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CPUC Meeting
VGI Standards Summary

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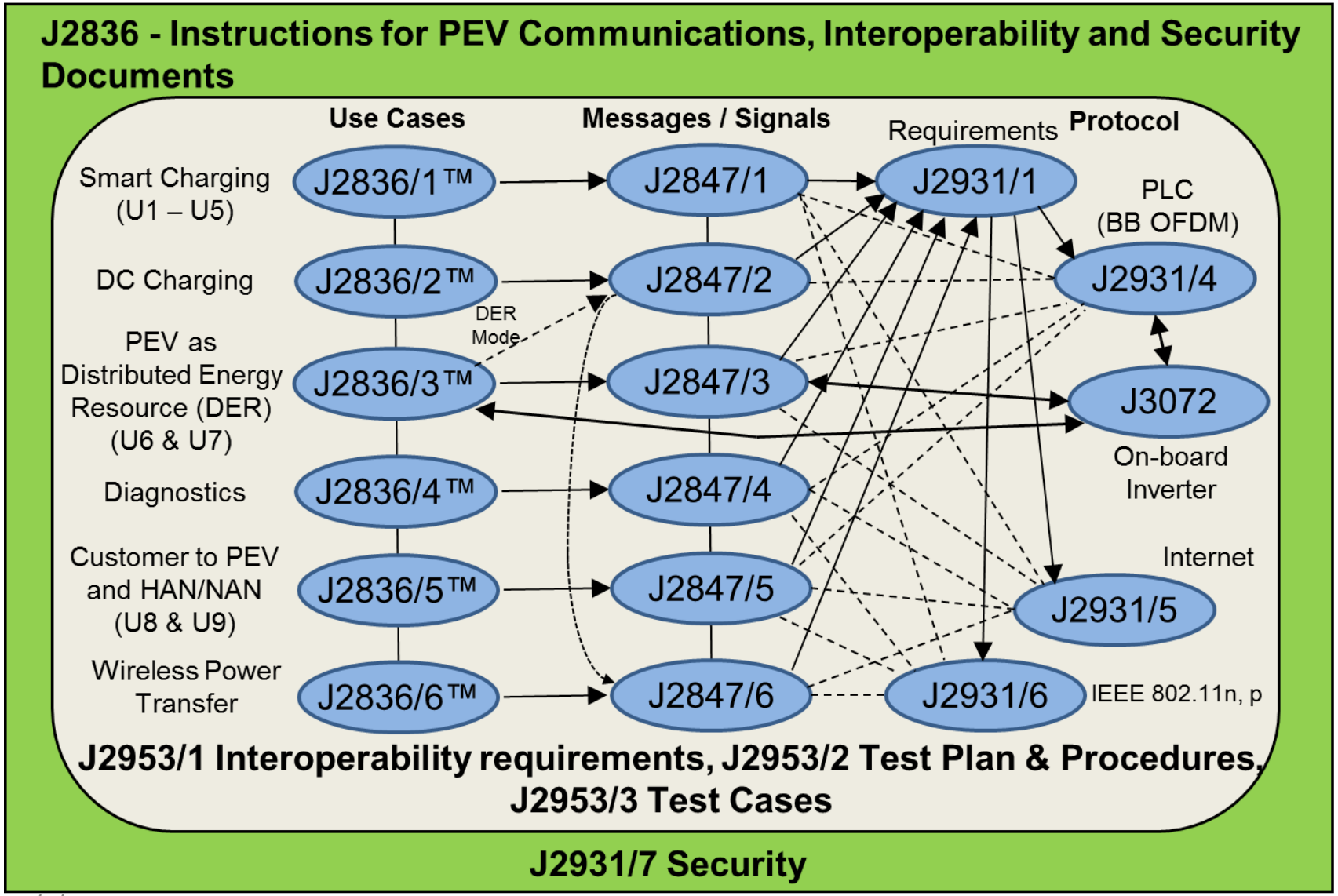
Discussion Points

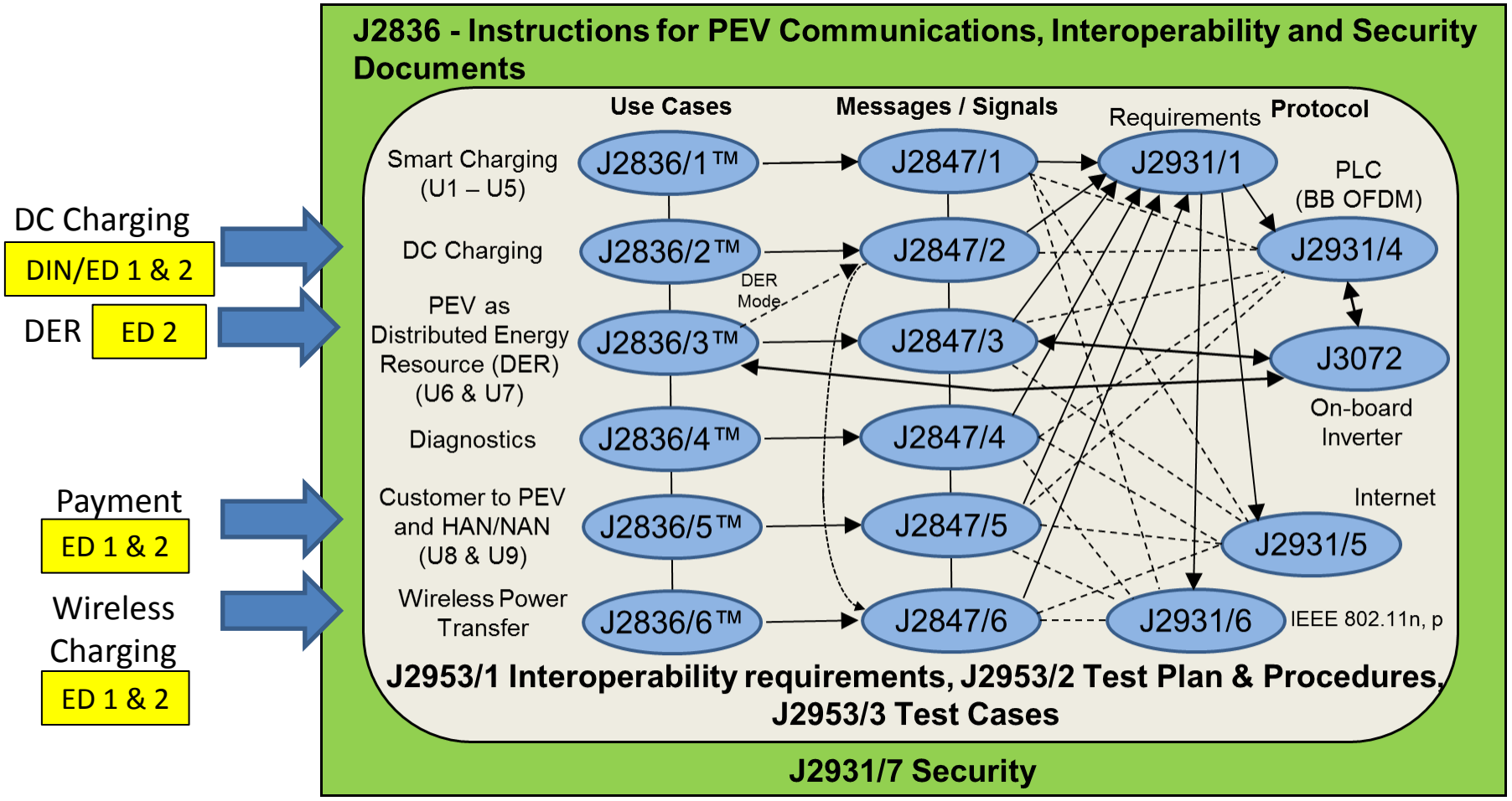
1. **The SAE Communication and Interoperability task force started working with EPRI and Utilities since 2007 to establish requirements for PEV energy transfer and communication. Engaged with the ISO/IEC team a year later.**
   a) ISO/IEC 15118, ED 1 was published in 2015, then reopened and expected publication of ED 2 by end of 2018, where it will be harmonized with SAE
   b) All Europe and USA DC charging is per DIN SPEC 70121:2014-12 and SAE, not ISO 15118 for the Combined Charging System (CCS) or IEEE 2030.1.1-2015 for CHAdeMO
2. **SAE's objective is to offer solutions for 100% of our customers and all requirements (present and future combinations)**
   a) PowerLine Carrier (PLC) is an opportunity but not the only solution as Telematics offers other benefits such as Load forecasting before charging. Note: Security is not a problem with PLC per se, but with 15118 it is.
   b) Wired (PLC) is required for direct association and DC charging (& DC DER). Planning for the energy transfer event and customer to vehicle interface is best suited using other approaches.
   c) 15118 payment is between the vehicle and EVSE, SAE is focused on payment (if required) between the customer and energy provider.
3. **Planning and scheduling the vehicle energy transfer session should be patterned after a "cell phone" Internet model**, by routing and not terminated communications, after connecting to a PLC enabled EVSE.
   – SAE standards is like a WiFi Access Point with more than one approach to plan and execute the energy session

SAE Document Interaction

Use Cases, Messages, Protocol, Interop and Security



ISO/DIN/SAE common material

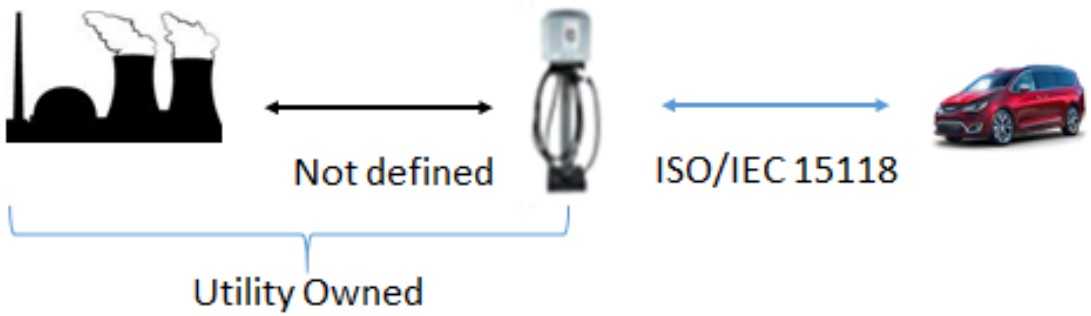


i. AC and DC DER is added to 15118 ED 2, is including reverse power flow, not the full Rule 21 requirements for frequency and voltage control. Schedule in in Backup (page 14) and released in two years (end of 2018)

ii. AC DER, 15118 ED 2, does not address the required circuit association (voltage basis) between the vehicle and grid. SAE J2847/2 and J3072 includes this.

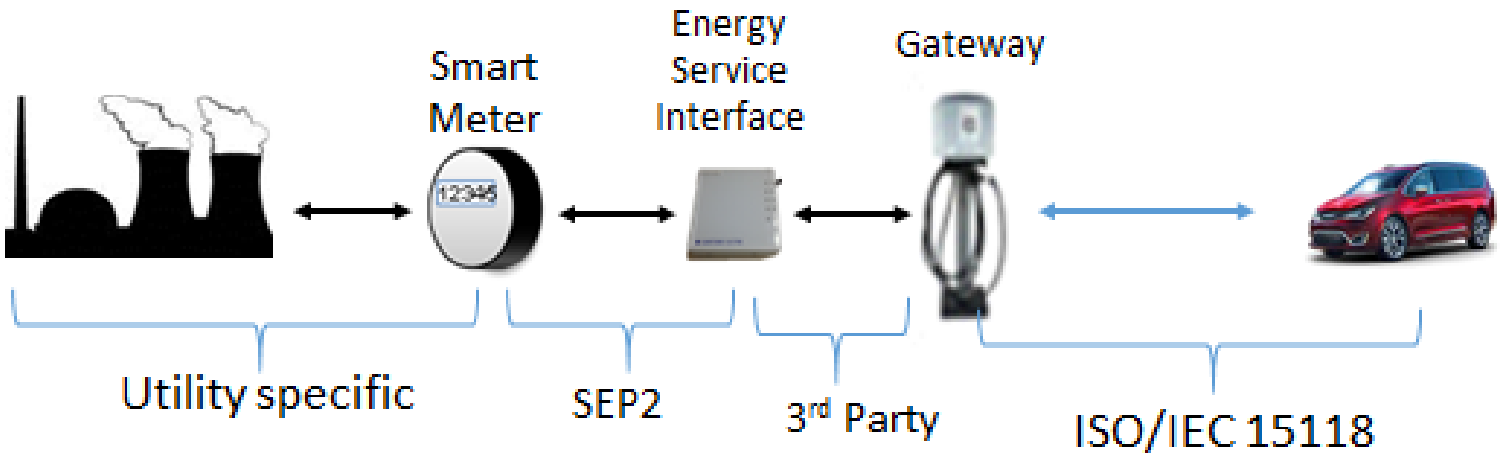
iii. ISO 15118 ED 1 & 2 summary of documents is shown in Backup (pages 15 & 16 respectively)

ISO 15118 architecture in Europe
(PLC only for AC & DC, WiFi for Wireless charging)



- EVSE is permanently mounted
- 2 step Communication process
  1. ISO 15118 is between Vehicle and EVSE
  2. Utility is to EVSE

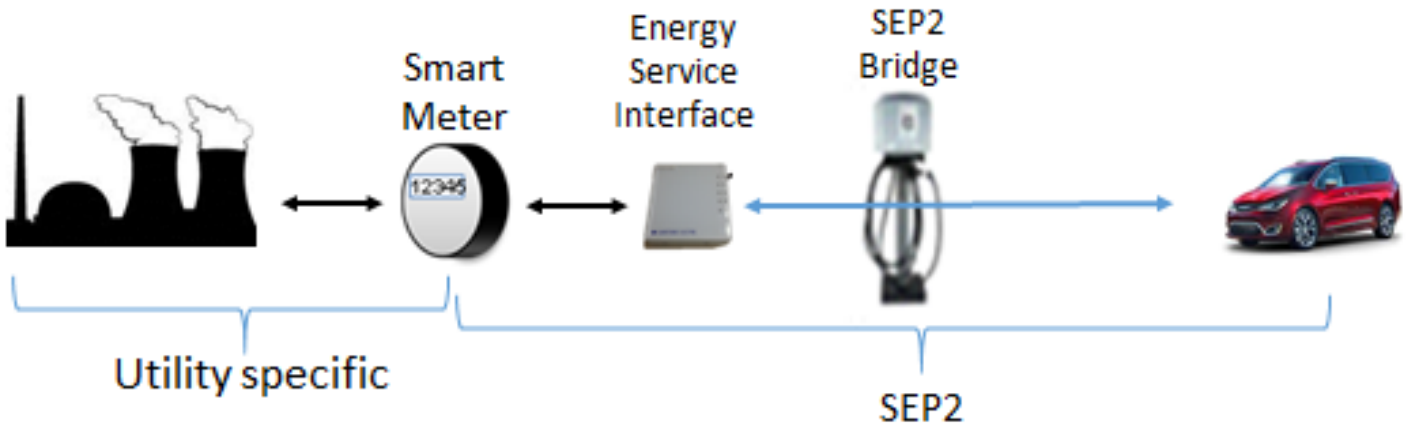
ISO 15118 architecture in USA



- 3 Step Communication process:
  1. Utility meter to ESI is SEP2,
  2. Vehicle to EVSE is 15118,
  3. 3rd party, between EVSE and ESI is required to read and translate the communication from the vehicle to Utility.
- EVSE (if private and less than 50A) is likely to be “plug-able” into an garage outlet, and is easily unplugged and relocated by any user. Has to be “fixed in place” but not permanent.
  - This allows separation between installing home wiring and EVSE installation, or allows use of an existing outlet.

SAE/IEEE architecture in USA

(SEP2 is PLC or WiFi or Zigbee protocol options)



- Utility meter to ESI is SEP2, vehicle to ESI is SEP2. Same model for home, business, fleet, MFD, etc.
- EVSE (if private or public) communication is "bridged" at 2nd layer of stack, so the protocol is changed but the vehicle is communicating with the Utility
- Price (ToU, CPP, RTP) and DR programs from legacy SEP1.x are used in SEP2, along with FlowReservation (vehicle power, energy, time required).
  - Price and DR have been used for decades since home A/C and hot water heaters are candidates for DR control to curtail or delay startup.
  - Once more homes include an EVSE, utility communication is required for vehicle charging coordination
  - Typical vehicle with 30 miles/day or 10 kWh is 7 kW for 2 hours

Backup

ISO/SAE status

Schedule:

- DIN SPEC 70121:2012-08, then updated and republished Dec, 2014 to document product releases (vehicle and EVSE). SAE harmonized and republished April,2015
- ISO 15118-1, 2 & 3 ED 1 published in 2015 (6-7 year process)
- ISO 15118-1, 2 & 3 ED 2 effort started in 2015 with expected publication end of 2018
  - Adds AC DER, DC DER, updates to AC, DC, Wireless charging, security is mandatory instead of optional, adds retries/restarts instead of ending charge is timing or messages are missed
  - Treating 838 comments, 286 technical, 84 general, 468 editorial comments
  - 569 accepted, 51 rejected, 91 noted, 125 discussion

Common Aspects:

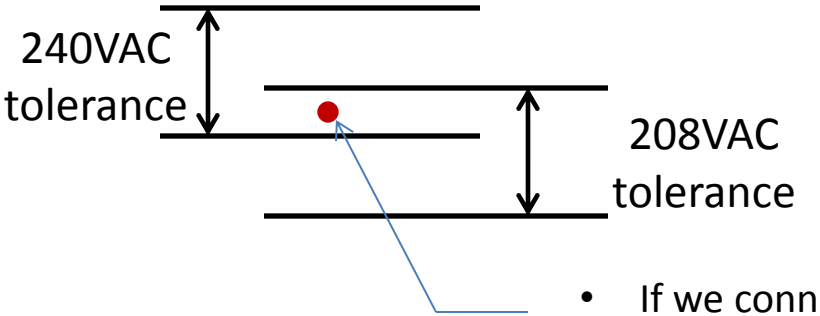
- DC Charging
  - **DIN SPEC 70121:2014-12 and SAE is used for all built product in Europe and USA, not ISO ED 1**
  - **ISO 15118 ED 1 (published in 2015) has 237 variations to the DIN SPEC**
  - SAE /2 series will include ISO/IEC ED 2 variations only (after addressing technical comments), not ED 1
- AC Charging (adds payment)
  - Plug and Charge (PnC)
  - External Identification Means (EIM) or RFID card
  - PLC payment will be added to SAE /5 series along other payment options/protocols that the customer plans to use, not the vehicle, as 15118 uses (personal cell phone, etc.)
- Wireless Power Transfer
  - Variations exist between ED 2 and SAE. SAE /6 series will be updated to include ED 2 variations while retaining legacy product messages

DER – 3rd party issue

- The vehicle controls charging
- The off-board system controls DER (not vehicle)
  - 15118 and 3rd party communication adds to complexity of trusting the source requesting DER commands to the vehicle

DER voltage basis (USA only)

- Europe is only one voltage at 230VAC single phase, USA can be either 208 or 240VAC
  - The vehicle needs a utility “voltage basis signal” upon each connection vehicle since these voltages overlap. If the vehicle measures inside this tolerance, and doesn’t have the basis, it could “induce a sag” on the grid. SEP2 provides this, 15118 does not.



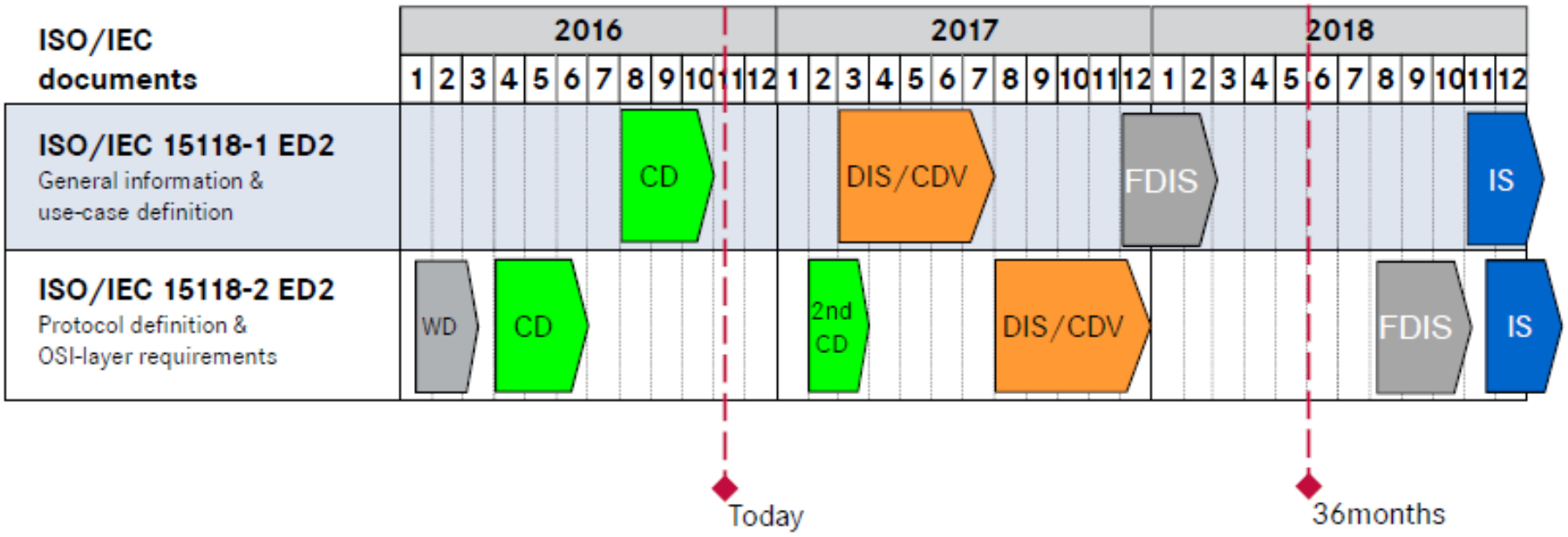
- If we connect and measure here, we don’t know if the “basis” is 240 or 208. If 240 and we drop below the minimum, we could induce a sag on the grid. Solar inverters also accomplish this but are always permanently connected at home. The EVSE may be a “plugable” unit.
- SEP2 sends the utility basis voltage signal to the vehicle.
- 15118 does not include this basis voltage signal and has no mechanism to transfer it between the ESI and PEV

Gateway vs. Bridge

	IEEE2030.5	ISO/IEC 15118	Gateway vs. Bridge
Layer 7 - Application	Function Sets, REST Resources	V2G App Layer Messages	**Gateway**: 15118 protocol translation (decodes the packets at the 15118 application layer and re-encodes it at the application layer of the other protocol)
Layer 6 - Presentation	XML, EXI	XML, EXI	
Layer 5 - Session	HTTP,HTTPS	V2GTP	
Layer 4 - Transport	TCP, UDP	TCP	
Layer 3 - Network	IPv4, IPv6	IPv4, IPv6	
Layer 2 – Data Link (MAC)			**Bridge**: SEP2 protocol switch
Layer 1 – Physical (PHY)			

The difference between a Gateway (better known as an Application Gateway) and a bridge is that two different protocols need an application gateway and the same protocol can bridge or switch at layer 2 and just needs to look at the destination address (in the packet header) and not decode the payload.

15118 ED 2 schedule



ISO 15118 ED 1

- **ISO 15118-1: Road vehicles - Vehicle to grid communication interface**
  - **Part 1: General information and use-case definition (J2836)**
- **ISO 15118-2: Road vehicles – Vehicle to Grid communication Interface**
  - **Part 2: Technical protocol description and Open Systems Interconnections (OSI) layer requirements (J2847)**
- **ISO 15118-3: Road Vehicles - Vehicle to grid communication interface**
  - **Part 3: Physical layer and Data Link layer requirements (J2931)**
- **ISO 15118-4 Ed.1: Road vehicles — Vehicle to grid communication interface**
  - **Part 4: Network and application protocol conformance test (J2953 is Interoperability)**
- **ISO 15118-5 Ed.1: Road vehicles - Vehicle to grid communication interface**
  - **Part 5: Physical and data link layer conformance test (J2953 is Interoperability)**
- **ISO 15118-6 Ed. 1.0: Road vehicles - Vehicle to grid communication interface**
  - **Part 6: General information and use-case definition for wireless communication (J2836/6)**
- **ISO 15118-7 Ed. 1.0: Road vehicles - Vehicle to grid communication interface**
  - **Part 7: Network and application protocol requirements for wireless communication (J2847/6)**
- **ISO 15118-8 Ed. 1.0: Road vehicles - Vehicle to grid communication interface**
  - **Part 8: Physical layer and data link layer requirements for wireless communication (J2931/6)**

ISO 15118 ED 2

- **ISO 15118-1: ED 2 - Road vehicles - Vehicle to grid communication interface**
  - **Part 1: General information and use-case definition (J2836)**
- **ISO 15118-2: ED 2 - Road vehicles – Vehicle to Grid communication Interface**
  - **Part 2: Technical protocol description and Open Systems Interconnections (OSI) layer requirements (J2847)**
- **ISO 15118-3: ED 2 - Road Vehicles - Vehicle to grid communication interface**
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