The Engineering Society For Advancing Mobility Land Sea Air and Space®
INTERNATIONAL
400 Commonwealth Drive, Warrendale, PA 15096-0001

SURFACE VEHICLE INFORMATION REPORT

SAE J1213-1

REV. SEPT1997

Issued 1988-04
Revised 1997-09

Superseding J1213-1 JUN91

Submitted for recognition as an American National Standard

(R) Glossary of Vehicle Networks for Multiplexing and Data Communications

1. ***Scope—***This document covers the general terms and corresponding definitions that support the design, development, implementation, testing, and application of vehicle networks.

The terminology also covers some terms and concepts of distributed embedded systems, network hardware, network software, physical layers, protocols, and other related areas.

1.1 **Objective—**This document aims at being a common reference of terminology, fundamental concepts, abbreviations, and acronyms used to support vehicle networking technology.

2. ***References***

2.1 **Applicable Publications—**The following publications form a part of the specification to the extent specified herein. Unless otherwise indicated, the latest revision of SAE publications shall apply.

2.1.1 SAE PUBLICATIONS—Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

SAE J1708—Serial Data Communications Between Microcomputer Systems in Heavy-Duty Vehicle Applications
SAE J1850—Class B Data Communication Network Interface
SAE J1930—Electrical/Electronic Systems Diagnostic Terms, Definitions, Abbreviations, and Acronyms
SAE J1939—Serial Control and Communications Vehicle Network
SAE J1939-71—Vehicle Application Layer
SAE J1962—Diagnostic Connector
SAE J1978—OBD II Scan Tool
SAE J1979—E/E Diagnostic Test Modes
SAE J2178—Class B Data Communication Network Messages
SAE J2178-1—Class B Data Communication Network Messages—Detailed Header Formats, and Physical Address Assignments
SAE J2178-3—Class B Data Communication Network Messages—Part 3—Frame IDS For Single-Byte Forms of Headers
SAE J2178-4—Class B Data Communication Network Messages—Message Definitions For Three Byte Headers
SAE J2190—Enhanced E/E Diagnostic Test Modes

QUESTIONS REGARDING THIS DOCUMENT: (724) 772-8512 FAX: (724) 776-0243
TO PLACE A DOCUMENT ORDER; (724) 776-4970 FAX: (724) 776-0790
SAE WEB ADDRESS http://www.sae.org

2.1.2 CALIFORNIA CODE OF REGULATIONS—Available from State of California.

California Code of Regulations, Title 13, 1968.1—Multifunction and Diagnostic System Requirements, 1994 and Subsequent Model-Year Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles with Feedback Fuel Control Systems

2.1.3 ISO PUBLICATIONS—Available from ANSI, 11 West 42nd Street, New York, NY 10036-8002.

ISO 9141—Road vehicles—Diagnostic systems—Requirements for interchange of digital information
ISO 14229—Road vehicles—Diagnostic systems—Diagnostic services specification
ISO 14230-1—Road vehicles—Diagnostic systems—Keyword protocol 2000—Part 1: Physical layer
ISO 14230-2—Road vehicles—Diagnostic systems—Keyword protocol 2000—Part 2: Data link layer
ISO 14230-3—Road vehicles—Diagnostic systems—Keyword protocol 2000—Part 3: Application layer
ISO 15031-3—Diagnostic connector and related electrical circuits: specification and use
ISO/IEC 9646—Information technology—Open systems interconnection—Conformance testing methodology and framework

3. Definitions

3.1 A Priori Knowledge—Knowledge about future behavior of a system that is known or available ahead of time.

EXAMPLE 1—A node which knows that a missing periodic or repetitive message is expected can automatically invoke an alternate strategy, based on this "a priori knowledge."

EXAMPLE 2—In a Time-Triggered Architecture, the points in time when a node is supposed to send a message is known ahead of time.

3.2 A/C—Air Conditioning

3.3 ABS—Antilock Braking System

3.4 ACK—Acknowledgment

3.5 Acknowledgment—A type of response which is used to indicate whether a message has been received properly.

Acknowledgments can be positive, indicating the message was received, or negative, indicating the message was not received.

3.6 Acknowledgment: Application—A confirmation that the requested action has been understood and performed.

3.7 ACP—Audio Control Protocol, a Ford proprietary UART-based protocol

3.8 Active State—The electrical state of a bus wire which results when one or more nodes transmit the "dominant' bus condition by "turning on" their physical layer transmit circuit. Alternate names: Active, Dominant.

Refer to the designated physical layer specification for signal levels. For SAE J1850: This is Voh volts for bus + (PWM and VPW) and Vol volts for bus - (PWM only).

3.9 Address—A designated message field used to point at a network object, data variable, node, or module. A network address may be used to establish the source or destination of a message.

EXAMPLE—Network objects that may be assigned an address could include: an engine control module, a data variable "Engine RPM", a "Lock Door" command, etc.

3.10 Address Filtering—The ability to select a particular address or group of addresses based on user-established selection criteria or filtering technique.

3.11 Address Structure—The organization of network addressing that is used for a given protocol. The address structure is specific to a protocol.

EXAMPLE—SAE J2178 includes the address structure used for SAE J1850.

3.12 AM Band—The band of frequencies associated with the standard broadcast Amplitude Modulation Stations (i.e., 535 kHz to 1.605 MHz).

3.13 Analog Actuator—Class A analog actuators convert some continuously varying output characteristic such as a continuously varying output value or magnitude.

Although the communicated value may or may not be digitally encoded, the action taken is intended to provide a continuous range.

An example of this is the flapper position in the heat exchanger. The actuator has a continuum of positions between a maximum and minimum value.

3.14 Analog Resolution—Analog resolution requirement is the largest level change that cannot be perceived by an occupant or operator. The analog resolution of the system should not allow the occupant to perceive discrete change.

EXAMPLE—"Opera Dimming" is an analog function. It can be achieved with discrete drive level changes that appear to the occupant as continuous dimming.

The discrete drive resolution of this actuator should resolve to a level that is finer than required by the analog resolution of the function.

3.15 Analog Sensor—A sensor that converts some measured continuously varying input characteristic as a continuously varying output value or magnitude.

The sensor has a maximum and minimum measurable input range that corresponds to a maximum and minimum output represented value.

3.16 Application/Affiliation—The application section briefly identifies the applications for which the protocol was designed to serve (e.g., military, aircraft, industrial, land, vehicles, trucks).

The affiliation section identifies the organization(s) that originally developed or specified the protocol or which now endorse the protocol. If hardware is available, this section should detail the components and manufacturer.

3.17 Application-To-Application Delay Time—Delay time in a communication network, starting at the request for transmission and terminating at the presentation of the transferred information to the respective application(s).

3.18 Application Layer—Provides access to the OSI environment for users and also provides distributed information services.

3.19 Application Process—A specific grouped set of actions performed by a system, subsystem, module, or component to handle a designated task or set of tasks.

3.20 Application Software—A software implementation that supports all required module processing activities.

Refers to the microprocessor programming that controls the external equipment/scan tool hardware so as to perform required SAE J1978 OBD II Scan Tool functions.

3.21 Application Specific Network Requirements—A document of specific rules that applies to all implementations that use the designated network protocol for the named application.

3.22 Arbitration—If two or more senders start transmitting messages at the same time, the media access conflict is resolved either by a nondestructive bitwise collision avoidance algorithm or by a collision resolution method.

For SAE J1850: The process of resolving which frame, or In-Frame Response data, continues to be transmitted when two or more nodes begin transmitting frames, or In-Frame Response data, simultaneously.

3.23 Arbitration-Based Protocol—A form of contention-based protocol where contention is evaluated bit-by-bit.

Arbitration-based protocols typically require that the physical length of the signal bus be sufficiently short such that the propagation time for signal transmission is significantly less than one information bit time.

A form of contention-based protocol where contention is evaluated bit-by-bit.

3.24 Arbitration Field—Bits within the message frame attributed to each message for controlling the arbitration.

3.25 Architecture—The organizational structure of vehicle multiplex network, mainly referring to the application structure and communications protocol.

3.26 ASC—ASCII Encoded SLOT

3.27 ASCII—American Standard Code for Information Interchange

3.28 ASR—Acceleration Slip Regulation (Traction Control)

3.29 Asynchronous Communications—Asynchronous Communications is a method of moving serial data that uses a start bit and stop bit of a designated bit duration which synchronizes the transmitting and receiving stations.

3.30 Audio Control Protocol—A two-wire UART-based serial communication network solution that operates at 9.7K bits/second. ACP is Ford's Audio Control Protocol.

3.31 Availability—The decimal fraction of the time during which a system is capable of performing its required functions.

3.32 AWG—Arbitrary Waveform Generator, American Wire Gauge.

3.33 Bandwidth—Network bandwidth is a measurement of the utilized capacity of a network. Typically indicated as a percentage and measured over some designated period of time.

3.34 Base Vehicle Wiring—The wiring structure associated with a vehicle that contains a minimum number of electrical and electronic components, i.e., a vehicle without any optional features.

3.35 Baseband—The band of frequencies occupied by unmodulated signals. The ratio of the information bandwidth (upper limit minus the lower limit of the frequency band) to the center frequency is typically larger than unity.

3.36 Baseband Communications—A communications method in which the transmitted signal is in its unmodulated form and not changed by modulation.

3.37 Baud Rate—An information signal transfer rate, measured in baud which is signal transitions per second. Baud rate is slowly being replaced by the designation Bit Rate.

3.38 BCD—Binary Coded Decimal

3.39 Binary Resolution—Binary resolution is the number of bits, in base 2, required to represent the full scale value of a data variable.

3.40 Bipolar Data—Data that is driven both positively and negatively from a common point such as a reference voltage or ground (0) potential.

3.41 Bit—Binary Digit. A single unit of binary information which has only two states. A bit may be used to indicate Yes/No, On/Off, or True/False.

3.42 Bit Encoding—A method in which the informational or logical bits, 1's and 0's, are translated into signals on the transmission medium by the physical interface (e.g., NRZ, PWM, VPW, Manchester).

3.43 Bit Rate—Number of bits transferred per time period during a network transmission, independent of bit representation. The bit rate is usually expressed in BPS or Bits Per Second.

3.44 Bit Stuffing—Technique used in bit-oriented protocols to provide edge transitions which are necessary to maintain synchronization when using a Non-Return-to-Zero bit encoding.

Whenever the transmitting logic encounters a certain number (stuff width) of consecutive bits of equal value in the data, it automatically stuffs a bit of complementary value—a stuff bit—into the outgoing bit stream.

Receivers destuff the frame by using an inverse procedure. For CAN: A method used to assure the transmitted and received messages maintain a minimum number of dominant to recessive edges, and vice versa, to maintain the proper resynchronization within the string of bits in a CAN Data Frame.

3.45 Bit Synchronized—Transmission of a frame in which the data bits are transmitted with the transmitter and receiver bit transitions aligned in time (synchronized).

3.46 Bit Time—The time duration of a single bit period for a given protocol. Depending on the protocol, a bit time may be of fixed duration or variable. Some protocols allow the bit timing to be adjustable (e.g., CAN).

Refer to the specific vehicle network's Physical Layer specification for a specific protocol bit time.

3.47 Bit Time Segment—A sub-division of a bit time.

EXAMPLE—The CAN protocol defines multiple bit time segments that are adjustable and used for bit sampling and re-synchronization.

3.48 Bitwise Arbitration—An arbitration method, whereby the individual bit collisions created by simultaneous access of multiple nodes on the network is resolved on a bit-by-bit basis.

Using media states of dominant and passive, the dominant bit transmitter will override all passive bit transmitters which are subsequently required to cease sending.

3.49 BMM—Bit Mapped with Mask (See SAE J2178.)

3.50 BMP—Bit Mapped without Mask (See SAE J2178.)

3.51 Bridge—For network-based systems, a device or node which moves messages between two physically separate networks that both use the same protocol.

3.52 BRK—Break

3.53 Broadband Communications—A communications method in which the transmitted signal is the original signal modulated onto a carrier. The form of modulation may be amplitude, frequency, or phase.

3.54 Broadcast Message—The transmission of information to more than one receiver as differentiated from node-to-node communications.

3.55 Broadcast Message—Any number of nodes can receive and simultaneously act upon the same broadcast message.

A type of message based only on the functional address of some system or subsystem entity.

3.56 Build-In Diagnostic Capability—An electronic device feature that requires the build-in test capabilities for the module, the module sensors, and module actuators.

3.57 Built-In Test—Test capabilities that are part of or internal to the device design.

3.58 Burst Noise—Unwanted electromagnetic disturbances that are manifested as relatively short period barrages (bursts) at random or repetitive rates.

3.59 Bus—A physical conductor used to transfer either power or data between two locations within an electrical system.

Topology of a communication network, where all nodes are reached by links, which allow transmission in both directions.

A network bus may be identified as a segment. See Segment (See SAE J1939.)

3.60 Bus – —A designated bus signal name used to identify a network wire. The minus "–" implies that the signal is negative, at ground, or more negative relative to the Bus+ signal in the "dominant" bus state.

3.61 Bus + —A designated bus signal name used to identify a network wire. The plus "+" implies that the signal is positive, at the power supply level, or more positive relative to the Bus– signal in the "dominant" bus state.

3.62 Bus Load: Maximum—The maximum allowable electrical impedance or load for a designated vehicle network.

3.63 Bus Signal: Names—A Bus Signal Name is the designated name assigned to a signal or wire of a network implemented using an electrical media. Multiple bus signal names usually have the "dominant" bus state as an attachment (e.g., Bus+ and Bus–, CAN_L and CAN_H).

3.64 Bus State—The logical or electrical state of the bus or transfer medium. For typical vehicle networks, one of two complementary states: "dominant" or "recessive".

3.65 Bus: Data—One or more physical conductors used to transfer data or information between two locations.

3.66 Bus: Power—One or more physical conductors used to transfer power between two locations.

3.67 Bus: Topology—A type of physical topology of a communication network, where all nodes are reached by passive links which allow transmission in both directions.

3.68 Busbar—A single conductor used to transfer power between two locations of an electrical system usually employed to deliver large current to electrical loads.

3.69 Bytewise Arbitration—An arbitration method, whereby the individual byte collisions created by simultaneous access of multiple nodes on the network are resolved on a byte-by-byte basis.

3.70 CAN—Controller Area Network. A protocol licensed by Bosch.

3.71 CARB—California Air Resources Board

3.72 Carrier—A wave suitable for modulation by an information bearing signal to be transmitted over a communications medium.

For a waveform to be considered to include a carrier, it shall have a separate carrier, as in amplitude and frequency modulation, rather than an inherent carrier, as in pulse width modulation.

3.73 Carrier Sense—Required for arbitration, the ability of a receiver to sense if another node is transmitting (providing a listen before talking capability) or to sense if any node is transmitting (adding a listening while talking capability).

3.74 Carrier Sense Multiple Access—An access method in which a node on a multiple node signal bus waits for an idle bus before attempting to transmit.

3.75 Carrier Sense Multiple Access with Collision Detection—A type of CSMA method in which a node that attempts to transmit and detects that another node is also transmitting will stop and delay a subsequent transmission for a time determined by a predefined arbitration algorithm.

3.76 CCD—Chrysler's Class B serial data communications protocol.

3.77 Centralized Control—An organization of a control system whereby a central control element exercises control over the remainder of the system (see also Master/Slave).

3.78 Certification—The act of certifying or the state of being certified; usually accompanied with an authoritative, written statement attesting that something has met a set of requirements.

3.79 Check Byte—An additional message field, usually a CRC or Checksum, that is used to increase the message transfer reliability. The CRC is statistically more robust and usually requires a hardware implementation.

3.80 Checksum—A simple computational algorithm applied to a data sequence that results in a value, the Checksum, which is included in a message to improve the transfer reliability. CRC is better.

A simple 8-bit summation of a series of bytes within a designated area of a message that are to be transmitted and subsequently checked by a receiver.

3.81 Class 2—The OEM specific name for General Motor's SAE J1850 protocol.

3.82 Class A Data Communication—A system whereby vehicle wiring is reduced by the transmission and reception of multiple signals over the same signal bus between nodes that would have been accomplished by individual wires in a conventionally wired vehicle.

The nodes used to accomplish mulitplexed body wiring typically did not exist in the same or similar form in a conventionally wired vehicle.

3.83 Class A Function—A distributed vehicle resident process or activity whose timing characteristic is governed by the expected response of a human.

Class A Functions are typically slow with response times that range in the 60 to 100 ms region with extended times to near 150 ms being acceptable on an infrequent basis.

3.84 Class A Network—A vehicle based multiplexing solution that handles the data transfers for a collection of Class A functions.

An example of a Class A Network may include both silicon-based mulitplexed solutions and software-based protocols such as ISO 9141.

3.85 Class A Sensors—A sensing, measuring, or input device usually classified into the areas of operator convenience, vehicle status, and vehicle message information for a monitored function.

They are characterized by moderate to slow times of being read and are non-time critical.

3.86 Class A System—A mulitplex system whereby vehicle wiring is reduced by the transmission and reception of multiple signals over the same signal bus between nodes that would have been accomplished by individual wires in a conventionally wired vehicle.

The nodes used to accomplish multiplexed body wiring typically did not exist in the same or similar form in a totally conventional wired vehicle.

3.87 Class B Data Communications—A communication system in which data variables are transferred between nodes to eliminate redundant sensors and other system elements.

The nodes in this form a multiplex system typically already existed as stand-alone modules in a conventionally wired vehicle. A Class B network may also be capable of performing Class A functions.

3.88 Class B Function—A distributed vehicle resident process or activity whose timing characteristic is governed either by a required moderate speed data transfer or by the expected response of a human.

Class B Functions have response times that depend upon the volume of network traffic, the expected human response time, and the amount of moderate speed data transfers.

3.89 Class B Network—A vehicle-based multiplexing solution that handles the data transfers for a collection of Class B functions.

Class B Network examples include all three SAE J1850 forms.

3.90 Class B System—A mulitplexed system where data, (e.g., parametric data values) is transferred between nodes to eliminate redundant sensors and other system elements.

The nodes in this form of a multiplex system typically already existed as stand-alone modules in a conventionally wired vehicle.

3.91 Class C Data Communications—A system whereby high data rate signals typically associated with real time control systems, such as engine controls and anti-lock brakes, are sent over the signal bus to facilitate distributed control and to further reduce vehicle wiring.

A Class C network may also be capable of performing Class A and Class B functions.

3.92 Class C Function—A distributed vehicle resident process or activity whose timing characteristic is governed by the response requirement of a high-speed control function (typically motion control).

Class C Functions are typically fast with response times that are dictated by the distributed high-speed control algorithm.

3.93 Class C Network—A vehicle-based mulitplexing solution that handles the data transfers for a collection of Class C functions.

An example of a Class C Network solution is the SAE J1939 CAN protocol.

3.94 Class C System—A multiplex system whereby high data rate signals typically associated with real-time control systems, such as engine controls and anti-lock brakes, are sent over the signal bus to facilitate distributed control and to further reduce vehicle wiring.

3.95 Class: Network—A hierarchical relationship exists between the classes of networks. By definition, Class C is a superset of Class B. Also, Class B is a superset of Class A.

It should be noted that this is a functional relationship only. Therefore, it is important to distinguish between the function and the application of the multiplex network.

3.96 Closed System—A system, consisting of nodes interconnected by a common communications medium (signal bus), which does not permit the easy addition of modules developed by another manufacturer and temporary connection to other networks, as in an open system.

3.97 Coaxial Cable—A communications medium (signal bus) with two concentric conductors separated by dielectric material(s) resulting in low losses and a relatively constant specific impedance over a wide range of frequencies.

3.98 Collision—For a protocol, the state-of-the-bus in which two or more active transmitters have simultaneously placed the bus into a conflicting state relative to the expected receive state.

3.99 Collision Detection—For a protocol, the ability to sense the state-of-the-bus during the transmission of data such that a comparison may be made to determine if a collision has occurred.

All arbitration-based protocols use collision detection as a portion of the arbitration algorithm.

3.100 Command Mode—A mode of operation of a master slave system where the Master Node takes prompt control of the network to achieve the input and/or output function.

3.101 Common Mode Bus Voltage Range—For CAN: Boundary voltage levels of VCAN_L and VCAN_H, for which proper operation is guaranteed if up to the maximum number of ECUs are connected to the bus line.

3.102 Common Mode Rejection Ratio—The ratio of the common mode input voltage to output voltage commonly expressed in dbV, i.e., the extent to which a differential amplifier rejects an output when the same signal is applied to both inputs.

3.103 Compliance—The act or process of complying with a wish, request, or demand to meet an official or authoritative requirement.

3.104 Complimentary Addressing—A mode of operation where an address provides one state of operation and the compliment address provides another state of operation.

3.105 Configuration Flexibility—Nodes may be added without requiring any change in the software or hardware of any existing node or application layer.

3.106 Contention—The action of contending for access rights to the network bus. A network state in which two or more transmitters are turned on simultaneously to conflicting states.

3.107 Contention-Based Protocol—A protocol in which nodes that seek the use of the transfer medium will contend for access rights to the bus by following the rules of a predefined arbitration algorithm.

3.108 Contention Process—A state-of-the-bus in which data from two or more transmitters are simultaneously attempting to use a single shared network medium.

A collision detection or arbitration process can be used to resolve the conflict.

3.109 Contiguous Bits—A sequential series or string of data bits that are continuous and without dead time between bits.

3.110 Control—An architectural system element which contains the algorithm for translating input mechanism abstractions into output mechanism abstractions and implements the desired customer and system behaviors for a given function or feature.

3.111 Control Architecture—An architecture (or structural organization) that supports the traditional functional processes of input, control, and output.

3.112 Control Architecture: Types—Control Architectures may include: Independent, Centralized, Master/Slave, Peer-to-Peer, or combination of these.

3.113 Control Field—A field in a frame which designates command information.

3.114 Control Mode—Control Mode and Command Mode are used interchangeably and refer to a mode of operation of a master slave system where the Master Node takes prompt control of the network to perform the input and/or output function.

3.115 Control Process—A function or series of actions performed to handle a class of activity that exercises authoritative or dominating influence upon information contained with a system, subsystem, or component.

3.116 Conventionally Wired Vehicle—The wiring structure associated with a vehicle that contains only conventional wiring without any type of multiplex or vehicle network.

3.117 Conversation—The network dialog or interchange of network messages used to support distributed system activity. The terms conversation and dialog are interchangeable.

The organization of dialog or conversation structure (session layer) establishes the conversation rules for a given network implementation.

3.118 CRC—Cyclic Redundancy Check

3.119 Crunch Points—The points of constriction within a vehicle where a large number of wires must cross such as the door pillar, engine compartment, or steering column.

3.120 CS—Checksum (See SAE J2178-4.)

3.121 CSMA—Carrier Sense Multiple Access

3.122 CSMA/CD—Carrier Sense Multiple Access with Collision Detection

3.123 Cyclic Redundancy Check—A computational algorithm applied to a data sequence that results in a value, the CRC, which is included in a message to improve the transfer reliability.

3.124 DA—Destination Address (See SAE J1939.)

3.125 Data—For a protocol, data is the fundamental information unit that moves across a network.

Data is located in a designated message or frame data field. Some protocols, like SAE J1939 and the 3-byte header implementation of SAE J1850 provide some additional locations.

For each network implementation, data is organized into a documented data structure (presentation layer) that establishes the data by name, the assigned network address, the data encoding, and the data definition.

3.126 Data Communications—The interchange of parametric data from one point to another over a medium.

3.127 Data Consistency—A feature of communications in some mulitplex wiring systems whereby it is determined and ensured that all required recipients of a message have received the message accurately before acting upon it simultaneously.

This feature is desirable in, for example, ensuring that all four lamps are turned on at once or that all four brakes are energized simultaneously.

Assures that a message is simultaneously accepted either by all nodes or by no node.

3.128 Data Field—A portion of a message that is designated to hold data rather than a message type, a command, address, checksum or CRC, acknowledge, or other in-frame response.

The data and data field are sometimes used interchangeably and both refer to a field within a message or frame.

For SAE J1850 protocols, the data field resides between header bytes and error detection byte. May include extended addresses and test modes.

For the CAN protocol, a zero to 64-bit field that contains the data as defined in the Application Layer. (See SAE J1939-71.)

3.129 Data Filtering—The ability to select a network data variable or group of network data variables based on user-established selection criteria or filtering technique.

3.130 Data Length Code—For CAN, the Data Length Code (DLC) defines the number of data bytes in a Data Frame. It is a 4-bit field and may contain a byte count of 0 to 8.

3.131 Data Link Layer—As one of the seven OSI layers, the data link layer defines the data transfer structure. Establishes the data encoding method, bit timing and synchronization, the message sequence, and handles interface to the physical layer.

The data link layer is between the physical layer and the network layer.

3.132 Data Page—For SAE J1939: One bit in the Identifier portion of the CAN Arbitration Field is used to select one of two pages of Parameter Group descriptions and to provide for future data content definitions.

3.133 Data Rate—Data rate and bit rate are sometimes used interchangeably and they both refer to the bits per time during transmission, independent of bit representation.

3.134 Data Size—The amount of data, usually measured in bytes, that is transferred by a message.

Most small area networks limit the maximum data size for a single message in order to maximize dialog and minimize bandwidth hogging.

3.135 Decibel Volts (dbV)—A measure of the relative strength of two signals where the value is 20 times the log of the ratio of the voltage of the two signals.

3.136 Decoding—For a physical layer, the process of retrieving a signal on the transmission medium that was encoded (e.g., NRZ, PWM, VPW, Manchester) back into the original logical, 1's and 0's bits.

3.137 Delay Time—The amount of time a signal or event is behind a reference point in time.

3.138 Destination Address—For SAE J1939: The Destination Address (DA) is a Protocol Data Unit (PDU) specific field in the 29-bit CAN identifier used to indicate the address of the intended receiver of the CAN message.

3.139 Destination Specific PDU Format—For SAE J1939: A designated PDU format that is used for messages to be sent to a particular destination address (DA).

3.140 Deterministic—A signal is said to be deterministic when the future behavior of the signal can be predicted precisely.

3.141 Diagnostic Message—A specific type of network message that supports a system or module diagnostic activity.

3.142 Diagnostics—The ability of a system to determine if failures are present in the system and relay this information for appropriate action.

3.143 Dialog—The network conversation or interchange of network messages used to support distributed system activity. The terms dialog and conversation are interchangeable.

The organization of dialog or conversation structure (session layer) establishes the conversation rules for a given network implementation.

3.144 Dialog Filtering—The ability to select a particular network dialog or group of dialogs based on user-established selection criteria or filtering technique.

3.145 Differential Internal Capacitance—For CAN: Capacitance, Cdiff, or an ECU seen between CAN_L and CAN_H during the recessive state when the ECU is disconnected from the bus line.

3.146 Differential Internal Resistance—For CAN: Resistance, Rdiff, of an ECU which is seen between CAN_L and CAN_H during the recessive state when the ECU is disconnected from the bus line.

3.147 Differential Receiver—A node receiver that contains a differential input.

3.148 Differential Twisted Pair—A transmission line consisting of two similar conductors that are insulated from each other and are twisted around each other.

The terms differential twisted pair and twisted pair are interchangeable.

3.149 Differential Voltage—For a two-wire physical layer that utilizes a differential transmit signal, the voltage measured across the two network wires.

For CAN: Vdiff = VCAN H – VCAN L, with the voltages VCAN_L and VCAN_H denoting the voltages of CAN_L and CAN_H relative to ground of each individual ECU.

3.150 Digital Actuator—A device which converts some system or module output characteristic into discrete output states.

The digital actuator has a maximum and minimum measurable range that corresponds to a fixed number of discrete output states.

EXAMPLE 1—Outputs that can have two states are the interior lights and parking lights.

EXAMPLE 2—The blower fan is a digital actuator with possibly four or more states: off, low, medium, and high.

3.151 Digital Sensor—An input-sensing device that converts a measured input characteristic into useful discrete digital states.

A digital sensor has a maximum and minimum measurable input range that corresponds to a fixed number of discrete output states.

3.152 Direct Addressing Mode—A mode of operation of a master/slave system in which the Master Node takes prompt control of the network to perform the input or output function.

The terms Direct Addressing, Control Mode, and Command Mode are used interchangeably.

3.153 Distributed Control—A control method spread across a distributed system which is usually based on either the Master/Slave or Peer-to-Peer control architecture.

3.154 Distributed Control System—An organization of a control system whereby control logic elements are physically located in several different places, as differentiated from a centralized organization of control.

3.155 Distributed Function—A function (or customer feature) that is distributed across multiple physical boundaries and is dependent upon the data transfer characteristics of a network to establish the distributed function's interconnectivity.

3.156 DLC—For CAN: Data Length Code

For SAE J1850: The OEM specific acronym for GM's Data Link Controller, another internal name for General Motor's SAE J1850 protocol IC implementation.

3.157 DLCS—For SAE J1850-GM: Data Link Controller Serial refers to the integrated circuit family developed by General Motors that supports SAE J1850 10.4 Kbps communication.

3.158 Dominant Bit—A bit which wins arbitration when contending for the bus.

For SAE J1850: a logic "0" is the dominant bit.
For SAE J1939: a logic "0" is the dominant bit.

3.159 Dominant State—The electrical state of the bus or media being in the Active State. The dominant state is the opposite of the recessive state.

3.160 DP—Data Page (See SAE J1939.)

3.161 Driver—An electrical circuit used to transfer information or electrical power to another system or module element.

EXAMPLE—An electrical load or power driver, solenoid driver, motor driver, actuator driver, a line driver, a display driver, etc.

3.162 DTC—Diagnostic Trouble Code (See SAE J2178.)

3.163 Dual Wire—A two-wire network connection that is routed adjacently throughout the network and can be either a twisted pair or a parallel pair of wires.

3.164 Duplex Bus—A multiplex bus where both transmission and reception occurs simultaneously on the same network media. Also referred to as Full Duplex.

3.165 DUT—Device Under Test

3.166 Dynamic Priority—Priority which may be altered during system operation.

3.167 Dynamic Range—The difference between the overload level and the minimum acceptable signal level in a multiplex system, sometimes expressed in dbV.

3.168 Electromagnetic Interference—The degradation of performance as a result of unintentional electromagnetic radiation (interference).

3.169 Electromagnetic Susceptibility—The sensitivity (susceptibility) to degradation of performance as a result of unintentional electromagnetic radiation or EMI.

3.170 EMI—Electromagnetic Interference

3.171 EMS—Electromagnetic Susceptibility

3.172 Encoding—For a physical layer, the process or method in which the logical information bits, 1's and 0's, are translated into signals on the transmission medium by the physical interface (e.g., NRZ, PWM, VPW, Manchester).

A method of representing information bits in data processing or communication system.

3.173 End of Frame—For CAN: The End-of-Frame (EOF) is a 7-bit field marking the ending of a CAN data frame.

3.174 End of Message—A character or set of characters used to signify the end of a message.

3.175 Engineering Resolution—The smallest subdivision to which a sensor's output must be resolved.

3.176 Engineering Units—Engineering units are the units of measure detected by and processed by the measuring system. Engineering units are a measure of Volume, Voltage, Displacement, Time, and other similar quantities.

The engineering unit can be measured as an absolute value (i.e., volts), as a ratio (i.e., decibel), or as a percentage (i.e., gas tank gauge).

3.177 Environmental Interface—Those physical and electrical interfaces, not designated within a specific interface, which establish the remaining interconnection between the local environment and the designated system, subsystem, module, device, component, element, or item.

3.178 EOD—End-of-Data

3.179 EOF—End- of-Frame (from CAN)

3.180 ERR—Error

3.181 Error—The inability of a system, module, or device to perform the intended function, feature, or activity. An error is caused by fault condition.

3.182 Error Detection Management—For a network, error detection management identifies the types of errors the protocol detects and recovery techniques it uses (e.g., wrong message length, parity, checksum, and CRC).

3.183 Error Message—A specific network message that is used to inform one or more nodes that an error condition has occurred.

3.184 Error Recovery Time—Time delay between detection of an error and restart of regular operation. This may include a re-initialization and reconfiguration.

3.185 Event-based—The attribute of transmission of data on a manually triggered event or on change of parametric value.

3.186 Event-driven—Activity caused by an event (not time).

3.187 Event-Triggered Architecture—A system architecture control method based specifically on the occurrence of events. An input, control, output, and network activity is only executed when a related event occurs.

The opposite control architecture philosophy to the event-triggered is the time-triggered architecture control method.

3.188 Event Filtering—The ability to select a particular network event or group of network events based on user-established selection criteria or filtering technique.

3.189 Event Message—A type of conversation that requires a single message transmission for a specific event occurrence.

3.190 Extended Address—Additional address information that provides a means to further define a message as being related to a specific geographical location or zone of the vehicle, independent of any node's physical address.

For some SAE J1850 implementations, the extended address is located in the data field of the message.

3.191 **Extended Frame—**For CAN: A message or data frame that uses the 29-bit identifier rather than the 11-bit identifier as defined in the CAN 2.0 specification.

3.192 **Failure—**The inability of a system to perform properly caused by faults.

3.193 **Fault—**The loss of proper function of a component (hardware or software) and can be either permanent or intermittent.

3.194 **Fault Detection—**The ability to sense a temporary or permanent error condition within a node.

3.195 **Fault Tolerance—**Ability of a system, module, or device to survive a certain number of failures while performing its required functions, but possibly with some degraded characteristics.

The quality of being capable of handling a failure or failure condition. Fault tolerance requires additional methods to provide the capability to operate and endure an adverse condition.

For a distributed system, a characteristic that allows the system or a portion of the system the ability to operate and endure an adverse condition.

3.196 **Fault Tolerance: Ground Shift—**A quality of being capable of handling a ground shift relative to the network wiring or system power. Requires additional methods to provide the capability to survive and possibly communicate during a ground shift condition.

3.197 **Fault Tolerance: Network—**The quality of being capable of handling a network fault or failure condition. Network fault tolerance requires additional methods to provide the capability to communicate during an adverse condition.

3.198 **Fault Tolerance: Network Wiring—**A quality of being capable of handling a network wiring fault or bus failure condition. Network wiring fault tolerance requires additional methods to provide the capability to survive and possibly communicate during an adverse condition.

3.199 **Fiber Optics—**A light-based communication medium consisting of one or more transparent glass or plastic fibers bundled essentially together and parallel to one another which transmit light along the fiber axis by a process of total internal reflection.

3.200 **Fiber Optics Receiver—**An assembly which accomplishes the receive function in fiber optics communications, typically consisting of a photo-detector (either a photo-diode or a photo-transistor) and a preamplifier.

3.201 **Fiber Optics Transmitter—**A unit which accomplishes the driver function in fiber optics communications, typically consisting of a light emitting diode (LED) and an LED drive circuit.

In contrast with the preamplifier of a fiber optics receiver, the LED driver circuit is not required to be, and typically is not, packaged with the LED.

3.202 **Filtering—**An action applied to a quantity of information with the intended purpose of selecting some particular portion of the information.

For a network test tool, filtering tends to reduce the amount of data to analyze.

3.203 **Filtering: Address—**The ability to select a specific address or group of addresses based on a selection criteria or filtering technique.

3.204 **Filtering: Data—**The ability to select a network data variable or group of network data variables based on a selection criteria or filtering technique.

3.205 **Filtering: Dialog—**The ability to select a particular type of network dialog or group of dialogs based on a selection criteria or filtering technique.

3.206 **Filtering: Event—**The ability to select a particular network event or group of network events based on a selection criteria or filtering technique.

3.207 **Filtering: Message—**The ability to select a particular message or group of messages based on a selection criteria or filtering technique.

3.208 **Firmware—**The microcomputer software program that is stored in the read only memory (ROM, EPROM, or Flash memory)

3.209 **Fixed Priority—**Priority preassigned before the start of system operation.

3.210 **Flexibility—**The quality of a system, module, or device to support some level of expendability.

A node's capacity to support the expendability of a vehicle mulitplex network such that the same node can be used for a base application as well as a high-end vehicle application without modification.

The ability of the system to function with nodes manufactured by various suppliers.

3.211 **FMEA—**Failure Mode Effects Analysis

3.212 **Ford-9141—**A UART-based protocol derived from ISO 9141 used at Ford for diagnostic applications only.

3.213 **Frame—**A frame is one complete transmitted information unit, data packet, or message.

For vehicle networking, the terms frame, message, and message frame are used interchangeably.

For SAE J1850: One complete and single message. May or may not include an In-frame Response. A frame is delineated by the Start-of-Frame (SOF) and End-of-Frame (EOF) symbols.

From OSI: A data-link protocol data unit which specifies the arrangement and meaning of bits or bit fields in serial data transmission across the transfer medium.

3.214 **Frame ID—**See SAE J2178-3: The Frame ID is the header byte for the Single Byte Header format and the one byte form of the consolidated header format.

The frame ID byte defines the target, source, and content of the frame.

3.215 **Framing Overhead—**The amount of non-data information contained in a message that is considered as overhead associated with the given protocol.

Framing overhead values may be used to compare protocols.

3.216 **Frequency Division Multiplex—**A physical layer encoding method that utilizes the principle of frequency sharing for a collection of information channels.

Data channels become modulated sinusoidal signals, called sub-carriers, which are each assigned to a restricted narrow frequency range and combined into a single resultant signal.

EXAMPLE—A multiplex radio transmission is the simultaneous transmission of two signals over a common carrier wave.

3.217 Function: Critical—A process including input, output, and control elements which is considered as essential to the expected or safe operation of a system. The use of the term critical is somewhat arbitrary and usually based on widespread or local judgment.

3.218 Function: Non-Critical—A process including input, output, and control elements which is not considered as essential to the expected or safe operation of a system. The use of the term critical is somewhat arbitrary and usually based on widespread or local judgment.

3.219 Functional Addressing—A network addressing method that allows a data transfer to one or more nodes on the network interested in that function. Functional addressing is intended for messages that may be of interest to more than a single node.

Functional addressing is considered to be the complement of Physical Addressing.

For SAE J2178: The functional address consists of a Primary ID or a Frame ID and may include a secondary ID and may also include an extended address.

EXAMPLE—An exterior lamp "off" message could be sent to all nodes controlling the vehicle exterior lamps by using a functional address.

3.220 Functional Superset—A Class C Mulitplex Network is defined as a functional superset of Class B and Class A Mulitplex Network; networks that have both physical and functional properties.

As a Functional Superset, the network must be capable of communications that would perform all of the functions of the networks in that set.

3.221 Gate—A minimum integrated circuit cell composed of transistors which form a circuit to perform a logic function such as NAND or NOR. The number of gates is typically used as a measure of a semiconductors size or complexity.

3.222 Gateway—A node used to interconnect the transfer of data between two physically separate networks that use two different protocols. As differentiated from a bridge, a gateway acts as a protocol-to-protocol converter.

3.223 Generic Network Requirements—A document of general rules that applies to all implementations that use the designated network protocol.

3.224 Global Address—A predefined address or ID used as a broadcast to all nodes on the network.

3.225 Global Error—Error in a communication network, which is similarly detected in all nodes.

3.226 Global PDU Format—For SAE J1939: A PDU format that is used to send information that has been labeled using the Group Extension technique and does not contain a destination address.

3.227 Global Time Base—For Time Triggered Protocol: A clock or timing device relating to, or involving the entire vehicle network used to provide a system time base.

3.228 GPIB—General Purpose Instrumentation Bus

3.229 Ground Offset—Difference in voltage at a module', node, or device ground point as compared to a reference ground point. See longitudinal noise.

3.230 Group Extension—For SAE J1939: The Group Extension (GE) is a PDU (Protocol Data Unit) specific field that is used as part of the information necessary to determine the Parameter Group Number.

3.231 Hall Effect—The creation of a voltage as the result of a perpendicular current and magnetic field applied to a semiconductor material or element.

3.232 Handshaking—The handshaking section describes the interaction of nodes within a network in order to effect a transfer of data.

This may include such things as negative and positive acknowledgment, and in-frame response.

3.233 HBCC—For Ford: Hosted Bus Controller Circuit. The integrated circuit developed by Ford that supports SAE J1850 41.7 Kbps PWM communication.

3.234 Header—A frame or message field used to contain non-data information. Usually contains network address and message type information.

For SAE J1850: The 1- or 3-byte field within a frame which contains information about the message priority, message source address, target address, message type, and in-frame response type.

The terms header and header field are used interchangeably.

3.235 Hex—Hexadecimal

3.236 Hexadecimal—A 4-bit numbering system common to computer programming and networking using the set of symbols: 0, 1, 2, 3, 4, 5,6, 7, 8, 9, A, B, C, D, E, and F to represent all the possible values of a nibble.

3.237 High-End Vehicle—A vehicle whose optional electronic feature content is relatively large when compared to a typical low-end vehicle.

3.238 Host: Tool—A portion of the Network Test System which resides in a personal or laptop computer and establishes the primary user interface to the network testing activities.

3.239 Host: Tool Software—The software portion of the Network Test System which resides in a personal or laptop computer and supports the network testing operations.

3.240 Host-Tool Interface—The physical and functional interconnection between the Host and the Tool elements of the Network Test System. Interface may be inside host for host-based tools or external for module-based tools.

3.241 Host Microcomputer—A microcomputer connected to a multiplex network interface, primarily providing computational services to all the vehicle application, e.g., engine control, body computer, etc., as well as the network protocol.

3.242 HVAC—Heating, Ventilation, Air Conditioning

3.243 IBS—Inter-Byte Separation

3.244 ID—Identifier

3.245 IDB—The upcoming ITS Data Bus. A standard in development by SAE.

3.246 IDE—Identifier Extension Bit

3.247 Identifier—A portion of a message or frame that usually contains network address information.

For CAN: That portion of the arbitration field that contains the 11- or 29-bit identifier.

3.248 Idle—The state-of-the-media or bus being idle or recessive. A period of time during which no data transfer is occurring.

3.249 Idle Detection—The capability of a circuit to detect the condition of an extended recessive bus period.

3.250 IFD—Interframe Delimiter (IFD)

3.251 IFR—In-Frame Response

3.252 IFS—Inter-Frame Separation

3.253 IG—Industry Group (See SAE J1939.)

3.254 Ignition-Off Power—The attribute of a vehicle-based electrical system to draw power with the vehicle ignition switch turned off.

3.255 Implement—A machine or device that may be attached to or detached from the vehicle.

3.256 In-Frame Acknowledgment—The form of the acknowledgment which is expected within that frame. See Acknowledgment.

3.257 In-Frame Response—A portion of a frame or message during which a message receiver will insert additional information into the original transmitted message.

The use of and the meaning of the in-frame response is protocol dependent.

Examples of in-frame responses include Acknowledge, Negative Acknowledge, the receiver(s) Source Address, and data.

3.258 In-Frame Response Type—The form of the in-frame response which is expected within that message.

3.259 Initialization—A mode of operation or period of time, usually during start-up, devoted to the initiation and configuration of all required subsystems and components in preparation for the expected system mode of normal operation.

3.260 Input—For a distributed embedded system, an architectural system element which interconnects an input device or signal to one or more Control elements by providing a data representation of the input.

3.261 Input Process—An operation or series of actions performed to handle a class of activity that brings information into a system, subsystem, or component.

3.262 Integration of Components—The process of combining two or more components, both physically as well as electrically, into one device, module, node, or system.

3.263 Integration of Features—The process of combining two or more electronic features, both physically as well as electrically, into one device, module, node, or system.

3.264 Inter-Byte Separation—An idle time duration between the data bytes of an asynchronous serial transmission within a message or frame.

3.265 Interframe Delimiter—A condition where data bytes of an asynchronous serial transmission within a frame are disjointed or separate with variable amounts of dead time between bytes.

The terms Interframe Delimiter (IFD), Interframe Separation (IFS), and Interframe Spacing are used interchangeably.

3.266 Internal Capacitance—For CAN: Capacitance, Cin, of an ECU seen between CAN_L (or CAN_H) and ground during the recessive state when the ECU is disconnected from the bus line.

3.267 Internal Delay Time—For CAN: The internal delay time of an ECU, tECU, is the sum of all asynchronous delays that occur along the transmission and reception path of any individual ECU, relative to the bit timing logic unit of the protocol IC.

3.268 Internal Resistance—For CAN: Resistance, Rin, of an ECU which is seen between CAN_L (or CAN_H) and ground during the recessive state when the ECU is disconnected from the bus line.

3.269 Internode Distance—The length of the transmission bus line between any two nodes.

3.270 Invalid—The condition of deviating outside the expected or established range.

3.271 Invalid Bit—A data bit that has deviated outside the established requirements.

3.272 ISO—International Organization for Standardization

3.273 ISO 14229—Generic specification for a diagnostic application using a network.

3.274 ISO 14230-1—The physical layer specification for KWP2000. (Reported as same as ISO 9141.)

3.275 ISO 14230-2—The data link layer specification for KWP2000. (Reported as same as ISO 9141.)

3.276 ISO 14230-3—An implementation specification of ISO 14229 which defines the basic structure of the KWP2000 protocol. Carries SAE J2190 and SAE J1979 concepts.

3.277 ISO 15031-3—Same as SAE J1962.

3.278 ISO 9646—Test procedures for networks.

3.279 K BPS—Kilo bits per second

NOTE—Based on 1000 not 1024.

3.280 KWP 2000—Key Word Protocol 2000

3.281 LAN—Local Area Network

3.282 Latency: Function—The total time required for a system to respond to a request. This includes the time to electrically sense an input, process the information, and electrically actuate an output device.

Function latency does not include mechanical travel for input switches nor the additional time an output device requires to mechanically reach its physical position.

3.283 Latency: Media Access—The time required by a system to access the medium so as to begin the delivery of information.

3.284 Latency: Message—The time that a node is ready to send specific information to the time of the start of the transmission of this information which will ultimately be successful.

Thus, the total time required to successfully send a desired message will be the sum of the message latency and the message transmission time.

3.285 Latency: Transfer—The time required to transfer a message from the transmitting node measured from the moment it is prepared to send the message until it is correctly received by the targeted receiver. Including retry.

3.286 Length: Maximum Bus—The maximum distance between any two nodes within a designated network implementation.

3.287 Limited Operation Strategy—A method of providing fault tolerance that utilizes an alternate operating strategy to maintain a limited portion of normal operation in case of failure.

3.288 Line Driver—A circuit or device used to transfer electrical energy into the communication medium or bus.

3.289 Line Receiver—A circuit or device used to receive electrically transmitted signals from the communication medium or bus.

3.290 Link—A serial communication system which is capable of supporting data transfers between two nodes.

3.291 Listen Only Mode—For a network-based device, a node which may receive only and may not transmit.

3.292 LLC—Logical Link Control (from OSI)

3.293 Load—A type of message command that indicates the operation of directly replacing the current/existing value of a parameter with the data content contained in the message.

3.294 Local Area Network—A data communication network that interconnects a group of computer-based modules across a local geographical area. A LAN is typically used to interconnect PCs in office, industrial, and commercial applications.

3.295 Local Error—For a distributed system, an error detected only in some nodes which is localized rather than global in nature.

3.296 Longitudinal Noise—Difference in voltage between two ground points as a result of ground offset electrical noise currents. See ground offset.

3.297 Low-End Vehicle—A vehicle whose optional electronic feature content is relatively small or limited when compared to a typical high-end vehicle.

3.298 Low Pass Filter—A filter, either analog or digital, which ideally passes all frequencies below a specified value and attenuates all frequencies above that value.

3.299 LSB—Least Significant Byte or Least Significant Bit

3.300 MAC—Medium Access Control (from OSI)

3.301 **Manchester—**A digital signaling technique in which there is a transition in the middle of each bit time. A "1" is encoded with a high level during the first half of the bit time and a "0" is encoded with a low level during the second half of the bit time.

For a Manchester waveform, there is a maximum of two transitions per bit time.

3.302 **Master—**For a Master/Slave type protocol, the module or node which acts as the primary and central controller of data transfer on a communication network.

For a control architecture that uses Master/Slave control, the system element which acts as the single and central controller.

3.303 **Master/Slave—**A type of system whereby one node (a module) acts as a master of central unit and controls the actions of the other nodes, designated as slaves or remote units.

3.304 **Media—**The physical medium used to move information between devices on a network. Wire, audio, light, and RF are common forms of communication

3.305 **Media Access—**Depending upon the type of protocol, the method used to award the communication network to one of the nodes for the transmission of a message.

3.306 **Media Access Method—**The method used to award the communication network to one of the nodes for the transmission of a message.

3.307 **Memory Requirements—**The size of memory required to implement the required functions.

3.308 **Message—**A distinctive sequence of transmitted information preceded by a Start-of-Message symbol, delimiter, or semaphore.

For most protocols, the terms message and frame are used interchangeably.

For SAE J1850: All of the data bytes contained in a frame. The message is what is left after the frame symbols have been removed from the frame.

For SAE J1939: One or more CAN Data Frames that have the same Parameter Group Number. A single Parameter Group Number transfer may take several CAN data frames.

3.309 **Message Administration—**The portion of a communication protocol specifying how to handle and to buffer entire messages and respective control bits, e.g., what messages shall be transmitted when, or whether messages shall be received and how they are presented to the application.

3.310 **Message Arbitration—**If two or more senders start transmitting messages at the same time, the media access conflict is resolved either by a nondestructive bitwise collision avoidance algorithm or by a collision resolution method.

3.311 **Message Filtering—**The ability to select a particular message or group of messages based on user-established selection criteria or filtering technique.

3.312 **Message Format—**The organizational description of the fields and elements of a specific type of protocol message. This includes the order, name, size, and meaning of all message fields and message symbols, delimiters, or semaphores.

3.313 Message Name—The label or title assigned to a message that is used to describe the message. The message name is somewhat more convenient to use rather than the hexadecimal representation of the message bytes.

3.314 Message Rate—Number of completed message transmissions per unit of time.

3.315 Message Set—An application specific document that lists all messages used for a designated vehicle or module.

3.316 Message Source—The device, module, or node that sends a message.

3.317 Message Structure—The structural architecture of all message types and formats that are supported by a protocol.

3.318 Message Transfer—The portion of the protocol dealing with the organization, meaning, and timing associated with the bits of data.

Message transfer deals with what bits must be sent and when they must be sent in accomplishing the transmission of a message.

3.319 Message Type—For some protocols, a classification of the different categories of messages, such as functional or physical.

EXAMPLE—The 3-byte header version of SAE J1850 allows up to 16 different message types including functional and physical.

3.320 Modified Frequency Modulation (MFM)—An encoding technique that defines two symmetrically spaced phases, data and clock, to a synchronizing signal and modulating data causes transitions at these phases depending on the logic level.

3.321 Modify—A type of message command used by some protocols that indicates the operation of directly changing the current/existing value of a parameter using the data content contained in the message as the modifier.

EXAMPLE—The 3-byte header version of SAE J1850 allows increment, decrement, or toggle the current/existing value.

3.322 Modulation—The process of altering the characteristics of a carrier frequency so that it changes in synchronous with the value of the modifying signal.

3.323 Module—An electronic subassembly, commonly with intelligence, which typically accepts input from switches and/or sensors and provides outputs to actuators, lamps, and/or displays.

3.324 Monitoring—During transmission of a message, the actual physical signal on the transmission line is fed back into the transmitting node in order to be compared with the transmitted reference signal.

Monitoring may be used for error detection, allowing to safely detect all global errors in a communication network.

3.325 MSB—Most Significant Byte or Most Significant Bit

3.326 Multi-drop Serial RS-485 Interface—A physical and electrical interface based on the standard known as RS-485 or based on a variant of the standard which supports bi-directional data transfer activities between two or more intelligent entities.

3.327 **Multicast—**For CAN: Addressing where a single frame is addressed to a group of nodes simultaneously. Broadcast is a special case of multicast, whereby a single frame is addressed to all nodes simultaneously.

3.328 **Multimaster—**For a network, system behavior that allows more than one module to temporarily control the communication network, sending information to or requesting information from other modules.

3.329 **Multipacket Messages—**For SAE J1939: Two or more CAN data frames (using the same identifier) that require transmission in order to transmit all data specific to a given Parameter Group Number.

3.330 **Multiple Byte Header Protocol—**A protocol that utilizes a number of bytes in the header field within a frame which directly contains information about the message priority, message source and target addressing, message type, and inframe response type.

3.331 **Multiple Receiver—**Ability to address more than one node with a single message.

3.332 **Multiplex—**To interleave or simultaneously transmit two or more messages on a single channel.

Mulitplex is the application of small area networking to the vehicle. The name was chosen as a convenient single-name term for a vehicle network.

3.333 **Multiplex Bus—**The wiring serving all multiplex system nodes and including the communication signal, power, and ground signals if appropriate.

The terms Multiplex bus and signal bus are sometimes used interchangeably.

3.334 **Multiplex Hardware—**A collection of electronic components used to support a selected protocol.

3.335 **Multiplex Infrastructure—**All R&D, engineering, manufacturing, and management activities that are used to support the application of a vehicle network. This may include design, development, integration, and testing activities from the vehicle level down to the chip level.

3.336 **Multiplex Integration Task—**Additional development work related to the integration of multiplexing into either the vehicle or into a module.

3.337 **Multiplex Software—**A single software driver or group of integrated software modules used to support a selected protocol.

3.338 **Multiplexing—**The process of combining several messages for transmission over the same signal path.

There are two widely used methods of multiplexing time division and frequency division.

The process of combining several messages for transmission over the same signal path.

3.339 **NA—**Not allowed (See SAE J1939.) See NL.

not applicable, not available

3.340 **NACK—**Negative Acknowledgment

3.341 **NAT—**Network Analyzer Tool

3.342 **NB—**Normalization Bit (See SAE J2178.)

3.343 Negative Acknowledgment: Protocol—A control character on a communications network transmitted from a receiving point as a negative response to the reception of the message.

The response signifies that the messages was not received correctly.

3.344 Negative Acknowledgment: System—For a distributed system, a response which indicates that a requested distributed function action could not be performed.

3.345 Network—A distributed system capable of supporting communications between two or more nodes.

A method of interconnecting a collection of two or more distributed processing subsystems, devices, computers, sensors, and actuators with the intended purpose of sharing information.

3.346 Network Data Variable—An informational container used to transfer a data quantity across a network.

3.347 Network Layer—One of the seven OSI layers which deals with the method of interconnecting or addressing network nodes.

The network layer establishes the Address Structure for a given protocol.

3.348 Network Object—A network-based data structure organized to contain a collection of related network data variables.

3.349 Network Termination—One or more electronic components added to the ends of the physical network wiring. Commonly used for terminating the SAE J1850-PWM and high-speed CAN network implementations.

3.350 Network Test System—A distributed embedded system capable of testing, transmitting, and receiving serial data transfers on a particular type of small area network. Commonly used to test the operation of a distributed product or system.

3.351 Network Test Tool—An electronic module or printed circuit card capable of testing, transmitting, and receiving serial data transfers on a particular type of small area network. Commonly used to test the operation of a distributed product or system.

3.352 Network Topology—Depending upon the point of view, the Network Topology is either the physical or the logical structure of the network.

3.353 Network Topology: Bus—With the Bus Network Topology, all nodes or stations are connected in parallel. A transmitting node is received by all other nodes. The removal of any node will not cause a loss of communications for any remaining nodes.

3.354 NL—It is not permitted. (Latin: non licet)

3.355 Node—A key physical and functional element of a distributed embedded system, usually located within a module, that supports the physical interconnection to a share media and allows data communication according to a designated protocol.

An electronic subsystem or circuit used to interconnect a module to a network.

3.356 Node-to-Node Communications—The transmission of information to a single receiver, as differentiated from broadcast communications.

3.357 Node-to-Node Message—A type of message based only on the physical address of a system module.

3.358 Node Address—An address number or identifier assigned to a physical node or module.

3.359 Non-Deterministic—A signal or process is said to be non-deterministic when the future behavior of the signal or process cannot be predicted and possesses a random characteristic.

3.360 Non-Return to Zero—A data bit encoding format in which the voltage or current value determines the data bit value (typically one or zero).

Within one and the same bit time interval, the signal level does not change. Only a change in logic level will cause a signal edge transition.

3.361 Normal Operation—A mode of operation or period of time devoted to the normal and expected processing activities of a system, subsystem, module, or component.

3.362 Normalization Bit—For SAEJ1850-VPW: A special Modulation bit symbol that follows an end-of-data symbol used to initialize an in-frame response with the proper phase.

3.363 NRZ—Non-Return to Zero

3.364 NS—not specified

3.365 NTS—Network Test System

3.366 NTT—Network Test Tool

3.367 OBD-II—On-Board Diagnostics-II

Requirements Document: California Code of Regulations, Title 13, 1968.1—Malfunction and Diagnostic System Requirements, 1994 and Subsequent Model-Year Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles With Feedback Fuel Control Systems.

3.368 Open System—A system, consisting of nodes interconnected by a common communications medium (signal bus) according to established standards, which will support temporary connections to manufacturing networks, diagnostics, and other local area networks.

3.369 Optical Coupling—A device designed to transfer electrical signals by utilizing light waves to provide coupling with electrical isolation between input and output.

3.370 OSI—Open System Interconnect

3.371 OSI Model—The Open System Interconnect model defines a seven-layer reference model for a data communications network.

The Open System Interconnect (OSI) model was developed by the International Organization for Standardization (ISO) in 1984 as a model of a computer communications architecture.

There are seven layers to the OSI model (Physical, Data Link, Network, Transport, Session, Presentation and Application). The intent is the protocols be developed to perform the functions of each layer as needed.

3.372 Out-of-Range—A signal that exceeds an expected level or range.

For RF communications: The condition of being too distance from a transmitter or receiver such that communications is not possible.

3.373 Output—For a distributed system, an architectural system element that accepts information in the form of a data structure from a Control element and converts the information into system output responses which may be signals or actuated devices.

3.374 Output Process—A task or series of actions performed to handle a class of activity that produces a result, or information, or moves information outside of a system, subsystem, or component.

3.375 P—Priority (See SAE J1939.)

3.376 Packet—For a protocol, a collection of different data items which are grouped together.

For SAE J1939: A single CAN data frame.

3.377 Parallel Bi-directional Interface—A physical and electrical interface common to personal computers which supports bi-directional data transfer activities between two and only two intelligent entities using the parallel port.

3.378 Parameter—A variable data quantity included in some messages. The parameter value, scaling, offset, units, transfer function, etc., are unique to each particular message.

3.379 Parameter Group—For SAE J1939: A named collection of data. A Parameter Group is assigned a number or address which is inserted into the 29-bit identifier of a CAN message.

3.380 Parameter Group Number—For SAE J1939: A 3-byte, 24-bit, representation of the Reserved Bit, Data Page, PDU Format, and GE fields. The Parameter Group Number (PGN) identify commands, data, request, acknowledgments, and negative-acknowledgments.

The PGN identifies the data in a message, regardless of whether it is a single packet or multipacket message. Parameter Groups are not dependent on the source address field thus allowing any source to send any Parameter Group Number.

3.381 Parity—A simple error detection method that uses a simple sum of all the binary bits in a byte or area of a message or frame. Parity may be designated as odd or even. See "parity bit".

3.382 Parity Bit—A check bit appended to a byte or frame that is used to improve the transfer reliability of a data transfer.

3.383 Parity Error—An error is determined when the locally calculated parity check bit disagrees with the parity check bit received in a data transfer.

3.384 Passive State—The media or bus state that is recessive. Opposite to the dominant state. The term Recessive is preferable to passive.

For SAE J1850: The state-of-a-bus wire which results when all nodes have "turned off" their physical layer circuitry. This is Vol volts for Bus + (PWM and VPW) and Voh volts for Bus− (PWM only).

3.385 PC—Personal Computer

3.386 PCI—Programmable Communications Interface. (Chrysler specific) A set of integrated circuits that supports SAE J1850 10.4 VPW communications with CRC error checking. Includes a control microcomputer, the Symbol Encoded Decoder (SED) and the Integrated Driver Receiver (IDR).

3.387 PDU—Protocol Data Unit (See SAE J1939.)

3.388 PDU Format—For SAE J1939: An 8-bit field in the 29-bit identifier that identifies the PDU format (PF). It also is one of the fields used to determine the Parameter Group Number which labels the data field of the CAN Data Frame.

3.389 PDU Specific—For SAE J1939: An 8-bit field in the 29-bit identifier depends upon the type of PDU format. The PS can be either a destination address (DA) or Group Extension (GE).

3.390 Peer-to-Peer—For a protocol, a media access mode of operation in which each node within the network uses the same media access algorithm such that a data transfer may be initiated by any node that gains access rights to the media.

3.391 Periodic Event Message—A type of conversation that requires a burst message transmission only during the time of an active event.

EXAMPLE—A "move seat forward" message could be repetitively transmitted based on the condition that the switch is still being held down.

3.392 Periodic Message—A type of conversation that requires a continued message transmission on a designated periodic basis by the assigned data home.

EXAMPLE—The vehicle speed could be repetitively transmitted at some designated rate in order to allow all users of vehicle speed the opportunity to receive and act upon the information.

3.393 PF—PDU Format (See SAE J1939.)

3.394 PG—Parameter Group (See SAE J1939.)

3.395 PGN—Parameter Group Number (See SAE J1939.)

3.396 Physical Addressing—Physical addressing allows a message to be addressed to a specific node or to all nodes or to a non-existent, null node.

The information in this message is only of relevance to a particular node so the other nodes on the bus should ignore the message, except for the case of the "all nodes" address.

3.397 Physical Interface—For a protocol, the description of the basic circuitry used to connect a node to the network, including a microcomputer if used. Usually includes the interface schematic, engineering specification, and additional support information.

3.398 Physical Layer—A collection of physical, electrical, and electronic components used to interconnect electronic modules, devices, or components with the intended purpose of supporting communications.

Concerns the transmission of unstructured bit stream over physical media; deals with the mechanical, electrical, functional, and procedural characteristics to access the physical media.

3.399 Physical Media—See transfer medium.

3.400 PID—Parameter Identification (See SAE J2178.)

3.401 PKT—Multiple Parameter Packet SLOT (See SAE J2178.)

3.402 PL—Physical Layer

3.403 **Poll—**For a protocol, the process by which a master device invites a slave device such as a sensor or actuator, one at a time, to transmit data or to act on command.

3.404 **Positive Acknowledgment—**For a protocol, a signal transmitted by a receiving node to indicate a positive response to the reception of a message. An in-frame response or subsequent message may be used to signify that the message was received correctly.

For a distributed system, a response which indicates that a requested distributed function action was properly performed.

3.405 **Power Bus—**The portion of the wiring serving all mulitplex system nodes which provides the electrical power to the nodes, providing the electrical energy used by the node and its associated electrical loads.

3.406 **Power Driver—**A solid-state device (driver) capable of turning on and off electrical loads requiring electrical power significantly in excess of semiconductor logic levels. A power driver can drive actuators, lamps, motors, etc.

A power driver provides the output function typically provided by a switch in a conventional automotive wiring system, but does not provide its input function.

3.407 **Power Interface—**A physical and electrical interface which supports the transfer of electrical power from the local power source to the designated system, subsystem, module, device, component, element, or item.

3.408 **Power Reduction Mode—**A mode of operation for a device, module, or node that requires less power than normal operation. Includes a method of transitioning to the lower power mode and returning to normal power mode.

3.409 **Presentation Layer—**One of the seven OSI layers that establishes the data structure. Establishes network data variables by name, the assigned network address, the data encoding, and the data definition.

Provides independence to the application process from differences in data representation (syntax).

The Data Structure of a protocol.

3.410 **Primary ID—**For SAE J1850: The primary ID identifies the target for a functional message and is the primary discriminator used to group functions into main categories.

3.411 **Prioritization: Message—**A bus access method which allows the priority of each message to be selectable and adjustable for a given network implementation. Message prioritization is assigned by system designers.

3.412 **Priority—**For a protocol, the rank order and precedence of a message. Message priority is a feature included in some protocols.

When multiple nodes simultaneously initiate message transmission, priority allows the highest priority message to win arbitration and continue transmission.

Attribute of a message controlling its ranking during arbitration. A high priority increases the probability that a message wins the arbitration process.

For SAE J1939: A 3-bit field within the 29-bit identifier that establishes the arbitration priority of a designated CAN message. 000 = highest priority; 111 = lowest

3.413 **Priority/Type—**The first byte of an SAE J2178 Three-Byte Header Message that primarily contains the message type and a message priority value.

3.414 **Priority: Dynamic—**A priority method which allows message prioritization to be altered during system operation.

3.415 **Priority: Fixed—**Priority preassigned before the start of system operation.

3.416 **PRN—**Parameter Reference Number (See SAE J2178.)

3.417 **Process—**A sequence of events ordered to serve some designated purpose.

3.418 **Propagation Delay—**The worst-case or maximum travel time of a signal from one location in a system, module, or device to another location.

3.419 **Propagation Delay: PL—**Specific to a physical layer, the worst-case or maximum propagation time through the network's designated transfer media or bus.

3.420 **Protocol—**A formal set of conventions, rules, and requirements governing the communication and transfer of data between distributed processing subsystems, devices, computers, sensors, and actuators.

3.421 **Protocol Coexistency—**The ability of a protocol to share a common media with another different protocol in such a manner that both may be used to transfer information.

3.422 **Protocol Data Unit—**For SAE J1939: A PDU is a specific CAN Data Frame.

3.423 **PS—**PDU Specific (See SAE J1939.)

3.424 **Pulse Width Modulation—**A bit-encoding format, used for serial communication, in which the time duration of the transmitted signal establishes the logical value of the data. Also identified as PWM.

3.425 **PWM—**Pulse Width Modulation

For SAE J1850: The automotive industry tradename used for the portion of the SAE J1850 protocol that uses Pulse Width Modulation encoding. (originator Ford Motor Company)

3.426 **R—**Reserved (See SAE J1939.)

3.427 **Random Lay Wire—**The placement of a wire or wires in a wire harness with no specific pattern.

3.428 **Real Time Control—**A control system that acts within the actual time the physical events take place.

3.429 **Receive—**For a distributed system, an element which receives a data transfer from a network and interconnects the received data structure to the correct Control or Output element.

3.430 **Receive Only Node—**For a network-based device, a node which may receive only and may not transmit.

3.431 **Receive Process—**For a distributed system, the activity that handles the reception of data transfers from a network and makes the information available to a designated process.

3.432 **Receiver—**A device that converts electrical or optical signals used for transmission back to information or data signals.

3.433 **Receiver List—**For a specific network implementation, a listing of the physical nodes of the network including both the node physical address and module acronym which receive messages.

3.434 Recessive Bit—A bit which loses arbitration when contending for the bus with a dominant bit.

For SAE J1850: A logic "1" is the recessive bit.

3.435 Recessive State—The electrical state-of-the-bus or media being in the non-dominant state or passive state. The recessive state is the opposite of the dominant state.

3.436 Redundancy—For a distributed system or module, additional functionality non-essential for normal operation but which allows the detection and management of fault conditions such that continuation of operation is possible.

3.437 Remote Transmission Request—For CAN: A protocol feature of allowing a node to request that another node send a message.

For SAE J1939: This message or frame type is not used. An alternate request mechanism is specified.

3.438 Repeater—A device used to extend the physical coverage of a network. A repeater will regenerate the data signal onto another physically separate network segment of the media.

The repeater allows the network to cover a greater distance, to connect more nodes onto the bus, or to connect to another type of media.

The protocol, addressing, data, and network bit rate will be the same on both sides of the repeater.

3.439 Reply Time of Acknowledge—The time between the end of the source-originated portion of the message and the start of the destination-originated portion of the same message.

3.440 Report—A type of message used to transmit a node's resident data value, based on a change of state; a change of value; on a periodic rate basis; or as a response to a specific request.

For CAN, a data frame is the same as a report message.

3.441 Request—For a protocol, a type of message used to ask or query a remote node's resident data value.

For CAN, a remote frame is the same as a request message.

For software, a request is a command to perform an action.

3.442 Reserved Bit—For SAE J1939: A single reserved bit in the 29-bit identifier for future definition by the SAE J1939 committee.

3.443 Reset—For a distributed system, the action of restoring a system, subsystem, module, or device to an initial prescribed state.

For a microcomputer or protocol IC, the electrical activity of restoring the device to its initial state.

3.444 Response—A message or portion of a message initiated by a receiving node as a result of a message transmitted by a different node.

A response can be an acknowledgment or response data, and it can be appended to the original message (immediate response) or a unique message (separate response).

3.445 Response-Type Messages—Messages that require a Response or Acknowledgment.

3.446 Response Current—A system that utilizes change in current signal which is used to indicate whether a message has been received properly.

3.447 Response Data—A response which provides the data or information requested in a preceding data transfer. May be an inframe response or a subsequent report message.

The response data is the information from a node on the network in response to a request from another node on the network.

3.448 Ring Topology—A physical bus topology with the ends of the bus (line or group of lines) tied together.

For a LAN, a bus topology in which all the nodes are physically interconnected in a ring or circular configuration.

3.449 Router—A device which allows segments with independent address spaces, data rates, and media to exchange messages. This permits each segment to operate with minimum bus loading yet still obtain critical messages from remote segments.

The protocol remains the same across all segments. Note that the router must have look-up tables to permit the translation and routing of a message with ID X on segment 1 to ID Y on segment 2.

3.450 RS-232—A physical and electrical interface, based on the well-known EIA standard which supports bi-directional serial data transfer activities between two and only two intelligent entities.

From the perspective of a protocol, RS-232 is a physical layer.

3.451 RS-485—A physical and electrical interface based on an EIA standard or based on a variant of the standard which supports bi-directional serial data transfer activities between two or more intelligent entities.

RS-485 was developed to support network communications between two or more intelligent entities.

From the perspective of a protocol, RS-485 is a physical layer.

3.452 RTB—Request to Broadcast (See SAE J1939.)

3.453 RTR—Remote Transmission Request (See SAE J1939.)

3.454 Rx—Receive

3.455 SA—Source Address (See SAE J1939.)

3.456 SAE—Society of Automotive Engineers, The Engineering Society for Advancing Mobility Land Sea Air and Space.

3.457 SAE J1213-1—An SAE Glossary of terms and definitions that supports Vehicle Networks for Multiplexing and Data Communications.

3.458 SAE J1708—A 9600 BPS Uart-based Heavy Truck protocol, primarily based in software and uses a variant of the industry-standard RS-485 interface.

3.459 SAE J1850—An SAE Standard that documents the physical and data transfer characteristics of each of the big three Class B Networks.

3.460 SAE J1850 Chrysler—The VPW version of SAE J1850 used by Chrysler.

3.461 SAE J1850 Ford—The PWM version of SAE J1850 used by Ford.

3.462 SAE J1850 GM—The VPW version of SAE J1850 used by GM.

3.463 SAE J1922—Heavy Truck Protocol based on SAE J1708 used to support motion control functions.

3.464 SAE J1939—An SAE Recommended Practice that defines a Class C vehicle network solution used by both the heavy truck and agriculture industries that is based on the CAN protocol operation at 250K BPS.

The SAE document—Recommended Practice for a Serial Control and Communication Vehicle Network

3.465 SAE J1939-1—Recommended Practice for a SC and C Vehicle Network. Truck and Bus specific.

3.466 SAE J1939-11—Recommended Practice for the Truck and Bus Physical Layer. 250kbaud, shielded, pair.

3.467 SAE J1939-12—Recommended Practice for the Con/Ag Physical Layer. 250kbaud, twisted quad.

3.468 SAE J1939-13—Recommended Practice for the Diagnostic Connector. Based on Deutsch nine pin connector.

3.469 SAE J1939-21—Recommended Practice for the Data Link Layer.

3.470 SAE J1939-31—Recommended Practice for the Network Layer.

3.471 SAE J1939-71—Recommended Practice for the Application Layer.

3.472 SAE J1939-72—Recommended Practice for Virtual Terminal of interest to Con/Ag. Based on ISO 11783.

3.473 SAE J1939-73—Recommended Practice for Applications Layer—Diagnostics.

3.474 SAE J1939-81—Recommended Practice for Network Management.

3.475 SAE J1939-82—Recommended Practice for Electrical Control Module compliance with SAE J1939 RPs.

3.476 SAE J2178—The SAE document (family) that establishes requirements for the message structure, data structure, and data definitions for SAE J1850-based Class B Networks.

3.477 SAE J2284—The SAE document that establishes requirements for the Passenger Car high-speed vehicle network that is based on the CAN protocol operation at 500 K BPS.

3.478 SAN—Small Area Network

3.479 SCP—For Ford: The OEM specific acronym for Standard Corporate Protocol which is the internal name of Ford' SAE J1850 protocol.

A two-wire, fault tolerant, serial communication network solution that operates at 41.7K bits/second. SCP is Ford's vehicle wide Class B network implementation of SAE J1850 that uses PWM.

3.480 Secondary ID—For SAE J2178-1: A second-level address extension to the Primary ID. Used to identify the functional target node for a message. Specific to the SAE J2178 three-byte header.

3.481 SED—State Encoded SLOT (see SAE J2178)

3.482 Segment—For SAE J1939: The physical media and attached nodes of a network. A single segment of a network is characterized by all the devices "seeing" the signal at the same time (i.e., there is no intermediate device between electrical sections of the network).

Multiple segments can be connected together by devices including repeaters, bridges, and routers.

3.483 Sensor—An input device that senses either the absolute value or a change in a physical quantity such as temperature, pressure, flow rate, and converts that change into a useful value for subsequent control processing.

3.484 Serial Communications—A method transmitting and receiving information or data on a bit-by-bit basis.

3.485 Serial Communications Interface (SCI)—A common industry standard microcomputer/communications interface that provides standard UART transmit and receive functions that support asynchronous serial data transfers.

The interface supports the common serial data encoding method of using a single start bit, eight data bits, and one stop bit to transfer a single byte of information. Some variations in data size, use of parity, and added stop bits may be used.

The terms Serial Communication Interface, SCI, and UART are used interchangeably.

3.486 Serial Data Transfer—A serial data transfer is the process of transmitting or receiving information using a sequential bit signaling method.

3.487 Session Layer—One of the seven OSI layers that provides the rules of conversation, a control structure for communication between applications. Establishes, manages, and terminates connections (sessions) between cooperating applications.

3.488 SFP—Signed Floating Point (Scientific Notation) SLOT (See SAE J2178.)

3.489 Shadow Nodes—For the Time Triggered Protocol: A node which receives input messages but does not produce any output as long as the other two nodes of the network are operational.

As soon as one of these other two nodes fails, the shadow node takes the Time Division Multiple Access (TDMA) slot from the failed node and produces output.

3.490 Shielded Cable—A wire, group of wires, or network cable that consists of one or more conductors within a shield constructed with a foil or braid material that provides some measure of lowering conducted or radiated emissions.

Shielded Cable is commonly used for audio, video, and higher speed data transmission wiring.

3.491 Shielded Twisted Pair—Two twisted conductors within a shield constructed with a foil or braid material.

3.492 Signal Bus—For a protocol, one or more wires which are solely dedicated to data communications between the nodes.

3.493 Single Byte Header Protocol—A protocol that utilizes a single byte in the header field within a frame which implicitly contains information about the message priority, message source and target addressing, message type, and inframe response type.

3.494 Sleep Mode—For a distributed system, a node's behavior when placed into a low-power consumption stand-by mode of operation during which the node is waiting to be switched on by a message or similar method.

Sleep mode is distinct from a Power Off Mode in which the node consumes no power and is essentially disconnected from the power supply.

3.495 Sleep State—For a system, module, node, or device, the state of being in sleep mode.

3.496 Sleep State Current—The amount of current consumption of a system, module, node, or device which is in the sleep mode.

3.497 SLOT—Scaling, Limit, Offset, and Transfer Function. An organized method of assigning attributes to network data parameters used by SAE J1939 and SAE J2178.

3.498 Small Area Network—A data communication network that interconnects a group of distributed processing subsystems, devices, computers, sensors, and actuators across a small geographical area.

An in-vehicle network like SAE J1850 or SAE J1939 is a small area network.

3.499 SNM—2's Complement Signed Numeric SLOT (See SAE J2178.)

3.500 SOF—Start-of-Frame

3.501 SOM—Start-of-Message

For SAE J2508: The 'start-of-message' is defined as the rising edge from 0 to 6 V in the voltage waveform.

3.502 Source—For a network protocol: The device, module, or node that initiates the transmission of a message.

3.503 Source ID—For SAE J2178 Three-Byte Header: The third byte of the header that identifies the physical node or physical address that is the source of the message.

3.504 Source Address—A numeric identifier or address that identifies the physical origin of a message or frame.

Some protocols include the source address as a part of the message.

For SAE J1939: An 8-bit field in the 29-bit identifier used to contain the unique identification of the source of the message. The SA field contains the address of the node that is sending the message.

3.505 SPN—Suspect Parameter Number (See SAE J1939.)

3.506 SRR—Substitute Remote Request (See SAE J1939.)

3.507 Standard Frame—For CAN: A data frame that uses the 11-bit identifier as defined in the CAN 2.0b specification.

3.508 Star Topology—A physical network topology in which nodes are interconnected via links to a central unit which acts as a central network processing unit or switching point.

3.509 Start Bit—The initial bit of an asynchronous serial data transmission that is used to locally synchronize the receiver such that the subsequent transmitted bits may be properly detected.

3.510 Start-of-Frame—For CAN: The initial dominant bit following a valid idle period that indicates the beginning of the frame.

3.511 Start-of-Message—A network signal, delimiter, messaging symbol, or semaphore that indicates the beginning of a message.

3.512 Stop Bit—The last bit of an asynchronous serial data transmission that is used to locally synchronize the receiver such that the previously detected bits may be considered as properly received.

3.513 Subnetwork—For SAE J1939: The network activity (message traffic) on a specific SAE J1939 segment. When multiple segments are used, Subnetworks may include Tractor; Trailer, Implement, and Braking System.

Subnetworks may be separated by a bridge or router to minimize total bus loading. Collectively the subnetworks are the SAE J1939 Vehicle Network.

3.514 Switch—A mechanically operated device for making breaking, or changing the connections in an electrical circuit.

In a conventional automotive wiring system, a switch serves as both the input device and the output device which provides electrical energy to the load.

3.515 Symbol—For a protocol: Any special signal, delimiter, or semaphore used to identify an individual data link component or constituent that is different from the normal encoding of message information.

Depending on the protocol, examples may include: Start-of-Message (SOM), Start-of-Frame (SOF), End-of-Data (EOD), End-of-Frame (EOF), End-of-Message (EOM), etc.

3.516 Synchronization—For a distributed system, a process used to ensure a certain amount timing consistency between all network nodes.

For protocol timing, a data transfer encoding method used to ensure an adequate level of timing consistency between the transmitter and all receiving nodes.

3.517 Synchronization Jump Width—For CAN: A special parameter which allows the bit timing to adjust. SJW allows PHASE SEG1 to be lengthened or PHASE SEG2 to be shortened based on the sampling of the previous bit period.

3.518 System Architecture—The organization of a distributed embedded system including, but not necessarily limited to, the location and ranking of logic or decision-making elements, and the types and methods of network communications between these elements.

3.519 System Latency—See Latency: Function

3.520 T-tap—A splice in a wiring harness forming a "T" connection.

Sometimes associated with automated insulation displacement type connection at a connector.

3.521 T-tap Connection—A method of interconnecting three wiring directions at a single point by adding a splice in a wiring harness to form a "T" connection.

3.522 Target—For a network protocol: The designated device, module, or node that receives the transmission of a message.

For SAE J2178 Three-Byte Header: The second byte of the header that points at a designated physical node or at a functional address (the Primary ID).

3.523 **Target Address—**The address of the node (Physical Address) or the function (Primary ID) for which the message is intended.

3.524 **TDMA—**Time Division Multiple Access

3.525 **Termination—**One or more physical components, typically resistors, required for proper network operation that must be included for some specific protocols.

Termination resistors may be located within a separate device or be located within one or more designated modules.

EXAMPLE—Both SAE J1939 and SAE J1850-PWM require the use of termination.

3.526 **Time-Critical Messages—**The attributes of a message that requires action in a very short period of time bordering on Real-Time Control requirements.

3.527 **Time-Triggered Architecture—**A system architecture control method based specifically on time. All input, control, output, and network events are executed at designated time intervals.

The opposite control architecture philosophy to the time-triggered is the event-triggered architecture control method.

3.528 **Time Division Multiple Access (TDMA)—**A general classification of multiplexing that utilizes Time Division Multiplex Protocols.

3.529 **Time Division Multiplex Protocol—**A protocol where the meaning of a piece of information on the signal bus is determined by its relationship (first, second, third, etc.) to the start of the message or bit stream.

In a time division multiplex protocol, data can be interleaved on a bit-by-bit, byte-by-byte, or block-by-block basis.

3.530 **Time Triggered Media Access—**Bus access is controlled by a global time base which opens slots to data depending on the network protocol.

3.531 **Time Triggered Protocol—**A real-time control system architecture where all system activities are triggered by the progression of real time. TTP requires clock synchronization by a global time base.

3.532 **Token—**The symbol of authority passed between nodes in a token passing protocol.

Possession of the token identifies the node currently in control of the medium.

3.533 **Token-Passing Protocol—**A protocol where a node which has communicated passes the control of the bus, including the right to communicate to another node, at the end of the message via a token.

3.534 **Token Slot Protocol—**A protocol where bus access is controlled by a time base which opens a time slot to a number of nodes that in turn take control of the network when there is data to communicate to another node.

3.535 **Tool Card—**A Network Test Tool implemented as a host-based printed circuit card.

3.536 **Tool Module—**A Network Test Tool implemented as a microcomputer-based module.

3.537 **Tool: Network Test—**A portion of the Network Test System which resides in a microcomputer-based module or host-based printed circuit card and directly interfaces with the small area network to support data transfer activities. Alternate name: Network Test Tool

3.538 **Tool-Network Interface—**The physical and functional interconnection which supports data transfer activities between the Tool and the designated network.

3.539 **Topology—**Depending upon the point of view, the topology is either the physical or the logical structure of the network.

The configuration of the interconnected elements of a system.

3.540 **Transceiver—**For a physical layer, an electrical circuit or device which both transmits (line driver portion) and receives (line receiver portion).

3.541 **Transfer Delay Time—**Time delay between request for and completion of transmission, which is the addition of transmission latency and transmission times.

3.542 **Transfer Medium—**Any physical medium including wire, fiber optic, infra-red, sound, or RF carrier that is capable of transferring information between two locations.

The physical medium generally associated or required by the given protocol (e.g., single wire, dual (parallel) wire, twisted pair, twisted pair with shield, dual twisted pair, fiber optics).

3.543 **Transfer Rate—**Information bits per unit of time during transmission, equivalent to bit rate.

3.544 **Transition: Signal—**The process of changing from one voltage level to another voltage level.

3.545 **Transmission Time—**Time duration for the transmission of a message, depending on message length and transfer rate.

3.546 **Transmit—**A distributed architectural system element that accepts information in the form of a data structure from either an Input or Control element and converts the information into a data transfer activity on a network.

3.547 **Transmit Process—**An activity that transfers data across a distributed system by converting information into electrical signals for sending over a communication medium.

3.548 **Transmitter—**A device that converts information or data signals to electrical or optical signals so that these signals can be sent over a communications bus (or transfer medium).

3.549 **Transport Layer—**One of the seven OSI layers which specifies the message structure, specifically the sequential arrangement and meaning of bit fields within a message. Provides error checking and message verification.

Message Structure

3.550 **Trapezoidal Waveform—**A sawtooth waveform superimposed onto a square wave.

3.551 **Triaxial Cable—**A transmission line consisting of three similar conductors that are insulated from each other and are usually twisted around each other to form a communication channel.

3.552 **TTP—**Time Triggered Protocol

3.553 **Twisted Pair—**A cable composed of two insulated conductors twisted about one another.

The purpose for twisting the conductors around each other is to reduce the Electric and Magnetic Field interaction with other conductors.

3.554 **Tx—**Transmit

3.555 **UART—**Universal Asynchronous Receiver/Transmitter. A circuit implementation that supports asynchronous communications. The UART is implemented as either a distinct integrated circuit or as an integral peripheral on many of the industry's 8-bit microcomputers.

A common industry standard microcomputer/communications interface that provides standard UART transmit and receive functions that support asynchronous serial data transfers.

The interface supports the common serial data encoding method of using a single start bit, 8-data bits, and one stop bit to transfer a single byte of information. Some variations in data size, use of parity, and added stop bits may be used.

The terms UART, Serial Communication Interface, and SCI are used interchangeably.

For PC serial ports, the UART is the data link layer and RS-232 is the physical layer.

3.556 **un—**Undefined (See SAE J1939.)

3.557 **Unit Load—**For a physical layer, the representative electrical load of a single device or node connected to the network. The unit load is used for testing purposes.

3.558 **UNM—**Unsigned Numeric SLOT (See SAE J2178.)

3.559 **User Interface—**A collection of physical input and output devices which interconnect the user (a human) to the designated system, subsystem, module, device, component, element, or item.

3.560 **Validation—**An act, process, or instance of declared or marked confirmation; especially the determination of the degree of validity by test evidence.

3.561 **Variable Pulse Width Modulation—**Also identified as VPW or VPWM.

3.562 **Variable Pulse Width Modulation—**A bit-encoding format, using both bus state and pulse width to encode bit information, used to reduce the number of bus transitions for a given bit rate.

EXAMPLE—The One ("1") is a dominant short pulse or a passive long pulse and the Zero ("0") is a long dominant pulse or a short passive pulse.

3.563 **Vehicle Network—**A vehicle resident, data communication system that supports information transfer between electronic modules using a shared media. A vehicle network may allow an interconnection to a remote device, perhaps a diagnostic tester.

3.564 **Verification—**The process of establishing the truth, accuracy, or reality of. The state of being verified or confirmed.

3.565 **VIN—**Vehicle Identification Number

3.566 **VPW—**Variable Pulse Width Modulation

The automotive industry tradename used for the portion of the SAE J1850 protocol that uses Variable Pulse Width encoding. (originator General Motors)

Users of the VPW version of SAE J1850 including General Motors and Chrysler.

3.567 VPWM—Variable Pulse Width Modulation (alternate abbreviation)

3.568 Wake Up Mode—For a distributed system, a node's behavior when transitioning from a low-power consumption (sleep or stand-by) mode of operation into normal operation mode.

The process of activating a node that is in the Sleep State.

3.569 WAN—Wide Area Network

3.570 Wave Shaped—For a network transmit circuit, a technique of rounding the corners of a trapezoidal waveform in order to minimize the EMI.

3.571 Wide Area Network—A data communication network that interconnects a group of high-speed computer-based modules across a wide geographical area. Typically a WAN is used to interconnect distant LANs.

4. Acronyms

A/C	Air Conditioning
ABS	Antilock Braking system
ACK	Acknowledgment
ACP	Audio Control Protocol, a Ford proprietary UART-based protocol
ASC	ASCII Encoded SLOT
ASCII	American Standard Code for Information Interchange
ASR	Acceleration Slip Regulation (Traction Control)
AWG	Arbitrary Waveform Generator, American Wire Gauge
BCD	Binary Coded Decimal
BMM	Bit Mapped with Mask (See SAE J2178.)
BMP	Bit Mapped without Mask (See SAE J2178.)
BRK	Break
CAN	Controller Area Network. A protocol licensed by Bosch.
CARB	California Air Resources Board
CCD	Chrysler's Class B serial data communications protocol
CRC	Cyclic Redundancy Check
CS	Checksum (See SAE J2178-4.)
CSMA	Carrier Sense Multiple Access
CSMA/CD	Carrier Sense Multiple Access with Collision Detection
DA	Destination Address (See SAE J1939.)
DLC	For CAN: Data Length Code
DLC	For SAE J1850: The OEM specific acronym for GM's Data Link Controller, another internal name for General Motor's SAE J1850 protocol IC implementation
DLCS	For SAE J1850-GM: Data Link Controller Serial refers to the integrated circuit family developed by General Motors that supports SAE J1850 10.4 Kbps communication
DP	Data Page (See SAE J1939.)
DTC	Diagnostic Trouble Code (See SAE J2178.)
DUT	Device Under Test
EMI	Electro-Magnetic Interference
EMS	Electro-Magnetic Susceptibility
EOD	End-of-Data
EOF	End-of-Frame (from CAN)
ERR	Error
FMEA	Failure Mode Effects Analysis
GPIB	General Purpose Instrumentation Bus
HBCC	For Ford: Hosted Bus Controller Circuit. The integral circuit developed by Ford that supports SAE J1850 41.7 Kbps PWM communication.

HVAC	Heating, Ventilation, Air Conditioning
IBS	Inter-Byte Separation
ID	Indentifier
IDB	The upcoming ITS Data Bus. A standard in development by SAE.
IDE	Identifier Extension Bit
IFD	Interframe Delimiter (IFD)
IFR	In-Frame Response
IFS	Inter-Frame Separation
IG	Industry Group (See SAE J1939.)
ISO	International Organization for Standardization
K BPS	Kilo bits per second (Note: based on 1000 not 1024.)
LAN	Local Area Network
LLC	logical Link Control (from OSI)
LSB	Least Significant Byte or Least Significant Bit
MAC	Medium Access Control (from OSI)
MSB	Most Significant Byte or Most Significant Bit
NA	Not Allowed (See SAE J1939.) See NL.
NA	Not applicable, not available
NACK	Negative Acknowledgment
NAT	Network Analyzer Tool
NB	Normalization Bit (See SAE J2178.)
NL	It is not permitted (Latin: non licet)
NRZ	Non-Return to Zero
NS	Not specified
NTS	Network Test System
NTT	Network Test Tool
OBD-II	On-Board Diagnostics-II
OSI	Open System Interconnect
P	Priority (see SAE J1939).
PC	Personal Computer
PCI	Programmable Communications Interface. (Chrysler specific)
PDU	Protocol Data Unit (See SAE J1939.)
PF	PDU Format (See SAE J1939.)
PG	Parameter Group Number (See SAE J1939.)
PGN	Parameter Group Number (See SAE J1939.)
PID	Parameter Identification (See SAE J2178.)
PKT	Multiple Parameter Packet SLOT (see SAE J2178.)
PL	Physical Layer
PRN	Parameter Reference Number (see SAE J2178.)
PS	PDU Specific (See SAE J1939.)
PWM	Pulse Width Modulation
PWM	For SAE J1850: The automotive industry tradename used for the portion of the SAE J1850 protocol that uses Pulse Width Modulation encoding. (originator Ford Motor Company)
R	Reserved (See SAE J1939.)
RTB	Request to Broadcast (See SAE J1939.)
RTR	Remote Transmission Request (See SAE J1939.)
Rx	Receive
SA	Source Address (See SAE J1939.)
SAE	Society of Automotive Engineers, The Engineering Society for Advancing Mobility Land Sea Air and Space
SAN	Small Area Network
SCP	For Ford: The OEM specific acronym for Standard Corporate Protocol which is the internal name of Ford's SAE J1850 protocol.
SED	State Encoded SLOT (See SAE J2178.)

SFP	Signed Floating Point (Scientific Notation) SLOT (See SAE J2178.)
SLOT	Scaling, Limit, Offset, and Transfer Function. An organized method of assigning attributes to network data parameters used by SAE J1939 and SAE J2178.
SNM	2's Complement Signed Numeric SLOT (See SAE J2178.)
SOF	Start-of-Frame.
SOM	Start-of-Message.
SPN	Suspect Parameter Number (See SAE J1939.)
SRR	Substitute Remote Request (See SAE J1939.)
TDMA	Time Division Multiple Access
TTP	Time Triggered Protocol
Tx	Transmit
UART	Universal Asynchronous Receiver/Transmitter
un	Undefined (See SAE J1939.)
UNM	Unsigned Numeric SLOT (See SAE J2178.)
VIN	Vehicle Identification Number
VPW	Variable Pulse Width Modulation
VPWM	Variable Pulse Width Modulation (alternative abbreviation)
WAN	Wide Area Network

PREPARED BY THE SAE VEHICLE NETWORK FOR MULTIPLEX AND DATA COMMUNICATION STANDARDS COMMITTEE

Rationale—Not applicable.

Relationship of SAE Standard to ISO Standard—Not applicable.

Application—This document covers the general terms and corresponding definitions that support the design, development, implementation, testing, and application of vehicle networks.

The terminology also covers some terms and concepts of distributed embedded systems, network hardware, network software, physical layers, protocols and other related areas.

Reference Section

SAE J1708—Serial Data Communications Between Microcomputer Systems in Heavy-Duty Vehicle Applications

SAE J1850—Class B Data Communication Network Interface

SAE J1930—Electrical/Electronic Systems Diagnostic Terms, Definitions, Abbreviations, and Acronyms

SAE J1939—Serial Control and Communications Vehicle Network

SAE J1939-71—Vehicle Application Layer

SAE J1962—Diagnostic Connector

SAE J1978—OBD II Scan Tool

SAE J1979—E/E Diagnostic Test Modes

SAE J2178—Class B Data Communication Network Messages

SAE J2178-1—Class B Data Communication Network Messages—Detailed Header Formats, and Physical Address Assignments

SAE J2178-3—Class B Data Communication Network Messages—Part 3—Frame IDS For Single-Byte Forms of Headers

SAE J2178-4—Class B Data Communication Network Messages—Message Definitions For Three Byte Headers

SAE J2190—Enhanced E/E Diagnostic Test Modes

ISO 9141—Road vehicles—Diagnostic systems—Requirements for interchange of digital information

ISO 14229—Road vehicles—Diagnostic systems—Diagnostic services specification

ISO 14230-1—Road vehicles—Diagnostic systems—Keyword protocol 2000—Part 1: Physical layer

ISO 14230-2—Road vehicles—Diagnostic systems—Keyword protocol 2000—Part 2: Data link layer

ISO 14230-3—Road vehicles—Diagnostic systems—Keyword protocol 2000—Part 3: Application layer

ISO 15031-3—Diagnostic connector and related electrical circuits: specification and use

ISO/IEC 9646—Information technology—Open systems interconnection—Conformance testing methodology and framework

Developed by the SAE Vehicle Network for Multiplex and Data Communication Standards Committee