfully claim an address before it may transmit and receive SAE J1939 messages using that address. A CA shall claim an address after completing its own Power On Self Test (POST), and whenever the CA's NAME changes (such as in response to the NAME Management PG, or when the CA is required to change its address in response to the Commanded Address PG).

If a CA is unable to claim an address or the CA hasn't attempted to claim an address, then the CA shall limit its transmitted SAE J1939 messages to those messages permitted for a CA without a claimed address (see 5.9.3).

5.9.2 Address Claim Operation

Address claim protocol consists of the following CA behaviors:

1. A CA shall send an Address Claimed PG for the address it is claiming. The Address Claimed PG is sent with the CA's NAME in the PG data and with the address being claimed as the source address. See 5.9.4.

2. A CA can send its first Address Claimed message unsolicited. After the first Address Claimed message, a CA shall send the Address Claimed message in response to a contending address claimed and in response to a Request for Address Claimed.

3. A CA shall be able to receive the Address Claimed message, including messages with a source address that matches the address claimed by the CA. See 5.9.5.

4. A CA shall monitor received Address Claimed messages for a contending address claim. A contending address claim is an Address Claimed message with a source address that matches the address the CA has claimed. See 5.9.3.

5. A CA shall use the NAME to determine priority (see 5.9.5) versus the contending address claim and to compose the Address Claimed message to send in response: If a CA wins address Arbitration over a contending Address Claim, then the CA shall send an Address Claimed message for its address to maintain its claim to the address. If a CA loses address arbitration to a contending address claim, then the CA shall send either an Address Claimed message for a different address or a Cannot Claim Address message (see 5.9.4.2).

6. A CA successfully claims an address as specified in 5.9.9. Upon successfully claim of an address, the CA can transmit and receive SAE J1939 messages using that address.

7. Once a CA has successfully claimed an address, the CA can continue to transmit and receive SAE J1939 messages using that address until it loses the address to a contending address claim, or the CA claims a different source address such as in response to a Commanded Address message.

8. If a CA loses an address a contending address claim, then the CA shall terminate all queued SAE J1939 messages and transport protocol session using that address (see 5.9.5).

5.9.3 Permitted Messages without a Claimed Source Address

A CA can only send requests for Address Claimed messages (see 5.9.13) and Cannot Claim Address messages (see 5.9.4.2) when the CA does not have a claimed source address: before the CA sends its first Address Claimed message and when the CA is unable to claim an address. In these cases, the CA shall use the NULL address as the source address for these messages.

5.9.4 Address Claimed PG (PGN 60928)

The Address Claimed message is a network management message used by a CA to claim an SAE J1939 address or to announce that the CA is unable to claim an address. The source address of the Address Claimed message is the source address being claimed. The data content of the Address Claimed message is the NAME of the CA that transmitted the message. When the Address Claimed message source address is the NULL address (254), that instance of the Address Claimed message is called a Cannot Claim Address message (see 5.9.4.2).

The Address Claimed message shall always be sent to the global address (255). This is necessary so all CAs will receive the Address Claimed message to monitor for contending address claims and to maintain address to NAME associations. The Address Claimed message shall be sent to the global address (255) even when sent in response to a destination specific Request for Address Claimed. The Address Claimed message is an exception to the requirements on Request message response behavior specified in SAE J1939-21 and SAE J1939-22.

A CA shall send the Address Claimed message:

1. To claim its initial address. This can be sent unsolicited or in response to a Request for Address Claimed.

2. When it receives a Request for Address Claimed. A CA shall not respond to a Request for Address Claimed if the CA has not yet attempted to claim an address.

3. When it receives a contending address claim. The Address Claimed message sent by the CA in response can be for the same source address, a different source address, or it can be a Cannot Claim Address message.

There is the possibility of CAN bus errors occurring when multiple CAs simultaneously send Address Claimed messages for the same source address but with different NAMEs. CAN bus errors occur because the NAMEs in the data field are different (the CAN arbitration field is the same for all of the CAN data frames). To minimize the probability of CAs generating bus errors until going bus off, a CA shall use a transmit delay when transmitting the Address Claimed message, as specified in 5.9.14. This is also true for simultaneous Cannot Claim Address messages.

Configuration of networks with multiple bridges can create significant delay between transmission and reception of address claims that traverse the bridges. The 250 ms delay can be inadequate in these systems to prevent further arbitration after a CA has successfully claimed an address.

Transmission Rate:	As required
Data Length:	8 bytes
Data Page	0
PDU Format:	238
PDU Specific:	255 (global address)
Default Priority:	6
Parameter Group Number:	60928 ($00EE00_{16}$)
Source Address:	0 to 253 (Address claimed for the Controller Application) 254 (Cannot Claim Address message. See 5.9.4.2.)

NAME can be viewed as a single 64-bit parameter:

Start Position	Length	Parameter Name	SPN
1-8	64 bits	NAME of Controller Application	2848 (see 5.9.4.1)

NAME can also be viewed as individual field parameters:

Start Position	Length	Parameter Name	SPN
1-3.1	21 bits	Identity Number	2837 (see 5.5.1.10)
3.6-4	11 bits	Manufacturer Code	2838 (see 5.5.1.9)
5.1	3 bits	ECU Instance	2840 (see 5.5.1.8)
5.4	5 bits	Function Instance	2839 (see 5.5.1.7)
6	8 bits	Function	2841 (see 5.5.1.6)
7.1	1 bit	Reserved	(see 5.5.1.5)
7.2	7 bits	Vehicle System	2842 (see 5.5.1.4)
8.1	4 bits	Vehicle System Instance	2843 (see 5.5.1.3)
8.5	3 bits	Industry Group	2846 (see 5.5.1.2)
8.8	1 bit	Arbitrary Address Capable	2844 (see 5.5.1.1)

5.9.4.1 NAME of Controller Application

The SAE J1939 NAME (see 5.5) of the CA that is claiming the associated address.

5.9.4.2 Cannot Claim Address Message

The Cannot Claim Address message is a specific instance of the Address Claimed message where the source address is 254, the NULL address. The Cannot Claim Address message announces that the CA, whose NAME is in the PG data, has attempted to claim an address but has been unable to claim any address. A CA shall send a Cannot Claim Address message after it loses address arbitration for its final possible address. The Cannot Claim Address message shall not be sent by a CA until it has attempted to claim an address.

5.9.5 Receiving Address Claimed PG

A CA shall be able to receive the Address Claimed message, including messages sent with the source address claimed or being claimed by the CA. A received Address Claimed message shall be used to monitor for a contending address claim (see 5.9.8) and to associate the source address to system function (see 5.9.12).

5.9.6 Address Arbitration

Address arbitration is the operation a CA performs to determine its Address Claimed message response to a contending address claim. Address arbitration is resolved by comparing the CA's NAME to the NAME from the contending Address Claimed message.

Priority to a source address is determined by comparing the NAMEs as 8-byte numeric values, where the Arbitrary Address Capable bit is the most significant bit of the most significant byte (see 5.5). Although this requires comparison of 8-byte NAMEs, it eliminates ambiguity in the address claiming process. Address arbitration is illustrated in Figures A2 and A3 in Appendix A.

If the CA's NAME is numerically lower than the NAME from the contending Address Claimed message, then the CA has priority to the address, i.e., it wins address arbitration.

If the CA's NAME is numerically higher than the NAME from the contending Address Claimed message, then the CA does not have priority to the address, i.e., it loses address arbitration.

The Address Claimed message sent by the CA depends on the priority evaluation:

1. If a CA wins address arbitration (has priority) over a contending address claim, then the CA shall send an Address Claimed message for the address to maintain its claim to the address. This announces the CA's claim to the address which will be received by the contending CA as a contending address claim.

2. If a CA wins address arbitration over a contending address claim, but the CA does not send an Address Claimed message for that same address, then the CA loses its claim to that address and the CA shall terminate any messages, as specified in 5.9.10.

3. If a CA loses address arbitration to a contending address claim and the CA has another address it can claim, then the CA shall send an Address Claimed message for a different source address. The CA shall terminate any messages, as specified in 5.9.10.

4. If a CA loses address arbitration to a contending address claim and the CA has no other source address to claim, then the CA shall send a Cannot Claim Address message (see 5.9.4.2). The CA shall terminate any messages, as specified in 5.9.10.

5.9.6.1 Arbitration Exceptions

As a result of their own safety and security analyses, system integrators may request that suppliers implement some exceptions or deviations to address arbitration rules. This is to mitigate the impact of bad actors on the system. For example: The manufacturer of a critical CA may be asked to retain its claimed source address and not be forced off the network by a device claiming to be that CA or claiming a higher priority NAME. If the CA recognizes the attempt, it may take remedial actions, possibly including sending diagnostic messages and safeguarding its functions as specified in 5.6.5. System designs that implement Address Arbitration process deviations should recognize the possible adverse consequences these deviations can impose on other devices within the system. Exceptions should be implemented in a way that do not force deviations to be implemented into non-system specific CAs, or any extended or external systems.

5.9.7 Selecting a Source Address to Claim

The initial source address claimed by a CA should be the CA's preferred address. If the CA is a standard CA (see 5.8.1), the CA's initial address should be the address the CA successfully claimed on its previous power cycle.

Prior to claiming an address, a CA can send a destination specific Request for Address Claimed message to the selected address to determine if the address is already claimed by another CA. This is the preferred approach since it minimizes the number of Address Claimed message in response. This is illustrated in Figure A5 in Appendix A.

Prior to claiming an address, a CA can send a Global Request for Address Claimed (GRAC) message to determine all addresses claimed by other CAs so the CA can select an address that has not been claimed. A GRAC message results in an Address Claimed message from each CA on the network. This is illustrated in Figure A6 in Appendix A.

The CA manufacturer shall define the method used by a CA to select another source address after losing address arbitration. If a CA loses address arbitration for its last possible address, then the CA shall send a Cannot Claim Address message.

5.9.8 Contending Claim for a Source Address

A CA shall receive Address Claimed messages to monitor for a contending claim to its address. A contending claim for an address, known as a contending address claim, is a received Address Claimed message with a source address that matches the address claimed or being claimed by the receiving CA (and the NAME in the received Address Claimed message is not the same as the receiving CA's NAME). If a CA receives all Address Claimed messages, including those it transmits, then the CA shall be able to identify messages it transmitted so that the CA doesn't treat them as contending address claims.

A CA shall send an Address Claimed message every time the CA receives a contending address claim. The Address Claimed message to be sent is determined by the result of address arbitration (see 5.9.6).

5.9.9 Successful Claim of a Source Address

A CA successfully claims an address when the CA sends an Address Claimed message for an address and there is no contending Address Claimed message within a specific period of time after the CA's Address Claimed message. The specific period of time is different for claims for a global preferred address and claims for a dynamic address.

1. When a CA is claiming a global preferred address, the claim is considered successful immediately after sending the Address Claimed message, effectively 0 ms after the Address Claimed message sent by the CA.

2. When a CA is claiming a dynamic address, the CA successfully claims the address when there has been no contending Address Claimed message within 250 ms after the Address Claimed message sent by the CA.

5.9.10 Losing a Claimed Source Address

Address arbitration can occur even after a CA has successfully claimed an address. If a CA has successfully claimed an address, then loses address arbitration to a contending Address Claim, the CA shall terminate any queued SAE J1939 messages using the lost address.

1. The CA shall terminate all queued SAE J1939 messages using the lost source address within the timeout and constraints specified in SAE J1939-21 and SAE J1939-22.

2. If the CA is the originator of an active transport protocol (TP) session, then the CA shall terminate any queued transport protocol SAE J1939 messages and the CA shall not send a transport protocol abort. The recipients of each TP session shall detect the TP session interruption through the normal TP timeouts, as specified in SAE J1939-21 and SAE J1939-22.

3. If the CA is the recipient of an active RTS/CTS TP session, then the CA shall terminate any queued TP SAE J1939 messages for that session and the CA shall not send a transport protocol abort. The originator of the RTS/CTS TP session shall detect the TP session interruption through the normal TP timeouts, as specified in SAE J1939-21 and SAE J1939-22.

4. If the CA is the recipient of a BAM TP session, then the CA can continue to receive SAE J1939 messages for the BAM TP session.

The above actions also apply if the CA claims a different source address after successfully claiming a source address, such as in response to a Commanded Address message or NAME Management message.

Other CAs shall use received Address Claimed messages to determine if a system function (by NAME) has changed its address or is unable to claim an address.

5.9.11 Cannot Claim a Source Address

Cannot Claim a Source Address refers to an operational state where a CA has no other source address to claim. A CA enters this operational state when the CA loses address arbitration and the CA has no other address to claim. A single address capable CA (see 5.7.2) enters this operational state when the CA loses address arbitration for its only possible address. An arbitrary address capable CA (see 5.7.1) will enter this state only after it has attempted to claim all dynamic source addresses which it is capable of using.

When a CA enters this operational state:

1. The CA shall send a Cannot Claim Address message (see 5.9.4.2).

2. The CA shall terminate any queued messages, as specified in 5.9.10.

When a CA is in this operational state:

1. The CA shall limit its SAE J1939 message transmissions to the permitted messages for a CA without a claimed source address (see 5.9.3).

2. The CA shall send a Cannot Claim Address message (see 5.9.4.2) in response to a Request for Address Claimed.

5.9.12 Address to NAME Association Management

A CA should use received Address Claim messages to catalog or identify the address to NAME associations for other CAs in the system. Cataloging the address to NAME associations allows a CA to identify the system function (i.e., NAME) that sent or will received a message and allows a CA to identify the address to use when sending message to a particular system function. When cataloging the source address to NAME association from received Address Claimed messages, the NAME associated to an address shall be the NAME in the PG data from the last (most recent) Address Claimed message with that source address. A CA can catalog the source address to NAME association for all claimed source addresses or a CA can catalog only those source addresses associated to NAMEs (system functions) required for the CA communications.

Due to the dynamic nature of SAE J1939 addresses, a CA should be programmed using a system function based model instead of an address based model for its SAE J1939 communications. In a system function based model, the CA is coded with the system functions, i.e., by NAME or subset of NAME (see 5.5.4), that are permissible originators for each message it can receive and coded with the system functions, i.e., by NAME or subset of NAME (see 5.5.4), that are recipients for each message it transmits. At run time, the CA can catalog the source address to NAME associations by monitoring the Address Claimed messages and use those associations to resolve addresses when sending and receiving SAE J1939 messages. When receiving a message, the CA can use the cataloged data to get the NAME (and system function) associated with the source address from the message. When sending a message to a particular system function, the CA can use the cataloged data to get the address associated to the particular system function (by NAME or NAME subset) and used that address as the destination address for the message.

A Global Request for Address Claimed (see 5.9.13) is an effective method for a CA to build or refresh its catalog of the address to NAME associations for all CAs, regardless of if the GRAC was sent by the CA or by another CA the network. A GRAC is also effective for identifying and removing NAME and address associations for addresses that were claimed by CAs no longer connected to the network.

A destination specific Request for Address Claimed can be an effective method for confirming NAME and address associations, especially for functions with global preferred addresses. For example, the transmission CA sends a destination specific Request for Address Claimed to address 0 (Engine 1) to confirm a powertrain engine CA has claimed address 0.

5.9.13 Request for Address Claimed

Request for Address Claimed is an alias for the Request PG (PGN 59904) for the Address Claimed PG (PGN 60928). It refers to an instance of the Request message with the PGN of the Address Claimed PG as its data. The Request for Address Claimed may be sent to any particular address (0 to 253) or to the global address (255).

A Global Request for Address Claimed (GRAC) refers to a Request for Address Claimed sent to the global address (255). A GRAC results in an Address Claimed message from every CA on the network. A GRAC is useful to identify the address associated to a one or more system functions (per NAME in the Address Claimed PG) and to compile the NAME and address associations for all CAs on the network.

A destination specific Request for Address Claimed refers to a Request for Address Claimed sent to a particular address. A destination specific Request for Address Claimed is useful when a CA is preparing to claim a particular address and wants to determine if another CA has already claimed that address. A destination specific Request for Address Claimed is also useful when a CA has detected a loss of communication with a particular address and wants to “ping” that address.

The Request for Address Claimed may be sent using the NULL address (254) as the message source address when the request is sent by CA that has not yet claimed an address. This allows a CA to determine if a specific address has already been claimed or to discover the addresses that have not been claimed yet.

5.9.13.1 Response to a Global Request for Address Claimed (GRAC)

A CA shall respond to a GRAC. The CA that sent the GRAC shall respond to its own GRAC.

1. A CA shall respond with an Address Claimed message using its claimed address or the address it is attempting to claim.

2. A CA shall respond with a Cannot Claim Address message if it has attempted to claim each of its possible addresses and has been unable to claim an address.

3. If a CA has not sent an Address Claimed message for its initial source address, then the CA can respond with the Address Claimed message for its initial source address; otherwise, the CA shall not respond to the GRAC.

5.9.13.2 Response to a Destination Specific Request for Address Claimed

A CA shall respond to a destination specific Request for Address Claimed only if the CA has claimed the address or the CA is attempting to claim the address. The CA shall respond with an Address Claimed message using its claimed address or the address it is attempting to claim. The Address Claimed message shall be sent to the global address (255), as specified in 5.9.4.

5.9.14 Address Claim Bus Collision Management

If multiple CAs with different NAMEs are claiming the same address, simultaneous Address Claimed messages by two or more of those CAs can result in bus errors. Similarly, if multiple CAs with different NAMEs are using the NULL address (Cannot Claim Address), simultaneous Address Claimed messages by two or more of those CAs can result in bus errors.

To minimize the probability of generating bus errors until going bus off, the following special processing shall be used when transmitting Address Claimed messages:

1. After transmitting an Address Claimed message, the transmitting CA shall monitor error code information. If an error code indicates that a bus error has occurred, any automatic retransmission attempts by the CAN controller should be canceled if possible.

2. The retransmission of the Address Claimed message shall be re-scheduled after end of frame plus a transmit delay.

3. The transmit delay shall be calculated to produce a pseudo-random value between 0 and 255. The NAME, ECU serial number, or other unique information within the CA shall be selected by the manufacturer to seed the pseudo-random number generator. The transmit delay shall be added to the normal idle period before the next Address Claimed message is transmitted. The next Address Claimed message shall be scheduled within ±0.6 ms of the calculated delay.

4. The delay shall be calculated by multiplying the 0 to 255 output of the pseudo-random number generator by 0.6 ms producing a delay range of 0 to 153 ms. If a second Address Claimed message transmission results in a bus error, the process shall be repeated with a new pseudo-random number.

The manufacturer of a CA should consider design solutions to minimize simultaneous initial Address Claimed messages particularly for an arbitrary address capable CA, or self-configurable address CA when multiple instances of the CA can be connected to a system. Design considerations can be solutions that compute random delays to minimize the probability the CAs issue initial Address Claimed PGs at the same time or solutions that can minimize the probability the CAs issue initial Address Claimed messages for the same address. Multiple instances of the same CA have the same initialization operations resulting in higher probability of simultaneously issuing initial Address Claimed messages for the same address and resulting in bus errors.

Figure A4 illustrates the process of simultaneous Address Claimed messages by two CAs with the same address.

5.9.15 Address Claim Protocol Message Sequences

Graphical schematics of the address claim protocol sequences for the different CAs under the various potential conditions are provided in Figures A1 to A7 in Appendix A. The conditions under which each figure applies are specified in the paragraphs below. The address and NAME prioritization process used in the figures is presented in 5.9.4. State transition diagrams describing address claiming processes are presented in Figures D1, D2, and D3 in Appendix D.

5.9.15.1 Message Sequences with Multiple CAs on the Network

Message sequences for the Address Claim Protocol with multiples CAs on the network are shown in Figures A1, A2, A3, and A4. The conditions included in these figures are:

1. CA with address claim and no contention
2. Two single address capable CAs attempt to claim the same address but not simultaneously
3. CA where NAME A is less than NAME B and CA B is self-configurable or arbitrary address capable
4. Two CAs attempting to claim the same address simultaneously

5.9.15.2 Message Sequences for a CA That Cannot Claim an Address

The message sequence for responding to a Request for Address Claimed by a CA that is unable to successfully obtain an address (see 5.9.11) is shown in Figure A8. The CA shall respond to a Request for Address Claimed with a Cannot Claim Address message after a transmit delay. In the case where there is a collision of the Cannot Claim Address messages, the process in 5.9.14 shall be used.

5.10 Commanded Address (PGN 65240)

The Commanded Address message is a network management message used by one CA to instruct another CA with a specific NAME to claim a specific address. The data content of the Commanded Address message contains a NAME and the new address. The NAME is the NAME of the CA (target CA) that is the intended recipient of the Commanded Address message. The address value is the address the target CA is requested to claim. The Commanded Address message is commonly sent by a network interconnection CA or a diagnostic scan tool to another CA on the network. Figures A9 and A10 illustrate the Commanded Address message to instruct a target CA with a specific NAME to use a specific address.

When a CA receives a Commanded Address message where the CA's NAME matches the NAME in the data of the Commanded Address message, then the CA can either send an Address Claimed message to claim the specified address or ignore the command by sending no response.

A state transition diagram describing the process for handling a commanded address is presented in Figure D3. Note that if the target CA does not accept the commanded address, an operator or technician must modify the CA's address or NAME through alternate means for the network to operate. If the address or NAME is modified, the CA shall claim the address before originating transmissions on the network. A CA manufacturer may elect not to accept Commanded Address messages from CAs other than service tools or network interconnection devices. Further, CA manufacturers may require some type of security verification process before accepting a Commanded Address message.

The Commanded Address message shall use the Broadcast Announce Mode (BAM) transport protocol when communicated on an SAE J1939-21 network segment.

Transmission Rate:	As required
Acknowledgement:	See Figures A9 and A10
Data Length:	9 bytes
Data Page:	0
PDU Format:	254
PDU Specific:	216
Default Priority:	6
Parameter Group Number:	65240 ($00FED8_{16}$)

NAME of Commanded Address Target

Start Position	Length	Parameter Name	SPN
1-3.1	21 bits	Identity Number	2837 (see 5.5.1.10)
3.6-4	11 bits	Manufacturer Code	2838 (see 5.5.1.9)
5.1	3 bits	ECU Instance	2840 (see 5.5.1.8)
5.4	5 bits	Function Instance	2839 (see 5.5.1.7)
6	8 bits	Function	2841 (see 5.5.1.6)
7.1	1 bit	Reserved	(see 5.5.1.5)
7.2	7 bits	Vehicle System	2842 (see 5.5.1.4)
8.1	4 bits	Vehicle System Instance	2843 (see 5.5.1.3)
8.5	3 bits	Industry Group	2846 (see 5.5.1.2)
8.8	1 bit	Arbitrary Address Capable	2844 (see 5.5.1.1)

Address Assignment

Start Position	Length	Parameter Name	SPN
9.1	8 bits	New Source Address	2847 (see 5.10.1.2)

5.10.1.1 NAME of Commanded Address Target (SPN 2849)

Identifies the particular CA to which the commanded address is being directed.

Data Length:	8 Bytes
Resolution:	One NAME per bit
Data Range:	0 to 18446744073709551615
Type:	Measured
Suspect Parameter Number:	2849
Reference:	5.10

5.10.1.2 Address Assignment (New Source Address) (SPN 2847)

This 8-bit field contains the address that is being requested to be claimed by the CA whose NAME matches the NAME conveyed in the first 8 bytes of the PG data.

Data Length:	1 Byte
Resolution:	One address per bit
Data Range:	0 to 253
Type:	Measured
Suspect Parameter Number:	2847
Reference:	5.10

5.11 NAME Management

5.11.1 Overview

The NAME Management message can be used to change fields of the NAME of a CA when configuring a network containing CAs with multiple instances of functions, ECUs, or vehicle systems. Changing the function of a generic ECU is another possible use of this message. This message is also useful when configuration by harness strapping or other methods of uniquely identifying CAs are not available. This message can be used in conjunction with manual setup steps and/or with the Commanded Address method to accomplish the configuration of the network.

One CA (commanding CA) may command another CA (target CA) to use a given NAME by using the NAME Management message. This message shall be used to instruct a target CA with a specific address to replace some fields of its NAME with newly specified values.

Although memory access can be used to modify the NAME fields, the NM method requires only an 8-byte message. This message requires less overhead to implement than the memory access method which requires transport protocol on SAE J1939-21 networks. This is advantageous for simple units or functions such as sensors which can be connected in multiples to a network. All but one of the fields of NAME can be modified with this message. The primary use of this message is to set the instance fields in the NAME, but all of the NAME fields can be modified by using this message except the identity number field which is to remain unchanged after initial manufacture.

It is optional for a CA to support the NAME Management message. If the message is supported, then the ECU manufacturer can limit the use of the message by not accepting it from CAs other than, e.g., service tools or network interconnect units. ECU manufacturers can also require additional security verification processes before accepting a NAME Management message. The ECU manufacturer can further limit the use of the message by only accepting changes to a subset of the fields of the NAME, e.g., the instance fields.

The CA commanding the changes to NAME fields shall correctly identify the addresses of CAs being changed prior to using this command. Commands are directed to addresses.

5.11.2 NAME Management (NM) PG (PGN 37632)

The NM message is used to manage the assignment of fields of the CA's NAME during a configuration of the network. The NM message contains 8 bytes of data and is sent as a destination specific (PDU1) message. Depending on the NM Control Mode, the message is either sent to the global address or to the address of the CA to be modified. The NM message can be sent from the commanding CA to a target CA and from the target CA to a commanding CA. An NM message sent from the target CA to the commanding CA is sent in response to an NM message from the commanding CA to the target CA.

There are two main users and several uses of the message:

1. A commanding CA (service tool or other ECU) can:
    a. Command a target CA to adopt a new pending NAME
    b. Request a pending or current NAME from a target
    c. Announce to one or more target CAs that they shall adopt their pending NAME
    d. Request that a CA with a specified NAME transmit the address claim message with its current NAME
2. A target CA can:
    a. Respond to requests for pending or current NAME
    b. ACK or NACK a command to change pending NAME
    c. Adopt a new NAME and send an Address Claimed message with its new NAME
    d. Send its Address Claimed message in response to a request for matching NAME

The Control Mode indicator, always sent in the least significant 4 bits of Byte 3, indicates how the NM message is being used. The other parameters are used for some modes but not all. When not used for a specific mode, the unused parameters shall be set to all 1s. Parameters used for each mode are shown in Table 3.

Transmission Rate: On request
Data Length: 8 bytes
Extended Data Page: 0
Data Page: 0
PDU Format: 147
PDU Specific: DA, Source address of the Controller Application whose NAME is to be modified
Default Priority: 6
Parameter Group Number: 37632 (009300h)
Data: See Table 3

Table 3 - NM PG data parameters

Start Position	Length	Parameter Name	SPN	Parameter Used in Modes	Ref Section
1	8 bits	NAME Checksum/Error Code	5657	Modes 0,4	5.11.2.1
2.1	1 bit	Manufacturer Code qualifier flag	5658	Modes 0,8	5.11.2.2
2.2	1 bit	ECU Instance qualifier flag	5659		5.11.2.3
2.3	1 bit	Function Instance qualifier flag	5660		5.11.2.4
2.4	1 bit	Function qualifier flag	5661		5.11.2.5
2.5	1 bit	Vehicle System qualifier flag	5662		5.11.2.6
2.6	1 bit	Vehicle System Instance qualifier flag	5663		5.11.2.7
2.7	1 bit	Industry Group qualifier flag	5664		5.11.2.8
2.8	1 bit	Arbitrary Address Capable qualifier flag	5665		5.11.2.9
3.1	4 bits	NM Control Mode Indicator	5666	ALL Modes	5.11.2.10
3.5	1 bit	Reserved			
3.6-4	11 bits	Commanded Manufacturer Code[(a)]	5667	Modes 0,1,2,3,8	5.11.2.11
5.1	3 bits	Commanded ECU Instance[(a)]	5668		5.11.2.12
5.4	5 bits	Commanded Function Instance[(a)]	5669		5.11.2.13
6	8 bits	Commanded Function[(a)]	5670		5.11.2.14
7.1	1 bit	Reserved			
7.2	7 bits	Commanded Vehicle System[(a)]	5671	Modes 0,1,2,3,8	5.11.2.15
8.1	4 bits	Commanded Vehicle System Instance[(a)]	5672		5.11.2.16
8.5	3 bits	Commanded Industry Group[(a)]	5673		5.11.2.17
8.8	1 bit	Commanded Arbitrary Address Capable[(a)]	5674		5.11.2.18

[(a)] These parameters shall be populated when their corresponding qualifier flag parameter is set to 0. When their qualifier flag parameter is set to 1, the parameter shall be set to all 1s.

The contents and interpretation of each parameter of the NM message are detailed in the following sections. Table 4 summarizes how each parameter is used in each of the various modes.

Table 4 - Parameter use by mode

	Modes								
	0	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
	Set Pending NAME	**Pending NAME Response**	**Current NAME Response**	**Set Pending NAME ACK**	**Set Pending NAME NACK**	**Request Pending NAME**	**Request Current NAME**	**Adopt Pend NAME**	**Request Address Claim**
NAME Checksum/Error Code	NAME Checksum	NA, Set to FFh	NA, Set to FFh	NA, Set to FFh	Error Code	NA, Set to FFh	NA, Set to FFh	NA, Set to FFh	NA, Set to FFh
Manufacturer Code Qualifier Flag	Flag Value	NA, Set to 1	NA, Set to 1	NA, Set to 1	Note 2	NA, Set to 1	NA, Set to 1	NA, Set to 1	Flag Value
ECU Instance Qualifier Flag	Flag Value	NA, Set to 1	NA, Set to 1	NA, Set to 1	Note 2	NA, Set to 1	NA, Set to 1	NA, Set to 1	Flag Value
Function Instance Qualifier Flag	Flag Value	NA, Set to 1	NA, Set to 1	NA, Set to 1	Note 2	NA, Set to 1	NA, Set to 1	NA, Set to 1	Flag Value
Function Qualifier Flag	Flag Value	NA, Set to 1	NA, Set to 1	NA, Set to 1	Note 2	NA, Set to 1	NA, Set to 1	NA, Set to 1	Flag Value
Vehicle System Qualifier Flag	Flag Value	NA, Set to 1	NA, Set to 1	NA, Set to 1	Note 2	NA, Set to 1	NA, Set to 1	NA, Set to 1	Flag Value
Vehicle System Instance Qualifier Flag	Flag Value	NA, Set to 1	NA, Set to 1	NA, Set to 1	Note 2	NA, Set to 1	NA, Set to 1	NA, Set to 1	Flag Value
Industry Group Qualifier Flag	Flag Value	NA, Set to 1	NA, Set to 1	NA, Set to 1	Note 2	NA, Set to 1	NA, Set to 1	NA, Set to 1	Flag Value
Arbitrary Address Capable Qualifier Flag	Flag Value	NA, Set to 1	NA, Set to 1	NA, Set to 1	Note 2	NA, Set to 1	NA, Set to 1	NA, Set to 1	Flag Value
NM Control Mode Indicator	0	1	2	3	4	5	6	7	8
Reserved	1	1	1	1	1	1	1	1	1
Commanded Manufacturer Code	New Value if Flag = 0, All 1s if Flag = 1	Field Value of Pending NAME	Field Value of Current NAME	Field Value of Pending NAME	NA, Set to all 1s	NA, Set to all 1s	NA, Set to all 1s	NA, Set to all 1s	Field Value of Current NAME
Commanded ECU Instance	New Value if Flag = 0, All 1s if Flag = 1	Field Value of Pending NAME	Field Value of Current NAME	Field Value of Pending NAME	NA, Set to all 1s	NA, Set to all 1s	NA, Set to all 1s	NA, Set to all 1s	Field Value of Current NAME
Commanded Function Instance	New Value if Flag = 0, All 1s if Flag = 1	Field Value of Pending NAME	Field Value of Current NAME	Field Value of Pending NAME	NA, Set to all 1s	NA, Set to all 1s	NA, Set to all 1s	NA, Set to all 1s	Field Value of Current NAME
Commanded Function	New Value if Flag = 0, All 1s if Flag = 1	Field Value of Pending NAME	Field Value of Current NAME	Field Value of Pending NAME	NA, Set to all 1s	NA, Set to all 1s	NA, Set to all 1s	NA, Set to all 1s	Field Value of Current NAME
Reserved	1	1	1	1	1	1	1	1	1
Commanded Vehicle System	New Value if Flag = 0, All 1s if Flag = 1	Field Value of Pending NAME	Field Value of Current NAME	Field Value of Pending NAME	NA, Set to all 1s	NA, Set to all 1s	NA, Set to all 1s	NA, Set to all 1s	Field Value of Current NAME
Commanded Vehicle System Instance	New Value if Flag = 0, All 1s if Flag = 1	Field Value of Pending NAME	Field Value of Current NAME	Field Value of Pending NAME	NA, Set to all 1s	NA, Set to all 1s	NA, Set to all 1s	NA, Set to all 1s	Field Value of Current NAME
Commanded Industry Group	New Value if Flag = 0, All 1s if Flag = 1	Field Value of Pending NAME	Field Value of Current NAME	Field Value of Pending NAME	NA, Set to all 1s	NA, Set to all 1s	NA, Set to all 1s	NA, Set to all 1s	Field Value of Current NAME
Commanded Arbitrary Address Capable	New Value if Flag = 0, All 1s if Flag = 1	Field Value of Pending NAME	Field Value of Current NAME	Field Value of Pending NAME	NA, Set to all 1s	NA, Set to all 1s	NA, Set to all 1s	NA, Set to all 1s	Field Value of Current NAME

Note 1: NA = Not Applicable

Note 2: When Error Code is set to 1 or 2, this flag is set to 1 if this is the disallowed item; otherwise, this flag is set to 0. For all other values of Error Code, this flag is set to 1.

5.11.2.1 NAME Checksum/Error Code (SPN 5657)

When the NM Control Mode Indicator is set to Mode 0 “Set Pending NAME,” NAME checksum is used as a check to ensure the NM message has been sent to the correct CA. It is a guard against the possibility that the address of the target CA is claimed by another CA after the commanding CA started the NAME change process. The NAME checksum byte contains the arithmetic sum of the 8 bytes of the target CAs original NAME truncated to 8 least significant bits.

When the NM Control Mode Indicator is set to Mode 4 – Set Pending NAME NACK, it represents an error code sent by the target CA. Code values are as follows:

0 Security not satisfied. Different address for Adopt Pending than Set Pending

1 Item(s) not allowed to change. Qualifier flags of disallowed items are set to one.

2 Item conflict. Cannot perform function assigned, cannot perform as arbitrary address capable, etc. Qualifier flags of disallowed items are set to one.

3 Checksum does not match.

4 Pending NAME not set.

5 Other.

6-254 Reserved.

255 Not Available.

Data Length:	8 bits
Resolution:	256 states/8 bit, 0 offset
Data Range:	0 to 255
Type:	Status
Suspect Parameter Number:	5657
Reference:	5.11.2

5.11.2.2 Manufacturer Code Qualifier Flag (SPN 5658)

When the NM Control Mode Indicator is set to Mode 0 – Set Pending NAME, this qualifier flag is used to indicate whether the Commanded Manufacturer Code (SPN 5667) parameter value shall be used to change the manufacturer code in the pending NAME of the target CA. When the flag is set to “0,” the manufacturer code shall be changed. When the flag is set to “1,” the manufacturer code shall not be changed.

When the NM Control Mode Indicator is set to Mode 4 – Set Pending NAME NACK, this qualifier flag is used only for error code 1 and 2. When the flag is set to “0,” the manufacturer code can be changed. When the flag is set to “1,” the manufacturer code cannot be changed. For all other error codes, the flag is not applicable and shall be set to “1.”

When the NM Control Mode Indicator is set to Mode 8 – Request NAME Address Claim, this qualifier flag is used to indicate whether the Commanded Manufacturer Code (SPN 5667) parameter value shall be used by the target CA to match the current NAME. When the flag is set to “0,” the Manufacturer Code field shall be used in the NAME match. When the flag is set to “1,” the Manufacturer Code field shall not be used in the NAME match. When the indicated fields of the target’s current NAME are matched to those in the request, the target CA shall send an Address Claimed message (PGN 60928).

For all other NM control modes, this field is not applicable and shall be set to 1.

Data Length:	1 bit
Resolution:	1 bit
Data Range:	0 to 1
Type:	Status
Suspect Parameter Number:	5658
Reference:	5.11.2

5.11.2.3 ECU Instance Qualifier Flag (SPN 5659)

When the NM Control Mode Indicator is set to Mode 0 – Set Pending NAME, this qualifier flag is used to indicate whether the ECU Instance (SPN 5668) parameter value shall be used to change the ECU Instance field in the pending NAME of the target CA. When the flag is set to “0,” the ECU Instance shall be changed. When the flag is set to “1,” the ECU Instance shall not be changed.

When the NM Control Mode Indicator is set to Mode 4 – Set Pending NAME NACK, this qualifier flag is used only for error code 1 and 2. When the flag is set to “0,” the ECU Instance field can be changed. When the flag is set to “1,” the ECU Instance field cannot be changed. For all other error codes, the flag is not applicable and shall be set to “1.”

When the NM Control Mode Indicator is set to Mode 8 – Request NAME Address Claim, this qualifier flag is used to indicate whether the ECU Instance field (SPN 5668) shall be used by the target CA to match the current NAME. When the flag is set to “0,” the ECU Instance field shall be used in the NAME match. When the flag is set to “1,” the ECU Instance field shall not be used in the NAME match. When the indicated fields of the target’s current NAME are matched to those in the request, the target CA shall send an Address Claimed message (PGN 60928).

For all other NM Control Modes, this field is not applicable and shall be set to 1.

Data Length:	1 bit
Resolution:	1 bit
Data Range:	0 to 1
Type:	Status
Suspect Parameter Number:	5659
Reference:	5.11.2

5.11.2.4 Function Instance Qualifier Flag (SPN 5660)

When the NM Control Mode Indicator is set to Mode 0 – Set Pending NAME, this qualifier flag is used to indicate whether the Function Instance field (SPN 5669) shall be used to change the Function Instance field in the pending NAME of the target CA. When the flag is set to “0,” the Function Instance shall be changed. When the flag is set to “1,” the Function Instance shall not be changed.

When the NM Control Mode Indicator is set to Mode 4 – Set Pending NAME NACK, this qualifier flag is used only for error code 1 and 2. When the flag is set to “0,” the Function Instance field can be changed. When the flag is set to “1,” the Function Instance field cannot be changed. For all other error codes, the flag is not applicable and shall be set to “1.”

When the NM Control Mode Indicator is set to Mode 8 – Request NAME Address Claim, this qualifier flag is used to indicate whether the Function Instance field (SPN 5669) shall be used by the target CA to match the current NAME. When the flag is set to “0,” the Function Instance field shall be used in the NAME match. When the flag is set to “1,” the Function Instance field shall not be used in the NAME match. When the indicated fields of the target’s current NAME are matched to those in the request, the target CA shall send an Address Claimed message (PGN 60928).

For all other NM Control Modes, this field is not applicable and shall be set to 1.

Data Length:	1 bit
Resolution:	1 bit
Data Range:	0 to 1
Type:	Status
Suspect Parameter Number:	5660
Reference:	5.11.2

5.11.2.5 Function Qualifier Flag (SPN 5661)

When the NM Control Mode Indicator is set to Mode 0 – Set Pending NAME, this qualifier flag is used to indicate whether the Function field (SPN 5670) shall be used to change the Function field in the pending NAME of the target CA. When the flag is set to “0,” the Function shall be changed. When the flag is set to “1,” the Function shall not be changed.

When the NM Control Mode Indicator is set to Mode 4 – Set Pending NAME NACK, this qualifier flag is used only for error code 1 and 2. When the flag is set to “0,” the Function field can be changed. When the flag is set to “1,” the Function field cannot be changed. For all other error codes, the flag is not applicable and shall be set to “1.”

When the NM Control Mode Indicator is set to Mode 8 – Request NAME Address Claim, this qualifier flag is used to indicate whether the Function field (SPN 5670) shall be used by the target CA to match the current NAME. When the flag is set to “0,” the Function field shall be used in the NAME match. When the flag is set to “1,” the Function field shall not be used in the NAME match. When the indicated fields of the target’s current NAME are matched to those in the request, the target CA shall send an Address Claimed message (PGN 60928).

For all other NM Control Modes, this field is not applicable and shall be set to 1.

Data Length:	1 bit
Resolution:	1 bit
Data Range:	0 to 1
Type:	Status
Suspect Parameter Number:	5661
Reference:	5.11.2

5.11.2.6 Vehicle System Qualifier Flag (SPN 5662)

When the NM Control Mode Indicator is set to Mode 0 – Set Pending NAME, this qualifier flag is used to indicate whether the Vehicle System field (SPN 5671) shall be used to change the Vehicle System field in the pending NAME of the target CA. When the flag is set to “0,” the Vehicle System shall be changed. When the flag is set to “1,” the Vehicle System shall not be changed.

When the NM Control Mode Indicator is set to Mode 4 – Set Pending NAME NACK, this qualifier flag is used only for error code 1 and 2. When the flag is set to “0,” the Vehicle System field can be changed. When the flag is set to “1,” the Vehicle System field cannot be changed. For all other error codes, the flag is not applicable and shall be set to “1.”

When the NM Control Mode Indicator is set to Mode 8 – Request NAME Address Claim, this qualifier flag is used to indicate whether the Vehicle System field (SPN 5671) shall be used by the target CA to match the current NAME. When the flag is set to “0,” the Vehicle System field shall be used in the NAME match. When the flag is set to “1,” the Vehicle System field shall not be used in the NAME match. When the indicated fields of the target’s current NAME are matched to those in the request, the target CA shall send an Address Claimed message (PGN 60928).

For all other NM Control Modes, this field is not applicable and shall be set to 1.

Data Length:	1 bit
Resolution:	1 bit
Data Range:	0 to 1
Type:	Status
Suspect Parameter Number:	5662
Reference:	5.11.2

5.11.2.7 Vehicle System Instance Qualifier Flag (SPN 5663)

When the NM Control Mode Indicator is set to Mode 0 – Set Pending NAME, this qualifier flag is used to indicate whether the Vehicle System Instance field (SPN 5672) shall be used to change the Vehicle System Instance field in the pending NAME of the target CA. When the flag is set to “0,” the Vehicle System Instance shall be changed. When the flag is set to “1,” the Vehicle System Instance shall not be changed.

When the NM Control Mode Indicator is set to Mode 4 – Set Pending NAME NACK, this qualifier flag is used only for error code 1 and 2. When the flag is set to “0,” the Vehicle System Instance field can be changed. When the flag is set to “1,” the Vehicle System Instance field cannot be changed. For all other error codes, the flag is not applicable and shall be set to “1.”

When the NM Control Mode Indicator is set to Mode 8 – Request NAME Address Claim, this qualifier flag is used to indicate whether the Vehicle System Instance field (SPN 5672) shall be used by the target CA to match the current NAME. When the flag is set to “0,” the Vehicle System Instance field shall be used in the NAME match. When the flag is set to “1,” the Vehicle System Instance field shall not be used in the NAME match. When the indicated fields of the target’s current NAME are matched to those in the request, the target CA shall send an Address Claimed message (PGN 60928).

For all other NM Control Modes, this field is not applicable and shall be set to 1.

Data Length:	1 bit
Resolution:	1 bit
Data Range:	0 to 1
Type:	Status
Suspect Parameter Number:	5663
Reference:	5.11.2

5.11.2.8 Industry Group Qualifier Flag (SPN 5664)

When the NM Control Mode Indicator is set to Mode 0 – Set Pending NAME, this qualifier flag is used to indicate whether the Industry Group field (SPN 5673) shall be used to change the Industry Group field in the pending NAME of the target CA. When the flag is set to “0,” the Industry Group shall be changed. When the flag is set to “1,” the Industry Group shall not be changed.

When the NM Control Mode Indicator is set to Mode 4 – Set Pending NAME NACK, this qualifier flag is used only for error code 1 and 2. When the flag is set to “0,” the Industry Group field can be changed. When the flag is set to “1,” the Industry Group field cannot be changed. For all other error codes, the flag is not applicable and shall be set to “1.”

When the NM Control Mode Indicator is set to Mode 8 – Request NAME Address Claim, this qualifier flag is used to indicate whether the Industry Group field (SPN 5673) shall be used by the target CA to match the current NAME. When the flag is set to “0,” the Industry Group field shall be used in the NAME match. When the flag is set to “1,” the Industry Group field shall not be used in the NAME match. When the indicated fields of the target’s current NAME are matched to those in the request, the target CA shall send an Address Claimed message (PGN 60928).

For all other NM Control Modes, this field is not applicable and shall be set to 1.

Data Length:	1 bit
Resolution:	1 bit
Data Range:	0 to 1
Type:	Status
Suspect Parameter Number:	5664
Reference:	5.11.2

5.11.2.9 Arbitrary Address Capable Qualifier Flag (SPN 5665)

When the NM Control Mode Indicator is set to Mode 0 – Set Pending NAME, this qualifier flag is used to indicate whether the Arbitrary Address Capable field (SPN 5674) shall be used to change the Arbitrary Address Capable field in the pending NAME of the target CA. When the flag is set to “0,” the Arbitrary Address Capable field shall be changed. When the flag is set to “1,” the Arbitrary Address Capable field shall not be changed.

When the NM Control Mode Indicator is set to Mode 4 – Set Pending NAME NACK, this qualifier flag is used only for error code 1 and 2. When the flag is set to “0,” the Arbitrary Address Capable field can be changed. When the flag is set to “1,” the Arbitrary Address Capable field cannot be changed. For all other error codes, the flag is not applicable and shall be set to “1.”

When the NM Control Mode Indicator is set to Mode 8 – Request NAME Address Claim, this qualifier flag is used to indicate whether the Arbitrary Address Capable field (SPN 5674) shall be used by the target CA to match the current NAME. When the flag is set to "0," the Arbitrary Address Capable field shall be used in the NAME match. When the flag is set to "1," the Arbitrary Address Capable field shall not be used in the NAME match. When the indicated fields of the target's current NAME are matched to those in the request, the target CA shall send an Address Claimed message (PGN 60928).

For all other NM Control Modes, this field is not applicable and shall be set to 1.

Data Length:	1 bit
Resolution:	1 bit
Data Range:	0 to 1
Type:	Status
Suspect Parameter Number:	5665
Reference:	5.11.2

5.11.2.10 NM Control Mode Indicator (SPN 5666)

This 4-bit parameter is used to define the purpose of the NM message.

Data Length:	4 bits
Resolution:	16 states
Data Range:	0 to 15
Type:	Status
Suspect Parameter Number:	5666
Reference:	5.11.2

Modes are defined as follows:

5.11.2.10.1 Mode 0 – Set Pending NAME

This form of the message is the command to the target CA at the destination address in the CAN Identifier to change its pending NAME to the NAME contained in the message data. All parameters of the message data are required.

The "Commanded" parameter values specify the new (i.e., commanded) NAME field values. These shall be qualified with the qualifier flags. A value of "0" in the qualifier flags indicates that the associated field shall be changed to the value in the corresponding parameter field in the message. A value of "1" indicates that the associated field shall remain unchanged.

The NAME checksum byte contains the arithmetic sum of the 8 bytes of the target CAs original NAME truncated to 8 least significant bits. This is used as a security check to make sure the command message has been received by the correct CA. This check guards against the possibility of the address having been changed through address arbitration.

5.11.2.10.2 Mode 1 – Pending NAME

This form of the message is sent by the target CA and is a response to a request for "pending" NAME. The CA's pending NAME is contained in the "Commanded" parameter fields. All "Commanded" parameter fields of the NAME are required. The qualifier flags and NAME checksum are not used and shall be set to all 1s. If the Pending NAME has not been set or is not valid, this form of the message shall not be sent. Rather, the Set Pending NAME NACK (mode 4) shall be sent.

5.11.2.10.3 Mode 2 – Current NAME

This form of the message is sent by the target CA and is a response to a request for "current" NAME. The CA's current NAME is contained in the "Commanded" parameter fields. All fields of the NAME are required. The qualifier flags and NAME checksum are not used and shall be set to all 1s.

5.11.2.10.4 Mode 3 – Set Pending NAME ACK

This form of the message is sent by the target CA indicating the most recently received “Set Pending NAME” command has been successfully fulfilled. The CA’s pending NAME is contained in the “Commanded” parameter fields. All “Commanded” parameter fields of the NAME are required. The qualifier flags and the NAME checksum are not used and shall be set to all 1s.

5.11.2.10.5 Mode 4 – Set Pending NAME NACK

This form of the message is sent by the target CA indicating the most recently received “Set Pending NAME” command or “Request Pending NAME” command was not successful. The NM Control Mode Indicator and the Error Code are always valid fields in this form of the message. The Qualifier Flags are only valid if the Error Code is set to “1” or “2.” All other fields are invalid. Invalid fields shall be set to all 1s.

5.11.2.10.6 Mode 5 – Request Pending NAME

This form of the message is sent by the commanding CA and is a request for the target CA to respond with its “pending” NAME. The NM Control Mode Indicator is the only valid field in this form of the message. All other fields shall be set to all 1s.

5.11.2.10.7 Mode 6 – Request Current NAME

This form of the message is sent by the commanding CA and is a request for the target CA to respond with its “current” NAME. The NM Control Mode Indicator is the only valid field in this form of the message. All other fields shall be set to all 1s.

5.11.2.10.8 Mode 7 – Adopt Pending NAME

This form of the message is sent by the commanding CA and is a “trigger” command to the targeted CA (or all CAs with pending NAMEs if sent to the global address) to adopt its pending NAME as its current NAME and to send an Address Claimed message with this new NAME. The NM Control Mode Indicator is the only valid field in this form of the message. All other fields are set to all 1s. This form of the message may be sent to a specific address or to the global address.

5.11.2.10.9 Mode 8 – Request NAME Address Claim

This form of the message is used to request that a CA whose address is unknown to the requester send the Address Claimed message, thus allowing the requester to determine the CA’s address. All or portions of the NAME can be specified in the request using the qualifier flags. This form of the message shall be sent to the global address.

This request differs from a Request for Address Claimed, which can request only a specific address or all CAs to send their address claims. This form of request allows a CA with a specific NAME or portions of the NAME whose SA is unknown to the requester to be singled out to announce its address and NAME. For example, this could be used to locate a CA with a specific function, manufacturer, instance, etc. Another example would be a request for a specific function only. All instances of that function would then respond allowing the requester to determine the number and addresses of the CAs providing that function on the network.

If a CA receives this request and the indicated qualifier fields match the current NAME, it shall send its address claim using its current NAME via the Address Claimed message (PGN 60928). If a CA receives this request but it doesn’t match the indicated fields of the current NAME, it shall not send an address claim and shall not send the Set Pending NAME NACK form of the NM message.

5.11.2.10.10 Modes 9 to 15 – Reserved for Future SAE Use

5.11.2.11 Commanded Manufacturer Code (SPN 5667)

When the NM Control Mode Indicator is set to Mode 0 – Set Pending NAME and the Manufacturer Code Qualifier Flag (SPN 5658) is set to "0," the commanding CA sets this 11-bit value to the desired Manufacturer Code. The target CA shall then use this 11-bit value for the Manufacturer Code in its Pending NAME. If the Manufacturer Code Qualifier Flag (SPN 5658) is set to 1 by the commanding CA, the target CA shall not change the Manufacturer Code field of the Current NAME when the adopt command is executed.

When the NM Control Mode Indicator is set to Mode 1 – Pending NAME, the target CA shall populate this field with the Commanded Manufacturer Code of its pending NAME.

When the NM Control Mode Indicator is set to Mode 2 – Current NAME, the target CA shall populate this field with the Commanded Manufacturer Code of its current NAME.

When the NM Control Mode Indicator is set to Mode 3 – Set Pending NAME ACK, the target CA shall populate this field with the Commanded Manufacturer Code of its pending NAME.

When the NM Control Mode Indicator is set to Mode 8 – Request NAME Address Claim, and the Manufacturer Code Qualifier Flag (SPN 5658) is set to "0," the commanding CA sets this 11-bit value to the Manufacturer Code that it wishes to match in the target CA's Current NAME. The target CA then uses this value in the match test against its Current NAME. If the Manufacturer Code Qualifier Flag (SPN 5658) is set to 1 by the commanding CA, the target CA shall ignore the Commanded Manufacturer Code field when matching the NAME.

For all other modes, Commanded Manufacturer Code shall be set to all 1s by command CA and target CA.

See 5.5.1.9 for the definition of Manufacturer Code.

Data Length:	11 bits
Resolution:	See 5.5.1.9
Data Range:	0 to 2047
Type:	Status
Suspect Parameter Number:	5667
Reference:	5.11.2

5.11.2.12 Commanded ECU Instance (SPN 5668)

When the NM Control Mode Indicator is set to Mode 0 – Set Pending NAME, and the ECU Instance Qualifier Flag (SPN 5659) is set to "0," the commanding CA sets this 3-bit value to the desired ECU Instance. The target CA shall then use this 3-bit value for the ECU Instance in its Pending NAME. If the ECU Instance Qualifier Flag (SPN 5659) is set to "1" by the commanding CA, the target CA shall not change the ECU Instance field of the Current NAME when the adopt command is executed.

When the NM Control Mode Indicator is set to Mode 1 – Pending NAME, the target CA shall populate this field with the ECU Instance of its Pending NAME.

When the NM Control Mode Indicator is set to Mode 2 – Current NAME, the target CA shall populate this field with the ECU Instance of its Current NAME.

When the NM Control Mode Indicator is set to Mode 3 – Set Pending NAME ACK, the target CA shall populate this field with the ECU Instance of its Pending NAME.

When the NM Control Mode Indicator is set to Mode 8 – Request NAME Address Claim, and the ECU Instance Qualifier Flag (SPN 5659) is set to "0," the commanding CA sets this 3-bit value to the ECU Instance that it wishes to match in the target CA's Current NAME. The target CA then uses this value in the match test against its NAME. If the ECU Instance Qualifier Flag (SPN 5659) is set to "1" by the commanding CA, the target CA shall ignore the Commanded ECU Instance field when matching the NAME.

For all other modes, Commanded ECU Instance shall be set to all 1s by command CA and target CA.

See 5.5.1.8 for the definition of ECU Instance.

Data Length:	3 bits
Resolution:	See 5.5.1.8
Data Range:	0 to 7
Type:	Status
Suspect Parameter Number:	5668
Reference:	5.11.2

5.11.2.13 Commanded Function Instance (SPN 5669)

When the NM Control Mode Indicator is set to Mode 0 – Set Pending NAME, and the Function Instance Qualifier Flag (SPN 5660) is set to “0,” the commanding CA sets this 5-bit value to the desired Function Instance. The target CA shall then use this 5-bit value for the Function Instance in its Pending NAME. If the Function Instance Qualifier Flag (SPN 5660) is set to “1” by the commanding CA, the target CA shall not change the Function Instance field of the Current NAME when the adopt command is executed.

When the NM Control Mode Indicator is set to Mode 1 – Pending NAME, the target CA shall populate this field with the Function Instance of its Pending NAME.

When the NM Control Mode Indicator is set to Mode 2 – Current NAME, the target CA shall populate this field with the Function Instance of its Current NAME.

When the NM Control Mode Indicator is set to Mode 3 – Set Pending NAME ACK, the target CA shall populate this field with the Function Instance of its Pending NAME.

When the NM Control Mode Indicator is set to Mode 8 – Request NAME Address Claim, and the Function Instance Qualifier Flag (SPN 5660) is set to “0,” the commanding CA sets this 5-bit value to the Function Instance that it wishes to match in the target CA’s Current NAME. The target CA then uses this value in the match test against its NAME. If the Function Instance Qualifier Flag (SPN 5660) is set to “1” by the commanding CA, the target CA shall ignore the Commanded Function Instance field when matching the NAME.

For all other modes, Commanded Function Instance shall be set to all 1s by command CA and target CA.

See 5.5.1.7 for the definition of Function Instance.

Data Length:	5 bits
Resolution:	See 5.5.1.7
Data Range:	0 to 31
Type:	Status
Suspect Parameter Number:	5669
Reference:	5.11.2

5.11.2.14 Commanded Function (SPN 5670)

When the NM Control Mode Indicator is set to Mode 0 – Set Pending NAME, and the Function Qualifier Flag (SPN 5661) is set to “0,” the commanding CA sets this 8-bit value to the desired Function. The target CA shall then use this 8-bit value for the Function in its Pending NAME. If the Function Qualifier Flag (SPN 5661) is set to “1” by the commanding CA, the target CA shall not change the Function field of the Current NAME when the adopt command is executed.

When the NM Control Mode Indicator is set to Mode 1 – Pending NAME, the target CA shall populate this field with the Function of its Pending NAME.

When the NM Control Mode Indicator is set to Mode 2 – Current NAME, the target CA shall populate this field with the Function of its Current NAME.

When the NM Control Mode Indicator is set to Mode 3 – Set Pending NAME ACK, the target CA shall populate this field with the Function of its Pending NAME.

When the NM Control Mode Indicator is set to Mode 8 – Request NAME Address Claim, and the Function Qualifier Flag (SPN 5661) is set to "0," the commanding CA sets this 8-bit value to the Function that it wishes to match in the target CA's Current NAME. The target CA then uses this value in the match test against its NAME. If the Function Qualifier Flag (SPN 5661) is set to "1" by the commanding CA, the target CA shall ignore the Commanded Function field when matching the NAME.

For all other modes, Commanded Function shall be set to all 1s by command CA and target CA.

See 5.5.1.6 for the definition of Function.

Data Length:	8 bits
Resolution:	See 5.5.1.6
Data Range:	0 to 254
Type:	Status
Suspect Parameter Number:	5670
Reference:	5.11.2

5.11.2.15 Commanded Vehicle System (SPN 5671)

When the NM Control Mode Indicator is set to Mode 0 – Set Pending NAME, and the Vehicle System Qualifier Flag (SPN 5662) is set to "0," the commanding CA sets this 7-bit value to the desired Vehicle System. The target CA shall then use this 7-bit value for the Vehicle System in its Pending NAME. If the Vehicle System Qualifier Flag (SPN 5662) is set to "1" by the commanding CA, the target CA shall not change the Vehicle System field of the Current NAME when the adopt command is executed.

When the NM Control Mode Indicator is set to Mode 1 – Pending NAME, the target CA shall populate this field with the Vehicle System of its Pending NAME.

When the NM Control Mode Indicator is set to Mode 2 – Current NAME, the target CA shall populate this field with the Vehicle System of its Current NAME.

When the NM Control Mode Indicator is set to Mode 3 – Set Pending NAME ACK, the target CA shall populate this field with the Vehicle System of its Pending NAME.

When the NM Control Mode Indicator is set to Mode 8 – Request NAME Address Claim, and the Vehicle System Qualifier Flag (SPN 5662) is set to "0," the commanding CA sets this 7-bit value to the Vehicle System that it wishes to match in the target CA's Current NAME. The target CA then uses this value in the match test against its NAME. If the Vehicle System Qualifier Flag (SPN 5662) is set to "1" by the commanding CA, the target CA shall ignore the Commanded Vehicle System field when matching the NAME.

For all other modes, Commanded Vehicle System shall be set to all 1s by command CA and target CA.

See 5.5.1.4 for the definition of Vehicle System.

Data Length:	7 bits
Resolution:	See 5.5.1.4
Data Range:	0 to 126
Type:	Status
Suspect Parameter Number:	5671
Reference:	5.11.2

5.11.2.16 Commanded Vehicle System Instance (SPN 5672)

When the NM Control Mode Indicator is set to Mode 0 – Set Pending NAME and the Vehicle System Instance Qualifier Flag (SPN 5663) is set to "0," the commanding CA sets this 4-bit value to the desired Vehicle System Instance. The target CA shall then use this 4-bit value for the Vehicle System Instance in its Pending NAME. If the Vehicle System Instance Qualifier Flag (SPN 5663) is set to "1" by the commanding CA, the target CA shall not change the Vehicle System Instance field of the Current NAME when the adopt command is executed.

When the NM Control Mode Indicator is set to Mode 1 – Pending NAME, the target CA shall populate this field with the Vehicle System Instance of its Pending NAME.

When the NM Control Mode Indicator is set to Mode 2 – Current NAME, the target CA shall populate this field with the Vehicle System Instance of its Current NAME.

When the NM Control Mode Indicator is set to Mode 3 – Set Pending NAME ACK, the target CA shall populate this field with the Vehicle System Instance of its Pending NAME.

When the NM Control Mode Indicator is set to Mode 8 – Request NAME Address Claim, and the Vehicle System Instance Qualifier Flag (SPN 5663) is set to "0," the commanding CA sets this 4-bit value to the Vehicle System Instance that it wishes to match in the target CA's Current NAME. The target CA then uses this value in the match test against its NAME. If the Vehicle System Instance Qualifier Flag (SPN 5663) is set to "1" by the commanding CA, the target CA shall ignore the Commanded Vehicle System Instance field when matching the NAME.

For all other modes, Commanded Vehicle System Instance shall be set to all 1s by command CA and target CA.

See 5.5.1.3 for the definition of Vehicle System Instance.

Data Length:	4 bits
Resolution:	See 5.5.1.3
Data Range:	0 to 15
Type:	Status
Suspect Parameter Number:	5672
Reference:	5.11.2

5.11.2.17 Commanded Industry Group (SPN 5673)

When the NM Control Mode Indicator is set to Mode 0 – Set Pending NAME and the Industry Group Qualifier Flag (SPN 5664) is set to "0," the commanding CA sets this 3-bit value to the desired Industry Group. The target CA shall then use this 3-bit value for the Industry Group in its Pending NAME. If the Industry Group Qualifier Flag (SPN 5664) is set to "1" by the commanding CA, the target CA shall not change the Industry Group field of the Current NAME when the adopt command is executed.

When the NM Control Mode Indicator is set to Mode 1 – Pending NAME, the target CA shall populate this field with the Industry Group of its Pending NAME.

When the NM Control Mode Indicator is set to Mode 2 – Current NAME, the target CA shall populate this field with the Industry Group of its Current NAME.

When the NM Control Mode Indicator is set to Mode 3 – Set Pending NAME ACK, the target CA shall populate this field with the Industry Group of its Pending NAME.

When the NM Control Mode Indicator is set to Mode 8 – Request NAME Address Claim, and the Industry Group Qualifier Flag (SPN 5664) is set to "0," the commanding CA sets this 3-bit value to the Industry Group that it wishes to match in the target CA's Current NAME. The target CA then uses this value in the match test against its NAME. If the Industry Group Qualifier Flag (SPN 5664) is set to "1" by the commanding CA, the target CA shall ignore the Commanded Industry Group field when matching the NAME.

For all other modes, Commanded Industry Group shall be set to all 1s by command CA and target CA.

See 5.5.1.2 for the definition of Industry Group.

Data Length:	3 bits
Resolution:	See 5.5.1.2
Data Range:	0 to 7
Type:	Status
Suspect Parameter Number:	5673
Reference:	5.11.2

5.11.2.18 Commanded Arbitrary Address Capable (SPN 5674)

When the NM Control Mode Indicator is set to Mode 0 – Set Pending NAME and the Arbitrary Address Capable Qualifier Flag (SPN 5665) is set to "0," the commanding CA sets this 1-bit value to the desired Arbitrary Address Capable state. The target CA shall then use this 1-bit value for the Arbitrary Address Capable state in its Pending NAME. If the Arbitrary Address Capable Qualifier Flag (SPN 5665) is set to "1" by the commanding CA, the target CA shall not change the Arbitrary Address Capable field of the Current NAME when the adopt command is executed.

When the NM Control Mode Indicator is set to Mode 1 – Pending NAME, the target CA shall populate this field with the Arbitrary Address Capable field of its Pending NAME.

When the NM Control Mode Indicator is set to Mode 2 – Current NAME, the target CA shall populate this field with the Arbitrary Address Capable field of its Current NAME.

When the NM Control Mode Indicator is set to Mode 3 – Set Pending NAME ACK, the target CA shall populate this field with the Arbitrary Address Capable field of its Pending NAME.

When the NM Control Mode Indicator is set to Mode 8 – Request NAME Address Claim, and the Arbitrary Address Capable Qualifier Flag (SPN 5665) is set to "0," the commanding CA sets this 1-bit value to the Arbitrary Address Capable state that it wishes to match in the target CA's Current NAME. The target CA then uses this value in the match test against its NAME. If the Arbitrary Address Capable Qualifier Flag (SPN 5665) is set to "1" by the commanding CA, the target CA shall ignore the Commanded Arbitrary Address Capable field when matching the NAME.

For all other modes, Commanded Arbitrary Address Capable field shall be set to all 1s by command CA and target CA.

See 5.5.1.1 for the definition of Arbitrary Address Capable field.

Data Length:	1 bit
Resolution:	See 5.5.1.1
Data Range:	0 to 1
Type:	Status
Suspect Parameter Number:	5674
Reference:	5.11.2

5.11.3 NAME Management Procedures

5.11.3.1 NAME Management Message Support

To determine if a CA supports the NM message, a commanding CA can send a request for the NM message. CAs that do not support this NM message shall respond to destination specific requests with the Acknowledgement message (PGN 59392) with the appropriate NACK control byte. CAs that do not support this NM message will not respond to a global request.

If the target CA supports the NM message, it shall send the NM message when requested. If it has a valid pending NAME, it shall set the mode indicator to "Pending NAME" and bytes 3 through 8 set to the pending NAME. If it does not have a valid pending NAME, it shall set the mode indicator to "Current NAME" and bytes 3 through 8 set to the current NAME. This allows a method of querying for the support of the NM message as well as for currently existing or pending NAME. This can be useful for a tool or other device trying to configure multiple devices.

A state transition diagram describing the process for handling an NM message is presented in Figure D4. Note that if the target CA does not accept the NM message, an operator or technician must modify the CA's source address or NAME through alternate means.

If the NAME is successfully modified, the target CA has a "pending" NAME. While in this pending state, the target CA can still be transmitting messages using its current NAME. The pending NAME does not take effect until the unit responsible for configuring the network sends an NM message with the mode indicator set to "Adopt Pending NAME." When this message is received, the target CA shall claim its address with its new NAME before originating or resuming transmissions on the network.

5.11.3.2 Set Pending NAME

A target CA, upon receipt of a NAME Management message sent to its address with the "Set Pending NAME" mode, shall respond in either of two ways:

1. The target CA can accept the commanded changes to fields of the NAME. These changes to the NAME along with the unchanged portions of the NAME become the pending NAME. The target CA shall respond by sending the NM message with the appropriate ACK mode indicator. See mode definitions in 5.11.2.10. The response shall include the pending NAME in bytes 3 through 8 and is sent to the address of the commanding CA. The target CA shall use its current address (the address last successfully claimed) when sending this message.

2. The target CA may reject the commanded changes to the NAME by sending the NM message with the mode indicator for Set Pending NAME NACK and the Error Code field set to the most appropriate value. See 5.11.2.1 for error values. If the error value is "item not allowed" or "item conflict," the qualifier flags in byte 2 shall be set to 1 for fields that cannot change and 0 for fields that can change. The other data bytes of the message shall be set to all 1s.

5.11.3.3 Adopt Pending NAME

The commanded NAME changes shall be stored temporarily by the target CA until the commanding CA completes all such commands and then sends the NM message with mode indicator for "Adopt Pending NAME." The target CA with temporarily stored (pending) NAME shall adopt the pending NAME and perform the necessary "reset" of the CA including sending the Address Claimed message with the new NAME. Note that the NM message with the "Adopt Pending NAME" mode indicator may be sent to the global address. This allows the commanding CA to configure multiple CAs and then simultaneously activate all NAME changes.

5.11.3.4 Verifying NAME Source Address

The identity of the CA to be changed and its source address shall be verified prior to sending the NM message. A target CA can acquire a new address through the address arbitration process at any time. Since the timing of this event relative to the commanding CA sending the NM message with the "Set Pending NAME" mode indicator is not synchronized, a method is needed to prevent a CA with a newly acquired address from being incorrectly commanded to a new NAME. To guard against this possible mismatch between address and NAME, the "Set Pending NAME" mode of the NM message includes a checksum of all 8 bytes of the original NAME of the intended recipient of the new NAME. See 5.11.2.1. See Figure A12 for an example.

5.11.3.5 Rules for Use of the NM Message

1. The target CA shall check each field marked for change and make sure it is able to provide the indicated behavior before accepting the change. See Figure A14.

2. If this message is supported, it shall at a minimum allow changing the ECU Instance and Function Instance.

3. Target CAs can accept "Set Pending NAME" commands from any CA.

4. A target CA shall verify that the CA which sent the "Adopt NAME" command is the same CA that sent the most recent "Set Pending NAME" command that the target CA accepted prior to acting on "Adopt NAME." See Figure A13.

5.12 Working Sets

A Working Set is a concept intended to associate a group of controllers on a network where several applications each with a distinct NAME possibly within different ECUs on different network nodes are acting as distributed processes to create a single function as far as communication is concerned. This is particularly important on an Agricultural Implement Bus where several dissimilar CAs (probably within different ECUs) are intended to co-operate as a single implement.

5.13 Network Error Management

Network error management exists to provide a means of detecting addressing related errors, for example, failure of a CA to successfully claim an address. Other addressing related errors, for example, duplicate address claims or duplicate NAMEs, can be detected by a diagnostic tool through the use of requests for Address Claimed.

5.13.1 Cannot Claim Address

If a CA has attempted and cannot successfully claim a source address because the address(es) it attempted to claim are already claimed on the network by a CA with a higher priority NAME, a Cannot Claim Address error exists. Service tools, and bridges in some systems, can be expected to detect and resolve failures to claim an address. Service tools may monitor the Cannot Claim Address message and report the problem to the operator of the tool.

5.13.2 Address Violation

Address violation occurs when two CAs are using the same SA. This can happen when configuring a new network or adding multiple identical ECUs to a network.

5.13.2.1 Attempt to Resolve Address Violation

If a CA receives a message, other than the Address Claimed message, which uses the CA's own SA, then the CA shall send the Address Claimed message for its address. This shall initiate address arbitration with the conflicting device. Since this address violation could occur often, the attempt to force address arbitration shall be limited to once every 5 seconds.

5.13.2.2 System Notification

If repeated attempts to resolve the address violation as described above are unsuccessful, the violated CA can choose to notify other CAs on the network by setting a DTC.

The attempt to resolve the address violation might not work if, for instance, an CA is not following the rules of address arbitration. It can be advantageous or important for other CAs on the network to be made aware that this is happening.

The suggested DTC is SPN = 2000+SA and FMI = 31.

5.14 Additional Minimum Network Management Functionality

The features provided by the network management protocol include more than the minimum required for a CA communicating on a SAE J1939 network. The minimum network procedures are those without which a CA cannot operate on a SAE J1939 network. The following section describes minimum network management capability for CAs to operate on a SAE J1939 network. These are in addition to the minimum requirements listed in 5.2. A summary of the requirements and capabilities for SAE J1939 CAs is provided in Appendix B.

5.14.1 Reaction to Power Supply and Other Related ECU Disturbances

Due to the questionable integrity of power supplied to ECUs on towed vehicles and the time required for address arbitration, the following criteria are established. This applies to all ECUs that are powered through a tractor interface connector on a towed subnetwork (corresponding to a breakaway connector for the agricultural industry group). Any disturbance, such as momentary power loss that lasts less than a specified time (2 ms minimum, 10 ms recommended), shall not require the CA to initiate an address claim for its previously claimed address. This does not preclude a CA from performing any degree of reset or re-initialization. The CA shall retain its NAME, claimed address, and address to NAME association data used by that CA through such a disturbance. For disturbances of longer duration or higher frequency, the CA should perform its network management functions as it normally does during a power up cycle. If the disturbance is longer than 1 second, then the CA shall perform its network management functions as it normally does during a power up cycle. This is needed to force towed vehicle systems to reinitialize after reconnection to the towing vehicle.

There is no requirement for towing vehicles.

5.14.2 Network Disruption during ECU Connection or Disconnection

Connection, disconnection, or power-up of the ECU shall not disrupt network communications. An example of network disruption is the uncontrolled transmission of a bit stream to the network during the power-up of an ECU.

5.14.3 Addresses Continuity Across Power-Down and Power-Up Cycles

CAs are strongly recommended remember their address and any addresses for CAs that are communicated with so that the CA can attempt to use the same addresses at the next power-up. Special requirements can override this recommendation, for example, in towed subnetworks of On-Highway trailers where the instance and associated addresses of the trailer can change at each power-up, or for example, when changing trailers.

5.15 Wake-Up and Sleep

For wake-up and sleep, SAE J1939 shall use methods described in AUTOSAR CAN Network Management. To ensure interoperability, the format of the message shall be fixed. The values for the global and channel configuration parameters given in Table 5 shall be used.

Within the AUTOSAR documentation, several ECU modes and network states are described. Generally, an ECU will remain in a low power sleep mode until awakened by an input signal or applicable WAKE message. It will use the WAKE message to keep other ECUs awake as needed, and then return to low power sleep mode when no other device is sending the WAKE message requesting it to stay awake.

5.15.1 Wake-Up and Sleep Message (WAKE) (PGN 64380)

The following parameter group and parameters have been reserved to implement AUTOSAR CAN Network Management.

Transmission Rate:	See Table 5 and 5.15.3
Data Length:	8 bytes
Extended Data Page:	0
Data Page:	0
PDU Format:	251
PDU Specific:	124
Default Priority:	7
Parameter Group Number:	64380 (00FB7Ch)

Start Position	Length	Parameter Name	SPN
1	8 bits	Control Bit Vector	8623 (see 5.15.1.1)
2-3	16 bits	Partial Networking Information	8624 (see 5.15.1.2)

5.15.1.1 Control Bit Vector (SPN 8623)

Control Bit Vector is a bitmapped parameter defined in the AUTOSAR documentation. Bits indicate such things as repeat message state, synchronized shutdown, active wake-up, and partial networking support. See Figure 4.

Data Length:	1 byte
Resolution:	1 bit
Data Range:	0 to 255
Type:	Status
Suspect Parameter Number:	8623
Reference:	5.15.1

5.15.1.2 Partial Networking Information (SPN 8624)

Partial Networking Information is a bitmapped parameter defined in the AUTOSAR documentation. Bits within the partial networking information field are used as a filter to select a subset of devices to which the wake-up message applies. The system integrator is responsible for the allocation of bits to partial network groups.

If unspecified, all bits shall be set to 1. This makes the device a member of all partial networks, and its wake-up message is effectively global. See Figure 4.

Data Length:	2 bytes
Resolution:	1 bit
Data Range:	0 to 65535
Type:	Status
Suspect Parameter Number:	8624
Reference:	5.15.1

Table 5 - AUTOSAR network management configuration parameters

Parameter	Value	Description
CanNmUserDataEnabled	FALSE	Switch for enabling user data support.
CanNmGlobalPnSupport	TRUE	Switch for enabling partial networking support globally.
CanNmBusLoadReductionEnabled	TRUE	Switch for enabling busload reduction support.
CanNmNodeIdEnabled	FALSE	Switch for enabling the source node identifier.
CanNmMsgCycleTime	1000 ms	Determines the periodic rate in the “periodic transmission mode with bus load reduction.”
CanNmMsgReducedTime	*offset* + 500 ms	Bus cycle time in the periodic transmission mode with bus load reduction. (See 5.15.3 for determination of *offset*.)
CanNmPduCbvPosition[1]	Byte 1	Defines the position of the control bit vector within the NM PDU.
CanNmRepeatMessageTime	3000 ms	Defines how long the NM shall stay in the Repeat Message State.
CanNmTimeoutTime	5000 ms	Denotes how long the NM shall stay in the Ready Sleep State before transition into the Prepare Bus-Sleep Mode is initiated.
CanNmWaitBusSleepTime	2000 ms	Denotes how long the NM shall stay in the Prepare Bus-Sleep Mode before transition into Bus-Sleep Mode shall take place.
CanNmPnInfoLength	2 byte	Specifies the length of the PN request information in the NM PDU.
CanNmPnInfoOffset	1 byte	Specifies the offset of the PN request information in the NM PDU.
CanNmPnResetTime	4000 ms	Specifies the runtime of the reset timer. This reset time is valid for the reset of PN requests.

[1] One-based per SAE J1939 convention. AUTOSAR documentation uses zero-based indexing.

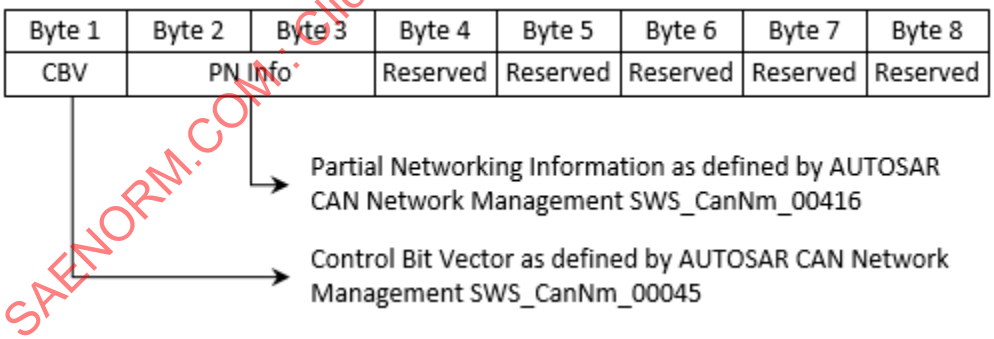


Figure 4 - AUTOSAR network management PDU format

5.15.2 Coordination of Address Claim

In the case that the network is asleep, sending an Address Claimed message is not productive. The CA used to wake the network is recommended to be a single address capable CA that claims a global preferred address (see 5.6.2.1). Address claim can then proceed as normal as devices awaken. If the CA used to wake the network is an arbitrary address capable CA that can claim a dynamic address, the CA shall use the NULL address (254) as the source address for the initial wake-up WAKE message, then claim an address and use its claimed address for subsequent keep-awake WAKE messages.

5.15.3 Bus Load Reduction

For effective bus load reduction, it is necessary for each CA to have a random or unique offset assigned for the reduced cycle time. Ideally, the reduced time would be assigned by the system integrator. The following formula may be used as a default for computing the CanNmMsgReducedTime offset:

$$offset = SA * 1.75 \text{ ms}$$

NOTE: Assignment is preferable because this formula can produce duplicate intervals when rounded to software loop time or transmit cycle time.

6. NOTES

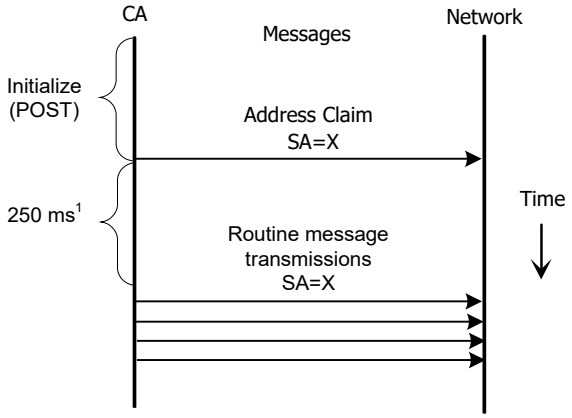
6.1 Revision Indicator

A change bar (I) located in the left margin is for the convenience of the user in locating areas where technical revisions, not editorial changes, have been made to the previous issue of this document. An (R) symbol to the left of the document title indicates a complete revision of the document, including technical revisions. Change bars and (R) are not used in original publications, nor in documents that contain editorial changes only.

PREPARED BY SAE TRUCK AND BUS CONTROL AND COMMUNICATIONS NETWORK COMMITTEE OF SAE TRUCK AND BUS ELECTRICAL AND ELECTRONIC STEERING COMMITTEE

APPENDIX A - NETWORK MANAGEMENT SEQUENCE TIMING DIAGRAMS

Figure A1 illustrates a CA claiming an address with no contention on its address claim. The CA starts sending routine messages when there has been no contending Address Claim within the required time period.



[1] Single Address CAs with addresses in the 0 to 127 and 248 to 253 ranges may omit the 250 ms delay.

Figure A1 - Address claim by a CA with no contention

Figure A2 illustrates single address capable CAs claiming the same address. In both sequences, CA B is performing its initialization when CA A sends its initial Address Claimed message for source address X, so CA B doesn't receive CA A's Address Claimed message. After finishing its initialization operations, CA B sends its initial Address Claimed message for source address X.

In the left sequence diagram, the numeric value of NAME for CA A is less than the numeric value of NAME B. CA A identifies the CA B address claim as a contending address claim. CA A evaluates the NAME to determine it has priority to address X and sends another Address Claimed message for address X. CA B identifies the CA A address claim as a contending address claim. CA B evaluates the NAME and determines it doesn't have priority to address X. CA B then sends a Cannot Claim Address message since it has no other address to claim.

In the right sequence diagram, the numeric value of NAME for CA A is greater than the numeric value of NAME B. CA A identifies the CA B address claim as a contending address claim. CA A evaluates the NAME and determines it doesn't have priority to address X. CA A then sends a Cannot Claim Address message since it has no other address to claim.

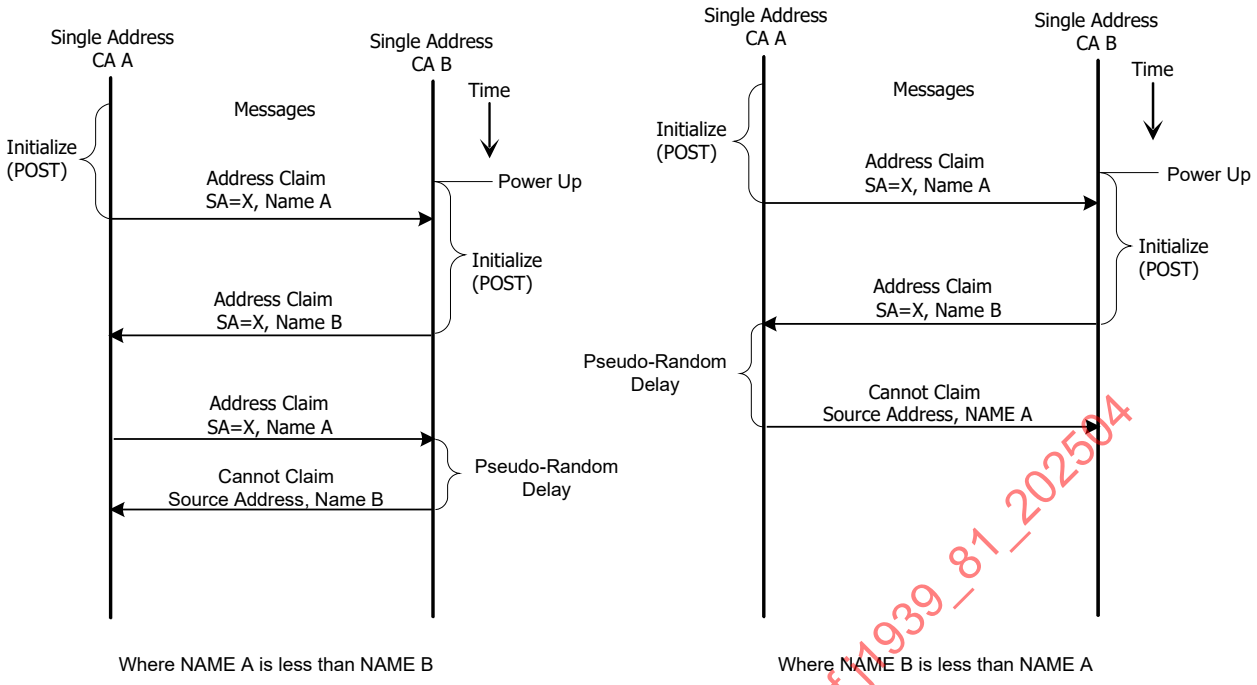


Figure A2 - Cannot claim address after contending address claim

Figure A3 illustrates two CAs claiming the same address, where CA B is an arbitrary address capable CA. In this example, the numeric value of NAME for CA A is less than the numeric value of NAME B. CA B is performing its initialization when CA A sends its initial Address Claimed message for address X, so CA B doesn't receive CA A's Address Claimed message. After finishing its initialization operations, CA B sends its initial Address Claimed message for address X. CA A identifies the CA B address claim as a contending address claim. CA A evaluates the NAME and determines it has priority to address X. CA A then sends another Address Claimed message for address X. CA B identifies the CA A address claim as a contending address claim. CA B evaluates the NAME and determines it doesn't have priority to address X. CA B selects another address (Y) and sends an Address Claimed message for address Y.

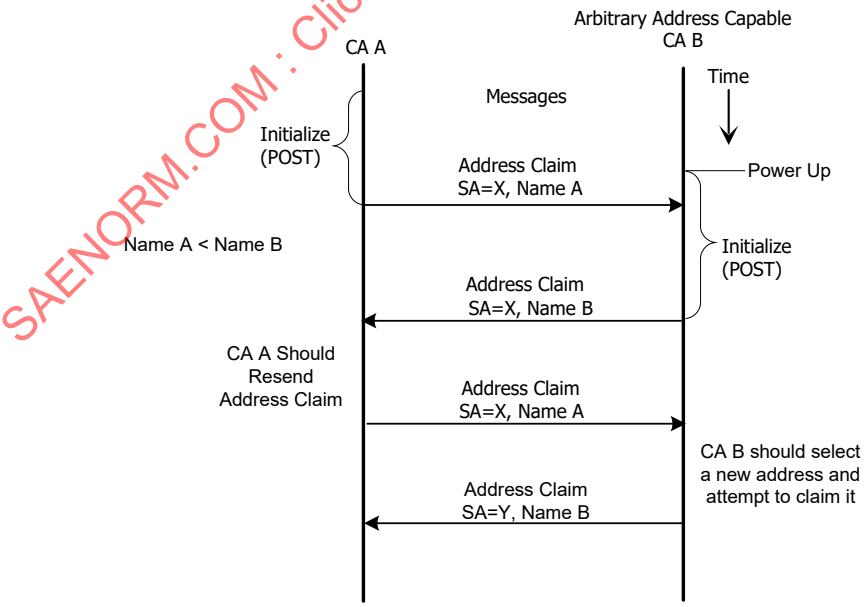


Figure A3 - Claim another address after contending address claim

Figure A4 illustrates the bus collision of the Address Claimed messages when two CAs send their Address Claimed messages simultaneously for the same address.

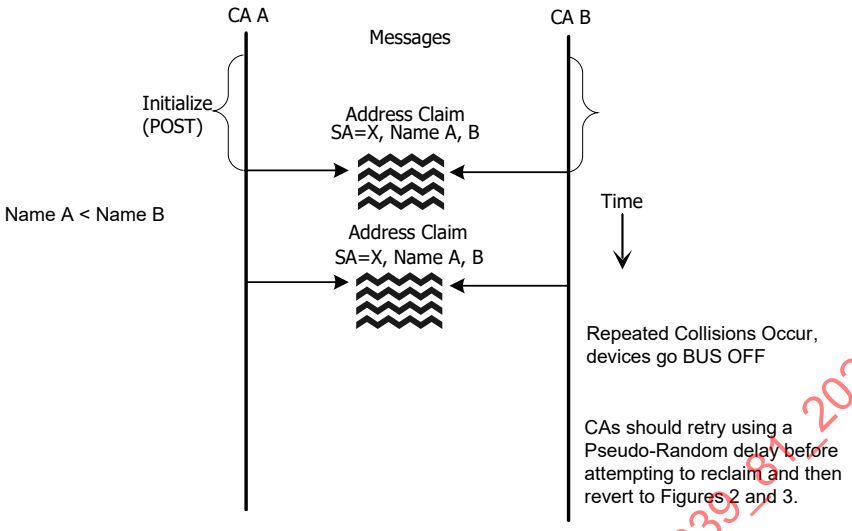
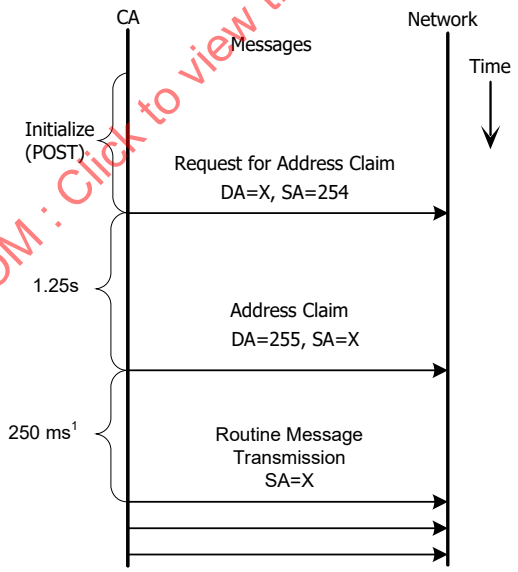


Figure A4 - Address claim bus collision

Figure A5 illustrates a CA using a Request for Address Claimed to determine if the specific address has been claimed before attempting to claim the address. The CA sends a destination specific Request for Address Claimed to address X. The CA determines that address X has not been claimed when it doesn't receive an Address Claimed message for address X within the standard response time out (per SAE J1939-21 and SAE J1939-22). The CA then sends an Address Claimed message for address X with no contending address claim.



[1] Single Address CAs with addresses in the 0 to 127 and 248 to 253 ranges may omit the 250 ms delay.

Figure A5 - Request for address claimed to check specific address