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

Part 4:
Network layer

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

Partie 4: Couche 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 2.

The main task of technical committees is to prepare International Standards. 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.

ISO 11783-4 was prepared by Technical Committee ISO/TC 23, Tractors and machinery for agriculture and forestry, Subcommittee SC 19, Agricultural electronics.

This second edition cancels and replaces the first edition (ISO 11783-4:2001), which has been technically revised.

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: Mobile data element dictionary
— Part 12: Diagnostics services
— Part 13: File server
— Part 14: Sequence control
Introduction

Parts 1 to 14 of ISO 11783 specify a communications system for agricultural equipment based on ISO 11898-1[1] and ISO 11898-2[2]. SAE J 1939[3] 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 1939/31[4]. 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
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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 4: Network layer

1 Scope

ISO 11783 as a whole 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 network layer, which defines the requirements and services needed for communication between control functions (CFs) in different segments of the ISO 11783 network. The various types of network interconnection units are defined in this part of ISO 11783.

2 Normative references

The following referenced documents are indispensable for the application 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

ISO 11783-5, Tractors and machinery for agriculture and forestry — Serial control and communications data network — Part 5: Network management

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

ISO 11783-9, Tractors and machinery for agriculture and forestry — Serial control and communications data network — Part 9: Tractor ECU
3 Terms and definitions

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

3.1 address space
allowable range of addresses on a particular subnetwork

NOTE When an NIU separates network segments, the same address can be used by CFs on each side of the NIU.

3.2 connection
establishment of dynamic virtual addresses in an NIU (network interconnection unit) for sending and receiving messages between CFs on different network segments that have different address spaces

3.3 network interconnection unit
NIU
electronic control unit (ECU) used for interconnecting networks or network segments

3.4 port
network segment interface to an NIU

NOTE An NIU has two or more ports connected to different network segments.

3.5 port pair
two ports of an NIU indicating the direction of data flow from one segment to another segment

3.6 transparent
CF which provides services to another CF without it being aware of the source of these services

NOTE The CFs need not be aware there is an NIU connecting the CFs together.

3.7 virtual CF
apparent CF established by an NIU on one network segment using the same NAME of the actual CF on a different network segment

3.8 actual CF
CF established directly by an ECU on the network segment

4 Description

4.1 Role of the network interconnection unit (NIU)

4.1.1 Message transfer

4.1.1.1 General

When multiple segments exist in a network, the NIU provides the means of transferring messages from one segment to another. The unit transfers individual message frames between two or more ports, of which there is one per segment.
4.1.1.2 Message-transfer tasks

Depending on its type (see 4.2 and Clause 7), the NIU can perform one or more of the following message-transfer tasks:

- forwarding (6.1);
- filtering (6.2);
- address translation (6.3);
- repackaging (6.4).

4.1.1.3 Main performance criteria

There are three main performance criteria for determining the suitability of an NIU for a given application:

a) maximum number of messages guaranteed to be forwarded per second: if this number is exceeded due to average or peak bus loads, messages can be lost;

b) maximum number of messages guaranteed to be filtered per second: if this number is exceeded due to the number of entries in the database, messages can be excessively delayed;

c) maximum transit delay: this is used to determine the worst-case latency for a message transmitted by one CF and received by another CF on another bus segment.

4.1.2 Database management

The NIU can also support bridge and database management (6.6), enabling access to, and configuration of, internal databases within the interconnection unit itself.

EXAMPLE Although a bridge separates two media segments and the message traffic on each, the network will still be considered a single network in terms of its address space and identifiers, as a result of the communication made possible by the interconnection unit.

4.1.3 Other network layer functions

Network interconnection units can perform other functions beyond those defined in this part of ISO 11783, as provided by the supplier or as dictated by the network configuration. ISO 11783-1 provides examples of these other functions.

4.2 Role of the network layer

The main role of the network layer is management of the transfer of messages between segments. The network layer includes a number of different types of network interconnection units which, depending on the functions required, can provide these services:

- the repeater forwards the messages (7.1);
- the bridge (7.2) filters messages and manages the message-filter database;
- the router (7.3) uses address translation to enable a network segment to appear as a single CF to other parts of the network;
- the gateway (7.4) repackages parameters into different messages for easier transfer, reception and interpretation by CFs;
— a special network interconnection unit, the tractor ECU, connects the implement and tractor buses on a tractor or self-propelled implement (see Figure 1, 5.1.3 and ISO 11783-9).

As well as these message-transfer functions, the network layer provides access to, and allows configuration of databases within, the NIU (4.1.2, 6.6 and ISO 11783-1).

NOTE The NIU can also participate in the address-claim procedure on behalf of CFs in a subnetwork (ISO 11783-5). However, because the use of a router or gateway for interfacing with a proprietary subnetwork is application-dependent, these NIUs are not defined in ISO 11783. Specific implementations can be developed by the component manufacturer, subsystem supplier or the OEM (original equipment manufacturer).

Figure 1 illustrates the topology of a typical network in agriculture and forestry that uses serial control and communications data NIUs. The maximum number of nodes per implement is specified in ISO 11783-2 and the maximum apparent number of CFs on a segment is limited by addressing as specified in ISO 11783-5.
Figure 1 — Typical ISO 11783 network