BERKELEY LAB

LAWRENCE BERKELEY NATIONAL LABORATORY

U.S. DEPARTMENT OF ENERGY

OpenADR 2.0 Briefing:

Open Automated Demand Response Communications

Rish Ghatikar, Mary Ann Piette, and Roger Levy
Demand Response Research Center

Sponsored by the California Energy Commission Public Interest Energy Research Program

DRRC Demand Response Research Center

Executive Summary

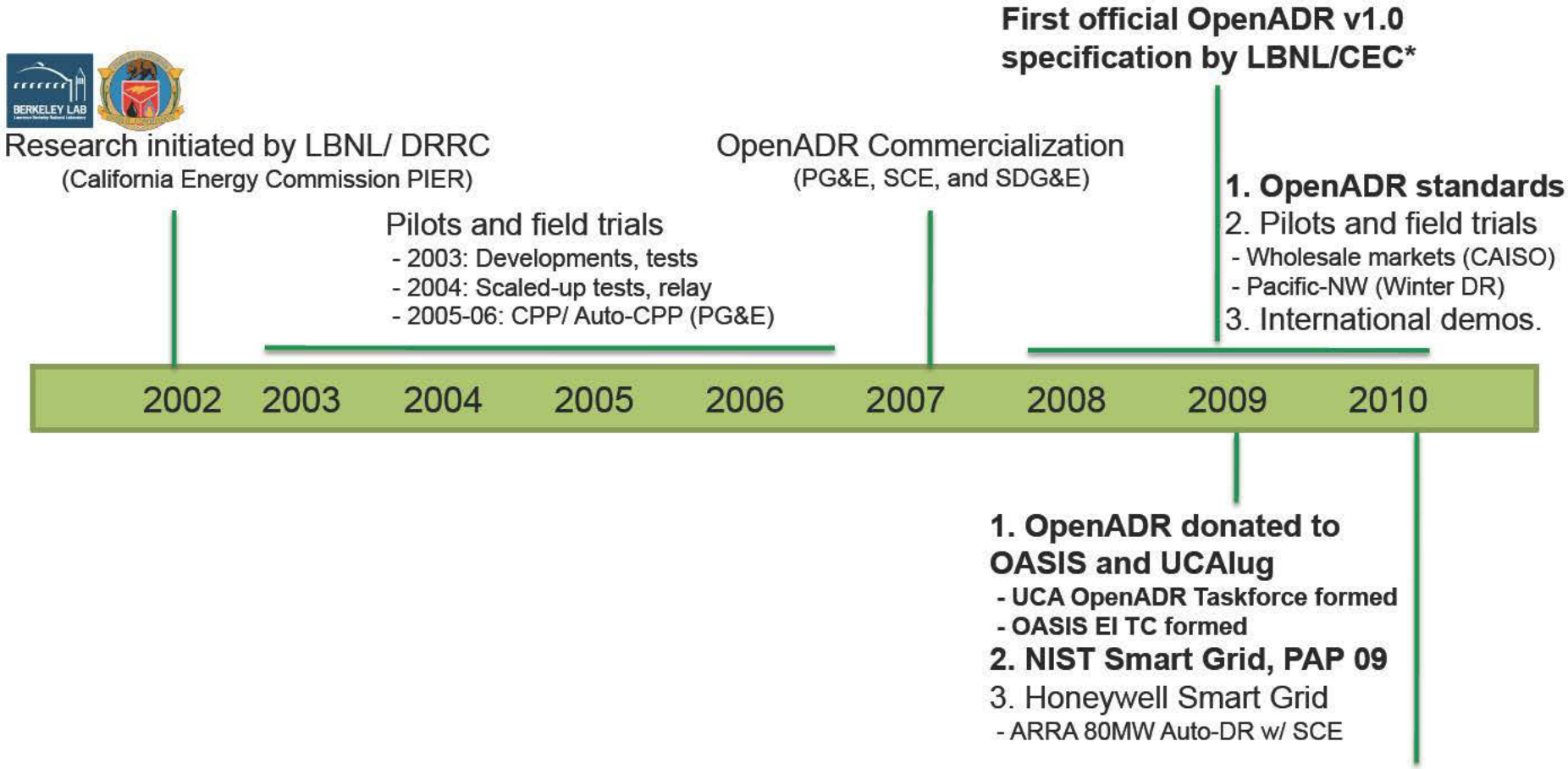
- **Purpose**: Facilitate OpenADR stakeholders' understanding and comments on draft OpenADR v2.0 profiles.
- **Background:** OpenADR is standardized by standards body. The body released draft for public review, ending Dec., 27.
- **Briefing:** Update on OpenADR v2.0 within national Smart Grid standards activity, links to OpenADR v1.0, and draft review.
- **Conclusions**:
  - Backward compatibility of commercial deployments to be retained.
  - Further revisions based on stakeholder inputs and requirements.
  - Public comments will address wider industry/stakeholder needs.
- **Next Steps**:
  - OpenADR v2.0 will become formal standards (in/before Summer 2011).
  - Industry represented OpenADR Alliance will advance OpenADR v2.0.
  - OpenADR standards will go through regulatory process for adoption.

Briefing Outline

- OpenADR Update
- OpenADR and Smart Grid Standards
- OpenADR v1.0 and v2.0
- Review of OpenADR v2.0 Profiles
- Conclusions and Next steps

- Acknowledgements:
  - California Energy Commission, Ed Koch (Akuacom Inc.)

OpenADR Update: History and Milestones



openADR ALLIANCE
http://www.openadr.org/

*OpenADR v1.0: http://openadr.lbl.gov/

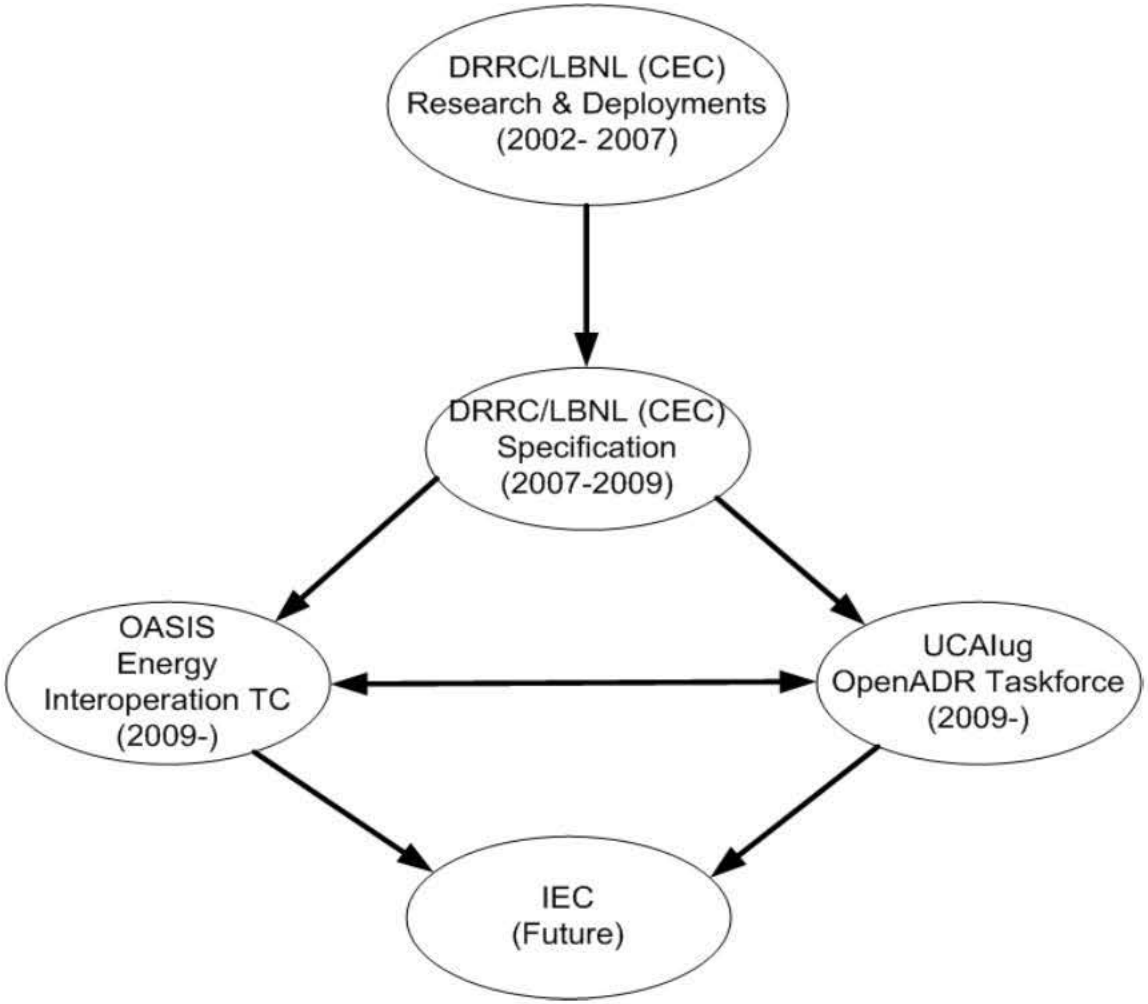
OpenADR Update: Client Development*

- *Over 60 key vendors implementing OpenADR Clients (and growing)!*
- *Conformance activities underway.*

*Starting Mid-2009, Akuacom Client Development Program: http://openadr.lbl.gov/pdf/openadr-client-develop.pdf

OPENADR AND SMART GRID STANDARDS

OpenADR Standardization Plans (Pre-Smart Grid)



NIST Smart Grid: Priority Action Plans (PAPs)

- National Institute of Standards and Technology (NIST) Smart Grid initiative started early 2009.
- PAP arises from the analysis of the applicability of Standards to the Use Cases of the Smart Grid.
- PAPs include identified experts in relative Standards Development Organizations (SDOs) – the PAP Working Group Management Team.
- Specifically, a PAP addresses either:
  - Gap where standard or standard extension is needed.
  - Overlap where 2 complementary standards address information in common but different for same scope.

Relevant Priority Action Plans (PAPs)*

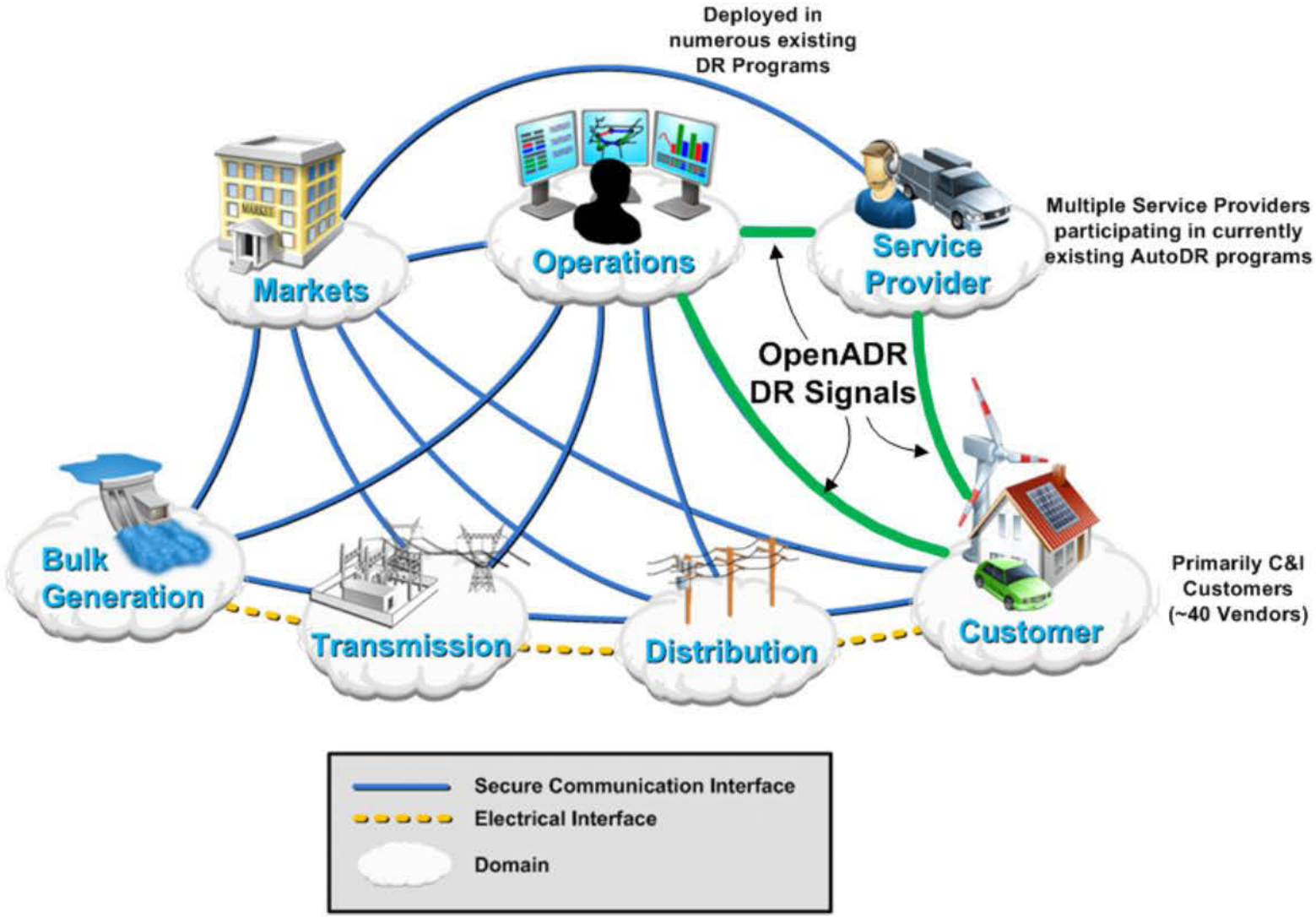
- PAP 03 – Price communications model
- PAP 04 – Schedule representation
- PAP 09 – Standard DR Signals (OpenADR)
- PAP 10 – Energy Information Exchange
- PAP 17 – Facility Smart Grid information

#	Priority Action Plan	#	Priority Action Plan
0	Meter Upgradeability Standard	1	Role of IP in the Smart Grid
2	Wireless Communications for the Smart Grid	3	Common Price Communication Model
4	Common Schedule Communication Mechanism	5	Standard Meter Data Profiles
6	Common Semantic Model for Meter Data Tables	7	Electric Storage Interconnection Guidelines
8	CIM for Distribution Grid Management	9	Standard DR and DER Signals
10	Standard Energy Usage Information	11	Common Object Models for Electric Transportation
12	Mapping IEEE 1815 (DNP3) to IEC 61850 Objects	13	Harmonization of IEEE C37.118 with IEC 61850 and Precision Time Synchronization
14	Transmission and Distribution Power Systems Model Mapping	15	Harmonize Power Line Carrier Standards for Appliance Communications in the Home
16	Wind Plant Communications	17	Facility Smart Grid Information Standard

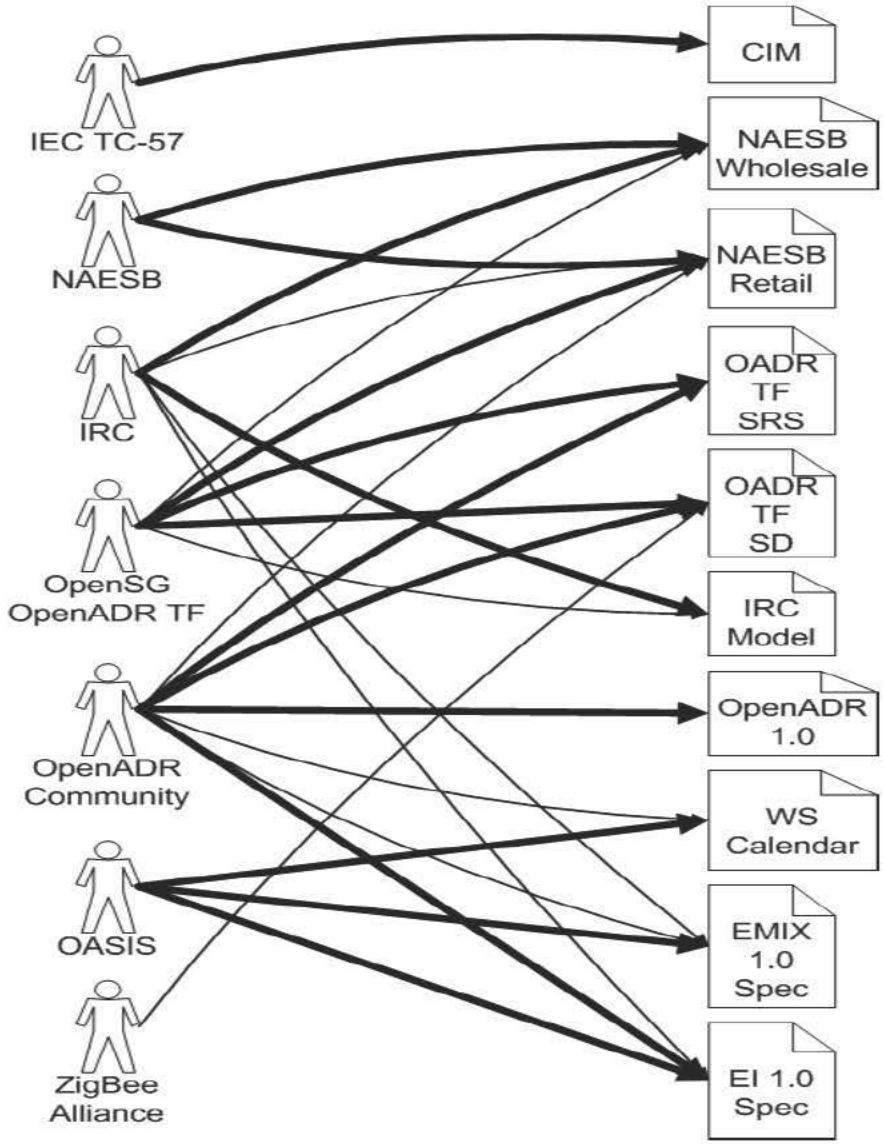
*PAP list: http://collaborate.nist.gov/twiki-sggrid/bin/view/SmartGrid/PriorityActionPlans

BERKELEY LAB

OpenADR Smart Grid Domain



Smart Grid PAP 03, 04, 09 Related Efforts



LEGEND:

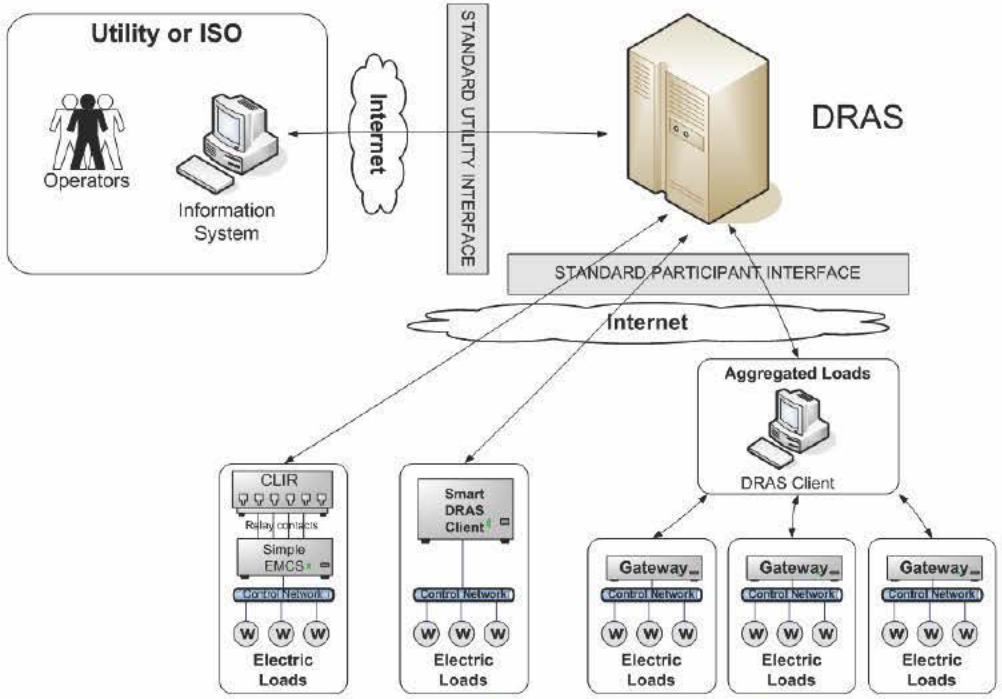
- **IEC**: International Electrotechnical Commission
- **NAESB**: North American Energy Standards Board
- **IRC**: ISO/RTO Council
  - **ISO**: Independent Systems Operator
  - **RTO**: Regional Transmission Organizations
- **OpenSG**: Open Smart Grid under UCA
  - **UCA**: Utilities Communications Architecture
  - **OpenADR TF**: OpenADR Task Force
- **OASIS**: Organization for Advancement of Structured Information Standards
- **CIM**: Common Information Model
- **OADR TF**: OpenADR Task Force
  - **SRS**: Systems Requirements Specifications
  - **SD**: Service Definitions
- **WS** Calendar: Web Services Calendar
- **EMIX**: Energy Market Information Exchange
- **EI**: Energy Interoperation

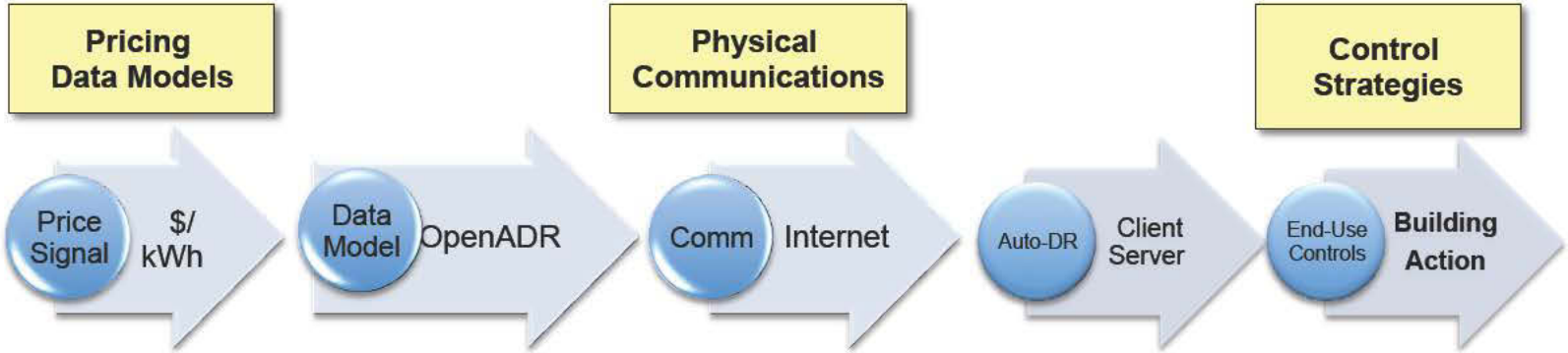
***Figure Source: Ed Koch (Akuacom, Inc)**

OPENADR V1.0 AND V2.0

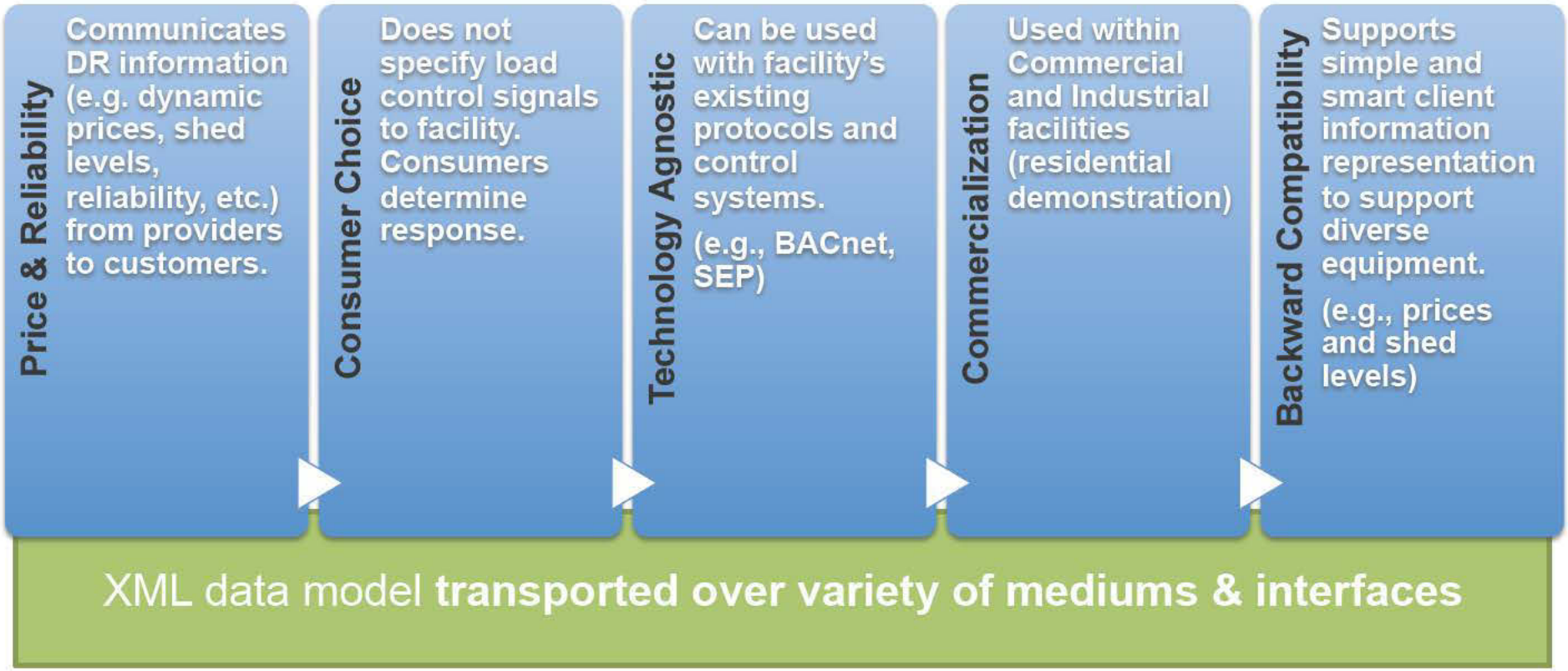
OpenADR v1.0

- *Automated DR signaling with standardized utility **price**, **reliability**, or **event signals** to trigger customers' pre-programmed energy management strategies*



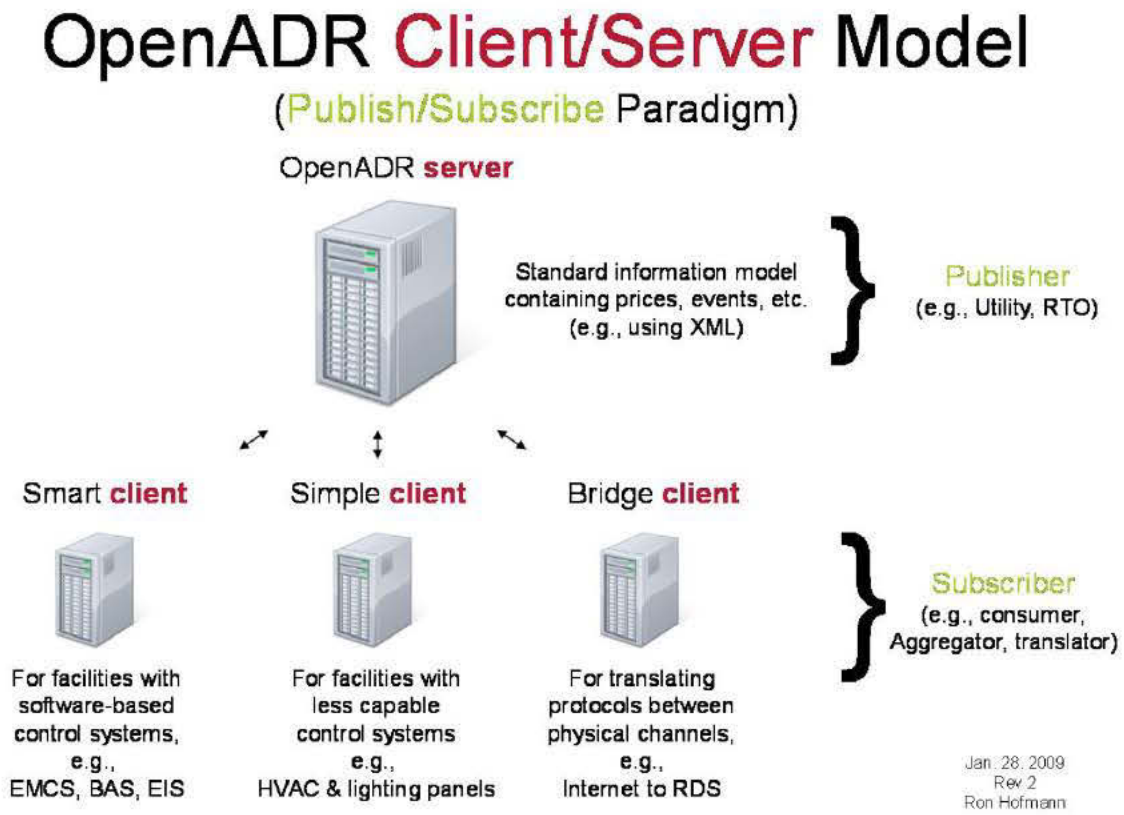


OpenADR v1.0 Features



OpenADR v1.0 Simple and Smart Clients

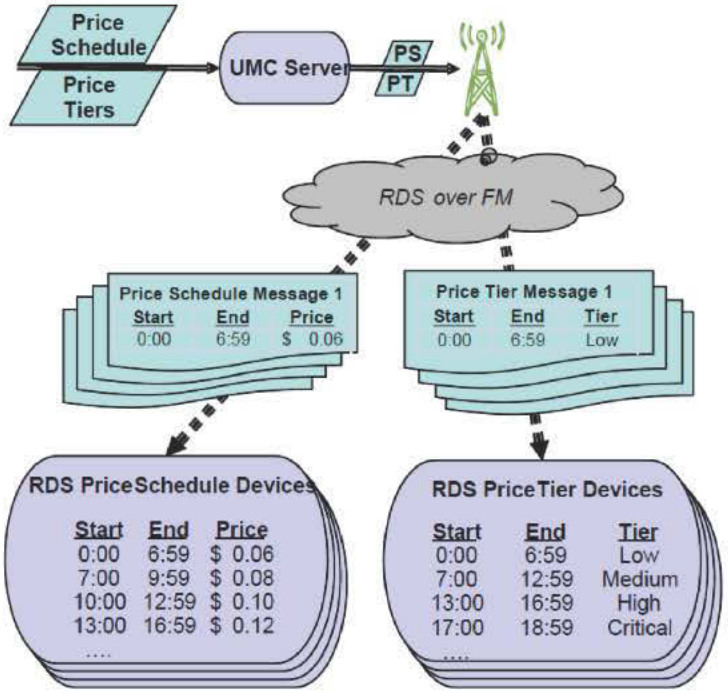
- Simple or Smart DR information sent as "one" XML message for the Clients within buildings.



Simple and Smart Clients Benefits

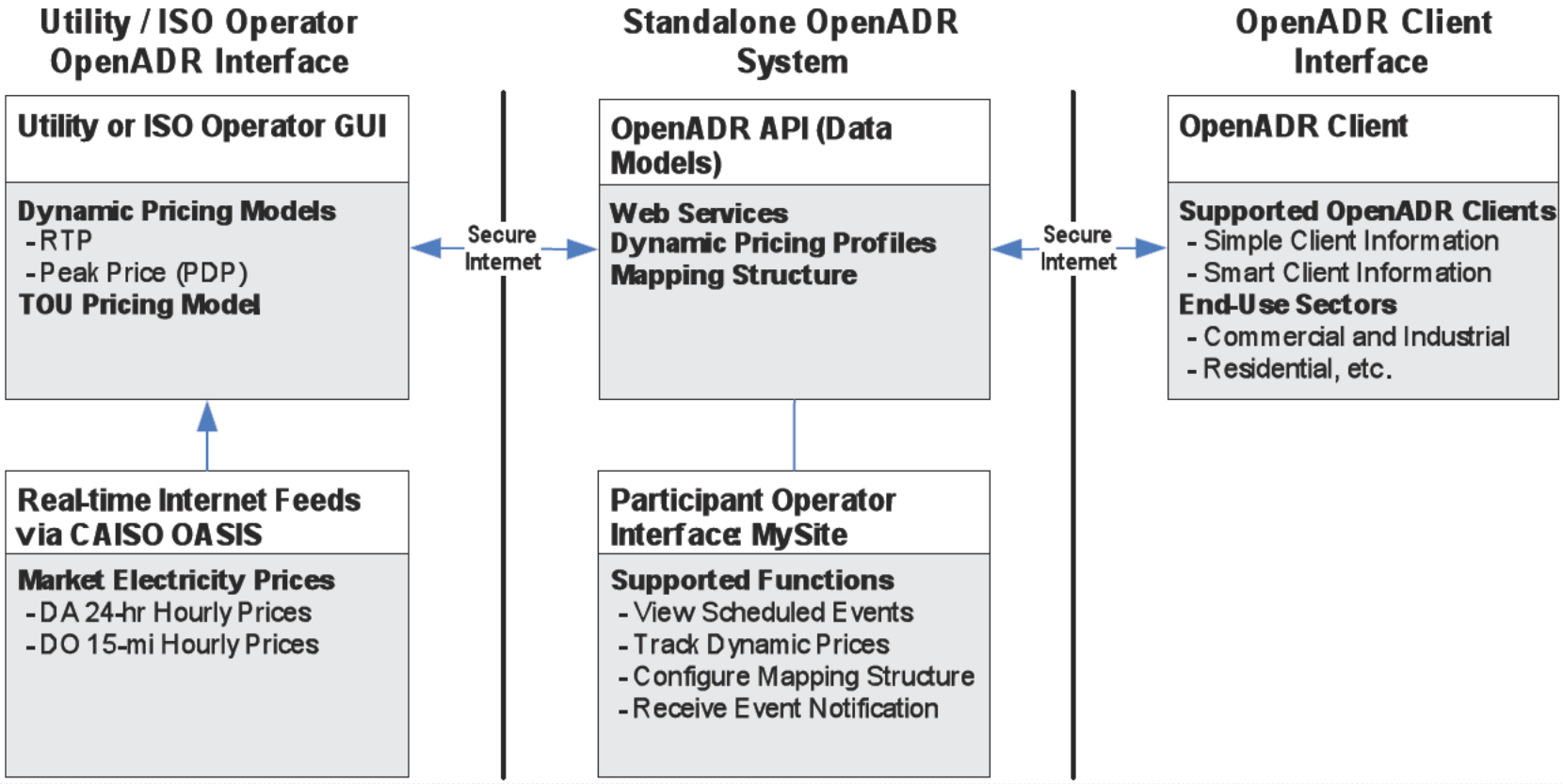
- Interface with legacy systems, less sophisticated clients.
- Extensibility of low processing devices.
- Lowered cost and less message transaction overheads.
- Enables innovation, technology interoperability, and information standardization.

- *Requirements for DR Simple and Smart Client information is important for current systems and market and for future advancements in technology and diversity.*
- *Simple Client structure facilitates interoperability and backward compatibility.*



OpenADR v1.0 Supports Dynamic Pricing

- RTP Elements: CAISO OASIS real-time Internet feeds.
- Dynamic Pricing type representations (PRICE_ABSOLUTE, PRICE_RELATIVE, PRICE_MULTIPLE).



OpenADR v2.0*

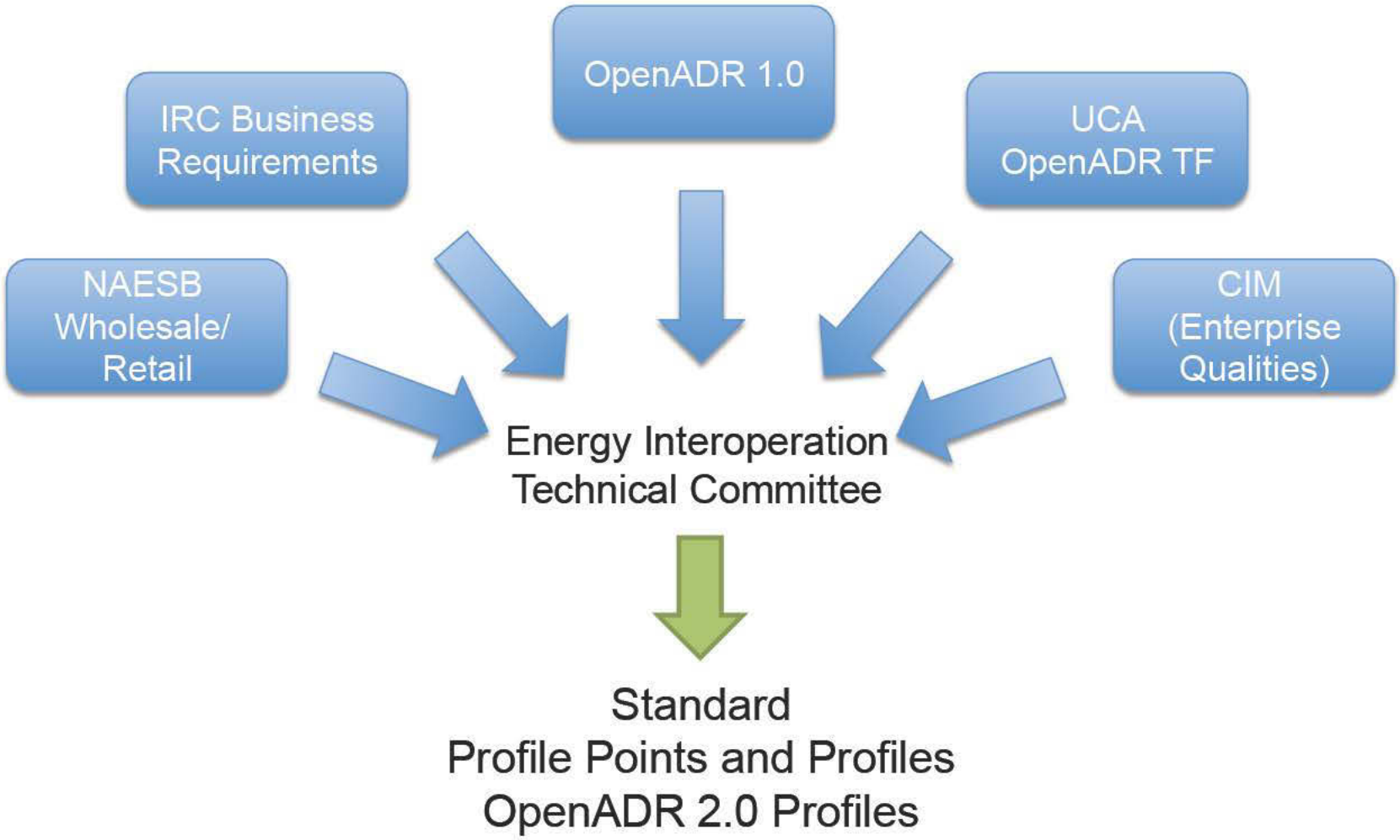
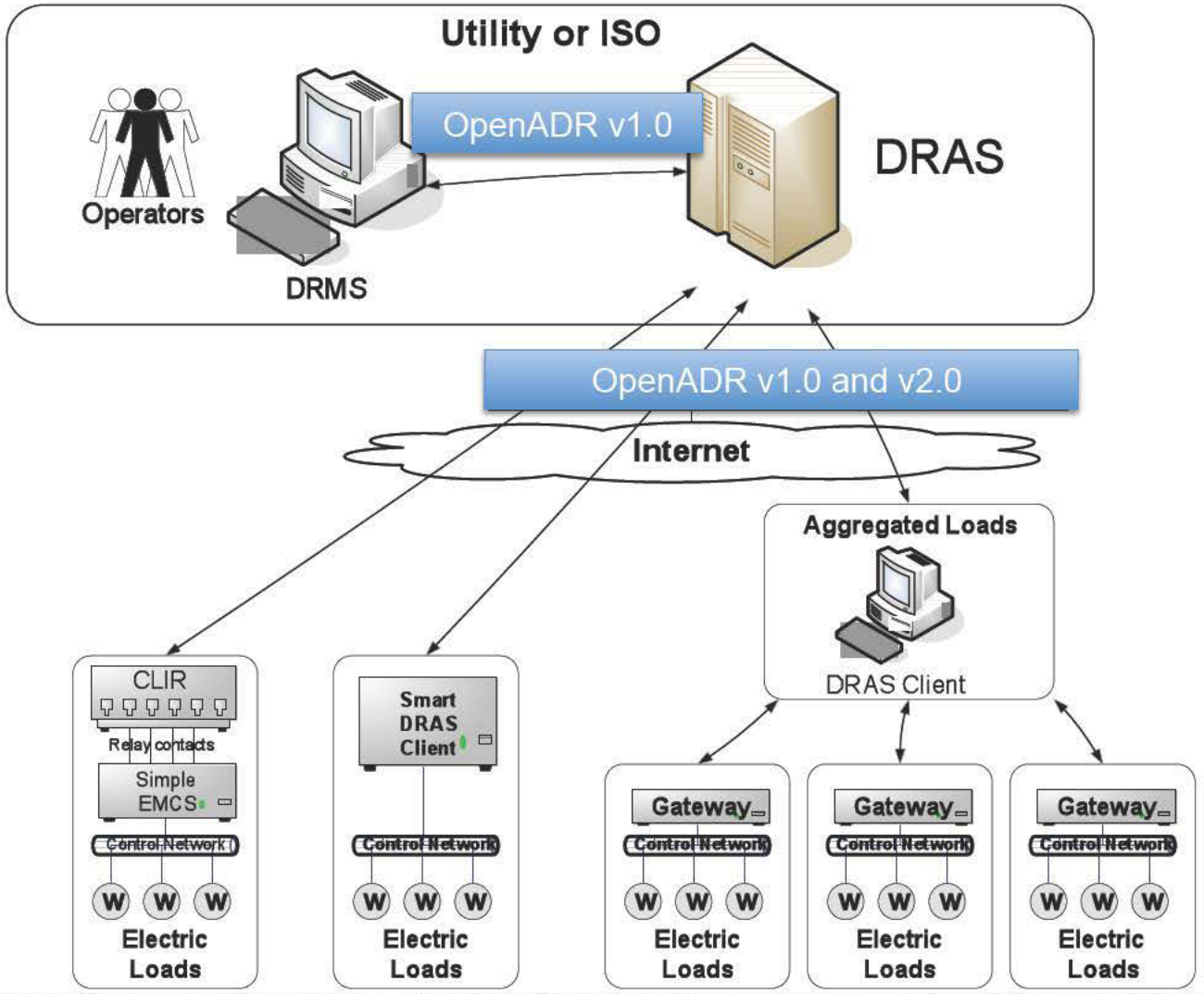


*Figure Source: Bill Cox (Grid-Interop 2010)

OpenADR v1.0 and v2.0: Similarities (and Differences)



OpenADR and Smart Grid Standards: OASIS Energy Interoperation Standards

- OASIS (Organization for Advancement of Structured Information Standards) is a renowned Standard Development Organization (SDO)
  - OpenADR is being standardized under Energy Interoperation (EI) Technical Committee (TC)
- EI TC is represented by stakeholders, industries.
  - **Participants:** OpenADR v1.0 Designers, ISO/RTO Council an, ISOs, Building Automation Systems experts, Utilities, Control vendors, Enterprise experts.

Southern California Edison	ISO/RTO Council (IRC)
Drummond Group Inc.	Midwest Independent Transmissio
Individual	LonMark International*
University of North Carolina at Cha	Individual
Individual	IBM
Schneider Electric	NIST*
Lawrence Berkeley National Labor	Siemens AG
NIST*	Electric Power Research Institute (
Electric Power Research Institute (	California Independent Operator C
Akuacom Inc.	NIST*
ISO/RTO Council (IRC)	Lawrence Berkeley National Labor
Siemens AG	New York Independent System Op

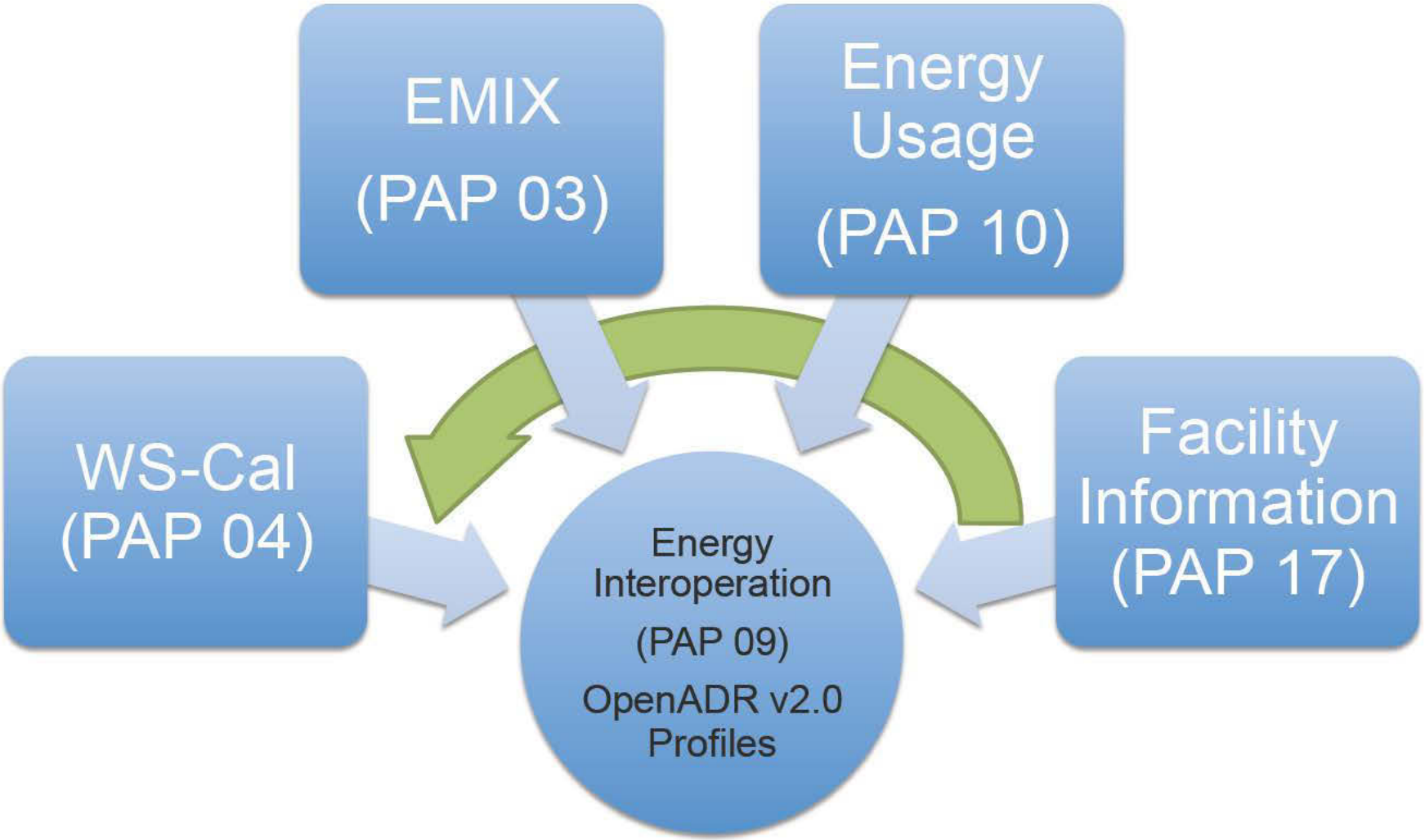
OASIS Energy Interoperation Goals

- Architectural models for
  - Data models for information exchange
  - Information exchange patterns
  - Distributed Energy Resources or DER (e.g., to/from/within Micro Grids)
- Use work across Smart Grid domain related to:
  - Price/Reliability DR from OpenADR v1.0: http://openadr.lbl.gov
  - Transactive Prices from Energy Market Information Exchange (EMIX): http://www.oasis-open.org/committees/emix
  - Common schedule from Web Service Calendar (WS-Cal): http://www.oasis-open.org/committees/ws-calendar
  - NAESB, UCA, Independent Systems Operators (ISO), Regional Transmission Operators (RTO) Council (IRC), etc.

OASIS Energy Interoperation TC Activities

- EI TC works to:
  - Describe information and communication models.
  - define service definitions consistent with Service Oriented Architecture (SOA) and eXtensible Mark-up Language (XML) vocabularies.
- Models for interoperability and standardization of:
  - Dynamic price signals
  - Reliability signals
  - Emergency signals
  - Communicate market participation information (e.g., bids)
  - Load predictability and generation information

OpenADR v2.0 Relationship to Smart Grid Standards



OpenADR v2.0 Profiles within EI v1.0

Scope	Contribution	Other Contribution
1. Dynamic Pricing (DR)	OpenADR v1.0	WS-Calendar (scheduling)
2. Reliability (DR)	OpenADR v1.0	WS-Calendar (scheduling)
3. Emergency (DR)	OpenADR v1.0	WS-Calendar (scheduling)
4. Demand Bidding (DR)	OpenADR v1.0	WS-Calendar (scheduling)
5. Economic Signals and Price Transactions	EMIX/ PAP 03	WS-Calendar (scheduling)
6. Price Transactions and Product Definitions	EMIX/ PAP 03	WS-Calendar (scheduling)
7. Load/Energy Usage	OpenADE/ PAP 10	New data models (OpenADR x.0) and/or OpenADE, etc.
8. DER Signals	OpenADE/ PAP 10 ASHRAE / PAP 17	PAP 09 includes DER, to be contributed from PAP 10 and 17.

REVIEW:
OPENADR V2.0 PROFILES

Review: EI v1.0 and OpenADR 2.0 Profiles

- OpenADR v2.0 profiles are part of EI v1.0
  - EI v1.0 open for 30-day public review (**ends Dec. 27!**).
  - At least one more 15-day public review following TC review.
- EI v1.0 and public review comment process:
  - TC members should send comments to TCs email list. Others should send comments to TC using the "Send A Comment" button on TCs web page:
    - http://www.oasis-open.org/committees/energyinterop/
  - For information on any patents disclosure essential to implementing this specification, and any offers of patent licensing terms, please refer to Intellectual Property Rights section of TC web page:
    - http://www.oasis-open.org/committees/energyinterop/ipr.php

Review: EI v1.0 and OpenADR 2.0 Profiles

- Draft of EI v1.0 is work in process and includes contributions from OpenADR v1.0
- Committee could not address certain areas pending information from another groups (highlighted):
  - **Defined migration path from OpenADR v1.0 (DR price, smart/simple)**
  - Support for IRC business information exchange requirements
  - Support for IRC registration services
  - Support for UCA OpenADR Task Force requirements and goals
  - XML schemas and WSDL for all the services and payloads.
  - Committee wishes to highlight certain areas under active discussion, including: WHAT HERE?
- Anyone can review all logged issues and resolution:
  - http://tools.oasis-open.org/issues/browse/ENERGYINTEROP

EI v1.0: Managed and Collaborative Energy

- Address supply–demand imbalances
- Managed Energy
  - Managed as per individual service provider goals
  - Control can be an issue
  - Contractual DR events (w/ consumer choice)
- Collaborative Energy
  - Choices consistent with business goals
  - Consider markets and requirements (e.g., RTP)
  - Promotes consumer choice

Review: EI v1.0 Architecture Concepts

- *Parties* are referred to actors
- Parties can take on *roles*
- Certain terminology of transactive markets
  - Identifies Business roles—*Buyer* and *Seller*
    - Any actor can take on Buyer or Seller role
- Relationship roles—Virtual End Nodes (VEN) and Virtual Top Nodes (VTN)
  - VTN and VEN concepts from EPRI White paper*

*http://www.oasis-open.org/committees/download.php/38301/EPRI%20Whitepaper1020432%20Advancement%20of%20DER.pdf

VEN and VTN Explained

- A VEN has one or more VTNs w/ one relationship
- A VTN has one or more VENs in a relationship

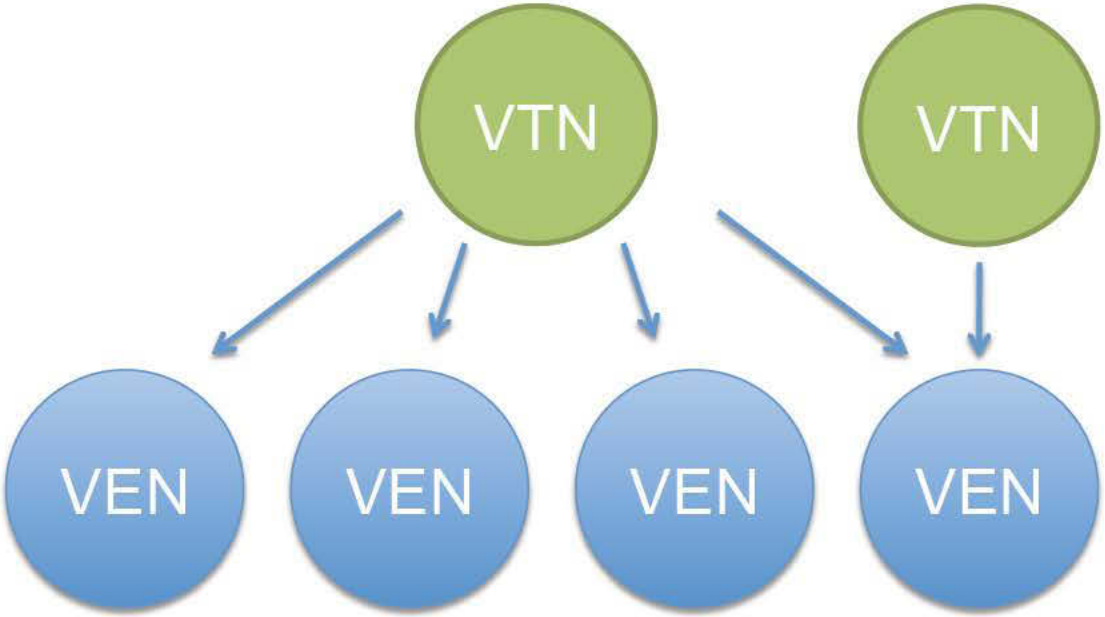


*Figure Source: Bill Cox (Grid-Interop 2010)

VEN and VTN Explained

- Parties can take dual roles – VEN and VTN
  - E.g., B, E, and G

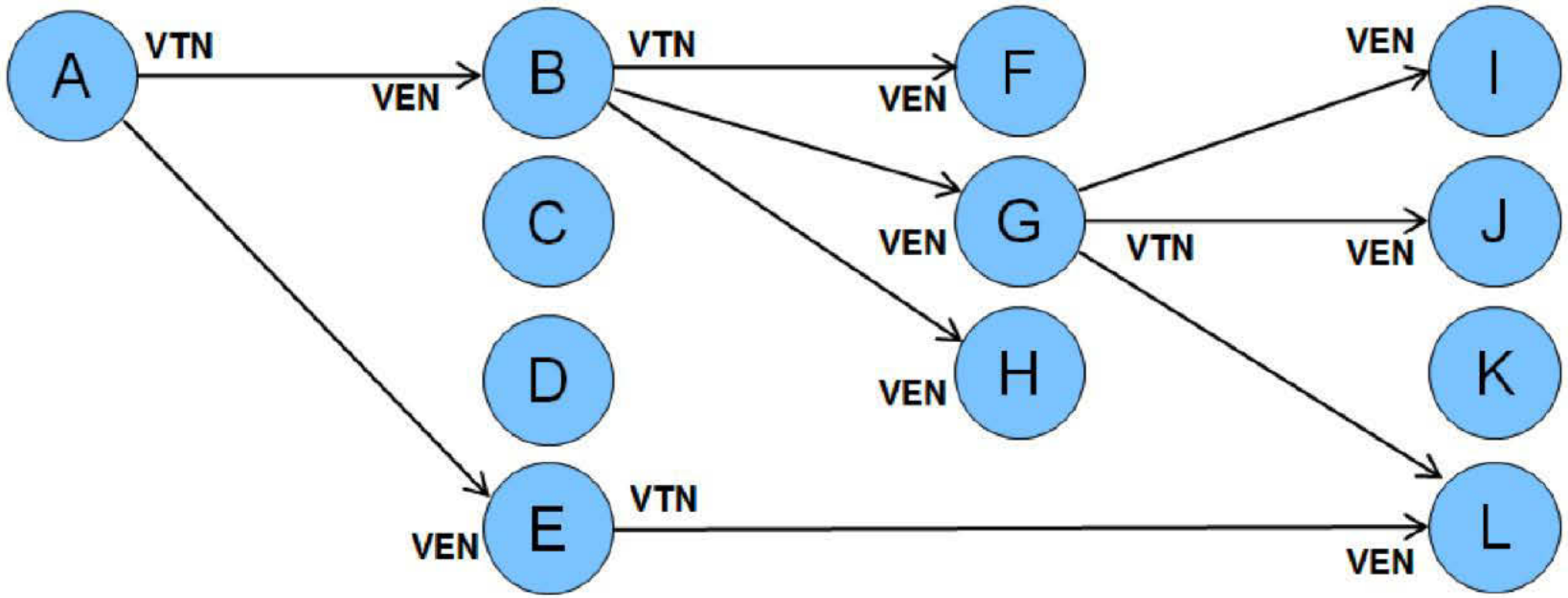


*Figure Source: EI v1.0

VEN and VTN: Multiple Service Provider – Customer Relationships

- Utilities, ISOs, and Aggregators models:
  - A can be a Utility/ISO Operator issuing DR signals
  - B and E are first level aggregators
  - G is a second level aggregator and B's customer
  - I, J, L are facilities/end-uses and are G's customers
  - L is also E's customer (multiple providers)

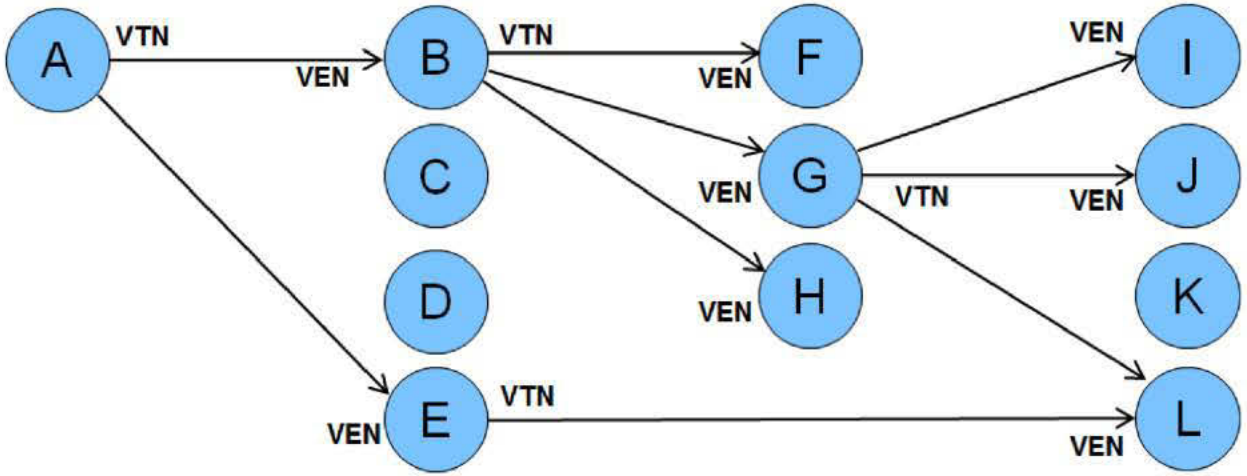


*Figure Source: EI v1.0

VEN and VTN: Service Provider – Enterprise Customer Relationships

- Utilities, ISOs, and enterprise or real-estate firms:
  - A can be a Utility/ISO Operator issuing DR signals
  - B and E (w/ C and D) are first level recipients
  - F, G, H are enterprise/real-estate firms with signals from B
  - I, J, L can be G's tenants
  - L can also receive signals from E (multiple providers)

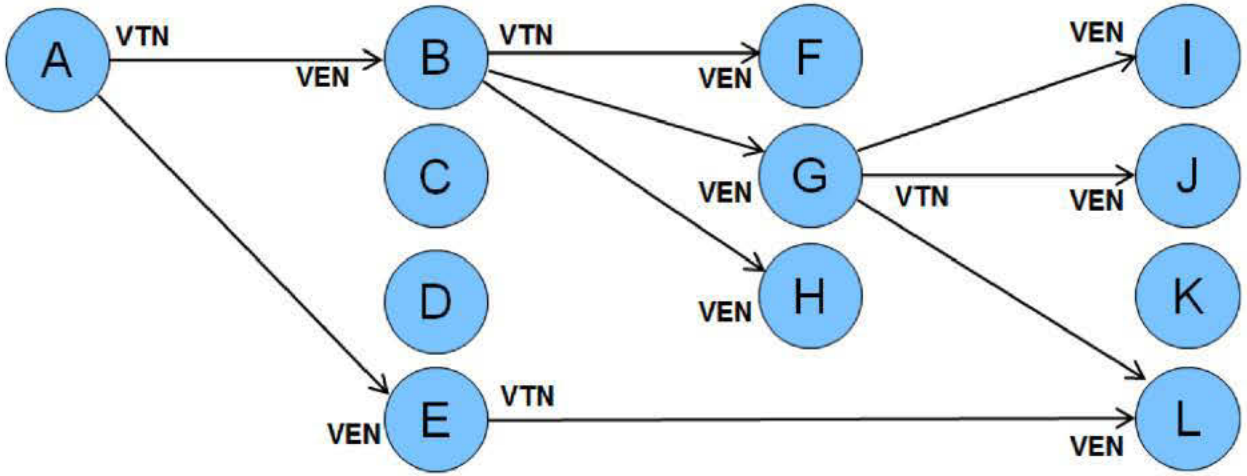


*Figure Source: EI v1.0

VEN and VTN: Service Provider – Campus/ Micro Grid Relationship

- Micro Grid scenario:
  - B is a Micro Grid market operator receiving signals from A
  - B distributes signals to control systems F, G, H that manage floors (or different campus buildings) in its building
  - I, J, L are end-uses (or central building control systems) G
  - L can also receives signals from E (multiple providers)

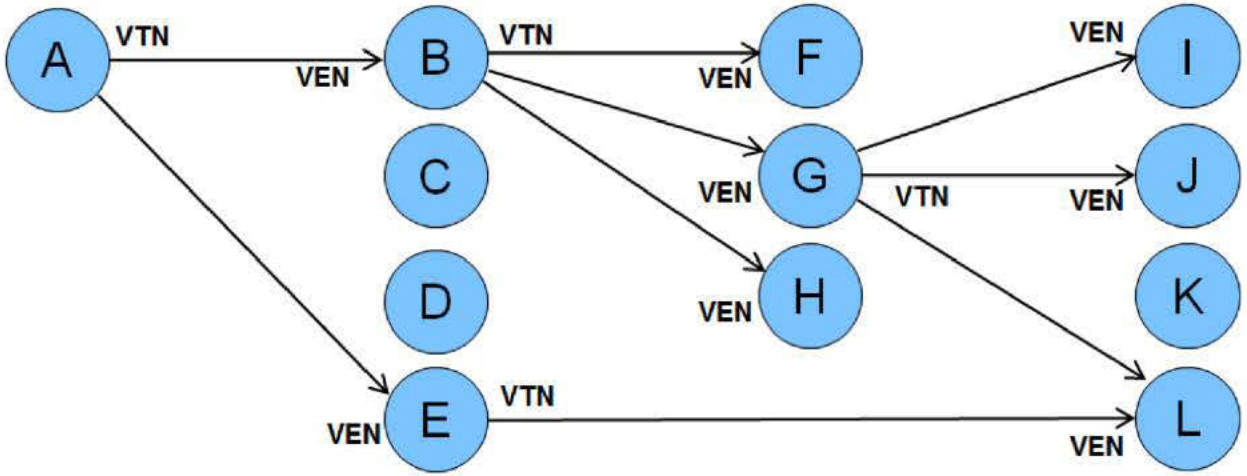


*Figure Source: EI v1.0

Review: OpenADR v2.0 Profiles in Document

- Energy Interop (EI) v1.0 document outline:
  1. Introduction
  2. EI Overview
  3. EI Architecture
  4. [Message Composition and Services]
  5. Security and Composition
  6. EI Services
  7. Transactive Services
  8. **Event Services**
  9. **Support Services**
  10. [Conformance]

EI DOCUMENT REVIEW: OPENADR V2.0 PROFILES

DOCUMENT SOURCES:

Editable: http://docs.oasis-open.org/energyinterop/ei/v1.0/csd01/energyinterop-v1.0-csd01.doc

PDF: http://docs.oasis-open.org/energyinterop/ei/v1.0/csd01/energyinterop-v1.0-csd01.pdf

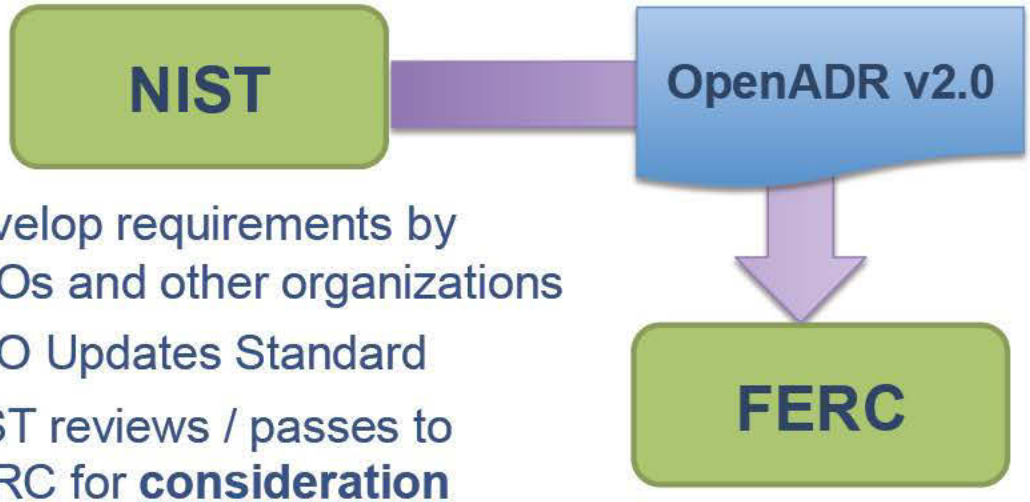
HTML: http://docs.oasis-open.org/energyinterop/ei/v1.0/csd01/energyinterop-v1.0-csd01.html

CONCLUSIONS AND NEXT STEPS

Conclusions

1. OASIS Energy Interoperation (EI) standards will house OpenADR v2.0 standards
   - OpenADR v2.0 is profiles within EI.
2. Architectural elements intended to be extensible for different use cases (provider-customer).
   - Address all stakeholders (C&I/ residential), simplicity, small-customer transaction costs, promote adoption/ scalability.
   - Smart Grid crosscutting standards are evolving.
3. Public Review ends on Dec 27, 2010
   - Issues with operation levels, price-responsive DR (RTP).
   - Probable final standards in/before Summer 2011.

Next Steps: Regulatory Process



- Develop requirements by SDOs and other organizations
- SDO Updates Standard
- NIST reviews / passes to FERC for **consideration**

- FERC (Federal Energy Regulatory Commission) determines whether to consider
- EISA (Energy Independence and Securities Act) required Rulemaking proceeding to adopt
- No authority under EISA for FERC to mandate or enforce
- Implementation / follow-up action dependent on:
  - Other FERC authorities
  - Other federal, state commission, or utility action
  - Voluntary market adoption

Next Steps: OpenADR Alliance*

- **Mission:** Foster the development, adoption, and compliance of the Open Automated Demand Response (OpenADR) standards through collaboration, education, training, testing, and certification.
- Responsible for OpenADR v2.0 profiles/conformance within EI v1.0
- **More information:** http://www.openadr.org/

*LBNL in the process of finalizing founding member agreement

DISCUSSION

Website: http://openadr.lbl.gov/

Contact: AutoDR@lbl.gov