Communications protocols to promote robust grid-EV interoperability

Presented by Bob Oliver

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POLLUTION PROBE

CLEAN AIR. CLEAN WATER.

What makes an electric vehicle (EV) different?

- Costs more to build than a similar gasoline or diesel powered vehicle, yet does not offer superior utility in terms of user mobility
- Yet, EV use displaces demand for gasoline and diesel by powering transportation with electricity, thus changing sources and levels of air emissions that contribute to poor air quality and climate change
- Moreover, EVs have big batteries, which are designed to accumulate, store and discharge energy, which can facilitate:
  - Buffering capacity that allows utilities to better match power supply and demand
  - Back-up power for household services during blackouts
  - Integration of household and community-based energy systems (e.g., rooftop and small-scale solar, distributed generation)
  - Personal mobility

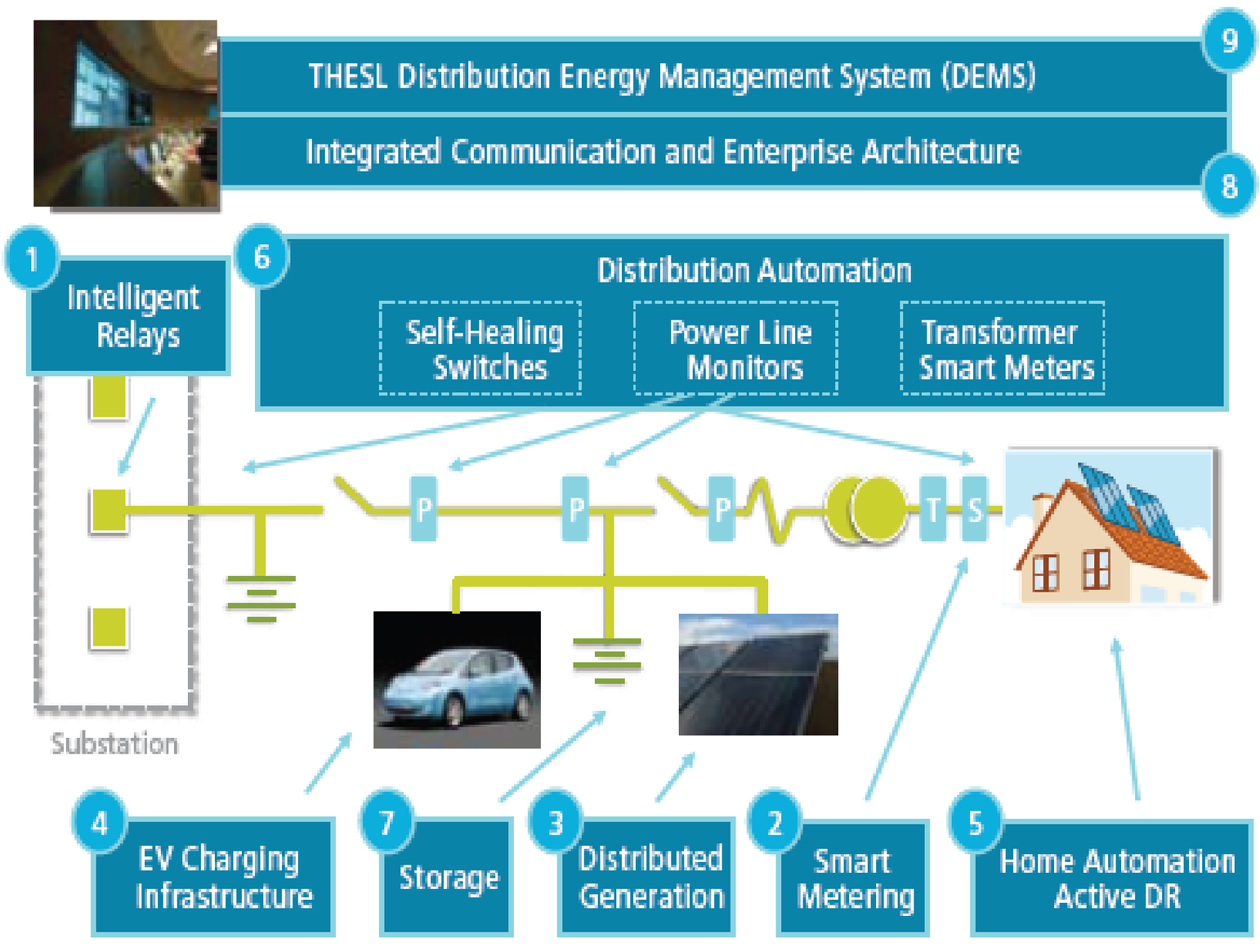
Convergence = Communications

- So, are EVs *more like* conventional vehicles with advanced battery systems? Or, are they *more like* advanced battery systems that happen to feature a mobility service?
- What if consumers are more responsive the latter of these two value propositions?
- What if utilities are interested in the potential of EVs to facilitate their “smart grid” objectives? What if it helps them to expand electricity services without expanding their infrastructure assets?
- The value proposition of EVs begins to look like part of a **convergence** of multiple and technologies and services, the benefits of which are oriented to multiple parties (utilities *and* end-users)
- To facilitate this convergence, we need a **communications** media; and this requires a common language (or “protocol”)

What does convergence look like?

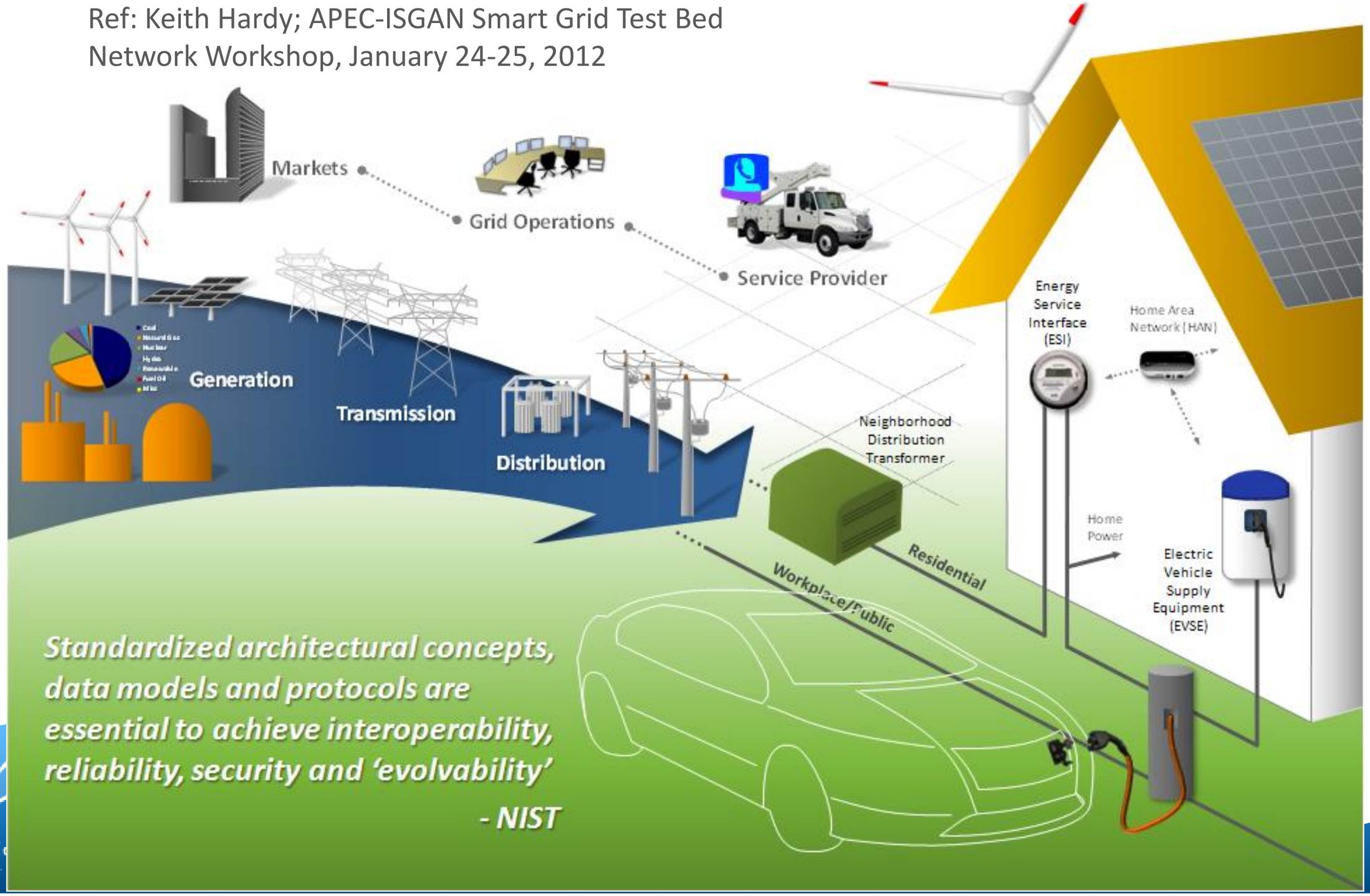
- A local distribution utility's perspective
  Ref: http://www.pollutionprobe.org/PDFs/EMMP.pdf

FIGURE 13: EVS IN TORONTO HYDRO-ELECTRIC SYSTEM'S SMART GRID (40)



What does convergence look like?

- US DOE's "Big Infrastructure Picture"
  Ref: Keith Hardy; APEC-ISGAN Smart Grid Test Bed Network Workshop, January 24-25, 2012



What standards exist?

* Referencing or relevant to 'V2G'

Building & Smart Grid

SAE
- J2293: EV Energy Transfer *
- J2836: PHEV-Grid Communication Practice *
- J2847: PHEV-Grid Communication TIR *

UL
- UL2735: Smart Utility Meters

Connectors and Cables

SAE
- J1772: Level 1 & 2 AC Charging Protocol

CSA
- TIL A-34: EV Connectors and Couplers
- TIL A-35: EV Cord Sets
- TIL J-39: EV Cord Sets
- TIL I-34: EV Connectors and Couplers

UL
- UL2251: EV plugs, receptacles, and couplers
- UL26: EV cable
- UL2734: Connectors for up to 600V

Electric Vehicle Supply Equipment

SAE
- J2931: EVSE-HAN Network Communication *
- J2953: Communication requirements for J2836

CSA
- TIL D-33: Charging interrupt up to 250Vac
- TIL I-44: Off-board charging systems to 600V
- C22.2No107.1-01: EVSE standards

UL
- UL2231: PPS for EV Supply Circuits
- UL2594: EV Supply Equipment
- UL2202: On/Off-Board Battery Charger

Electric Vehicle Standards

SAE
- J1711: HEV and PHEV Fuel Economy Test Proc'd
- J2841: Utility Factor Used in J1711 calculation
- J2894: On-Board Charger Power Quality

CSA
- C22.2No107.1-02: Battery Chargers

UL
- UL2202: On/Off-Board Battery Charger
- UL458A: Converters
- UL1004-1: Traction Motors
- UL2580: EV Batteries

Harmonization efforts are underway…

- In November 2011, US DOE and European Commission Agree on Cooperative Activities to Support Harmonization
- Among other goals:
  - Establish Electric Vehicle / Smart Grid Interoperability Centres, at Argonne National Laboratory in the United States and JRC-Ispra, in Italy

Photo courtesy of US Department of State

- Active role in standardization; supporting data-driven standards refinement and development, a common approach between EU and US testing of electric vehicle and smart grid equipment, all in an effort to **promote cooperative development of and support for global standards**

Ref: Keith Hardy; APEC-ISGAN Smart Grid Test Bed Network Workshop, January 24-25, 2012

…so are industry-led pilot projects!

- On August 22, 2012, Duke Energy and Toyota announced a joint smart grid pilot project in Indiana, US, to test power-grid load-equalization and to establish an optimized vehicle-charging scheme
- The communication standards developed by SAE to facilitate bi-directional digital communication protocol between PHEVs and utility companies will be used to equalize day-and-night load on the grid through a demand response system
- Charging through a variable toll system will also be investigated
- The pilot will use the Homeplug Green PHY, a power-line communications standard based on SAE J2931, enabling the sharing of data collected in a home network between the PHEV and the utility

"Smart charging through two-way communications with utilities will not only be a benefit to the customers, but is crucial for the promotion of transportation electrification" – Edward J. Mantey, Vice President of Vehicle Planning and Corporate Strategy at the Toyota Technical Centre

Ref: www.renewgridmag.com/e107_plugins/content/content.php?content.8847

EVE Informal Working Group Considerations

- Are communications protocols to promote robust grid-EV interoperability consistent with the objectives of the IWG?
- Would globally harmonized standards on communications protocols for grid-EV interoperability fall under the IWG mandate and its TOR?
- If so, then the current relevant standards that are in place or under development in the primary EV markets around the world should be identified and thoroughly assessed
- With the scope of the current standards fully understood, the IWG could develop a set of objectives for a global standard (consider conferring with Argonne National Laboratories, CSA, SAE, etc.)
- A globally harmonized communications protocol should ensure that any EV can operate with any EV charging station, and that energy transfer to (and from) the EV can be remotely managed from ‘before’ or ‘behind’ the meter

Thank You!

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