Load as a Regulation Resource

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CERTS review
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Outline

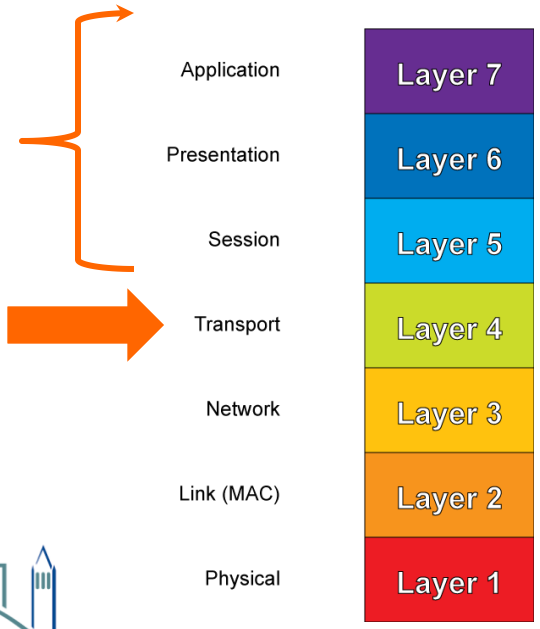
- **Phase 1 summary**
  - **Overview of OpenADR**
  - **Major Phase 1 accomplishments**
- **Project objectives**
- **Tasks and major technical accomplishments completed**
- **Deliverables and schedule**
- **Risk Factors**
- **Follow-on Work**

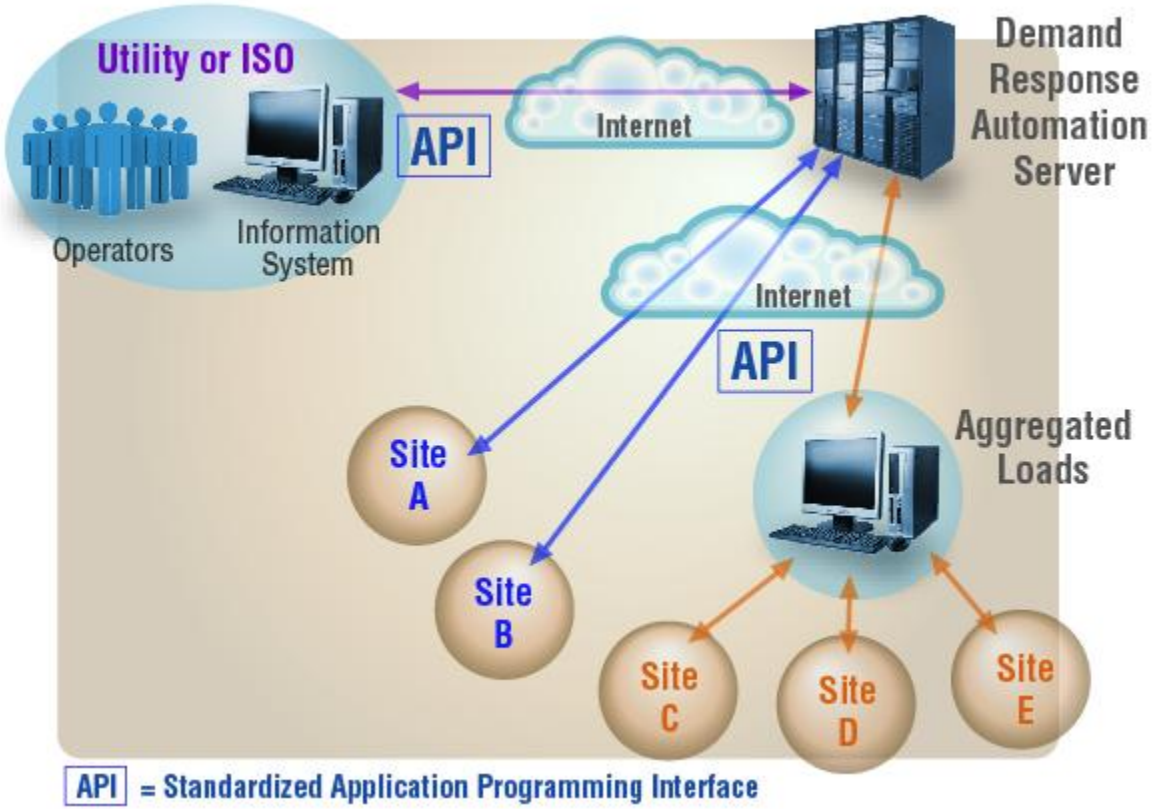
What is OpenADR and how does it work?

Signaling- continuous, 2-way, secure messaging system for dynamic prices, emergency and reliability signals.

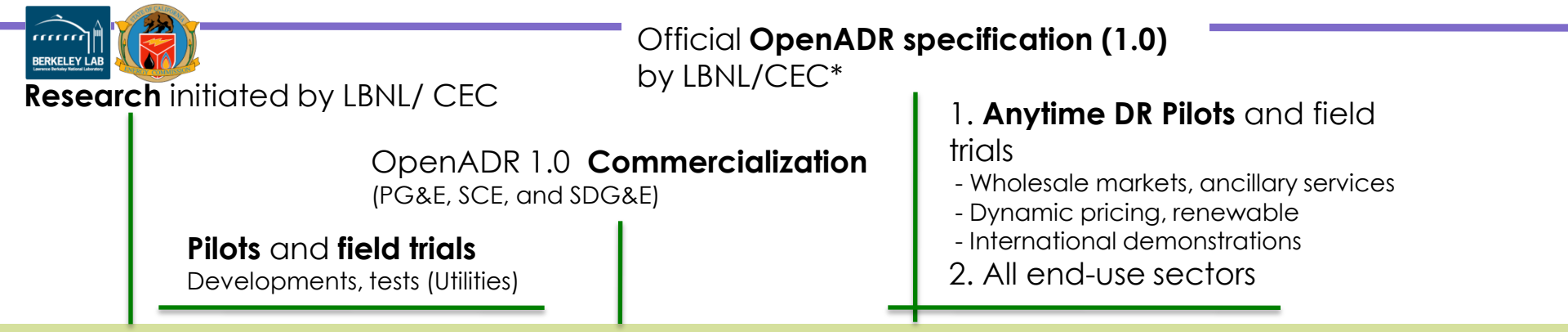
Transport independent

Hardware retrofit or embedded software - many clients fully implemented with existing XML software





OpenADR Interoperability Quest



<u>Standards *Lifecycle* Process</u>: A complete process before a standard is ready for commercial adoption.**

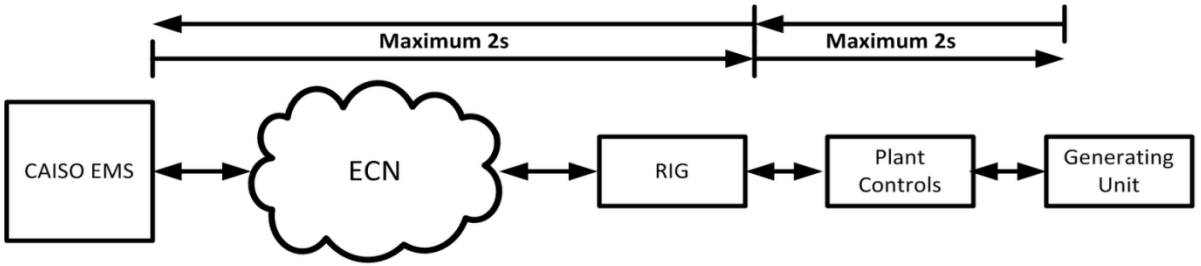
1. Research and development
2. Pilots and field trials
3. Standards development
4. Conformance and interoperability

*** OpenADR v1.0: http://openadr.lbl.gov/**
**** Publication: http://drrc.lbl.gov/sites/drrc.lbl.gov/files/LBNL-5273E.pdf**

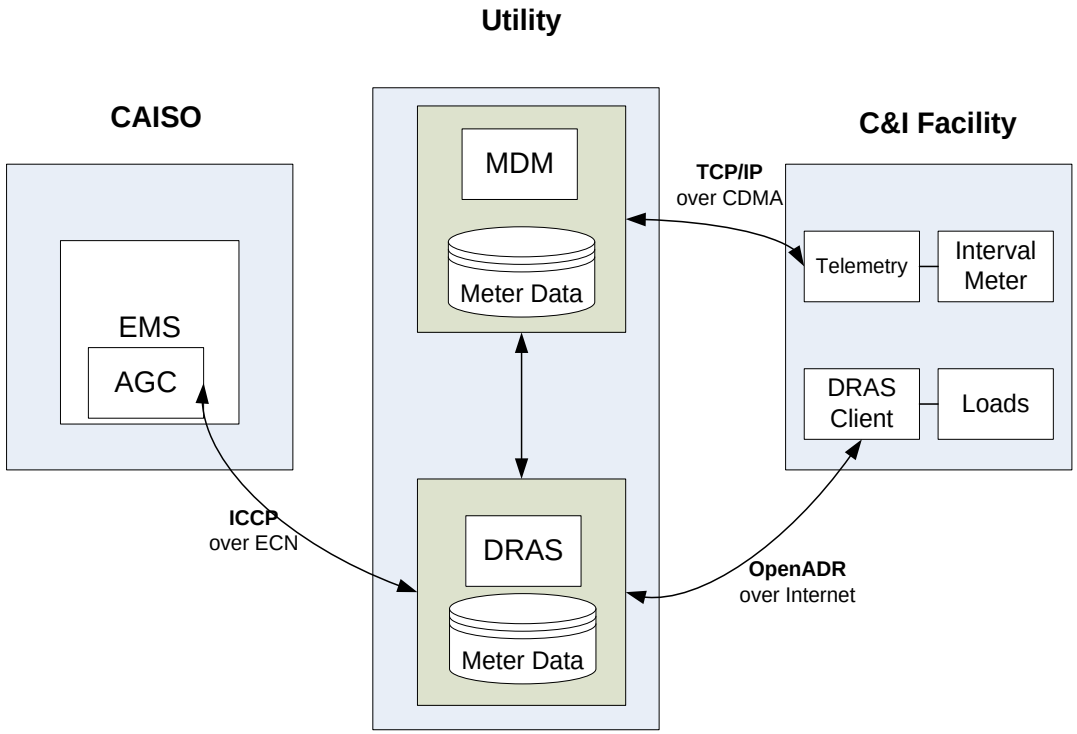
OpenADR Application for Ancillary Services

Scope:

- OpenADR and telemetry feedback
- Transport
  - Latencies associated with communications to facility
  - Latencies associated within facility
- Security



CAISO EMS: The energy management system used to manage the supply demand balance
ECN: Energy Communications Network, a Internet like entity dedicated to CAISO communication with generators and loads
RIG: Remote Intelligent Gateway. A device the provides protocol and data support in compliance with CAISO standards.
Plant Controls. Direct digital controls, regulate up or down, change set point, etc.



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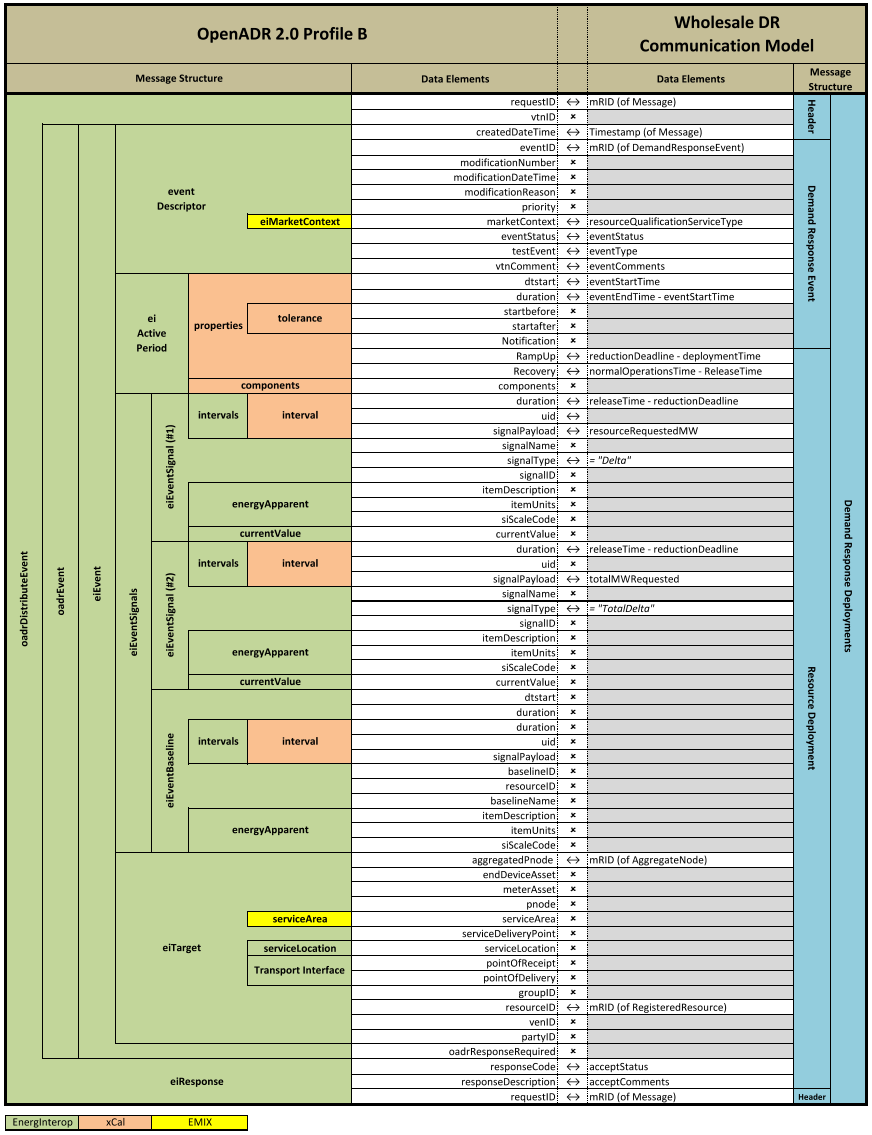
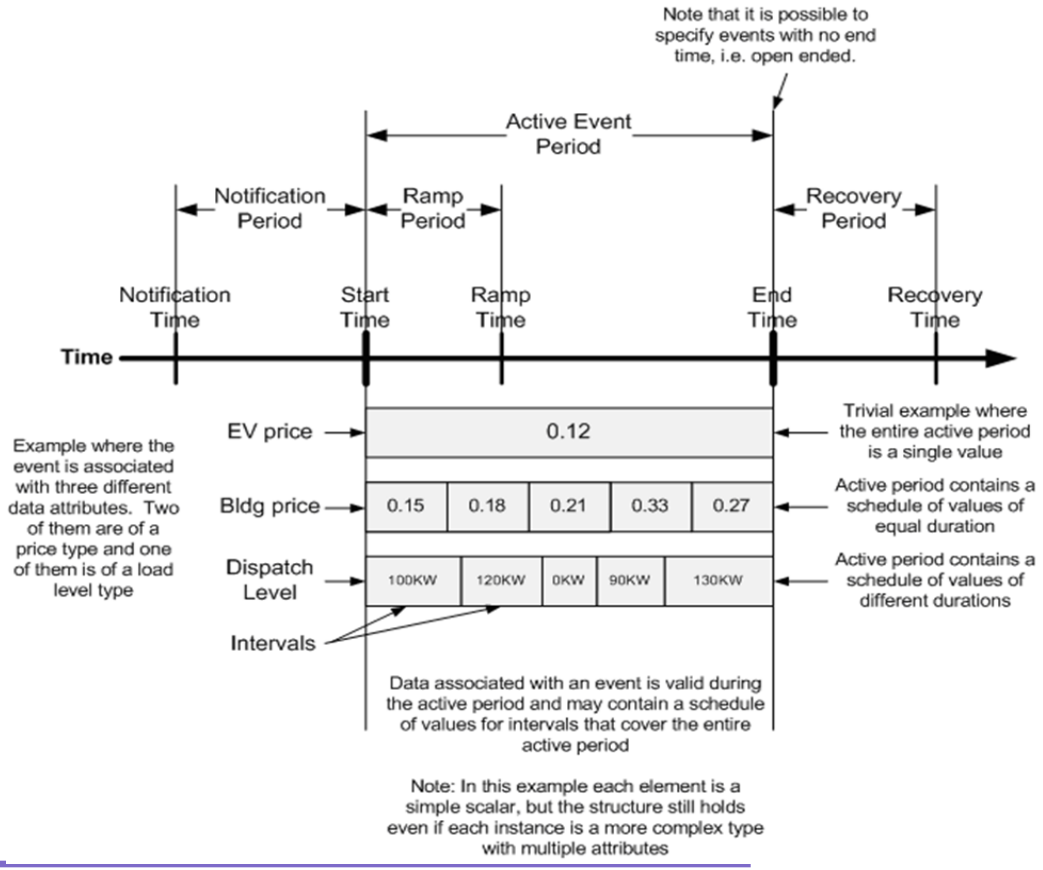
Major accomplishments – OpenADR 2.0b

- Neither OpenADR 1.0 nor 2.0a included a feedback capability
- A NIST PAP 19 (Wholesale Demand Response Communication Protocol) was established. This effort is led by the IRC. OpenADR 2.0 profile was mapped onto IRC requirements. We added lacking fields (such as telemetry) to develop 2.0b.
- OpenADR 2.0b is currently under development and expected to be finalized by the end of the year.
- Typical product development cycle is 6-9 months.



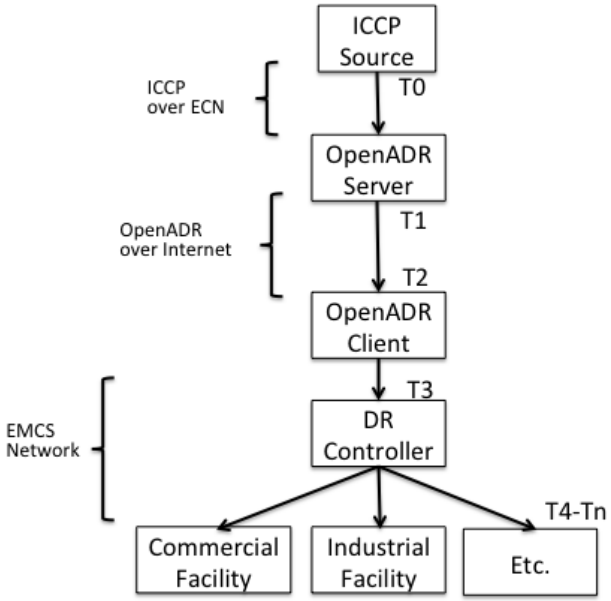
Major Accomplishments: OpenADR for Fast DR and Aggregation

- **OpenADR 2.0 information exchange model has the following attributes to be used for aggregation:**
  - ***DeviceAsset***
  - ***Groupname***
  - ***GroupID***
  - ***ResourceID***

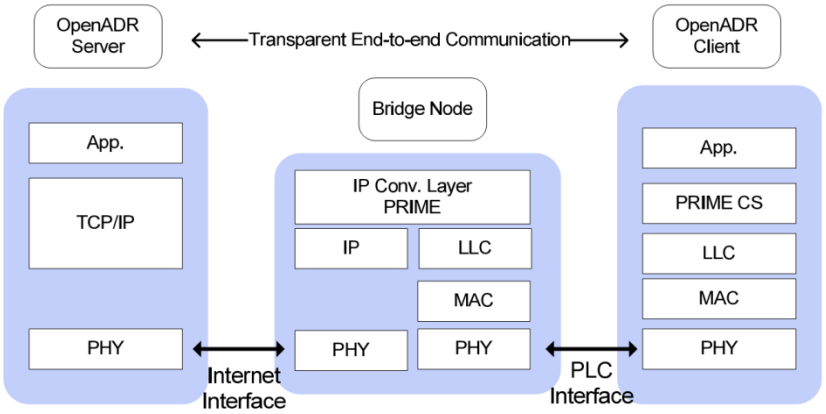


Major accomplishments - Transport

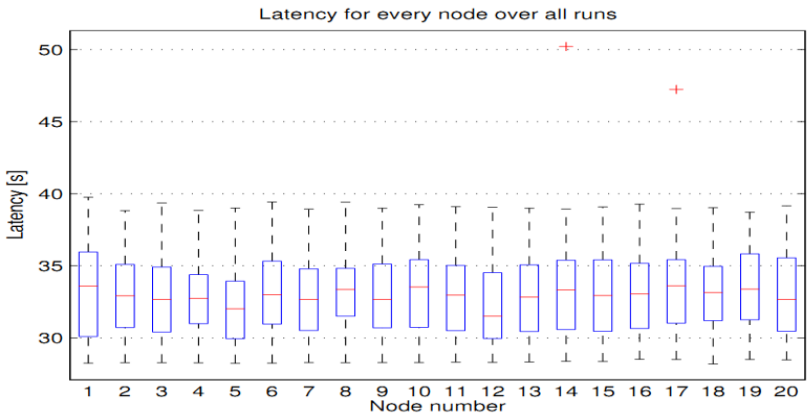
- Latencies associated with communications are due to channel characteristics. Identified the following transports and worked with the OpenADR Alliance to define their characteristics :
  - SOAP
  - REST
  - AtomPub
  - XMPP
  - AMQP
  - PubSubHubub
  - SIP
  - Comet
  - Web Socket
  - IMS
  - OPC
  - BACNet Web Services
  - CoAP
  - ICCP
- Considered various message exchange mechanisms
  - PUSH
  - PULL
  - LONG POLLING



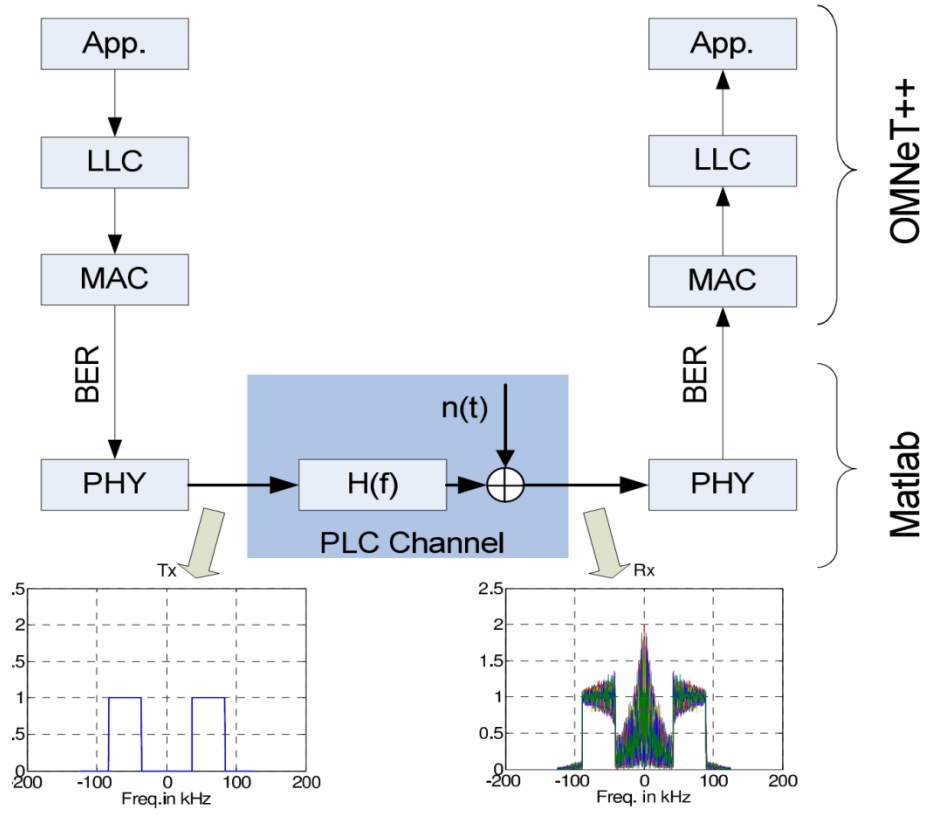
Major accomplishments – Transport (cont.)



- Average round-trip latency is 33 sec.



Simulation of Low Voltage PLC Networks to Propagate OpenADR signals



Phase 2: Project Objectives

- **To collect and evaluate the price of ancillary services products around the country.**
- **To collect and evaluate the enablement costs for various end uses and sectors.**
- **To evaluate the security of communication and control technologies.**
- **To develop new models for demand-side modeling into ISO systems.**
- **To develop methods to forecast demand response resources.**

Tasks

1. Survey existing ISO ancillary services markets to collect the various prices of the products; highlight profitable opportunities for the customers;
2. Survey the existing deployments around the country to determine the cost of participation of customers into various AS markets by surveying aggregators and individual customers who have been actively participating in AS markets around the country.
3. Evaluate the security of communication and control technologies that enable AS markets.
4. Survey the ISOs to understand the current models that are being used for representing and managing demand-side resources and propose new models if necessary.
5. Develop methods to forecast demand response resources to deliver the availability of resources with a certainty factor.

Task 1. Price of AS Products

- **Collected Data from 6 ISO/RTO's for years 2009-2011**
  - **Data includes:**
    - Hourly Market Clearing Prices for Ancillary Services [$/MW-h]
    - Hourly Market Size [MW-h]
- **Examined Variation**
  - **Annual, Seasonal, Monthly and Daily**

Market Value of Ancillary Services

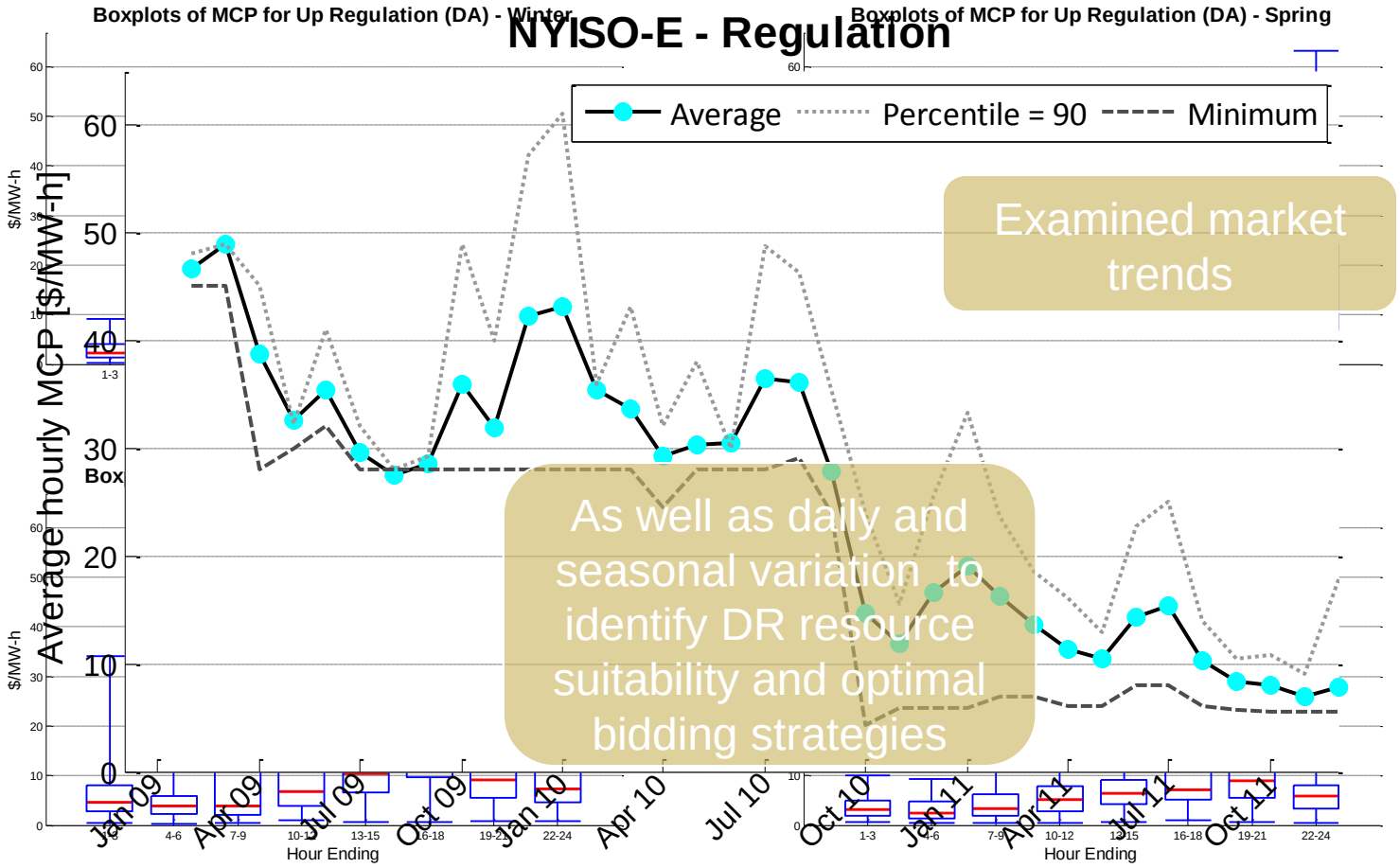
Examining historical hourly price, hourly capacity procurement, and annual market size in organized ISO/RTO Markets

2010 Avg ISO/RTO AS MCPs

Avg (std)	Regulation			Operating Reserves		
[$/MW-h]	Down	Up	Combined	10-Min Spinning	10-Min Non-Spinning	30-min Supplemental
CAISO	8.06 (9.28)	6.75 (5.54)		5.24 (5.87)	0.60 (2.55)	
ERCOT	9.76 (3.79)	8.58 (8.68)		9.03 (2.95)	4.31 (6.12)	
MISO			12.17 (6.41)	4.02 (4.59)	1.46 (1.37)	
PJM			17.95 (14.04)	0.12 (1.01)		
NYISO-E			28.80 (13.61)	6.23 (5.36)	2.29 (2.24)	0.13 (0.23)
NYISO-W			28.80 (13.61)	4.41 (3.63)	0.87 (1.52)	0.13 (0.23)
ISO-NE			7.07 (3.37)			

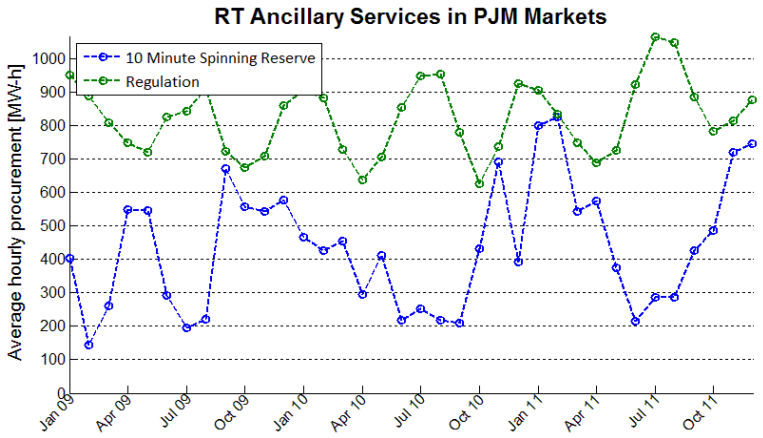
* Data gathered using Ventyx Velocity Suites

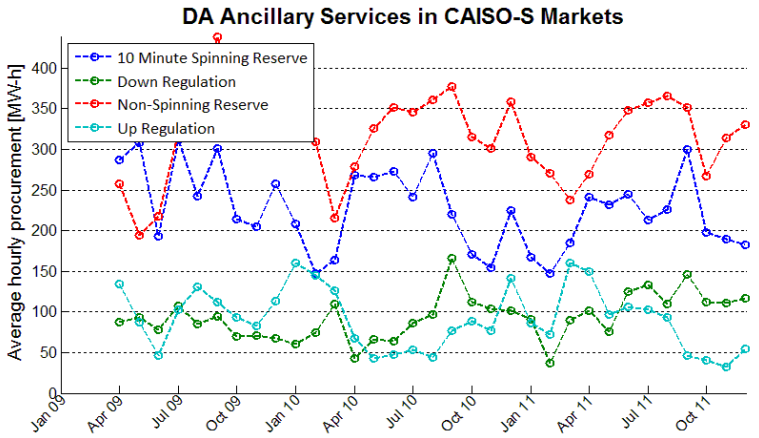
Trends in AS Market Clearing Price

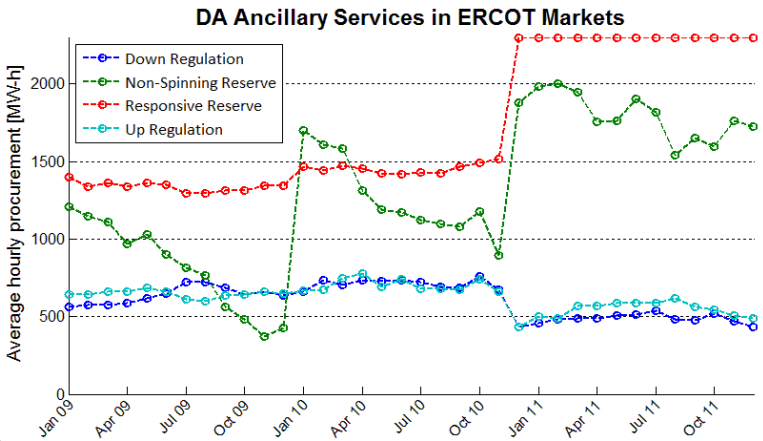


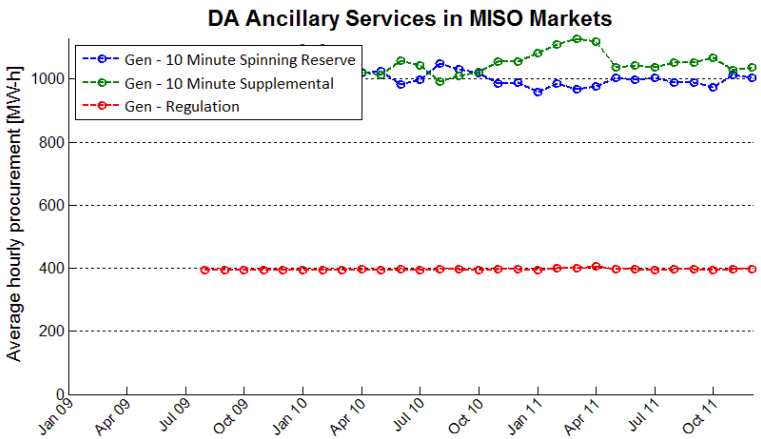
Market Size

- **Market procurement data [MW-h] for CAISO, MISO, ERCOT, and PJM gathered from Ventyx Velocity Suites and ISO sites**









Task 2. Enablement Costs

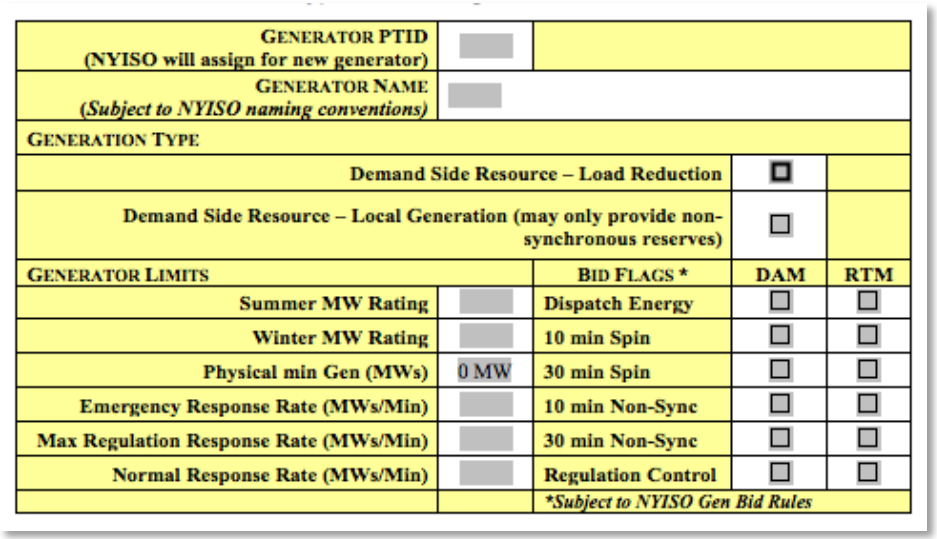
- **Interviewed ENBALA and EnerNOC**
  - The most expensive enablement cost is customized engineering effort for each site.
  - Second is the cost of telemetry equipment and establishing ECN – Limiting participation of small loads.
- **Literature Search**
  - Data from ALCOA, Sunnyvale Wastewater Treatment Facility and Cal-Steel.
- **More data is needed**

Task 3. Major Accomplishment: Development of OpenADR 2.0b Security

- Conforming to Smart Grid Testing and Certification Committee's Interoperability Process Reference Manual (IPRM)
- Considering a spectrum of security mechanism including:
  - authentication: digital certificates (X.509), username/password pairs
  - authorization: digital certificates(X.509), username/password pairs, usually handled internally and rejected by the application.
  - confidentiality: message encryption using TLS (transport level security) with digital certificates
  - integrity: message signing using TLS (transport level security) with digital certificates
  - non-repudiation: uses a combination of the above including message signing using digital signatures, time-stamps, and encryption

Task 4. Survey of DR models

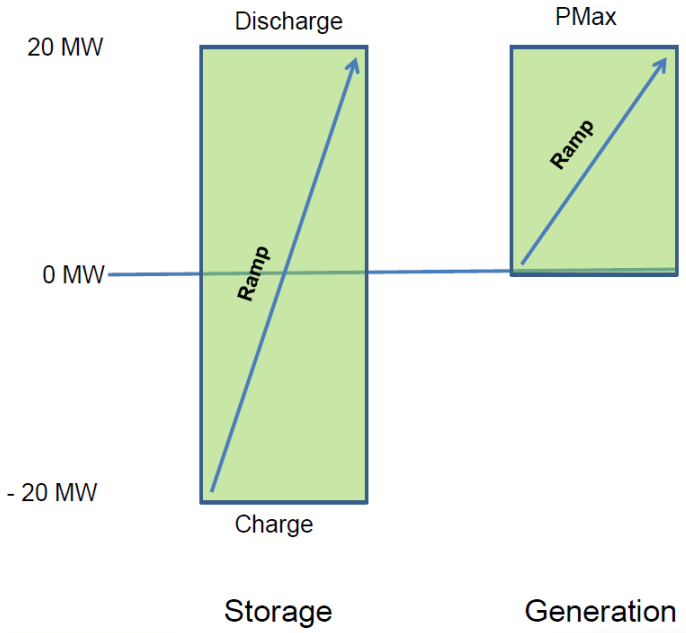
- Started with California's Non-Generation Resource Model.
- Investigated NYISO's DR model for the Demand Side Ancillary Services Program (DSASP)
  - DR to participate in Regulation, frequency response and operating reserves
- Next: PJM.



GENERATOR PTID (NYISO will assign for new generator)				
GENERATOR NAME *(Subject to NYISO naming conventions)*				
GENERATION TYPE				
Demand Side Resource – Load Reduction			☐	
Demand Side Resource – Local Generation (may only provide non-synchronous reserves)			☐	
GENERATOR LIMITS		BID FLAGS *	DAM	RTM
Summer MW Rating		Dispatch Energy	☐	☐
Winter MW Rating		10 min Spin	☐	☐
Physical min Gen (MWs)	0 MW	30 min Spin	☐	☐
Emergency Response Rate (MWs/Min)		10 min Non-Sync	☐	☐
Max Regulation Response Rate (MWs/Min)		30 min Non-Sync	☐	☐
Normal Response Rate (MWs/Min)		Regulation Control	☐	☐
		**Subject to NYISO Gen Bid Rules*		

New ISO Market Models: CAISO's NGR

- **Non-Generator Resource (NGR) model enables demand response and storage participation in Ancillary Service markets.**
- **Innovations:**
  - Consumption is modeled as negative generation.
  - Storage units are continuously dispatchable from consumption (negative) to generation (positive)
  - Model includes charge limits and energy shed limits to indicate energy limitations of these resources
  - Regulation Energy Management (REM)



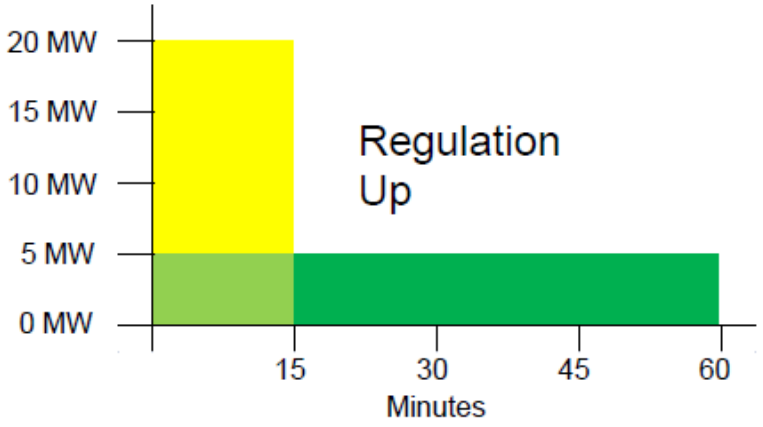
CAISO's Regulation Energy Management

- **REM allows resources to bid according to a 15-min continuous energy requirement vs. 60-min.**
- **CAISO manages REM resource state of charge**
  - **CAISO's EMS purchases energy for resource in the 5-minute market to offset energy consumed during regulation to maintain state of charge at 50%.**
- **REM Resource can only provide Regulation**

Example: 20 MW / 5 MWh limited energy resource

Green – prior requirement

Yellow – regulation energy management



Task 5. DR Forecasting

- **Experimenting with better load forecasting methods:**
- **Autoregressive Integrated Moving Average (ARIMA) models such as Reg-ARIMA-X, Reg-SARIMA-X, SARIMA with Fourier**

Next Step:

DR Forecasting

Deliverables for Phase 2 and Schedule

- Two Documents (reports or papers):
  1. The value of DR in AS markets (December 2012)
  2. Comparison of various load and DR forecasting methods (March 2013)

Risk Assessment

- **Delays due to the late start.**
- **Risks associated with collecting enablement costs**
- **Field testing concepts depends on developing relationships with customers and entities interested in these markets.**

Follow-on Work

- PG&E is interested in working with us to do field tests with Refrigerated Warehouses and other customer groups using OpenADR 2.0b.
- We'd like
  - to continue using simulation tools to screen communication media for fast DR applications
  - to partner with a building controls company to experiment with a bottom up controls option for commercial building controls – We've been talking with Pacific Controls.
  - Experiment using DR forecasting capabilities with ASHRAE SPC201 development effort
  - Use the OpenSEG concept to test the use of Smart meters for telemetry purposes.

THANK YOU!

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http://drrc.lbl.gov