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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

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 23, *Tractors and machinery for agriculture and forestry*, Subcommittee SC 19, *Agricultural electronics*.

This third edition cancels and replaces the second edition (ISO 11783-5:2011), which has been technically revised.

The main changes compared to the previous edition are as follows.

— The physical requirements are moved to ISO 11783-2.

A list of all parts in the ISO 11783 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

ISO 11783-1 to ISO 11783-14 specify a communications system for agricultural equipment based on ISO 11898[4][5] 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 document is harmonized with SAE J 1939/81[6]. General information on ISO 11783 can 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.

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

Part 5: Network management

1 Scope

This document describes the management of source addresses (SAs) for control functions (CFs) of 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 of network-connected ECUs.

2 Normative references

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

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

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

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

3 Terms and definitions

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

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

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
current NAME
CF NAME that is transmitted in its address-claimed-message

3.2
NAME management
NM
method for changing the NAME of a CF at run time

3.3
pending NAME
NAME temporarily stored by a particular CF as the result of *NAME management* (3.2) messages received from a qualified source

3.4
random transmit delay
RTxD
delay time calculated by multiplying a random number in the range 0 to 255 with 0,6 ms

Note 1 to entry: A seed to the random number generator can use the identity number in the NAME, or other unique information within the CF.

4 Technical requirements

4.1 General

The network management specified in this document provides the definitions and procedures necessary to uniquely identify CFs on the network, manages the assignment of addresses, and handles network errors.

A CF's ability to select an address depends on the CF's address configuration capabilities as described in 4.2.

Each CF 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 specified in 4.3.

CFs shall successfully claim an address according to the procedures detailed in 4.4 prior to sending any other messages on the network. Multiple CFs can work together to perform a function, provided each CF claims its own address following the rules in 4.4.2.3.

If a CF cannot successfully claim an address, it shall report this to the network as described in 4.4.2.4.

Network initialization sequences associated with the address claiming process are described in 4.5.

This document no longer contains physical requirements. These requirements are included in ISO 11783-2:2019.

4.2 Address configuration capabilities

4.2.1 General

Address configuration is the method by which a particular CF determines the SA, which it shall use for an address claim. For the purposes of the address claim process, there are two basic address configuration capabilities: non-configurable address and self-configurable address. These are distinguished by the value in the "self-configurable address" field in the most significant bit position in the CF's NAME.

CFs conforming to ISO 11783 shall be self-configurable address capable. Non-configurable address capable CFs shall be tolerated on the network to allow compatibility with CFs conforming to the first edition of this document (ISO 11783-5:2001) and CFs conforming to SAE J1939.

There are also two extended address configuration capabilities: command-configurable address and service-configurable address. A CF may implement one or more of the extended address configuration capabilities.

4.2.2 Non-configurable address

A non-configurable address CF cannot change its initial address during the address claim process. If multiple non-configurable address CFs are claiming the same address then only the CF with the highest priority NAME can obtain the address, the others shall announce their inability to claim an address.

The "self-configurable address" field is the most significant bit in the CF's NAME and therefore a non-configurable address CF always has higher priority than a self-configurable address CF. This implies that a non-configurable address CF forces a self-configurable address CF to claim another address.

4.2.3 Self-configurable address

A self-configurable address CF is one that can select its initial address based on proprietary algorithms, and then claim that address. This CF, 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 "self-configurable address" field in the NAME (see 4.3.2) indicates whether or not a CF has this capability.

The CF shall only change its initial address when it loses address arbitration, and it shall only use addresses in the range 128 to 247 inclusive. But if the CFs function is one that has an assigned preferred address, then it may also use the preferred address.

4.2.4 Service-configurable address

A service-configurable address CF is one whose source address can be changed in the field by a service technician. The address can be altered by any one of a number of proprietary techniques or by using the commanded-address message, while in a “service” mode of operation. A service tool may be used for this operation.

4.2.5 Command-configurable address

A command-configurable address CF is one whose source address can be altered using the commanded-address message. The change can take place at any time, without the intervention of a service tool or the requirement of a special service mode of operation. It does require the presence on the network of a CF that can send the appropriate command to cause the address change.

4.3 NAME and address requirements

4.3.1 General

A NAME is a 64-bit entity composed of fields defined in Table 1. Every CF transmitting messages on an ISO 11783 network shall have a unique NAME. A CF’s NAME describes the function that a CF performs and its numerical value is used in the arbitration for address (see Annex A for examples of NAMEs). NAMEs are normally established during initial network configuration on a machine, or when a CF in an ECU is added to an existing network.

An address is used on an ISO 11783 network to provide a unique message identifier and to determine a message source which is known as a source address (SA). The procedures for address management in the ISO 11783-5 protocol enable individual SAs to be associated with particular CFs (see 4.4.2). In the case of an ECU that implements several CFs, a different address-configuration capability may exist for each of the CFs and each CF shall claim a unique SA.

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 retains a consistent definition.

4.3.2 NAME

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

The relationship between the 64-bit value used for arbitration priority (see 4.5.3), the data bytes in the address-claimed-message (see 4.4.2.3) and the NAME fields (Table 1) is shown in Figure 1.

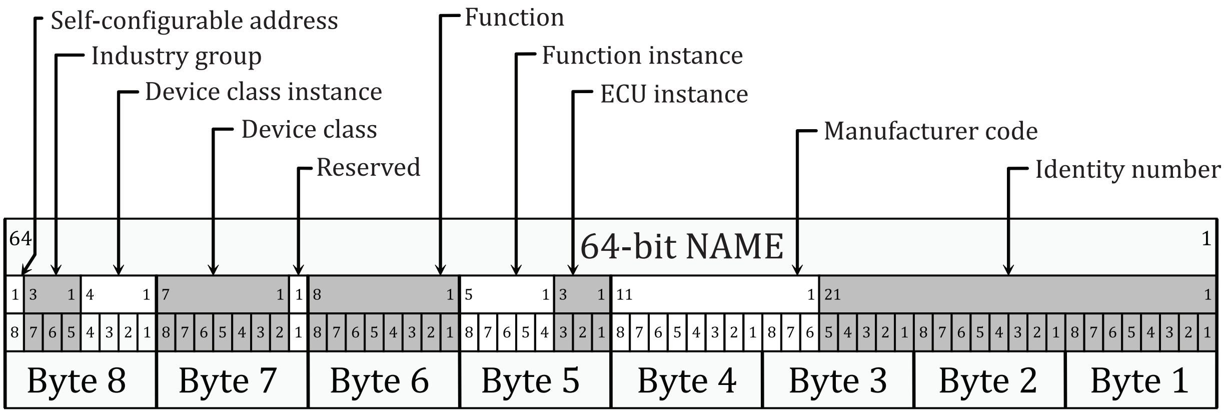

Figure 1 — Structure of the 64-bit NAME

Table 1 — NAME fields

Field	SPN	Definition	No. of bits	Byte no.	Byte ordering[a]
Self-configurable address	2844	Indicates whether a CF is self-configurable (1) or not (0); shall always be known and set to the appropriate value	1	8	Bit 8: Self-configurable address
Industry group[d]	2846	Defined and assigned by ISO, identifies NAMEs associated with industries (such as agricultural equipment)	3		Bit 7 to bit 5: Industry group (most significant at bit 7)
Device class instance	2843	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[d]	2842	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, such as “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[d]	2841	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 CF, though not implying any specific capabilities	8	6	Bit 8 to bit 1: Function (most significant at bit 8)
Function instance	2839	Indicates specific occurrence of a function on a particular device system of a network	5	5	Bit 8 to bit 4: Function instance (most significant at bit 8)
ECU instance	2840	Indicates which of a group of ECUs associated with a given function is referenced	3		Bit 3 to bit 1: ECU (most significant at bit 3)

[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.

[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 length code (DLC) in the message.

[d] See ISO 11783-1 for numerical values of industry groups, device classes, functions and manufacturer codes.

Table 1 *(continued)*

Field	SPN	Definition	No. of bits	Byte no.	Byte ordering[a]
Manufacturer code[d]	2838	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	2837	Assigned by the ECU manufacturer.	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]

[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.

[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 length code (DLC) in the message.

[d] See ISO 11783-1 for numerical values of industry groups, device classes, functions and manufacturer codes.

Table 1 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.

The reserved bit shall be set to zero.

Any instance field in the NAME can be changed and reconfigured when an ECU is installed, or where there are multiple instances, on the network by the NAME management message (see 4.5.3).

An agreement can be reached, where appropriate, between the manufacturer and the system integrator on the interpretation and use of function instances. For example, a manufacturer or other parts of ISO 11873 may use the function instance to indicate position or special functionality of a CF.

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.

Where a function is managed by two separate ECUs, 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. The ECU manufacturer shall ensure that the NAME is unique and non-varying when power is removed. Where all other fields can be identical to the NAME of another CF, the NAME shall be made unique by setting the identity number (such as a serial number or a data/time code on the product).

Figure 2 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.

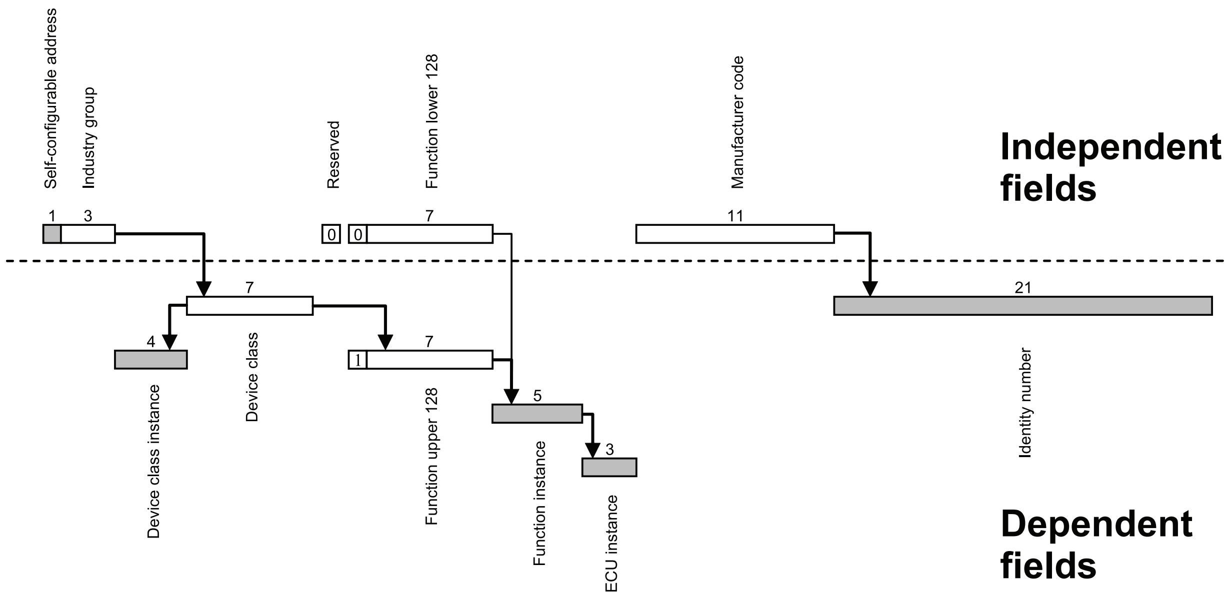

Figure 2 — NAME-field relationships and dependencies

4.3.3 Address

4.3.3.1 General

An address is a one-byte value identifying a particular CF on a network. The address of a CF is incorporated into the CAN identifier of every message sent by that CF and is used to provide uniqueness to messages that are sent by the CF. After initial power-up and when the network is operating, each CF shall have a unique SA. An SA can be associated with a different CF after each power up of the network and can also vary from one network connection to another network connection. The NAME, which is associated with a source address, includes the identification of the function the CF performs and retains this consistent definition regardless of the source address that the CF uses.

4.3.3.2 Preferred address

CFs can operate on an ISO 11783 network using an assigned preferred address. If the preferred address has already been claimed, the CF shall either attempt to claim another SA, or send a cannot-claim-source-address address message depending on the CF's addressing capability and the availability of an unused address. When the CF claims another address, this new address shall be stored as the initial address to be used at all subsequent power-ups.

See ISO 11783-1 for a list of assigned preferred addresses.

A CF claiming a preferred address in the range 0 to 127 and 248 to 253 shall perform the function defined for that preferred address and shall specify that function within its NAME.

The function performed by a CF shall never be deduced from the SA alone; only the CF's NAME shall be used to establish the function[1)].

4.3.3.3 Self-configurable address

ISO 11783 CFs that do not have an assigned preferred address or cannot claim their preferred address shall claim an address in the range of 128 to 247. Since multiple CFs can be claiming addresses in this

1) The first edition of this document (ISO 11783-5:2001) did not enforce the address-to-function relation.