SAE INTERNATIONAL

SURFACE VEHICLE RECOMMENDED PRACTICE

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Network Management

RATIONALE

Repaired broken cross reference links.

FOREWORD

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. The SAE J1939-81 document defines the address arbitration process and messages required by all ECUs to acquire and maintain a network address on an SAE J1939 communication network.

The SAE J1939 communications network is a high speed ISO 11898-1 CAN based communications network that supports 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 communications network is developed for use in heavy-duty environments and suitable for horizontally integrated vehicle industries. The SAE J1939 communications network is applicable 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. The physical layer aspects of SAE J1939 reflect its design goal for use in heavy-duty environments. Horizontally integrated vehicles involve the integration of different combinations of loose package components, like as engine and transmissions that are sourced from many different component suppliers. 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.

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1. SCOPE

SAE J1939-81 Network Management defines the processes and messages associated with managing the source addresses of applications communicating on an SAE J1939 network. Network management is concerned with the management of source 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 source addresses, network management also specifies initialization 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 J1939/31 Network Layer

SAE J1939/71 Vehicle Application Layer

SAE J1939/73 Application Layer - Diagnostics

SAE J1939DA Digital Annex of Serial Control And Communication Heavy Duty Vehcile Network Data

3. DEFINITIONS

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

3.1 Terminology Used in Network Management

3.1.1 Additional Terms and Definitions

3.1.1.1 Address Configuration and Capability

Address configuration is the method by which a particular Controller Application (CA) determines the source address it shall use for Address Claim. For the purposes of the Address Claim process, there are two capabilities: Single Address Capable and Arbitrary Address Capable. These are described in detail in 4.3.

For the purposes of network management, there are three types of CAs: Standard, Diagnostic/Development Tools, and Network Interconnection CAs. Each of these types has a specific role in a SAE J1939 network, and therefore has different rules and responsibilities. These are detailed in 4.4.

3.1.1.2 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 may contain one or more CAs. Each CA shall have one address and an associated NAME in order to communicate on the SAE J1939 network.

3.1.1.3 Current NAME

The NAME of a CA that is transmitted in its address claim 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. See Pending NAME.

3.1.1.4 NAME

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

3.1.1.5 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” message such as discussed in 4.6.2.2.10.8.

3.1.1.6 Task Controller

Electronic control unit on the mobile implement control system that is responsible for the sending, receiving and logging of process data. Reference ISO 11783 part 10.

3.1.1.7 Virtual Terminal

Virtual Terminal (VT) 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.

3.1.1.8 Working Set

Group of NAMEs in one or more ECUs 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.

3.1.1.9 Working Set Master

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

3.1.1.10 Working Set Member

One of a number of CAs that collectively form the working set in addition to the working set master.

4. TECHNICAL REQUIREMENTS

4.1 General

The Network Management layer in an SAE J1939 network provides the definitions and procedures necessary to uniquely identify CAs on the network, manage the assignment of addresses, and manage network errors.

- Each 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 to change that address are presented in 4.2.

- CAs shall successfully claim an address according to the procedures explained in 4.5 prior to sending any other messages on the network. Multiple ECUs and/or CAs can work together as working sets to perform functions but shall follow the rules in 4.6.3.

- The inability to successfully claim an address according to the procedure shall be handled and reported to the network in a standard way expressed in 4.7.

- A minimum set of network management requirements, including required responses to power interruptions are listed in 4.8.

4.2 NAME and Address Requirements

Every CA that transmits messages on a SAE J1939 network shall have a NAME and successfully acquire an address before the CA may transmit normal network traffic. The NAME serves two purposes, first, to provide a functional description of the CA (e.g., Engine Number 1, Engine Number 2, Transmission Number 1, Anti-Lock Brake System 1) and second, to provide a numerical value that may be used in address arbitration.

An address is used within SAE J1939 networks to provide uniqueness to message identifiers and to allow the source of a message to be determined. (Addresses are sometimes referred to as “Source Addresses” indicating the latter use). Address claim messages, which contain both a source address and a NAME, are used to associate a NAME with a particular address on the network. The association of an address with a unique NAME (4.2.1) also provides means to associate an address with a CA. Manufacturers of ECUs and integrators of networks shall assure that the NAMEs of all CAs intended to transmit on a particular network are unique.

4.2.1 NAME (SPN 2848)

NAME is a 64 bit identifier for a CA and is composed of 10 fields. The values for five of these fields are derived from assignment lists managed by SAE J1939. They are:

- Industry Group

- Vehicle System

- Reserve

- Function

- Manufacturer Code

The remaining five values are either derived from characteristics of the network and vehicle architecture or under direct control of the manufacturer. They are:

- Arbitrary Address Capable

- Vehicle System Instance

- Function Instance

- ECU Instance

- Identity Number

The NAME associated with a CA provides the primary identification of the CA and the function that the CA has on the network. Source addresses in the SAE J1939 network serve as a convenient 8-bit shortcut or alias to identify a particular CA. Address management procedures in the network management protocol allow the association of individual source addresses with the NAME of the CA, and the annunciation of that association onto the network. Appendix C provides examples of the construction of NAMEs for SAE J1939 ECUs.

4.2.1.1 Using NAME

Each CA on a network shall have one NAME so the CA may be uniquely identified by its primary function. A CA's NAME is also used in arbitration when multiple CAs attempt to claim the same address, reinforcing the need for unique identification. In turn, each CA on the network shall have a single address which is unique; so that it can properly arbitrate CAN Data Frames with other ECUs.

NAME is an 8 byte numerical value composed of 10 fields. The numeric value of NAME is used for comparing NAMEs to determine higher priority for claim to the same address (see 4.5.1). The NAME fields are prioritized from left to right as shown in Figure 1. When the NAME is placed into the data field of a CAN message, 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. The byte ordering of the NAME fields in a CAN message is shown in Table 1. The definitions for each of the 10 fields are provided in 4.2.1.4.1 through 4.2.1.4.10 .

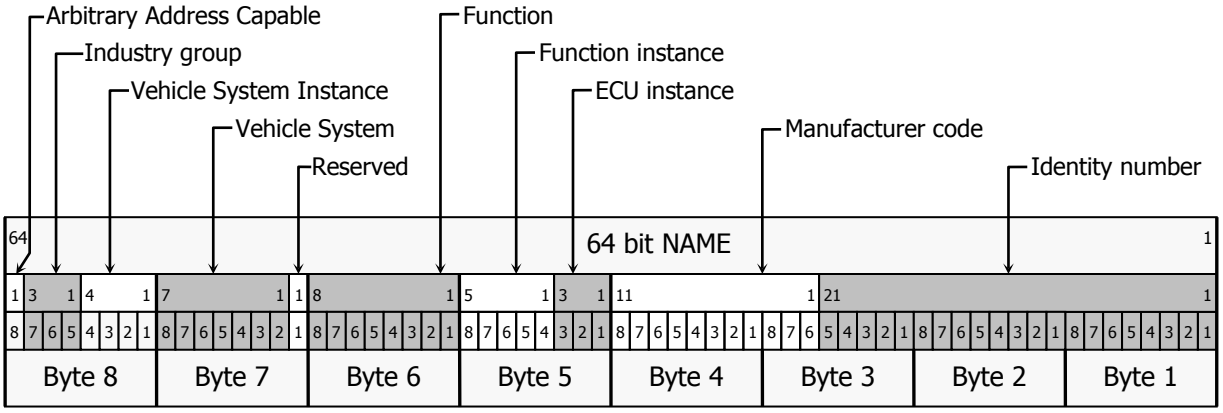


Figure 1 - Fields of NAME

Table 1 - NAME fields information

Start Position	Length	Parameter Name	SPN	Ability to be set to "Not Available"	Reference
1-3.1	21 bits	Identity Number	2837	NO	4.2.1.4.10
3.6-4	11 bits	Manufacturer Code	2838	NO	4.2.1.4.9
5.1	3 bits	ECU Instance	2840	NO	4.2.1.4.8
5.4	5 bits	Function Instance	2839	NO	4.2.1.4.7
6	8 bits	Function	2841	YES	4.2.1.4.6
7.1	1 bit	Reserved	N/A	N/A	N/A
7.2	7 bits	Vehicle System	2842	YES	4.2.1.4.4
8.1	4 bits	Vehicle System Instance	2843	NO	4.2.1.4.3
8.5	3 bits	Industry Group	2846	NO	4.2.1.4.2
8.8	1 bit	Arbitrary Address Capable	2844	NO	4.2.1.4.1

Listings of numerical values for Industry Groups, Vehicle Systems, Functions, and Manufacturer Codes are found in Appendix B of SAE J1939.

To uniquely name each CA within an ECU, SAE J1939 defines a 64 bit NAME consisting of the fields shown in Table 1. The Function Instance, ECU Instance, and Identity Number fields permit multiple CAs within one or multiple ECUs of the same make and model to coexist on the same network but still have unique NAMEs for each. See Appendix B of SAE J1939 for current assignments.

With a length of 64 bits, a NAME is inconvenient to use in normal communications. Therefore, once the network is fully initialized, each ECU utilizes an 8 bit address as its source identifier or alias to provide a way to uniquely access a given CA on the network. For example, an engine may be assigned address 00, but if a second engine is present, it needs a separate, unique address (e.g., 01) and instance.

To facilitate the initialization process of determining the addresses of CAs within each ECU on the network, commonly used devices have Preferred Addresses assigned by SAE J1939 (Preferred Addresses are listed in SAE J1939 Appendix B, Tables B2 through B9). Using the Preferred Addresses minimizes the frequency of multiple devices attempting to claim the same address.

Figure 2 further depicts the mapping of 64 bit NAME to the 8 data bytes in Address Claimed Message.

NAME fields	Arbitrary Address Capable	Inudstry 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	1	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	10110010	00001000	10000000	00011001	00000011	10100010	10011001	00001110	
data byte #	B2	08	80	19	03	A2	99	0E	
	byte 8	byte 7	byte 6	byte 5	byte 4	byte 3	byte 2	byte 1	

Note: Data bytes in this example are shown in reverse order for convenience when mapping the NAME fields to the 64 ibt value.
The data bytes will actually appear on the bus in the opposite order.

Figure 2 - Example of name mapping to data bytes

Priority is based on value of the 64-bit NAME parameter as displayed in Figure 2 The priority in this example is the integer $B209801903A2990E_{16}$.

4.2.1.2 Examples of NAME Usage

Each ECU on the network shall contain at least one CA. Each CA has its own NAME and address associated with it. There are examples such as an engine and engine retarder residing in a common ECU containing multiple NAMEs and multiple addresses. The address of a CA within an ECU defines a specific communications source or destination for messages. The NAME includes identification of the primary function performed at that address and adds an indication of the instance of that functionality in the event that multiple ECUs with the same primary function coexist on the same network. Several different CAs of the same function can coexist on the network, each identified by its own address and NAME.

As a further example, when the transmission is commanding a specific torque value from the engine (address 00), this shall be differentiated from the transmission commanding a specific torque value from the engine brake (retarder) (address 15). As can be seen by this example, a single ECU on the network may have multiple addresses (usually one per CA) and each address shall have an associated NAME.

4.2.1.3 Storing NAME

Although the entire NAME need not be field programmable, the instance fields are strongly recommended to be alterable. This allows for correct configuration of ECUs when, for example, a spare is installed in the field, or multiple instances may exist on a vehicle. Field programmability of the entire NAME field as well as the preferred address is recommended.

NAME may be programmed through use of the memory access protocol with Directed Spatial Addressing. The pointer Extension shall be set to 00000000_2 indicating SPN Space with SPN of the NAME of Controller Application (SPN 2848) used as the index of the desired object as described in SAE J1939-73. Individual fields of the NAME could also be indexed in this manner by using their SPNs. Parts of a CA's NAME may also be modified via the NAME management service described in 4.6.2.

4.2.1.4 NAME Fields

The fields that comprise NAME are prioritized from left to right as shown in Figure 1. The Vehicle System and Function fields shall be set to indicate Not Available (all bits set to 1) if values for these fields are not known or not defined in SAE J1939. All other fields in the NAME shall be set to their proper value. Table 1 summarizes this requirement.

The meaning of the contents of the Vehicle System field is dependent on the Industry Group field contents. Further, the content of the Function field is dependent on the Vehicle System field contents when the value for Function is in the range from 128 to 254 (inclusive) (see 4.2.1.5).

4.2.1.4.1 Arbitrary Address Capable Field (SPN 2844)

This 1-bit field indicates whether a CA is able to use an arbitrary source address to resolve an address claim conflict. If this bit is set to “1”, the CA is capable of resolving an address conflict with a CA whose NAME has a higher priority (lower numeric value) by selecting an arbitrary source address from the range 128 to 247 inclusive and claiming that source address. A self-configurable CA that computes its address but can claim only from a more restricted set of addresses is not considered arbitrary address capable (e.g., On-Highway Trailers). See 4.5 of this document for details of the address claim process.

1 = This CA is capable of selecting alternate source addresses itself if needed during address arbitration.

0 = This CA is not capable of selecting alternate source addresses itself.

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

4.2.1.4.2 Industry Group Field (SPN 2846)

The Industry Group field identifies the particular industry that is 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. The list of defined Industry Groups is available in Table B1 in Appendix B of the SAE J1939 base document. The Industry Group value affects the interpretation of the Vehicle System field and the Function field. The interpretation of the Industry Group field is independent of other NAME fields.

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 field value is selected from the All Industry NAME Functions Table (Table B11 in Appendix B of the SAE J1939 base document), then the Industry Group field shall be set to either:

   a. Any defined Industry Group value from Table B1 in Appendix B of the SAE J1939 base document shall be used.

   b. If using a Vehicle System description from Table B12 in Appendix B of the SAE J1939 base document, then Industry Group value shall be set to the Industry Group value specified for that Vehicle System.

2. If the Function field value is selected from the Industry Group Specific NAME Functions (i.e., from Table B12 in Appendix B of the SAE J1939 base document), 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

4.2.1.4.3 Vehicle System Instance Field (SPN 2843)

Vehicle System Instance is a 4-bit field used to identify a particular occurrence of a particular Vehicle System within a connected network. The Vehicle System 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 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 Vehicle System 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 may 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

4.2.1.4.4 Vehicle System Field (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 each 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 in Table B12 in Appendix B of the SAE J1939 base document. Vehicle System provides a common name for a group of functions within a connected network.

Examples of Vehicle Systems for currently defined Industry Groups are "tractor" in the "Common" Industry Group, "Trailer" in the On-Highway Industry Group, and planter in the "Agricultural Equipment" Industry Group. Users shall select the Vehicle System number that corresponds to the intended system in the above mentioned tables.

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 in Table B12 in Appendix B of the SAE J1939 base document.

The selection of the Vehicle System value shall be influenced by the Function value selection, as describe below.

1. If the Function field value is selected from the All Industry NAME Functions (Table B11 in Appendix B of the SAE J1939 base document), then the Vehicle System field shall be set to either:

    a. the "Non-specific System" (value 0)

    b. the "Not Available" (value 127)

    c. If using a Vehicle System description from Table B12 in Appendix B of the SAE J1939 base document, then Vehicle System value shall be set to the Vehicle System value specified for that Vehicle System.

2. If the Function field value is selected from the Industry Group Specific NAME Functions (Table B12 in Appendix B of the SAE J1939 base document), 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

4.2.1.4.5 Reserved Field

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

4.2.1.4.6 Function Field (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 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 All Industry Functions 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 by SAE J1939 in Tables B11 and B12 of the SAE J1939 base document. The list of defined All Industry Function values is available in Table B11 in Appendix B of the SAE J1939 base document. The list of defined Industry Group Specific Function values is available in Table B12 in Appendix B of the SAE J1939 base document.

If the CA is to use a Function that is defined within the Industry Group Specific Function value range (Table B12), 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

4.2.1.4.7 Function Instance Field (SPN 2839)

The Function Instance is a 5-bit field that identifies the particular occurrence of a Function on the same Vehicle System on a given network. 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 may be necessary. As an example, consider an implementation consisting of two engines and two transmissions. It may 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

4.2.1.4.8 ECU Instance Field (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

4.2.1.4.9 Manufacturer Code Field (SPN 2838)

The Manufacturer Code is an 11-bit field that indicates the company associated with or responsible for the production of the electronic control module for which this NAME is being referenced. The Manufacturer Code value shall only be one of the Manufacturer Code values assigned by SAE J1939. The list of defined Manufacturer Code values is available in Table B10 in Appendix B of the SAE J1939 base document. 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

4.2.1.4.10 Identity Number Field (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. This field is necessary to resolve any address contention. The manufacturer shall provide this uniqueness among products. It is the manufacturers 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

4.2.1.5 Dependencies in the NAME Fields

Figure 3 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.

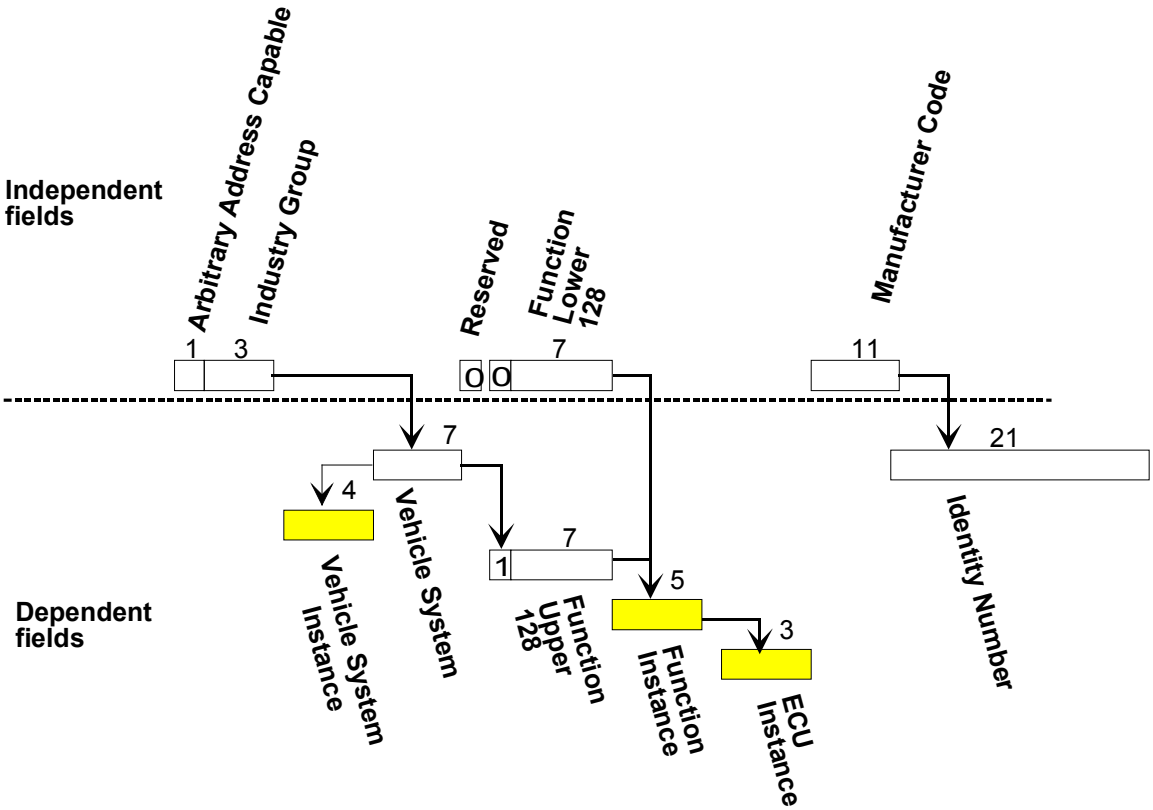


Figure 3 - Dependencies in the NAME fields

4.2.2 Addresses

An address is a one-byte value identifying a particular CA in a network. The address of a CA is incorporated into the identifier of every message sent by that CA and is used to provide uniqueness to messages that are sent by the CA.

4.2.2.1 Preferred Addresses

Some CAs that operate on a SAE J1939 network have an assigned preferred address (see SAE J1939, Tables B2 to B9) that the CA shall attempt to use first. If one CA's preferred address has been successfully claimed (in use) by a second CA on the network, the first CA has the option of attempting to secure another source address or it may send a Cannot Claim Address message depending on the ECU's addressing capability and the availability of an unused address.

A CA claiming a preferred address in the range 0 to 127 and 248 to 253 shall perform the function defined for that preferred address and specify that Function within its NAME. Other CAs may assume the CA claiming a preferred address performs the function defined in Tables B2 to B9.

4.2.2.2 Arbitrary Address Capable

Other CAs that do not have an assigned preferred address shall initially claim an address in the range of 128 to 247 inclusive. Since multiple CAs may be claiming addresses in this range the preferred implementation shall be arbitrary address capable. This will allow the address claim process to result in unique addresses for each CA on the network.

4.2.2.3 Unique Addresses

Source addresses shall be unique within a particular vehicle or vehicle subnetwork. Source addresses may be associated with different CAs after each power up of the vehicle and may also vary from vehicle to vehicle.

4.2.2.4 Address Assignment Guidance

Some address capabilities may be better suited to certain CAs than others. For instance, arbitrary addressing capability may be better suited to CAs that may be attached to an already operating network, such as data loggers, calibration ECUs, bridges, or implements. This is due to the possibility of encountering multiple CAs of the same type that can potentially claim the same initial address. Other devices that can benefit from using arbitrary address capability are "traveling" CAs that can be moved from vehicle to vehicle, CAs that can appear on networks in multiples (e.g., window or door controllers) and any device that does not perform a function specified by the lower 128 preferred addresses.

Some CAs are assigned addresses in the lower 128 range of source addresses and use one of the Single Address capabilities. These are typically powertrain related and other functions that are common on many vehicles. Due to the limited number of addresses available for this addressing mode, Arbitrary Address capability is recommended for most new CAs.

4.2.2.5 Address Imposters

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 to broadcast commands or data from that same given source address. Devices acting as impostors (transmitting under another CA's source address) may result in unexpected or damaging vehicle operation. Designers of ECUs may take precautions to detect such imposters and take actions appropriate to the system under control.

For example, the ECU that successfully claimed an address could monitor messages with its own address to detect imposter transmissions.

Appropriate actions may include setting a fault code, entering a default mode, etc.

4.2.2.6 Reprogrammable Preferred Address

A CA's initial address, the address the CA attempts to claim on first power-up, shall be set by the manufacturer to match the list of application-defined preferred addresses wherever possible (SAE J1939 Tables B2 to B9). However, a CA's initial address is strongly recommended to be reprogrammable to permit an OEM to properly configure a vehicle. Although this may not be necessary for standard CAs (see 4.4.1), it provides flexibility for applications where multiple instances of a given CA (i.e., when there are two engines, etc.) may exist. This reprogrammability feature is especially important for temporarily connected or aftermarket ECUs.

4.2.2.7 The 254 Address

The network address 254, also known as the NULL address, is only permitted in the Source Address field of the SAE J1939 message identifier and is intended for use only within Network Management communications.

4.2.2.8 The 255 Address

The network address 255, also known as the Global address, is permitted in the Destination Address field of the SAE J1939 message identifier but never in the Source Address field.

4.3 Address Configuration and Capability

Address configuration is the method by which a particular CA determines the source address it will use for Address Claim. For the purposes of the Address Claim process, there are two primary capabilities: Arbitrary Address Capable and Single Address Capable which has four subtypes. These are distinguished by the value in the Arbitrary Address Capable field in the most significant bit position in the CA's NAME.

Five different addressing capabilities are supported in this Recommended Practice. Support for these addressing capabilities in this standard is not intended to imply that a given CA shall support specific capabilities. SAE J1939 CAs are not required to possess a specific addressing capability, however they are required to perform the minimum Network Management functions described in 4.8 of this document and may for particular applications be required by the manufacturer to have such capabilities.

4.3.1 Arbitrary Address Capable CA

An Arbitrary Address Capable CA is one that is able to select its source address from any appropriate SA (including those in the range 128 to 247 inclusive) based on internal algorithms, and then claim that address. This CA, in cases of address conflict, is also able to re-calculate its address and re-claim (unless all 120 of the addresses between 128 and 247 are used). The value in the Arbitrary Address Capable field in the NAME (see 4.2.1.4.1) indicates whether or not a CA has this capability. This capability is needed particularly for CAs that are expected to exist as multiple instances on a single vehicle.

In cases when arbitrating with non-arbitrary address capable CAs, the Arbitrary Address Capable CA shall be the one to lose arbitration for a Preferred Address since the setting of the Arbitrary Address Capable bit in its NAME lowers its priority for address claim. This is correct behavior since its ability to operate correctly on the network shall not be affected by the loss of arbitration. Note that if its function is one that would normally use a Preferred Address in the lower 128, it shall claim that address first. Only upon losing arbitration during Address Claim shall it claim an unused address from the range above 128.

4.3.2 Single Address Capable CA

NOTE: The use of Single Address Capable CAs is discouraged for new devices, due to the limited number of available Preferred Addresses in B Tables of Appendix B of the SAE J1939. Rather, Arbitrary Address Capable devices are encouraged.

A Single Address Capable CA is one that normally is able to claim a single Source Address. The value in the Arbitrary Address Capable field is zero in the NAME of these CAs. These CAs have no means to alter the address they claim and use without intervention through some external process. Within the Single Address Capable group, there are four different methods by which the CA is able to have its address changed. All but one involves an external agent.

Four classifications of Single Address Capable CAs are defined below to allow different methods of changing the targeted source address. These classifications are not necessarily mutually exclusive. For example, an ECU that is a Self-Configurable Address CA could simultaneously be a Service Configurable Address CA and a Command Configurable Address CA. A designer may allow this just in case the CA is unable to claim any of the addresses within its limited set.

4.3.2.1 Non-Configurable Address CA

A Non-Configurable Address CA is one which has a fixed source address provided by its manufacturer. This address is not alterable by any means, including service procedures. Note that a “Service Procedure” that replaces the software that is executing in the ECU and thereby defining the CA may still change the address used by the CA.

4.3.2.2 Service Configurable Address CA

A Service Configurable Address CA is one whose source address may be changed in the field by a service technician. The address may be altered by using the Commanded Address message, while in a "service" mode of operation. It is very likely that a service tool would be involved.

4.3.2.3 Command Configurable Address CA

A Command Configurable Address CA is one whose source address is able to be altered using the Commanded Address message. The change can take place as the ECUs on the vehicle power up, without the intervention of a service tool or the requirement of a special service mode of operation. It does require the presence on the vehicle of a CA that can send the appropriate command to cause the address change, and code in the Command Configurable Address CA to recognize and authenticate that command.

4.3.2.4 Self-Configurable Address CA

This is a special case where the CA is capable of determining which one of a limited set of Source Addresses it shall use based on information it obtains from the vehicle’s configuration. An example of this is a Trailer Bridge that determines it is Trailer No. 2 in a vehicle. While it is able to change the Source Address (SA) it shall use based on this internal determination, it can use only that address while it is in that particular position on the vehicle. If that trailer were moved to Trailer No. 1 position, the CA would use the address specified for Trailer No. 1. Note that there is just one address that is appropriate for use at each position: the CA first learns its position, and then creates the new NAME using that position information, and then chooses the appropriate address. A device that uses information from a connector plug to determine whether it is on the left or right side of the vehicle would also be in this class. Note that these CAs are capable of changing their addresses solely on the basis of a change in NAME.

4.4 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 5 in Appendix B.

4.4.1 Standard CAs

Standard CAs are those CAs 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. Standard CAs do not have the ability to modify the source addresses of any other CAs except as a result of the address claiming process.

Standard CAs may or may not possess any of the addressing capabilities listed in 4.3. It is not the intent of this document to require a particular address configuration capability for any Standard CA.

These CAs have the REQUIRED behaviors:

1. Shall issue a valid Address Claimed message before using a source address.

2. Shall transmit either an Address Claimed or a Cannot Claim SA Message upon receipt of a request for Address Claimed message.

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

4.4.2 Diagnostic/Development Tool CAs

Diagnostic and Development Tool CAs are those which are connected to a particular SAE J1939 subnetwork for the purpose of analyzing, debugging, developing or monitoring any CA on the subnetwork or the operation of the subnetwork itself. Although these tools are not expected to be permanently attached to a subnetwork, such a tool may well be a permanent part of a particular vehicle or craft. In either case, the capabilities of these tools are more extensive than those of Standard CAs. They are 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).

These may be proprietary tools intended to operate on or in a given manufacturer's ECUs. They may be a general purpose tool intended to operate on ECUs provided by several manufacturers. Or they may be intended to work primarily on the network itself, providing network integration services for system integrators and OEM vehicle manufacturers.

These CAs:

1. Shall have all the network management capabilities of standard CAs.

2. Support Commanded Address and NAME management messages when needed by the system.

3. Send Request for Address Claim before attempting to claim an address. This is facilitates the use of multiple tools in a system without unnecessary changing of addresses.

4. Have the ability to have its address configured to avoid conflicts with other tools.

5. Understand and support Working Sets if used in the system.

4.4.3 Network Interconnection CAs

Network Interconnection CAs are those that exist primarily for the purpose of interconnecting networks or subnetworks. They typically consist of repeaters, bridges, routers and gateways. In one manner or another, all network interconnection CAs forward messages from one subnetwork to another.

Subnetworks interconnected by Network Interconnection CAs may have the same protocol, as in two SAE J1939 subnetworks in the same vehicle; they may have different protocols, such as from SAE J1708/J1587 to SAE J1939, or may be interconnected off-vehicle subnetworks, such as satellite link, token ring or cellular modem.

Network Interconnection CAs serving as gateways translate from SAE J1939 subnetworks to various other networks. This document shall deal only with the SAE J1939 portions of those CAs.

These CAs:

1. Shall have all the network management capabilities of standard CAs.

2. Send Request for Address Claim before attempting to claim an address. This facilitates the use of multiple NIUs in a system without unnecessary changing of addresses.

3. Support Commanded Address and NAME management messages. This allows systems with multiple subnetworks and potentially multiple NIUs to be configured.

4. Have the ability to have its address configured to avoid conflicts with other NIUs.

4.5 Network Management Procedures - Required

Network management procedures are the messages passed and the actions taken by individual CAs to collectively manage the network. The primary functions of the Network Management protocol are those of Address Management and Network Error Management.

The Address Claimed message is used by each CA to acquire a unique address on the vehicle network after completing its own Power On Self Test (POST) and before originating other communications messages. Successful claiming of an address by a CA consists of sending an Address Claim message for the address to be claimed and not receiving contending claims for that address. Single Address CAs with addresses in the 0 to 127 and 248 to 253 ranges may begin regular network communications immediately after sending the address claim message. Other CAs shall not begin or resume origination of normal network traffic until 250 ms after claiming an address (see Figure A1 in Appendix A) to allow contending claims to be made before the address is used.

The procedure below assures that any duplicate addresses are detected during initialization processes and resolved at that time.

4.5.1 Address Claim Prioritization

In the event that two CAs contend for an address, priority shall be allotted to the CA with the lowest numerical value of the NAME. The NAME shall be treated as a single 8-byte numerical value. For determination of value, the Arbitrary Address Capable bit shall be considered the most significant bit. For example, should Engine 0 and Engine 1 both desire the same address, Engine Instance 0 shall have a lower absolute value NAME and therefore shall win address arbitration. This process is shown in Figures A2 and A3 in Appendix A.

Although this requires comparison of the 8-byte NAMEs in the Address Claimed Message data fields, it eliminates ambiguity in the address claiming process.The entire 64 bits of the NAME are considered together as a 64-bit integer. The NAME with the smaller integer value is the NAME with the higher priority (see 4.2.1.2).

4.5.2 Address Claim Requirements

Every CA is required to claim its source address upon initialization and upon any change of the CA's NAME or source address. A CA may support and act on a Commanded Address message, in which case, the later requirement provides confirmation that the Commanded Address message was accepted. The requirement also assures that each CA takes responsibility for obtaining a valid address and that other CAs properly arbitrate for the address if the CA has not yet heard their address claim.

The destination address for an address claim shall be global (255) to "announce" the claim message to all CAs on the network.

A CA that is configured to receive messages that it transmits shall be able to differentiate between Address Claimed messages received from itself and those received from other CAs. This capability is necessary to allow duplicate addresses to be detected.

4.5.2.1 Requirements for Requests for Address Claimed

The source address for a Request for Address Claimed message shall be the NULL address (254) if the request is from a CA that has not yet successfully claimed an address.

4.5.3 Address Claim Initialization Rules

In general, most ECUs shall use their Preferred Addresses immediately upon power up. A specific procedure for assigning addresses after power up is used to resolve any conflicts that may occur. This procedure is defined in this document and elaborated on in SAE J1939. Each ECU shall be capable of announcing which addresses it intends to use. This is the address claim feature. Two options are available:

1. Upon power-up and whenever requested, an ECU shall send an Address Claimed message for each CA it contains to claim an address. When an ECU sends the Address Claimed message, all ECUs record or compare this newly claimed address to their table of used network addresses. Not all ECUs are required to maintain such a table, but all shall at least compare the newly claimed address with their own. Should multiple ECUs claim the same address, the one having the lowest value NAME uses this address and the other(s) shall claim a different address or stop transmitting on the network.

2. An ECU may send a request for Address Claimed message to determine addresses claimed by other ECUs. When an ECU sends a request for Address Claimed, all requested ECUs then send their Address Claimed messages. This permits transitional ECUs (tools, trailers, etc.) or ECUs powering up late to compile a current address table, so that an available address can be found and claimed or to determine which ECUs are currently on the network. This approach permits the option of self-configurable addresses for those ECUs which may need it, but does not make this a requirement for all ECUs. Self-configurable addressing is optional; those ECUs which might be expected to encounter address conflicts are recommended to support this capability.

The following rules apply to all CAs (minimum requirements):

4.5.3.1 Response to a Request for Address Claimed Sent to the Global Address

A CA shall always respond to a Request for Address Claimed directed to the global address with either an Address Claimed message or if the CA has not been successful in claiming an address, a Cannot Claim Address message.

4.5.3.2 Response to a Request for Address Claimed Sent to a Specific Address

A CA shall always respond to a Request for Address Claimed where the destination address of the request is the CA's address. The response to the request, the Address Claimed message, shall be sent to the global address (255).

4.5.3.3 Response to Address Claims of Own Address

A CA shall retransmit an address claim if it receives an address claim with a source address that matches its own and if its own NAME is of a lower value (higher priority) than the NAME in the claim it received. If the CA's NAME is of a higher value (lower priority) than the NAME in the claim it received, the CA shall not continue to use that address. (It may send a Cannot Claim Address message or it may attempt to claim a different address.)

4.5.3.4 Contention for an Address

A CA that discovers it cannot use an address due to a higher priority competing claim shall either send a Cannot Claim Address message (Non-configurable, Service configurable, or Command configurable) or select another address and attempt to claim that address (Self-configurable and Arbitrary Address Capable). If unable to claim an address the CA shall also suspend transmissions of:

1. Any future messages other than response to a global request for address claim

2. Existing messages queued up for transmission

3. Any destination specific TP sessions that are active (see also 4.5.8)

4. Any broadcast announce TP sessions that are active

A CA previously communicating to this CA shall detect that the CA has become disabled or changed its address by monitoring the Address Claim by the more dominant CA (lower name value) as well as by monitoring the Cannot Claim Address message.

4.5.4 Message Sequences for Initialization

Graphical schematics of the initialization 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 4.5.1. State transition diagrams describing address claiming processes are presented in Appendix D, Figures D1, D2, and D3.

4.5.4.1 Message Sequences for Initialization for all CAs on the Network

Message sequences for initialization of all CAs using the network are shown in Appendix A, Figures A1, A2, A3 and A4. The condition under which the sequence applies is summarized in the table below.

Figure	Condition under which sequence is applicable
A1	CA with address claim and no contention
A2	Two Single Address CAs Attempt to Claim the Same Address but not Simultaneously
A3	CA where NAME A is less than NAME B and CA B is Self Configurable or Arbitrary Address Capable
A4	Two CAs Attempting to Claim the Same Address Simultaneously

4.5.4.2 Potential Identical Identifiers in Network Management Messages

The possibility exists for messages with the same identifiers to be generated by different CAs with three of the network management messages. These messages are (1) request for Address Claimed, (2) Address Claimed, and (3) Cannot Claim Address messages.

1. The sending of a Request for Address Claimed message simultaneously by two different CAs that are both sending from the NULL address (254) is not a problem because the data field is the same for both messages.

2. The sending of an Address Claimed message simultaneously by two different CAs which are contending for the same address shall cause bus collisions because the NAMEs in the data field of the message shall be different. See 4.5.4.3 for the resolution method.

3. The sending of a Cannot Claim Address message simultaneously by two different CAs from address 254 shall cause bus collisions because the NAMEs in the data field shall be different. See 4.5.4.3 for the resolution method.

4.5.4.3 Address Claim Bus Collision Management

If multiple CAs have the same address and different NAMEs, simultaneous Address Claimed messages shall result in bus errors. To minimize the probability of modules generating bus errors until going bus off, the following special processing shall be used when transmitting claim messages.

After transmitting any claim message, the transmitting CA shall monitor error code information. If the error code indicates that a bus error has occurred, any automatic retransmission attempts by the CAN peripheral shall be canceled if possible.

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

The transmit delay shall be calculated to produce a pseudo-random value between 0 and 255. The NAME, 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 claim message is transmitted. The module shall be able to schedule the next claim message within ±0.6 ms of the calculated delay.

The delay shall be calculated by multiplying the 0 to 255 output of the pseudo-random number generator by 0.6 m (the maximum time one message requires on the bus) producing a delay range of 0 to 153 ms. If a second claim message transmission results in a bus error, the process shall be repeated with a new pseudo-random number.

Figure A4 in Appendix A illustrates the process of simultaneous claims by two CAs of the same address.

4.5.4.4 A CA which is Unable to Successfully Obtain an Address

The message sequence for answering a request for Address Claimed by a CA that is unable to successfully obtain an address 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 4.5.4.3 shall be used. A CA that is unable to successfully claim an address shall send no messages except:

1. A Cannot Claim Address message in response to requests for Address Claimed or to respond to a Commanded Address message, or

2. A request for Address Claimed message.

4.5.5 Requests for Address Claimed for Self-Configurable Addressing CAs

A Self-Configurable Addressing or Arbitrary Address Capable CA may elect to obtain a list of the addresses already claimed on the network before claiming an unused address. Note that the CA may, upon discovery that its preferred address has been claimed, request the addresses of all CAs on the network using the source address of 254 and then claim an address that was not previously claimed. Preferably, a Self-Configurable Addressing or Arbitrary Address Capable CA shall transmit a request for Address Claimed with a destination address set to the preferred address it would like to claim for the purpose of finding an unclaimed address. The Address Request sent to the global address shall be used with care since it generates a response from every CA on the network (Appendix A, Figure A6). The specific request shall be directed at an address that is not likely to be occupied and shall minimize message traffic (Appendix A, Figure A5).

4.5.5.1 Technical Note Regarding Multiple Self-Configurable Addressing CAs

Special care shall be taken in the design of arbitrary address capable CAs if more than one of a manufacturer's ECUs may be connected in a system. These CAs may have the same initialization algorithm and may issue simultaneous initial Address Claimed messages. If these CAs attempt to claim the same address, a bus-OFF condition is likely to occur. Manufacturers shall design CAs of this type to minimize the probability that they issue initial address claims at the same time. Alternatively, manufacturers may design CAs of this type to minimize the probability that the CAs initially claim the same addresses. The use of both of these techniques would significantly improve (shorten) initialization time.

4.5.5.2 CAs Not Permanently Connected to the Network

A request for Address Claimed message may be used to determine if an address is being used before attempting to claim that address. This process allows an arbitrary address capable device to create less address contention when it initializes on the network. This procedure is appropriate for CAs such as tools that are not permanently connected to the network. Message sequences for initialization of CAs not permanently connected to the network are shown in Appendix A, Figure A6. The request for Address Claimed message preceding the claim can be used in identifying an unused address for CAs that are arbitrary address capable.

4.5.6 Construction of Address to NAME Association Tables

Request for Address Claimed sent to specific addresses or to the global address may be used to construct an address to NAME association table. This table may be used in some CAs to confirm the associations for critical functions, for example, to confirm that the powertrain engine is located at address 0 to insure that torque/speed control messages from the transmission are sent to the proper destination. In CAs where a small number of address to NAME associations are required, Requests for Address Claimed sent to a specific address shall be used. In a diagnostic tool where all of the CAs on a network need to be inventoried, a Request for Address Claimed sent to the global address is appropriate.

Network Management messages have the same characteristics and requirements as other SAE J1939 messages with the exceptions of the use of the NULL address. The request for Address Claimed message is a conventional Request message as described in SAE J1939-21. The null address (254) is acceptable in the source address field of a network management message only if the message is a request for Address Claimed or a Cannot Claim Address message. A request directed to the NULL address (254) yields no responses.

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 2 summarizes the messages.

Table 2 - Network management messages

Message name	PGN	PF	PS	SA	Data Length (Bytes)	Data
Request PG (request for Address Claimed)	59904 (See SAE J1939-21)	234	DA	SA(1)	3	PGN 60928
Address Claimed						
Address Claimed	60928	238	255	SA	8	NAME
Cannot Claim Source Address	60928	238	255	254	8	NAME
Commanded Address	65240	254	216	SA	9(2)	NAME, new SA
NAME Management	37632	147	DA	SA	8	NAME fields, qualifiers and mode

(1) Source address could be set to 254 if no address has yet been claimed.
(2) Commanded Address message is sent with the Transport Protocol BAM (See SAE J1939-21).

4.5.7 Request Message (PGN 59904) for Address Claimed (PGN 60928)

The request message (PGN 59904) for the Address Claimed message (PGN 60928) is used by any CA to request the NAMEs and addresses of CAs in ECUs attached to the network. Upon receipt of the request message for Address Claimed, each CA shall transmit an Address Claimed message containing its address and its NAME. Any CA that is unable to successfully claim an address shall respond with a Cannot Claim Address message (4.5.8.3) unless the CA has not yet attempted to claim an address. CAs that have not attempted to claim an address shall now claim an address. These CAs shall not send a Cannot Claim Address message or any other message until an Address Claim has been attempted.

The request message for the Address Claimed message may be sent to any particular address (0 to 253) or to a global destination address (255). A CA preparing to use a particular address may interrogate that address by sending a request for address claim to that particular address to determine if another CA has claimed it. A CA may determine the existence of a functioning CA with a particular NAME on the network by sending a request for Address Claim to the global address (255) and examining the responses.

The source address for a request for Address Claimed message shall be the NULL address (254) if the request is from a CA that has not yet claimed an address.

A CA shall respond to its own request for Address Claimed message if the request was directed to the global address.

4.5.8 Address Claimed/Cannot Claim (PGN 60928)

The Address Claimed PGN may be used in two ways: to claim an address, and to announce that a CA was unable to claim an address. The former case is referred to in 4.5.8.1 as the Address Claimed message, and the latter in 4.5.8.3 as the Cannot Claim Address message. The Address Claimed message is used by any CA to either respond to a received request message for the Address Claimed message or to simply claim a single address on the network. CAs shall issue it during initialization of a network or when attaching to a running network. If a CA receives an Address Claimed message claiming its own source address, it shall compare the NAME that was received in the Address Claimed message with its own NAME and determine which CA has a higher priority NAME (lower numeric value as described in 4.5.1).

If the CA receiving the Address Claim determines that it has the higher priority NAME it may then transmit an Address Claimed message containing its NAME and address. However if it has the lower priority NAME it shall either attempt to claim a different address or send a Cannot Claim Address message. A CA that loses address arbitration in this manner and is in the process of sending a transport protocol message shall immediately cease sending the transport protocol message and shall not send a Transport Protocol Abort. Receivers of the transport protocol message shall detect the interruption through the normal transport protocol timeout process as specified in SAE J1939-21 (1.25 second). Queued transport protocol frames shall cease within the timeout and constraints given in SAE J1939-21, 5.10.3.4 (50 ms).

A CA may send the Cannot Claim Address message (see 4.5.8.3) or a Request for Address Claim using the NULL address as a source address (see 4.5.7) provided it has attempted the address claim and without having successfully claimed an address. A network interconnection CA shall not use its own address in communications on the network until it has successfully claimed that address. Handling messages of other CAs is a special case for network interconnection devices. Network interconnection devices acting entirely as repeaters may pass messages bearing the originator's Source Address before claiming their own addresses (for further requirements for network interconnection devices see SAE J1939-31).

Configuration of networks with multiple bridges may create significant delay between transmission and reception of address claims that traverse the bridges. The 250 ms delay may not be adequate in these systems to prevent further arbitration after a CA has successfully claimed an address.

Once a CA has successfully claimed an address, it may begin transmitting other messages on the network and respond to any further Requests for Address Claim.

No valid claim shall be made for Address 254, the NULL address. An Address Claimed message sent with address 254 as the source address is a Cannot Claim Address message (see 4.5.8.3).

The Address Claimed message shall always be sent to the global address (255) to provide all ECUs on the network the information to maintain a current address to NAME correspondence. The Address Claimed message shall be sent to the global address (255) even when requested in a destination specific message. The Address Claimed message is an exception to the requirements on request messages specified in SAE J1939-21. (SAE J1939-21 defines that a request message that is directed to a specific address be responded to with the destination set to the requester.)

4.5.8.1 Address Claimed Message

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)

NAME can be viewed as a single 64-bit parameter

Start Position	Length	Parameter Name	SPN
1-8	64	NAME of Controller Application	2848

NAME can also be viewed as individual field parameters

Start Position	Length	Parameter Name	SPN
1-3.1	21 bits	Identity Number	2837
3.6-4	11 bits	Manufacturer Code	2838
5.1	3 bits	ECU Instance	2840
5.4	5 bits	Function Instance	2839
6	8 bits	Function	2841
7.1	1 bit	Reserved	
7.2	7 bits	Vehicle System	2842
8.1	4 bits	Vehicle System Instance	2843
8.5	3 bits	Industry Group	2846
8.8	1 bit	Arbitrary Address Capable	2844

The individual fields of NAME are defined in 4.2.1.

4.5.8.2 NAME of Controller Application (SPN 2848)

The 8-byte value which uniquely identifies the particular CA that is claiming the associated address.

Data Length:	8 Bytes
Resolution:	See 4.2.1
Data Range:	0 to 18446744073709551615
Type:	Measured
Suspect Parameter Number:	2848
Reference:	4.5.8.1 and 4.5.8.3

4.5.8.3 Cannot Claim Address

The Cannot Claim Address message has the same PGN as the Address Claimed message but has a source address of 254, the NULL address. A Cannot Claim Address message is transmitted by any CA that cannot claim its preferred address and does not have arbitrary addressing capability, or has arbitrary addressing capability but cannot claim an address because none are available for use.

The Cannot Claim Address message may be sent as a response to a Request for Address Claim message. A pseudo-random delay of between 0 and 153 ms shall be inserted between the reception of a message triggering the response and the Cannot Claim Address response. The delay is intended to minimize the potential that two Cannot Claim Address messages shall cause bus errors. This bus error can occur when two or more Cannot Claim Address messages with identical PGNs and SAs of 254 are sent simultaneously. Differences in the messages will not occur during the arbitration frame, but during the data fame (containing the NAME) where bit checking shall force an error frame aborting the message. Therefore, only after the CRC portion of the message shall the error frame be asserted, thereby consuming a large number of bit times on the bus. The method for generating the pseudo-random delay is described in 4.5.4.3.

An ECU that cannot claim an address shall not send any message other than the Cannot Claim Address message or a Request for Address Claim.

4.6 Network Management Procedures - Optional

4.6.1 Commanded Address (PGN 65240)

A network interconnection CA, a bridge for example, or a diagnostic or scan tool may command another CA (Commanded CA) to use a given source address with the Commanded Address Message. The Commanded Address message shall be used to instruct a CA with a specific NAME to use a specific source address (Figures A9 and A10 in Appendix A). Upon receipt of a Commanded Address message containing its own NAME, a CA shall react in one of two ways: it may accept by initiating an address claim procedure using the new address provided in the Commanded Address message or ignore the command by sending no response. If the commanded address is successfully claimed, future transmissions from the CA shall use the commanded address until another Commanded Address message is received or, through power-up or address contention, another address claim process is completed. If the Commanded CA elects to receive the Commanded Address message and cannot change to the commanded address, it shall ignore the commanded address.

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

The Commanded Address message contains 9 bytes of data and shall be sent using the Broadcast Announce Mode (BAM) of the transport protocol (SAE J1939-21) and shall be sent to the global address (255). CAs designed to support the Commanded Address message shall also support the BAM form of the Transport Protocol.

4.6.1.1 Commanded Address Message

Transmission rate: As required
Acknowledgement: See Figures A9 and A10 in Appendix A
Data length: 9 bytes
Data page: 0
PDU format: 254
PDU specific: 216
Default priority: 6
Parameter group number: 65240 ($00FED8_{16}$)

Start Position	Length	Parameter Name	SPN
NAME of Commanded Address Target			
1-3.1	21 bits	Identity Number	2837
3.6-4	11 bits	Manufacturer Code	2838
5.1	3 bits	ECU Instance	2840
5.4	5 bits	Function Instance	2839
6	8 bits	Function	2841
7.1	1 bit	Reserved	
7.2	7 bits	Vehicle System	2842
8.1	4 bits	Vehicle System Instance	2843
8.5	3 bits	Industry Group	2846
8.8	1 bit	Arbitrary Address Capable	2844
Address Assignment			
9.1	8 bit	New source address	2847

4.6.1.2 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: 4.6.1.1

4.6.1.3 Address Assignment (new source address) (SPN 2847)

This 8-bit field is the 9th byte of the data field of the Commanded Address message. It contains the source address that is to be assigned to the CA matching the NAME conveyed in the first eight bytes of this Commanded Address message. All messages originating from this CA after reception of the Commanded Address message and successful claim of that address shall use that source address.

Data Length: 1 Byte
Resolution: one address per bit
Data Range: 0 to 253
Type: Measured
Suspect Parameter Number: 2847
Reference: 4.6.1.1

4.6.2 NAME Management

4.6.2.1 Overview

This 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 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 source 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. 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 through 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 may limit the use of the message by not accepting it from CAs other than e.g., service tools or network interconnect units. ECU manufacturers may also require additional security verification processes before accepting a NAME Management message. The ECU manufacturer may 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 source addresses of CAs being changed prior to using this command. Commands are directed to source addresses.

4.6.2.2 NAME Management (NM) Message (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 destination specific to the source address of the CA to be modified.

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 claim its new NAME on the network
    d. Send its address claim 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 parameter fields are used for some modes but not all. When not used for a specific mode, the unused fields shall be set to all 1s. Fields 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 field is to be modified
Default priority: 6
Parameter group number: 37632 (0x009300)
Data:

Table 3 - NM message fields

Start Position	Length	Parameter Name	SPN	Parameter used in Modes	Ref Section
1	8 bits	NAME Checksum/Error Code	5657	Modes 0,4	4.6.2.2.1
2.1	1 bit	Manufacturer Code qualifier flag	5658	Modes 0,8	4.6.2.2.2
2.2	1 bit	ECU Instance qualifier flag	5659		4.6.2.2.3
2.3	1 bit	Function Instance qualifier flag	5660		4.6.2.2.4
2.4	1 bit	Function qualifier flag	5661		4.6.2.2.5
2.5	1 bit	Vehicle System qualifier flag	5662		4.6.2.2.6
2.6	1 bit	Vehicle System Instance qualifier flag	5663		4.6.2.2.7
2.7	1 bit	Industry Group qualifier flag	5664		4.6.2.2.8
2.8	1 bit	Arbitrary Address Capable qualifier flag	5665		4.6.2.2.9
3.1	4 bits	NM Control Mode indicator	5666	ALL Modes	4.6.2.2.10
3.5	1 bit	Reserved			
3.6-4	11 bits	[a] Commanded Manufacturer Code	5667	Modes 0,1,2,3,8	4.6.2.2.11
5.1	3 bits	[a] Commanded ECU Instance	5668		4.6.2.2.12
5.4	5 bits	[a] Commanded Function Instance	5669		4.6.2.2.13
6	8 bits	[a] Commanded Function	5670		4.6.2.2.14
7.1	1 bit	Reserved			
7.2	7 bits	[a] Commanded Vehicle System	5671	Modes 0,1,2,3,8	4.6.2.2.15
8.1	4 bits	[a] Commanded Vehicle System Instance	5672		4.6.2.2.16
8.5	3 bits	[a] Commanded Industry Group	5673		4.6.2.2.17
8.8	1 bit	[a] Commanded Arbitrary Address Capable	5674		4.6.2.2.18

[a] These fields shall be populated when their corresponding qualifier flag is set to 0. When their qualifier flag is set to 1, the field shall be set to all 1s.

The contents and interpretation of each field of the NM message are detailed in the following sections. Table 4 summarizes how each field 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 NAK**	**Request Pending NAME**	**Request Current NAME**	**Adopt Pend NAME**	**Request Address Claim**
NAME Checksum / Error Code	NAME Checksum	NA, Set to $FF	NA, Set to $FF	NA, Set to $FF	Error Code	NA, Set to $FF	NA, Set to $FF	NA, Set to $FF	NA, Set to $FF
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.

4.6.2.2.1 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 SA of the target CA having been claimed by another CA through the address arbitration process since 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 “NAME NACK”, it represents an error code sent by the target CA. Code values are as follows:

0 - Security not satisfied. Different SA 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:	4.6.2.2

4.6.2.2.2 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 field (SPN 5667) shall be used to change the Manufacturer Code field 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 - NAME NACK this qualifier flag is used only for error code 1 and 2. When the flag is set to "0" the Manufacturer Code field can be changed. When the flag is set to "1" the Manufacturer Code field cannot be changed. For all other error codes the flag is not applicable and therefore 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 field (SPN 5667) 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 a NAME claim 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: 4.6.2.2

4.6.2.2.3 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 field (SPN 5668) 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 - 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 therefore 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 a NAME claim 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: 4.6.2.2

4.6.2.2.4 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 - 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 therefore 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 a NAME claim 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: 4.6.2.2

4.6.2.2.5 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 - 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 therefore 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 a NAME claim 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:	4.6.2.2

4.6.2.2.6 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 - 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 therefore 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 a NAME claim 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:	4.6.2.2

4.6.2.2.7 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 - 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 therefore 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 a NAME claim message PGN 60928.

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

Data Length: 1 bits
Resolution: 1 bit
Data Range: 0 to 1
Type: Status
Suspect Parameter Number: 5663
Reference: 4.6.2.2

4.6.2.2.8 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 - 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 therefore 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 a NAME claim message PGN 60928.

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

Data Length: 1 bits
Resolution: 1 bit
Data Range: 0 to 1
Type: Status
Suspect Parameter Number: 5664
Reference: 4.6.2.2

4.6.2.2.9 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 - 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 therefore 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 a NAME claim 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:	4.6.2.2

4.6.2.2.10 NM Control Mode Indicator (SPN 5666)

This four 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:	4.6.2.2

Modes are defined as follows:

4.6.2.2.10.1 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 one contained in the message. All data fields of the message are required.

The “Commanded” parameter fields are 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 SA having changed through the address arbitration process.

4.6.2.2.10.2 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 NACK (mode 4) shall be sent.

4.6.2.2.10.3 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.

4.6.2.2.10.4 Mode 3 – 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.

4.6.2.2.10.5 Mode 4 – 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 Control Mode parameter and the Error Code parameter are always valid fields in this form of the message. The Qualifier Flags are only valid if the Error Code parameter is set to "1" or "2". All other fields are invalid. Invalid fields shall be set to all 1s.

4.6.2.2.10.6 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 control mode parameter is the only valid field in this form of the message. All other fields shall be set to all 1s.

4.6.2.2.10.7 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 control mode parameter is the only valid field in this form of the message. All other fields shall be set to all 1s.

4.6.2.2.10.8 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 their pending NAME as its current NAME and to initiate the Address Claim procedure with this new NAME. The control mode parameter 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 SA or to the global address.

4.6.2.2.10.9 Mode 8 – Request NAME Address Claim

This form of the message is used to request that a CA whose SA is unknown to the requester send the address claim message, thus allowing the requester to determine the CA’s SA. All or portions of the NAME may 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 the Request PGN containing the Address Claimed message PGN 60928 which can request only a specific SA 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 requestor 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 requestor to determine the number and SAs 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 NAME NACK form of the NM message.

4.6.2.2.10.10 Modes 9 to 15 – reserved for future SAE use.

4.6.2.2.11 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 – 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 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 4.2.1.4.9 for the definition of Manufacturer Code.

Data Length:	11 bits
Resolution:	See 4.2.1.4.9
Data Range:	0 to 2047
Type:	Status
Suspect Parameter Number:	5667
Reference:	4.6.2.2

4.6.2.2.12 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 – 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 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 4.2.1.4.8 for the definition of ECU Instance.

Data Length:	3 bits
Resolution:	See 4.2.1.4.8
Data Range:	0 to 7
Type:	Status
Suspect Parameter Number:	5668
Reference:	4.6.2.2

4.6.2.2.13 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 – 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 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 4.2.1.4.7 for the definition of Function Instance.

Data Length:	5 bits
Resolution:	See 4.2.1.4.7
Data Range:	0 to 31
Type:	Status
Suspect Parameter Number:	5669
Reference:	4.6.2.2

4.6.2.2.14 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 – 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 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 1’s by command CA and target CA.

See 4.2.1.4.6 for the definition of Function.

Data Length:	8 bits
Resolution:	See 4.2.1.4.6
Data Range:	0 to 254
Type:	Status
Suspect Parameter Number:	5670
Reference:	4.6.2.2

4.6.2.2.15 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 – 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 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 4.2.1.4.4 for the definition of Vehicle System.

Data Length:	7 bits
Resolution:	See 4.2.1.4.4
Data Range:	0 to 126
Type:	Status
Suspect Parameter Number:	5671
Reference:	4.6.2.2

4.6.2.2.16 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 – 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 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 4.2.1.4.3 for the definition of Vehicle System Instance.

Data Length:	4 bits
Resolution:	See 4.2.1.4.3
Data Range:	0 to 15
Type:	Status
Suspect Parameter Number:	5672
Reference:	4.6.2.2

4.6.2.2.17 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 – 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 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 1’s by command CA and target CA.

See 4.2.1.4.2 for the definition of Industry Group.

Data Length:	3 bits
Resolution:	See 4.2.1.4.2
Data Range:	0 to 7
Type:	Status
Suspect Parameter Number:	5673
Reference:	4.6.2.2

4.6.2.2.18 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 – 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 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 4.2.1.4.1 for the definition of Arbitrary Address Capable field.

Data Length:	1 bit
Resolution:	see 4.2.1.4.1
Data Range:	0 to 1
Type:	Status
Suspect Parameter Number:	5674
Reference:	4.6.2.2

4.6.2.3 NAME Management Procedures

4.6.2.3.1 NAME Management Message Support

To determine if a CA supports the NM message a commanding CA may send the Request PGN 59904 for the NM message. CAs that do not support this NM message shall respond with the Acknowledgement message PGN 59392 with the appropriate NACK control byte. ECUs that are not aware of this message shall either NACK the request or ignore it.

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 a NM message is presented in Appendix D, Figure D4. Note that if the target CA does not accept the NM message, an operator or technician shall 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 re-issue an Address Claim with its new NAME and successfully claim an address with that NAME before originating or resuming transmissions on the network.

The NAME Management message has multiple uses. These uses are identified by a mode indicator parameter in the message. See 4.6.2.2.10.

4.6.2.3.2 Set Pending NAME

A target CA, upon receipt of a NAME Management message with the “Set Pending NAME” mode and its own source address as the destination address, shall respond in either of two ways:

1. The target CA may 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 4.6.2.2.10. The response shall include the pending NAME in bytes 3 through 8 and is sent to the SA of the commanding CA. The target CA shall use its current SA (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 NACK and the Error Code field set to the most appropriate value. See 4.6.2.2.1 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 may change. The other data bytes of the message shall be set to all 1s.

4.6.2.3.3 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 the sending of the Address Claim 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.

4.6.2.3.4 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 SA through the address claiming 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 SA from being incorrectly commanded to a new NAME. To guard against this possible mismatch between SA 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 4.6.2.2.1. See Appendix A, Figure A12 for example.

4.6.2.3.5 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 Appendix A Figure A14.

2. If this message is supported, it shall as a minimum allow the changing of ECU instance and Function instance.

3. Target CAs may accept “set pending” 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 Appendix A, Figure A13.

4.6.3 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 ECU's 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.

The Working Set is able to, for network purposes, allow the use of a single Address as a subset of the "global" destination for one-to-many communications, and to permit the receiver of many-to-one communications to associate each of the many entities with the others that form the particular set. The format for the communications becomes one-to-one in each case, with the user device sending all data for the Working Set to the address of the network CA that has taken the role of Working Set Master. The Working Set allows a set of CAs to be identified to the network as being associated with a particular function or purpose on the network. Any other CA on the network may choose to interact with the Working Set by sending messages to the working set master or, if appropriate, sending messages directly to any of the working set members.

Messages sent to the working set master shall be interpreted by the master to determine if further action on behalf of the working set is required including any additional communication with the members.

Messages received by other CAs from working set members are known to be associated with the particular working set and shall be interpreted accordingly.

The term "user" in these notes is intended to mean a controller application (CA) that understands Working Sets and knows how to communicate with the Set as a separate entity. The user is not a member of the set being described, but is not prohibited from being a Member (or Master) of another Working Set.

4.6.3.1 Use in Agricultural Systems

An example of the use of Working Sets is in agricultural equipment. Several CAs, possibly within different ECUs, upon an implement system (planter for instance) need to communicate with the Virtual Terminal display in a way that the VT understands that all of those NAMEs are supplying data as a single implement entity.

Further rules guiding the use of Working Sets in an agricultural system are given in the ISO 11783 documents. These include regulation of when and how the members shall communicate with ECUs outside the working set.

4.6.3.2 Application Notes

Two message types are needed to define a Working Set. The first is a definition of the set's size; the second identifies the members of the set. All of these messages (the "Working Set Master" defining the Set size, and the series of "Working Set Member" messages giving the NAMEs of all Members except the Working Set Master) are transmitted by the Working Set Master. The messages are defined in 4.6.3.3 and 4.6.3.3.

The Working Set concept is not a required element of SAE J1939 Network Management. However, when it is used specific rules detailed here and elsewhere shall be followed.

4.6.3.2.1 Message sequence

A "Working Set Master" message shall always be followed by the appropriate (one less than Working Set size) number of "Working Set Member" messages. A user of the Working Set that does not receive the correct number of Member definitions shall request the "Working Set Master" PGN from the Master of the Set. The requirement of the first sentence in this note means that the Master shall completely define the Set on receipt of this request.

4.6.3.2.2 Working Set Member Message Spacing

Working Sets shall be defined by the NAMEs of the Working Set Members. "Working Set Member" messages shall be sent with a spacing of about 100 ms between them. If more than 350 ms elapses after a "Working Set Member" message, the receiver shall assume that the Working Set Master believes the list to be complete.

4.6.3.2.3 Compatibility with Conventional Network Processes

Working Set Members are still individual functions on the network, and as such will still communicate as individuals. Fault messages will be sent from the CA's source address (SA), and any commands to clear fault tables, program parameters, etc, will still be addressed to the individual SA of the intended CA .

Applications that do not work with Working Sets shall ignore the Working Set messages and communicate directly with all other network devices.

4.6.3.2.4 Constraints on Working Set Membership

Each CA on the network may be a member of only one Working Set. If an existing Working Set Master issues a new "Working Set Master" message, users of Working Sets on the network shall replace the old Working Set definition with the new one. Working Set Masters shall accept the responsibility of re-defining their Working Set if they know of needed changes, and may send a "Working Set Master" message with data of zero if the Working Set's purpose is finished. Users of the Working Set shall not count on receiving such a message.

4.6.3.2.5 Configuration Changes

4.6.3.2.5.1 Master NAME change

Changing the NAME of the Working Set Master shall require that it create a new Working Set. The old Working Set shall cease to exist but its definition shall remain in the memory of the user devices until some clean-up method is exercised. Although it would be convenient if all Working Set Masters cleared their Sets before changing their NAMEs, that is not likely to happen at all times. The burden of detecting and correcting problems like duplication of Members is on the user of the Working Set. Users of Working Sets shall have to periodically check for duplications and for unused Working Sets in order to recover the internal memory used for those Sets that are no longer active.

4.6.3.2.5.2 Master SA changes

Note that a change in the Source Address of the Working Set Master shall NOT change the definition of the Set. Users shall update the association of SA to NAME when the new Address Claim is received, and Members shall change the address through which they expect to receive Working Set communications.

4.6.3.2.5.3 Member SA changes

A change in the Source Address of a Working Set Member shall result in the need for the users of Working Sets to associate the new SA with the appropriate Working Set. Since the Working Set Members are defined by NAME, the SA change (assuming that the NAME is unchanged) can be handled by the Working Set users as they receive new Address Claim messages.

4.6.3.2.6 Missing Working Set Members

A Working Set may be created with Members including those that are not currently on the network. Users shall create the Working Set with the total number of Members specified, and add the SA of members as they claim addresses. This process differs little from the above process of changing the SA of a Member that is active but which changes SA due to a later address claim by another device. In such a case it is the responsibility of the Working Set Master to know the NAMEs of all of the potential Members of the Working Set. Alternatively, the Master can revise the Working Set definition when the new Member joins the network.

4.6.3.3 Working Set Master Message – WSMSTR (PGN 65037)

This message is sent by the Master of a Working Set to identify how many members there are in the set. The Working Set Master shall be counted as a member in the total. The source address of this message shall be the SA associated with the Working Set Master's NAME. Also particular Working Sets shall be identified by their Master's NAME.

Transmission rate:	As required
Data length:	8 bytes
Data page:	0
PDU format:	254 PDU2 Global
PDU specific:	13
Default priority:	7
Parameter group number:	65037 ($FE0D_{16}$)

Byte: 1	Bits 8-1	Number of Members in Working Set	See 4.6.3.3.1
Bytes 2-8:		reserved	

4.6.3.3.1 Number of Members

The count of the number of members in a particular Working Set. The particular Working Set is identified by the NAME of the Working Set Master, which is associated with the Source Address of the message containing this parameter. No member (as identified by a specific NAME) shall belong to more than one Working Set at a time.

Data Length:	1 Byte
Resolution:	1 member
Data Range:	2 to 250 (minimum of 2 members in a working set and a maximum of the limit of nodes in the SAE J1939 network)
Type:	Measured
Suspect Parameter Number:	2409

4.6.3.4 Working Set Member Message – WSMEM (PGN 65036)

This message is sent by the Master of a Working Set to identify an individual member of a specific Working Set (Master's Source Address identifies the particular Working Set). There may be a number of these messages sent by a Master. The number of messages shall be one less than the number of members in the Working Set. No message is required to identify the Master's NAME since it may be obtained from the Master's Address Claim. This message structure requires that units communicating with a Working Set shall verify that they have received the appropriate number of Working Set Member messages identifying all of the members of the particular Working Set.

Transmission repetition rate:	As required
Data length:	8 bytes
Data page:	0
PDU format:	254 PDU2 Global
PDU specific:	12
Default priority:	7
Parameter group number:	65036 ($FE0C_{16}$)

NAME of Working Set Member — NAME of this specific member of the Working Set identified by the source address of this message.

Byte: 1	Bits 8-1	Least significant byte of Identity Number	See 4.2.1.4.10
Byte: 2	Bits 8-1	Second byte of Identity Number	See 4.2.1.4.10
Byte: 3	Bits 8-6	Least significant 3 bits of Manufacturer Code	See 4.2.1.4.9
	Bits 5-1	Most significant 5 bits of Identity Number	See 4.2.1.4.10
Byte: 4	Bits 8-1	Most significant 8 bits of Manufacturer Code	See 4.2.1.4.9
Byte: 5	Bits 8-4	Function Instance	See 4.2.1.4.7
	Bits 3-1	ECU Instance	See 4.2.1.4.8
Byte: 6	Bits 8-1	Function	See 4.2.1.4.6
Byte: 7	Bits 8-2	Vehicle System	See 4.2.1.4.4
	Bit 1	Reserved	See 4.2.1.4.5
Byte: 8	Bit 8	Arbitrary Address Capable	See 4.2.1.4.1
	Bits 7-5	Industry Group	See 4.2.1.4.2
	Bits 4-1	Vehicle System Instance	See 4.2.1.4.3

4.6.3.5 NAME of Working Set Member

The identifier of the particular CA that is a member of the Working Set identified by the source address of this message. This parameter is a NAME with the format described in 4.2.1.

Data Length:	8 Bytes
Resolution:	See 4.2.1
Data Range:	0 to 18446744073709551615
Type:	Measured
Suspect Parameter Number:	2845
Reference:	4.6.3.4

4.7 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 may be detected by a diagnostic tool through the use of the request for address claim capability.

4.7.1 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, may 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.

4.7.2 Address Violation

Address violation occurs when two CAs are using the same SA. This may happen when configuring a new network or adding multiple identical ECUs to a network. This needs to be resolved for the network to work properly.

4.7.2.1 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 claim message to the global 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.

4.7.2.2 System Notification

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

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

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

4.8 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. They are described in the following clauses.

4.8.1 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 re-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 result in network re-initialization (a new round of address claim). This does not preclude a CA from performing any degree of reset or re-initialization within the CA. The CA shall retain its NAME, address, and any NAME/address tables used by that CA through such a disturbance. For disturbances of longer duration or higher frequency, network re-initialization shall be performed and is required if the disturbance is longer than 1 second. The required re-initialization after 1 second is needed to force towed vehicle systems to reinitialize after reconnection to the towing vehicle.

There is no requirement for towing vehicles.

4.8.2 Minimum Network Management Capability

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 4.5. A summary of the requirements and capabilities for SAE J1939 CAs is provided in Appendix B.

4.8.2.1 Request for Address Claimed Message

See 4.5.7 for detailed descriptions of required messages and behavior.

4.8.2.2 Address Claimed Message before Using a Source Address

No CA shall originate a message on the network until it has successfully claimed an address with these exceptions:

1. The CA may transmit a Request for Address Claimed using the NULL address as a source address.

2. The CA shall respond to a request for Address Claimed message directed to the global address (255) by transmitting its claim: see 4.5.3.1 for details.

3. A network interconnection device acting entirely as a repeater may pass messages bearing the Source Address of the originator before claiming its own address. (For further requirements for network interconnection devices see SAE J1939-31.)

Once a CA has successfully claimed an address, it may respond to a Request for Address Claimed and immediately resume transmitting other messages on the network.

If the source address or NAME of a CA is modified (for example, through the Commanded Address message or through proprietary techniques), the CA shall re-issue an Address Claim before originating transmissions on the network.

See 4.5.8 for detailed descriptions of required messages and behavior.

4.8.2.3 NAME Changes

If a CA's NAME is changed through any of the methods mentioned in this document, the CA shall reclaim a source address according to all the normal rules of address claim. Other CAs that need to know NAME to address association shall update their stored associations whenever they see a new successful claim.

In a working set, the working set master is responsible to notice NAME changes that require the broadcast of a new Working Set Master message to inform users that a change to the set has been made.

If parts of a CA's NAME are changed through memory access or other methods that do not trigger the reissue of the address claim message, the tool or CA responsible for making the change shall issue a Request for Address Claimed to assure the changes shall be properly registered with all concerned CA's on the network.

4.8.2.4 Disruption of the Network During Connection or Disconnection of an ECU

Connection, disconnection, or power-up of the ECU shall not disrupt network communications. Disruption of the network might consist of uncontrolled transmission of a bit stream to the network during the power-up of an ECU.

4.8.2.5 Continuity of Addresses Across Power-Down and Power-Up Cycles

CAs are strongly recommended to be able to remember their source 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. This shall be done except in cases where special requirements override this recommendation, for example in towed subnetworks of On-Highway trailers where the instance and associated addresses of the trailer may change at each power-up, or for example, when changing trailers.

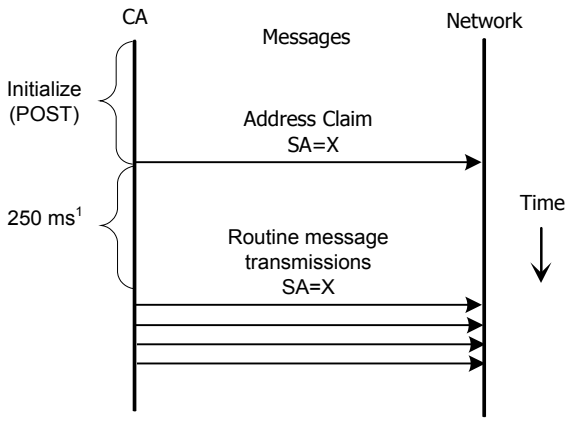
5. NOTES

5.1 Revision Indicator

A change bar (l) 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 THE SAE TRUCK AND BUS CONTROL AND COMMUNICATIONS NETWORK COMMITTEE OF THE TRUCK AND BUS ELECTRICAL AND ELECTRONIC STEERING COMMITTEE

APPENDIX A - INITIALIZATION SEQUENCE TIMING DIAGRAMS



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

Figure A1 - Initialization of a CA with address claim and no contention

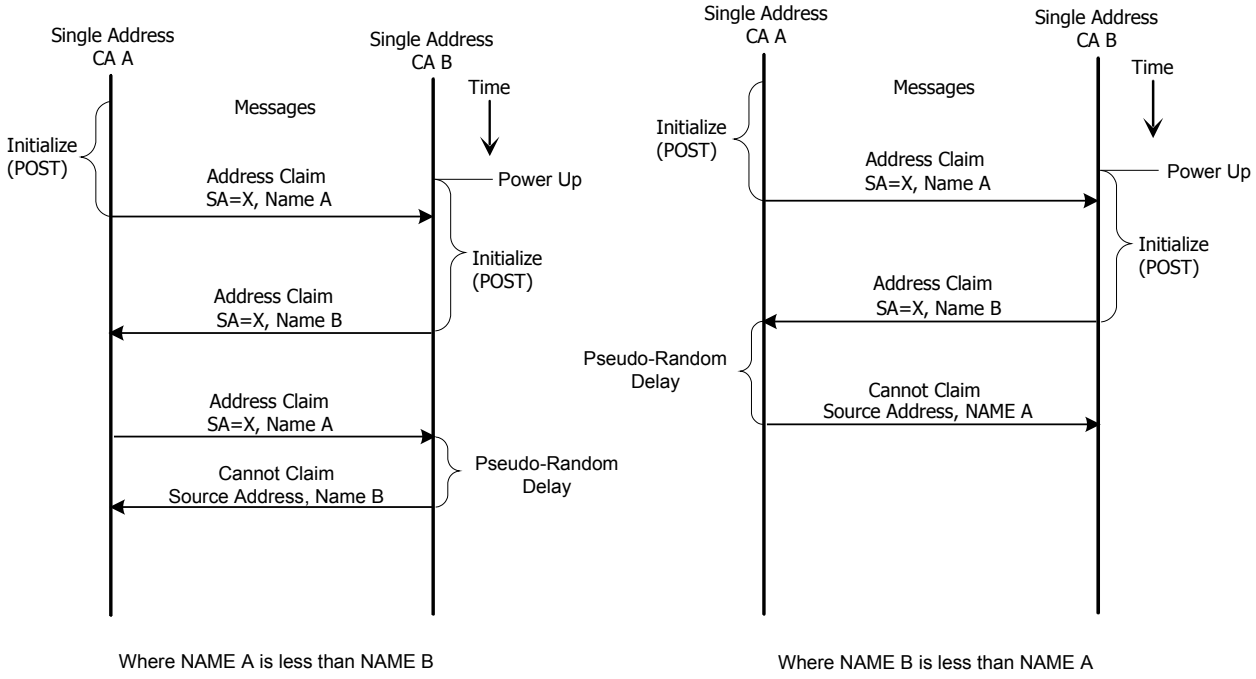


Figure A2 - Initialization of an ECU where two single address CAs attempt to claim the same address but not simultaneously

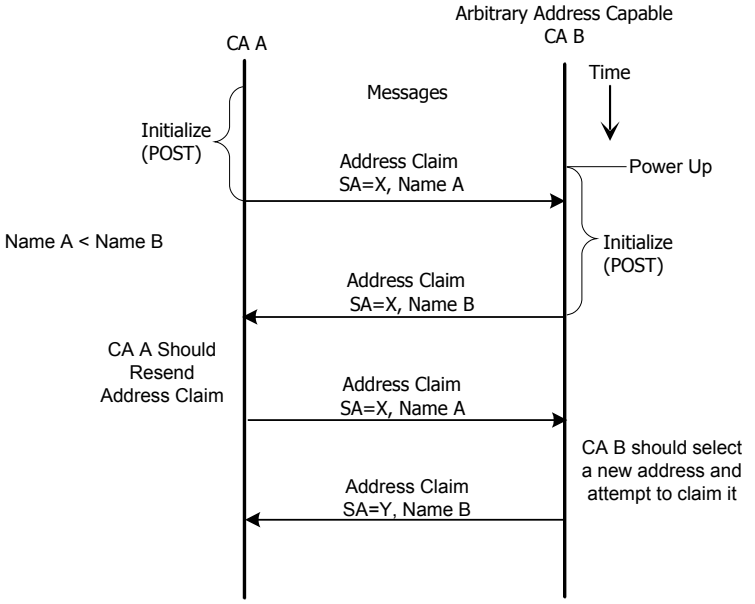


Figure A3 - Initialization of a CA where name A is less than name B and CA B is arbitrary address capable

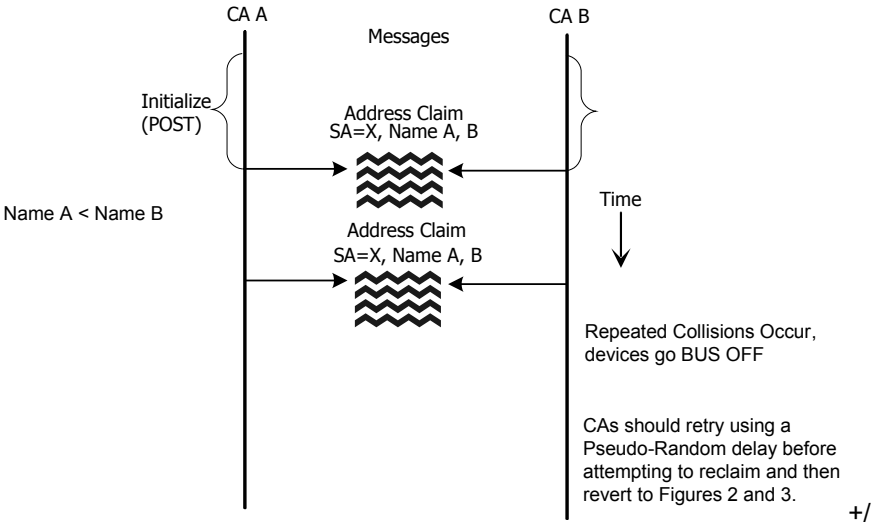
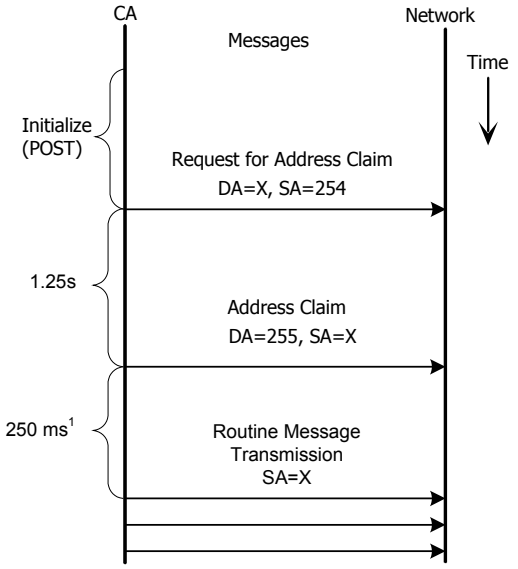
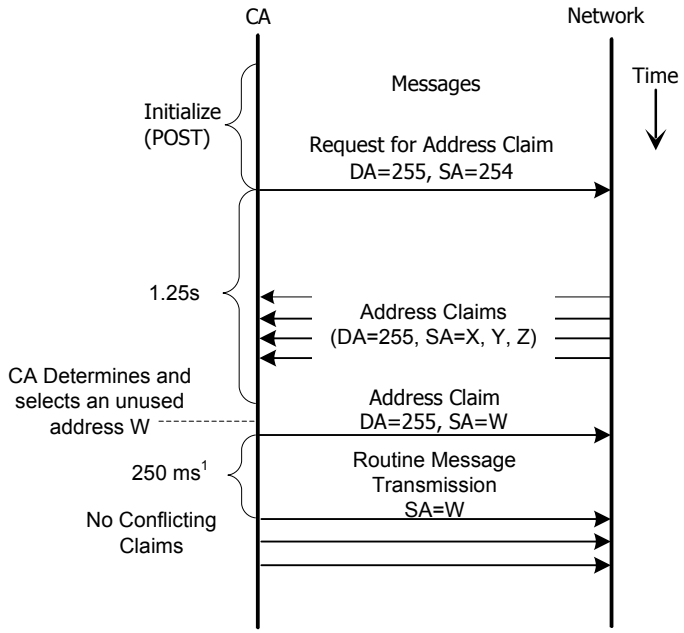


Figure A4 - Initialization of a CA with two CAs attempting to claim the same address simultaneously



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

Figure A5 - Initialization of an arbitrary address capable CA for a specific address with no contention



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

Figure A6 - Initialization of an arbitrary address capable CA with a request for address claimed sent to the global address

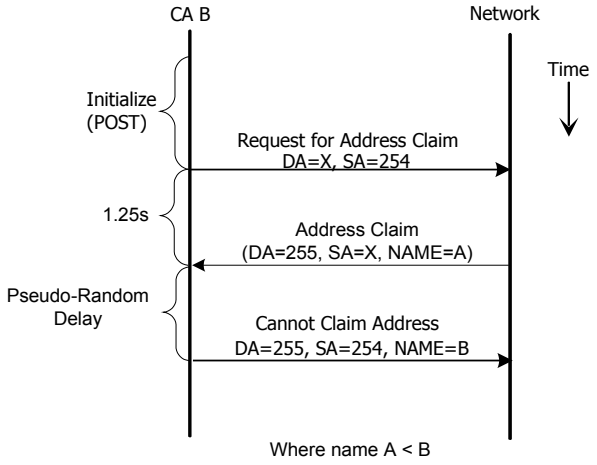


Figure A7 - Initialization of a single address CA with a request for address claimed for a specific source address where address is in use

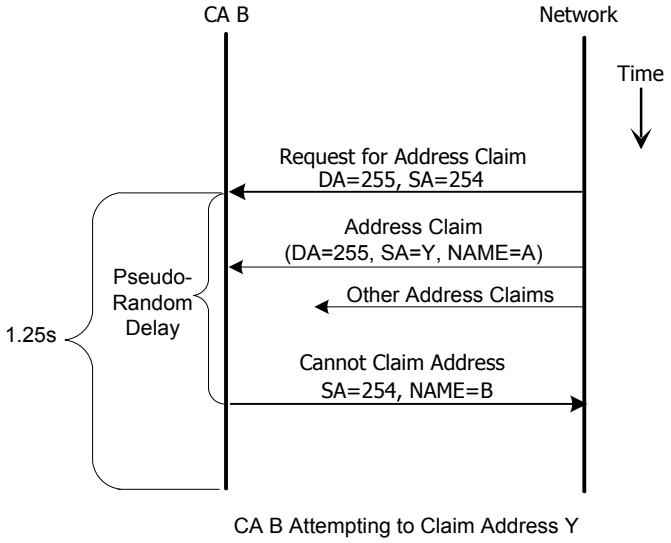


Figure A8 - Response to a request for address claimed by a CA which has been earlier unsuccessful in claiming an address.

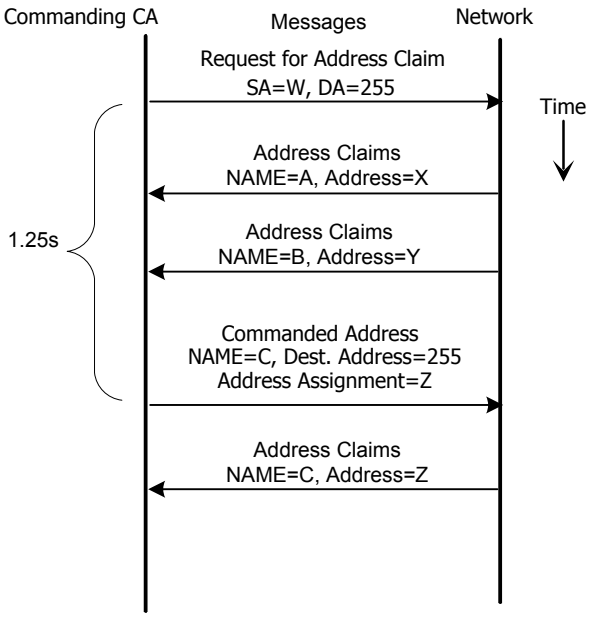


Figure A9 - Commanding an address of a CA which does not have an address, has not attempted to claim an address yet and supports the commanded address message

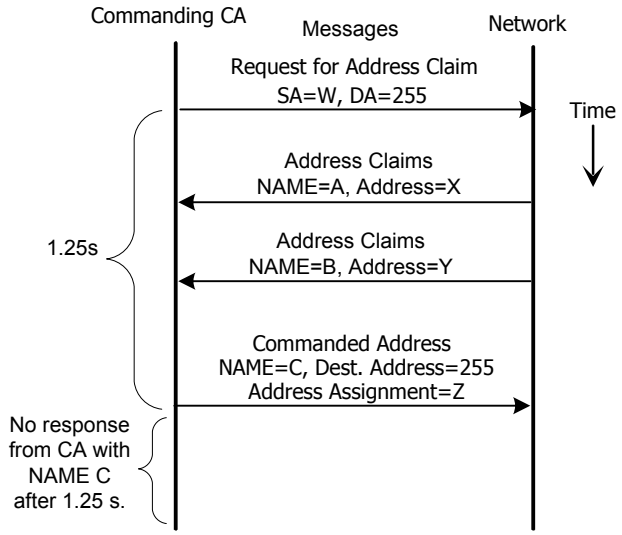


Figure A10 - Commanding an address of a CA which does not have an address, has not attempted to claim an address yet and the commanded CA does not support a commanded address message

NOTE: The commanded ECU may elect not to support the Commanded Address message in which case, the Commanded Address message shall be ignored.

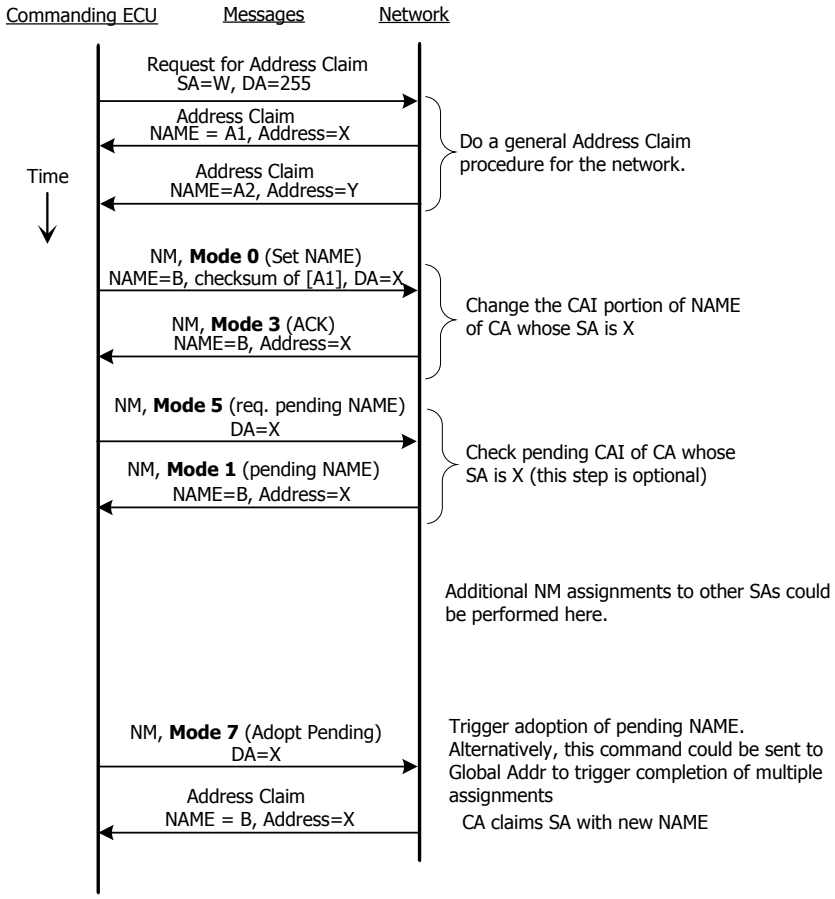


Figure A11 - Commanding a CA that supports NAME management to change its NAME

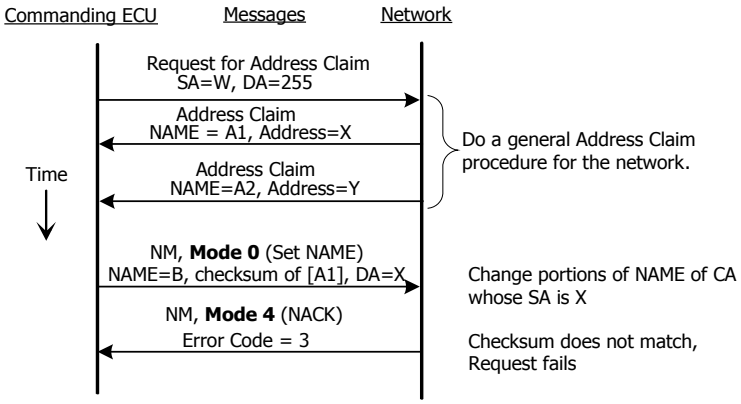


Figure A12 - Commanding a CA that supports NAME management to change its NAME fails due to incorrect NAME checksum of original NAME

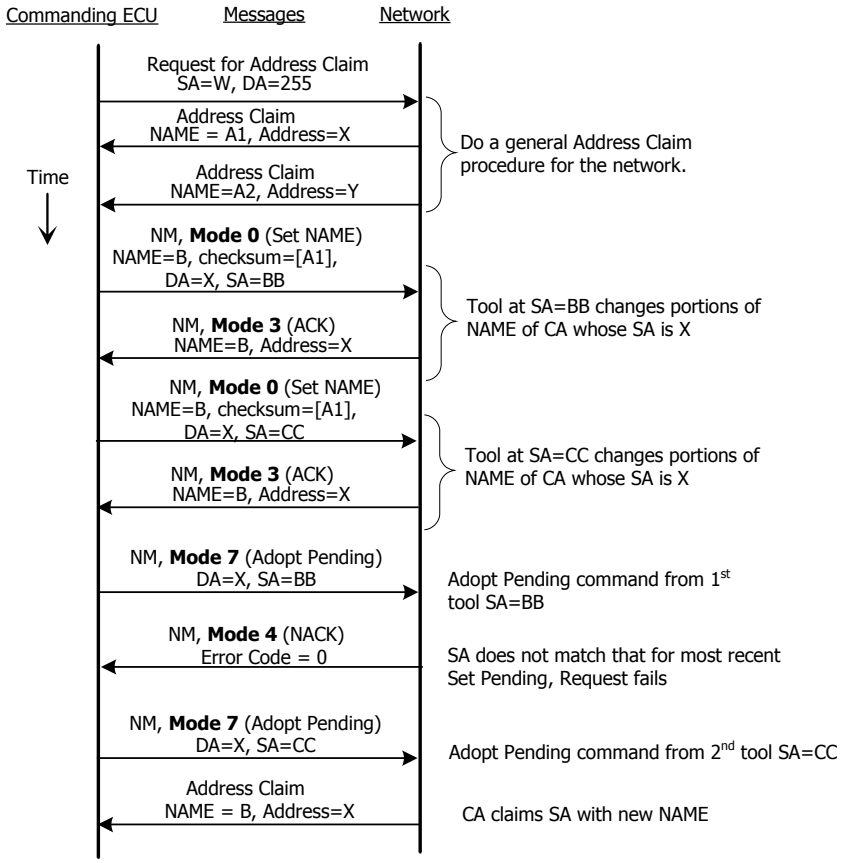


Figure A13 - Two tools Command a CA that supports NAME Management to change its NAME. Only most recent tool to change pending NAME can issue adopt command successfully.

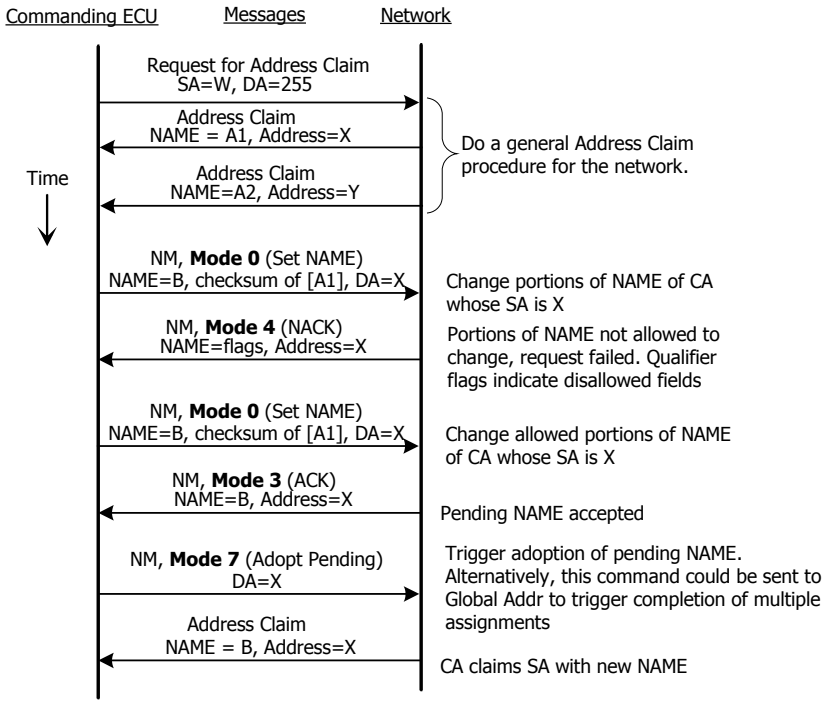


Figure A14 - Commanding a CA that supports NAME Management to change its NAME. Some NAME fields not allowed to change. ECU NACKs request until only valid changes are requested.

APPENDIX B - SUMMARY OF REQUIREMENTS AND CAPABILITIES OF CAS

NOTE: Other than the required categories (R), the classifications are provided for general guidance only.

Table 5 - Summary of requirements and capabilities of CAs

CAPABILITY	STANDARD					DIAGNOSTIC / DEVELOPMENT TOOLS					NETWORK INTERCONNECTION				
KEY: R - REQUIRED D - DESIRABLE P - PERMISSIBLE N - NOT RECOMMENDED OR REQUIRED NA - NOT APPLICABLE	NON-CONFIGURABLE	SERVICE-CONFIGURABLE	COMMAND CONFIGURABLE	SELF-CONFIGURABLE	ARBITRARY ADDRESS CAPABLE	NON-CONFIGURABLE	SERVICE-CONFIGURABLE	COMMAND CONFIGURABLE	SELF-CONFIGURABLE	ARBITRARY ADDRESS CAPABLE	NON-CONFIGURABLE	SERVICE-CONFIGURABLE	COMMAND CONFIGURABLE	SELF-CONFIGURABLE	ARBITRARY ADDRESS CAPABLE
ISSUE A VALID ADDRESS CLAIMED MESSAGE BEFORE USING A SOURCE ADDRESS (4.5.8)	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
UPON RECEIPT OF A REQUEST FOR ADDRESS CLAIMED MESSAGE, AN CA SHOULD TRANSMIT AN ADDRESS CLAIMED OR A CANNOT CLAIM SA MESSAGE (4.5.8.1, 4.5.8.3)	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
NAME RETAINED ACROSS POWER UP CYCLE (4.8.1)	R	R	R	D	D	R	R	R	D	D	R	R	R	D	D
ADDRESS RETAINED ACROSS POWER UP CYCLE (4.8.2.5)	R	R	R	D	D	R	R	R	D	D	R	R	R	D	D
NAME FIELD PROGRAMMABILITY (4.2.1)	NA	D	D	D	D	NA	D	D	D	D	NA	D	D	D	D
ADDRESS TABLE RETAINED ACROSS POWERUP (4.8.1)	P	P	P	D	D	P	P	P	D	D	P	P	P	D	D
SUPPORT COMMANDED ADDRESS MESSAGE CONTAINING OWN NAME (4.6.1)	NA	P	R	P	P	NA	D	R	D	D	NA	D	R	D	D
SUPPORT TRANSMISSION OF COMMANDED ADDRESS MESSAGE (4.6.1)	P	P	P	P	P	D	D	D	D	D	P	P	P	P	P
SEND REQUEST FOR ADDRESS CLAIM BEFORE ATTEMPTING TO CLAIM (4.5.7)	P	P	P	P	P	D	D	D	D	D	P	P	P	P	D
ADDRESS CONFIGURATION CAPABILITY (4.3	P	P	P	P	P	N	P	D	D	D	P	P	P	P	P
MONITOR AND CORRECT SITUATIONS WHERE CAS CANNOT CLAIM ADDRESSES (4.5.8)	N	N	N	N	N	D	D	D	D	D	P	P	P	P	P
SUPPORT NAME MANAGEMENT CAPABILITY (4.6.2)	NA	P	P	P	P	NA	P	P	P	P	NA	P	P	P	P
SUPPORT FOR WORKING SETS (4.6.3)	P	P	P	P	P	D	D	D	D	D	P	P	P	P	P

APPENDIX C - NAME EXAMPLES

C.1 NAME EXAMPLES

Three examples of the NAMEs are shown below, ranging from a very simple case to a very complex case. Due to the nature of the naming convention, NAMEs in these examples are expressed in binary. Appendix B of SAE J1939 shall be used as a source when constructing a NAME. For questions about the individual fields of the NAME, refer to 4.2.1, Figure 1 - Fields of NAME and Definitions in this document.

C.1.1 A Single ECU with a CA Serving an Engine on an On-Highway Heavy-Duty Truck

From Appendix B, Table B1 of SAE J1939, the Industry Group for this application is On-Highway that has an Industry Group value of 1. (Had the specific application not been identified it would have been correct to place an engine controller within the Global, applies to all, Industry Group.) For a tractor in Industry Group 1, the Vehicle System value is 1 from Appendix B, Table B12 of SAE J1939. The Vehicle System Instance is 0 since there is only one and therefore it must be the first instance. From the pointer to Table B11, we find engines are to have a Function value of 0. As this is a single-engine vehicle, the Function Instance value is also set to 0. Since there is only one ECU, the ECU Instance value is 0. The Manufacturer Code, and the Identity Number bits are shown in a generic form. This yields the ECU name as shown in Figure C1:

Arbitrary Address Capable	Industry Group	Vehicle System Instance	Vehicle System	Reserved	Function	Function Instance	ECU Instance	Mfg. Code	Identity Number
1 bit	3 bit	4 bit	7 bit	1 bit	8 bit	5 bit	3 bit	11 bit	21 bit
0	001	0000	0000001	0	00000000	00000	000	mm...m	ii...i

Figure C1 - Example NAME for a single ECU with a CA serving an engine on an on-highway heavy-duty truck

C.1.2 Brakes on the Second Trailer of Heavy-Duty Truck

This example illustrates NAME assignment for a single ECU with a single CA that has Single Address capability and is serving as a brake controller on the second trailer of heavy-duty truck. From Appendix B, Table B1 of SAE J1939, the Industry Group for this application is On-Highway and has an Industry Group value of 1. The Vehicle System Name value for a trailer is 2, which is found in Appendix B, Table B12 of SAE J1939 under the On-Highway Industry Group. The Vehicle System Instance is 1 for the second Instance of trailer. Brake Controller CAs on a trailer are identified as a "Brakes - System Controller" and have a Function value of 9. Assuming this is the only Brake controller on the trailer, the Function Instance value is set to 0. Since there is only one ECU for this ABS CA, the ECU Instance value is 0. The Manufacturer Code, and the Identity Number bits are again shown in a generic form. See Appendix C, Figure C2.

Arbitrary Address Capable	Industry Group	Vehicle System Instance	Vehicle System	Reserved	Function	Function Instance	ECU Instance	Mfg. Code	Identity Number
1 bit	3 bit	4 bit	7 bit	1 bit	8 bit	5 bit	3 bit	11 bit	21 bit
0	001	0001	0000010	0	00001001	00000	000	mm...m	ii...i

Figure C2 - Example NAME for an ABS on the second trailer of heavy-duty truck

C.1.3 Agricultural Planters with Separate Section Controls

This example illustrates NAME assignment for two agricultural planters connected together in a system with separate Section Control on eight individual sections, each section with two ECUs. From Appendix B, Table B1 of SAE J1939, the Industry Group for this application is Agricultural Equipment and has an Industry Group value of 2. For a planter in this Industry Group, the Vehicle System Name value is 4 from Appendix B, Table B12 of SAE J1939. Since this is an agricultural implement, self-configurable or arbitrary addressing shall be used. This example assumes the CA is arbitrary address capable, thus the Arbitrary Address Capable bit is set to 1. Since there are two planters, the Vehicle System Instances would be 0 for CAs on planter 1 and 1 for CAs on planter 2. Since the CA's Function is Section On/Off Control, the Function Name value is 129. The Function Instance field would run from 0 to 7 on each of the planters to identify row 1 through 8. Since there are two ECUs per section, the ECU instances of 0 and 1 would occur for each of the eight Function values. The Manufacturer Code, and the Identity Number bits are shown in a generic form. The resulting NAMEs are shown in Figure C3:

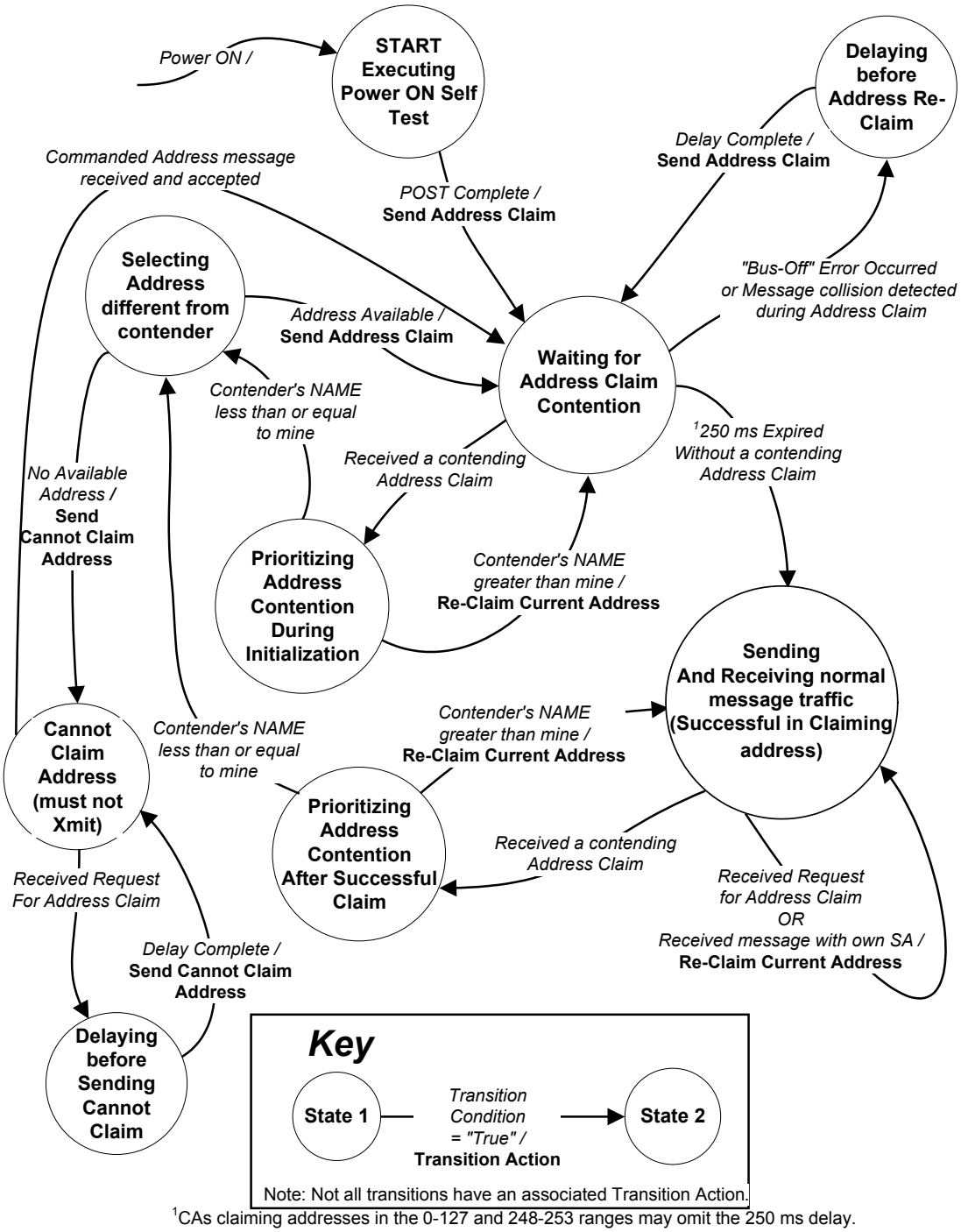
	Arbitrary Address Capable	Ind. Group	Vehicle System Instance	Vehicle System	Reserved	Function	Function Instance	ECU Instance	Mfg. Code	Identity Number
	1 bit	3 bit	4 bit	7 bit	1 bit	8 bit	5 bit	3 bit	11 bit	21 bit
	1	010	No.	Planter	0	Section Control	No.	No.	mm...m	Mfg. Assigned
Planter '1', Section '1', ECU '1'	1	010	0000	0000100	0	10000001	00000	000	mm...m	ii...i
Planter '1', Section '1', ECU '2'	1	010	0000	0000100	0	10000001	00000	001	mm...m	ii...i+n
Planter '1', Section '2', ECU '1'	1	010	0000	0000100	0	10000001	00001	000	mm...m	ii...i+p
Planter '1', Section '2', ECU '2'	1	010	0000	0000100	0	10000001	00001	001	mm...m	ii...i+q
	...	...	...	...	...	...	...	...	...	...
Planter '2', Section '8', ECU '1'	1	010	0001	0000100	0	10000001	00111	000	mm...m	ii...i+r
Planter '2', Section '8', ECU '2'	1	010	0001	0000100	0	10000001	00111	001	mm...m	ii...i+s

Figure C3 - Example NAMES for agricultural planters with separate section controls

APPENDIX D - STATE TRANSITION DIAGRAMS FOR ADDRESS CLAIMING PROCESSES

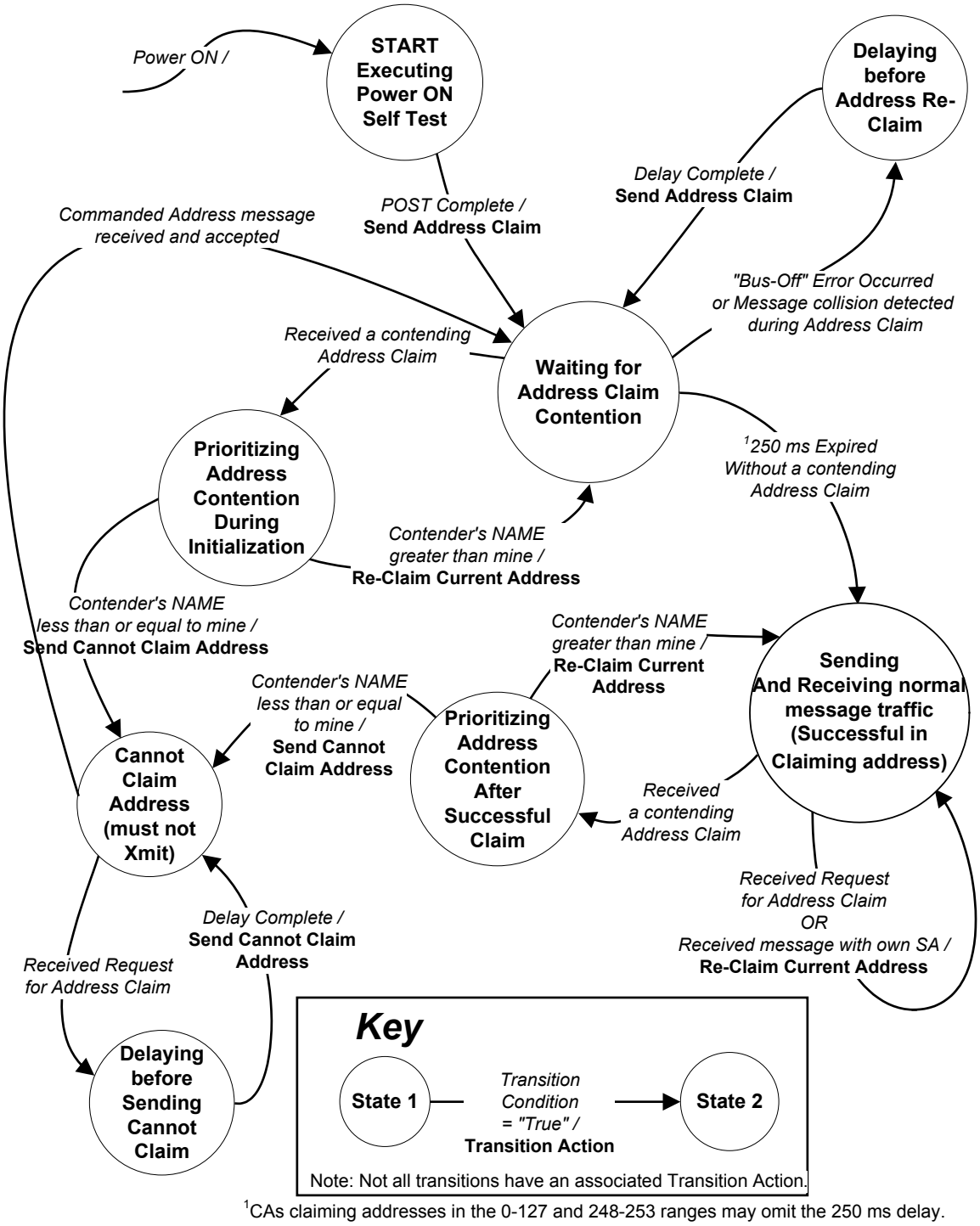
State transition diagrams are presented in Figures D1, D2, and D3 for address claiming processes. Processes are presented for initialization of both single address capable and arbitrary address capable ECUs. These diagrams are intended to clarify processes outlined throughout this specification. The specifications in the paragraphs of this document have precedence in the event of any discrepancy between the text and figures.

States are shown in the diagrams as circles with the title of the state enclosed in the circle. Arrows leaving the states have associated text describing the event that triggers transition from the state. In some cases, there is an action that takes place after the trigger upon entering the next state. In these cases the triggering event text is followed by a slash (/) and then the transition action text.



[1]CAs claiming addresses in the 0-127 and 248-253 ranges may omit the 250 ms delay.

Figure D1 - State transition diagram for initialization of arbitrary address capable CAs



[1]CAs claiming addresses in the 0-127 and 248-253 ranges may omit the 250 ms delay.

Figure D2 - State transition diagram for initialization of single address CAs

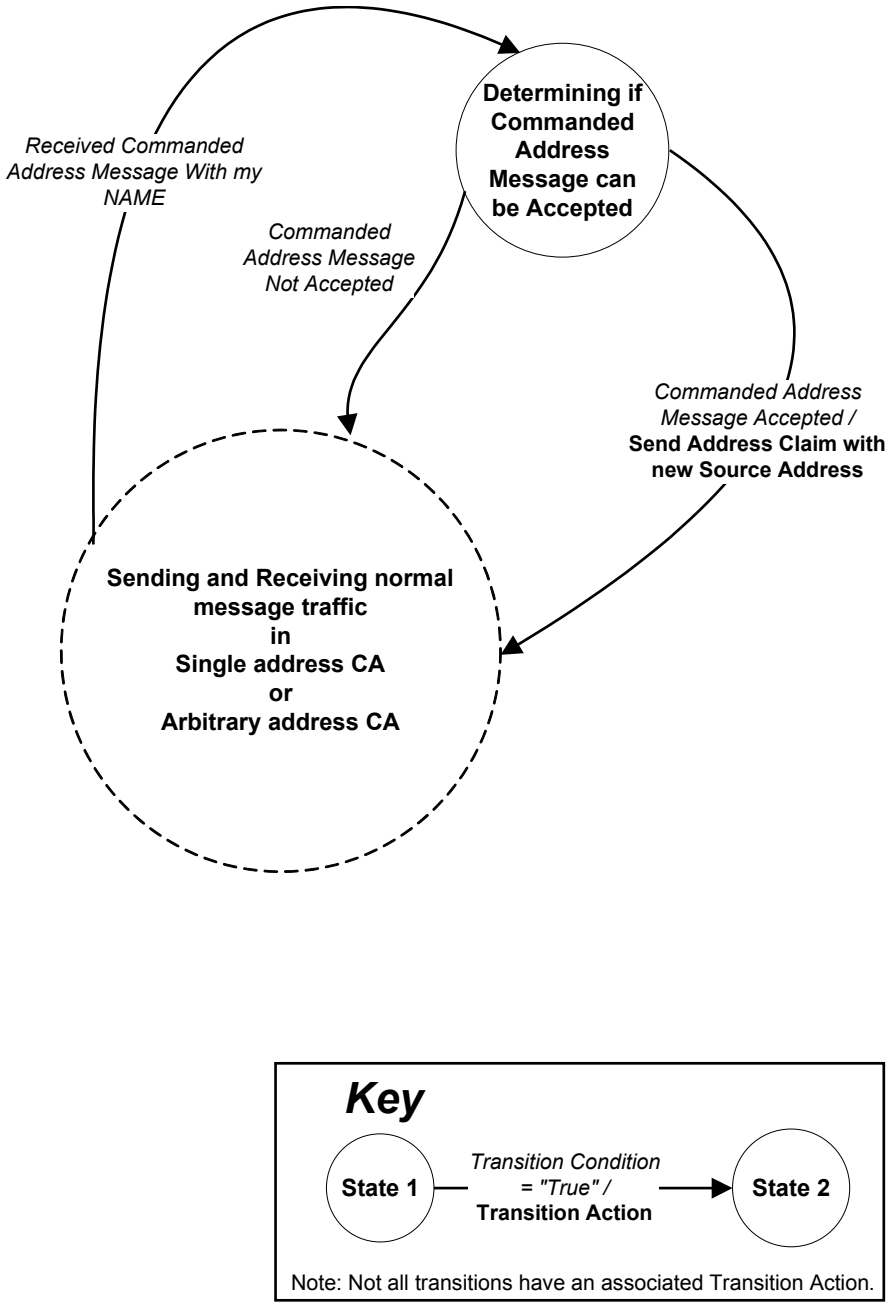


Figure D3 - State transition diagram for response of a CA to the commanded address message

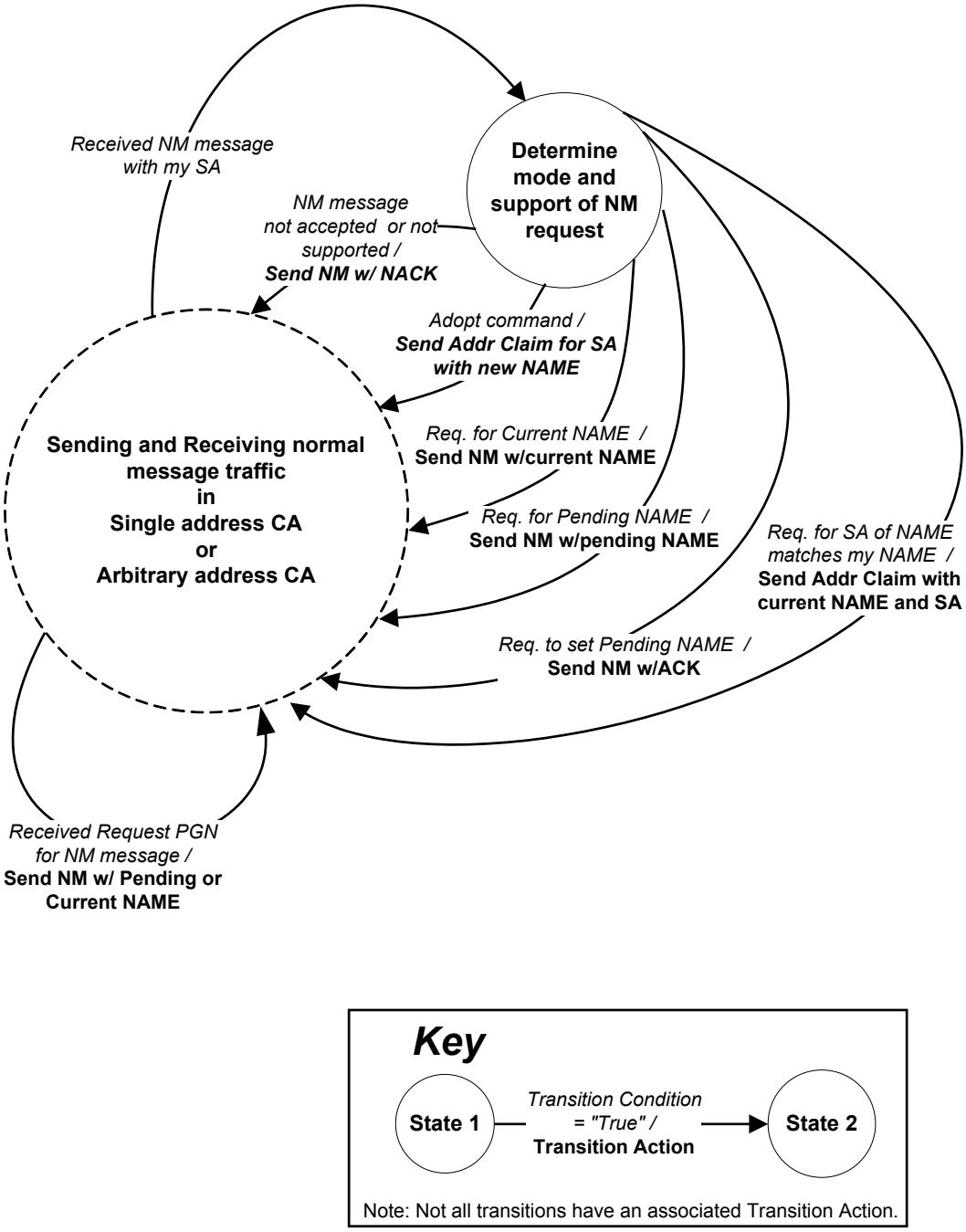


Figure D4 - State transition diagram for response of a CA to the NAME message