



SURFACE VEHICLE INFORMATION REPORT

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Digital Communications for Plug-in Electric Vehicles

RATIONALE

SAE J2931/1 provides the high-level requirements for plug-in electric vehicle (PEV) charging and discharging. This update is for the scheduled Five-Year Review; tables were updated to include missing headers.

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For more information on this standard, visit
https://www.sae.org/standards/content/J2931/1_202309

Documents

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1. SCOPE

This SAE Information Report, SAE J2931, establishes the requirements for the powerline carrier (PLC) digital communication between plug-in electric vehicles (PEVs), the electric vehicle supply equipment (EVSE) and the utility or service provider, energy services interface (ESI), advanced metering infrastructure (AMI), and home area network (HAN).

This specifies the digital communication protocol stack between PEVs and the EVSE. The purpose of the stack outlined in Figure 1 and defined by layers 3 to 6 of the open systems interconnection (OSI) reference model (Figure 1) is to use the functions of layers 1 and 2 specified in SAE J2931/4 and export the functionalities to layer 7 as specified in SAE J2847/2 (as of August 1, 2012, revision) and SAE J2847/1 (targeting revision at the end of 2012).

Communications between the EVSE and other than PEV entities such as AMI, ESI, HAN, utility head-end, etc., as shown in Figure 2 are outside of the scope of this document. It is presumed that a bridging device will be required to carry PEV information beyond the EVSE and may be collocated with the latter.

The effort continues however, to additional comments and viewpoints, while the task force also continues additional testing and early implementation. Results of this effort will then be incorporated into updates of this document and lead to a republished versions as needed.

The SAE J2931 family of documents has been organized into several “slash” subsections:

This document, SAE J2931/1, defines architecture and general requirements including association, registration, security, and HAN requirements, as well as mapping to other SAE documents.

SAE J2931/4 defines the MAC and PHY layer implementation of digital communications using BB OFDM and either the SAE J1772 pilot wire or mains.

Testing and validation of the aforementioned physical layer specifications is ongoing, and it is possible that the results of said testing may preclude one or more of the proposed solutions as unable to meet the technical requirements. Reduction of the available options to a single, worldwide standard remains the long-term goal.

The document mapping of the PEV communication standards are further defined in Section 5.

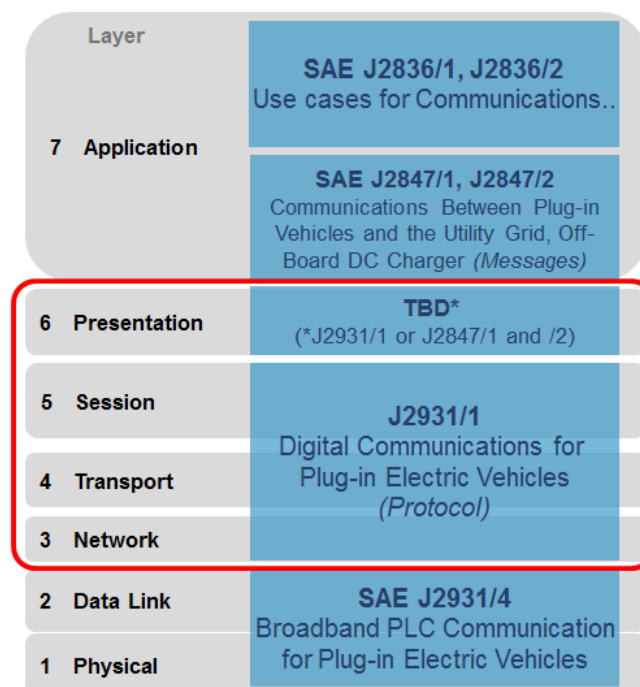


Figure 1 - Digital communications protocol stack

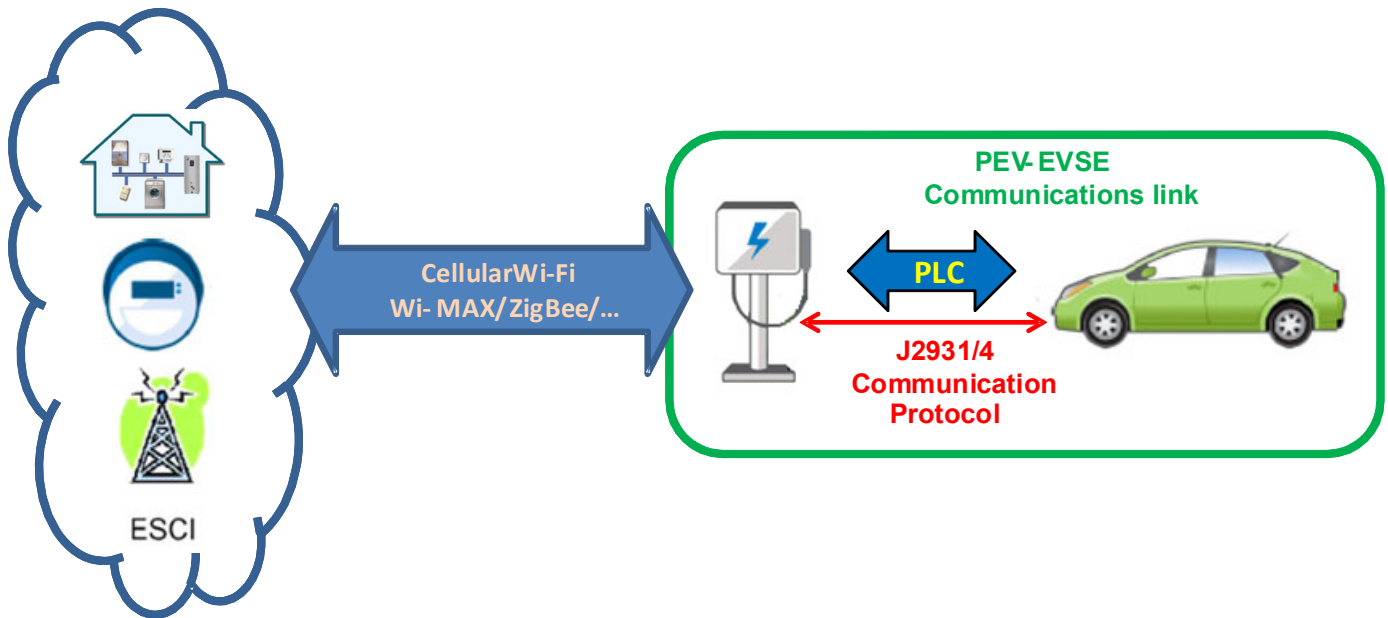


Figure 2 - SAE J2931/1 document scope: PEV-EVSE communication protocol

1.1 Purpose

The purpose of SAE J2931 is to define the digital communications interface between the PEV and an off-board device to which it communicates. Such off-board devices may include one or more of an EVSE, DC charger, HAN, AMI meter, etc.:

- To provide a safe electric energy transfer.
- To interact with energy providers in a secure manner.
- To communicate information to the customer on the transaction.

In this regard, SAE J2931 serves to complement SAE J1772, which describes the analog communication between the EVSE and the PEV. The Use Cases for communications between a PEV and the utility or service provider are described in SAE J2836 with the functional message details included in SAE J2847.

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 issue of SAE publications shall apply.

2.1.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

SAE J1772	SAE Electric Vehicle and Plug-in Hybrid Electric Vehicle Conductive Charge Coupler
SAE J2836	Instructions for Using Plug-in Electric Vehicle (PEV) Communications, Interoperability and Security Documents
SAE J2847/1	Communication for Smart Charging of Plug-in Electric Vehicles Using Smart Energy Profile 2.0
SAE J2847/2	Communication Between Plug-in Vehicles and Off-Board DC Chargers

SAE J2847/3 Communication for Plug-in Vehicles as a Distributed Energy Resource

SAE J2931/4 Broadband PLC Communication for Plug-in Electric Vehicles

2.1.2 DIN Publications

Copies of these documents are available online at <https://www.din.de/en/>.

DIN 70121 Electromobility Digital Communication Between a DC EV Charging Station and an Electric Vehicle for Control of DC Charging in the Combined Charging System

2.1.3 ISO Publications

Copies of these documents are available online at <https://webstore.ansi.org/>.

ISO 15118-1 Road vehicles - Vehicle to grid communication interface - Part 1: General information and use-case definition

ISO 15118-2 Road vehicles - Vehicle to grid communication interface - Part 2: Network and application protocol requirements

ISO 15118-3 Road vehicles - Vehicle to grid communication interface - Part 3: Physical and data link layer requirements

ISO 10731 Information Technology Open Systems Interconnection - Basic Reference Model - Conventions for the Definition of OSI Services

2.1.4 Internet Engineering Task Force (IETF) Publications

Copies of these documents are available online at <https://www.ietf.org/>.

IETF RFC 768 User Datagram Protocol

IETF RFC 793 Transmission Control Protocol - DARPA Internet Program - Protocol Specification

IETF RFC 1323 TCP Extensions for High Performance

IETF RFC 1624 Computation of the Internet Checksum via Incremental Update

IETF RFC 1981 Path MTU Discovery for IP Version 6

IETF RFC 2018 TCP Selective Acknowledgment Options

IETF RFC 2460 Internet Protocol, Version 6 (IPv6) Specification

IETF RFC 2988 Computing TCP's Retransmission Timer

IETF RFC 3484 Default Address Selection for Internet Protocol version 6 (IPv6)

IETF RFC 3782 The NewReno Modification to TCP's Fast Recovery Algorithm

IETF RFC 4291 IP Version 6 Addressing Architecture

IETF RFC 4294 IPv6 Node Requirements

IETF RFC 4429 Optimistic Duplicate Address Detection (DAD) for IPv6

IETF RFC 4443 Internet Control Message Protocol (ICMP v6) for the Internet Protocol Version 6 (IPv6) Specification

IETF RFC 4861	Neighbor Discovery for IP Version 6 (IPv6)
IETF RFC 4862	IPv6 Stateless Address Autoconfiguration
IETF RFC 4884	Extended ICMP to Support Multi-Part Messages
IETF RFC 5095	Deprecation of Type 0 Routing Headers in IPv6
IETF RFC 5220	Problem Statement for Default Address Selection in Multi-Prefix Environments: Operational Issues of RFC 3484 Default Rules
IETF RFC 5482	TCP User Timeout Option
IETF RFC 5681	TCP Congestion Control
IETF RFC 5722	Handling of Overlapping IPv6 Fragments
IETF RFC 5871	IANA Allocation Guidelines for the IPv6 Routing Header
IETF RFC 6298	Computing TCP's Retransmission Timer
IETF RFC 6335	Internet Assigned Numbers Authority (IANA) Procedures for the Management of the Service Name and Transfer Protocol Port Number Registry

2.1.5 World Wide Web Consortium (W3C) Publications

Copies of these documents are available online at <https://www.w3.org/>.

W3C EXI 1.0 Efficient XML Interchange (EXI) Format 1.0, W3C Recommendation

2.2 Related Publications

The following publications are provided for information purposes only and are not a required part of this SAE Technical Report.

2.2.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

SAE J2836/1	Use Cases for Communication Between Plug-in Vehicles and the Utility Grid
SAE J2836/2	Use Cases for Communication Between Plug-in Vehicles and Off-Board DC Charger
SAE J2836/3	Use Cases for Plug-in Vehicle Communication as a Distributed Energy Resource
SAE J2836/4	Use Cases for Diagnostic Communication for Plug-in Electric Vehicles
SAE J2836/5	Use Cases for Customer Communication for Plug-in Electric Vehicles
SAE J2836/6	Use Cases for Wireless Charging Communication for Plug-in Electric Vehicles
SAE J2847/6	Communication for Wireless Power Transfer Between Light-Duty Plug-in Electric Vehicles and Wireless EV Charging Stations
SAE J2847/1	Communication for Smart Charging of Plug-in Electric Vehicles Using Smart Energy Profile 2.0
SAE J2847/2	Communication Between Plug-in Vehicles and Off-Board DC Chargers

SAE J2847/3	Communication for Plug-in Vehicles as a Distributed Energy Resource
SAE J2931/1	Digital Communications for Plug-in Electric Vehicles
SAE J2931/4	Broadband PLC Communication for Plug-in Electric Vehicles
SAE J2894/1	Power Quality Requirements for Plug-in Electric Vehicle Chargers

2.2.2 ANSI Accredited Publications

Copies of these documents are available online at <https://webstore.ansi.org/>.

OpenHAN SRS 2.0 UCAlug Home Area Network System Requirements Specification

2.2.3 NIST Publications

Available from NIST, 100 Bureau Drive, Stop 1070, Gaithersburg, MD 20899-1070, Tel: 301-975-6478, www.nist.gov.

NIST IR 7628 Guidelines for Smart Grid Cybersecurity

2.2.4 IEEE Publications

Available from IEEE Operations Center, 445 and 501 Hoes Lane, Piscataway, NJ 08854-4141, Tel: 732-981-0060, www.ieee.org.

IEEE 2030.5-2018 Standard for Smart Energy Profile Application Protocol (SEP2)

2.2.5 Relation to Other Standards

2.2.5.1 Definition of OSI-Based Services

This document is based on the conventions discussed in the OSI service conventions (refer to ISO 10731) as they apply for the individual layers specified in this document. This document describes requirements applicable to layers 3 to 6 according to the OSI layered architecture.

2.2.5.2 Usage of RFC References

When RFCs are referenced, all “must/must not” requirements are mandatory. If a referenced RFC has been updated by one or several RFC, the update is fully applicable for this standard. If an update or part of an update applicable to an RFC referenced herein is not compatible with the original RFC or the implementation described by this standard, the update shall not apply.

3. DEFINITIONS

3.1 INBAND COMMUNICATIONS

Refers to types of communications using a digital signal modulated over the SAE J1772 pilot wire.

3.2 POWER LINE CARRIER (PLC)

Refers broadly to the group of communications technologies in which a modulated carrier is transmitted over AC power circuits. The same communications technologies and designs may sometimes also be applied to circuits that do not carry AC current.

3.3 PLUG-IN ELECTRIC VEHICLE (PEV)

This is the generic term used to describe any vehicle that plugs in to receive electrical energy. This includes many different classifications of vehicles, such as battery electric vehicles (BEVs), plug-in hybrid electric vehicles (PHEVs), extended range electric vehicles (E-REVs), and so on.

3.4 ELECTRIC VEHICLE SUPPLY EQUIPMENT (EVSE)

This is the generic term used to describe the device that is physically connected and provides energy to the vehicle. EVSEs may take several physical forms, and their logical function may likewise differ substantially. Physical forms include a mobile cordset used for 120 VAC charging, a fixed or wall-mounted 240 VAC charger, or an off-board DC charger. In terms of logical function, any EVSE may or may not include one or more of the following: a “gateway” or physical layer bridge function to bridge PEV communications to the HAN/AMI, a device that communicates directly with the HAN/AMI itself, etc.

3.5 ENERGY SERVICES INTERFACE (ESI)

An ESI provides a particular logical function in the HAN. It is an interface which enables secure communications between authorized parties (e.g., utility or service provider, consumer, non-utility or service provider service providers, EMS, etc.) and all commissioned HAN devices that are registered to it. The HAN architecture allows for more than one ESI in a consumer premises. Each ESI creates an independent logical power distribution network within the premises, each with its own security, described further in SAE J2931/7, Section 5. HAN devices (e.g., EMS, internet gateway, etc.), which are active on multiple physical networks or transmission media, must have a logical separation between those networks.

3.6 END-USE MEASUREMENT DEVICE (EUMD)

This is the device that is responsible for metering of energy being transferred to a PEV, and is required for utility or service provider programs such as special EV rates or roaming. The EUMD may be either a physically discrete unit (for example, a submeter located in a branch circuit for PEV charging), or a logical function integrated into another physical device (for example, the EUMD logical function may be built into an EVSE or the EV). The EUMD is typically (but not necessarily) owned, certified, and implemented at the discretion of the local utility or service provider or energy distributor and may be subject to regulatory control.

3.7 HOME AREA NETWORK (HAN)

Refers to the network inside a residence that is usually owned, controlled and or managed by the home owner. A residence includes houses, apartments and other types of premise. Energy-related devices may use this network in the residence and may share the medium with other devices or networks. Examples of such devices include, but are not limited to appliances, displays, thermostats, etc. A PEV or EVSE may also be considered a HAN device, if it is capable of communicating with other devices in the network.

3.8 ENERGY MANAGEMENT SYSTEM (EMS)

An application used for controlling multiple energy-controllable devices (e.g., pool pump, programmable communicating thermostat, light switches, PEV charging, etc.). This application may reside within a HAN device (e.g., programmable communicating thermostat, in-home display, computer, cable set-top box, other computing device, etc.). This application may also control other devices or systems in the home providing integrated automated services for the consumer.

It may be owned and operated by the home/premise owner, utility or service provider, or other party.

3.9 ASSOCIATION CONTROL

Entity, that provides the whole functionality for EV to EVSE association and initialization, via the data link control SAP. This entity also controls the relationships between the basic signaling and the upper layers. The entity indicates link status and error information to higher layers. The control of PLC network management parameters is handled over the control SAP.

3.10 CHARGING SESSION

Time between the beginning (connection of the cable) and the end (disconnection of the cable) of a charging process.

NOTE: During a charging session, the EV may have none, one, or many periods of charging the battery, doing pre-conditioning or post-conditioning.

3.11 SERVICE ACCESS POINT (SAP)

Port or logical connection point to one of the seven layers of the open system interconnection (OSI) model.

3.12 DATA LINK CONTROL SERVICE ACCESS POINT (SAP)

Port or logical connection point between data link and network layer.

3.13 IP ADDRESS

IP-layer identifier for an interface or a set of interfaces.

3.14 GLOBAL ADDRESS

IPv6 globally routable address.

3.15 INITIALIZATION

Process of interaction between the EV, the EVSE and an external trigger, beginning from plug-in of the charging cable assembly until the decision for the charging mode to be applied.

3.16 LINK LOCAL ADDRESS

IP address with link-only scope that can be used to reach neighboring nodes attached to the same link.

3.17 MAC ADDRESS

Unique identifier assigned to network interfaces for communication on the data link layer.

3.18 MESSAGE SET

Set of mandatory messages and parameters for a specific protocol.

3.19 NODE

Device that is part of a communication network; e.g., a device implementing IPv6 in an IP network.

3.20 PHY

An implementation of the physical layer in the OSI architecture. Connects the data link layer and subsequent upper layers of the OSI model to a physical medium.

3.21 PROFILE

Group of mandatory and optional message sets.

3.22 SDP CLIENT

V2G entity that uses the SDP server to retrieve configuration information about the SECCs.

3.23 SDP SERVER

V2G entity providing configuration information for accessing the SECC.

3.24 TIMEOUT

Specific time a V2G entity monitors the communication system for a certain event to occur. If the specified time is exceeded, the respective V2G entity initiates the related error handling.

3.25 TIMER

Device or piece of software used in an implementation for measuring time. Depending on the specific use case a timer is used to trigger certain system events as well.

3.26 V2G COMMUNICATION SESSION

Association of two specific V2G entities for exchanging V2G messages.

3.27 V2G ENTITY

Primary or secondary actor participating in the V2G communication.

3.28 V2G MESSAGE

Message exchanged on application layer.

3.29 V2GTP ENTITY

V2G entity supporting the V2G transfer protocol.

4. ACRONYMS

For the purposes of this document, the following abbreviations apply:

AMI	Automated Metering Infrastructure
D-LINK	Data Link
DER	Distributed Energy Resource
DRLC	Demand Response/Load Control
EDC	EndDeviceControls
EMS	Energy Management System
ESI	Energy Services Interface
EV	Electric Vehicle
EVCC	Electric Vehicle Communication Controller
EVSE	Electric Vehicle Supply Equipment
EXI	Efficient XML Interchange
GUID	Globally Unique Identifier
HAN	Home Area Network
ICT	Information and Communications Technology
IP	Internet Protocol
MAC	Media Access Control
MME	Management Message Entry
ND	Neighbor Discovery
NMK	Network Management Key
OSI	Open Systems Interconnection

PDU	Protocol Data Unit
PEV	Plug-in Electric Vehicle
PLC	Power Line Communication
RFC	Request for Comments
SAP	Service Access Point
SDP	SECC Discovery Protocol
SDU	Service Data Unit
SE	Supply Equipment
SECC	Supply Equipment Communication Controller
SEP 2.0	Smart Energy Protocol 2.0
SLAAC	Stateless address auto configuration
TCP	Transmission Control Protocol
V2G	Vehicle-to-Grid Communication (refer to ISO 15118)
V2GTP	V2G Transfer Protocol
V2GTPPT_EXI	V2G Transfer Protocol Payload Type for EXI Messages
UDP	User Datagram Protocol
XML	Extensible Markup Language

5. DOCUMENT MAPPING

5.1 Summary

SAE has published multiple documents relating to PEVs and vehicle-to-grid interfaces. The purpose of this section is to describe the content within and relationships between the various documents, and examples of how to apply them to various scenarios. Existing document series are listed below, with a brief explanation of each.

- SAE J1772: Defines the physical interface and coupler requirements for PEVs.
- SAE J2836 series: General requirements and use cases. This document is divided into several sections. SAE J2836/1 is for utility/smart grid messaging. SAE J2836/2 is for DC charge control. SAE J2836/3 is for reverse energy flow. SAE J2836/4 is for diagnostics. SAE J2836/5 is for consumer requirements and the HAN.
- SAE J2847 series: Functional messaging requirements. This series of documents defines the functional messages required for a given function. This series is divided into several sections, which correspond to SAE J2836 above. SAE J2847/1 is for utility/smart grid messaging. SAE J2847/2 is for DC charge control. SAE J2847/3 is for reverse energy flow.
- SAE J2931 series: Digital communications for PEVs. This series of documents defines the requirements to enable digital communications for PEVs. This series is divided into several sections. SAE J2931/1 describes overall general requirements, and SAE J2931/4 proposed to define a HomePlug GreenPHY based MAC/PHY. Testing and validation of the aforementioned physical layer specifications is ongoing, and it is possible that the results of said testing may preclude one or more of the proposed solutions as unable to meet the technical requirements. Reduction of the available options to a single, worldwide standard remains the long-term goal.

The examples in the next section are to provide a clear overview of which specifications are applicable to different architectural and functional scenarios. Note that the scenarios described below are not mutually exclusive, and may be combined. For example, it is possible to implement utility or service provider programs using IEEE 2030.5 or Smart Energy Protocol 2.0 (SEP 2.0) together with DC energy transfer.

5.2 Example: Utility or Service Provider Programs Using IEEE 2030.5

- SAE J2836/1 defines the use cases for utility or service provider programs (U1 through U5) and system architecture.
- SAE J2847/1 defines the functional messaging between the PEV and the energy management system (such as an AMI meter, premise-based charge controller, etc.) and communication protocol stack information.
- SAE J1772 defines the physical interface and connector requirements.
- Digital communications interface:
 - SAE J2931/1 defines general communications requirements.
 - The MAC/PHY layer used for communication is defined by a subsequent section of SAE J2931, such as SAE J2931/4. Harmonization and testing efforts with respect to these sections and technologies is ongoing.

5.3 Example: DC Energy Transfer

- SAE J2836/2 defines the architectural requirements for DC energy transfer.
- SAE J2847/2 defines the functional messaging between the PEV and the off-board DC charger, and communication protocol stack information.
- SAE J1772 defines the physical interface and connector requirements.
- Digital communications interface:
 - SAE J2931/1 defines general communications requirements.
 - The MAC/PHY layer used for communication is defined by a subsequent section of SAE J2931, such as SAE J2931/4. Harmonization and testing efforts with respect to these sections and technologies is ongoing.

5.4 Example: Reverse Power Flow

- SAE J2836/3 defines the architectural requirements for reverse power flow.
- SAE J2847/3 defines the functional messaging required for reverse power flow, and communication protocol stack information.
- SAE J1772 defines the physical interface and connector requirements.
- Digital communications interface:
 - SAE J2931/1 defines general communications requirements.
 - The MAC/PHY layer used for communication is defined by a subsequent section of SAE J2931, such as SAE J2931/4. Harmonization and testing efforts with respect to these sections and technologies is ongoing.

6. REQUIREMENTS

6.1 High-Level Requirements

The following is a set of high-level requirements that shall be met:

- Use the existing charging Infrastructure; i.e., SAE J1772.
- Enable both public and residential charging.
- Accommodate both AC and DC charging methods.
- Interact with energy providers to optimize energy transfer at the lowest energy cost.
- Provide a single interoperable standard to assure compatible systems. Global acceptance is desired.
- Communicate with customer.
- Minimal customer interaction.
- Requirements should provide expansion capabilities and headroom.
- The selected vehicle communications technology must provide reliable communications in typical residential and commercial environments. These environments may include multiple devices, operating using multiple communications technologies, sharing a medium and therefore drive the need to consider both compatibility of technologies as well as potential interoperability.
- Security for the four basic areas including (1) utility communication, (2) DC charging/discharging, (3) telematics, and (4) wireless charging are identified in SAE J2931/7, Section 5.

6.2 Assumptions

The following are assumed:

- Home area networks will use a variety of different physical communication interfaces and protocols.
- The communication interface for receiving energy information is known as the ESI. The ESI is defined in the OpenHAN SRS version 2.0. The ESI may host various PEV resources important in managing PEV interactions with energy information. The PEV may “register” with the ESI for a charging session and may request and receive charging session information. In a typical home setting, the ESI may be the premise’s smart meter, as well as other forms (e.g., EVSE, internet gateway, PEV-hosted).
- An energy management system (EMS) if utilized may provide a gateway between the utility or service provider HAN and the consumer HAN and the Internet.
- A PEV can implement all of the anticipated functionality.
- If an intelligent PEV is connected to an Intelligent EVSE, the control can be taken over by the PEV.
- EVSE may control the charging of the PEV but may be limited in functionality; e.g., it has no knowledge of PEV’s state of charge.
- A method is required to correctly measure energy consumption of an individual PEV (e.g., for tax credits, special tariffs). This requires that a physical and logical relationship be established between a PEV, the EUMD measuring its consumption, and the premise’s electrical meter such that the PEV’s consumption be calculated separately from the premise’s consumption. This relationship is further defined in this document.

- The security requirements for human users and software applications are different from the purely technical security requirements found in many communication and device standards. For user security standards, more emphasis must be on “policy and procedures” and “roles and authorization” rather than “bits and bytes” cryptographic technologies that should be included in information and communications technology (ICT). In addition, engineering practices and system configurations must be taken into account, since no cryptography can compensate for poor design. Figure 3 illustrates the relationships between security requirements, threats, and attacks.

Security is structured into four sections in SAE J2931/7:

- Section 1: Security requirements for standards and specifications which do not address specific cybersecurity technologies but where interactions between human users, software applications, and smart devices must be secured.
- Section 2: Security requirements for standards and specifications that address ICT.
- Section 3: Engineering design and configuration requirements that provide system reliability, defense in depth, and other security threat mitigations.
- Section 4: Security requirements related to the OSI reference model.

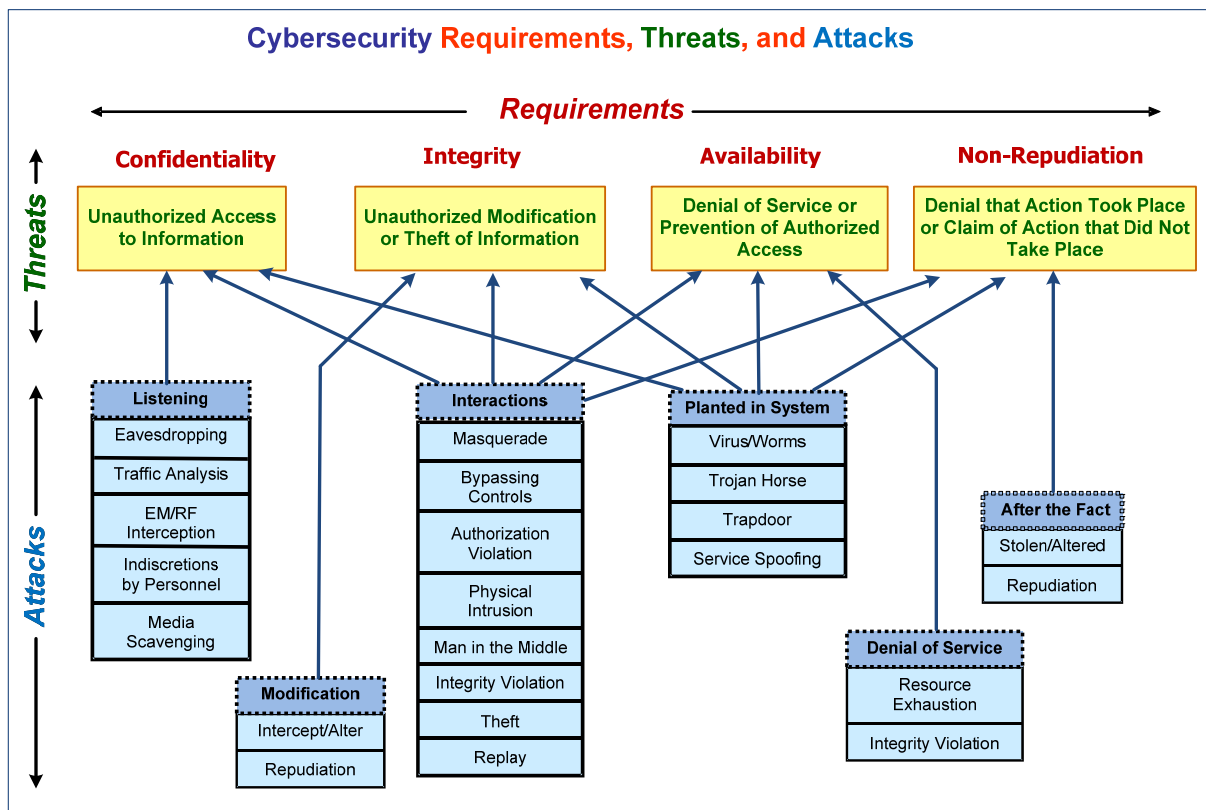


Figure 3 - Security requirements, threats, and possible attacks

6.3 Existing Charging Infrastructure

The conductive charging Infrastructure is defined in SAE J1772. The EVSE safely provides power to the PEV. SAE J1772 covers vehicle charging with both AC and DC current and defines three different power/voltage levels for each.

- AC Level 1 uses 120 V and the EVSE (typically a mobile cordset type) is normally part of the cable between the electric vehicle and a 15 A outlet.
- AC Levels 2 and 3 and DC Levels 1, 2, and 3 have the EVSE permanently mounted at the charging location.

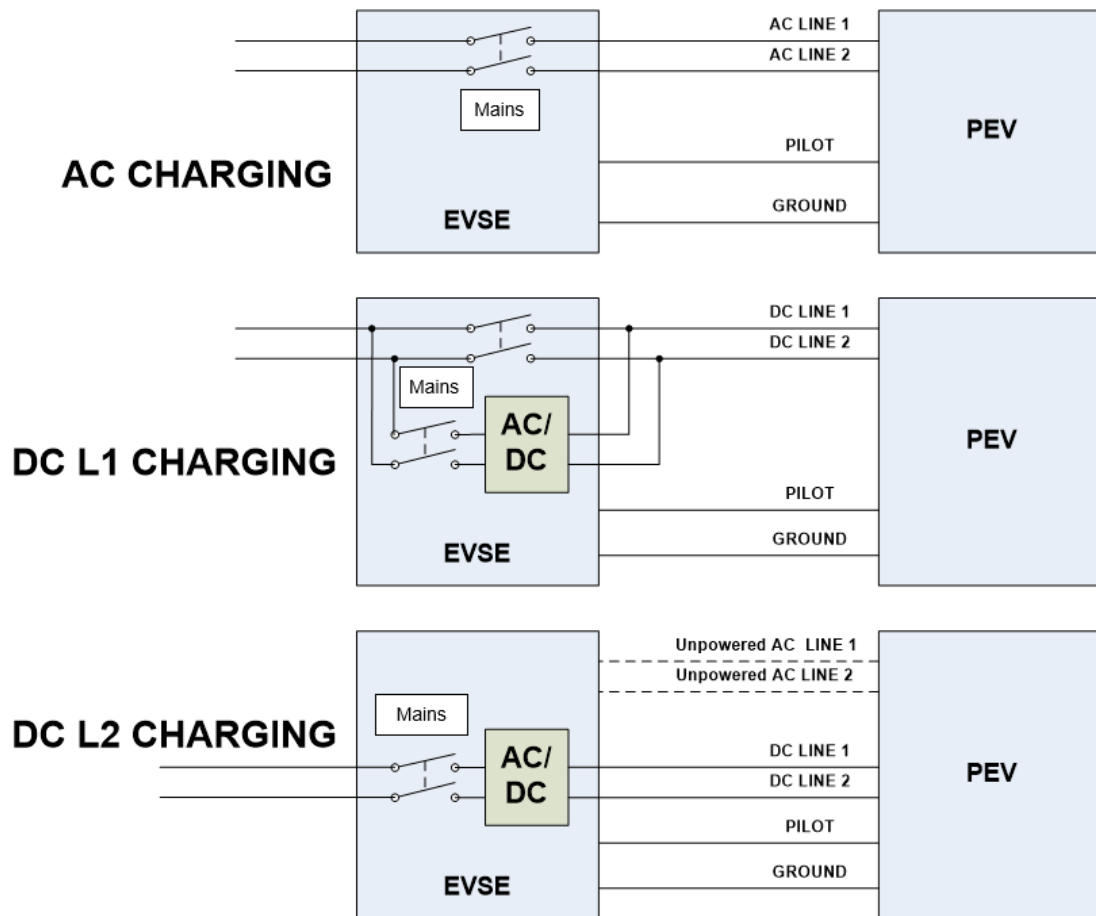


Figure 4 - Charging infrastructure

Notes for Figure 4:

- The pilot shares the system ground return circuit.
- If the communications medium between the PEV and the EVSE (or HAN), is not wireless, there are two possible wired connections: the Mains (in case of AC or DC L1/L2) and the pilot wire, which have a different set of characteristics, such as loads and interfering noise sources. The pilot wire extends only between the PEV and the EVSE.
- There may exist other media that may play a role in the future but the primary focus of this requirement document is on PLC which is being pursued as a primary option for PEV communication.

6.4 General Requirements

The priority column as defined in HAN SRS 2.0 includes:

- B or Basic: Minimum compliance threshold (required attribute). These are requirements basic to the function or logical device. Logical devices must comply with all basic requirements to be considered utility or service provider basic-compliant.
- O or Optional: Suggested requirement; some utilities, service providers, or other users of the standard may require these. These are requirements that are suggested to be included for this logical device. Vendors are encouraged to include optional functionality in a logical device where appropriate or cost effective. It is possible that some utilities may choose to include these as basic or enhanced requirements in their procurements.
- TBD or To Be Determined: The requirement cannot be defined at this time due to a lack of available data, pending development of future standards, requirements, etc.

Table 1 - General requirements

Requirement ID	Requirement	Reference	Priority
Application Requirements			
RD.App.1	Support basic utility or service provider use cases.	SAE J2836/1	Basic
RD.App.2	Support basic utility or service provider messages.	SAE J2847/1, SEP 2.0, ISO 15118	Basic
RD.App.3	If DC charging is provided, then support off board charger use cases.	SAE J2836/2	Basic
RD.App.4	If DC charging is provided, then support DC messages.	SAE J2847/2, ISO 15118	Basic
RD.App.5	Support reverse energy flow use cases.	SAE J2836/3	TBD
RD.App.6	Support reverse energy flow messages.	SAE J2847/3	TBD
RD.App.7	Support diagnostics use cases.	SAE J2836/4	TBD
RD.App.8	Support diagnostic messages.		TBD
RD.App.9	Support customer and HAN use cases.	SAE J2836/5	Optional
RD.App.10	Support customer and HAN messages.		Optional
RD.App.11	Utility or service provider messages and DC will use as many common components/software layers as possible and still comply with basic requirements to minimize cost.		Basic
RD.App.12	Interoperate with all EVSE and EV.	SAE J2953/1, SAE J2953/2	Basic
RD.App.13	Communication solution must not interfere with operation of existing legacy devices compliant with the current (2010) release of SAE J1772.	SAE J1772	Basic
RD.App.14	Support for multiple EUMDs, EVSEs, and ESIs on the same physical network (transformer).		Basic
RD.App.15	Support public and residential charging.		Basic
Common Communication Requirements			
RD.Comm.1	The DC and utility or service provider messages shall use the same channel or media between the EV and EVSE to minimize cost based on the different requirements.		TBD
RD.Comm.2	Meet industry EMC and radiated RF standards.		Basic
RD.Comm.3	Full compliance with SAE licensing terms—RANZ preferred.		Basic
RD.Comm.4	Solution shall be automotive-qualified.	AEC-Q100 for ICs and AEC-Q101 for discrete semis	Basic
RD.Comm.5	Solution shall demonstrate technological maturity proven in other general contexts.	Specific metrics TBD	TBD
RD.Comm.7	Global acceptance is desired.		Optional
RD.Comm.8	Solution shall be available from multiple vendors.		Basic
RD.Comm.9	Length of cordset is defined as in SAE J1772, with an assumed typical value of 25 feet.		Basic
RD.Comm.10	Solution shall be an international standard, i.e., IEEE.		Basic
RD.Comm.11	Resulting standard shall select one medium and one PLC technology for communication over the cordset.		Basic

6.5 Association Requirements

A HAN and neighborhood network may contain several ESIs, EUMDs, and EVSEs. A PEV and cordset EVSE are not permanent members of a HAN.

An association process is used to physically and logically associate which ESI, EUMD, and/or EVSE is connected to the PEV requesting a charge so that services (e.g., energy usage, billing, special EV tariffs, calculating tax, or carbon credits) can be securely offered and managed per NISTIR 7628, requirement SG.AC-4 for access enforcement.

6.6 Authentication Requirements

Once the PEV is authenticated and authorized by the correct servers in the HAN per NISTIR 7628, requirement SG.IA-5 for device identification and authentication, the PEV can discover the hosts of the Smart Energy Resources (e.g., metering, pricing, demand response/load control [DRLC]) it supports. Depending on the physical communications media used or HAN configuration, the EUMD may make the charging session information available to associated PEVs. The functionality of the system will be determined by the availability of Smart Energy Resource servers in the HAN.

Figures 5 and 6 shows the EUMD is electrically connected between the ESI and EVSE (it may be integrated). Figure 7 shows the EUMD integrated into the EV. Although this could eliminate the need to associate, as in the above, there could be substantial regulatory hurdles to redefine a EUMD in the PEV.

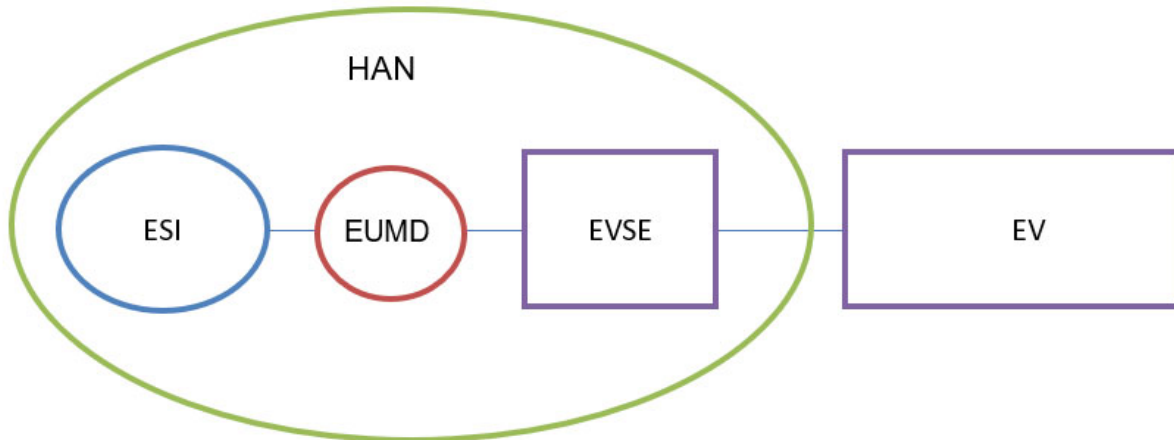


Figure 5 - Electrical network: HAN EUMD

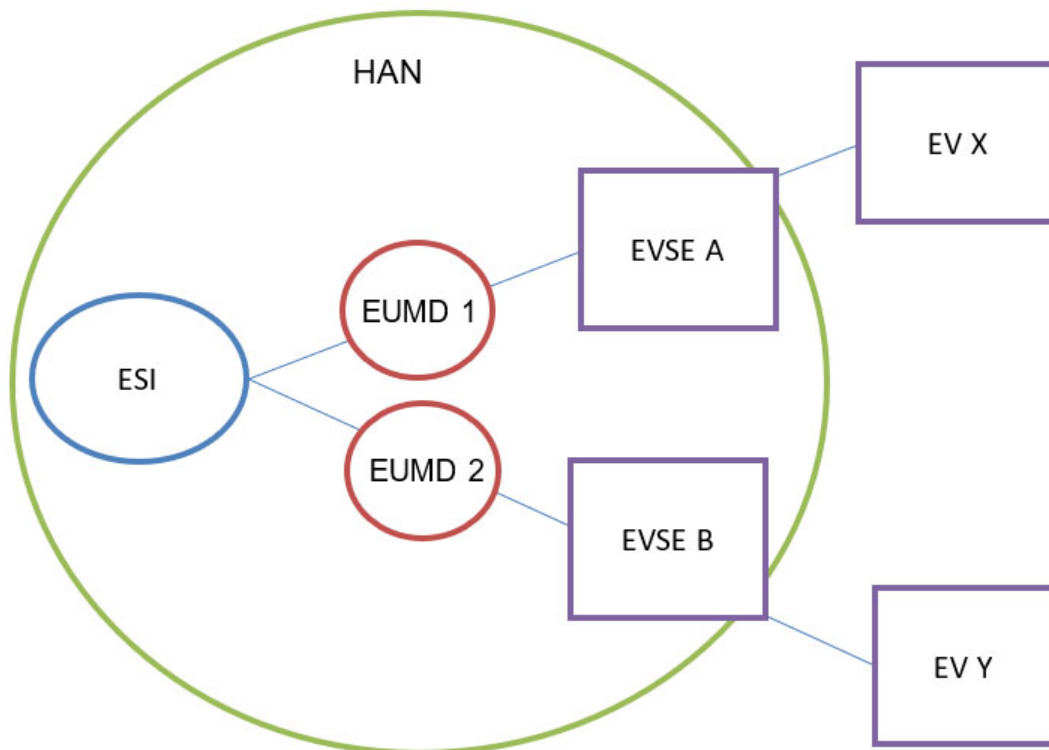


Figure 6 - Electrical network: multiple EVSE and multiple EUMD