Status: TEST

Version: 1.0

IEEE 2030.5 V2G-AC Profile

Implementation Guide for SAE J3072

SunSpec Specification

Abstract

SAE J3072 defines the interactions between an EVSE and a PEV for the PEV to be granted permission to discharge to the electric grid. This document defines an IEEE 2030.5 compliant profile for implementing SAE J3072 and can be used as an implementation guide on for using IEEE 2030.5 to satisfy SAE J3072 requirements.

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Revision History

Version	Date	Comments
0.7	01-18-2022	Draft candidate.
1.0	06-27-2022	Promoted to TEST status: ready for field trials and early deployments but not suitable for interoperability certification.

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1 Introduction

This profile serves to assist EVSE and PEV manufacturers, operators, and system integrators to implement the SAE J3072 requirements using the IEEE 2030.5 protocol.

SAE J3072 establishes requirements for a grid support inverter system function which is integrated into a plug-in electric vehicle (PEV) which connects in parallel with an electric power system (EPS) by way of conductively coupled, electric vehicle supply equipment (EVSE). Refer to SAE J3072 section 1 for an overview of the scope, purpose, and background of the standard.

This profile applies to System Type A1 (SAE J1772 AC L2 IEEE 2030.5). Information which is defined by SAE J3072 is directly exchanged between the EVSE and PEV using P2P PLC over the SAE J1772 control pilot in accordance with SAE J2931/4. The higher OSI-layers follow SAE J2931/1 and IEEE 2030.5 to the extent needed to meet the SAE J3072 requirements.

1.1 References

IEEE 1547-2018	*IEEE Standard for Interconnection and Interoperability of Distributed Energy Resources with Associated Electric Power Systems Interfaces* Unless otherwise indicated, any reference to IEEE 1547 refers to the 2018 revision.
IEEE 1547.1-2020	*IEEE Standard Conformance Test Procedures for Equipment Interconnecting Distributed Energy Resources with Electric Power Systems and Associated Interfaces* Unless otherwise indicated, any reference to IEEE 1547.1 refers to the 2020 revision.
IEEE 2030.5-2018	*IEEE Standard for Smart Energy Profile Application Protocol* Unless otherwise indicated, any reference to IEEE 2030.5 refers to the 2018 revision.
IEEE 802.3	*Standards defining the physical layer and data link layer's media access control (MAC) of wired Ethernet*
SAE J1772	*SAE Electric Vehicle and Plug-in Hybrid Electric Vehicle Conductive Charge Coupler*
SAE J2836/3	*Use Cases for Plug-In Vehicle Communication as a Distributed Energy Resource*
SAE J2847/3	*Communication for Plug-in Vehicles as a Distributed Energy Source* This IEEE 2030.5 V2G-AC Profile supersedes the SAE J2847/3 recommended practice guide.
SAE J2931/1	*Digital Communications for Plug-in Electric Vehicles*
SAE J2931/4	*Broadband PLC Communication for Plug-in Electric Vehicles*
SAE J3072-2021	*Interconnection Requirements for Onboard, Grid Support Inverter Systems.* Unless otherwise indicated, any reference to SAE J3072 refers to the 2021 revision.
UL 1741	*Standard for Inverters, Converters, Controllers and Interconnection System Equipment for Use with Distributed Energy Resources*

1.2 Acronyms

Acronym	Name
DER	Distributed Energy Resource
DME	DER Managing Entity
DNS-SD	Domain Name Service – Service Discovery
EPS	Electric Power System
EVSE	Electric Vehicle Supply Equipment
IEEE	Institute of Electrical and Electronics Engineers
mDNS	Multicast Domain Name System
MITM	Man-in-the-Middle
OID	Object Identifier (as used by the ITU and ISO/IEC)
PEV	Plug-in Electric Vehicle
PIN	Personal Identification Number as defined by IEEE 2030.5
PLC	Power Line Carrier
RA	Router Advertisement
RS	Router Solicitation
SAE	Society of Automotive Engineers
SLAAC	Stateless Address Auto-Configuration
SLAC	Signal Level Attenuation Characterization
ULA	Unique Local Address
URI	Uniform Resource Identifier
V2G	Vehicle-to-Grid

Table 1 – Acronyms

2 Guiding Principles

The following principles have been used to help guide the development of this profile. From a communications perspective

1. Establish a complete profile – To achieve complete interoperability a complete profile is required including a data model, messaging model, communication protocol and security. Without a complete profile specification, it would be impossible to achieve communications interoperability without additional systems integration activities.
2. Eliminate optionality and keep to a single base specification – Optionality in the specification can serve to hinder interoperability when parties chose to implement.
3. Create a minimal specification – A simple interface serves to lower costs and improve quality.

Strictly focus on EVSE to PEV communications. All other communications are out of scope from the perspective of this profile.

2.1 Scope of Profile

Normally, a profile simply limits the scope of the underlying standard (i.e., IEEE 2030.5) for a specific use case (i.e., SAE J3072). However, this profile does more than this. It also serves as an implementation guide for developers. As such, this profile fills in gaps in the communications protocol as well as the functional behavior of the EVSE and the PEV that are not directly addressed in other standards. There are normative requirements defined in this profile that are not provided in SAE J3072, IEEE 2030.5, or IEEE 1547.

2.2 Using the Profile

This document is a profile of the IEEE 2030.5 communications protocol for use in implementing the SAE J3072 standard. Knowledge of SAE J3072 is needed to understand the required interactions between the EVSE and the PEV for the PEV to be authorized to discharge. Knowledge of IEEE 2030.5 is needed to understand how messages are exchanged between the EVSE and the PEV. The purpose of the message exchanges between the EVSE and the PEV is to affirmatively convey the IEEE 1547 Management Information controls to the PEV. As such, knowledge of IEEE 1547 is useful.

3 System Architecture Overview

This section describes the system architecture and an overview of the expected operations of the system. This section is informative, not normative. The normative profile requirements will be described in section 4.

3.1 System Concept

The figure below (reproduced from SAE J3072 Figure 1) provides a system concept for a plug-in electric vehicle (PEV) with an onboard inverter system interconnecting to the electric power system (EPS) by way of a conductive coupling to electric vehicle supply equipment (EVSE). Refer to SAE J3072 section 4.1 for a complete description of the system concept underlying the standard.

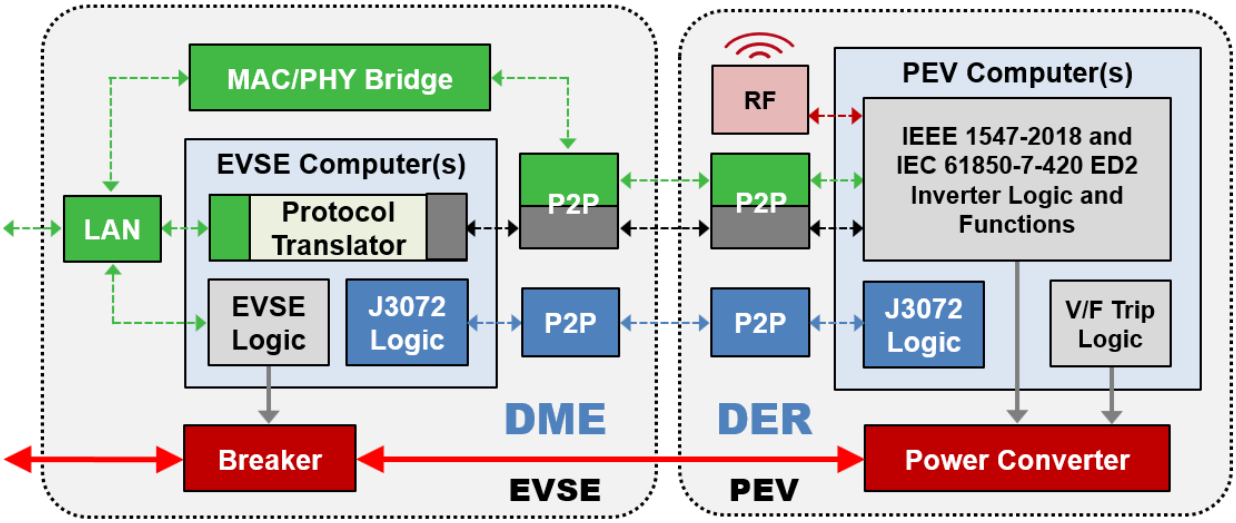

Figure 1 – System Concept

The primary focus of this document is to define requirements for the information that must be shared between the EVSE and the PEV, using the IEEE 2030.5 protocol, for the purpose of setting up the onboard inverter system for discharging at the EVSE site and for the EVSE to authorize the PEV inverter to discharge. These functions are illustrated by the dark blue boxes.

3.2 Security Considerations

Section 4.1.3 discusses security requirements. However, as this profile only addresses communications between the EVSE and the PEV, these requirements only consider the communications between the EVSE and the PEV and do not consider out-of-band communications to the EVSE, the PEV, or the security of the information stored on the EVSE or PEV.

3.3 Communications Architecture

The communications between the EVSE and the PEV is a point-to-point physical PLC link over the SAE J1772 control pilot. The PLC link supports an IEEE 802.3 physical layer and data link layer (layer 2, MAC layer). TCP/IP is expected to run on top to the link layer.

For multi-port EVSEs, each port is a physically separate point-to-point PLC link. From the EVSE point of view, each port appears as a separate network interface.

3.4 Expected EVSE and PEV Operations

The EVSE is an IEEE 2030.5 server that hosts all the required SAE J3072 resources for interacting with a J3072 compliant PEV. The PEV is an IEEE 2030.5 client that performs all the SAE J3072 functions required for obtaining the authorization to discharge.

When a PEV connects to the EVSE, the SAE J3072 authorization sequence begins. The PEV uses Service Discovery to find the EVSE server. The PEV establishes a TLS session to communicate with the EVSE server. The PEV performs Resource Discovery to find the locations of the relevant resources on the EVSE server. The PEV performs the J3072 Information Exchange needed to obtain authorization to discharge.

The EVSE evaluates the information exchange to see if the PEV satisfies all conditions needed for authorization to discharge. The EVSE grants or denies authorization.

This sequence of operations, triggered by the initial connection of the PEV to the EVSE, occurs once. If the EVSE denies authorization to the PEV, the PEV does not retry the authorization sequence. Instead, the PEV operates in its “Non-SAE J3072” mode of operation as it continues to monitor the authorization to discharge signal in case its authorization status changes.

The PEV then enters periodic operations where it continuously monitors its authorization to discharge. If the PEV is authorized to discharge, it sends metrology and status information the EVSE server. If the PEV is not authorized to discharge, it sends the “not authorized” status to the EVSE and can send metrology and other status information, but it is not obligated to do so.

Periodic operations continue for the duration of the charging session.

3.4.1 Service Discovery

When the PEV plugs into the EVSE, the PLC on the control pilot creates a network connection for IPv6 communications between the PEV and the EVSE. IPv6 Stateless Address Autoconfiguration (SLAAC) is used to establish unique-local addresses (ULA). The EVSE creates an IPv6 prefix and advertises this prefix using IPv6 Router Advertisements (RA). The PEV client uses Router Solicitation (RS) messages to request RA’s and uses the prefix in the RA to generate its own ULA.

For service discovery, the EVSE server implements an IPv6 mDNS responder and the PEV client discovers the EVSE server using IPv6 mDNS as defined in the IEEE 2030.5 standard.

3.4.2 TLS Session Establishment

After determining the EVSE server address and resource locations using mDNS, the PEV client makes a TLS connection to the EVSE server. Both the EVSE server and the PEV client have a valid IEEE 2030.5 compliant certificate that is exchanged and mutually authenticated as part of the TLS handshake.

3.4.3 Resource Discovery

After establishing a TLS connection, the PEV client obtains resource information located on the EVSE server. Resource discovery starts with the *DeviceCapability* resource, whose location was provided by mDNS. The client uses the *DeviceCapability* resource to discover other resources located on the EVSE server.

3.4.3.1 SelfDevice

DeviceCapability provides a link to the EVSE *SelfDevice* resource. This resource is used by the EVSE server to convey site limits to the PEV. The relevant site limits are defined in SAE J3072 Table 2.

3.4.3.2 EndDevice

DeviceCapability provides a link to the *EndDevice* resource. The PEV client traverses the *EndDevice* resource to find information specifically assigned to it. Resources found in *EndDevice* include:

- *FunctionSetAssignments* (FSA) where the PEV client can be directed to specific *DERPrograms* it must follow. These *DERPrograms* can contain the site's SAE J3072 Management Information (i.e., IEEE 1547 *DERCurves* and *DERControls*).
- DER information links where the PEV client can send its nameplate ratings, settings, and status. The EVSE uses the settings reported by the PEV to verify it is compatible with the site limits.
- *DeviceInformation* link where the PEV client can send its identity and other information
- *LogEvent* link where the PEV client can send any alarm messages. This link is optional in this profile.
- *PEVInfo* link where the PEV can send PEV related information. The PEV's Inverter System Model (ISM) number is sent to the EVSE server via this link. The EVSE server can verify the PEV's ISM is on the list of approved models.

3.4.3.3 Mirror Usage Point

DeviceCapability provides a link to the *MirrorUsagePoint* resource. The PEV client uses this resource to create a mirror usage point where it can send metrology information to the EVSE server. The EVSE server can use this information to help determine if the PEV is staying within its assigned limits.

3.4.3.4 Log Event List

DeviceCapability provides a link to the *LogEventList* resource. The PEV client uses this resource to send alarm messages to the EVSE server. Log Event support is not required in this profile.

3.4.3.5 Time

DeviceCapability provides a link to the *Time* resource. The PEV client uses this resource to obtain system time for event timing and timestamping messages. Note the EVSE can also provide a *Time* link within an FSA. In this case, the FSA *Time* link is used for the *DERProgram* timing.

3.4.4 Information Exchange to Obtain Authorization to Discharge

After the PEV has obtained the site limits and management information that are applicable to this site, and the EVSE has verified the information reported by the PEV is within the site limits, and the EVSE has optionally verified the PEV ISM is on the approved list, the EVSE grants the PEV authorization to discharge. Note that authorizing the PEV to discharge does not mean the PEV immediately starts discharging. The PEV may be commanded to start and stop discharging by a process outside the scope of SAE J3072.

The resource that is used to signal authorization to discharge is the *opModEnergize* object. This object maps to the IEEE 1547 Permit Service parameter.

If a PEV fails to get the authorization to discharge for any reason, it operates in its “Non-SAE J3072” mode of operation as it continues to monitor the *opModEnergize* object to see if will eventually get authorized.

While it does not have authorization to discharge, the PEV may choose to perform periodic metrology and status reporting described in section 4.7.2 but it has no obligation to do so. However, the PEV continues to send the heartbeat message for loss of communications detection described in section 4.8.1.1 regardless of its authorization to discharge status.

3.4.5 Periodic Operations

Periodic operations consist of the required SAE J3072 EV and EVSE functionality necessary to support operations after the PEV(s) has been authorized to discharge and prior to the end of the authorized discharge session. This includes ensuring the PEV remains compliant with the site settings and discharge authorizations, PEV management, and PEV monitoring.

3.4.5.1 PEV Compliance

For compliance, SAE J3072 requires the EVSE to be able to detect when the PEV is discharging incorrectly. To accomplish this, it is assumed the EVSE has metering hardware that can measure the output of the PEV. The EVSE may also rely in part on the metrology reported by the PEV for this determination. If the PEV is detected to be discharging outside the limits provided during the authorization to discharge process, the EVSE will remove authorization to discharge within 1 second. PEVs will also support per-second monitoring of its authorization to discharge. If the PEV detects authorization to discharge has been removed, the PEV will cease to discharge within a specified time limit. If the PEV continues to discharge when authorization to discharge has not been granted or has been removed, the EVSE will physically disconnect the PEV from the site.

3.4.5.2 PEV Management

IEEE 2030.5 supports two types of controls: *DERControls* and *DefaultDERControls*. A *DERControl* includes a start time, duration, and control-related parameters. Responses to *DERControls* (event status) may be required to be provided. *DefaultDERControls* are a type of control that is meant to be active if no *DERControl* is active. *DefaultDERControls* do not include start time and durations, nor are responses provided. The EVSE and the PEV will support both types of controls

During the discharging session, the EVSE may be sent a control from an external DER Managing Entity (DME). The EVSE will relay this control and related event parameters to the connected and approved PEV when it is received. If no PEV is connected and approved to discharge, the EVSE may store DER control events. The EVSE and PEV are required to support all control-related capabilities as defined in SAE J3072 sections 4.6.6, 4.7.2, and 4.7.4.

3.4.5.3 PEV Monitoring

Per SAE J3072, the PEV will periodically provide monitoring and PEV information to the EVSE. Monitoring information consists of measurements, status and other information that can be used to manage the PEV charging and discharging. The PEV and EVSE are required to support the monitoring information in SAE J3072 sections 4.7.3 and 4.7.4.

The PEV is required to be able to post this information as fast as one second, but in practice, the frequency of posting this information may be much lower. The EVSE server will use the

postRate attributes found the PEV's *EndDevice* and *MirrorUsagePoint* resource to indicate the required posting rates. The PEV will periodically poll these resources to obtain the required rates. The EVSE should also make these *postRates* configurable.

3.5 Other Functions

3.5.1 Exception Handling

The PEV operates in its "Non-SAE J3072" mode of operation unless it has been granted the authorization to discharge by the EVSE. The authorization to discharge could be removed explicitly by the EVSE by setting the *DefaultDERControl:opModEnergize* resource to false. When the PEV detects the authorization to discharge has been removed, the PEV will cease to discharge within a specified time limit.

The authorization to discharge is implicitly removed upon loss of communications with the EVSE or any other exception encountered by the PEV.

The PEV can force a restart of the SAE J3072 authorization process by a TBD method.

The EVSE monitors the PEV to verify the PEV is discharging within its authorized limits. The EVSE should withhold the authorization to discharge if it encounters any exception with the PEV. If the EVSE decides to withhold authorization, the EVSE should allow the PEV to operate in its preferred charging mode. The EVSE should only open the contactor if the PEV is discharging when it has not been authorized or if it is discharging outside its authorized limits.

The EVSE can force a restart of the SAE J3072 authorization process by a TBD method.

3.5.2 Coordinated Charging/Discharging

SAE J3072 requires the implementation of SAE J2836/3 Use Case U6 "Coordinated Charge/Discharge Management Function".

3.5.3 PEV Sleep/Wake Functions

For some scenarios, the PEV may go into a long-term sleep mode and then wakes up to resume normal operations. SAE J3072 does address this use case. Until SAE J3072 addresses this issue in a future revision, this profile recommends treating sleep mode as if the PEV has disconnected and the wake mode as if the PEV has re-connected.

4 Profile Normative Requirements

This section contains all the normative requirements of this profile. The following conventions are used.

- Mandatory: MUST, MUST NOT, SHALL, SHALL NOT
- Recommended: RECOMMENDED, SHOULD, SHOULD NOT
- Optional: MAY

Note: SAE J3072 requires compliance to IEEE 1547-2018 and IEEE 1547.1-2020. This profile indirectly references those documents as they are device and interconnection standards, whereas this profile is a communications protocol standard. However, it is helpful for the reader to be aware that much of the PEV/EVSE interactions originate from IEEE 1547 requirements.

4.1 IEEE 2030.5 Requirements

All devices SHALL comply with the IEEE 2030.5-2018 or later standard unless otherwise noted. If the standard is referenced without a date (e.g., IEEE 2030.5), the applicable version is IEEE 2030.5-2018.

4.1.1 Function Sets

As a profile of the IEEE 2030.5 standard, this section defines the IEEE 2030.5 function sets that are required to be implemented to support this profile. The EVSE MUST operate as an IEEE 2030.5 Server. The EVSE MAY operate as an IEEE 2030.5 Client, but this functionality is beyond the scope of this profile. The PEV MUST operate as an IEEE 2030.5 Client. The PEV MAY operate as an IEEE 2030.5 Server, but this functionality is beyond the scope of this profile. The following table shows the function sets that MUST be implemented for this profile. Other function sets MAY be implemented.

Function Set	EVSE (IEEE 2030.5 Server)	PEV (IEEE 2030.5 Client)
DeviceCapability	MUST	MUST
Time	MUST	MUST
SelfDevice:DER	MUST	MUST
EndDevice:DeviceInformation	MUST	MUST
EndDevice:PowerStatus:PEVInfo	MUST	MUST
EndDevice:DER	MUST	MUST
EndDevice:FunctionSetAssignment	MUST	MUST
MirrorUsagePoint	MUST	MUST
DER (Programs)	MUST	MUST
Response	MUST	MUST
Subscription/Notification	MUST	MAY

Table 2 – Profile Function Sets

4.1.2 Session-Static Resources

IEEE 2030.5 clients do not assume that URIs for resources are fixed on all servers or even on a given server (over time), but rather retrieve the appropriate URIs through resource discovery and links within resources. However, the IEEE 2030.5 standard does make the following allowance.

For network efficiency, devices MAY assume URIs are fixed on a particular server over time.

This profile uses this allowance to improve efficiency and simplify implementations by making certain Server resources static for the duration of the connect session. The table below shows which resources the EVSE server MUST remain static for the duration of the charge session.

Function Set	Resource
DeviceCapability	*DeviceCapability* and all top-level links
SelfDevice	*SelfDeviceLink*, all top-level links under *SelfDevice*, and all links under *SelfDevice:DERList:DER*
EndDevice	*EndDeviceListLink*, all top-level links under *EndDevice*, and all links under *EndDevice:DERList:DER*
MirrorUsagePoint	*MirrorUsagePointList* and *MirrorUsagePoint* in the Location Header

Table 3 – Session-Static Resources

4.1.3 Security

This profile supports all the security and certificate requirements of IEEE 2030.5 unless otherwise noted. The EVSE Server and the PEV Client MUST have an IEEE 2030.5 compliant certificate. All communications in this profile MUST use HTTPS. HTTP MUST NOT be used.

4.1.3.1 Additional Security Considerations

The only known vulnerability to the communications link between the EVSE and the PEV is a Man-In-the-Middle threat.

4.1.3.1.1 MITM Threat

The interface between the EVSE and the PEV defined in this document is subject to Man-In-the-Middle (MITM) attacks. In theory, an attacker can set up an illegitimate server on the PLC link and try to convince the PEV to talk to it instead of the EVSE server. In practice, this is probably difficult to do because of the point-to-point physical connection, and the SLAC protocol is used for the PEV to establish the PLC link to the correct EVSE. Also, an attacker must have a copy of a legitimate private key and certificate chained back to a valid Certificate Authority for this attack to work. However, even though this spoofing is difficult, it is not impossible; the risk of an MITM attack is low, and the risks of a successful attack are acceptable. Therefore, this profile does not attempt to mitigate this MITM risk.

4.1.3.1.2 MITM Mitigation Considerations

This profile considered the use of the IEEE 2030.5 Registration PIN for the PEV to authenticate the EVSE server to mitigate the MITM threat. This mitigation technique requires both the EVSE and the PEV to support Registration, and it requires additional user interactions that degrade the user experience.

Weighing the benefits of this MITM protection versus the added burden to the user, this profile chose not to implement this mitigation technique.

4.1.4 Subscription and Notification

This profile requires certain Server resources MUST be subscribable to improve efficiency. The following table lists the resources the Server MUST make subscribable.

Resource
DER:DERProgram:DERControlList
DER:DERProgram:DefaultDERControl
FunctionSetAssignmentsList
DER:DERProgramList

Table 4 – Subscribable Resources

The PEV client SHOULD use Subscription/Notification to improve network efficiency. If Subscription/Notification fails for the PEV or if the PEV chooses not to use subscriptions, the PEV MUST poll these resources at the *pollRate* specified by the EVSE server. For these subscribable resources, the EVSE server MUST be capable of setting the *pollRate* as fast as 1 second and the PEV client MUST be capable of polling at a *pollRate* as fast as every 1 second.

In addition, the EVSE SHALL set the *DERProgramList:pollRate* to 1 second and this *pollRate* SHALL NOT be changeable.

4.2 Networking

The scope of this networking section is the link between the EVSE and the PEV.

4.2.1 Physical Layer

SAE J3072 System Type A1 (AC Level 2 Charging) uses power-line communications (PLC) over the SAE J1772 control pilot as a point-to-point physical connection between the EVSE and the PEV as specified in Appendix G.3 of the SAE J3072 standard.

4.2.2 MAC Layer

The PLC connection provides an IEEE 802.3 ethernet link between the EVSE and the PEV.

4.2.3 IP Layer

IPv6 SHALL be used for all SAE J3072 communications between the EVSE and the PEV. IPv4 is not supported.

IPv6 unique local addresses (ULA) in the address block `fd00::/8` SHALL be used. The PEV SHALL use SLAAC (stateless address autoconfiguration) to obtain the unique local address for SAE J3072 EVSE communications. The EVSE SHALL advertise the ULA network prefix via Router Advertisement (RA) messages using a Router Advertisement daemon or equivalent.

The IPv6 link-local address of `ff02::fb` SHALL be used for mDNS service discovery.

4.2.4 Bridging, Routing, and Multi-Server Support

On the initial PEV connection, the EVSE SHALL prohibit bridging and/or routing of the PEV communications. Therefore, the EVSE SAE J3072 (IEEE 2030.5) server is the only server visible to the PEV on initial connection.

Once the EVSE has successfully authorized the PEV to discharge, the EVSE MAY optionally enable bridging and/or routing of non-SAE J3072 PEV communications. The enabling of bridging and/or routing can expose the PEV to other servers providing other services. The interactions of the PEV with other servers is outside the scope of this profile.

For an SAE J3072 compliant PEV that has failed to get authorization to discharge, an SAE J3072 compliant EVSE MAY choose to bridge and/or route non-SAE J3072 communications but has no obligation to do so. However, the EVSE MUST continue the SAE J3072 communications between the PEV and EVSE.

Bridging and/or routing of a Non-SAE J3072 compliant PEV's communications is outside the scope of this profile. An SAE J3072 compliant EVSE MAY choose to bridge and/or route its communications but has no obligation to do so.

4.2.5 TCP, UDP, and Upper Layers

This profile does not make any changes to these layers.

4.3 Service Discovery

Multicast DNS (mDNS) defined in IETF RFC 6762 SHALL be used to perform DNS-like queries on the local link between the EV and the EVSE. The mDNS reserves ".local" domain to name services that have link-local scope and uses link-local multicast addressing for requests and either multicast or unicast addressing for responses. IPv6 address SHALL be supported by the mDNS mechanism. For backward compatibility, extended multicast xmDNS SHOULD be used to support devices that have implemented the xmDNS services. Optionally, client devices SHOULD support out of band discovery as a fallback when mDNS or xmDNS services are not available. Unicast DNS where a DNS name server is used SHALL NOT be required.

The mDNS Service Instance Name for this profile SHALL have the following format:

```
device-000001111114._smartenergy._tcp.local
```

where `device-000001111114` is the <Instance> portion, `smartenergy` is the Service Name, `tcp` is the transport protocol, and `local` is the <Domain> portion.

4.3.1 Subtype Query

Subtype query where the client devices can discover other 2030.5 resources beyond DeviceCapability MAY be implemented by the 2030.5 server and client following the IEEE 2030.5 Subtype query feature. These resources MAY be discoverable by the client using mDNS subtype query: *EndDevice* ("edev" subtype name), *SelfDevice* ("sdev" subtype name), *MirrorUsagePointList* ("mup" subtype name).

4.4 Security

The EVSE and the PEV in this profile complies with all the IEEE 2030.5 security requirements.

The device certificate for the PEV SHALL comply with the IEEE 2030.5 Device certificate as defined in IEEE 2030.5 with the clarifications in this section. The PEV make and model SHALL be encoded in the *HardwareModuleName* object. As specified in IEEE 2030.5, the *hwType* field of the *HardwareModuleName* is an Object ID (OID) assigned from the PEV manufacturer's own base OID arc according to its own policies. The manufacturer's base OID identifies the make of the PEV. Within the manufacturer's OID domain, a unique OID is assigned to each vehicle model. Therefore, the *hwType* field encodes both the make and model of the PEV. The PEV manufacturer SHALL assign a unique *hwType* OID for each of its PEV models.

4.5 Resource Discovery

This section describes the resources required to support SAE J3072 interactions between the EVSE and the PEV.

4.5.1 Device Capability

The EVSE and PEV MUST support the *DeviceCapability* function set. The PEV SHALL discover the location of the EVSE Server's *DeviceCapability* resource using mDNS.

The EVSE SHALL populate the following links in the *DeviceCapability* resource:

- *EndDeviceListLink*
- *SelfDeviceLink*
- *TimeLink*
- *MirrorUsagePointListLink*

The EVSE SHALL NOT populate *DeviceCapability* with a *DERProgramListLink*. Normally, IEEE 2030.5 uses this resource for public *DERPrograms*. For this profile, public *DERPrograms* are not supported. Instead, the PEV locates its *DERPrograms* using the *FunctionSetAssignmentListLink* contained in the PEV's *EndDevice* instance.

The PEV SHALL get the *DeviceCapability* resource from the EVSE Server.

4.5.2 TLS Session Establishment and Authentication

When the PEV makes a connection to the EVSE to get the *DeviceCapability* resource, a TLS connection is negotiated between the TLS client (PEV) and the TLS server (EVSE). During the TLS handshake, the EVSE and PEV mutually exchange their IEEE 2030.5 device certificates. At this point, the EVSE knows the identity of the PEV and can calculate the PEV's LFDI/SFDI from its certificate. The EVSE MAY use the PEV's LFDI/SFID for authentication against an Allow List. How the EVSE is provisioned with this Allow List is beyond the scope of this profile. The EVSE MAY use the PEV make/model information encoded in the PEV certificate's *HardwareModuleName* object as an additional authorization criterion.

If the EVSE chooses not to authenticate the PEV, the EVSE SHALL terminate the TLS session. If the EVSE detects a TLS handshake failure, EVSE SHALL terminate the TLS session. If the PEV detects a TLS handshake failure, the PEV SHALL terminate the TLS session. If the PEV detects or generates a terminated TLS session, the PEV SHALL revert to its "Non-SAE J3072" mode of operation.

4.5.3 EndDevice

The EVSE and PEV MUST support the *EndDevice* function set. The EVSE SHALL populate the *EndDeviceList* with an *EndDevice* instance representing the connected PEV.

The PEV SHALL get its *EndDevice* instance from the EVSE Server. This can be done in two ways. The EVSE Server MAY support mDNS *EndDevice* subtype queries. Alternately, the PEV can discover the location of its *EndDevice* instance by walking the *EndDeviceList* whose location is specified in *DeviceCapability*. If the PEV fails to locate its *EndDevice* instance, the PEV SHALL consider the SAE J3072 authorization failed and revert to its "Non-SAE J3072" mode of operation.

After finding the location of its *EndDevice* instance, the PEV SHALL get its *EndDevice* instance.

The EVSE SHALL populate the *EndDevice* instance with the following resources:

- *DeviceInformationLink*
- *PowerStatusLink*
  - *PowerStatus:PEVInfo*
- *SubscriptionListLink*
- *DERListLink*
  - *DER:DERCapabilityLink*
  - *DER:DERSettingsLink*
  - *DER:DERAvailabilityLink*
  - *DER:DERStatus*
- *FunctionSetAssignmentsListLink*

The EVSE SHALL NOT populate the *EndDevice* instance with the *RegistrationLink* resource. The *Registration* resource is normally used by an IEEE 2030.5 client to verify it is connected to

the correct server. For the SAE J3072 use case, the only sever visible to the PEV client upon connection is the EVSE SAE J3072 server, so the *Registration* resource is not needed.

The EVSE MAY populate the *EndDevice* instance with other resources.

4.5.3.1 DeviceInformationLink

The PEV SHALL populate the *DeviceInformationLink* with information specified in SAE J3072 Table C4 unless otherwise noted here.

Although SAE J3072 Table C4 marks the following objects as “R” (required by IEEE 2030.5), they are not actually required by IEEE 2030.5. The PEV SHALL NOT be required to populate *DeviceInformation* with the following resources:

- *functionsImplemented*
- *gpsLocation*
- *pollRate*

4.5.3.2 PowerStatusLink

The PEV SHALL populate the *PowerStatus:PEVInfo* with information specified in SAE J3072 Table C9.

4.5.3.3 SubscriptionListLink

The EVSE MUST make the resources in Table 4 subscribable. The PEV MAY use the *SubscriptionListLink* to subscribe to any of the subscribable resources in Table 4.

4.5.3.4 DERListLink

The EVSE SHALL populate the DERListLink with a *DER* instance containing links to *DERCapability*, *DERSettings*, *DERAvailability*, and *DERStatus*. Typically, a single a *DER* instance is all that is needed to implement this profile.

The PEV SHALL populate the *DERCapability* with information specified in SAE J3072 Table C5.

The PEV SHALL populate the *DERSettings* with information specified in SAE J3072 Table C3.

The PEV SHALL populate the *DERAvailability* with information specified in SAE J3072 Table C9.

The PEV SHALL use *DERStatus* to send heartbeat messages to the EVSE as described in section 4.8.1.1. The PEV SHALL use *DERStatus:inverterStatus* to report status information required in section 4.7.2 and section 4.8.3.

4.5.3.5 FunctionSetAssignmentsListLink

The EVSE SHALL populate the *FunctionSetAssignmentsList* with a *FunctionSetAssignments* instance. Typically, a single a *FunctionSetAssignments* instance is all that is needed to implement this profile.

The *FunctionSetAssignments* instance SHALL contain a *TimeLink*. The PEV SHALL use the *TimeLink* to obtain the EVSE Server time.

The *FunctionSetAssignments* instance SHALL contain a *DERProgramListLink*. The *DERProgramListLink* SHALL contain a *DERProgram*. Typically, a single a *DERProgram* is all that is needed to implement this profile.

The *DERProgram* SHALL contain a *DefaultDERControlLink*. The EVSE SHALL populate the *DefaultDERControl* with the *opModEnergize* object which is used to grant or deny authorization to discharge.

If the site settings use the Enter Service function, the EVSE SHALL populate the *DefaultDERControl* with information specified in SAE J3072 Table C7 with values applicable to the local jurisdiction.

The *DERProgram* SHALL contain a *DERControlListLink*. The EVSE SHALL populate the *DERControlList* with all the SAE J3072 management information (i.e., DER curves and controls) in effect for this site.

The PEV SHALL obtain the *FunctionSetAssignmentsList*, *DERProgramList*, *DERProgram*, *DefaultDERControl*, and the *DERControlList* and its contents.

4.6 Initial Information Exchange

Resource discovery is complete once the PEV has discovered the locations of all the relevant resources on the EVSE. Before the EVSE authorizes the PEV to discharge, the PEV exchanges information with the EVSE. The Information Exchange consists of three steps:

1. The PEV gets site limit parameters from the EVSE
2. The PEV sends configuration information to the EVSE
3. The PEV gets and applies management information from EVSE

Step 1 MUST occur before step 2 as the site limits from step 1 affects the configuration information reported in step 2. After the PEV performs all three steps, the PEV goes into Periodic Operations and monitors the EVSE for authorization to discharge.

After the PEV completes the three steps, the EVSE MAY authorize the PEV to discharge if the PEV meets all the discharge requirements.

4.6.1 Step 1: PEV Gets the Site Limits

The PEV gets the sites limits from the EVSE's *SelfDevice:DER:DERSettings* resource. The contents of this resource on the EVSE represents the site limits the PEV adheres to when authorized to discharge at this site. SAE J3072 Table 2 lists the site limit values provided by the EVSE, and SAE J3072 Table C3 maps these limits to the appropriate *SelfDevice:DER:DERSettings* resource.

The EVSE MUST provide all the *SelfDevice:DER:DERSettings* resources listed in SAE J3072 Table C2.

The PEV MUST get all the EVSE's *SelfDevice:DER:DERSettings* resources listed in SAE J3072 Table C2.

4.6.1.1 Active Power Limit

The EVSE SHALL use its *SelfDevice:DER:DERSettings:WMax* resource to convey the Active Power limit to the PEV. The Active Power limit (WMax) is used instead of the Apparent Power limit (VAMax) to be compatible with IEEE 1547. IEEE 1547 also defines the priority of Active and Reactive power. The EVSE MAY use the *DERControl:opModMaxLimW* to further limit the PEV maximum active power where there are additional constraints that require lowering the limit from the default value of 100%. Note that the 100% reference point equals the PEV's Active Power limit reported in the PEV's *EndDevice:DER:DERSettings:WMax* setting. If

opModMaxLimW is used to change the active power limit, this does not change the *%setMaxW* reference point for any curve or control that uses *%setMaxW* as the reference type.

One example of an additional constraint is the multi-port EVSE use case. When the first PEV plugs into a multi-port EVSE, the first PEV gets the site limits from the EVSE's *SelfDevice:DER:DERSettings* resource. When a second PEV plugs in, the EVSE may need to further limit the maximum active power limit of the first PEV. It can do so using the *DERControl:opModMaxLimW* control targeted to the first PEV.

Note: Defined by their J3072 System Type, signals for the supply equipment electrical limits are supplied outside of the communication defined in this profile. For example, when operating under System Type A1 this is provided by the PWM in amperes. These limits must be respected during operation.

4.6.2 Step 2: PEV Sends Configuration Information to the EVSE

After obtaining the site limits from the EVSE, the PEV provides configuration information to the EVSE. The PEV sends this information to the EVSE by a PUT or POST of resources to the appropriate link provided by the *EndDevice* instance. The required configuration information is listed in SAE J3072 Table 3. The contents of this table map to various resources in the IEEE 2030.5 *DERSettings*, *DeviceInformation*, and *DERCapability* objects.

4.6.2.1 IEEE 2030.5 DERSettings Object

SAE J3072 uses the *DERSettings* object for the PEV to report its site-adjusted settings to the EVSE.

The PEV MUST send all the J3072 marked resources listed in SAE J3072 Table C3 to the EVSE's *EndDevice:DER:DERSettings* link.

The PEV SHALL include the *setMaxWh* resource as part of its *DERSettings*. The *setMaxWh* resource is currently not a requirement in SAE J3072, but it is needed as the reference for the PEV state of charge percentage. Future revisions of SAE J3072 will probably mandate this resource.

4.6.2.2 IEEE 2030.5 DeviceInformation Object

SAE J3072 uses the *DeviceInformation* object to convey SAE J3072 specific information. This information includes the SAE J3072 Certification Status, the Certification Date, the vehicle VIN, the Inverter System Model Number, and other information. This information helps the EVSE to determine whether the PEV is eligible for authorization to discharge.

Note: How the EVSE obtains the database of approved ISM numbers is outside the scope of this profile.

The PEV MUST send all the resources listed in SAE J3072 Table C4 to the EVSE's *EndDevice:DeviceInformation* link.

4.6.2.3 IEEE 2030.5 DERCapability Object

SAE J3072 uses the *DERCapability* object for the PEV to send some general nameplate information to the EVSE. These nameplate resources are listed in SAE J3072 Table C5.

The PEV MUST send all the SAE J3072 marked resources listed in SAE J3072 Table C5 to the EVSE's *EndDevice:DER:DERCapability* link.

4.6.2.4 IEEE 2030.5 DERAvailability Object

SAE J3072 uses the *DERAvailability* object for the PEV to send storage related information to the EVSE for the coordinated charge/discharge use case. These resources are listed in SAE J3072 Table C9.

The PEV MUST send all the resources listed in SAE J3072 Table C9 to the EVSE's *EndDevice:DER:DERAvailability* link.

4.6.2.5 IEEE 2030.5 PEVInfo Object

SAE J3072 uses the *PEVInfo* object for the PEV to send storage related information to the EVSE for the coordinated charge/discharge use case. These resources are listed in SAE J3072 Table C9.

The PEV MUST send all the resources listed in SAE J3072 Table C9 to the EVSE's *EndDevice:PowerStatus:PEVInfo* link.

4.6.3 Step 3: PEV Gets Management Information from the EVSE

As a condition for authorization to discharge, the PEV gets and applies Management Information from the EVSE. Management Information consists of the DER curves and controls that are in effect for the site. SAE J3072 provides a list of the Management Information functions in SAE J3072 Table 14.

SAE J3072 requires the PEV to configure itself to the IEEE 1547 Management Information default values at the time it connects to the EVSE. SAE J3072 allows the EVSE to assume the PEV is operating with the IEEE 1547 default settings such that the EVSE only needs to send the PEV Management Information that is different from the IEEE 1547 defaults.

Although SAE J3072 allows the EVSE to assume the PEV is operating with IEEE 1547 defaults upon connection, this profile mandates the EVSE SHALL provide **ALL** Management Information listed in SAE J3072 section 4.6.6.11 that are in effect for the site upon connection. Some Management Information controls in section SAE J3072 section 4.6.6.11 are mutually exclusive. For example, the Constant Power Factor and Constant Reactive Power controls cannot both be simultaneously active. The EVSE MUST ensure that all the Management Information that are in effect for the site are mutually compatible.

When providing Management Information, the EVSE MUST exclusively use the *DERControl* or the *DefaultDERControl* version of the function as specified in Table 5, Column 4 below.

This profile requires responses for all *DERControls*. The EVSE MUST set the *responseRequired* attribute bit 0 (message received) and bit 1 (event response). The EVSE SHALL set the start time of each Management Information *DERControl* to the current time. The EVSE SHALL set the duration of each Management Information *DERControl* to the maximum allowed value of 4294967295 (`0xffffffff`) seconds.

This profile requires separate responses for each *DERControl*. Therefore, the EVSE SHALL only create *DERControls* containing a single IEEE 2030.5 *opMod*… function. For each *DERControl*, the EVSE SHALL set bit 0 and bit 1 of the control's *responseRequired* field.

The PEV SHALL get all *DERControls* provided by the EVSE.

Note: For this profile, the PEV sends the Event Started *Response* prior to being authorized to discharge by the EVSE.

In a typical connect session, the Management Information DER controls do not change for the duration of the connect session. However, there can be cases where the EVSE needs to

change the Management Information during a connect session. In this case, the EVSE MAY create a new *DERControl* with a more recent start time such that the new *DERControl* supersedes the existing *DERControl*. It is expected that the PEV transitions from the superseded *DERControl* to the superseding *DERControl* without disrupting ongoing operations.

4.6.4 Authorization to Discharge

After completing the three steps above, the EVSE can determine if the PEV is authorized to discharge. At a minimum, the EVSE MUST verify the following:

- The PEV is Certified
- The PEV's status as a 2-quadrant or 4-quadrant inverter matches the site setting
- The PEV's ISM number is in the approved database
- The PEV's reported configuration information complies with the site limits
- The PEV has provided all the Event Received and Event Started *Responses* for all the Management Information provided by the EVSE.

The EVSE MAY use the PEV make/model information encoded in the PEV certificate's *HardwareModuleName* object to authenticate the PEV as an additional condition for authorization to discharge.

The authorization to discharge maps to the IEEE 1547 "Permit Service" parameter which maps to the IEEE 2030.5 *DefaultDERControl:opModEnergize* boolean object in this profile.

To indicate the PEV is authorized to discharge, the EVSE MUST set *DefaultDERControl:opModEnergize* to true. To revoke authorization to discharge for any reason, the EVSE MUST set *DefaultDERControl:opModEnergize* to false.

After completing the steps above, the PEV goes to periodic operations while monitoring the *DefaultDERControl:opModEnergize* object for changes to the authorization to discharge.

4.6.5 Enter Service

Once the PEV has obtained its authorization to discharge, it MAY do so based on controls that are outside the scope of this profile. If the PEV does discharge, it does so according the Enter Service parameters it obtained in the Management Information transfer.

How the EVSE obtains the Enter Service parameters is outside the scope of this profile. Normally this information is provided by the utility. If the EVSE can determine if the grid voltage and frequency are already at acceptable values, the EVSE MAY reduce the Enter Service Delay presented to the PEV in the Management Information transfer to improve response times.

4.7 Periodic Operations

4.7.1 PEV Control

The following requirements SHALL apply once the PEV has received its permission to discharge (*opModEnergize*). If the PEV has not received permission to discharge, it MUST continue to monitor the EVSE Server's *opModEnergize* via polling or subscription while it is connected to the EVSE.

DERControls SHALL conform to IEEE 2030.5 section 10.2.3 event rules.

The EVSE server and PEV client SHALL support the Management Information functions in Table 5.

The EVSE SHALL be the only server for the Management Information controls in Table 5. The PEV MUST NOT accept any Management Information controls from any other server.

For each Management Information control, the EVSE SHALL exclusively use the DERControl Type specified in the 3rd column of Table 5. Functions marked as *DERControl* SHALL NOT be used as *DefaultDERControls*. Functions marked as *DefaultDERControls* SHALL NOT be used as *DERControls*.

Function	IEEE 2030.5 Control	IEEE 2030.5 DERControl Type
Constant Power Factor	*opModFixedPFInjectW*	DERControl
Volt-Var Curve	*opModVoltVar*	DERControl
Watt-Var Curve	*opModWattVar*	DERControl
Constant Var	*opModFixedVar*	DERControl
Volt-Watt Curve	*opModVoltWatt*	DERControl
High Frequency Trip	*opModHFRMustTrip*	DERControl
Low Frequency Trip	*opModLFRMustTrip*	DERControl
Limit Active Power	*opModMaxLimW*	DERControl
Enter Service	*setESDelay, setESHighFreq, setESHighVolt, setESLowFreq, setESLowVolt, setESRampTms, setESRandomDelay*	DefaultDERControl
High Frequency Droop	*opModFreqDroop*	DERControl
Low Frequency Droop	*opModFreqDroop*	DERControl
High Voltage Trip	*opModHVRTMomentaryCessation* *opModHVRMustTrip*	DERControl
Low Voltage Trip	*opModLVRTMomentaryCessation* *opModLVRMustTrip*	DERControl

Table 5 – Required Management Information Functions

4.7.2 PEV Monitoring

The PEV SHALL use *DERStatus:inverterStatus* to report is authorization to discharge status. The following enumerations SHALL be used as indicated.

- "0 – N/A" SHALL indicate the PEV is awake and authorized to discharge.
- "2 – sleeping" SHALL indicate the PEV is sleeping.
- "3 – starting up or ON but not producing power" SHALL indicate the PEV is awake but not authorized to discharge.

The PEV MUST provide the monitoring information as described in Table 6 when awake and authorized to discharge (*opModEnergize*). If the PEV is awake but not authorized to discharge,

it MAY provide the monitoring information. The PEV SHALL NOT provide monitoring information if it is sleeping.

Except for *alarmStatus*, the PEV SHALL provide the monitoring information in Table 6 based on the EVSE's *EndDevice:postRate* and the *MirrorUsagePoint:postRate*. The EVSE SHOULD provide a default value of 15 seconds for these *postRates*.

If the EVSE does not provide an *EndDevice:postRate* resource, the PEV SHALL use a *postRate* of 15 seconds.

If the EVSE does not provide a *MirrorUsagePoint:postRate* resource, the PEV SHALL use a *postRate* of 15 seconds.

Per SAE J3072, the PEV SHALL be able to provide *PEVInfo* and *DERAvailability* information as fast as one second.

The PEV SHALL poll for changes to the *EndDevice:postRate* and the *MirrorUsagePoint:postRate* resources based on the *pollRate* set by the EVSE. The EVSE SHOULD provide a default value of 15 seconds for these *pollRates*.

If the EVSE does not provide an *EndDeviceList:pollRate* resource, the PEV SHALL use a *pollRate* of 15 seconds.

If the EVSE does not provide a *MirrorUsagePointList:pollRate* resource, the PEV SHALL use a *pollRate* of 15 seconds.

All *MirrorMeterReadings*, *DERStatus*, *PEVInfo* and *DERavailability* data SHALL include a date-time stamp.

The PEV SHALL update its *EndDevice:DER:DERStatus:alarmStatus* as alarms are set and cleared. When no alarms are present, the PEV SHALL set the *alarmStatus* accordingly.

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Monitoring Information	IEEE 2030.5 Usage
Active Power (W)	ReadingType uom: 38 (watts) ReadingType phase: 128 (A) ReadingType:flowDirection: 19 (reverse) ReadingType:accumulationBehavior: 12 ReadingType:powerOfTenMultiplier
Reactive Power (Var)	ReadingType uom: 63 (vars) ReadingType phase: 128 (A) ReadingType:flowDirection: 19 (reverse) ReadingType:accumulationBehavior: 12 ReadingType:powerOfTenMultiplier
Voltage (V)	ReadingType uom: 29 (voltage) ReadingType phase: 128 (A) ReadingType:accumulationBehavior: 12 ReadingType:powerOfTenMultiplier
Frequency (Hz)	ReadingType uom: 33 (frequency) ReadingType phase: 128 (A) ReadingType:accumulationBehavior: 12 ReadingType:powerOfTenMultiplier
Operational State	*DERStatus:operationalModeStatus*
Connection Status	*DERStatus:genConnectStatus* *DERStatus:inverterStatus*
Alarm Status	*DERStatus:alarmStatus*
State of Charge	*DERStatus:stateOfChargeStatus*
Time of Update	*DERStatus:readingTime*
Time Charge is Needed	*PEVInfo:timeChargeIsNeeded*
Target State of Charge	*PEVInfo:targetStateOfCharge*
Energy Request	*PEVInfo:energyRequestNow*
Minimum Charging Duration	*PEVInfo:minimumChargingDuration*
Duration Maximum Charge Rate	*DERAvailability:maxChargeDuration*
Duration Maximum Discharge Rate	*DERAvailability:availabilityDuration*
Time of Reference	*PEVInfo:timeChargingStatus*

869 Table 6 – SAE J3072 Required Monitoring Information

870 EVSE servers SHALL support the IEEE 2030.5 *MirrorUsagePoint* for PEV metrology reporting.
871 PEV clients SHALL use the IEEE 2030.5 Metering Mirror function set to report metrology data.

The PEV SHALL create its *MirrorUsagePoint* with the following requirements:

- *deviceLFDI* SHALL be included.
- *roleFlags* SHALL set “bit 2 – isPEV”. All other bits SHALL NOT be set.
- *serviceCategroyKind* SHALL be set to “0 – electricity”.

The PEV SHALL create *MirrorMeterReadings* for Active Power, Reactive Power, Voltage, and Frequency with the corresponding required *ReadingType* fields shown in Table 6. The *dataQualifier* field SHALL NOT be provided. Other *ReadingType* fields MAY be provided.

The monitoring data SHALL use a DER reference frame. Active and Reactive power flow from the PEV to the electric grid SHALL have positive values. Active and Reactive power flow from the electric grid to the PEV SHALL have negative values.

4.8 Other Functions

4.8.1 Exception Handling

4.8.1.1 Loss of Communications when PEV is Connected to the EVSE

The PEV SHALL send an *EndDevice:DER:DERStatus* message every 1 second irrespective of the *EndDevice:postRate*. This message serves as a heartbeat to determine a loss of communications.

The EVSE SHALL monitor the reception of this heartbeat message. If the EVSE fails to receive 10 consecutive heartbeat messages, the EVSE SHALL consider this a loss of communications and SHALL revoke the authorization to discharge by setting *DefaultDERControl:opModEnergize* to false.

If the EVSE receives 3 consecutive heartbeat messages, the EVSE shall consider this a restoration of communications and SHALL authorize the PEV to discharge provided the PEV still satisfies the criteria of section 4.6.4.

If the PEV fails to successfully send the heartbeat message 10 consecutive times, the PEV considers this a loss of communications and SHALL cease to discharge per SAE J3072 section 4.6.2.

If the PEV successfully sends the heartbeat message 3 consecutive times, the PEV considers this a resumption of communications and MAY start discharging as long as it is still authorized to do so (*DefaultDERControl:opModEnergize* is true).

4.8.1.2 EVSE Gatekeeper Function

The EVSE SHALL open the contactor if the PEV is discharging when it has not been authorized or if it is discharging outside its authorized limits.

The EVSE SHALL open the contactor immediately if it detects the PEV is discharging prior to the EVSE authorizing it to discharge.

The EVSE can revoke a PEV’s authorization to discharge at any time based on its evaluation on the compliance of the PEV. Once the EVSE has revoked the PEV’s authorization to discharge, the PEV SHALL cease to discharge within 3 seconds.

4.8.2 Coordinated Charging/Discharging

SAE J3072 requires the implementation of this use case. Once authorization to discharge is obtained, the EVSE MUST be capable of sending the *DERControl:opModFixedW* to implement the charge/discharge function. The PEV MUST support the *DERControl:opModFixedW* function where a positive value represents PEV discharging, and a negative value represents PEV charging.

The PEV MUST send the additional monitoring information described in SAE J3072 section 4.7.4 and SAE J3072 Table 17. The PEV MUST implement the IEEE 2030.5 mapping described in SAE J3072 Table C19.

4.8.3 PEV Sleep/Wake Functions

SAE J3072 does not directly address this issue. For this profile, if the PEV was authorized to discharge and now wants to enter sleep mode, it SHALL post an *EndDevice:DER:DERStatus:inverterStatus* enumeration value of “2 – sleeping” before it enters in sleep mode. In sleep mode, PEV SHALL NOT send any metrology or status information to the EVSE.

When the EVSE receives the *inverterStatus* of “2 – sleeping”, the EVSE SHALL revoke the PEV’s authorization to discharge by setting the *DefaultDERControl:opModEnergize* object to false.

Upon waking from sleep, the PEV SHALL first re-acquire all the Management Information from the EVSE in case any has changed while the PEV was sleeping. After re-acquiring the Management Information, the PEV SHALL post an *EndDevice:DER:DERStatus:inverterStatus* enumeration value of “0 – N/A” to indicate to the EVSE that the PEV is ready to resume authorization to discharge. After posting its *inverterStatus*, the PEV re-enters periodic operations.

Upon receiving the updated *EndDevice:DER:DERStatus:inverterStatus* enumeration value of “0 – N/A” from the PEV, the EVSE MAY re-authorize the PEV to discharge if the PEV meets all the authorization criteria from section 4.6.4.

4.9 Exceptions and Clarifications

This section lists the requirements of this profile that supersede the requirements and recommendations of other standards.

4.9.1 Management Information

SAE J3072 allows the EVSE to assume the PEV is operating with IEEE 1547 defaults upon connection. This assumption allows the EVSE to only send Management Information controls that differ from the IEEE 1547 defaults.

To promote operational clarity, the EVSE SHALL provide **ALL** Management Information listed in SAE J3072 section 4.6.6.11 that are in effect for the site even when those values do not differ from the IEEE 1547 or SAE J3072 defaults.

IEEE 2030.5 does not have an explicit concept of enabling/disabling a control. For this profile, in the absence of a Management Information control, the PEV MUST disable that control.

In IEEE 2030.5, when there is no active DERControl or DefaultDERControl in effect for a given function, the state of that function defaults to the DER device’s default. However, for this profile,

when there is no active DERControl or DefaultDERControl in effect for a given function, the PEV shall disable that function.

4.9.2 Momentary Cessation Function

SAE J3072 states Momentary Cessation for ride-through curves shall not be supported whereas IEEE 1547 mandates the support of this function.

To maintain compliance with IEEE 1547, the PEV and EVSE SHALL support the *opModHVRTMomentaryCessation* and *opModLVRTMomentaryCessation* curve controls.

4.9.3 Frequency Droop Function

SAE J3072 states the default mode of operation for the Frequency Droop function is OFF (disabled). IEEE 1547 does not recognize an on/off control for this function – it assumes Frequency Droop is always ON (enabled).

To maintain compliance with IEEE 1547, the PEV SHALL use a default mode of operation for the Frequency Droop function of ON (enabled) using IEEE 1547 default values.

4.9.4 PEV Maximum Wh Setting

SAE J3072 does not require the PEV to report the *EndDevice:DER:DERSettings:setMaxWh* resource.

Since this resource is needed as the reference for the state of charge percentage, the PEV SHALL include the *setMaxWh* resource as part of its *DERSettings*.

4.9.5 EVSE Nominal Voltage for Site Limits

IEEE 2030.5 provides two possible resources for the EVSE to establish the site's nominal voltage: *SelfDevice:DER:DERSettings:setVRef* or *SelfDevice:DER:DERSettings:setVNom*.

To promote consistency with IEEE 1547, the EVSE SHALL use the *setVRef* resource to establish the site's nominal voltage as this resource maps more closely to the IEEE 1547 nominal voltage. The EVSE SHALL NOT include the *setVNom* resource.

4.9.6 EVSE Active Power Site Limit

The EVSE SHALL use its *SelfDevice:DER:DERSettings:WMax* resource to convey the Active Power limit to the PEV. To maintain compliance with IEEE 1547, the Active Power limit (WMax) is used instead of the Apparent Power limit (VAMax).

4.9.7 Reactive Power Control Priority

IEEE 1547 states the following reactive power controls are mutually exclusive:

- Constant Power Factor
- Volt-Var
- Watt-Var
- Constant Reactive Power

IEEE 1547 and SAE J3072 are silent on what happens if more than one of the above controls are sent to the DER. To avoid ambiguity and to maintain compliance with IEEE 1547, the EVSE SHALL NOT enable more than one of the reactive power controls listed above.

Note: This profile does not dictate the behavior of the PEV if the EVSE erroneously enables more than one reactive power control.

5 Informative Examples of IEEE 2030.5 Messages

5.1 Service Discovery

The PEV connects to the EVSE (1) and performs mDNS and DNS-SD (2,3) to discover the location of the *DeviceCapability* resource.

The PEV and EVSE then perform TLS setup (4) to establish a secure connection.

The PEV then gets the *DeviceCapability* resource (5).

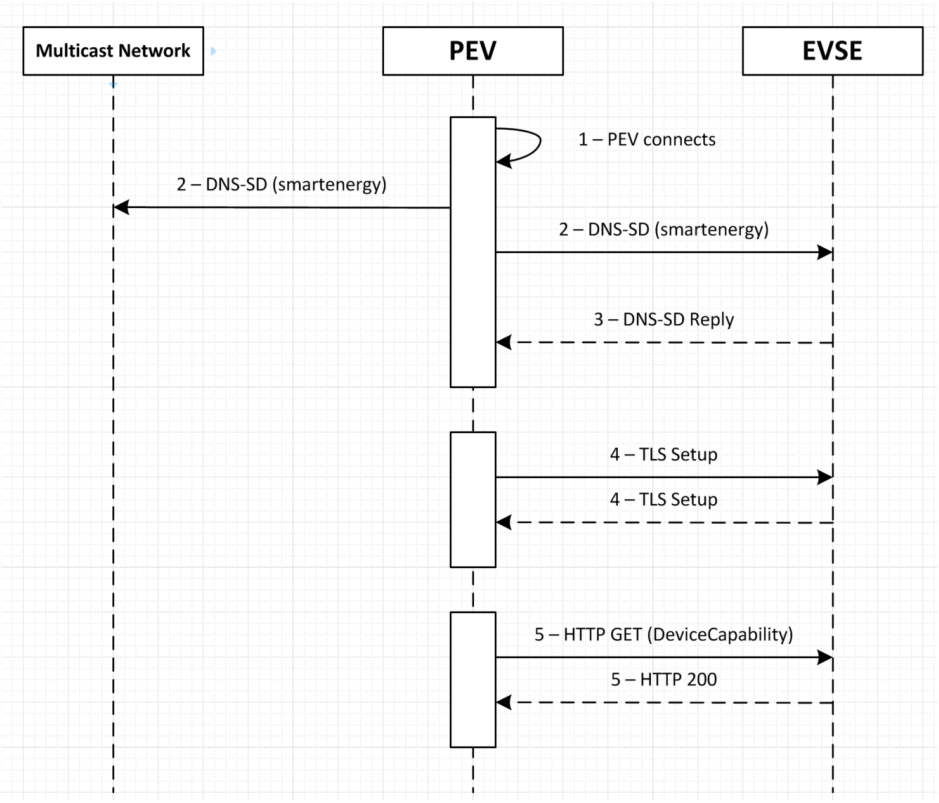

Figure 2 – mDNS/DNS-SD Discovery

2 – DNS-SD Query	Example
IPv6 Source Address	`fe80::0102:0304:0506:0708`
IPv6 Source Port	`5353`
IPv6 Destination Address	`ff02::fb`
IPv6 Dest Port	`5353`
Service Name	`_smartenergy._tcp.local`

Table 7 – DNS-SD Query

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3 – DNS-SD Reply	Example
IPv6 Source Address	fe80::1112:1213:1516:1718
IPv6 Source Port	5353
IPv6 Destination Address	ff02::fb
IPv6 Destination Port	5353
Service Instance Name	evse-301115568938._smartenergy._tcp.local
TXT Record	txtvers=1
TXT Record	dcap=/dcap
TXT Record	https=443
TXT Record	level=-S1
AAAA Record	fd12:3456:789a:1::1 fe80::1112:1213:1516:1718

1001 Table 8 – DNS-SD Reply

1002 5.2 Resource Discovery

1003

PEV gets Device Capability.

```
GET /dcap HTTP/1.1
HTTP/1.1 200 OK

<DeviceCapability xmlns="urn:ieee:std:2030.5:ns" href="/dcap" pollRate="15">
  <ResponseSetListLink href="/rsps" all="1"/>
  <TimeLink href="/tm"/>
  <UsagePointListLink href="/upt" all="1"/>
  <EndDeviceListLink href="/edev" all="1"/>
  <MirrorUsagePointListLink href="/mup" all="1"/>
  <SelfDeviceLink href="/sdev"/>
</DeviceCapability>
```

PEV gets Time.

```
GET /tm HTTP/1.1
HTTP/1.1 200 OK

<Time xmlns="urn:ieee:std:2030.5:ns" href="/tm">
  <currentTime>1670691660</currentTime>
  <dstEndTime>1667728800</dstEndTime>
  <dstOffset>3600</dstOffset>
  <dstStartTime>1647079200</dstStartTime>
  <quality>7</quality>
  <tzOffset>-28800</tzOffset>
</Time>
```

PEV gets EndDeviceList.

This list contains the EndDevice for the PEV.

```
GET /edev HTTP/1.1
HTTP/1.1 200 OK

<EndDeviceList xmlns="urn:ieee:std:2030.5:ns" href="/edev"
  subscribable="0" all="1" results="1" pollRate="15">
  <EndDevice href="/edev/1">
    <DERListLink href="/edev/1/der" all="1"/>
    <deviceCategory>010000</deviceCategory>
    <DeviceInformationLink href="/edev/1/di"/>
    <DeviceStatusLink href="/edev/1/dstat"/>
```

Since there is only one EndDevice instance, it is returned as part of the list response.	<lFDI>A2038B8645F15C66D889FFBC4352AC0B8CDACBA1</lFDI> <PowerStatusLink href="/edev/1/pwrstat"/> <sFDI>434902610920</sFDI> <changedTime>1670691600</changedTime> <enabled>true</enabled> <FunctionSetAssignmentsListLink href="/pev/fsa" all="1"/> <postRate>15</postRate> <SubscriptionListLink href="/edev/1/subs"/> </EndDevice> </EndDeviceList>
PEV gets its DERList. There is a single DER and we got it in the list response. The EVSE should only provide 1 DER for the PEV.	GET /edev HTTP/1.1 HTTP/1.1 200 OK <DERList xmlns="urn:ieee:std:2030.5:ns" href="/edev/1/der" all="1" results="1" pollRate="15"> <DER href="/edev/1/der/1"> <DERAvailabilityLink href="/edev/1/der/1/dera"/> <DERCapabilityLink href="/edev/1/der/1/dercap"/> <DERSettingsLink href="/edev/1/der/1/derg"/> <DERStatusLink href="/edev/1/der/1/ders"/> </DER> </DERList>

1004 Table 9 – Resource Discovery

1005 5.3 PEV Gets Site Limits

1006

PEV gets EVSE's SelfDevice.	GET /sdev HTTP/1.1 HTTP/1.1 200 OK <SelfDevice xmlns="urn:ieee:std:2030.5:ns" href="/sdev"> <DERListLink href="/sdev/der" all="1"/> <deviceCategory>020000</deviceCategory> <lFDI>702C9E51D2D02EFD488453A2BB684C205380B9CF</lFDI> <sFDI>301115568938</sFDI> </SelfDevice>
PEV gets the EVSE's DERList. There is a single DER and we got it in the list response. The EVSE should only provide 1 DER it its DERList.	GET /sdev/der HTTP/1.1 HTTP/1.1 200 OK <DERList xmlns="urn:ieee:std:2030.5:ns" href="/sdev/der" all="1" results="1" pollRate="15"> <DER href="/sdev/der/1"> <DERSettingsLink href="/sdev/der/1/derg"/> </DER> </DERList>

PEV gets EVSE's DERSettings. This resource contains the site settings.	GET /sdev/der/1/derg HTTP/1.1 HTTP/1.1 200 OK <DERSettings xmlns="urn:ieee:std:2030.5:ns" href="/sdev/der/1/derg"> <setGradW>0</setGradW> <setMaxChargeRateW> <multiplier>0</multiplier> <value>6500</value> </setMaxChargeRateW> <setMaxV> <multiplier>0</multiplier> <value>250</value> </setMaxV> <setMaxVar> <multiplier>0</multiplier> <value>3000</value> </setMaxVar> <setMaxVarNeg> <multiplier>0</multiplier> <value>3000</value> </setMaxVarNeg> <setMaxW> <multiplier>0</multiplier> <value>6500</value> </setMaxW> <setMinV> <multiplier>0</multiplier> <value>200</value> </setMinV> <setVRef> <multiplier>0</multiplier> <value>208</value> </setVRef> <setVRefOfs> <multiplier>0</multiplier> <value>0</value> </setVRefOfs> <updatedTime>1668099600</updatedTime> </DERSettings>

1007 Table 10 – PEV Gets Site Limits

5.4 PEV Sends Info to EVSE

PEV put its Device Information.	PUT /edev/1/di HTTP/1.1 <DeviceInformation xmlns="urn:ieee:std:2030.5:ns" href="/edev/1/di"> <lFDI>A2038B8645F15C66D889FFBC4352AC0B8CDACBA1</lFDI> <mfDate>1606809600</mfDate> <mfHwVer>J3072 Certified</mfHwVer> <mfID>37250</mfID> <mfInfo>PEV Maker</mfInfo> <mfModel>ISM Value</mfModel> <mfSerNum>PEV VIN</mfSerNum> <primaryPower>2</primaryPower> <secondaryPower>0</secondaryPower> <swActTime>1668099600</swActTime> <swVer>PEV SW 1.0</swVer> </DeviceInformation> HTTP/1.1 204 No Content
PEV puts its PowerStatus which contains the PEVInfo resource.	PUT /edev/1/pwrstat HTTP/1.1 <PowerStatus xmlns="urn:ieee:std:2030.5:ns" href="/edev/1/pwrstat"> <batteryStatus>1</batteryStatus> <changedTime>1670691670</changedTime> <currentPowerSource>2</currentPowerSource> <PEVInfo> <chargingPowerNow> <multiplier>0</multiplier> <value>6000</value> </chargingPowerNow> <energyRequestNow> <multiplier>3</multiplier> <value>24</value> </energyRequestNow> <maxForwardPower> <multiplier>0</multiplier> <value>6500</value> </maxForwardPower> <minimumChargingDuration>14400</minimumChargingDuration> <targetStateOfCharge>8500</targetStateOfCharge> <timeChargeIsNeeded>1670713200</timeChargeIsNeeded> <timeChargingStatusPEV>1670691670</timeChargingStatusPEV> </PEVInfo> </PowerStatus> HTTP/1.1 204 No Content

PEV puts its DER Capability. These are the nameplate ratings for the PEV.	PUT /edev/1/der/1/dercap HTTP/1.1 <DERCapability xmlns="urn:ieee:std:2030.5:ns" href="/edev/1/der/1/dercap"> <modesSupported>01DD69AB</modesSupported> <rtgAbnormalCategory>2</rtgAbnormalCategory> <rtgMaxW> <multiplier>0</multiplier> <value>6500</value> </rtgMaxW> <rtgNormalCategory>1</rtgNormalCategory> <rtgOverExcitedPF> <displacement>800</displacement> <multiplier>-3</multiplier> </rtgOverExcitedPF> <rtgOverExcitedW> <multiplier>0</multiplier> <value>6000</value> </rtgOverExcitedW> <rtgReactiveSusceptance> <multiplier>0</multiplier> <value>0</value> </rtgReactiveSusceptance> <rtgUnderExcitedPF> <displacement>800</displacement> <multiplier>-3</multiplier> </rtgUnderExcitedPF> <rtgUnderExcitedW> <multiplier>0</multiplier> <value>6000</value> </rtgUnderExcitedW> <type>81</type> </DERCapability> HTTP/1.1 204 No Content
PEV puts its adjusted settings based on the site limits it got from the EVSE. These settings must be compatible with the EVSE site limit for the PEV to be authorized to discharge.	PUT /edev/1/der/1/derg HTTP/1.1 <DERSettings xmlns="urn:ieee:std:2030.5:ns" href="/edev/1/der/1/derg"> <modesEnabled>01DD69AB</modesEnabled> <setESDelay>30000</setESDelay> <setESHighFreq>6100</setESHighFreq> <setESHighVolt>10500</setESHighVolt> <setESLowFreq>5900</setESLowFreq> <setESLowVolt>9500</setESLowVolt> <setESRampTms>6000</setESRampTms> <setESRandomDelay>0</setESRandomDelay> <setGradW>1000</setGradW> <setMaxChargeRateVA> <multiplier>0</multiplier> <value>6500</value> </setMaxChargeRateVA> <setMaxChargeRateW> <multiplier>0</multiplier> <value>6500</value> </setMaxChargeRateW>

```
  <setMaxDischargeRateVA>
    <multiplier>0</multiplier>
    <value>6500</value>
  </setMaxDischargeRateVA>
  <setMaxDischargeRateW>
    <multiplier>0</multiplier>
    <value>6500</value>
  </setMaxDischargeRateW>
  <setMaxV>
    <multiplier>0</multiplier>
    <value>250</value>
  </setMaxV>
  <setMaxVA>
    <multiplier>0</multiplier>
    <value>6500</value>
  </setMaxVA>
  <setMaxVar>
    <multiplier>0</multiplier>
    <value>3000</value>
  </setMaxVar>
  <setMaxVarNeg>
    <multiplier>0</multiplier>
    <value>3000</value>
  </setMaxVarNeg>
  <setMaxW>
    <multiplier>0</multiplier>
    <value>6500</value>
  </setMaxW>
  <setMinV>
    <multiplier>0</multiplier>
    <value>200</value>
  </setMinV>
  <setSoftGradW>1000</setSoftGradW>
  <setVNom>
    <multiplier>0</multiplier>
    <value>208</value>
  </setVNom>
  <setVRef>
    <multiplier>0</multiplier>
    <value>208</value>
  </setVRef>
  <setVRefOfs>
    <multiplier>0</multiplier>
    <value>0</value>
  </setVRefOfs>
  <updatedTime>1670691670</updatedTime>
</DERSettings>

HTTP/1.1 204 No Content
```

1011

PEV put its DER Availability.	PUT /edev/1/der/1/dera HTTP/1.1 <DERAvailability xmlns="urn:ieee:std:2030.5:ns" href="/edev/1/der/1/dera"> <availabilityDuration>12000</availabilityDuration> <maxChargeDuration>18000</maxChargeDuration> <readingTime>1670691670</readingTime> <reserveChargePercent>2500</reserveChargePercent> <reservePercent>2500</reservePercent> </DERAvailability> HTTP/1.1 204 No Content
PEV put its DERStatus. In this update, the inverterStatus value is 3 indicating the PEV is not authorized to discharge	PUT /edev/1/der/1/ders HTTP/1.1 <DERStatus xmlns="urn:ieee:std:2030.5:ns" href="/edev/1/der/1/ders"> <alarmStatus>00</alarmStatus> <genConnectStatus> <dateTime>1670691600</dateTime> <value>02</value> </genConnectStatus> <inverterStatus> <dateTime>1670691600</dateTime> <value>3</value> </inverterStatus> <operationalModeStatus> <dateTime>1670691600</dateTime> <value>2</value> </operationalModeStatus> <readingTime>1670691670</readingTime> <stateOfChargeStatus> <dateTime>1670691670</dateTime> <value>5000</value> </stateOfChargeStatus> </DERStatus> HTTP/1.1 204 No Content

1012 Table 11 – PEV Sends Info to EVSE

1013

5.5 PEV Gets Management Information

PEV gets its Function Set Assignments List. There is a single FSA and we got it in the list response. The EVSE should only provide 1 FSA for the PEV.	GET /pev/fsa HTTP/1.1 HTTP/1.1 200 OK <FunctionSetAssignmentsList xmlns="urn:ieee:std:2030.5:ns" href="/pev/fsa" subscribable="1" all="1" results="1" pollRate="15"> <FunctionSetAssignments href="/pev/fsa/1"> <DERProgramListLink href="/pev/derp" all="1"/> <TimeLink href="/tm"/> <mRID>EFEF000100000000000000000000D17E</mRID> <description>PEV FSA</description> </FunctionSetAssignments> </FunctionSetAssignmentsList>
PEV gets Time.	GET /tm HTTP/1.1 HTTP/1.1 200 OK <Time xmlns="urn:ieee:std:2030.5:ns" href="/tm"> <currentTime>1670691660</currentTime> <dstEndTime>1667728800</dstEndTime> <dstOffset>3600</dstOffset> <dstStartTime>1647079200</dstStartTime> <quality>7</quality> <tzOffset>-28800</tzOffset> </Time>
PEV gets its DER ProgramList. There is a single DERProgram and we got it in the list response. The EVSE should only provide 1 DERProgram for the PEV.	GET /pev/derp HTTP/1.1 HTTP/1.1 200 OK <DERProgramList xmlns="urn:ieee:std:2030.5:ns" href="/pev/derp" subscribable="1" all="1" results="1" pollRate="1"> <DERProgram href="/pev/derp/1"> <mRID>DDDD000100000000000000000000D17E</mRID> <description>PEV DER Program</description> <ActiveDERControlListLink href="/pev/derp/1/actderc" all="1"/> <DefaultDERControlLink href="/pev/derp/1/dderc"/> <DERControlListLink href="/pev/derp/1/derc" all="9"/> <DERCurveListLink href="/pev/derp/1/dc" all="8"/> <primacy>2</primacy> </DERProgram> </DERProgramList>

PEV gets its DefaultDERControl. This resource contains the *opModEnergize* object which is the boolean that grants the PEV the authorization to discharge.	GET /pev/derp/1/dderc HTTP/1.1 HTTP/1.1 200 OK <DefaultDERControl xmlns="urn:ieee:std:2030.5:ns" href="/pev/derp/1/dderc" subscribable="1"> <mRID>DDDD00010001000000000000000D17E</mRID> <description>Default DERC</description> <DERControlBase> <opModEnergize>false</opModEnergize> </DERControlBase> <setESDelay>30000</setESDelay> <setESHighFreq>6100</setESHighFreq> <setESHighVolt>10500</setESHighVolt> <setESLowFreq>5900</setESLowFreq> <setESLowVolt>9500</setESLowVolt> <setESRampTms>6000</setESRampTms> <setESRandomDelay>0</setESRandomDelay> </DefaultDERControl>
PEV gets its DERControlList. Each Management Information function must have its own DERControl. In this example, there are 9 Management Information functions that are active for the site, so the DERControlList contains 9 entries. In this example, the PEV gets the list contents 3 at a time. This is the request for the first 3 list entries.	GET /pev/derp/1/derc?s=0&l=3 HTTP/1.1 HTTP/1.1 200 OK <DERControlList xmlns="urn:ieee:std:2030.5:ns" href="/pev/derp/1/derc" subscribable="1" all="9" results="3"> <DERControl href="/pev/derp/1/derc/1" replyTo="/rsps/1/rsp" responseRequired="07"> <mRID>CCCC00090000000000000000000D17E</mRID> <description>MI-Freq-Droop</description> <creationTime>1670691600</creationTime> <EventStatus> <currentStatus>1</currentStatus> <dateTime>1670691600</dateTime> <potentiallySuperseded>false</potentiallySuperseded> </EventStatus> <interval> <duration>4294967295</duration> <start>1670691600</start> </interval> <DERControlBase> <opModFreqDroop> <dBOF>61000</dBOF> <dBUF>59000</dBUF> <kOF>100</kOF> <kUF>100</kUF> <openLoopTms>200</openLoopTms> </opModFreqDroop> </DERControlBase> <deviceCategory>010000</deviceCategory> </DERControl> <DERControl href="/pev/derp/1/derc/1" replyTo="/rsps/1/rsp" responseRequired="07"> <mRID>CCCC00080000000000000000000D17E</mRID> <description>MI-HFRT-Must</description> <creationTime>1670691600</creationTime> <EventStatus>

	<currentStatus>1</currentStatus> <dateTime>1670691600</dateTime> <potentiallySuperseded>false</potentiallySuperseded> </EventStatus> <interval> <duration>4294967295</duration> <start>1670691600</start> </interval> <DERControlBase> <opModHFRTMustTrip href="/pev/derp/1/dc/2"/> </DERControlBase> <deviceCategory>010000</deviceCategory> </DERControl> <DERControl href="/pev/derp/1/derc/1" replyTo="/rsps/1/rsp" responseRequired="07"> <mRID>CCCC0007000000000000000000D17E</mRID> <description>MI-HVRT-MomCess</description> <creationTime>1670691600</creationTime> <EventStatus> <currentStatus>1</currentStatus> <dateTime>1670691600</dateTime> <potentiallySuperseded>false</potentiallySuperseded> </EventStatus> <interval> <duration>4294967295</duration> <start>1670691600</start> </interval> <DERControlBase> <opModHVRTMomentaryCessation href="/pev/derp/1/dc/4"/> </DERControlBase> <deviceCategory>010000</deviceCategory> </DERControl> </DERControlList>
In this example, the PEV gets the list contents 3 at a time. This is the request for the middle 3 list entries.	GET /pev/derp/1/derc?s=3&l=3 HTTP/1.1 HTTP/1.1 200 OK <DERControlList xmlns="urn:ieee:std:2030.5:ns" href="/pev/derp/1/derc" subscribable="1" all="9" results="3"> <DERControl href="/pev/derp/1/derc/1" replyTo="/rsps/1/rsp" responseRequired="07"> <mRID>CCCC0006000000000000000000D17E</mRID> <description>MI-HVRT-Must</description> <creationTime>1670691600</creationTime> <EventStatus> <currentStatus>1</currentStatus> <dateTime>1670691600</dateTime> <potentiallySuperseded>false</potentiallySuperseded> </EventStatus> <interval> <duration>4294967295</duration> <start>1670691600</start> </interval> <DERControlBase> <opModHVRTMustTrip href="/pev/derp/1/dc/5"/>

	<pre></DERControlBase>
	<deviceCategory>010000</deviceCategory>
	</DERControl>
	<DERControl href="/pev/derp/1/derc/1" replyTo="/rsps/1/rsp"
	responseRequired="07">
	<mRID>CCCC0005000000000000000000D17E</mRID>
	<description>MI-LFRT-Must</description>
	<creationTime>1670691600</creationTime>
	<EventStatus>
	<currentStatus>1</currentStatus>
	<dateTime>1670691600</dateTime>
	<potentiallySuperseded>false</potentiallySuperseded>
	</EventStatus>
	<interval>
	<duration>4294967295</duration>
	<start>1670691600</start>
	</interval>
	<DERControlBase>
	<opModLFRTMustTrip href="/pev/derp/1/dc/7"/>
	</DERControlBase>
	<deviceCategory>010000</deviceCategory>
	</DERControl>
	<DERControl href="/pev/derp/1/derc/1" replyTo="/rsps/1/rsp"
	responseRequired="07">
	<mRID>CCCC0004000000000000000000D17E</mRID>
	<description>MI-LVRT-MomCess</description>
	<creationTime>1670691600</creationTime>
	<EventStatus>
	<currentStatus>1</currentStatus>
	<dateTime>1670691600</dateTime>
	<potentiallySuperseded>false</potentiallySuperseded>
	</EventStatus>
	<interval>
	<duration>4294967295</duration>
	<start>1670691600</start>
	</interval>
	<DERControlBase>
	<opModLVRTMomentaryCessation href="/pev/derp/1/dc/9"/>
	</DERControlBase>
	<deviceCategory>010000</deviceCategory>
	</DERControl>
	</DERControlList></pre>

In this example, the PEV gets the list contents 3 at a time.
 	
This is the request for the last 3 list entries.
	<pre>GET /pev/derp/1/derc?s=0&l=3 HTTP/1.1
	HTTP/1.1 200 OK
	
	<DERControlList xmlns="urn:ieee:std:2030.5:ns" href="/pev/derp/1/derc"
	subscribable="1" all="9" results="3">
	<DERControl href="/pev/derp/1/derc/1" replyTo="/rsps/1/rsp"
	responseRequired="07">
	<mRID>CCCC0003000000000000000000D17E</mRID>
	<description>MI-LVRT-Must</description>
	<creationTime>1670691600</creationTime>
	<EventStatus>
	<currentStatus>1</currentStatus></pre>

	<dateTime>1670691600</dateTime> <potentiallySuperseded>false</potentiallySuperseded> </EventStatus> <interval> <duration>4294967295</duration> <start>1670691600</start> </interval> <DERControlBase> <opModLVRTMustTrip href="/pev/derp/1/dc/10"/> </DERControlBase> <deviceCategory>010000</deviceCategory> </DERControl> <DERControl href="/pev/derp/1/derc/1" replyTo="/rsps/1/rsp" responseRequired="07"> <mRID>CCCC000200000000000000000000D17E</mRID> <description>MI-Volt-Var</description> <creationTime>1670691600</creationTime> <EventStatus> <currentStatus>1</currentStatus> <dateTime>1670691600</dateTime> <potentiallySuperseded>false</potentiallySuperseded> </EventStatus> <interval> <duration>4294967295</duration> <start>1670691600</start> </interval> <DERControlBase> <opModVoltVar href="/pev/derp/1/dc/11"/> </DERControlBase> <deviceCategory>010000</deviceCategory> </DERControl> <DERControl href="/pev/derp/1/derc/1" replyTo="/rsps/1/rsp" responseRequired="07"> <mRID>CCCC000100000000000000000000D17E</mRID> <description>MI-Volt-Watt</description> <creationTime>1670691600</creationTime> <EventStatus> <currentStatus>1</currentStatus> <dateTime>1670691600</dateTime> <potentiallySuperseded>false</potentiallySuperseded> </EventStatus> <interval> <duration>4294967295</duration> <start>1670691600</start> </interval> <DERControlBase> <opModVoltWatt href="/pev/derp/1/dc/12"/> </DERControlBase> <deviceCategory>010000</deviceCategory> </DERControl> </DERControlList>

Table 12 – PEV Gets Management Information

5.6 PEV Gets Management Information Curves

PEV gets the HFRT Must Trip curve.	GET /pev/derp/1/dc/2 HTTP/1.1 HTTP/1.1 200 OK <DERCurve xmlns="urn:ieee:std:2030.5:ns" href="/pev/derp/1/dc/2"> <mRID>EEEE000200000000000000000000D17E</mRID> <description>HFRT-Must</description> <creationTime>1670691600</creationTime> <CurveData> <xvalue>16</xvalue> <yvalue>6300</yvalue> </CurveData> <CurveData> <xvalue>16</xvalue> <yvalue>6200</yvalue> </CurveData> <CurveData> <xvalue>30000</xvalue> <yvalue>6200</yvalue> </CurveData> <CurveData> <xvalue>30000</xvalue> <yvalue>6150</yvalue> </CurveData> <CurveData> <xvalue>10000</xvalue> <yvalue>6150</yvalue> </CurveData> <curveType>2</curveType> <xMultiplier>-2</xMultiplier> <yMultiplier>-2</yMultiplier> <yRefType>0</yRefType> </DERCurve>

PEV gets the HVRT Momentary Cessation curve.	GET /pev/derp/1/dc/4 HTTP/1.1 HTTP/1.1 200 OK <DERCurve xmlns="urn:ieee:std:2030.5:ns" href="/pev/derp/1/dc/4"> <mRID>EEEE0004000000000000000000000D17E</mRID> <description>HVRT-MomCess</description> <creationTime>1670691600</creationTime> <CurveData> <xvalue>0</xvalue> <yvalue>11000</yvalue> </CurveData> <CurveData> <xvalue>1300</xvalue> <yvalue>11000</yvalue> </CurveData> <curveType>4</curveType> <xMultiplier>-2</xMultiplier> <yMultiplier>-2</yMultiplier> <yRefType>0</yRefType> </DERCurve>
PEV gets the HVRT Must Trip curve.	GET /pev/derp/1/dc/5 HTTP/1.1 HTTP/1.1 200 OK <DERCurve xmlns="urn:ieee:std:2030.5:ns" href="/pev/derp/1/dc/5"> <mRID>EEEE0005000000000000000000000D17E</mRID> <description>HVRT-Must</description> <creationTime>1670691600</creationTime> <CurveData> <xvalue>16</xvalue> <yvalue>13000</yvalue> </CurveData> <CurveData> <xvalue>16</xvalue> <yvalue>12000</yvalue> </CurveData> <CurveData> <xvalue>1300</xvalue> <yvalue>12000</yvalue> </CurveData> <CurveData> <xvalue>1300</xvalue> <yvalue>11000</yvalue> </CurveData> <CurveData> <xvalue>10000</xvalue> <yvalue>11000</yvalue> </CurveData> <curveType>5</curveType> <xMultiplier>-2</xMultiplier> <yMultiplier>-2</yMultiplier> <yRefType>0</yRefType> </DERCurve>

PEV gets the LFRT Must Trip curve.	GET /pev/derp/1/dc/7 HTTP/1.1 HTTP/1.1 200 OK <DERCurve xmlns="urn:ieee:std:2030.5:ns" href="/pev/derp/1/dc/7"> <mRID>EEEE0007000000000000000000D17E</mRID> <description>LFRT-Must</description> <creationTime>1670691600</creationTime> <CurveData> <xvalue>16</xvalue> <yvalue>0</yvalue> </CurveData> <CurveData> <xvalue>16</xvalue> <yvalue>5650</yvalue> </CurveData> <CurveData> <xvalue>30000</xvalue> <yvalue>5650</yvalue> </CurveData> <CurveData> <xvalue>30000</xvalue> <yvalue>5850</yvalue> </CurveData> <CurveData> <xvalue>100000</xvalue> <yvalue>5850</yvalue> </CurveData> <curveType>7</curveType> <xMultiplier>-2</xMultiplier> <yMultiplier>-2</yMultiplier> <yRefType>0</yRefType> </DERCurve>
PEV gets the LVRT Momentary Cessation curve.	GET /pev/derp/1/dc/9 HTTP/1.1 HTTP/1.1 200 OK <DERCurve xmlns="urn:ieee:std:2030.5:ns" href="/pev/derp/1/dc/9"> <mRID>EEEE0009000000000000000000D17E</mRID> <description>LVRT-MomCess</description> <creationTime>1670691600</creationTime> <CurveData> <xvalue>0</xvalue> <yvalue>5000</yvalue> </CurveData> <CurveData> <xvalue>150</xvalue> <yvalue>5000</yvalue> </CurveData> <curveType>9</curveType> <xMultiplier>-2</xMultiplier> <yMultiplier>-2</yMultiplier> <yRefType>0</yRefType> </DERCurve>

PEV gets the LVRT Must Trip curve.	GET /pev/derp/1/dc/10 HTTP/1.1 HTTP/1.1 200 OK <DERCurve xmlns="urn:ieee:std:2030.5:ns" href="/pev/derp/1/dc/10"> <mRID>EEEE000A0000000000000000000D17E</mRID> <description>LVRT-Must</description> <creationTime>1670691600</creationTime> <CurveData> <xvalue>200</xvalue> <yvalue>0</yvalue> </CurveData> <CurveData> <xvalue>200</xvalue> <yvalue>5000</yvalue> </CurveData> <CurveData> <xvalue>2100</xvalue> <yvalue>5000</yvalue> </CurveData> <CurveData> <xvalue>2100</xvalue> <yvalue>8800</yvalue> </CurveData> <CurveData> <xvalue>10000</xvalue> <yvalue>8800</yvalue> </CurveData> <curveType>10</curveType> <xMultiplier>-2</xMultiplier> <yMultiplier>-2</yMultiplier> <yRefType>0</yRefType> </DERCurve>
PEV gets the Volt-Var curve.	GET /pev/derp/1/dc/11 HTTP/1.1 HTTP/1.1 200 OK <DERCurve xmlns="urn:ieee:std:2030.5:ns" href="/pev/derp/1/dc/11"> <mRID>EEEE000B0000000000000000000D17E</mRID> <description>Volt-Var</description> <creationTime>1670691600</creationTime> <CurveData> <xvalue>9000</xvalue> <yvalue>10000</yvalue> </CurveData> <CurveData> <xvalue>9800</xvalue> <yvalue>0</yvalue> </CurveData> <CurveData> <xvalue>10200</xvalue> <yvalue>0</yvalue> </CurveData> <CurveData> <xvalue>11000</xvalue> <yvalue>-10000</yvalue>

	</CurveData> <curveType>11</curveType> <xMultiplier>-2</xMultiplier> <yMultiplier>-2</yMultiplier> <yRefType>1</yRefType> </DERCurve>
PEV gets the Volt-Watt curve.	GET /pev/derp/1/dc/12 HTTP/1.1 HTTP/1.1 200 OK <DERCurve xmlns="urn:ieee:std:2030.5:ns" href="/pev/derp/1/dc/12"> <mRID>EEEE000C0000000000000000000D17E</mRID> <description>Volt-Watt</description> <creationTime>1670691600</creationTime> <CurveData> <xvalue>10200</xvalue> <yvalue>10000</yvalue> </CurveData> <CurveData> <xvalue>11000</xvalue> <yvalue>0</yvalue> </CurveData> <curveType>12</curveType> <xMultiplier>-2</xMultiplier> <yMultiplier>-2</yMultiplier> <yRefType>0</yRefType> </DERCurve>

Table 13 – PEV Gets Management Information Curves

5.7 PEV Responses

PEV posts its DERControl Response – Received for the first DERControl. Since the event start time is in the past, the response is immediately sent.	POST /rsps HTTP/1.1 <DERControlResponse xmlns="urn:ieee:std:2030.5:ns"> <createdDateTime>1670691680</createdDateTime> <endDeviceLFDI>A2038B8645F15C66D889FFBC4352AC0B8CDACBA1</endDeviceLFDI> <status>1</status> <subject>CCCC0001000000000000000000D17E</subject> </DERControlResponse> HTTP/1.1 201 Created Location: /rsps/1/rsp/1

PEV posts its DERControl Response – Received for the second DERControl. Since the event start time is in the past, the response is immediately sent.	POST /rsps HTTP/1.1 <DERControlResponse xmlns="urn:ieee:std:2030.5:ns"> <createdDateTime>1670691680</createdDateTime> <endDeviceLFDI>A2038B8645F15C66D889FFBC4352AC0B8CDACBA1</endDeviceLFDI> <status>1</status> <subject>CCCC000200000000000000000000D17E</subject> </DERControlResponse> HTTP/1.1 201 Created Location: /rsps/1/rsp/2 # # Note: The Received responses to the other 7 DERControls are not shown. #
PEV posts its DERControl Response – Started for the first DERControl. Since the event start time is in the past, the response is immediately sent.	POST /rsps HTTP/1.1 <DERControlResponse xmlns="urn:ieee:std:2030.5:ns"> <createdDateTime>1670691680</createdDateTime> <endDeviceLFDI>A2038B8645F15C66D889FFBC4352AC0B8CDACBA1</endDeviceLFDI> <status>2</status> <subject>CCCC000100000000000000000000D17E</subject> </DERControlResponse> HTTP/1.1 201 Created Location: /rsps/1/rsp/10
PEV posts its DERControl Response – Started for the second DERControl. Since the event start time is in the past, the response is immediately sent.	POST /rsps HTTP/1.1 <DERControlResponse xmlns="urn:ieee:std:2030.5:ns"> <createdDateTime>1670691680</createdDateTime> <endDeviceLFDI>A2038B8645F15C66D889FFBC4352AC0B8CDACBA1</endDeviceLFDI> <status>2</status> <subject>CCCC000200000000000000000000D17E</subject> </DERControlResponse> HTTP/1.1 201 Created Location: /rsps/1/rsp/11 # # Note: The Started responses to the other 7 DERControls are not shown. #

Table 14 – PEV Responses

5.8 PEV Sets Up Metrology

PEV posts its Mirror Usage Point. The EVSE returns the location of the created MUP. The MUP contains one Mirror Meter Reading for Active Power.	POST /mup HTTP/1.1 <MirrorUsagePoint xmlns="urn:ieee:std:2030.5:ns"> <mRID>FFFF0000000000000000000000D17E</mRID> <description>PEV MUP</description> <roleFlags>04</roleFlags> <serviceCategoryKind>0</serviceCategoryKind> <status>1</status> <deviceLFDI>A2038B8645F15C66D889FFBC4352AC0B8CDACBA1</deviceLFDI> <MirrorMeterReading xmlns="urn:ieee:std:2030.5:ns"> <mRID>FFFF0001000000000000000000000D17E</mRID> <description>Active Power</description> <ReadingType> <accumulationBehaviour>12</accumulationBehaviour> <flowDirection>1</flowDirection> <phase>128</phase> <powerOfTenMultiplier>0</powerOfTenMultiplier> <uom>38</uom> </ReadingType> </MirrorMeterReading> </MirrorUsagePoint> HTTP/1.1 201 Created Location: /mup/1
PEV gets the Mirror Usage Point. The PEV gets the MUP to see what the EVSE sets as the post rate for meter readings.	GET /mup HTTP/1.1 HTTP/1.1 200 OK <MirrorUsagePointList xmlns="urn:ieee:std:2030.5:ns" href="/mup" all="1" results="1" pollRate="15"> <MirrorUsagePoint href="/mup/1"> <mRID>FFFF0000000000000000000000D17E</mRID> <description>PEV MUP</description> <roleFlags>04</roleFlags> <serviceCategoryKind>0</serviceCategoryKind> <status>1</status> <deviceLFDI>A2038B8645F15C66D889FFBC4352AC0B8CDACBA1</deviceLFDI> <postRate>15</postRate> </MirrorUsagePoint> </MirrorUsagePointList>

PEV creates the Active Power MMR.	POST /mup/1 HTTP/1.1 <MirrorMeterReading xmlns="urn:ieee:std:2030.5:ns"> <mRID>FFFF0001000000000000000000000D17E</mRID> <description>Active Power</description> <ReadingType> <accumulationBehaviour>12</accumulationBehaviour> <flowDirection>1</flowDirection> <phase>128</phase> <powerOfTenMultiplier>0</powerOfTenMultiplier> <uom>38</uom> </ReadingType> </MirrorMeterReading> HTTP/1.1 204 No Content Location: /upt/1/mr/1
PEV creates the Reactive Power MMR.	POST /mup/1 HTTP/1.1 <MirrorMeterReading xmlns="urn:ieee:std:2030.5:ns"> <mRID>FFFF0002000000000000000000000D17E</mRID> <description>Reactive Power</description> <ReadingType> <accumulationBehaviour>12</accumulationBehaviour> <flowDirection>1</flowDirection> <phase>128</phase> <powerOfTenMultiplier>0</powerOfTenMultiplier> <uom>63</uom> </ReadingType> </MirrorMeterReading> HTTP/1.1 204 No Content Location: /upt/1/mr/2
PEV creates the Voltage MMR.	POST /mup/1 HTTP/1.1 <MirrorMeterReading xmlns="urn:ieee:std:2030.5:ns"> <mRID>FFFF0003000000000000000000000D17E</mRID> <description>Voltage</description> <ReadingType> <accumulationBehaviour>12</accumulationBehaviour> <phase>128</phase> <powerOfTenMultiplier>-2</powerOfTenMultiplier> <uom>29</uom> </ReadingType> </MirrorMeterReading> HTTP/1.1 204 No Content Location: /upt/1/mr/3

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PEV creates the Frequency MMR.	POST /mup/1 HTTP/1.1 <MirrorMeterReading xmlns="urn:ieee:std:2030.5:ns"> <mRID>FFFF0004000000000000000000D17E</mRID> <description>Frequency</description> <ReadingType> <accumulationBehaviour>12</accumulationBehaviour> <phase>128</phase> <powerOfTenMultiplier>-2</powerOfTenMultiplier> <uom>33</uom> </ReadingType> </MirrorMeterReading> HTTP/1.1 204 No Content Location: /upt/1/mr/4
PEV posts a new Active Power reading. The update rate is set by the MeterUsagePoint: postRate.	POST /mup/1 HTTP/1.1 <MirrorMeterReading xmlns="urn:ieee:std:2030.5:ns"> <mRID>FFFF0001000000000000000000D17E</mRID> <description>Active Power</description> <Reading> <timePeriod> <duration>0</duration> <start>1670691670</start> </timePeriod> <value>6000</value> </Reading> </MirrorMeterReading> HTTP/1.1 204 No Content Location: /upt/1/mr/1
PEV posts a new Reactive Power reading. The update rate is set by the MeterUsagePoint: postRate.	POST /mup/1 HTTP/1.1 <MirrorMeterReading xmlns="urn:ieee:std:2030.5:ns"> <mRID>FFFF0002000000000000000000D17E</mRID> <description>Reactive Power</description> <Reading> <timePeriod> <duration>0</duration> <start>1670691670</start> </timePeriod> <value>0</value> </Reading> </MirrorMeterReading> HTTP/1.1 204 No Content Location: /upt/1/mr/2

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PEV posts a new Voltage reading. The update rate is set by the MeterUsagePoint: postRate.	POST /mup/1 HTTP/1.1 <MirrorMeterReading xmlns="urn:ieee:std:2030.5:ns"> <mRID>FFFF0003000000000000000000000D17E</mRID> <description>Voltage</description> <Reading> <timePeriod> <duration>0</duration> <start>1670691670</start> </timePeriod> <value>20800</value> </Reading> </MirrorMeterReading> HTTP/1.1 204 No Content Location: /upt/1/mr/3
PEV posts a new Frequency reading. The update rate is set by the MeterUsagePoint: postRate.	POST /mup/1 HTTP/1.1 <MirrorMeterReading xmlns="urn:ieee:std:2030.5:ns"> <mRID>FFFF0004000000000000000000000D17E</mRID> <description>Frequency</description> <Reading> <timePeriod> <duration>0</duration> <start>1670691670</start> </timePeriod> <value>6000</value> </Reading> </MirrorMeterReading> HTTP/1.1 204 No Content Location: /upt/1/mr/4

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5.9 Subscriptions and Notifications

PEV creates a subscription to the DERControlList. The PEV specifies a limit of 1, so that the first DERControl in the list is sent in the Notification.	POST /edev/1/subs HTTP/1.1 <Subscription xmlns="urn:ieee:std:2030.5:ns"> <subscribedResource>/pev/derp/1/derc</subscribedResource> <encoding>0</encoding> <level>+S1</level> <limit>1</limit> <notificationURI> https://[fd12:3456:789a:1::2]:443/ntfy </notificationURI> </Subscription> HTTP/1.1 201 Created Location: /edev/1/subs/1
EVSE posts a Notification to the PEV. The Notification is a change to the DERControlList caused by the creating of a new DERControl.	POST https://[fd12:3456:789a:1::2]:443/ntfy HTTP/1.1 <Notification xmlns="urn:ieee:std:2030.5:ns" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"> <subscribedResource>/pev/derp/1/derc</subscribedResource> <Resource xsi:type="DERControlList" href="/pev/derp/1/derc" subscribable="1" all="9" results="1"> <DERControl href="/pev/derp/1/derc/1" replyTo="/rsps/1/rsp" responseRequired="07"> <mRID>CCCC00090000000000000000D17E</mRID> <description>MI-Freq-Droop</description> <creationTime>1670691600</creationTime> <EventStatus> <currentStatus>1</currentStatus> <dateTime>1670691600</dateTime> <potentiallySuperseded>false</potentiallySuperseded> </EventStatus> <interval> <duration>4294967295</duration> <start>1670691600</start> </interval> <DERControlBase> <opModFreqDroop> <dBOF>61000</dBOF> <dBUF>59000</dBUF> <kOF>100</kOF> <kUF>100</kUF> <openLoopTms>200</openLoopTms> </opModFreqDroop> </DERControlBase> <deviceCategory>010000</deviceCategory> </DERControl> </Resource> <status>0</status> <subscriptionURI> https://[fd12:3456:789a:1::1]:443/edev/1/subs/1

	</subscriptionURI> </Notification> HTTP/1.1 201 Created # # Note: The notification returns the first DERControl in the list. The PEV # client would need to GET the remaining 8 DERControls from the list. The # examples in section 5.4 show how to page through the list 3 at a time. #
PEV creates a subscription to the Default DERControl.	POST /edev/1/subs HTTP/1.1 <Subscription xmlns="urn:ieee:std:2030.5:ns"> <subscribedResource>/pev/derp/1/dderc</subscribedResource> <encoding>0</encoding> <level>+S1</level> <limit>1</limit> <notificationURI> https://[fd12:3456:789a:1::2]:443/ntfy </notificationURI> </Subscription> HTTP/1.1 201 Created Location: /edev/1/subs/2
EVSE posts a Notification to the PEV. The Notification is a change to the Default DERControl. The PEV specifies a limit of 1, so that the Default DERControl is included in the Notification.	POST https://[fd12:3456:789a:1::2]:443/ntfy HTTP/1.1 <Notification xmlns="urn:ieee:std:2030.5:ns" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"> <subscribedResource>/pev/derp/1/derc</subscribedResource> <Resource xsi:type="DefaultDERControl" xmlns="urn:ieee:std:2030.5:ns" href="/pev/derp/1/dderc" subscribable="1"> <mRID>DDDD00010001000000000000000D17E</mRID> <description>Default DERC</description> <DERControlBase> <opModEnergize>false</opModEnergize> </DERControlBase> <setESDelay>30000</setESDelay> <setESHighFreq>6100</setESHighFreq> <setESHighVolt>10500</setESHighVolt> <setESLowFreq>5900</setESLowFreq> <setESLowVolt>9500</setESLowVolt> <setESRampTms>6000</setESRampTms> <setESRandomDelay>0</setESRandomDelay> </Resource> <status>0</status> <subscriptionURI> https://[fd12:3456:789a:1::1]:443/edev/1/subs/2**Error! Hyperlink reference not valid.** </subscriptionURI> </Notification>

	HTTP/1.1 201 Created

Table 16 – Subscriptions and Notifications

5.10 Periodic Gets of Information

PEV gets the Default DERControl every 1 second if it has not subscribed to the resource. The key purpose is to monitor the *opModEnergize* object for changes to the authorization to discharge.	GET /pev/derp/1/dderc HTTP/1.1 HTTP/1.1 200 OK <DefaultDERControl xmlns="urn:ieee:std:2030.5:ns" href="/pev/derp/1/dderc" subscribable="1"> <mRID>DDDD00010001000000000000000D17E</mRID> <description>Default DERC</description> <DERControlBase> <opModEnergize>false</opModEnergize> </DERControlBase> <setESDelay>30000</setESDelay> <setESHighFreq>6100</setESHighFreq> <setESHighVolt>10500</setESHighVolt> <setESLowFreq>5900</setESLowFreq> <setESLowVolt>9500</setESLowVolt> <setESRampTms>6000</setESRampTms> <setESRandomDelay>0</setESRandomDelay> </DefaultDERControl>
PEV gets the DERControlList every 1 second if it has not subscribed to the resource. The key purpose is to monitor for changes to the Management Information controls. The PEV shall stop discharging if it cannot comply with any Management Information values.	GET /pev/derp/1/derc HTTP/1.1 HTTP/1.1 200 OK <DERControlList xmlns="urn:ieee:std:2030.5:ns" href="/pev/derp/1/derc" subscribable="1" all="9" results="1"> <DERControl href="/pev/derp/1/derc/1" replyTo="/rsps/1/rsp" responseRequired="07"> <mRID>CCCC00090000000000000000D17E</mRID> <description>MI-Freq-Droop</description> <creationTime>1670691600</creationTime> <EventStatus> <currentStatus>1</currentStatus> <dateTime>1670691600</dateTime> <potentiallySuperseded>false</potentiallySuperseded> </EventStatus> <interval> <duration>4294967295</duration> <start>1670691600</start> </interval> <DERControlBase> <opModFreqDroop> <dBOF>61000</dBOF> <dBUF>59000</dBUF> <kOF>100</kOF> <kUF>100</kUF> <openLoopTms>200</openLoopTms> </opModFreqDroop>

	</DERControlBase> <deviceCategory>010000</deviceCategory> </DERControl> </DERControlList> # # Note: The queries for the other 8 DERControls in the list are not shown. #
PEV monitors its EndDevice instance. The primary purpose is to detect changes to the postRate.	GET /edev/1 HTTP/1.1 HTTP/1.1 200 OK <EndDevice xmlns="urn:ieee:std:2030.5:ns" href="/edev/1"> <DERListLink href="/edev/1/der" all="1"/> <deviceCategory>010000</deviceCategory> <DeviceInformationLink href="/edev/1/di"/> <DeviceStatusLink href="/edev/1/dstat"/> <lFDI>A2038B8645F15C66D889FFBC4352AC0B8CDACBA1</lFDI> <PowerStatusLink href="/edev/1/pwrstat"/> <sFDI>434902610920</sFDI> <changedTime>1670691600</changedTime> <enabled>true</enabled> <FunctionSetAssignmentsListLink href="/pev/fsa" all="1"/> <postRate>15</postRate> <SubscriptionListLink href="/edev/1/subs"/> </EndDevice>
PEV monitors its MUP instance. The primary purpose is to detect changes to the postRate.	GET /mup/1 HTTP/1.1 HTTP/1.1 200 OK <MirrorUsagePoint xmlns="urn:ieee:std:2030.5:ns" href="/mup/1"> <mRID>FFFF0001000000000000000000000D17E</mRID> <description>PEV MUP</description> <roleFlags>04</roleFlags> <serviceCategoryKind>0</serviceCategoryKind> <status>1</status> <deviceLFDI>A2038B8645F15C66D889FFBC4352AC0B8CDACBA1</deviceLFDI> <postRate>15</postRate> </MirrorUsagePoint>

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5.11 PEV Sends Periodic Information

PEV puts its DERStatus every 1 second. Posting of this resource is used as a heartbeat message for loss of communications detection. In this update, the inverterStatus value is 0 indicating the PEV is authorized to discharge.	PUT /edev/1/der/1/ders HTTP/1.1 <DERStatus xmlns="urn:ieee:std:2030.5:ns" href="/edev/1/der/1/ders"> <alarmStatus>00</alarmStatus> <genConnectStatus> <dateTime>1670691600</dateTime> <value>02</value> </genConnectStatus> <inverterStatus> <dateTime>1670691685</dateTime> <value>3</value> </inverterStatus> <operationalModeStatus> <dateTime>1670691600</dateTime> <value>2</value> </operationalModeStatus> <readingTime>1670691685</readingTime> <stateOfChargeStatus> <dateTime>1670691685</dateTime> <value>5001</value> </stateOfChargeStatus> </DERStatus> HTTP/1.1 204 No Content
PEV puts its PowerStatus which contains the PEVInfo resource.	PUT /edev/1/pwrstat HTTP/1.1 <PowerStatus xmlns="urn:ieee:std:2030.5:ns" href="/edev/1/pwrstat"> <batteryStatus>1</batteryStatus> <changedTime>1670691685</changedTime> <currentPowerSource>2</currentPowerSource> <PEVInfo> <chargingPowerNow> <multiplier>0</multiplier> <value>6000</value> </chargingPowerNow> <energyRequestNow> <multiplier>3</multiplier> <value>24</value> </energyRequestNow> <maxForwardPower> <multiplier>0</multiplier> <value>6500</value> </maxForwardPower> <minimumChargingDuration>14400</minimumChargingDuration> <targetStateOfCharge>8500</targetStateOfCharge> <timeChargeIsNeeded>1670713200</timeChargeIsNeeded> <timeChargingStatusPEV>1670691685</timeChargingStatusPEV> </PEVInfo> </PowerStatus>

	HTTP/1.1 204 No Content
PEV put its DER Availability.	PUT /edev/1/der/1/dera HTTP/1.1 <DERAvailability xmlns="urn:ieee:std:2030.5:ns" href="/edev/1/der/1/dera"> <availabilityDuration>12000</availabilityDuration> <maxChargeDuration>18000</maxChargeDuration> <readingTime>1670691685</readingTime> <reserveChargePercent>2500</reserveChargePercent> <reservePercent>2500</reservePercent> </DERAvailability> HTTP/1.1 204 No Content
PEV posts its Meter Readings – Active Power. The update rate is set by the MeterUsagePoint: postRate.	POST /mup/1 HTTP/1.1 <MirrorMeterReading xmlns="urn:ieee:std:2030.5:ns"> <mRID>FFFF000100000000000000000000D17E</mRID> <description>Active Power</description> <Reading> <timePeriod> <duration>0</duration> <start>1670691685</start> </timePeriod> <value>5975</value> </Reading> </MirrorMeterReading> HTTP/1.1 204 No Content
PEV posts its Meter Readings – Reactive Power. The update rate is set by the MeterUsagePoint: postRate.	POST /mup/1 HTTP/1.1 <MirrorMeterReading xmlns="urn:ieee:std:2030.5:ns"> <mRID>FFFF000200000000000000000000D17E</mRID> <description>Reactive Power</description> <Reading> <timePeriod> <duration>0</duration> <start>1670691685</start> </timePeriod> <value>0</value> </Reading> </MirrorMeterReading> HTTP/1.1 204 No Content

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PEV posts its Meter Readings – Voltage. The update rate is set by the MeterUsagePoint: postRate.	POST /mup/1 HTTP/1.1 <MirrorMeterReading xmlns="urn:ieee:std:2030.5:ns"> <mRID>FFFF0003000000000000000000D17E</mRID> <description>Voltage</description> <Reading> <timePeriod> <duration>0</duration> <start>1670691685</start> </timePeriod> <value>20825</value> </Reading> </MirrorMeterReading> HTTP/1.1 204 No Content
PEV posts its Meter Readings – Frequency. The update rate is set by the MeterUsagePoint: postRate.	POST /mup/1 HTTP/1.1 <MirrorMeterReading xmlns="urn:ieee:std:2030.5:ns"> <mRID>FFFF0004000000000000000000D17E</mRID> <description>Frequency</description> <Reading> <timePeriod> <duration>0</duration> <start>1670691685</start> </timePeriod> <value>6001</value> </Reading> </MirrorMeterReading> HTTP/1.1 204 No Content

1041 Table 18 – PEV Sends Periodic Information

5.12 Other Functions

PEV gets new DERControl.
 	
The new DERControl contains the *opModMaxLimW* control to adjust the Active Power limit for the site.
	`GET /pev/derp/1/derc?s=1 HTTP/1.1`
	`HTTP/1.1 200 OK`
	
	`<DERControlList xmlns="urn:ieee:std:2030.5:ns" href="/pev/derp/1/derc" subscribable="1" all="10" results="1">`
	`<DERControl href="/pev/derp/1/derc/1" replyTo="/rsps/1/rsp" responseRequired="07">`
	`<mRID>CCCC000A0000000000000000000D17E</mRID>`
	`<description>Dynamic Active Power Limit</description>`
	`<creationTime>1670695200</creationTime>`
	`<EventStatus>`
	`<currentStatus>1</currentStatus>`
	`<dateTime>1670695200</dateTime>`
	`<potentiallySuperseded>false</potentiallySuperseded>`
	`</EventStatus>`
	`<interval>`
	`<duration>4294967295</duration>`
	`<start>1670695200</start>`
	`</interval>`
	`<DERControlBase>`
	`<opModMaxLimW>5000</opModMaxLimW>`
	`</DERControlBase>`
	`<deviceCategory>010000</deviceCategory>`
	`</DERControl>`
	`</DERControlList>`

PEV posts its DERControl Response – Received.
 	
Since the event start time is in the past, the response is immediately sent.
	`POST /rsps HTTP/1.1`
	
	`<DERControlResponse xmlns="urn:ieee:std:2030.5:ns">`
	`<createdDateTime>1670695205</createdDateTime>`
	`<endDeviceLFDI>A2038B8645F15C66D889FFBC4352AC0B8CDACBA1</endDeviceLFDI>`
	`<status>1</status>`
	`<subject>CCCC000A0000000000000000000D17E</subject>`
	`</DERControlResponse>`
	
	`HTTP/1.1 201 Created`
	`Location: /rsps/1/rsp/19`

PEV posts its DERControl Response - Started
 	
Since the event start time is in the past, the response is immediately sent.
	`POST /rsps HTTP/1.1`
	
	`<DERControlResponse xmlns="urn:ieee:std:2030.5:ns">`
	`<createdDateTime>1670695205</createdDateTime>`
	`<endDeviceLFDI>A2038B8645F15C66D889FFBC4352AC0B8CDACBA1</endDeviceLFDI>`
	`<status>2</status>`
	`<subject>CCCC000A0000000000000000000D17E</subject>`
	`</DERControlResponse>`
	
	`HTTP/1.1 201 Created`
	`Location: /rsps/1/rsp/20`

PEV gets new DERControl. The new DERControl contains the *opModFixedW* control to coordinated charging and discharging.	GET /pev/derp/1/derc HTTP/1.1 HTTP/1.1 200 OK <DERControlList xmlns="urn:ieee:std:2030.5:ns" href="/pev/derp/1/derc" subscribable="1" all="11" results="1"> <DERControl href="/pev/derp/1/derc/1" replyTo="/rsps/1/rsp" responseRequired="07"> <mRID>CCCC000B0000000000000000000D17E</mRID> <description>Active Power Setpoint</description> <creationTime>1670698800</creationTime> <EventStatus> <currentStatus>1</currentStatus> <dateTime>1670698800</dateTime> <potentiallySuperseded>false</potentiallySuperseded> </EventStatus> <interval> <duration>4294967295</duration> <start>1670698800</start> </interval> <DERControlBase> <opModFixedW>2500</opModFixedW> </DERControlBase> <deviceCategory>010000</deviceCategory> </DERControl> </DERControlList>
PEV posts its DERControl Response – Received. Since the event start time is in the past, the response is immediately sent.	POST /rsps HTTP/1.1 <DERControlResponse xmlns="urn:ieee:std:2030.5:ns"> <createdDateTime>1670698805</createdDateTime> <endDeviceLFDI>A2038B8645F15C66D889FFBC4352AC0B8CDACBA1</endDeviceLFDI> <status>1</status> <subject>CCCC000B0000000000000000000D17E</subject> </DERControlResponse> HTTP/1.1 201 Created Location: /rsps/1/rsp/21
PEV posts its DERControl Response - Started Since the event start time is in the past, the response is immediately sent.	POST /rsps HTTP/1.1 <DERControlResponse xmlns="urn:ieee:std:2030.5:ns"> <createdDateTime>1670698805</createdDateTime> <endDeviceLFDI>A2038B8645F15C66D889FFBC4352AC0B8CDACBA1</endDeviceLFDI> <status>2</status> <subject>CCCC000B0000000000000000000D17E</subject> </DERControlResponse> HTTP/1.1 201 Created Location: /rsps/1/rsp/22

1044 Table 19 – Other Functions