



# **Standards for Automated Demand Response and EPRI's Auto DR Demonstration**

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# Agenda

- EPRI IntelliGrid Program & Role in DR Standards
- Drivers & Benefits & Evolution of DR Standards
- EPRI Automated Demand Response & Ancillary Services Demonstration

# IntelliGrid Program

Information & Communication Technologies (ICT) to Enable.....

The IntelliGrid Program conducts research, development and demonstrations on the **Information and Communications Technologies (ICT)** that **Enable** Smart Grid applications



# PS161D - ICT for Intelligent Customer Integration Including Metering & DR (Managed by Brian Seal)



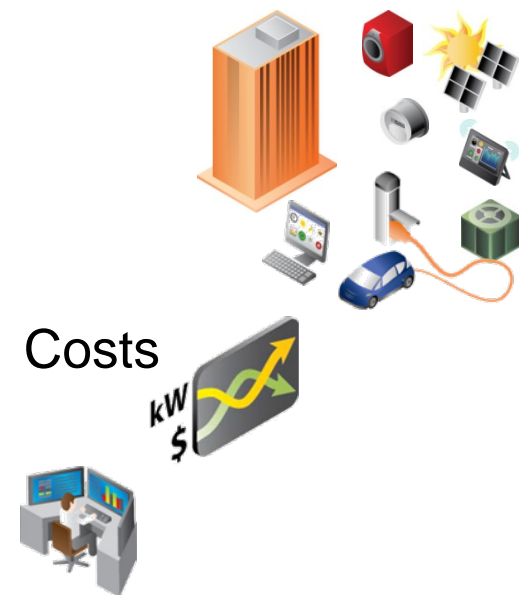
- Focus - Integration of customers (C&I and Residential)
  - Requirements & Use Cases
    - The “Why” & “How” (Metering and DR)
  - Communication architectures
    - End-to-end, tying it
  - Communication protocols, PLC
  - Protocols
    - Standards, Interoperability, Accelerating Development, Testing and Demonstrating

**Emphasis on Applying Standards  
to Accelerate Adoption & Benefits**



# Drivers - Benefits of Standardized DR/DER Messaging

- Pricing & DR Event Interoperability (Utilities & ISO's)
- Commercial off-the-shelf (COTS) Products
- Increased Operational Efficiency, Reliability, Security
- New Services through Competitive Innovation
- Lower Design, Installation, Operation & Maintenance Costs
- Larger pool of talent to support & maintain Systems



- Lawrence Berkeley National Lab and AutoGrid, Inc. were awarded an ARPA-E funding for an OpenADR project that .....
  - “is expected to provide a 90% reduction in the cost of operating DR programs in the US.”

- <http://newscenter.lbl.gov/news-releases/2011/10/03/berkeley-lab-to-share-in-three-new-arpa-e-energy-projects/>

# Where have we been?

## Non-Proprietary, Non-Standard Information

- Real-Time Prices Example
- Google Gadgets
  - ([www.jaynick.com](http://www.jaynick.com))
  - Ameren Program
  - ComEd Program
- Each Gadget Custom
- Non-Standard Formats Still Require Customization



# Locational Prices - Each ISO Price Format Unique

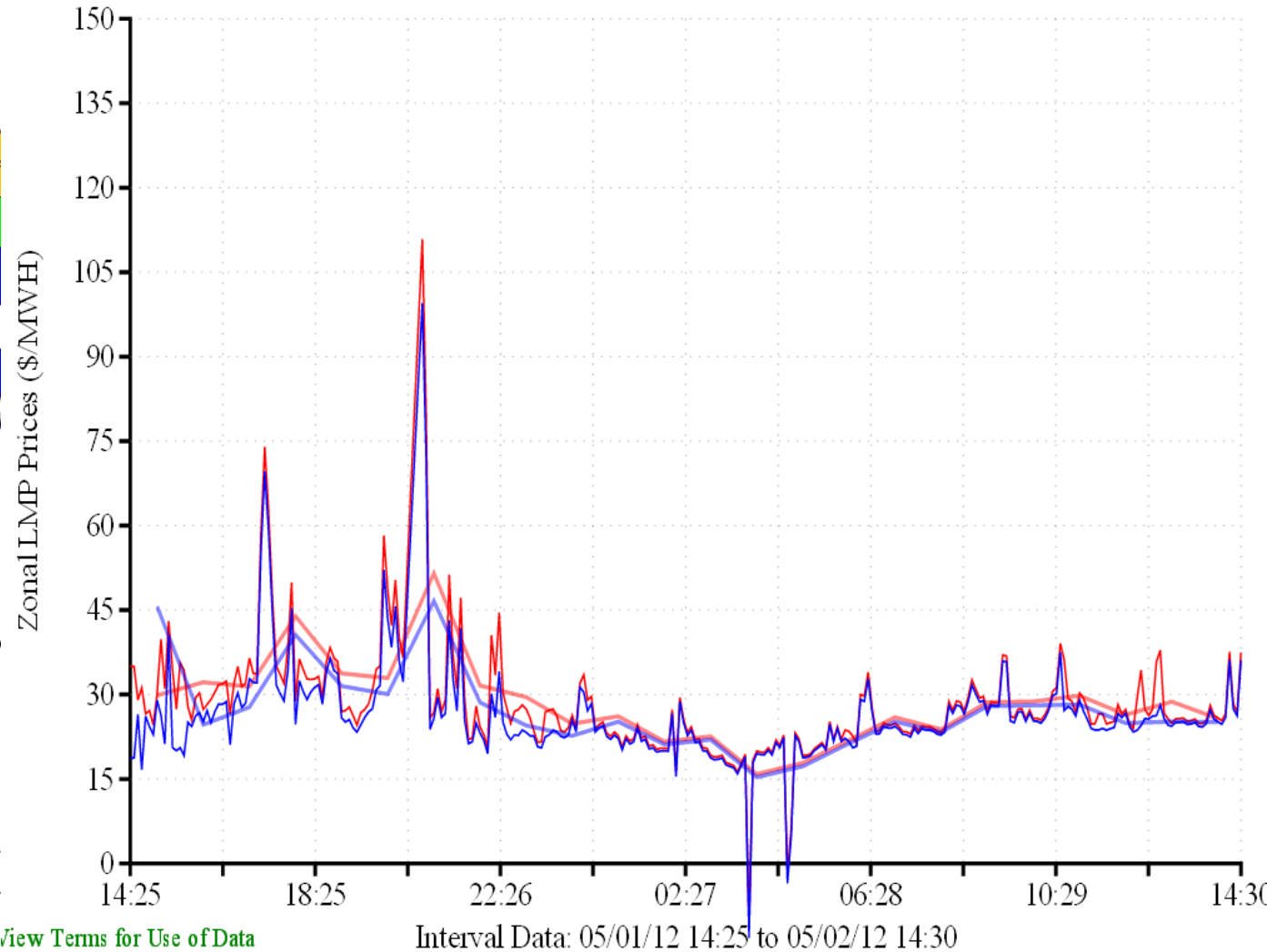
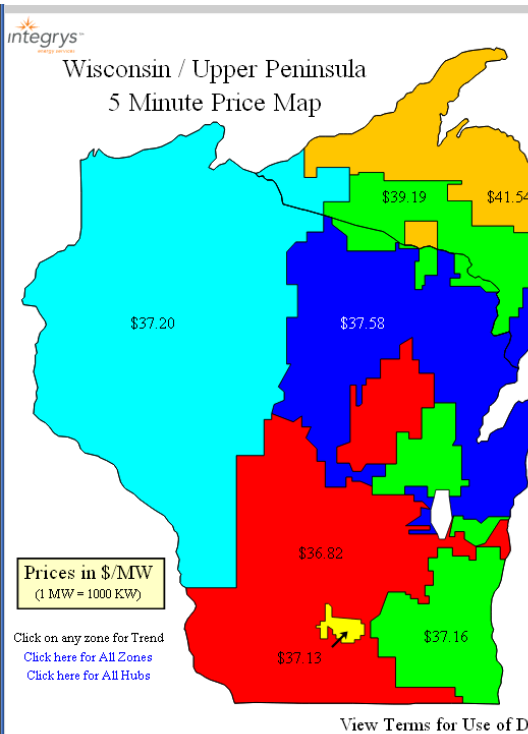
(IntegrYS Energy - <http://www.integrYSenergy.com/misc/LMPData/>)

WPS.WPSMLMP

WPS.WPSMLMP Avg

WPS.MPU LMP

WPS.MPU LMP Avg



# How can Demand Response be Enabled?

- How can the Cost of DR be Lowered?
- How can Innovation be Encouraged?
- How can DR be Automated to Encourage Participation?
  
- What if?
  - Every Utility & ISO used the same Messages for Energy Prices and Events?
  - Prices & Events Could be Securely Communicated via multiple Communication Media?
  - You could get real-time Feedback on the Availability & Performance of Participating Loads?

**This is what OpenADR is Attempting to Do**



# OpenADR Interoperability Quest

(Slide from LBNL)



Research initiated by LBNL/ CEC

Official OpenADR specification (v1.0)  
by LBNL/CEC

OpenADR 1.0 Commercialization  
(PG&E, SCE, and SDG&E)

Pilots and field trials  
Developments, tests (Utilities)

1. **Anytime DR Pilots** and field trials
  - Wholesale markets, ancillary services
  - Dynamic pricing, renewable
  - International demonstrations
2. All end-use sectors

2002 to 2006 2007 2008 2009 2010 2011 2012

1. OpenADR Standards Development
  - OASIS (EI TC), UCA, IEC
2. NIST Smart Grid, PAP 09

EI 1.0 standards  
- OpenADR profiles\*\*

OpenADR 2.0 specifications  
- Products, commercialization  
- International standards (IEC)  
- Interoperability testing on April 2!

 Testing/Certification (v2.0)

**Standards Interoperability Lifecycle Process:**  
A complete process before a standard is ready  
for commercial adoption.\*\*\*

1. Research and development
2. Pilots and field trials
3. Standards development
4. Conformance and interoperability

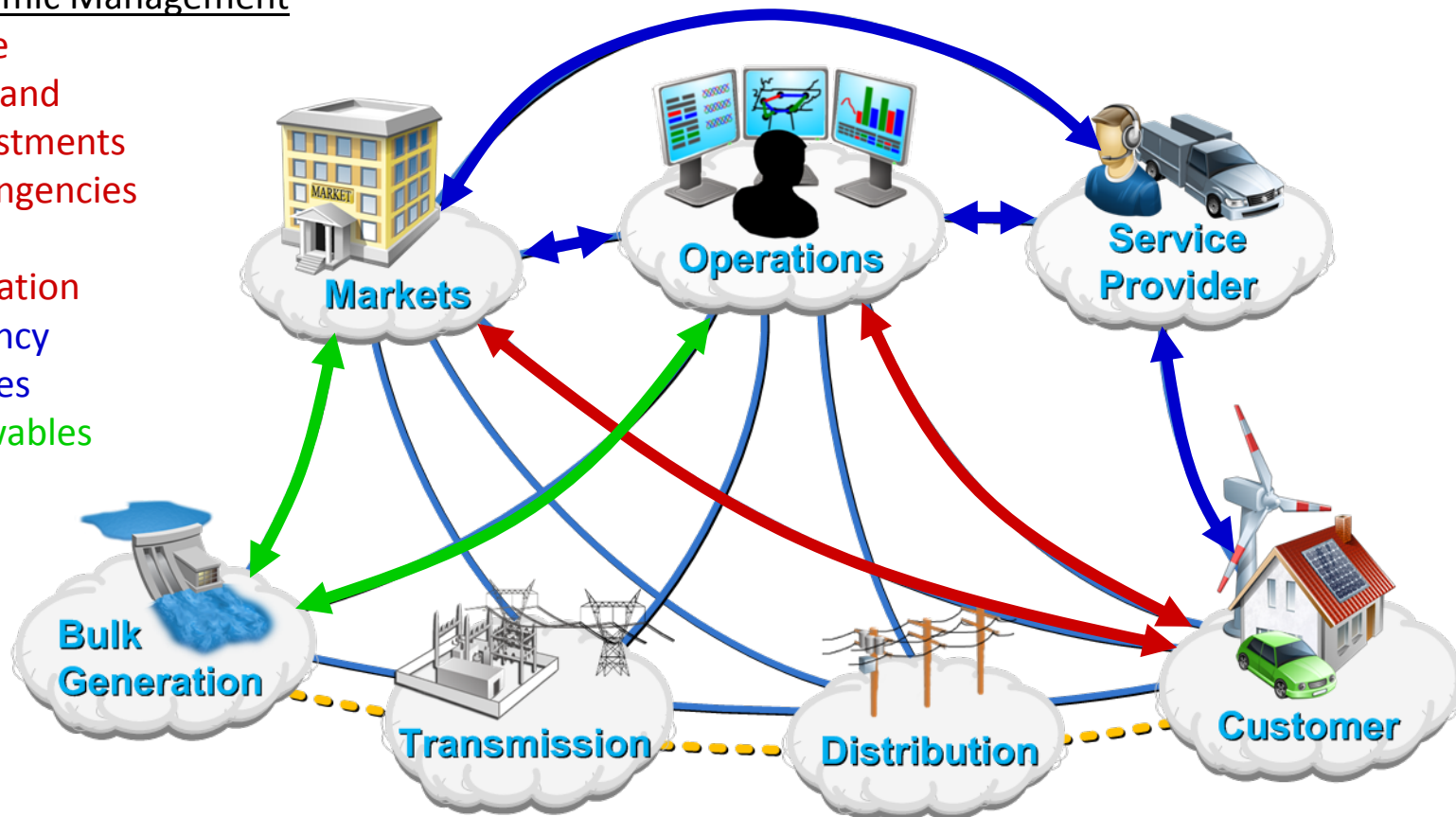
\*\* OASIS EI 1.0 standards: <http://www.oasis-open.org/committees/download.php/45425/energyinterop-v1.0-cs01.zip>

\*\*\* Publication: <http://drcc.lbl.gov/sites/drcc.lbl.gov/files/LBNL-5273E.pdf>

# Standardized Messaging for Supply & Demand Management with Demand-Side Resources & DER

## Reliability & Economic Management

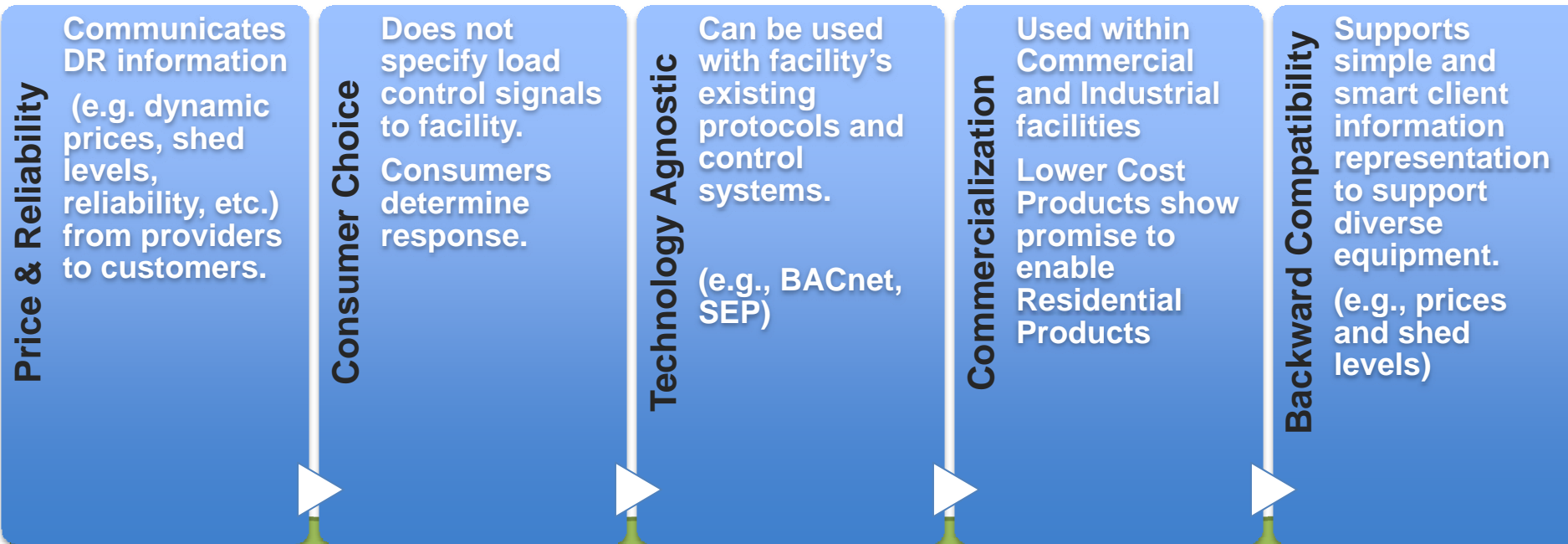
- Demand Response
- Reduce Peak Demand
- Defer Capital Investments
- Distribution Contingencies
- Fault Recovery
- Efficiency Optimization
- Market Transparency
- Enable Third Parties
- Large Scale Renewables
- Area Balancing



Graphic: EPRI Report to NIST on the Smart Grid Interoperability Standards Roadmap, June 2009

# OpenADR Features and Benefits

- Enables Low Cost Automation & Fast Response of loads for DR



XML data model transported over variety of mediums & interfaces

# OpenADR 2.0 Profiles for Certification

- **Profile A:** Resource-constrained, low-end embedded devices that can support basic DR services and markets.
  - Simple clients that can be used for any facilities/end-uses.
- **Profile B:** High end embedded devices which can support most DR services and markets.
  - Smart clients for facilities/end-uses with sophisticated systems.
- **Profile C:** Sophisticated controls and high end computer systems like servers to support all services and markets.
  - Smart clients for facilities/end-uses with sophisticated systems and aggregators.
  - Includes Feedback (Availability and Performance of Loads)

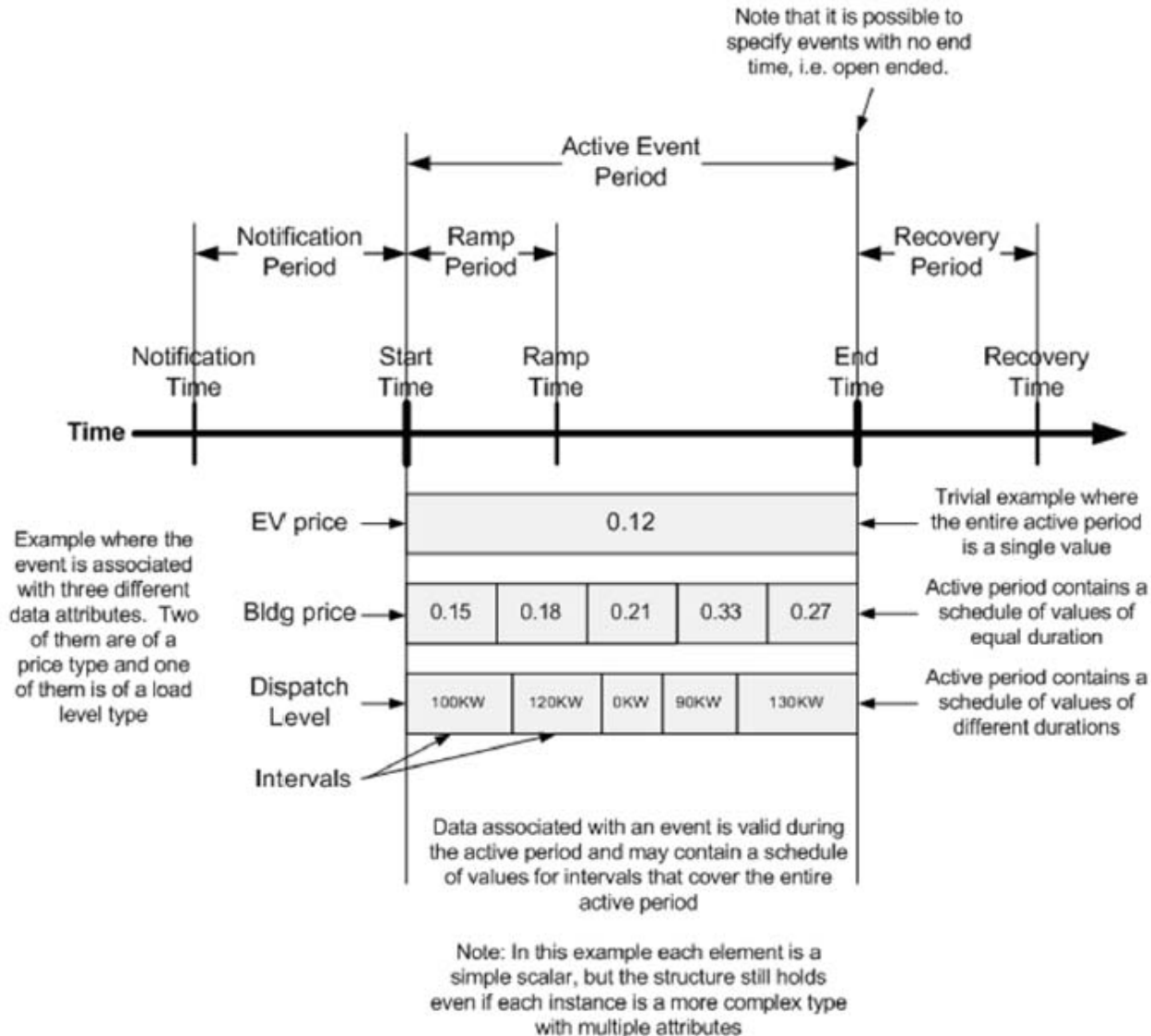
# OpenADR Profiles - Examples

OASIS Energy Interop Services	Profile A (Now)	Profile B (2-3 Mo)	Profile C (6 Mo)
<b>EiEvent</b> – Core Functions (Pull)	X	X	X
<b>EiQuote</b> (Dynamic Prices – Push)		X	X
<b>EiOpt</b>		X	X
<b>EiStatus</b>		X	X
<b>EiFeedback</b>			X

# Services Example - EiEvent

<i>Service</i>	<i>Operation</i>	<i>Response Operation</i>	<i>Service Consumer</i>	<i>Service Provider</i>	<i>Notes</i>
EiEvent	EiCreateEvent	EiCreatedEvent	VTN	VEN	Create and send a new Event
EiEvent	EiChangeEvent	EiChangedEvent	VTN	VEN	Modify an existing Event
EiEvent	EiRequestEvent	EiReplyEvent	Either	Either	Request outstanding Events; request semantics with optional time Interval
EiEvent	EiRequestPending Event	EiReplyPending Event	Either	Either	Similar to Request Events except that Reply returns Event IDs and Modification Numbers only.
EiEvent	EiCancelEvent	EiCanceledEvent	VTN	VEN	Cancel one or more Events
EiEvent	EiDistributeEvent	—	VTN	VEN	Broadcast of Event.

# OpenDR Events and Associated Signals



\*Figure Source: OASIS Energy Interop Draft Standards (<http://www.oasis-open.org/committees/energyinterop/>)

# OpenADR Alliance Members

The OpenADR Alliance is the Certification Body for Vendors

## Sponsors



## Contributors



LOCKHEED

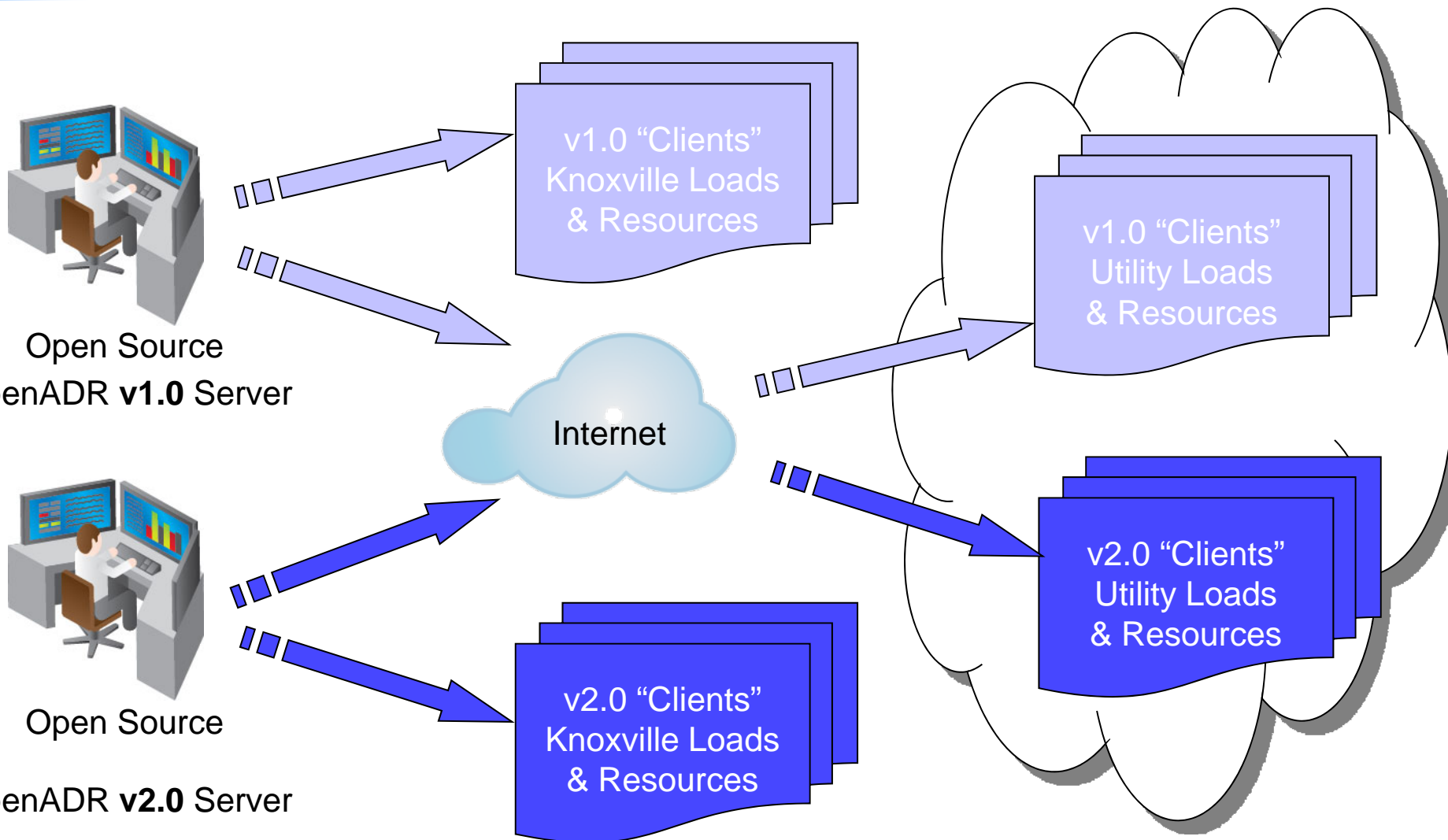
## Adopters



Over 60 Vendors Developing  
OpenADR v2.0  
Servers & Clients

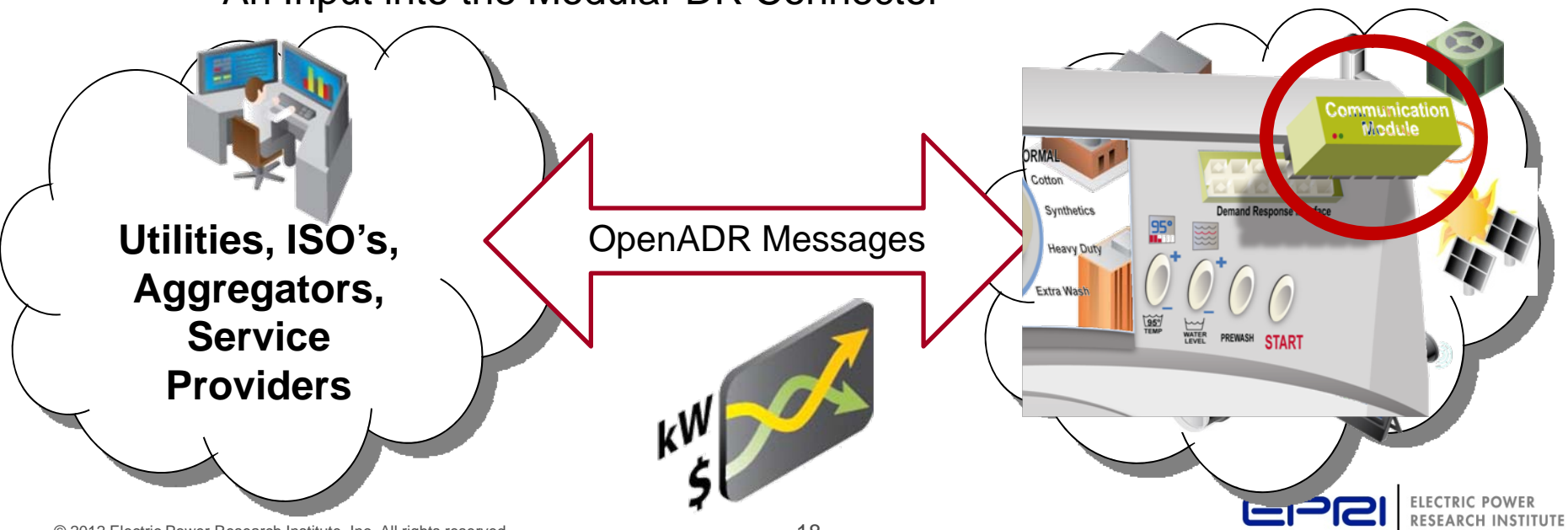


# EPRI Knoxville Laboratory Environment for Evaluating OpenADR with Members



# What OpenADR is NOT

- This is NOT a replacement for Home or Building Management Systems (i.e. Smart Energy Profile (SEP))
  - But OpenADR is:
    - An Input to Building Management Systems
    - An Input to Home Area Networks like SEP
    - Able to provide control signals directly to end-devices
    - An Input into the Modular DR Connector



# Automated Demand Response and Ancillary Services Demonstration

## Objectives and Scope

- Advance Standards for (DR) and Ancillary Services (Fast DR) thru Utility Demonstrations
- Address Research Questions
  - Quality of service, Reliability, Security, Privacy, Scalability, etc.
- Develop Utility DR Technology Roadmaps

## Value

- Increase Adoption of Commercialized Products & Enable Innovation
- Understand Utility Migration Strategies for OpenADR Implementation
- Characterize Classes Loads for Ancillary Services



## Details and Contact

- Three-Year Program
- Ingrid Bran  
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- Chuck Thomas  
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**Advance Standards for Automated DR & Ancillary Services**

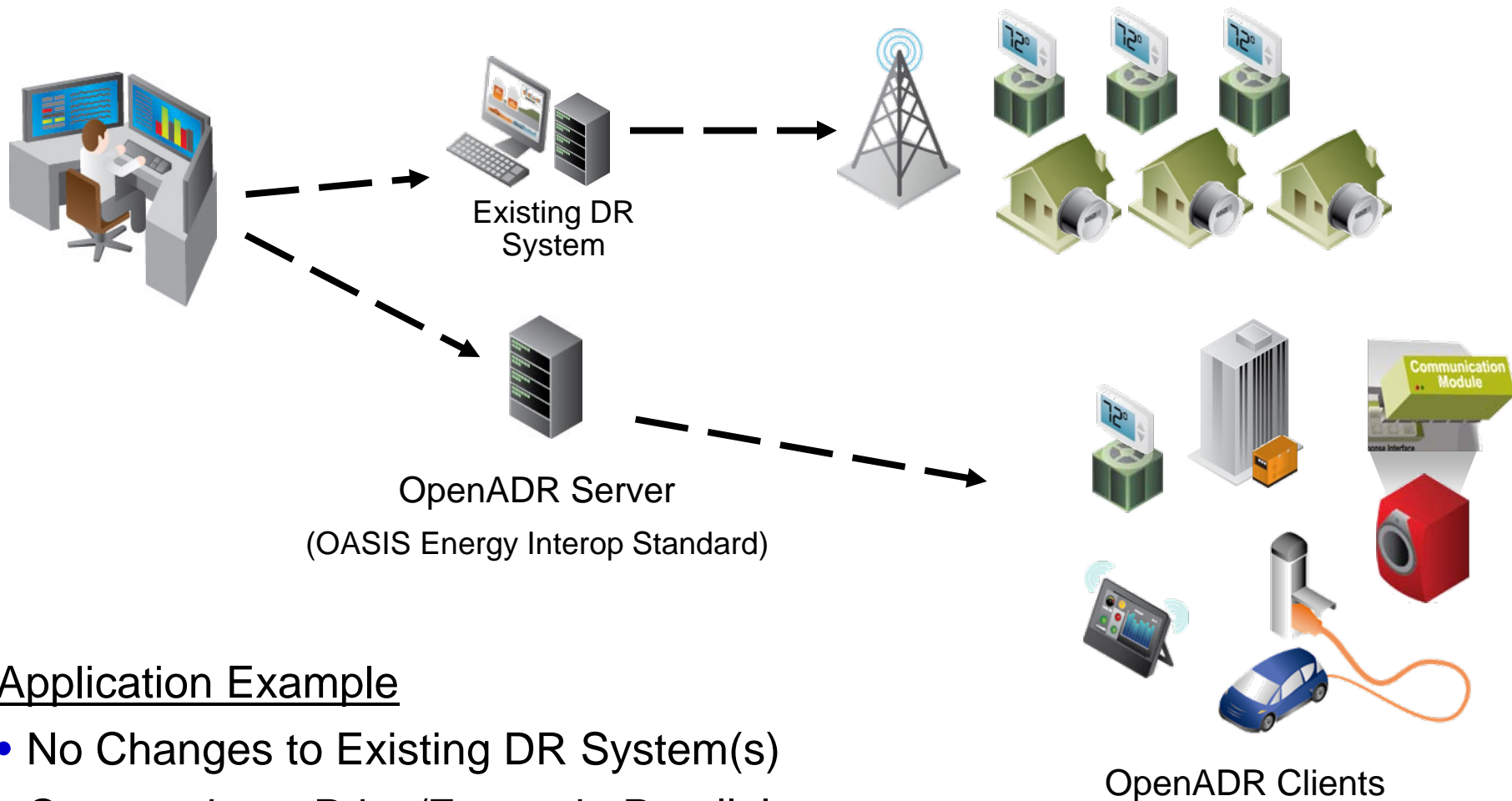
# EPRI's Auto DR Demonstration

## -What The Project Is and Is NOT

- It is NOT
  - A Detailed Program Design for DR
  - A Product Certification Effort
- It Will
  - Research what OpenADR CAN do (Capabilities)
  - Explore what Applications can be ENABLED
  - Evaluate responsiveness of Types of Loads
  - Evaluate Architectures to Preserve Existing (Legacy) DR Systems
  - Evaluate Certified Products in Utility “Host-Site” Demo’s
  - Feed information into Standards Bodies where Gaps Exist

# Example Application 1

Send Price and/or DR Signals from Existing Utility/ISO Programs

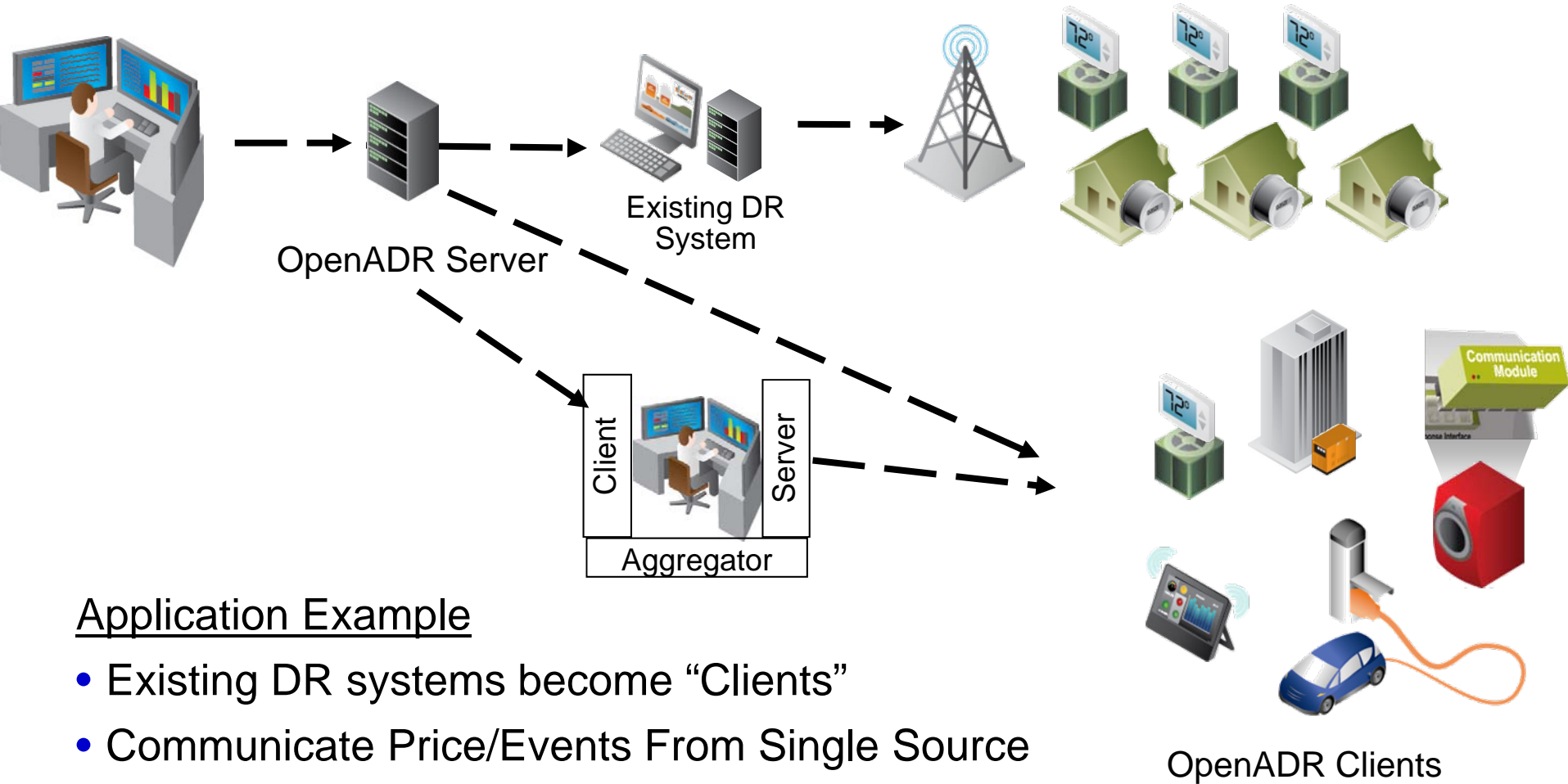


## Application Example

- No Changes to Existing DR System(s)
- Communicate Price/Events in Parallel
- Minimal additional Cost

# Example Application 2

## Use OpenADR as Central Price/Event Server

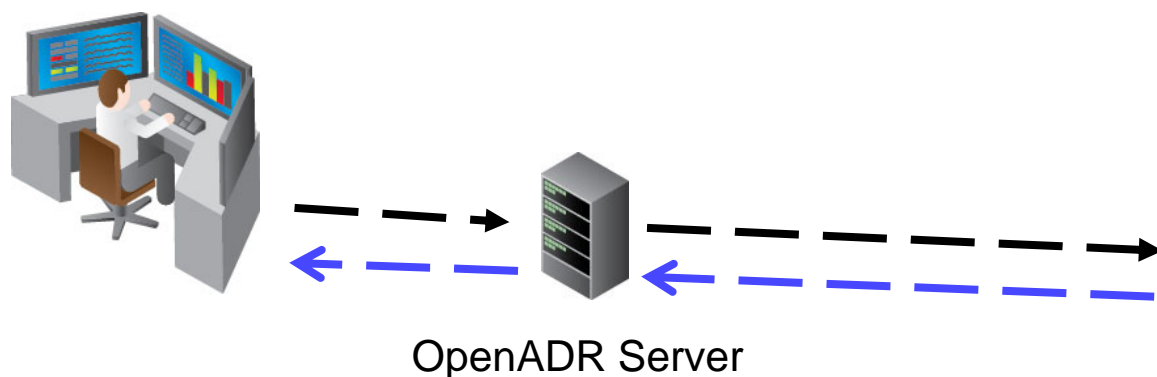


### Application Example

- Existing DR systems become “Clients”
- Communicate Price/Events From Single Source
- Communicate to 3<sup>rd</sup> Party Aggregators

# Example Application 3

## Evaluate Capabilities & Performance/Value of Resource Feedback

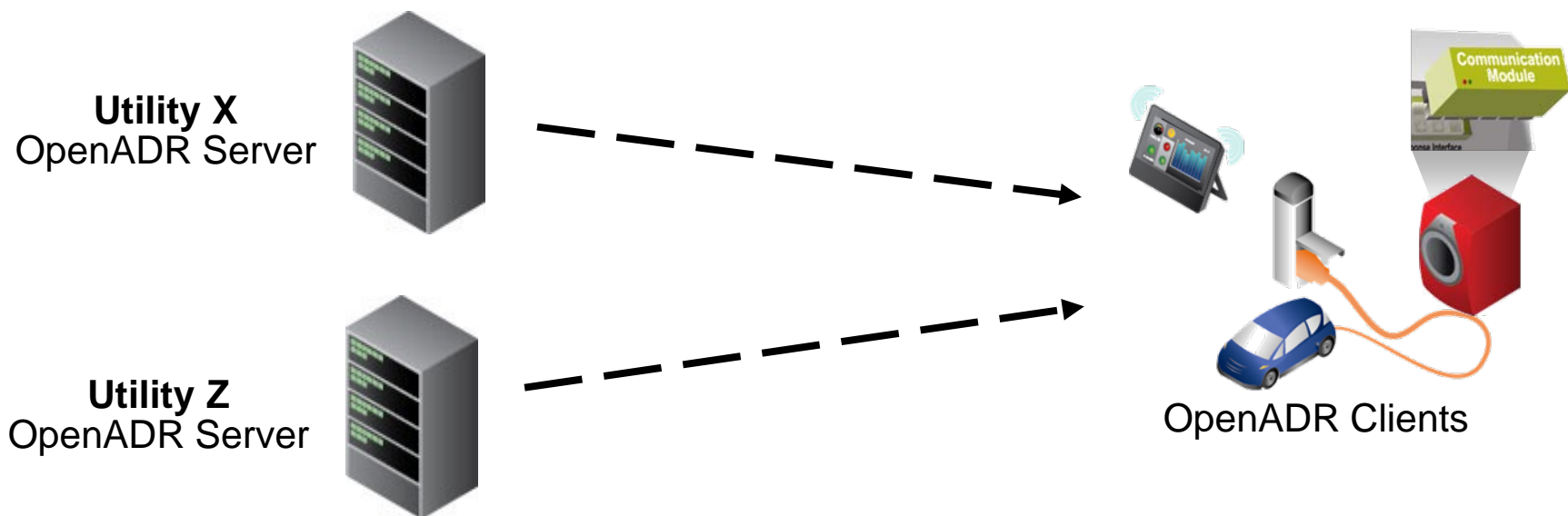


### Application Example

- Communicate Events
- Get visibility into Availability of Resources
  - Can they Shed? How Much?
- Validate Performance
  - Did they shed? How Much?

# Example Application 4

Evaluate Interoperability of Clients from One Utility Rate to Another



## Application Example

- Product / Client Moves from One Utility Service Territory to Another
- Deploy Clients in Multiple Utility/ISO Territories, Verify Interoperability
- Each Host will Deploy a Client in Knoxville – we will Test this



# EPRI's Auto DR Demo Objectives



## Understand Technical Capabilities of OpenADR v2.0

- For Demand Response & Fast DR (Ancillary Services) Functions
- Compare OpenADR **Capabilities** vs. Existing Program **Requirements**

## Address Technical Research Questions

- How well does OpenADR perform?
  - Quality of Service, Reliability, Security, Privacy, Scalability
- What customer classes & resources are best suited for OpenADR?
  - Applicability to Residential, Commercial & Industrial Customers?
  - Classes of Loads/Resources are suited for Ancillary Services?

## Develop DR/DER Integration Migration Paths & Roadmaps

- What Architectures Enable Legacy Systems to Co-exist w/OpenADR?
- From Existing Utility/ISO Programs to OpenADR v2.0
- From OpenADR v1.0 to OpenADR v2.0

# Coordination & Next Meeting



- Coordination with Other Entities
  - EPRI – Facilitating Interests & Requirements of Utilities
  - OpenADR Alliance – Certifying Vendor Products
  - Coordinating Joint Research with LBNL
  - Sharing information with NYSERDA
  - Monitoring/Participating in NIST PAPs & OASIS EI
- Next EPRI Auto DR Demonstration Meeting
  - Tentatively October 9<sup>th</sup> & 10<sup>th</sup> at NYISO, Albany NY
  - For Members of the Demonstration
  - Working to Coordinate another Joint Session with the OpenADR Alliance

# Together...Shaping the Future of Electricity

## Thank You

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# Pre-Project Deliverable: White Paper

- Automated Demand Response Today
  - Review of DR
  - Accumulated Experience
  - Current State
  - Bidding DR Resources into Ancillary Services Market
- Published in March 2012
  - Available at [www.epri.com](http://www.epri.com)
  - Product Number 1025008



# Benefits of EPRI Demonstration



## EPRI's Collaborative Research Model

- Leveraged Funding (Expecting 10-20+ Utility & ISO Members)
- First Hand Knowledge of ISO's & Utilities **Deploying** OpenADR
  - Utility Host-Sites
- Access to EPRI's Knoxville Lab, [Server](#), [Clients](#) & Performance Results

## Understand Opportunities & Challenges

- How can this Innovation be Applied to your Environment?
- Understand how to have OpenADR Co-exist w/Existing Systems

## Support Industry Coordination

- LBNL, OpenADR Alliance, NIST PAP09, OASIS Energy Interop
- Have Utility/ISO Voices Heard (Vendors & Standards Dev.)
- Increased Adoption of Commercialized OpenADR Products
  - Encourage the Free Market to Innovate (Avoid Vendor Lock-in)