

# SURFACE VEHICLE STANDARD

**SAE** J1939-01

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Submitted for recognition as an American National Standard

## Recommended Practice for Control and Communications Network for On-Highway Equipment

**Foreword**—This series of SAE Recommended Practices have been developed by the Truck and Bus Control and Communications Network Subcommittee of the Truck and Bus Electrical and Electronics Committee. The objectives of the subcommittee are to develop information reports, recommended practices and standards concerned with the requirements design and usage of devices which transmit electrical signals and control information among vehicle components. The usage of these recommended practices is not limited to truck and bus applications, other applications may utilize them as long as they adhere to the recommended practices listed herein.

These SAE Recommended Practices are intended as a guide toward standard practice and are subject to change so as to keep pace with experience and technical advances.

As described in the parent document, SAE J1939, there are a minimum of five documents required to fully define a complete version of this network. This particular document, SAE J1939-01, identifies one such complete network by specifying the particular set of SAE J1939 documents which define the Truck and Bus Control and Communications Vehicle Network as it applies to on-highway equipment.

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- 1 **Scope**—This series of recommended practices are intended for heavy duty vehicles used on roads (on-highway). It is recognized that these recommended practices or portions may be utilized for other applications such as stationary applications which use vehicle derived components (e.g., generator sets). Such alternative applications are allowed even though they are not the primary intent of this SAE recommended practice.

The purpose of these recommended practices is to provide an open interconnect system for electronic systems. It is the intention of these recommended practices to allow electronic devices to communicate with each other by providing a standard architecture.

Vehicles covered include all on-highway straight trucks and road trains. A road train consists of one towing vehicle (tractor), and one or more towed vehicle(s) (trailers and dollies). Dolly axles within the road train are considered to be towed vehicles.

- 1.1 **Degree of Openness**—A network based upon this document is open to the degree that any two devices which conform to SAE J1939-01 can be connected via the network and communicate with each other without functional interference. Devices that conform to different SAE J1939-0x documents may not be capable of communicating directly with one another and in some cases may cause degradation or complete disruption of the entire network.

## 2. References

- 2.1 **Applicable Documents**—The following publications form a part of this specification to the extent specified herein. Unless otherwise indicated, the latest version 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 J1939—Recommended Practice for a Serial Control and Communications Vehicle Network

SAE J1939-11—Physical Layer—250K Bits/s, Shielded Twisted Pair

SAE J1939-13—Off-Board Diagnostic Connector

SAE J1939-15—Reduced Physical Layer, 250K Bits/s, Un-Shielded Twisted Pair (UTP)

SAE J1939-21—Data Link Layer

SAE J1939-31—Network Layer

SAE J1939-71—Vehicle Application Layer

SAE J1939-73—Application Layer - Diagnostics

SAE J1939-81—Network Management Protocol

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

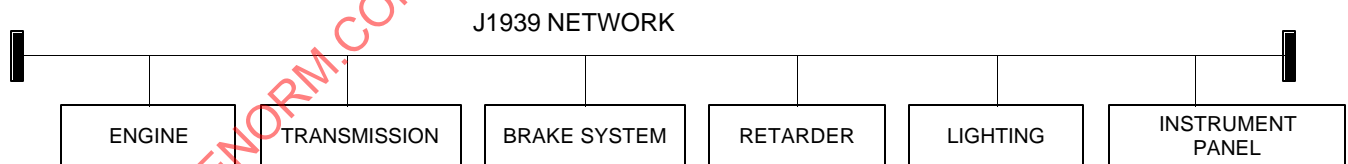
ISO 11992

### 3. Technical Requirements

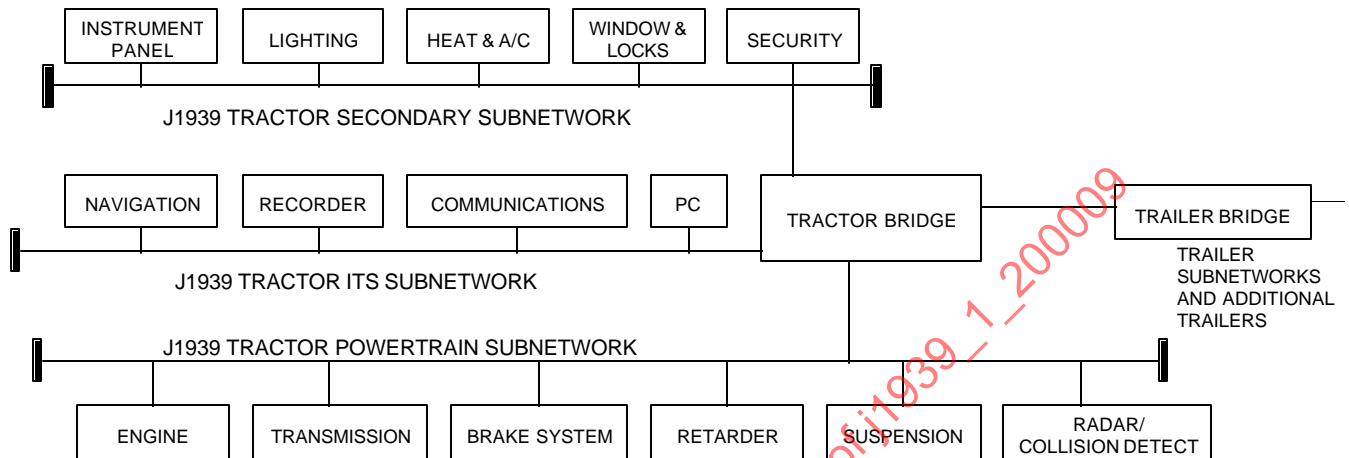
**3.1 Use of SAE J1939 Documents**—The SAE J1939 family of networks follows the 7 layer OSI network architecture with a different document describing each layer used (not all 7 layers are used). The SAE J1939-01 on-highway equipment network makes use of the following J1939 related documents:

SAE J1939	This top-level document describes the network in general, the OSI layering structure, the subordinate document structure, and provides control for all preassigned values and names.
SAE J1939-11	Physical Layer, 250K Bits/s, Shielded Twisted Pair. Used on the tractor and as a subnetwork on trailers.
SAE J1939-13	Physical Layer, Off-Board Diagnostic Connector. Used to access the network with external devices such as diagnostic tools.
SAE J1939-15	Reduced Physical Layer, 250K Bits/s, Un-Shielded Twisted Pair (UTP)
SAE J1939-21	Data Link Layer
SAE J1939-31	Network Layer
SA E1939-71	Vehicle Application Layer. Provides the definition of most data elements and messages.
SAE J1939-73	Application Layer - Diagnostics. Provides the definition of data elements and messages used for diagnostics and related network support functions.
SAE J1939-81	J1939 Network Management Protocol

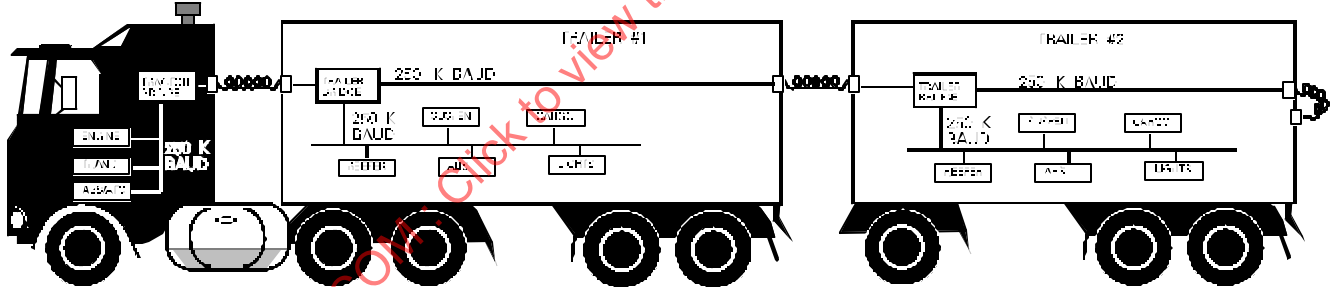
**3.2 Use of Subnetworks**—The network may consist of a single physical layer as shown in Figure 1, as a primary network with one or more subnetworks connected to it, or as multiple subnetworks as shown in Figure 2. The particular devices shown in these figures are only for illustrative purposes; the exact set of devices used may vary considerably from vehicle to vehicle. Either SAE J1939-11 or -15 physical layer may be used for the primary or subnetworks. A bridge is used whenever a subnetwork connects to a primary network or to another subnetwork. An example of bridge placement is at every trailer or dolly which will provide address assignment and electrically isolate the trailer subnetwork from the primary network. Not explicitly illustrated but implied is that dollies utilize the same bridge and subnetwork structure as trailers. Figure 3 illustrates the use of these different physical layers within a typical truck with trailers connected.



**FIGURE 1—SINGLE NETWORK (SPECIFIC ATTACHED DEVICES ARE ONLY AS EXAMPLES)**



**FIGURE 2—EXAMPLE OF VEHICLE USING MULTIPLE SUBNETWORKS  
(SPECIFIC ATTACHED DEVICES ARE ONLY AS EXAMPLES)**



**FIGURE 3 – A POSSIBLE ON-HIGHWAY TRUCK IMPLEMENTATION**

The number of subnetworks and the selection of devices to be connected to each are left to the vehicle manufacturer to define. The use of SAE J1939 on any towed vehicle (trailer or dolly) will automatically result in the use of at least two subnetworks, one for the tractor and one for the towed vehicle.

The decision to use multiple subnetworks on the tractor may be driven by the number or types of devices to be supported. The bridge between these subnetworks can be used to filter messages between them, effectively isolating one subnetwork from the other with the exception of those messages that are allowed to pass through the bridge. The tractor and trailer bridges may also include the ability to filter messages on each side of it that are not applicable to the vehicle on the other side. For instance, there is no need to transmit the majority of engine or transmission messages back to the towed vehicle.

"ISO 11992 has been published as a worldwide standard to allow point-to-point communications between towing and towed vehicles across dedicated twisted pair wiring. This solution is used in ECE countries (especially in Europe) where it is a legal requirement for braking systems that use digital data communication between towing and towed vehicles. Because two (new) connector pins are needed for this connection ISO 11992 has not been generally accepted by North American customers. Nevertheless, ISO 11992 could be implemented also in the North American market if a need is identified. Development of alternative means of linking SAE J1939 networks on towing and towed vehicles continues in North America.

**3.3 Intelligent Transportation System Implementations**—There are a number of Intelligent Transportation System (ITS) applications that will be used in commercial on-highway vehicles. Among these are various navigation aids, traveler information systems, commercial vehicle weigh-in-motion, automated credentials and clearances, hazardous materials control, and automated border crossings. These applications will often require the addition of devices that are not normally a part of the primary vehicle. Some of these devices may be installed during initial manufacturing, but many will be installed as after-market devices.

For passenger cars, there is generally a clear distinction between the ITS applications and normal vehicle functions/systems. This fact, when combined with the manufacturers desire to prevent aftermarket devices from interfacing with any primary vehicle networks, dictates the need for a totally distinct network protocol for ITS applications and devices. For commercial vehicles, there is considerable overlap between primary and/or normally included systems and those used for ITS applications. For commercial vehicles, there is also a willingness to accept select aftermarket devices being connected to the vehicle's network, as the entire vehicle can often be considered to be a collection of "aftermarket" devices, reflecting the nature of the horizontally integrated industry. Having a unique network protocol just for ITS is a decided disadvantage rather than the advantage it offers to passenger cars. For this reason, plus the fact that SAE J1939 was initially developed with many of the ITS applications in mind, it is anticipated that SAE J1939 may be used for all ITS applications.

There may be occasional need to utilize a different network, such as the passenger car ITS DataBus (IDB). For the IDB or any other comparable network, a gateway will be required to provide an interface between SAE J1939 and this other network. It will be up to the vehicle manufacturer to determine the desirability of adding this additional network with the necessary gateway function (in general, a gateway is more complex and thus more expensive than a bridge). As of the publication date of this document, IDB devices are planned, but not yet in production. Should such devices become commonplace in passenger cars, it may become justifiable to add the gateway so as to enable use of these off-the-shelf passenger car devices.

As shown in Figure 4, the ITS functions can be supported by the SAE J1939 network or by adding a gateway to the IDB network. The figure illustrates the use of a separate SAE J1939 subnetwork for ITS functions, but of course this is not a requirement and the exact architecture is left to the vehicle manufacturer. As shown, it is possible to distribute such functions between any combination of the SAE J1939, SAE J1708, and IDB networks. As with the previous architectural illustrations, the devices shown are examples only and will vary from vehicle to vehicle.