

Class C Application Requirement Considerations

Foreword—Three classes of vehicle communications have been defined by the SAE Vehicle Networking for Multiplexing & Data Communications Standards Committee. One of those classes, Class C applications, represents those communications which are intended for real-time control systems such as engine controls and anti-lock brakes in order to facilitate distributed control and further reduce vehicle wiring. The requirements for these applications are different from those required for either Class A or Class B applications. This paper describes those requirements specific to a Class C application. An example system is provided for consistency of discussion.

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1. **Scope**—This SAE Recommended Practice will focus on the requirements of Class C applications. The requirements for these applications are different from those required for either Class A or Class B applications. An overall example system is provided for consistency of discussion.

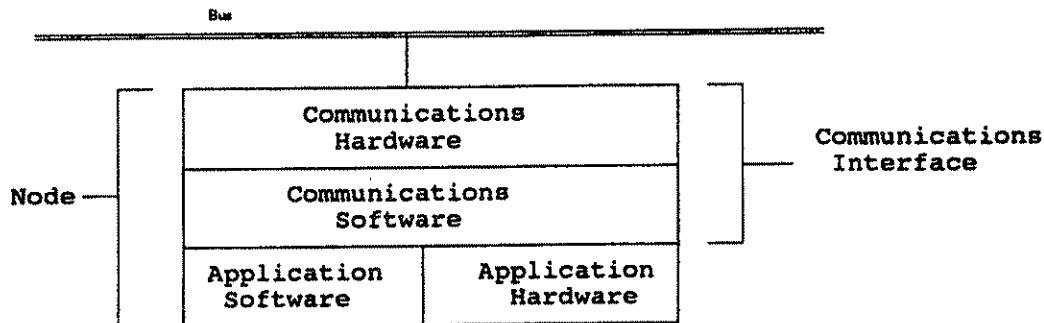


FIGURE 1—TYPICAL NODE BLOCK DIAGRAM

Figure 1 is a block diagram of a typical network node. The hardware and software for both the communication interface and the application itself are shown. For the purposes of this discussion the communication hardware and software will be considered as the communication interface. This paper will discuss the requirements for the communication interface (both hardware and software) without necessarily determining whether it will be accomplished by hardware or software. This choice is left as a subsequent trade-off. Thus requirements are presented from the perspective of the application.

The examples provided are for discussion purposes only and are in no way intended to be an endorsement or recommendation of how a specific application should be designed.

- 1.1 **Background**—Three classes of vehicle communications have been identified by the SAE Vehicle Networking for Multiplexing & Data Communications Standards Committee. These classes are defined as follows:

- a. Class A—A potential multiplex system usage 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 conventionally wired vehicle.
- b. Class B—A potential multiplex system usage whereby data 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.
- c. Class C—A potential multiplex system usage 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 further reduce vehicle wiring.

These three classes describe the various applications of communication that are anticipated to exist within a vehicle. Each class is intended to be able to support the lower level classes of applications also. That is, Class A systems are designed for basic low level switch multiplexing. Class B introduces the aspect of parametric data sharing while still providing for Class A applications. Class C introduces the aspect of real-time closed-loop feedback machine control but still allows Class B and Class A tasks to be performed. Issues such as cost, reliability, and performance will determine which link or combination of links are most appropriate for a given application.

It is believed there are significant benefits available to the automotive, component, and semiconductor manufacturers in developing a standard Class C communication network. The work performed toward standardization of the Class B network has provided insight into the magnitude of and potential methods for this effort, and has shown that this is a significant undertaking — one which must be initiated early. A discussion of the benefits of standardization are presented in Appendix A.

2. *References*

2.1 Applicable Publications—The following publication forms a part of this specification to the extent specified herein. The latest issue of SAE publications shall apply.

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

SAE J1850—Class B Data Communication Network Interface

2.1.2 OTHER PUBLICATIONS

Ford Motor Company, "ETX-I Final Report," Volume I

Patil, P. B., et. al., "Electric Transaxle System Design for an Advanced Electric Vehicle Powertrain," EVC Expo 83, Paper No. 8324, Dearborn, Michigan, October, 1983

Bates, B., et. al., "A Vehicle Control System for an Electric Vehicle," 19th IECEC, Paper No. 849441, San Francisco, California, August, 1984

Landman, R. G., et. al., "Control System Architecture for an Advanced Electric Vehicle Powertrain," SAE Paper No. 871552, Future Transportation Technology Meeting, Seattle, Washington, August, 1987

3. Example Description—To clarify the communication requirements of a distributed control system, an electric vehicle drive- and brake-by-wire system is described. One version of the system was implemented in an advanced electric vehicle powertrain called ETX-I (ETX-Electric Trans-Axle). The system consisted of seven modules: the vehicle controller (V/C), the inverter/motor (I/M) controller, the instrument panel display, the transmission, the traction battery, brakes, and driver inputs.

The vehicle controller is the command center of the system. It electronically interprets all driver demands by monitoring the accelerator and brake pedals and the shift lever and provides the desired wheel torque response by appropriately controlling the inverter, motor, transmission, and brake operation. It also provides fault management and diagnostics. In the ETX implementation, two dedicated serial data links were used: one between the vehicle controller and I/M controller and the other between the vehicle controller and the display. All other signals, such as between the vehicle controller and the transmission or the I/M controller and the inverter, used hard wires. However, a network-based system configuration with intelligent nodes for each major subsystem as shown in Figure 2 is feasible and is used to illustrate the communication requirements of a distributed control system.