
**Tractors and machinery for agriculture and
forestry — Serial control and
communications data network —**

**Part 5:
Network management**

*Tracteurs et matériels agricoles et forestiers — Réseaux de commande et
de communication de données en série —*

Partie 5: Gestion du réseau



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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

International Standard ISO 11783-5 was prepared by Technical Committee ISO/TC 23, *Tractors and machinery for agriculture and forestry*, Subcommittee SC 19, *Agricultural electronics*.

ISO 11783 consists of the following parts, under the general title *Tractors and machinery for agriculture and forestry — Serial control and communications data network*:

- *Part 1: General standard for mobile data communication*
- *Part 2: Physical layer*
- *Part 3: Data link layer*
- *Part 4: Network layer*
- *Part 5: Network management*
- *Part 6: Virtual terminal*
- *Part 7: Implement messages application layer*
- *Part 8: Power train messages*
- *Part 9: Tractor ECU*
- *Part 10: Task controller and management information system data interchange*
- *Part 11: Data dictionary*

Annex A of this part of ISO 11783 is for information only.

Introduction

Parts 1 to 11 of ISO 11783 specify a communications system for agricultural equipment based on the CAN 2.0 B [1] protocol. SAE J 1939 documents, on which parts of ISO 11783 are based, were developed jointly for use in truck and bus applications and for construction and agricultural applications. Joint documents were completed to allow electronic units that meet the truck and bus SAE J 1939 specifications to be used by agricultural and forestry equipment with minimal changes. This part of ISO 11783 is harmonized with SAE J 1939/81 [2]. General information on ISO 11783 is to be found in ISO 11783-1.

The purpose of ISO 11783 is to provide an open, interconnected system for on-board electronic systems. It is intended to enable electronic control units (ECUs) to communicate with each other, providing a standardized system.

The International Organization for Standardization (ISO) draws attention to the fact that it is claimed that compliance with this part of ISO 11783 may involve the use of a patent concerning the controller area network (CAN) protocol referred to throughout the document.

ISO takes no position concerning the evidence, validity and scope of this patent.

The holder of this patent right has assured ISO that he is willing to negotiate licences under reasonable and non-discriminatory terms and conditions with applicants throughout the world. In this respect, the statement of the holder of this patent right is registered with ISO. Information may be obtained from:

Robert Bosch GmbH
Wernerstrasse 51
Postfach 30 02 20
D-70442 Stuttgart-Feuerbach
Germany

Attention is drawn to the possibility that some of the elements of this part of ISO 11783 may be the subject of patent rights other than those identified above. ISO shall not be held responsible for identifying any or all such patent rights.

Tractors and machinery for agriculture and forestry — Serial control and communications data network —

Part 5: Network management

1 Scope

This part of ISO 11783 specifies a serial data network for control and communications on forestry or agricultural tractors and mounted, semi-mounted, towed or self-propelled implements. Its purpose is to standardize the method and format of transfer of data between sensor, actuators, control elements, and information-storage and -display units, whether mounted on, or part of, the tractor or implement. This part of ISO 11783 describes the management of source addresses (SAs) for electronic control units (ECUs), the association of addresses with the functional identification of a device and the detection and reporting of network-related errors. It also specifies procedures for initialization and response to brief power outages, and minimum requirements, for network-connected ECUs.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of ISO 11783. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of ISO 11783 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 3339-0:1986, *Tractors and machinery for agriculture and forestry — Classification and terminology — Part 0: Classification system and classification*

ISO 11783-1:—¹⁾, *Tractors and machinery for agriculture and forestry — Serial control and communications data network — Part 1: General standard for mobile data communication*

ISO 11783-2:—¹⁾, *Tractors and machinery for agriculture and forestry — Serial control and communications data network — Part 2: Physical layer*

ISO 11783-3:1998, *Tractors and machinery for agriculture and forestry — Serial control and communications data network — Part 3: Data link layer*

ISO 11783-4, *Tractors and machinery for agriculture and forestry — Serial control and communications data network — Part 4: Network layer*

1) To be published.

3 Terms and definitions

For the purposes of this part of ISO 11783, the terms and definitions given in ISO 11783-1 and the following apply.

3.1

non-configurable-address ECU

ECU having an SA set by its manufacturer in accordance with the preferred addresses of this part of ISO 11783 and not able to be changed (for example, a service tool)

3.2

service-configurable-address ECU

ECU having an SA that can be changed in operational service mode, normally using a service tool and any of a number of proprietary techniques, or using the commanded-address message

3.3

command-configurable-address ECU

ECU having an SA that can be changed using the commanded-address message during normal operation

3.4

self-configurable-address ECU

ECU having an SA that, based on internal calculations, determines and then claims its own source address or, if unsuccessful in that claim, can recalculate and claim another address

4 General description

4.1 Address configuration

Address configuration is the obtainment by an ECU of a source address that identifies it on an ISO 11783 network. The ECU can be a non-configurable-address, service-configurable-address, command-configurable-address or self-configurable-address ECU, with the address configuration describing the manner in which the ECU obtains its SA. Address configuration is distinct from address claiming, the process whereby the ECU broadcasts its intent to use a particular address (4.3.3).

NOTE It is not the aim of this part of ISO 11783 to require that an ECU possess a particular address-configuration capability. Support for self-configurable addressing in this part of ISO 11783 does not imply that a given ECU should support self-configurable addressing. ISO 11783 ECUs are not required to possess a self-configurable addressing capability.

4.2 Types of ECU

4.2.1 Standard ECU

The standard ECU is one whose primary function neither involves network communication, programming nor diagnosis, and whose role is other than that of a tool or network interconnection unit. The standard ECU is used in engines, transmissions, virtual terminals, application-rate-control and traction-control systems. Data loggers and recorders fall into the same category; however, where these assume diagnostic tool functions, they will need to conform to the requirements pertaining to diagnostic tools (4.2.2). The standard ECU lacks the ability to modify the source address of another ECU, except as a result of address claiming. Standard ECUs may or may not be capable of self-configurable addressing.

4.2.2 Diagnostic/development tool

Diagnostic and development tool ECUs are those connected to an ISO 11783 subnetwork for the purpose of analysing, debugging, developing or monitoring any ECU 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 machine or implement. In either case, the capabilities of these tools are more extensive than those of standard ECUs because they are primarily designed to interact with other ECUs on the network and have no other external functionality (a diagnostic tool, for example, is not expected to provide torque, plant beans or brake an implement).

Such a tool can be proprietary, to be used on a particular manufacturer's ECU, or general-purpose, for application on ECUs made by several manufacturers. It can also be designed primarily for work on the network itself, providing network integration services for the system integrator or original equipment manufacturer (OEM).

4.2.3 Network interconnection unit

Network interconnection units are ECUs such as repeaters, bridges and gateways that enable communication between different networks or subnetworks, forwarding messages from one subnetwork to another (see also ISO 11783-4). Subnetworks linked by network interconnection units can have the same protocol, as in the case of two ISO 11783-specified subnetworks in the same machine, or different ones, as in the case of ISO 11783 and SAE J 1708 or J 1587 subnetworks. They can also communicate with other, off-machine subnetworks, such as satellite links, token rings or cellular modems.

NOTE Network interconnection units serving as gateways translate from ISO 11783 subnetworks to various other networks. This part of ISO 11783 deals only with the ISO 11783 portions of those ECUs.

4.3 NAME and address

4.3.1 In the context of ISO 11783, a NAME²⁾ is a 64-bit entity composed of fields (5.1.2) assigned by ISO. An ECU's NAME describes its function and place in the network, and any function on a network can be designated by a NAME. Every ECU transmitting messages on an ISO 11783 network shall have a NAME, in order to have a functional description and numerical value that can be used in address arbitration (see annex A for examples of NAMES). NAMES are normally established during initial network configuration, or when an ECU is added to the network.

4.3.2 An address is used on an ISO 11783 network to make a message identifier unique, and to determine a message source, when it is known as a source address. The procedures for address management in the ISO 11783-network-management protocol enable individual SAs to be associated with particular ECU functions (6.2). In the case of the ECU that implements several functions, a different address capability can exist for each of the functions, even if each has only one node.

4.3.3 An address-claim message containing both a NAME and an SA is used to associate the two on the network. The association of a unique NAME and address also associates the address with the corresponding function. However, regardless of the SA with which it is associated, a NAME will retain a consistent definition.

5 Specifications

5.1 NAME

5.1.1 General

Each ECU on a network shall have at least one NAME, identifying the ECU by its primary function.

Network integrators and ECU manufacturers shall ensure that each ECU on a particular network has a unique NAME not possessed by another ECU on that network.

5.1.2 NAME fields

5.1.2.1 Table 1 defines and specifies the fields that comprise a NAME, listing them in order of priority, from the self-configurable-address bit to the identity number's least significant byte.

2) Software label for the 8 byte number that contains fields for identifying a function performed by a unit or subunit connected to the ISO 11783 network.

Table 1 — NAME fields

Field	Definition	No. of bits	Byte no.	Byte ordering ^a
Self-configurable address	Indicates whether an ECU is self-configurable (1) or not (0); needs always to be known and set to the appropriate value	1	8	Bit 8: Self-configurable address
Industry group	Defined and assigned by ISO, identifies NAMES associated with industries (e.g. agricultural equipment)	3		Bit 7 to bit 5: Industry group (most significant at bit 7)
Device class instance	Indicates occurrence of a particular device class in a connected network; definition depends on industry group field contents (see Figure 1)	4		Bit 4 to bit 1: Device class instance (most significant at bit 4) ^b
Device class	Defined and assigned by ISO, provides a common NAME for a group of functions within a connected network; when combined with an industry group can be correlated to a common NAME, e.g. "planter" with "agricultural equipment"	7	7	Bit 8 to bit 2: Device class (most significant at bit 8)
Reserved	Reserved for future definition by ISO	1		Bit 1: Reserved
Function	Defined and assigned by ISO: when value between 0 and 127, independent of any other field for definition; when > 127 and < 254, definition depends on device class; when combined with industry group and device class, can be correlated to a common NAME for specific hardware, though not implying any specific capabilities	8	6	Bit 8 to bit 1: Function (most significant at bit 8)
Function instance	Indicates specific occurrence of a function on a particular device system of a network ^a	5	5	Bit 8 to bit 4: Function instance (most significant at bit 8)
ECU instance	Indicates which of a group of ECUs associated with a given function is referenced ^c	3		Bit 3 to bit 1: ECU (most significant at bit 3)
Manufacturer code	Assigned by committee (see ISO 11783-1), indicates manufacturer of ECU for which the NAME is being referenced; independent of any other NAME field	11	4	Bit 8 to bit 1: Most significant 8 bits of manufacturer code (most significant at bit 8)
			3	Bit 8 to bit 6: Least significant 3 bits of manufacturer code (most significant at bit 8)
Identity number	Assigned by the ECU manufacturer, necessary where the NAME is not unique (i.e. two identical NAMES on the same network)	21		Bit 5 to bit 1: Most significant 5 bits of identity number (most significant at bit 5)
			2	Bit 8 to bit 1: Second byte of identity number code (most significant at bit 8)
			1	Bit 8 to bit 1: Least significant byte of identity number (most significant at bit 8) ^c

NOTE See 11783-1 for numerical values of industry groups, device classes, functions and manufacturer codes.

^a The byte ordering of the NAME fields is arranged so that the NAME can be treated as a number, consistent with ISO 11783-7^[3].

^b Bit 1 is the last of the data bits sent and closest to the cyclic redundancy code (CRC) in the message.

^c Bit 8 is the bit closest to the data link control (DLC) in the message.

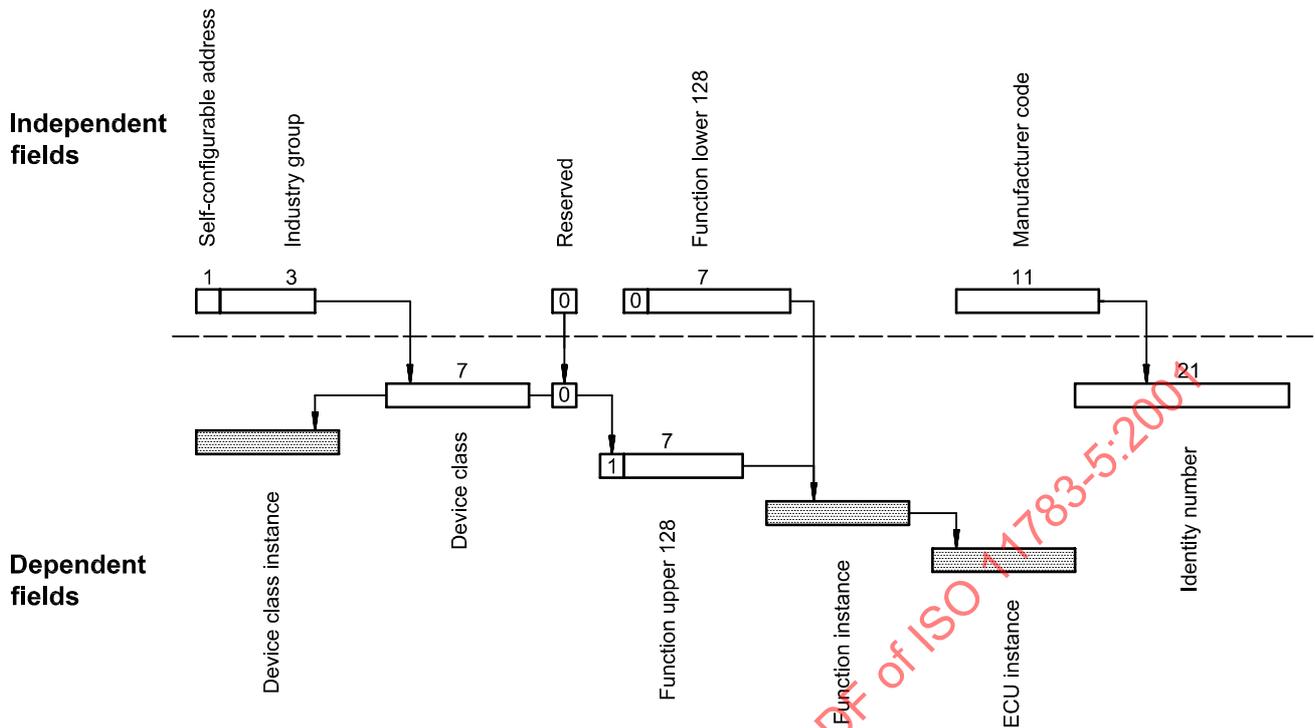


Figure 1 — NAME-field relationships and dependencies

5.1.2.2 It shall be possible to program all the fields that comprise a NAME.

5.1.2.3 If the data for any NAME field (except the self-configurable address) is unknown or unavailable, it should be set to binary "1" to indicate this.

5.1.2.4 The reserved bit should be set to zero.

5.1.2.5 Any instance field in the NAME should be able to be changed and reconfigured when an ECU is installed, or where there are multiple instances, on the network. In the case of a single, or first, device class, function or ECU, the corresponding instance field should be set to zero to indicate this.

An agreement can be reached, where appropriate, between the manufacturer and the system integrator on the interpretation and use of function instances.

EXAMPLE In the case of two engines and transmissions, agreement is reached that engine instance 0 be physically connected to transmission instance 0, and engine instance 1 to transmission instance 1.

5.1.2.6 Where a single engine is managed by two separate control units, each attached to the same ISO 11783 network, the ECU instance field should be set to 0 for the first ECU and to 1 for the second.

5.1.2.7 The ECU manufacturer shall ensure that the identity number is unique (ensured by the manufacturer using an identity number, a serial number or a data/time code on the product), and non-varying when power is removed.

5.1.2.8 Figure 1 shows the relationships between the fields, as well as the dependence of the upper 128 functions on device class and industry group, the dependence of identity number on manufacturer code, and the independence of function 0 to function 127 from either industry group or device class. The number of bits that each field comprises is noted above each field.

5.2 Address

5.2.1 After initial power and the network is operating, each ECU shall have at least one unique SA, so that controller-area-network (CAN) data frames can be properly arbitrated with other ECUs. Each SA shall be unique to its network.

5.2.2 Although an SA may be associated with different ECUs after each network power-up, varying from network to network, the ECU operating on an ISO 11783 network with an assigned preferred address shall attempt to use that address first. If the preferred address has already been claimed or is in use, depending on its addressing capability and address availability, the ECU shall either attempt to secure another SA, or send a cannot-claim-source-address message (6.2.4).

5.2.3 The initial address (that which the ECU attempts to claim on power-up) should be set by the manufacturer to match the list of preferred addresses in ISO 11783-1. The preferred address for an ECU should be able to be reprogrammed in order to permit the OEM to properly configure the system. Although this may not be necessary, it provides flexibility for applications where there are multiple instances of an ECU, for example, where there are two engines. However, it will be necessary in the case of temporary or after-market ECUs, which on power-up should transmit a request-for-address-claimed message (6.2.2), sending this to an appropriate address to determine if it is available.

5.2.4 After each power-up, the self-configurable-address ECU installed on an implement or trailer network that can be attached to a network in operation should store the address that it has claimed as an initial address so that it can be used at the next power-up.

6 Network-management requirements and recommendations

6.1 General

Network management procedures include the messages exchanged and actions taken by ECUs to collectively manage the network. Address and network-error management (6.2 and 6.3, respectively) are the network-management protocol's primary roles. With the exception of a limitation on use of the null address, network-management messages have the same characteristics, and are subject to the same requirements, as other ISO 11783 messages (for example, the request-for-address-claimed message is the conventional request message specified in ISO 11783-3).

The null address (254) is acceptable in a network management message's SA field only when the message is a request-for-address-claimed or a cannot-claim-source-address message.

6.2 Address-management messages and procedures

6.2.1 Address-management-message functions

The set of address-management messages (see Table 2) is used by an ECU to:

- request a NAME and address used by another ECU on the network (request-for-address-claimed message),
- claim an address (address-claimed message),
- announce the inability to claim an address (cannot-claim-source-address message),
- command another ECU to assume a new address (commanded-address message).

Table 2 — Address-management messages

Message	PGN	PF	PS	SA	DLC	Data
Request for address claimed (request PG)	59 904 ^a	234	DA	SA ^b	3	PGN 60928
Address claimed	60 928	238	255	SA	8	NAME
Cannot claim source address	60 928	238	255	254	8	NAME
Commanded address	65 240	254	216	SA	9 ^c	NAME, new SA

^a See ISO 11783-3.

^b The SA may be set to 254 if an address has not yet been claimed.

^c The commanded address message shall be sent using the broadcast announce mode (BAM) transport protocol.

6.2.2 Request for address claimed

6.2.2.1 The request-for-address-claimed message may be transmitted by any ECU to request the NAME and address of any other ECU attached to the network. Upon its receipt, the receiving ECU shall respond with an address-claimed message containing its address and its ECU NAME, while the ECU that is not able to claim an address shall respond with a cannot-claim-source-address message (see 6.2.3 for the procedure in both cases). The exception to this requirement is the ECU that has not yet attempted to claim an address, which shall not send a cannot-claim-source-address message, nor, in fact, participate in any network communications, before attempting to claim an address.

6.2.2.2 The SA for a request-for-address-claimed message shall be the null address if the message is from an ECU that has not yet claimed an address.

6.2.2.3 An ECU may transmit a request-for-address-claimed message either to the global destination address (255), or to a particular address. In the first case, the ECU can then determine the existence on the network of another ECU with a particular NAME by examining the responses to its message to the global destination address, while in the second case, the initiating ECU will interrogate the other to determine if the address has already been claimed. The ECU shall respond to its own request-for-address-claimed message.

6.2.3 Address claimed

6.2.3.1 The address-claimed message may be used by an ECU either to respond to a request-for-address-claimed message or to claim an address on the network. It may be issued either during network initialization or when an ECU is added to a network in operation. If an ECU receives an address-claimed message claiming its own source address, it shall compare its own NAME with the one received and determine which NAME has the higher priority, i.e. the lower numeric value. If it determines it has the higher priority, the ECU shall transmit an address-claimed message containing its NAME and address. If, however, it has the lower priority, it shall either claim a new address or transmit a cannot-claim-source-address message (6.2.4). A single parameter group number (PGN) is used for both the address-claimed and cannot-claim-source-address messages. See Table 3.

6.2.3.2 In order to successfully claim an address, the ECU sending an address-claimed message shall not receive a contending claim from another ECU for at least 250 ms. A network interconnection unit shall not use its own address in communications on the network until it has already successfully claimed an address (forwarding messages between other ECUs is a special task of the network interconnection unit). However, a network interconnection unit may forward messages before claiming its own address.

6.2.4 Cannot claim source address

6.2.4.1 A cannot-claim-source-address message is transmitted by any ECU that cannot claim its preferred address and does not have the self-configurable addressing capability, or that has the self-configurable address capability but cannot claim an address because none is available for use. The message may be sent in response to a request-for-address-claim or address-claimed message. Although the cannot-claim-source-address message has the same PGN as the address-claimed message, its SA shall be the null address (254).

6.2.4.2 A pseudo-random delay as described in 6.4.6.1.2 should be inserted between the reception of a message triggering the cannot-claim-source-address response and the sending of the response in order to minimize the possibility of two such responses causing bus errors.

6.2.4.3 An ECU that cannot claim an address shall send no message other than a cannot-claim-source-address or request-for-address-claimed message.

Table 3 — Address-claimed/cannot-claim-source-address message procedure

Transmission repetition rate	As required	
Data length	8 bytes	
Data page	0	
Protocol data unit (PDU) format	238	
PDU-specific	255 (global address)	
Default priority	6	
PGN	60928 (00EE00 _{HEX})	
SA	Address claimed	0 to 253
	Cannot claim source address	254 (null address)
Bytes 1 to 8	NAME	

6.2.5 Commanded address

6.2.5.1 This can be used by a network interconnection unit such as a bridge or by a tool to command another ECU (thereafter known as the commanded ECU) to use a particular SA. The ECU to which a commanded-address message is sent may either act upon or ignore it, and should not respond if receiving the message but unable to change to the commanded SA. An operator or technician could then modify the commanded ECU's SA by other means. The ECU manufacturer could prevent its product from accepting commanded-address messages from any ECU other than a bridge or service tool, or demand a security-verification for its ECU to accept such a message. See Table 4.

Table 4 — Commanded-address-message procedure

Transmission repetition rate	As required
Acknowledgement	(See Figure 2 and Figure 3)
Data length	9 bytes
Data page	0
Protocol data unit (PDU) format	254 (null address)
PDU-specific	216
Default priority	6
PGN	65240 (00FED8 _{HEX})
Bytes 8 to 1	NAME
Byte 9	Address assignment field (new SA) ^a
^a Contains SA assigned to the ECU with NAME corresponding to that in the first eight bytes of the commanded-address message.	

6.2.5.2 When it accepts a commanded-address message, the commanded ECU shall issue an address-claimed message using the address specified in the commanded-address message as its new SA. This SA shall be the one that appears in the SA field of all the commanded ECU's future messages until it receives either another commanded-address message, or, through power-up or address contention, it completes another address-claim process (Figure 2 and Figure 3).

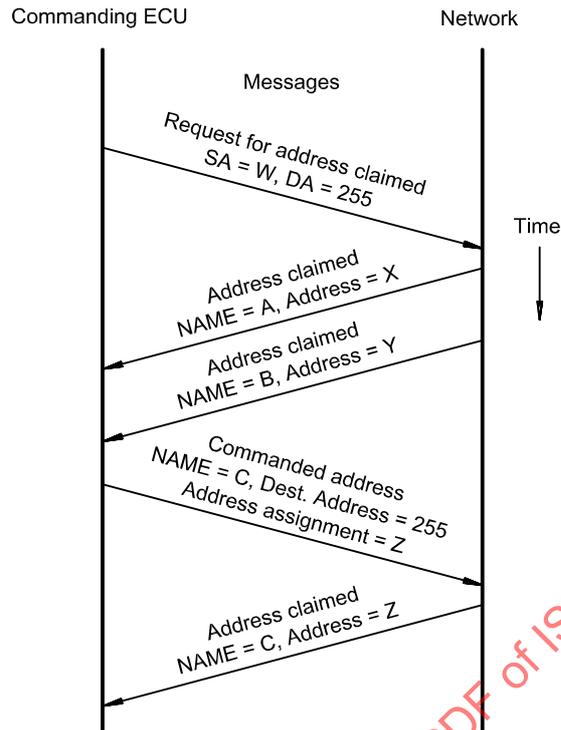


Figure 2 — Commanded address supports and accepts commanded-address message

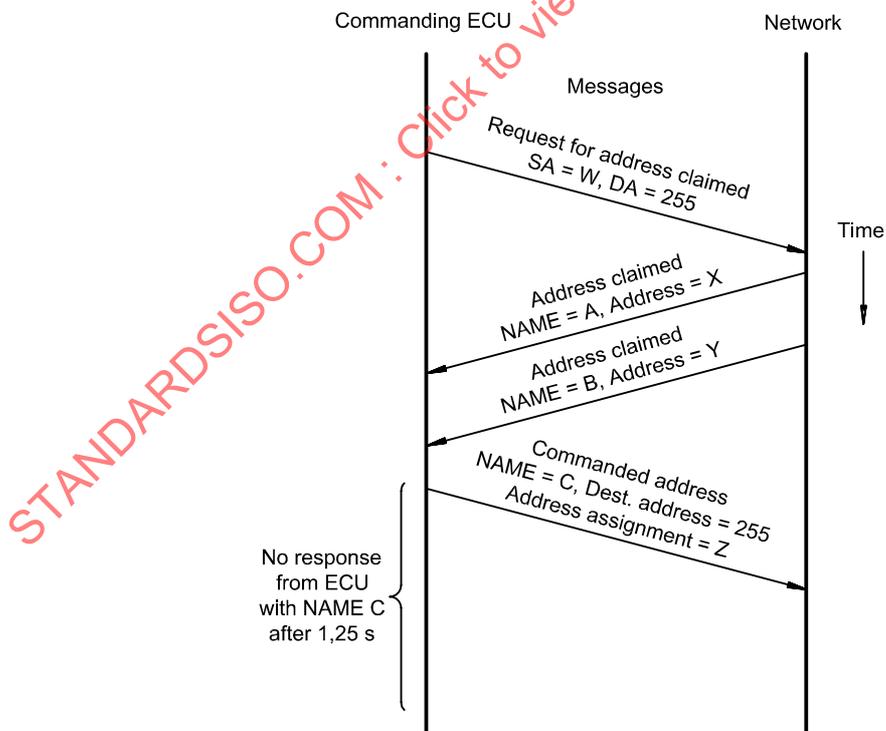


Figure 3 — Commanded address does not support, or ignores, commanded-address message

6.2.5.3 The commanded-address message shall contain 9 bytes of data and shall be sent to the global address (255) using the broadcast announce mode (BAM) of the transport protocol (ISO 11783-3). Therefore, ECUs designed to support the commanded-address message will also support BAM.

6.3 Network-error management

Network error management refers to the detection of certain addressing errors, for example, the failure of an ECU to secure an address or addresses. Other addressing errors, such as duplicate address claims or NAMEs, can be detected by a diagnostic tool using a request-for-address-claimed message. If an ECU attempting to claim an SA is unsuccessful because the same network address has already been claimed by an ECU with a higher priority NAME, a cannot-claim-address error shall be generated.

6.4 Initialization

6.4.1 Acquisition of a unique address

When initializing, after having completed a power on self test (POST) and before originating any other communication, the ECU shall transmit an address-claimed message in order to acquire a unique address on the network.

6.4.2 Address claim requirements

The following list comprises the main requirements for avoiding contention, and for detecting and eliminating duplicate addresses during initialization.

- a) The ECU shall claim its own address when initializing and when and if responding to a command to change its NAME or address (the latter instance in confirmation of its acceptance of a commanded-address message). This will ensure that each ECU takes responsibility for obtaining a valid address and correctly arbitrates for an address if its claim has not yet been received by another ECU.
- b) The destination address for an address-claimed message shall be the global address (255), in order that the transmitting ECU's claim be announced to all other ECUs on the network. (It should be noted that this is an exception to a requirement of ISO 11783-3.)
- c) An ECU shall be able to differentiate between address-claimed messages it receives from other ECUs and those sent by itself.
- d) No ECU may begin, or resume, transmission on the network until 250 ms after it has successfully claimed an address (Figure 4).

6.4.3 Other basic requirements for initialization

6.4.3.1 An ECU shall respond to a request-for-address-claimed message directed to the global address with either an address-claimed message or, if the claim is unsuccessful, a cannot-claim-source-address message.

6.4.3.2 The ECU shall emit no response as required by 6.4.3.1 if an address claim has not been attempted.

6.4.3.3 An ECU shall respond to a request-for-address-claimed message when the destination address is the same as the ECU's address, and shall transmit its response to the global address (255).

An ECU shall transmit an address claim if it receives an address-claimed message with an SA matching its own, and if its own NAME has a priority lower than the claim received.

If an ECU NAME has a higher priority than the NAME in a received address-claimed message, it shall discontinue using the address. It may then transmit a cannot-claim-source-address message or attempt to claim another address.

6.4.3.4 A non-configurable-, service-configurable- or command-configurable-address ECU that is unable to use a particular address shall transmit a cannot-claim-source-address message.

6.4.3.5 A self-configurable-address ECU that cannot use the particular address it is attempting to claim shall select another address and attempt to claim it.

6.4.3.6 An ECU that has previously communicated with another ECU unable to claim a particular address shall be capable of detecting when that other ECU has been “disabled” by monitoring its cannot-claim-source-address message as well as the address-claimed message of the higher-priority ECU that impeded the claim.

6.4.3.7 Service tools, and bridges in certain systems, shall be expected to detect and resolve address-claim failures. Such a tool should be able to monitor the cannot-claim-source-address message and report the problem to its operator.

6.4.4 Message sequences

The required message sequences for initialization of an ECU on a network in various situations, either in the absence or presence of contention, are illustrated schematically in Figure 4 to Figure 7.

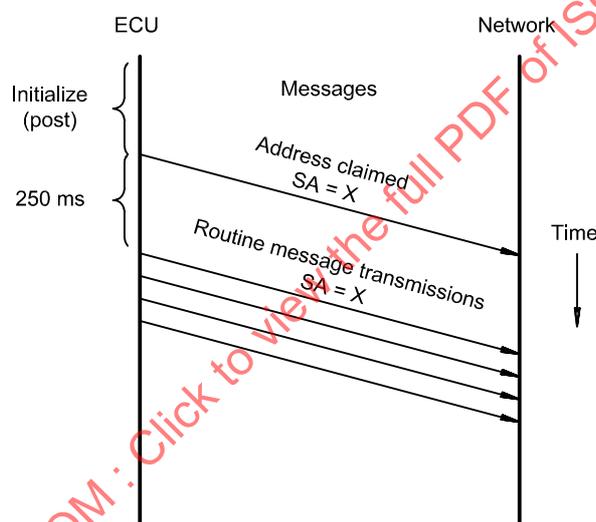


Figure 4 — Initialization of an ECU claiming an SA without contention

6.4.4.1 Address-claim prioritization

Where a single address is contested by two ECUs, priority shall be given to the ECU with the NAME of lower numerical value and thus higher priority. This NAME should be treated as an 8-byte value, with the most significant bit at the self-configurable-address-bit determining numerical value. Although necessitating comparison of the 8-byte NAMES in the respective address-claimed-message data fields of the contending ECUs, this eliminates ambiguity from the address claiming process.

EXAMPLE Engine 0 and Engine 1 both desire the same address. Engine instance 0 has, by definition, a lower absolute value NAME and will therefore win address arbitration (Figure 5 to Figure 7).

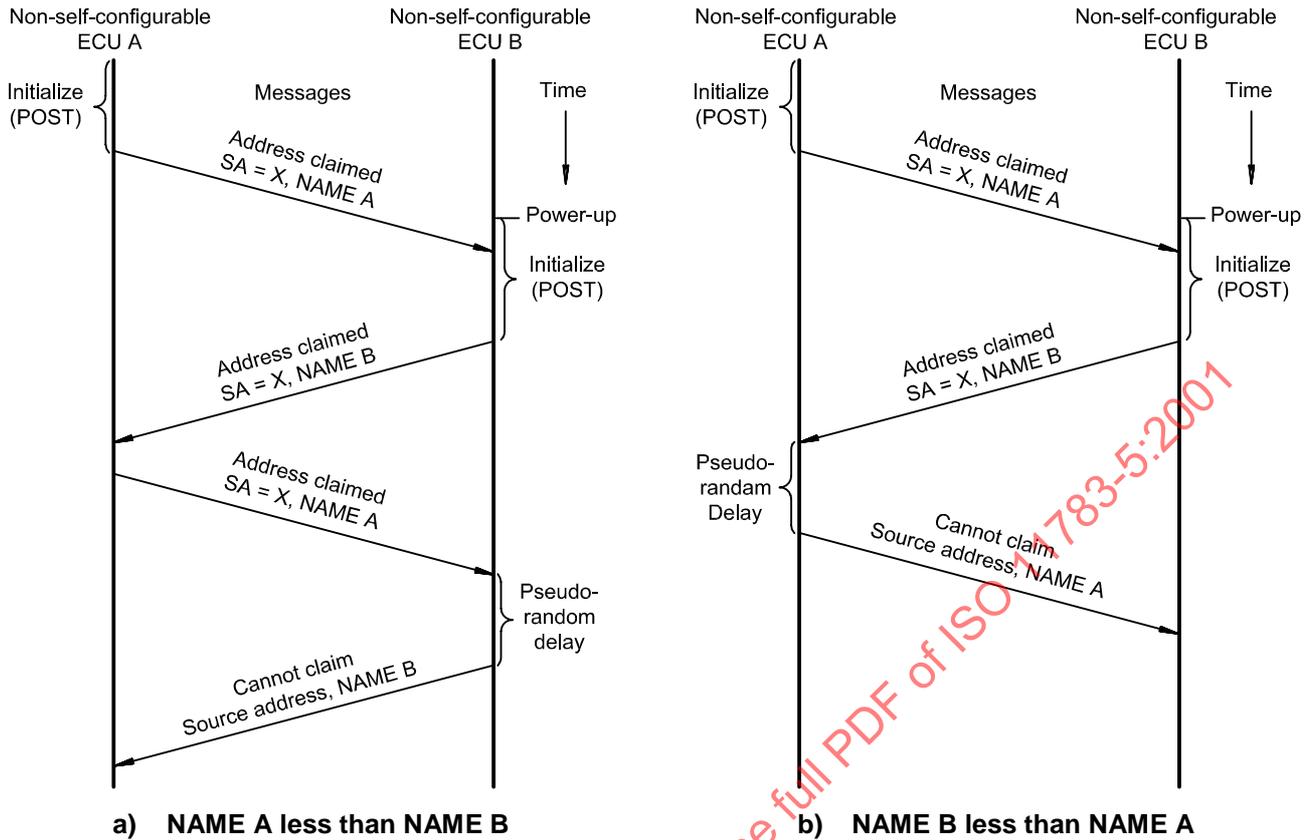


Figure 5 — Initialization of two ECUs that are not self-configurable-addressing attempting to claim the same address and whose claims are unsynchronized

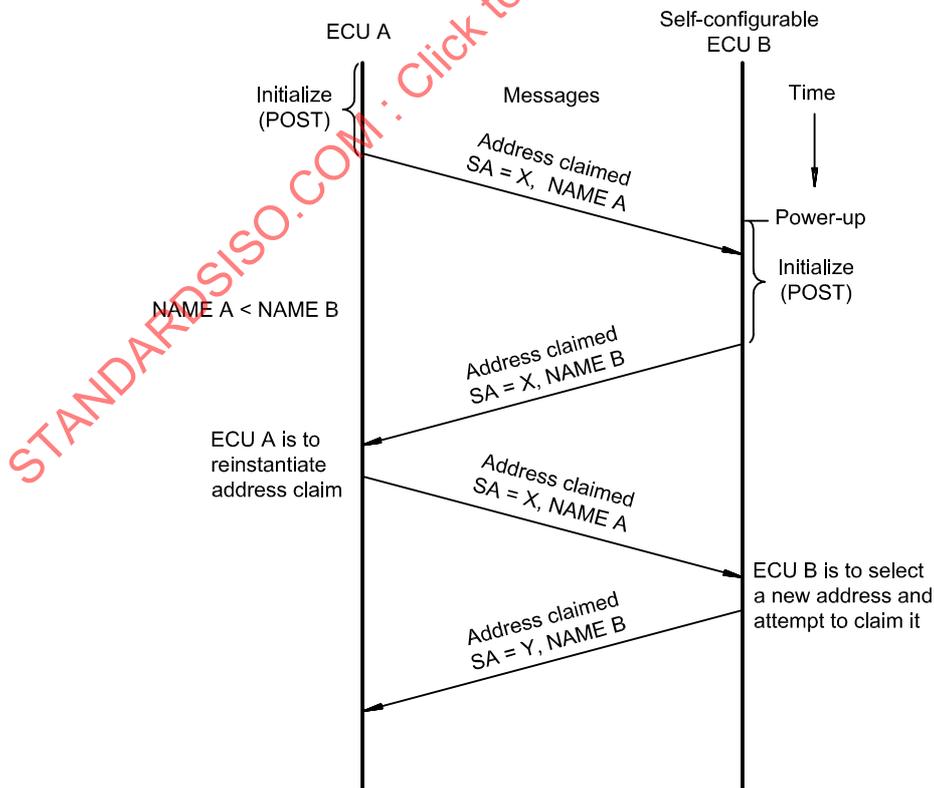


Figure 6 — Initialization of a non-configurable-address ECU (A) with NAME of higher priority than that of a self-configurable-address ECU (B)

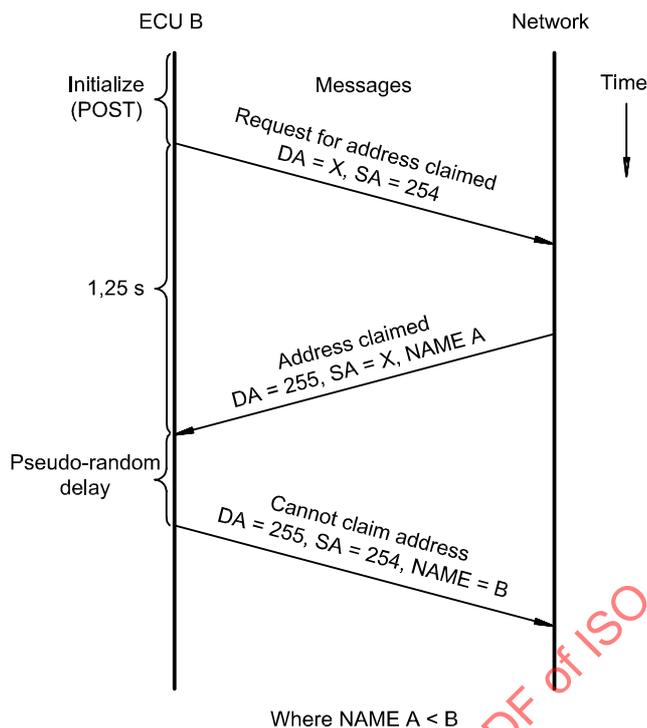


Figure 7 — Initialization of an ECU (B) that is not self-configurable addressing, request-for-address-claimed message, address already in use

6.4.4.2 Identical identifiers

6.4.4.2.1 Network messages with identical identifiers could be generated by different ECUs when the request-for-address-claimed, address-claimed or cannot-claim-source-address message is used (Figure 8). The case of two identical identifiers generated by a request-for-address-claimed message transmitted simultaneously by two ECUs, both sending from the null address (254), presents no problem, as the data field will be the same for both messages. However, in the case of address-claimed messages transmitted simultaneously by more than one ECU contending for the same address, bus collisions will occur owing to the difference between the NAMEs in their respective data fields. For the same reason, cannot-claim-source-address messages transmitted simultaneously by more than one ECU from the null address will also cause bus collisions.

6.4.4.2.2 To manage this problem (until going bus-off) the following procedure should be followed. After transmitting an address-claim message, the transmitting ECU should monitor the error code information and, if this information indicates that a bus error has occurred, wherever possible any automatic retransmission attempts by the CAN peripheral should be cancelled. Retransmission of the claim message should be rescheduled for after the standard idle period plus a transmit delay (6.4.6.1).

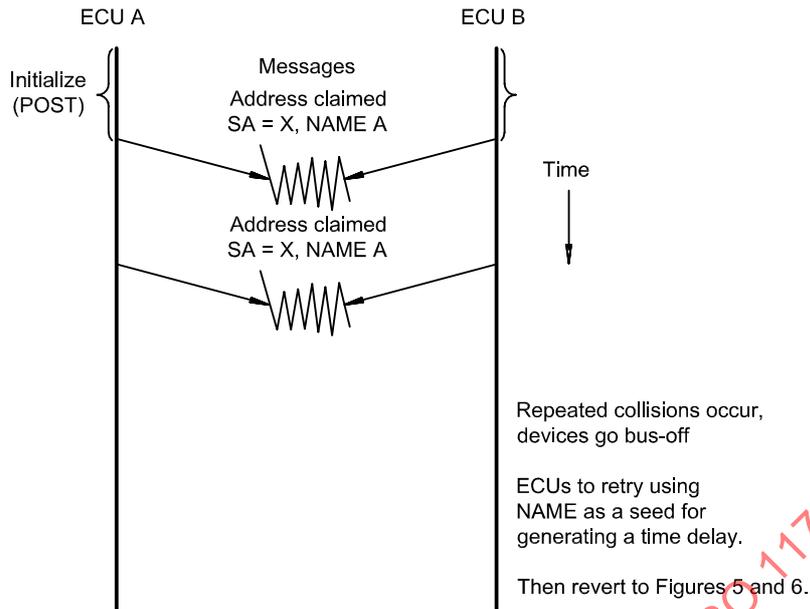


Figure 8 — Initialization in the case of two ECUs contending for the same address whose claims are synchronized

6.4.5 ECU unable to obtain an address

6.4.5.1 An ECU unable to claim an address (Figure 9) may not send any messages except for:

- a cannot-claim-source-address message in response to request-for-address-claimed messages,
- the response to a commanded-address message,
- a request-for-address-claimed message.

6.4.5.2 Moreover, after having sent a cannot-claim-source-address message, the ECU may not transmit another request-for-address-claimed message until the power is turned off, and then may attempt to claim an address when the power is turned back on again.

6.4.5.3 Where a collision of cannot-claim-source-address messages occurs, the procedure described in 6.4.4.2.2 should be used.

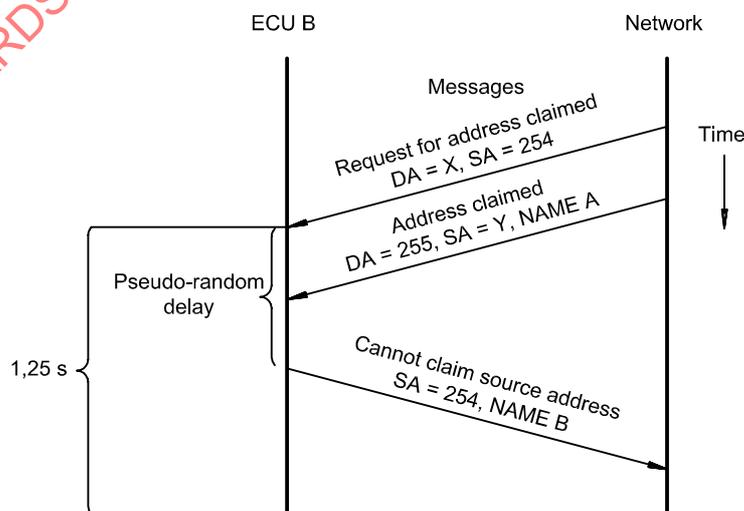


Figure 9 — ECU unable to claim an address

6.4.6 Self-configurable-address ECU

6.4.6.1 Address-claimed message

6.4.6.1.1 The self-configurable-address ECU shall schedule its transmission of the address-claimed message to follow its POST-period-plus-transmit-delay. The transmit delay may be calculated using the identity number in the NAME of the address-claimed message, or else other unique information within the ECU may be selected by the manufacturer as a seed to feed a random number generator that will produce a value of between 0 and 255. The delay shall be added to the normal idle period before the next claim message is transmitted. The ECU should be able to schedule the next claim message within $\pm 0,6$ ms of the calculated delay.

6.4.6.1.2 The idle delay addition is one of 256 delays, calculated by multiplying the 0 to 255 output of the random number generator by 0,6 ms, giving a delay range of 0 ms 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.

6.4.6.1.3 A self-configurable-address ECU should store its claimed address as an initial address, in addition to the addresses of the ECUs with which it communicates, so that it can attempt to use the same address at the next power-up.

6.4.6.2 Request-for-address-claimed message

6.4.6.2.1 A self-configurable-address ECU can elect to obtain a list of the addresses already claimed on the network before itself claiming an address. If finding its preferred address already claimed, it may request the addresses of all ECUs on the network by using the null address (254) as the SA, and then take an unclaimed address. Preferable to this is its transmission of a request-for-address-claimed message to a destination address (DA) unlikely to have been already claimed (Figure 10). This procedure avoids transmission to the global address (255), which generates a response from every ECU on the network, and thus minimizes message traffic (Figure 11).

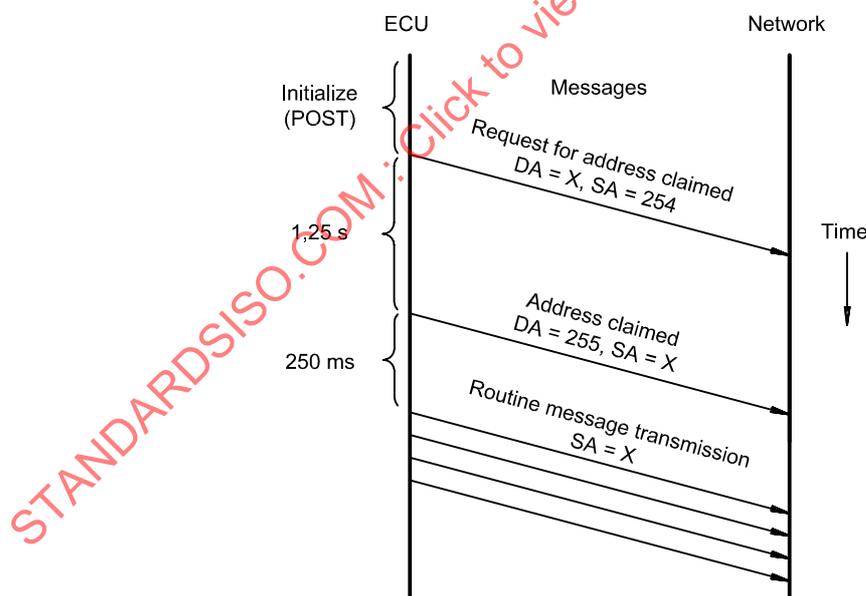


Figure 10 — Initialization of self-configurable-address ECU claiming SA without contention

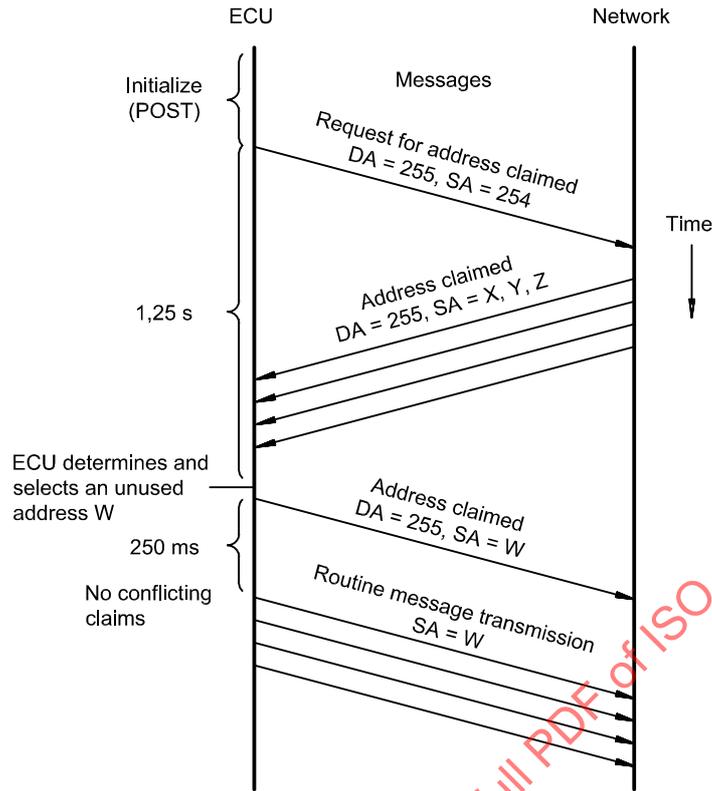


Figure 11 — Initialization of self-configurable-address ECU sending request-for-address-claimed message to the global address

6.4.6.2.2 A request-for-address-claimed message may be used to determine if an address is being used before the attempt is made to claim it. This allows the self-configurable-address ECU to minimize address contention when initializing on the network, and is appropriate for ECUs such as tools that are not permanently connected to the network. Message sequences for the initialization of ECUs not permanently connected are also illustrated by Figure 10 and Figure 11.

6.4.7 Address-to-NAME association table

The request-for-address-claimed message transmitted either to a specific, or to the global, address can be used to construct an address-to-NAME association table, used by certain ECUs to confirm the associations for critical functions.

EXAMPLE An address-to-NAME association table confirms that a powertrain engine is located at address 0, thereby ensuring that torque/speed control messages from the transmission are sent to the correct destination.

For ECUs where only a small number of address-to-NAME associations are required, the message should be sent to a specific address, while in the case of a diagnostic tool applied to all the ECUs on a network, the message should be sent to the global address.

6.5 Network functionality

6.5.1 Minimum requirements

6.5.1.1 General

The minimum requirements to be met in order that ECU communications can physically function on an ISO 11783 network are specified in 6.5.1.2.

NOTE Additional physical requirements are presented in ISO 11783-2.