

EPRI | ELECTRIC POWER
RESEARCH INSTITUTE

AMI/HAN Group Meeting

10/31/2008

Standards and Requirements

- New documents are **SAEJ2836** & **SAEJ2847**
 - J2836 - Recommended Practice for Communication between Plug-in Vehicles and the Utility Grid
 - J2847 - Information Report for Use Cases for J2836
- The primary purpose of J2836 is *grid-optimized energy transfer for plug-in electric vehicles* – that is, ensuring that vehicle operators have sufficient energy for driving while enabling the delivery of that energy to vehicles in ways that minimize stress upon the grid.
- The purpose of J2847 is to document the set of use cases which must be supported by J2836.

High Level PHEV Communication Requirements

- Supports secure two-way communication with the Energy Services Communication Interface (i.e., Utility)
- Supports time- or price-based charging preferences based on current electric rate/tier
- Supports vehicle charging at any voltage
- Supports vehicle roaming and unified billing infrastructure
- Supports Customer override/opt-outs
- PEV-to-Utility communications technology based on open standards

SAE J2836/J2847 Effort Update

1. Use Cases

- Posted P1, P2 & P3 – TOU, demand response, price signals
- P4 in process – active load mgmt
- Established Sub Work Group

2. Communication

- Considering ZigBee (smart meter) to HomePlug (vehicle) – requires bridge device – presented in HAN - CA PEV Connectivity Workshop - 080917
- Transport-independent approach: also support non-AMI environments via direct broadband, in-vehicle telematics, etc.
- Goal: common application layer (Smart Energy profile)
- Participating in ZB+HP Smart Energy discussion in Vancouver 10-9-08

SAE Work Schedule

- 1 Utility programs
 1. Time of Use (TOU) pricing demand side management programs
 2. Discrete Event demand side management program (Direct Load Control)
 3. Periodic/Hourly Pricing Price Response program
 4. Active Load Management program
 5. More?
- -2 Energy Transfer (J2293 thrifted, optimized & expanded)
 1. AC
 2. DC
- -3 Reverse Energy Transfer
 1. Home Generator (V2H)
 2. Islanding (V2L)
 3. Vehicle to Vehicle (V2V)
 4. Vehicle to Grid (V2G)

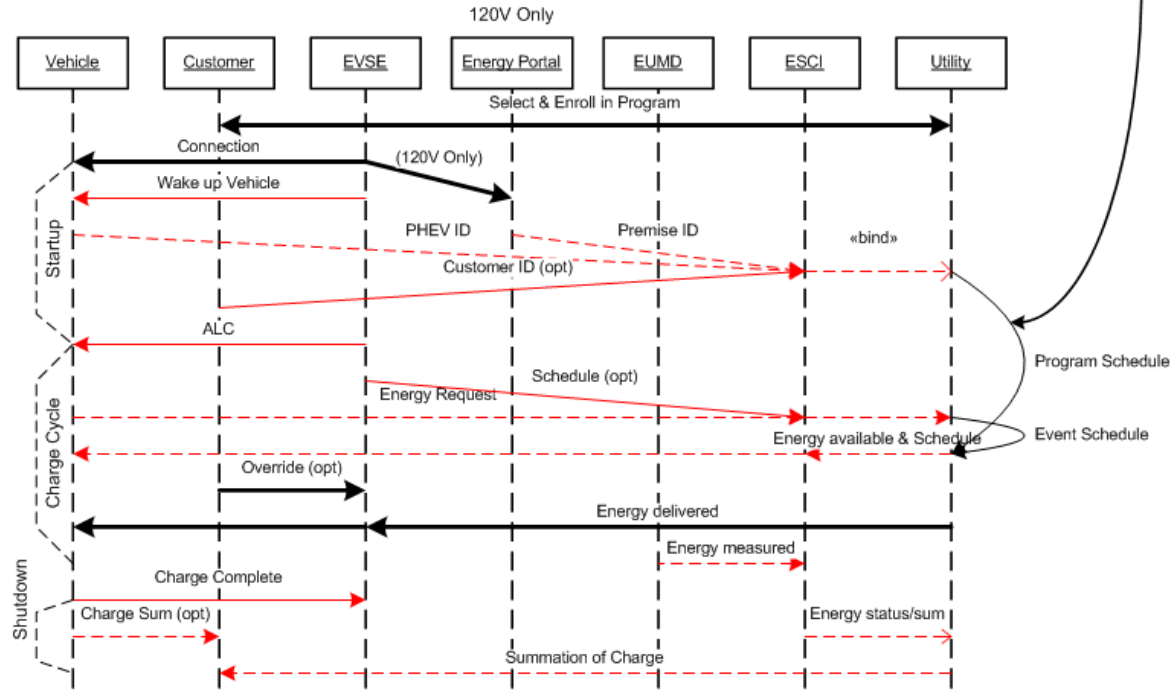
120V connection using cordset – TOU Plan

- 1) Separate Actions & Signals from Messages
- 2) Determine override method(s)
- 3) Determine latency of Vehicle start time until Utility start time (power down, then wake up close to scheduled time)

P1 & 2 (120V Cordset):
 TOU Program (binding & re-binding events) - EUMD is required.
 Charge at customer premise (optional is other premise - within utility territory)
 Billing to customer account
 Feedback status to customer

Event # 1
 Bob's, at work @ 8AM with sports car - TOU doesn't apply

Event # 2
 Bob's at home, @ 4PM with sports car - apply TOU
 Truck & van already plugged in.
 (delay charge until 8PM)



Start time is pre-established from TOU plan.
 (i.e. TOU applies from 4-8PM only)
 Utility establishes bases on enrollment
 (Dependant on Energy required for predictable connection cycles (SOC))

Energy requested & Schedule (vehicle)

- 1) Rate - ALC or charger size, whatever is smaller
- 2) Amount - Charge required (rate and duration of both bulk & top-off)
 - a. Small or large based on SOC, capacity, RESS technology
- 3) Duration - Time available (expected interval of consumption)
 - a. Flexible or rigid based on items 1 & 2

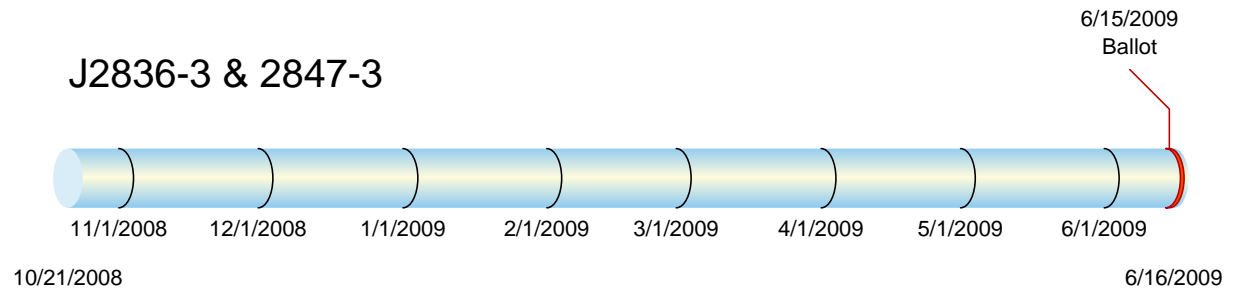
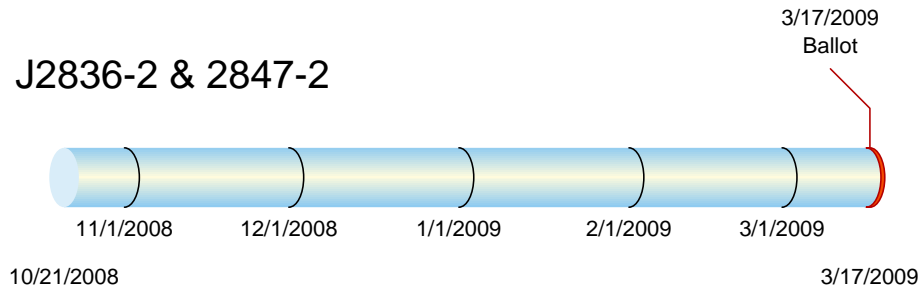
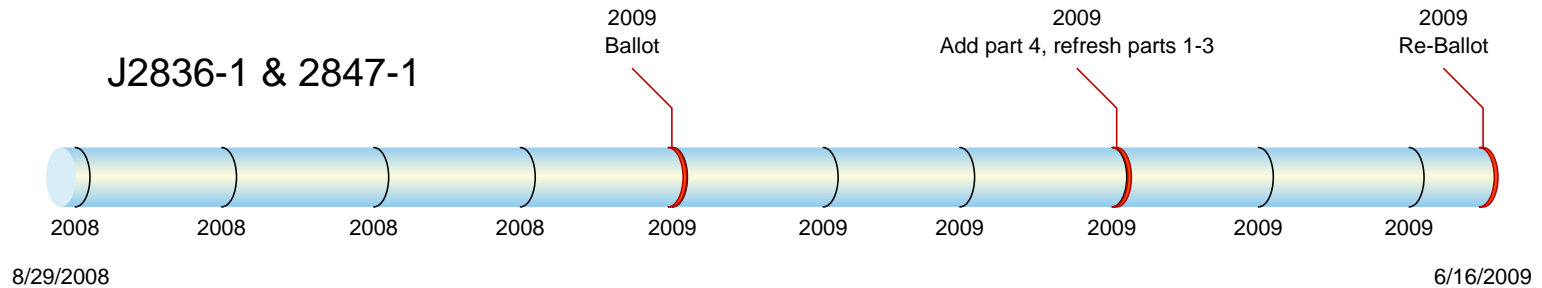
Energy available & Schedule (utility)

- 1) Load chart status
 - a. Balance local request with anticipated global loads
- 2) Price info (based on anticipated load)



Use Case Sequence Diagram

SAE J2836/J2847 Road Map



RTP Object Development

- Develop Real Time Pricing: Application Level Communications “objects”
- Flexible to accommodate a plausible wide variety of rate structures
 - RTP Objects Structured on UCA 2.0 later to become IEC 61850

Smart Charging Progress Update

- Agreed-upon grid \leftrightarrow vehicle communications requirements at application and transport layers
 - Application Layer: ZigBee Smart Energy Profile 1.x compliant
 - Transport Layer: PLC HomePlug 1.0 compliant
- EPRI leading to harmonize standards activities with OEM requirements (Ford, GM etc)
 - Communications technologies
 - Technical standards and current SDO activity
 - Understanding Smart Charging features, requirements and architecture
 - Identifying technology verification areas
- Developing a plan to do technology evaluations and demonstrations for Grid to vehicle connectivity
 - Energy Efficiency and Demand Response programs
 - Covering AMI and non-AMI utility territories
- Actively supported by 42 utilities

Agreed-upon grid-vehicle communications requirements

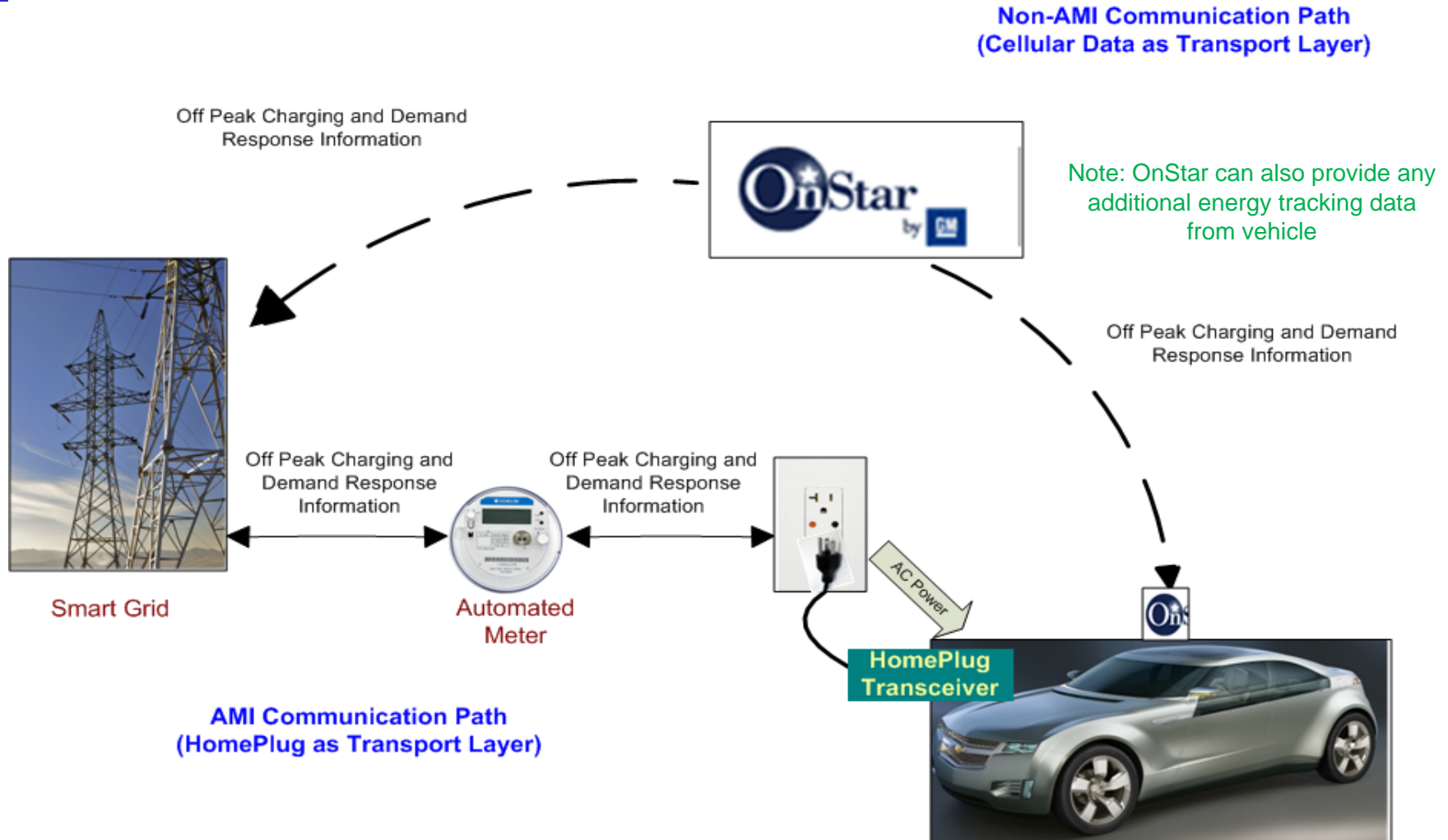
- Harmonizing Activities with SDOs – SAE, IEEE, NIST and ZigBee alliance
- Consistent with IntelliGrid CIM vision
- Prioritized as Near, Mid and Long-term
 - Near-term: Off-peak Charging, Demand Response, Load Control – local territory
 - Mid-Term: Near-term + roaming
 - Long-Term: Possibly on-board measurement, integrated billing and V2G

Areas of technology verification

- Application Layer – test compliance with ZigBee SEP 1.x and J2836 on GM EREV hardware
- Transport Layer – verify ZigBee Wireless / HomePlug 1.0 wired interoperability and conformance to SEP 1.x
- Demonstrate HomePlug suitability to multi-residential, commercial and public charging infrastructure
- Demonstrate AMI and non-AMI integration with PHEV technology on a representative hardware setup
- Demonstrate smart grid integration with smart PHEVs
 - Transmission and Distribution automation systems

Numerous Pathways to Implement Smart Charging

Engage Automotive Companies as Development Partners



PHEV / EREV