

J1939 Protocol

The SAE J1939 set of profiles is based on the Controller Area Network (CAN) data link layer (ISO 11898-1) using the extended frame format (29-bit identifiers). Several documents have undergone revision after the initial publication in 1998. The specifications have been added to, parts taken off and clarified. The set of specifications, include:

- J1939/11 Physical Layer (250 kbit/s, shielded twisted pair)
- J1939/12 Physical Layer (twisted quad of wires and active bus termination)
- J1939/13 Off-Board Diagnostic Connector
- J1939/15 Reduced Physical Layer (250 kbit/s, unshielded twisted pair)
- J1939/21 Data Link Layer
- J1939/31 Network Layer
- J1939/71 Vehicle Application Layer
- J1939/73 Application Layer Diagnostics
- J1939/81 Network Management

The naming of the layers is not always compliant to the OSI reference model and to CiA's recommend terminology. The J1939/21 and J1939/31 define partly an application layer, and the J1939/71 and J1939/73 specify an application profile.

SAE J1939/11

This physical layer specification is based on the ISO 11898-2 standard (high-speed CAN physical layer). It defines a single, linear, shielded twisted-pair of wires running around the vehicle linking each of its ECUs together. The topology is supposed to be a linear bus running at 250 kbit/s with termination resistors to reduce reflections.

A J1939 network can be made of multiple bus sections, each one linked with a bridge. The main function of the bridge is to provide electrical isolation between different segments so that electrical failure of one system will not cause such failure to an adjacent system. For example, the failure of the CAN/J1939 system on the trailer should not cause the failure of the truck's tractor main CAN/J1939 control system. The maximum number of ECUs is 30, and the maximum bus length is 40 m.

SAE J1939/21

The SAE J1939/21 is the heart of the J1939 set of specifications. It describes commonly used messages such as Request, Acknowledgement, and Transport Protocol messages. The Transport Protocol specifies the breaking up of large amounts of data into multiple CAN-sized frames, along with adequate communication and timing to support effective frame transmission between nodes. Slight modifications have added flexibility to the Transport Protocol, allowing the sender (server) of data to specify the number of CAN frames to be sent at any one time. Previously, this number was greatly determined by the receiver's (client's) limitations in the number of frames it could receive.

The 29-bit identifier comprises the following sub-fields: priority, reserve, data page, PDU format, PDU specific, and source address. The source address field ensures unique CAN identifiers, so no two nodes can ever transmit the very same CAN identifier. In the beginning, J1939 grouped several parameters (signals) together into a Parameter Group (PG). Each PG was then assigned a number: its PGN (Parameter Group Number). The PGN

identifier contained a reserve bit, a data page bit, a PDU format field, and a PDU-specific field. This structure has since caused some confusion with regard to PDU1-type (destination-specific) messages. Since the PDU-specific (group extension) field becomes the Destination Address in a PDU1 message, the question arose if the PGN changes, which it does not. The PGN is a static number referring to the data being transmitted and should be considered independently of the CAN identifier.

SAE J1939/31

This specification describes bridge functionality, how CAN messages from one network to another are transferred. The message filter function in the bridge reduces the transmission of CAN messages in the individual network segments.

SAE J1939/71

The so-called application layer (in CiA terms it is an application profile), all parameters as well as assembled messages called parameter groups are specified. Each CAN message is referenced by a unique number, the PGN (parameter group number). The latest release of the J1939/71 document incorporates several approved additions, and brings the total number of defined messages up to almost 150.

New message additions support anti-theft, fuel-specific, turbocharger, ignition, and tire pressure functions, among others. These additions and enhancements include the addition of the "source address of controlling device" parameter to several engine, transmission and brake controller messages. Inclusion of this parameter in a message will allow the receiving device to identify the original source of the message (e.g., a particular device from a bridged network).

SAE J1939/73

Additions to the diagnostics document (J1939/73) involve memory access, start/stop functions, binary data transfer, security, and calibration information. Memory access is provided with security levels. The start/stop message is used during diagnostics performance, to stop other devices from broadcasting (including nodes providing bridges to other networks). Revisions of the J1939/73 document also provide clarification regarding DTC (diagnostic trouble code) encoding in the data field. This encoding, previously interpreted differently by various manufacturers, was standardized, utilizing the reserved bit as the Conversion Method (CM) bit.

SAE J1939/81

The J1939/81 Draft includes state diagrams for initialization and more clearly defines constraints on the use of addresses.

The J1939/82 Draft specifies the proper procedure for self-compliance and presents a scripting language that tightly defines compliance processes, and the J1939/83 Tutorial Draft provides an explanation of J1939.

For more detailed information please visit <http://www.simmasoftware.com/j1939.html>