Open Source Software
Experiences, Opportunities and Challenges

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The Open Source Software Journey….

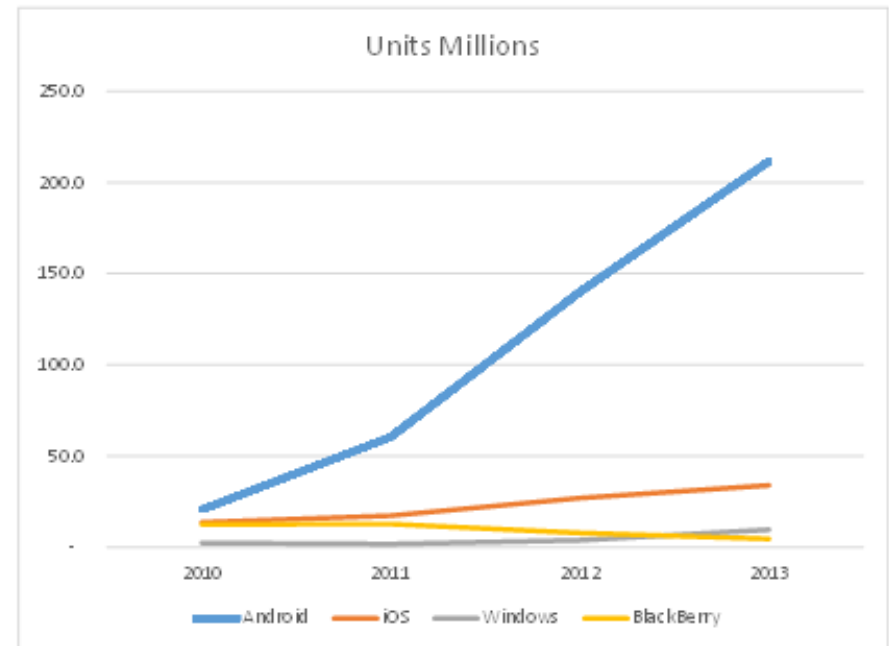Ernest Shackleton's expeditions to Antarctica

The "Ernest Shackleton's" of OSS have had successes!

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Example of Open Source Software Proliferation

Android Over 80% Market Share In Global Smartphone Shipments

3rd Quarter Units (Millions)				
	2010	2011	2012	2013
Android	20.5	60.5	139.9	211.6
iOS	13.5	17.3	26.9	33.8
Windows Phone	2.2	1.7	3.7	9.5
BlackBerry OS	12.5	12.7	7.7	4.5
Others	32.4	23.0	8.4	1.70
TOTAL	81.1	115.2	186.6	261.1

3rd Quarter Marketshare				
	2010	2011	2012	2013
Android	25.3%	52.5%	74.9%	81.0%
iOS	16.6%	15.0%	14.4%	12.9%
Windows Phone	2.7%	1.5%	2.0%	3.6%
BlackBerry OS	15.4%	11.0%	4.1%	1.7%
Others	40.0%	20.0%	4.5%	0.6%

Units Millions — line chart of Android, iOS, Windows, BlackBerry from 2010 to 2013.

- Note: Apple has 57 percent of all smart phone profits according to Strategy Analytics
  (http://www.businessweek.com/articles/2013-05-16/google-makes-android-but-samsung-makes-all-the-money)

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Utility OSS successes that are growing in use with strong user and support communities

- **OpenDSS** - Open Distribution System Simulator EPRI (2004)
  - Over 17,000 downloads with robust support from EPRI
  - Contributions from education & software vendors
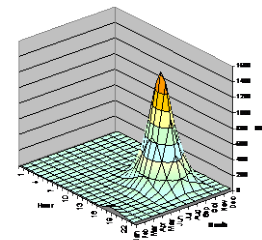
- **GridLab-D** –Developed by PNNL (2009)

  Power distribution system simulation and analysis tool for users who design and operate distribution systems

- **OpenADR** – Initiated by LBNL in 2002, International
  - Standardized Messaging for DR/DER Pricing & Events
  - OpenADR Alliance – Certification Testing
  - EPRI Open Source VTN & VEN 2 weeks ago

Niche or Emerging Applications for Electric Power Industry

Acceleration & Evaluation of Standards

Users/Adopters Benefit through Collaboration

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Additional EPRI OSS Emergent Successes …

- EPRI Trending Towards More Use of OSS
  - **Mobile Integrated Data Access System**
    http://sourceforge.net/projects/midas-ffdv/
  - **OpenETran** – transient simulator
    http://sourceforge.net/projects/epri-openetran/
  - **openFLE** – fault location - http://openfle.codeplex.com/
  - **openXDA** – disturbance analytics - http://openxda.codeplex.com/
  - **Open PQ Dashboard** – a new application to aggregate and display power quality information

**Development of OSS for Electric Industry meshes well with EPRI Collaborative R&D Model**

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The Power of the Plug & Socket

What new products have been invented that utilize this "interface"? **(Patent issued in 1903)**

How could I design a new device without knowing the standard plug specification?

<u>Consider the opposite</u>
**How can I design a specification without having to know what products will use it?**
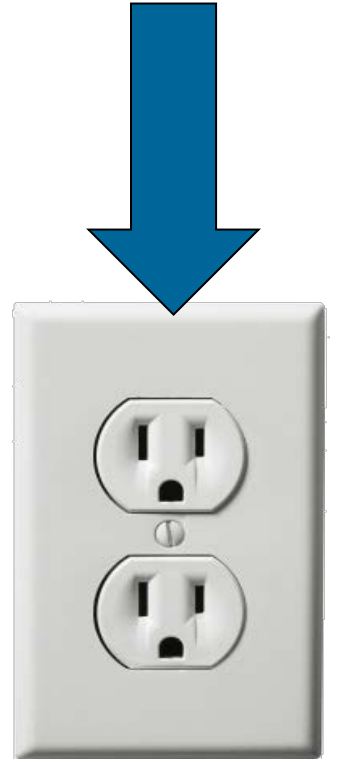
Standards for communication devices can be developed without knowing what will interface with it in the future.

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PNNL Future Power Grid Initiative

► GridOPTICS^{TM}

- Architecture to simplify IT systems to support complex collection of physical systems interacting with the electric grid
- Built from open components - emphasis on **<u>interfaces</u>** to support analytics
- Designed to handle synchrophasor data velocity and volume
- Currently being tested and refined. Open source release 2014.
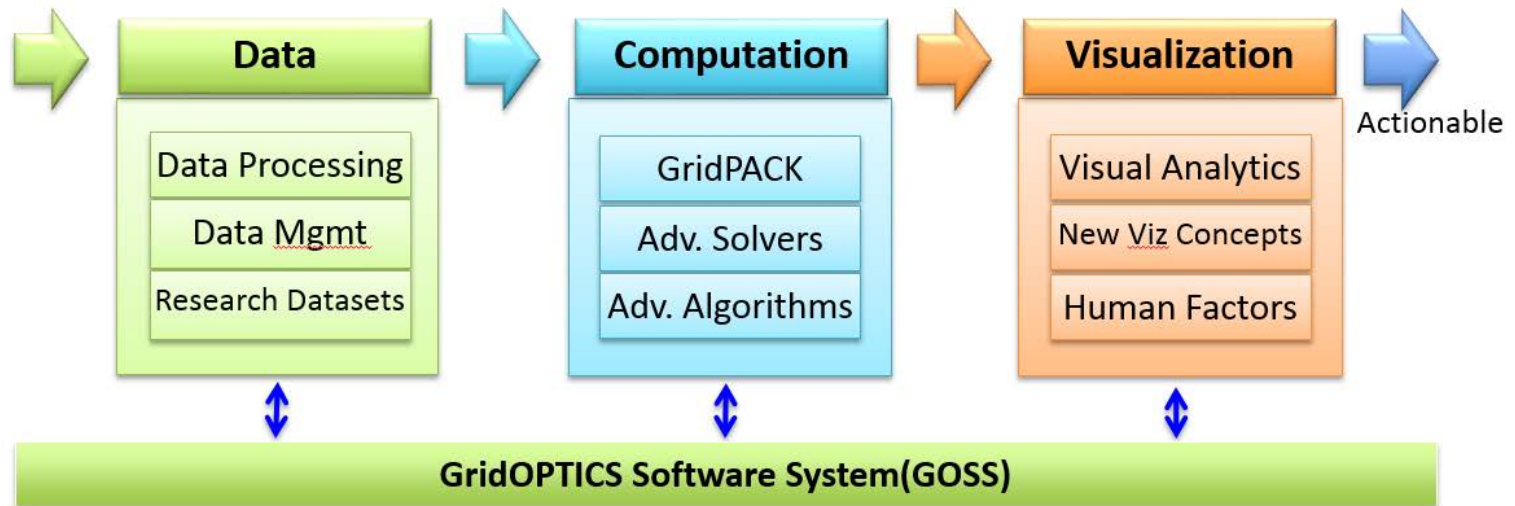
# Open Automated Demand Response (OpenADR) DR & DER Messaging
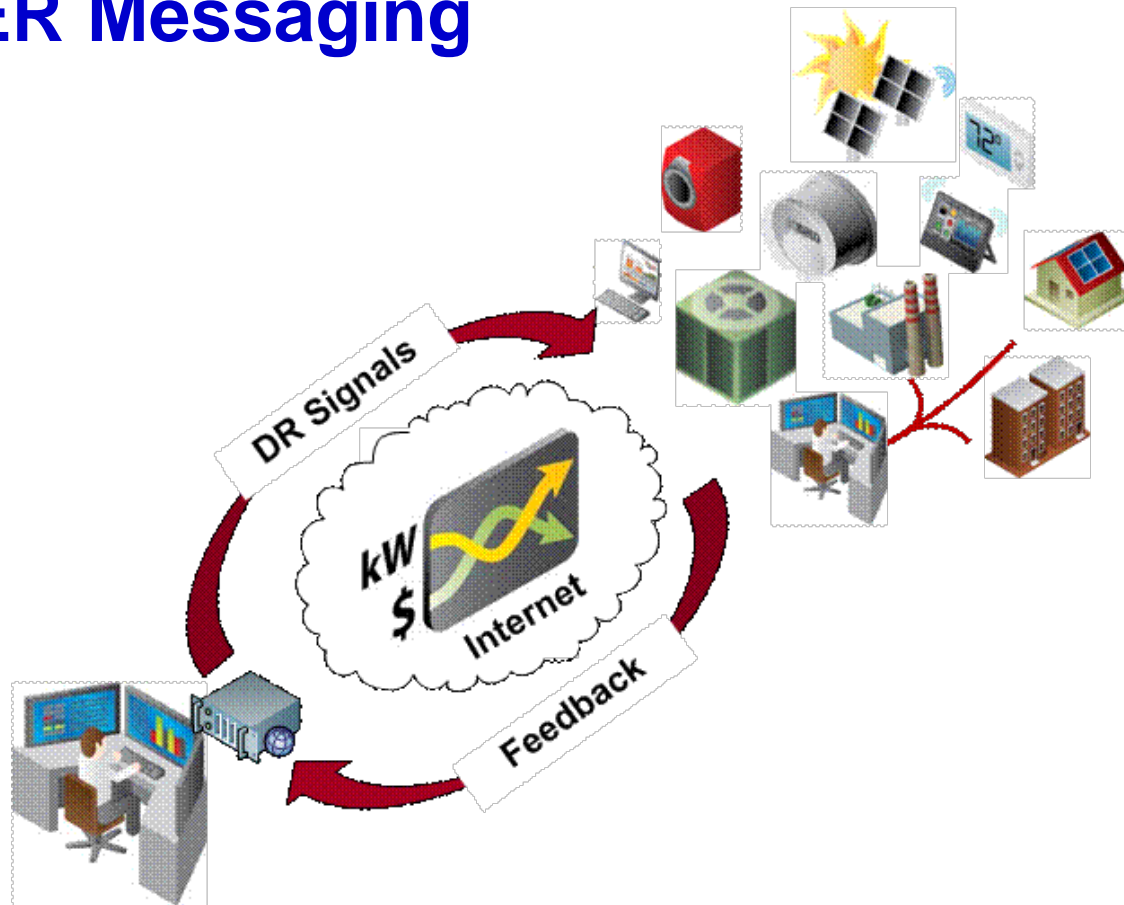
Growing as most prominent standard for Integrating DR & DER

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DR & DER Signal Types in OpenADR 2.0b

Applies to:

- **Loads**: Air Conditioning, Water Heaters, Thermostats, Electric Vehicles

- **Resources**: Storage, Microgrids, Solar, DG, Buildings

- **Business Models**: ISO's, Utilities, Aggregators, Device Manufacturers
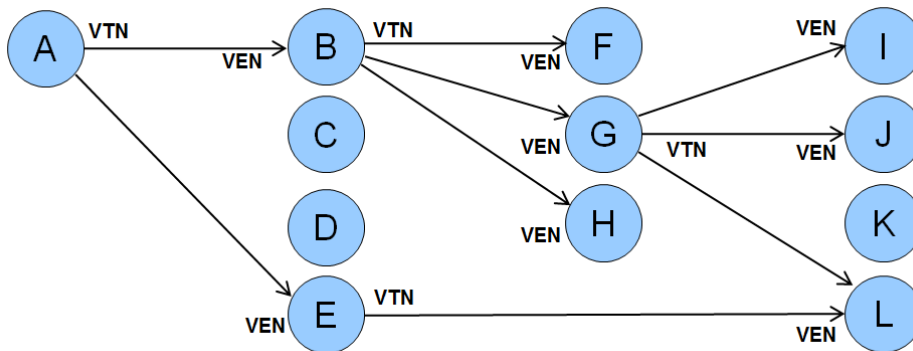
Recursive Architecture:
VTN=Virtual Top Node,   **VEN**=Virtual End Node

Signal_Types

ELECTRICITY_, Price
PRICE, Price, Price
ELECTRICITY_, priceRelative
PRICE, PriceRelative
ELECTRICITY_, priceMultiplier
PRICE, PriceMultiple
ENERGY_PRICE, price
ENERGY_PRICE, priceRelative
ENERGY_PRICE, priceMultiplier
DEMAND_CHARG, price
DEMAND_CHARG, priceRelative
DEMAND_CHARG, priceMultiplier
BID_PRICE, price
BID_LOAD, setpoint
BID_ENERGY, setpoint
CHARGE_STATE, energyXXX
CHARGE_STATE, energyXXX
CHARGE_STATE, None
LOAD_DISPATCH, setpoint
LOAD_DISPATCH, delta
LOAD_DISPATCH, multiplier
LOAD_DISPATCH, level,
LOAD_CONTROL, x- LoadControlCapacity
LOAD_CONTROL, x-LoadControlLevelOffset
LOAD_CONTROL, LoadControlSetpoint
LOAD_CONTROL, x-LoadControlPercentOffset

Does it Matter what the Resource is?

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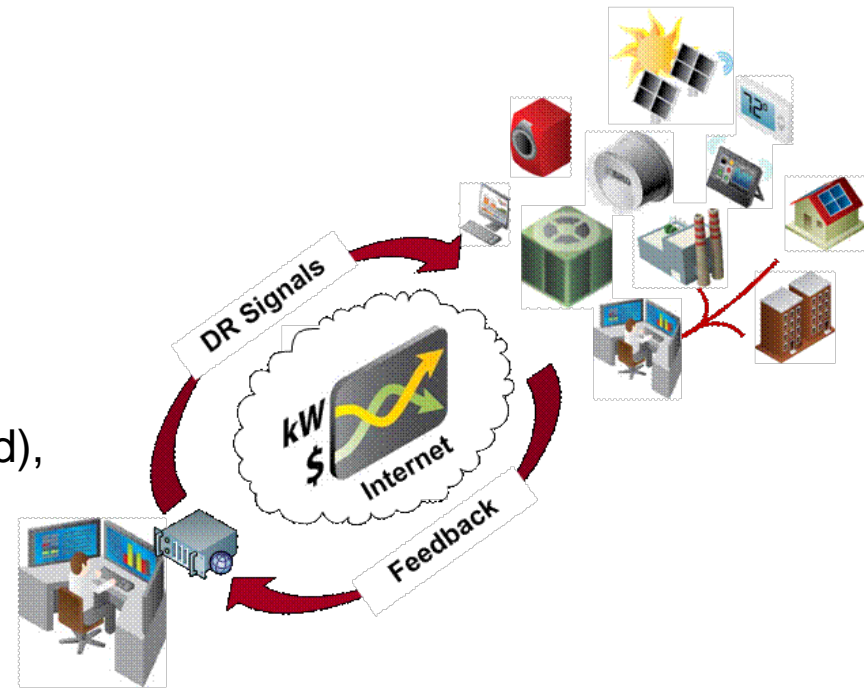
OpenADR Activities

EPRI Demonstrations

- **ISO's:** CAISO and NYISO
- **US Utilities**: AEP, KCPL, Southern Co
- **International Utilities**: ESB Networks (Ireland), EdF (France), TEPCO (Japan)

Many More In Progress

- California Utilities
- LBNL
- OpenADR Alliance - ~100 Members

International Adoption

- Now an IEC Publicly Available Specification (PAS)

DR Signals

kW $

Internet

Feedback

Virtual Top Node (VTN) - Server
http://sourceforge.net/projects/openadr2vtn/

Virtual End Node (VEN) - Client
https://sourceforge.net/projects/openadr2bven-pull/

EPRI Open Source Contribution Accelerating Adoption
Significant Impact with Global Adoption

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GOSSA
Grid Open Source Software Alliance

- **Focus**: Electric energy industry open source software (OSS)

- **Business structure**: Not-for-profit corporation

- **Approach**: Public-private collaboration

- **Initial scope:** Defined with input from EPRI, NERC, NRECA, University of Illinois, DOE, PJM and a variety of electric energy stakeholders

- **Key stakeholders:** Utilities, electric entities, government agencies, universities, suppliers and international participants

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GOSSA Value Add

- ## Guidelines
  Develop and maintain Grid OSS development and quality requirements

- ## Community Interaction
  Provide a forum for the grid community to collaborate, to identify the need for, and to develop and improve Grid OSS

- ## Grid OSS Inventory Awareness
  Maintenance of a virtual, one-stop shop for Grid OSS with regular updates provided to the GOSSA community

- ## Technology Transfer
  Support the distribution, utilization and integration of Grid OSS

- ## Technical Support Network Development
  Provide support to Grid OSS developers and users

Collecting input from stakeholders to refine services
Workshop being planned for early Summer 2014
(Tentative Date – May 29th, Charlotte, NC)

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Together…Shaping the Future of Electricity

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