(R) GLOSSARY OF VEHICLE NETWORKS FOR MULTIPLEXING AND DATA COMMUNICATIONS—SAE J1213/1 JUN91

SAE Information Report

Report of the Electrical and Electronics Systems Technical Committee approved April 1988. Completely revised by the SAE Vehicle Network for Multiplexing and Data Communications Standards Committee June 1991.

1. Scope—This SAE Information Report provides definition for terms (words and phrases) which are generally used within the SAE in describing network and data communication issues. In many cases, these definitions are different from those of the same or similar terms found in nonautomotive organizations, such as the Institute of Electrical and Electronic Engineers (IEEE). The Vehicle Networks for Multiplexing and Data Communications committee has found it useful to collect these specific terms and definitions into this document so documents related to the multiplexing and data communications issues will not need an extensive definitions section.

This document is intended to be the central reference for terms and definitions related to multiplexing and data communications and as such is intended to apply equally to Passenger Car, Truck and Bus, and Construction and Agriculture organizations within SAE. An attempt to use common terms across these applications has been made, so that these organizations can all utilize this glossary.

As terms are introduced for individual SAE documents, these terms will be considered for incorporation into this glossary. Any SAE document, of course, has the ability to define terms specific to that document which may be different from the definitions herein. However, authors are encouraged to use these terms as defined herein to reduce confusion.

Many of the terms in this revision of the document have been contributed by the related International Standards Organization (ISO) from their document ISO/TC22/SC3/WG1 N310E, dated November 1987.

This document shall be periodically reviewed for new terms to be included and possible modifications to the existing definitions. The addition of new terms is probable as the organization further documents Class A and Class C issues.

2. References

2.1 Applicable Documents—The following publications form a part of this specification to the extent specified herein.

2.1.1 ISO PUBLICATIONS—Available from ANSI, 11 West 42nd Street, New York, NY 10036

ISO/TC22/SC3/WG1 N310E—Glossary

3. Terms and Definitions

Acknowledgement—A type of response which is used to indicate whether a message has been received properly. Acknowledgements can be positive, indicating the message was received, or negative, indicating the message was not received.

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).

Arbitration—Making a decision relative to a controversy existing at the inputs of the nodes involved.

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.

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

Availability—The decimal fraction of the time during which a system is capable of performing its required functions. Availability is determined from reliability (Mean Time Between Failures) and repair time (Mean Time to Restore) by the relationship A = MTBF / (MTBF + MTTR). To avoid ambiguity, it is possible to define different levels or modes of operation and to determine an availability for each level or mode.

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.

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

Baud Rate—Transfer rate, measured in bauds which is signal transitions per second.

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Bit Rate—Bits per time during transmission, independent of bit representation.

Bit-by-Bit Contention—A contention-based arbitration, whereby the contention created by simultaneous access of multiple nodes on the network is resolved bit-by-bit. For example, bits may be represented as dominant and passive on the physical layer, dominant bits overriding passive ones in case of contention. For this example, the message with a dominant bit in the arbitration field survive without destruction, all others discontinue transmission. This procedure is repeated through all bits of the arbitration field.

Bridge—A node used to connect two networks that use similar protocols, as differentiated from a gateway.

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

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

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

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.

Carrier Sense—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). These capabilities permit the design of contention based protocols.

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

Carrier Sense Multiple Access With Collision Detection (CSMA/CD)—A type of CSMA method whereby when a node which is attempting to transmit detects that another node is also attempting to transmit, it delays for a time determined by a predefined contention algorithm.

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).

Class A System—A multiplex 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.

Class B System—A multiplex system whereby 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.

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.

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.

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.

Collision Avoidance Protocol—A protocol in which a node waits a fixed period of time after the end of the last message or after detecting that another node is also attempting to transmit before trying to transmit or to transmit again. Each node in a network is assigned a different fixed period of time.

Communication Control Instruction—Instruction which controls the process of message transfer in a communication system.

Communication Integrity—Feature of a communication system, that the information is transferred uncorrupted and arrives at its destination(s) without modification.

Contention—A state of the bus in which two or more transmitters are turned on simultaneously to conflicting states.

Contention-Based Protocol—A protocol or organization of communications data where the nodes providing the data seek the use of the communications medium (signal bus) and the bus is awarded based upon the application of a predefined algorithm (typically a priority structure) to the information the nodes provide.

Data Consistency—A feature of communications in some multiplex 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.

Distributed Control—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.

Driven Line Length—Total line length driven by any one node.

Driver—A solid state device used to transfer electrical power to the next stage, which may be another driver, an electrical load (power driver), a wire or cable (line driver), a display (display driver), etc.

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

Encoding—A method of how to represent information bits in data processing or communication systems.

Error—The inability of a system to perform properly caused by faults.

Error Message—Special message within a communication network informing all nodes about an error.

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

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

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

Fiber Optics—A communications medium (signal bus) consisting of either individual fibers or an assemblage of transparent glass or plastic fiber(s) bundled essentially together parallel to one another. This fiber or bundle of fibers has the ability to transmit light along its axis by a process of total internal reflection.

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

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 drive circuit is not required to be, and typically is not, packaged with the LED.

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

Flexibility—Ability of the system to function with nodes manufactured by various suppliers.

Flexible System—A system, consisting of nodes interconnected by a common communications medium (signal bus) according to established standards, to which nodes manufactured by another supplier can be added.

Frequency Division Multiplex Protocol—A protocol where the meaning of a bit of information on the signal bus utilizes the principle of frequency sharing among information channels where the data from each channel are used to modulate sinusoidal signals called sub-carriers so that the resultant signal representing each channel contains only frequencies in a restricted narrow frequency range. Multiplex radio transmission, for instance, is the simultaneous transmission of two signals over a common carrier wave.

Functional Addressing—Labeling of messages based on their operation code or data content.

Functional Assignment of Wires—Functional specification for each wire on the physical layer and labeling it with a name.

Gateway—A node used to connect networks that use different protocols, as differentiated from a bridge. A gateway acts as a protocol converter.

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

Ground Bus—The portion of the wiring serving all multiplex system nodes which provides ground potential and a return path for the current drawn by the node.

Initialization—Parameterization and eventual configuration of a system during start-up.

Internode Distance—Signal line length between any two nodes.

Length of Communication Medium—Maximum distance between any two nodes.

Line Driver—A solid state device (driver) used to transfer electrical energy to a wire or cable communications medium (signal bus), performing the transmit portion of the transceive function.

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Line Receiver—A solid state device used to receive electrically transmitted signals from a wire or cable communications medium (signal bus), performing the receive portion of the transceive function.

Link—A relatively simple communications system which is capable of supporting communications between exactly two nodes, typically located at the physical ends of the system.

Listening-Mode—On-mode, receive only; i.e., transmission is not allowed.

Local Error—Error in a communication network, which is detected only in some of the nodes.

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

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 are they presented to the application.

Message Frame—A portion of a communication protocol within the message transfer, specifying the arrangement and meaning of bits or bit fields in the sequence of transfer across the transmission medium.

Message Latency—The time required by a system to access the medium so as to begin the delivery of information. Message latency is measured from 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.

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

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.

Module—A subassembly with intelligence which typically accepts inputs from switches and/or sensors and provides outputs to actuators, lamps, and/or displays. In a multiplex system, a module is one type of node.

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.

Multi-Master—A system partitioned into several modules, where more than one module may temporarily control the communication network, sending information to or requesting information from other modules.

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

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

Multiplex Bus—The wiring serving all multiplex system nodes and including the signal, power, and ground buses.

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. (See the separate definitions of each.)

Network—A system capable of supporting communications by three or more nodes.

Network Access Scheme—Method used to award the communication network to one of the nodes for the transmission of a message.

Node—Any subassembly of a multiplex system which communicates on the signal bus. In addition to modules, nodes may include other devices which contain the intelligence necessary to support these communications. A node includes a transceiver.

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

Non-Return to Zero (NRZ)—A data bit format where the voltage or current value (typically voltage) determines the data bit value (typically one or zero).

Object Layer—The portion of a communication protocol specifying how to handle and to buffer entire messages and their respective control bits, and how to interface the actual application.

Off-Mode—System behavior when switched off.

On-Mode—System behavior in full operation.

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.

Physical Addressing—Labeling of messages for the physical address location of their source and/or destination(s). This is independent of its geographic location, connector pin, and/or wire identification assignments.

Physical Layer—The properties of the communications medium (signal bus) which can be determined by electrical measurements, such as voltages, currents, impedances, rise times, etc.

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

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.

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

Protocol—A formal set of conventions or rules for the exchange of information between nodes, including the procedures for establishing and controlling transmissions on the multiplex signal bus (message administration) and the organization, meaning, and timing associated with the bits of data (message transfer).

Pulse Width Modulation—A data bit format where the width of a pulse of constant voltage or current determines the value (typically one or zero) of the data transmitted.

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

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

Redundancy—Added features in a communication and/or data processing system which are not essential for the specified operation but which allow the detection of errors or continuation of operation in case of defects.

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.

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

Response Data—A response to a message which provides the data (information) requested in the message.

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

Self-Blocking—The assignment process of multiple tasks to a single execution instance is called self-blocking, if it may get stuck without a chance for recovery.

Signal Bus—The wire(s) in the portion of the wiring serving all multiplex system nodes which are dedicated to communications between the nodes.

Sleep-Mode—Node behavior on a low power consumption standby, waiting to be switched on by a message. This is distinct from an Off-Mode where there is no power consumption, disconnected from the power supply.

Star Topology—Nodes connected by links to a central unit which acts as a central processor or switching point.

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. In a multiplex system, the input device is designated as a switch, and the output device is designated as a driver.

Synchronization—Procedure to ensure a desired timing for interrelated actions and/or processes.

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

System Elasticity—The capability to easily add or delete nodes and functions, permitting the multiplex wiring system to be easily expanded or contracted as required. Reprogramming of units not added or deleted should be minimized in an elastic system. This expansion and contraction may be due to model to model variations, year to year changes, or the desire for new features and accessories.

Time Division Multiplex Protocol—A protocol where the mean-

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