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Agricultural and Forestry Off-Road Machinery Control and Communication Network

RATIONALE

Updates have been made to synchronize this document with updates in other documents of the series. Language has been clarified. A section on how to design ECUs for both Truck & Bus and Agricultural & Forestry networks has been added. A section documenting the process used to standardize A&F networks has been added.

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 J1939-02 document specifies a particular set of SAE J1939 documents which define an SAE J1939 network as it applies to agricultural and forestry equipment.

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, such as engines 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 J1939-02 Agricultural and Forestry Off-Road Machinery Network specifies the requirements for application of SAE J1939 in agricultural and forestry equipment. This document specifies the series of documents within the set of SAE J1939 documents that are applicable to agricultural and forestry equipment and provides further requirements for this industry.

The SAE and ISO groups have cooperated to define agricultural and forestry networks in a manner to allow compatibility of ECUs and messaging protocols between the A&F and the T&B networks.

2. REFERENCES

2.1 Related Publications

The following publications are provided for information purposes only and are not a required part of this SAE Technical Report.

2.1.1 ISO Publications

Available from American National Standards Institute, 25 West 43rd Street, New York, NY 10036-8002, Tel: 212-642-4900, www.ansi.org.

ISO 11783 Tractors and Machinery for Agriculture and Forestry - Serial Control and Communications Data Network

2.1.2 NMEA Publications

Available from National Marine Electronics Association, 7 Riggs Ave., Severna Park, MD 21146, 410-975-9425, www.nmea.org.

NMEA 2000 National Marine Electronics Association Standard for Serial-Data Networking of Marine Electronic Devices

3. DEFINITIONS

Terms and abbreviations are defined in SAE J1939 Top Level for use in the context of this document. Additional terms are defined below.

3.1 TERMS

3.1.1 Controller Application

The software within an Electronic Control Unit (ECU) that performs a particular control function. More than one Controller Application may reside within an ECU.

3.1.2 Configurable Messages

A set of message PGNs that can be configured to contain any desired combination of a set of parameters (SPNs) that are designated to be configurable.

3.1.3 Farm Management Information System

The office computer system for the farmer or contractor. It includes the software for farm management such as book keeping, payroll, resource management for machines, products, workers, field management, GIS, decision support systems and task management.

3.1.4 Fast Packet

A transport protocol method employing broadcast messages with no minimum separation between packets

3.1.5 Implement Network

Network segment that connects agricultural implement ECUs as well as some tractor ECUs such as Virtual Terminal

3.1.6 ISOBUS

Standardization of the agricultural implement network defined in ISO 11783

3.1.7 Management Computer Interface

The method of exchanging information between the FMIS and the vehicle Task Controllers using XML data format. A physical interface is not specified.

3.1.8 Network Interconnection ECU

A device that exists primarily for interconnecting networks or sub networks. Specific implementations for “forwarding” messages include: Repeater, Bridge, Router, and Gateway.

3.1.9 Process Data

A message that is used for the transmission of measured data and/or set point commands to one or more controllers.

3.1.10 Task Controller

An electronic unit on the mobile implement control system that is responsible for the sending, receiving and logging of Process Data. A Task Controller may have an operator interface.

3.1.11 Termination Bias Circuit

A circuit required at each end of a network segment that provides bias voltages for the CAN High and CAN Low signals and the common mode impedance termination for the respective conductors.

3.1.12 Tractor Network

Network segment that connects mainly tractor mounted ECUs including power train modules.

3.1.13 Tractor ECU

Standardized network interconnect device between tractor network and implement network.

3.1.14 Virtual Terminal

An ECU, consisting of a graphical display and input functions, which provides the capability to display information to and retrieve data from an operator for a connected implement or Working Set.

3.2 ABBREVIATIONS

Abbreviations are defined in SAE J1939 for use in the context of this document.

A&F Agricultural and Forestry - A&F networks are those that are governed by this document and by ISO 11783
CA Controller Application
ECU Electronic Control Unit. Any of a number of electronic modules contained in a machine that communicates with other ECU's via the SAE J1939 network standard.
ETP Extended Transport Protocol
FMIS Farm Management Information System
ISO International Organization for Standardization
ISO/TC 23/SC 19/WG 1 International Organization for Standards, Technical Committee 23, subcommittee 19, working group 1- the group responsible for maintaining the ISOBUS protocol standard for A&F networks
NMEA National Marine Electronics Association
SAE Society of Automotive Engineers
SPN Suspect Parameter Number
T&B Truck and Bus
TBC Termination Bias Circuit
VT Virtual Terminal
XML eXtensible Markup Language

4. DOCUMENTATION STRUCTURE

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

Agricultural and forestry CAN communication networks are defined and standardized based upon the SAE J1939 T&B standard and further elaborated in ISO 11783 to produce compatible networks. See section 5 for details of the working process between SAE and ISO working groups.

A subset of the SAE J1939 documents is applicable for forestry and agricultural equipment. A combination of the SAE J1939 and ISO 11783 documents completely specifies the agricultural and forestry off-road control and communications networks. The series of documents applicable for agricultural and forestry equipment are listed in Table 1. Some information relating to foundation principles on which the networks operate are contained in both sets of documents. Other information relating to A&F application specific features and services are contained only in the ISO documents.

Section 6 of this document summarizes the major points about each of the documents listed above. Additionally, section 7 gives some guidance for those familiar with SAE J1939 who may want to design ECUs that will also be compatible with the Ag and Forestry networks described here.

TABLE 1 - A&F APPLICABLE DOCUMENTS

SAE Document	ISO Document	Summary
SAE J1939 Top Level Document	N/A	This top-level document describes the network in general and its appendices include pre-assigned NAMES, preferred addresses, PGNs and suspect parameters.
SAE J1939-02 Agricultural and Forestry Off Road Machinery Control and Communication Network	ISO 11783 Part 1 General Standard	The application layer for off-road equipment being described in this document. A primary intent of this document is to describe the A&F network and the harmonization of SAE and ISO standards that results in a complete network definition. This standard specifies a serial data network for control and communications on forestry or agricultural tractors, mounted, semi-mounted, towed or self-propelled implements. Its purpose is to standardize the method and format of transfer of data between sensors, actuators, control elements, information storage and display units whether mounted on or part of the tractor, or any implements.
No SAE equivalent. See ISO Document	ISO 11783 Part 2 Physical Layer	The agricultural implement network physical layer consists of a 250 K bit/s, twisted, non-shielded, quad-cable physical layer and active terminators. This physical layer is unique to A & F. ECUs designed for the T &B networks are compatible with this physical layer.
SAE J1939-13 Diagnostics Connector	Included in ISO 11783 Part 2	The Off-Board Diagnostic connector used on the vehicle to get access to the vehicle communication links. A & F networks use the type 1 connector for 250K baud.
SAE J1939-14 Physical Layer, 500Kbps	No ISO equivalent. See SAE Document.	500k baud currently not used in A & F networks
SAE J1939-21 Data Link Layer	ISO 11783 Part 3 Data Link Layer	These documents describe the use of the CAN 29 bit identifier and the basic transport protocol mechanism.
SAE J1939-31 Network Layer	ISO 11783 Part 4 Network Layer	These documents describe the network layer, which defines the requirements and services needed for communication between electronic control units in different segments of the off-road network. The various types of network interconnection unit are defined. The ISO document includes a powerful capability allowing connections to be established between networks with separate address spaces.
SAE J1939-71 Application Layer	ISO 11783 Part 8 Powertrain Messages	These particular standards contain the Messages required by tractors and self-propelled implements on the powertrain or tractor network.
No SAE equivalent. See ISO Document	ISO 11783 Part 7 Implement Messages Application Layer for Agriculture	This part of ISO 11783 describes the tractor-implement specific messages application layer of the network, specifying the message set and defining the messages used for communication with and between tractors and connected implements.
No SAE equivalent. See ISO Document	IISO 11783 Part 6 Virtual Terminal	This part of ISO 11783 describes a universal Virtual Terminal that can be used by an operator to interface with both tractor and implement electronic control units.
SAE J1939-73 Diagnostics Application	IISO 11783 Part 12	The diagnostics application layer.
No SAE equivalent. See ISO Document	ISO 11783 Part 9 Tractor ECU	This part of ISO 11783 describes the tractor ECU, the electronic control unit that provides the gateway between the network's tractor and implement networks, as well as performing other tractor functions.
No SAE equivalent. See ISO Document	ISO 11783 Part 10 Task Controller	This particular standard describes the Task Controller Applications Layer, which defines the requirements and services needed for communicating between a task controller in the system and electronic control units of one or more implements. The data format to communicate with the farm management computer, the calculations required for control and the message format sent to the ECU are defined in this document.
No SAE equivalent. See ISO Document	ISO 11783 Part 11 Mobile Data Element Dictionary	This particular standard describes the Data Elements that are used by the Process Data Messages as defined in Part 10 of this standard. This data dictionary information is available as an online data base.
No SAE equivalent. See ISO Document	ISO 11783 Part 13 File Server	This particular document section describes a File Server capability for use by tractors and self-propelled implements for storage of large amounts of data for other devices on the network.

SAE Document	ISO Document	Summary
SAE J1939-74 Application Layer – Configurable Messages	No ISO equivalent. See SAE Document.	An application layer that allows users to use parameters that have previously been identified as configurable to be packed into messages in a proprietary manner for optimizing network performance. Parameters from other SAE J1939 documents are not to be sent via the configurable messages. Configurable messaging is not allowed on ISOBUS (implement network) but could potentially be used on the tractor network or on a closed system network.
SAE J1939-75 – Generator Sets and Industrial	No ISO equivalent. See SAE Document	An application layer with messages dealing with stationary equipment and generator sets.
SAE J1939-81 Network Management	ISO 11783 Part 5 Network Management	These documents describe the management of source addresses for electronic control units, the association of addresses with the control functions , response to brief power outages, and minimum requirements for network-connected electronic control units
SAE J1939-82 – Compliance	No ISO equivalent. See SAE Document	A testing plan and a set of requirements that need to be met for each SAE J1939 document or layer.

5. STANDARDIZATION PROCESS WITH REGARD TO AG AND FORESTRY NETWORKS

SAE J1939 and ISO 11783 Task Forces originally worked in parallel with overlapping memberships to insure that Ag and Forestry networks were compatible with SAE J1939 networks. This allows the controller hardware and much of the software drivers for both networks to be the same. This section documents the process followed to maintain continued compatibility between T&B and A&F networks.

5.1 Communication and Administration

Any person may make requests to the SAE J1939 committee. SAE J1939 identifies, when possible, requests that are Ag and Forestry related and asks that they be reviewed by ISO/TC23/SC19/WG1 first. Any needed requests are then made of SAE J1939 for numerical assignments.

ISO/TC23/SC19WG1 confines its work to the Ag and Forestry applications and whenever possible directs requests for powertrain or other general purpose usage to SAE J1939. However this does not limit ISO/TC23/SC19WG1 from considering those requests and passing along its recommendations to SAE.

Overlapping membership between groups periodically reviews documents with the goal of harmonizing items of shared interest.

Typical processes for creating compatibility between networks are described in the following sections.

5.2 Messages

29 bit message identifiers are used and definitions for bits and bit fields for priority, page, PDUF, PDUS, and source address are common. Assignments for PGNs are made from a common space by SAE J1939. Requests to SAE J1939 for Ag and Forestry related assignments are made by ISO/TC23/SC19WG1 when they have completed their own vetting and approval process.

A common assignment space for all PGNs, SPNs, NAME fields, FMIs, etc. is used and managed by SAE J1939 so there are no duplicate or conflicting assignments. The shared goal is that ECUs that are connected to either type of network will not behave unpredictably due to misinterpretation of messages.

Many of the messages defined in SAE J1939-71 application layer are intended to be used unchanged in Ag and Forestry networks. These include powertrain control messages, vehicle lighting control messages, joystick and other human machine interface messages, and hydraulic control messages.

Some of the Ag and Forestry messages are identified by name and PGN only in the SAE J1939 documents with the full description and behavior fully documented in the ISO 11783 documents.

5.3 Parameters

Both entities use common slot definitions for example use of error bit regions and “not available” codes for each slot size and type.

ISO 11783 approves message definition and parameter definitions for agricultural and forestry applications. These are submitted to SAE J1939 and usually accepted without modification. The SPN and PGN (titles) are then assigned numbers by SAE J1939 and listed with all other such items in the SAE J1939 documents and database. One exception is that Agricultural NAMES are assigned numbers by ISO 11783. These are communicated to SAE J1939 and included in the database periodically.

5.4 Additional items

Use of NAMES for address arbitration shall follow the same rules so controllers can exist cooperatively on the same network. ISO/TC23/SC19/WG1 assigns numerical values for functions in industry group 2 – Agriculture. The lower 128 functions are shared among all industry groups are harmonized. The upper 128 functions are specific to the industry and vehicle system. For industry group 2 these upper functions are assigned by ISO/TC23/SC19/WG1 for each of its vehicle systems.

SAE J1939 contains assigned values from ISO 11783 in a summary form but does not contain detail and usage rules for those items.

6. TECHNICAL REQUIREMENTS

6.1 Network Description

Networks may consist of one or more connected network segments based on the SAE J1939 component documents specified in Table 1.

Figure Figure 1 depicts a typical network that may be found on a tractor and connected implements. This particular network has three network segments, the tractor network segment interconnecting components on the tractor, the implement network segment interconnecting the implement and tractor, and an implement sub-network segment connected to the implement network by a bridge. At least one of the network segments shown is required to form a network, but in most systems, at least the tractor and implement network will exist.

Each of the boxes depicted in Figure 1 represents an ECU. Several of the ECUs in Figure 1 require significant standardization and are described further in documents that are a part of this series. Those ECUs include:

1. The virtual terminal described in ISO 11783 Part 6

2. The tractor ECU described in ISO 11783 Part 9

3. The task controller described in ISO 11783 Part 10

4. The engine controller as described in SAE J1939-71.

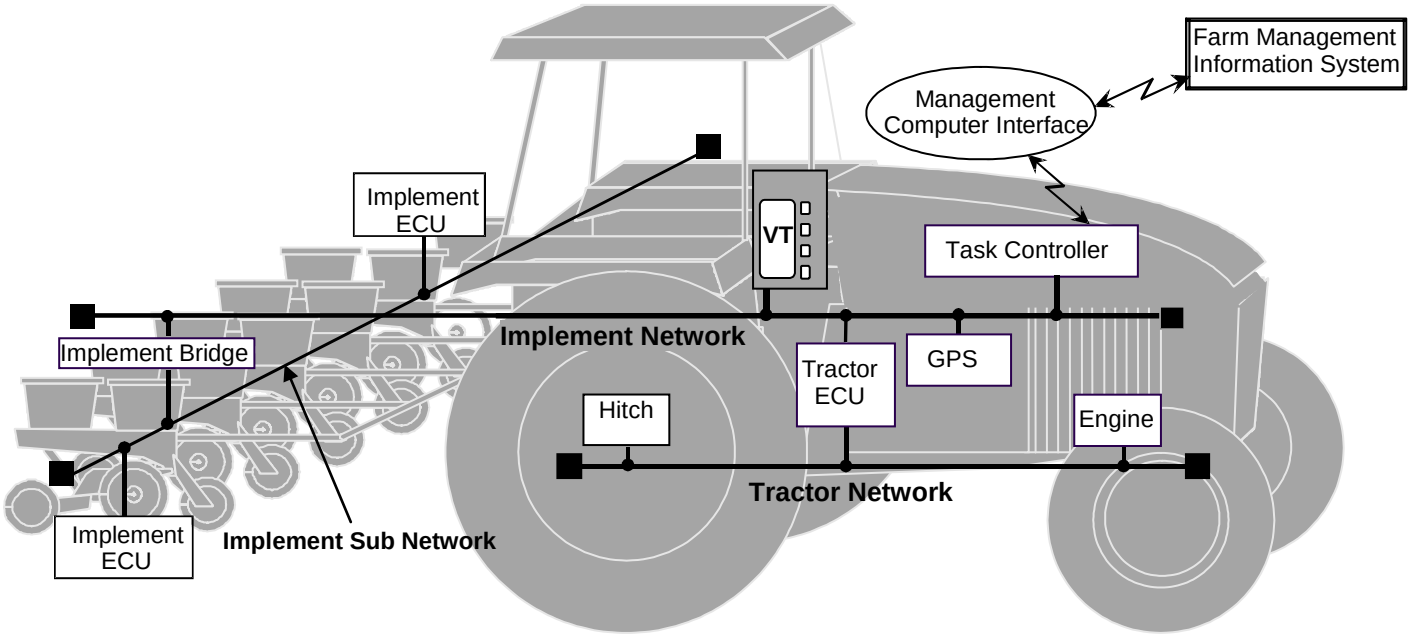

FIGURE 1 - A TYPICAL NETWORK TRACTOR NETWORK, IMPLEMENT NETWORK AND IMPLEMENT SUB-NETWORK

6.2 Physical Layer

ISO 11783 Part 2 describes the physical layer intended for use in this network. The document identifies the media as an unshielded twisted quad cable with characteristic impedance of 75 Ω as well as the connectors and signaling for the network. Users should refer to ISO 11783 Part 2 for required connectors and placement. A diagnostic connector is required as a part of the network. The required diagnostic connector is defined in SAE J1939-13. Required placement for the diagnostic connector is provided in ISO 11783 Part 2. Both Tractor Network and Implement Network segments are present in the diagnostic connector.

This physical layer design is not shielded but instead requires that signal transition times on the CAN lines be controlled to limit radiated emissions. The slope on bit rise and fall times of 200 ns nominal, 100 ns minimum and 500 ns maximum are the same as specified for SAE J1939.

This network requires active termination. These Termination Bias Circuits (TBCs) are required at each physical end of the network to provide the electrical bias and common mode termination needed to suppress reflections.

The CAN bit sample point for ISO 11783 is 80% ± 3% of the bit time, referenced to the start of the bit time". This differs from the Truck and Bus standard of SAE J1939-11 whose sample point is "as close to but not greater than 7/8 (87.5%) of a bit time".

When a network is extended, for instance by connecting an implement to a tractor, the TBC in the breakaway (implement) connector must be removed since the connector is no longer the physical end of the network. The implement now provides the TBC at the end of the network, which may be another breakaway connector at the back of the implement.

6.3 Data Link Layer

SAE J1939-21 describes the data link layer intended for use in this network. Major items include:

- The use of the 29-bit identifier, the protocol data units, message priority and source address fields are described.
- The transport protocol method for handling messages with more than 8 bytes is defined. Both broadcast and connection management forms of transport protocol are supported. These mechanisms are limited to transporting data objects between 9 and 1785 bytes.

SAE J1939-21 specifies that the ACK in response to a REQUEST message must use the global response regardless of how the request was made. Additional data link features supported in this Off Road Machinery Control and Communications Network are:

- NMEA2000 messages that carry GPS information are used in some off-road machines to enable navigation features. For NMEA2000 navigation messages on the implement network, the Fast Packet method may be used so as to reduce the inter-frame time. The definition of Fast Packet is found in the NMEA2000 Standard. This mechanism is limited to transporting data objects between 9 and 223 bytes.
- An additional “extended” transport protocol (ETP) mechanism is prescribed in ISO 11783 Part 6. This ETP allows ECUs to transport data objects up to 117M bytes in size. This capability is often needed to handle the Virtual Terminal data objects.
- ISO 11783 part 3 does not require the ACK in response to a REQUEST message to be global but provides rules for response to requests based on request type.

ISO 11783 Part 3 is harmonized with SAE J1939-21.

6.4 Network Layer

SAE J1939-31 and ISO 11783 Part 4 are harmonized and describe the network layer intended for use in this network. Various types of network interconnect units are possible. Filtering, forwarding and repackaging of messages are possible. There is also a means of node identification for units connected on another port of the network interconnect unit.

Messages exist to allow the filter database for a network interconnect unit to be configured for different types of message passing and for performance metrics to be accessed.

The physical layer timing requirements of ISO 11783 Part 2 prevent the effective use of repeaters. Since the ISO 11783 network has a sample point of 80 % of the bit time and allows a transition time equal to ¼ bit time, true repeaters cannot be used. Repeaters should not be used to extend the implement network.

ISO 11783 Part 4 has an added capability that allows tools or controller applications to “navigate” across gateways to network segments with different address spaces. It does this through a mechanism for establishing connections to the desired controller application in the other address space. The connections use a virtual address on the local network to “map” to the appropriate address in the other address space. The gateway forwards messages to or from these virtual addresses. This allows systems to be designed with more than 250 network nodes. It also allows subsystems to exist in near isolation of other subsystems yet allow diagnostic or other communication when needed.

6.5 Application Layers

Several application layers are defined for use in this network.

SAE J1939-71 describes messages for general-purpose use and messages for use on the tractor network.

SAE J1939-73 defines diagnostics for the network.

ISO 11783 part 6 defines messages and behavior for Virtual Terminal. See section 4.7.

ISO 11783 part 10 defines messages and behavior for Task Controller. See section 4.9.

ISO 11783 parts 7, 10 and 11 define messages and behavior for Management Computer interface. See section 4.10.

Additionally any of the other SAE J1939 application layers may be potentially useful and may be used in A & F networks as needed.

SAE J1939-74 Application - Configurable Messaging

SAE J1939-75 Application Layer - Generator Sets and Industrial

6.6 Network Management

SAE J1939-81 describes the management layer intended for use in these networks. A more rigorous requirement for survival of power glitches is imposed for agricultural and forestry machines and implements beyond that existing in SAE J1939-81. These requirements are defined in ISO 11783 Part 5 and summarized in the following paragraphs.

6.6.1 Power Supply Disturbances

ECUs on an ISO 11783 network should be able to handle voltage transients and interruptions. Reactions to voltage disturbances of different durations should be processed as detailed in the following clauses. The times are defined for transients and interruptions that occur from the nominal specified supply voltage for the ECU.

6.6.1.1 Ten milliseconds or Less Transients and Interruptions

If normal power (ECU_PWR) is restored within 10 ms and if interruptions are spaced at least 100 ms apart then the ECU should have no occurrences of:

- Loss of normal network communications nor loss of in-process messages
- Processor reset
- Loss of data in volatile memory, including network configuration information and/or messages in progress over the network

6.6.1.2 Greater Than One Second Transients and Interruptions

If normal power is not restored within 1 s then the ECU must reset and complete a Power On Self Test (POST).

6.6.1.3 Greater Than Ten milliseconds and Less Than One Second Transients and Interruptions

If power is disrupted for greater than 10 ms but less that 1 s, internal requirements of the ECU will determine if a reset is required or is not required.

6.6.2 Working Sets

Groupings of ECUs, called working sets, as described in SAE J1939-81 Network Management, are likely to be used extensively in Agricultural networks in order to create distributed control over agricultural implements connected to tractors.

6.6.3 NAME Assignment

The use of NAMEs and Source Addresses described in SAE J1939-81 applies to SAE J1939-02 networks.

On the implement network (ISOBUS) arbitrary address capability is required. Implement control functions are required to be self-configuring because they can be attached to an already operating network. Presently, the Ag/Forestry Preferred Source Address table (SAE J1939, Table B4) is controlled by ISO 11783 and no additions are allowed.

- The NAMES for Agricultural and Forestry devices are selected from tables maintained by ISO 11783 in an appendix and are referred to as the B tables. These names are mirrored in SAE J1939 Appendix B12, Industry Group 2.

6.6.4 Initialization Processes

Due to the potentially high number of ECUs present on agricultural systems, two initialization items are emphasized here:

1. Multiple identical CAs are possible on an implement, for instance for “per row” monitors or controllers. This possibility creates the potential for destructive message collisions during the address claim process. To remedy this situation, special processing rules during power up initialization are outlined in SAE J1939-81 section 4.4.3.3. The processing includes delaying any retries of any failed address claim messages by a pseudo random delay of between 0 and 153 msec.

2. Since arbitrary address capability is required on the implement network, it is also a requirement for the CAs to maintain a table correlating NAMEs to source addresses and to use this table to associate transmitted and received messages with the correct CA. See SAE J1939-81 section 4.5.6.

6.6.5 Implement Instance Initialization Processes

When assigning instances to implements to precisely specify an implement location, the rule is to number from left to right followed by front to rear followed by bottom to top. See ISO 11783 Part 7 section A.25.6.

6.7 Virtual Terminal

A standard for a virtual terminal is provided in ISO 11783 Part 6. The VT is an electronic unit that provides a standardized operator interface to a system. The VT provides operator input and output capabilities in a single electronic unit. The VT is shown in Figure 1 attached to the implement network. Tractor ECUs or other ECUs within the tractor connected to the implement network may utilize the VT by the same method as an implement ECU.

6.8 Tractor ECU

The Tractor ECU provides a communications link between the Implement Network and the Tractor Network and acts as a network interconnection unit to assure both electrical and message isolation.

This ECU is used to represent the tractor in communications on the Implement Network. Messages sent from any ECU on the Implement Network that may need to be directed to an ECU residing on the tractor should be sent to the Tractor ECU and any messages sent to ECUs on the Implement Network from Tractor ECUs must use the source address of the Tractor ECU. The network interconnection unit must provide appropriate acknowledgments or responses to the requesting or commanding ECU.

Three classes of Tractor ECU capability have been defined. Each class must support a minimum set of messages including all the messages of the next lower class. Details of the Tractor ECU and lists of the required messages for each class are found in ISO 11783 Part 9. The required messages are described in detail in ISO 11783 part 7.

6.9 Task Controller

Task controllers provide control via the ISO 11783 network. Task data received via the Management Computer Interface is stored in the task controllers. These tasks are scheduled by the task controller, which sends control messages to the appropriate ECUs for execution. The task controllers can also record data received from ECU as tasks are being completed. This data can be transferred to the Management Computer through the Management Computer Interface. The operation of the task controller and the format of messages sent and received from ECUs is detailed in ISO 11783 Part 10.

6.9.1 Object Reference Structure

The object reference structure describes the method that a task controller uses to refer to a particular controlled section of an implement. This structure is used not only to allow set points to be sent to objects on an implement but also to allow objects to send actual values back to the task controller.

6.10 Management Computer Interface

Though the physical interface between the Farm Management Information System and the vehicle is not specified in this standard, the messaging is defined in ISO 11783 Part 10 Task Controller. Information about tasks to be performed by the vehicles' ECUs is transferred in XML format from the farm management system to the task controllers. The task controllers then parse the information using the Process Data message described in ISO 11783 Part 7 Implement Messages Application Layer for Agriculture and whose elements are described in ISO11783 Part 11 Mobile Data Element Dictionary.

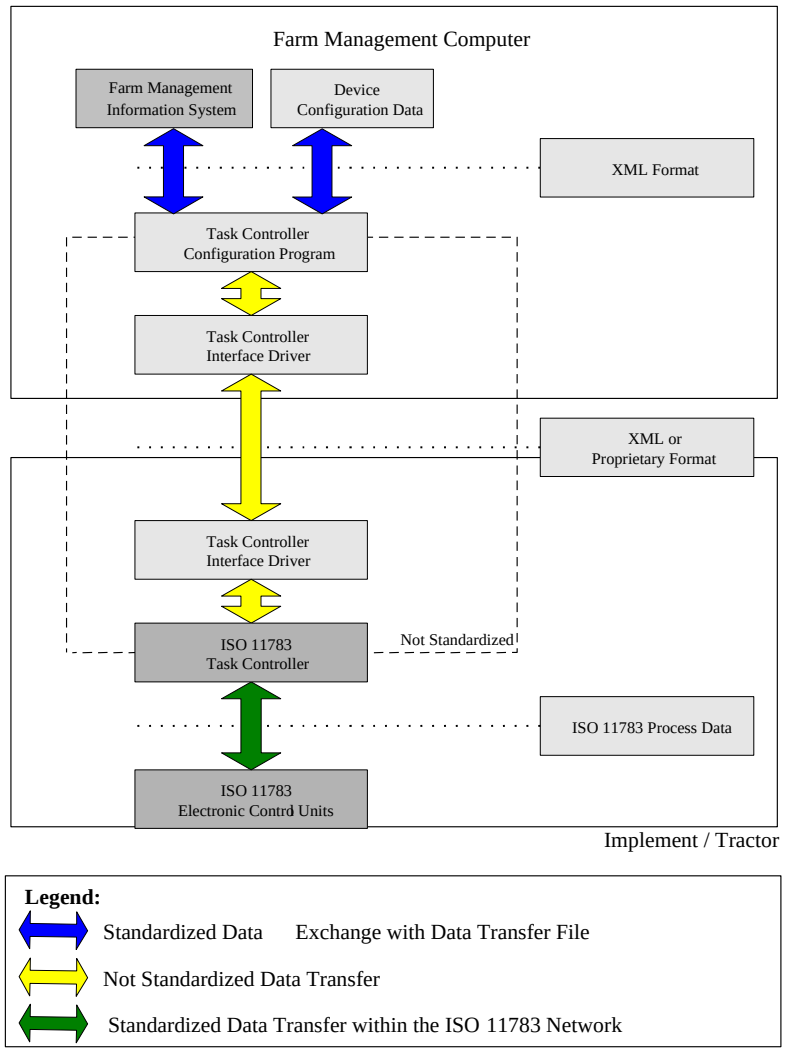

FIGURE 2 - MANAGEMENT COMPUTER INTERFACE

7. DESIGNING A&F NETWORKS

For those familiar with J1939 T&B networks this section summarizes some of the key points made so far in this document that must be kept in mind when creating ECUs and networks that will comply with this A&F application network standard.

7.1 Network interface

The electronic circuit design for an ECU designed to meet SAE J1939-11 or SAE J1939-15 requirements will also work in an A&F network. This includes rise and fall times. The A&F network media has a characteristic impedance of 75 Ω instead of the 120 specified for T&B networks. Many modern CAN transceivers work over this range of impedances.

The power supply interruption requirement in section 4.6.1.1 of this document requires that an ECU not lose messages or even reset for up to a 10 ms power interruption as opposed to the minimum of 2 ms specified for T&B networks. This more severe requirement is meant to address the potential for such interruptions to occur across the tractor/implement interface connector.

7.2 Low level CAN drivers

A small but important difference exists in the sample time specification of the bits. SAE J1939 specifies the sample point to be as close to but no greater than 87.5% of the bit time. The A&F specification is as close to but no greater than 80% of the bit time. This requires calculating the clocking and timing parameters and setting the bit timing registers appropriately.

7.3 High level protocol items

Use of arbitrary address capability is mandatory on the A&F network. This requirement simplifies the integration of multiple implements and implement subsystems. It also eliminates the need to assign and maintain preferred address tables. However, this requirement implies that the NAME address table must be built and maintained by each ECU.

8. NOTES

8.1 Marginal Indicia

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 J1939 TRUCK AND BUS CONTROL AND COMMUNICATIONS NETWORK COMMITTEE OF THE SAE TRUCK AND BUS ELECTRICAL AND ELECTRONICS STEERING COMMITTEE