Interoperability

GRID MODERNIZATION INITIATIVE
U.S. Department of Energy

Context

Too many devices and systems today cannot interoperate or require difficult and time-consuming integration processes. This results in fewer deployed new technologies (including Distributed Energy Resources - DER) and higher costs.

Key Objectives:

- Advance adoption of interoperable products and services in the energy sector.
- Align stakeholders on a strategic vision.
- Develop measures and tools to support interoperability.

Partner Involvement

Advancing interoperability requires stakeholder alignment; it's a shared challenge. To achieve alignment, the project regularly meets with 16 industry partners and holds 2 public events per year to provide critical review of ideas and plans, and help shape the work to reflect the concerns of industry.

Declaration of Interoperability

About 50 people from a cross section of industry met to create a "declaration of interoperability" that lays out a common definition of interoperability, problems caused by poor interoperability, and a commitment to advance interoperability. This involves changes to integration technologies and business processes within sectors across them.

Columbus, OH

Chicago, IL

Industry Workshops

At a September 2016 workshop held in Chicago, industry participants advanced criteria for interoperability, enhanced integration vision stories, and affirmed project directions.

The ~50 participants offered diverse perspectives on challenges and goals that tested universal concepts and principles, and explored scope and direction of the project using DER integration as an example. The next event is planned for May 2017 in Columbus.

Project Outreach

The Public Utilities Fortnightly (April 2017) includes an article about this project, discussing the importance of interoperability as more smart devices are deployed. Presentations and discussions have also been held at GWAC, SGIP, and AHR Expo events. Project information has been circulated in the SGIP, NIST, and LonMark newsletters. The project will also be describing its work at the IEEE ISGT, IEEE PES, SEPA Grid Evolution, and Transactive Energy Systems Conferences.

Expected Outcomes

- Establish an interoperability strategic vision.
- Describe the state, challenges, and path forward to advance interoperability.
- Offer tools to facilitate gap analysis, develop roadmaps, and demonstrate vision concepts

Year 1 Deliverables

This project provides leadership visibility to DOE as a champion for grid modernization interoperability with a number of deliverables, including:

- Strategic Vision
- Roadmap Methodology
- Interoperability Maturity Model

Year 2 Deliverables

- Socialize an interoperability strategic vision document.
- Demonstrate interoperability measurement and path forward.
- Complete draft of interoperability procurement tools.

Year 3 Deliverables

- Introduce incentives for industry participation to advance interoperability.
- Identify commonality across technology domains
- Reduce the uniqueness in the number of DER interface agreements
- Set course for standards convergence

U.S. DEPARTMENT OF ENERGY

April 18, 2017

Devices and Integrated Systems Testing

PNNL-SA-125102

GMLC Interoperability Technical Review Meeting

May 10-11, 2017

Columbus, Ohio

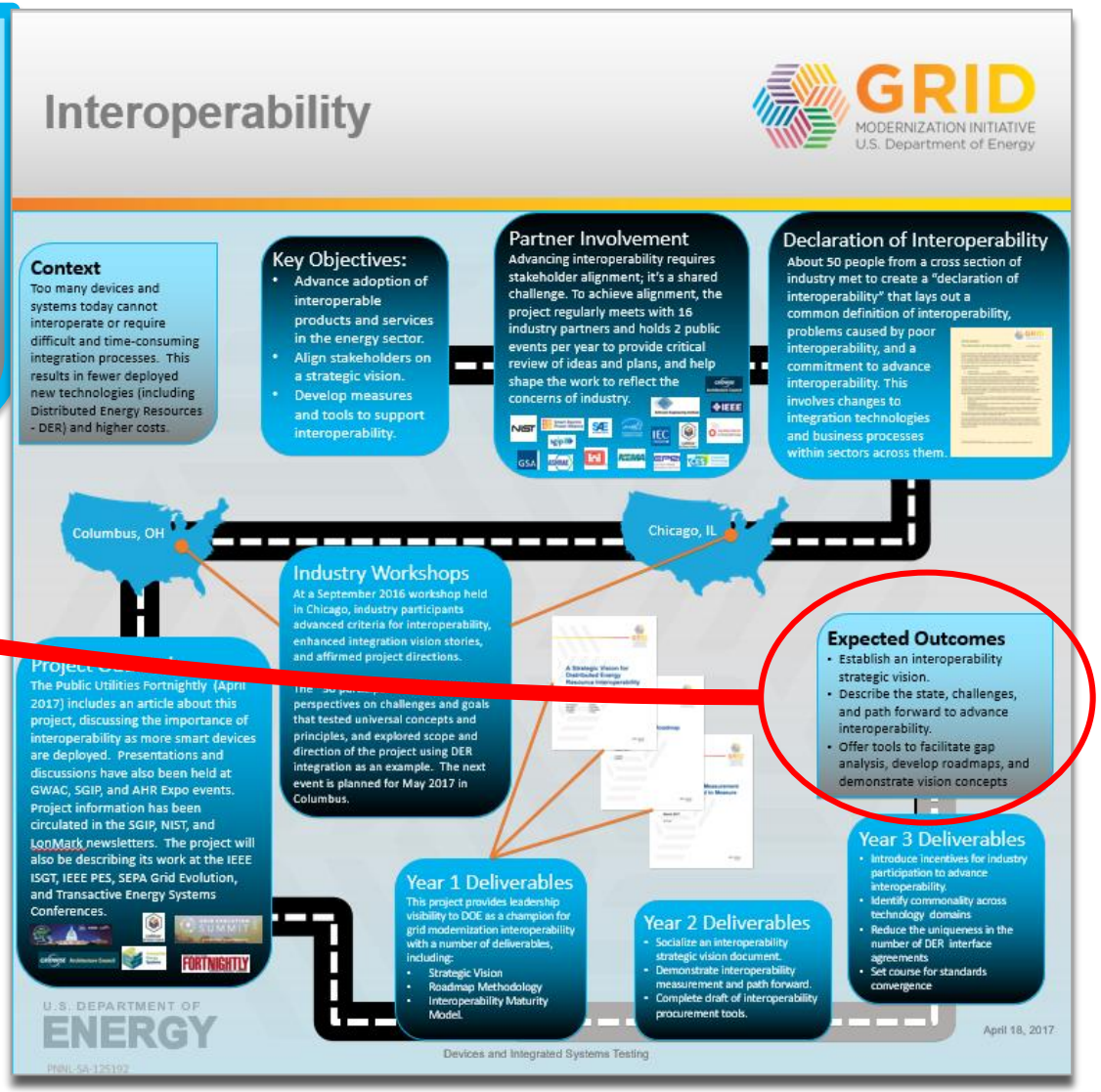
AMERICAN ELECTRIC POWER
BOUNDLESS ENERGY™

Raymond Kaiser

Local Focus. Global Reach.
Amzur Technologies

Begin with the End in Mind

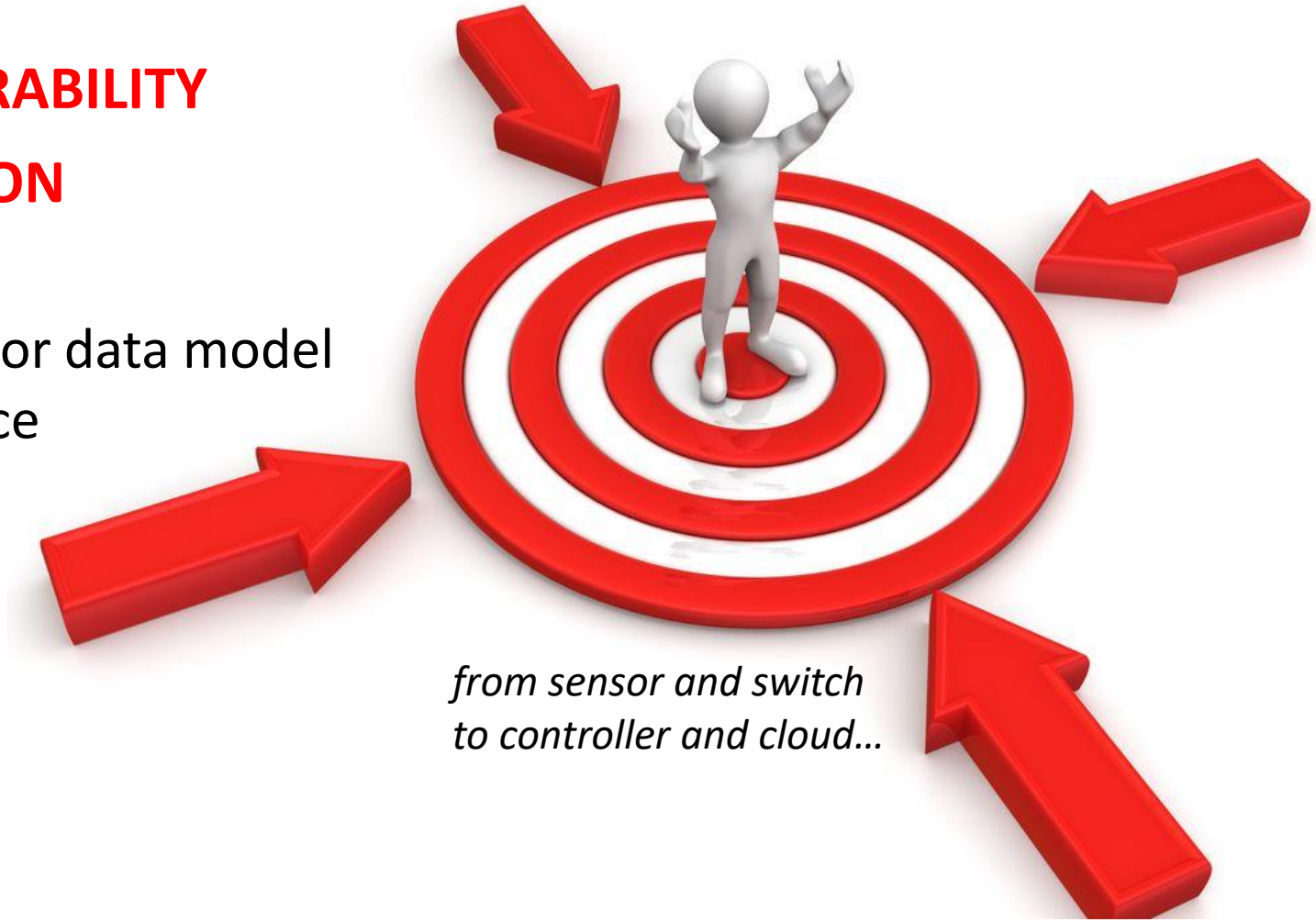
- Interoperability Strategic Vision
- Current State, Challenges, and Path
- Tools and Roadmap
- Demonstration



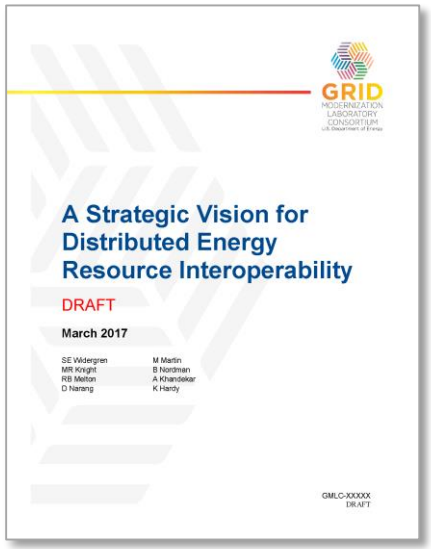
DER Interoperability Strategic Vision

Connect

any information or data model
any app or service
any data
any entity
any facility
any device
on time
at every scale.



from sensor and switch to controller and cloud…



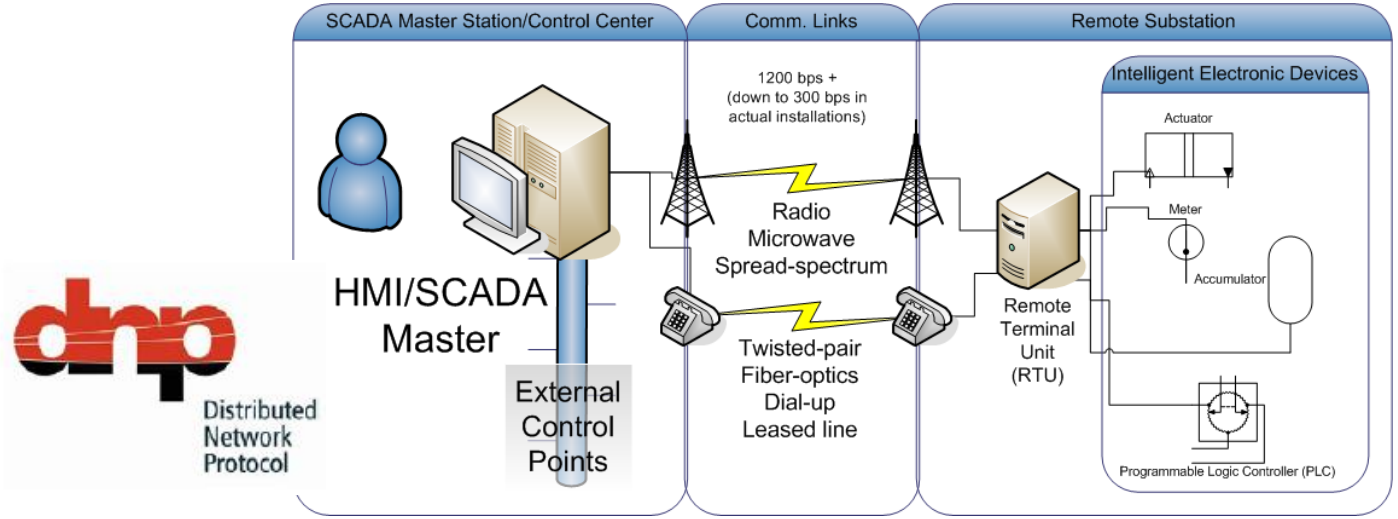
CURRENT STATE

DER C&C

Confusing and overlapping mix of models, standards, and protocols.

ARCHITECTURAL CHALLENGE
SCADA Sclerosis

Master-Slave hierarchy between Master Stations, RTUs, and other **intelligent electronic devices**.



Intelligent Electronic Devices are a bit **smarter** these days.

Current SCADA architecture cannot support millions of smarter devices.

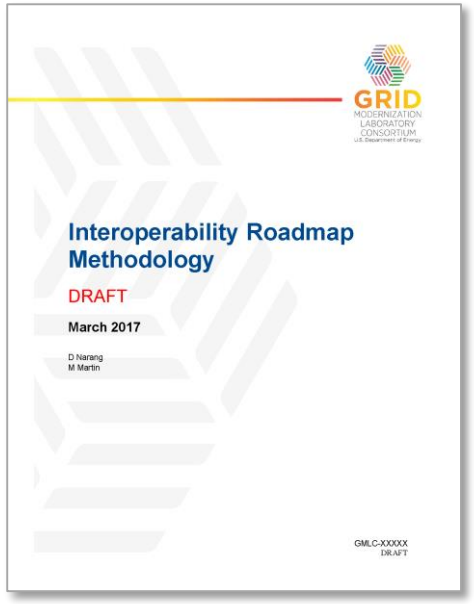
Introducing iPhone

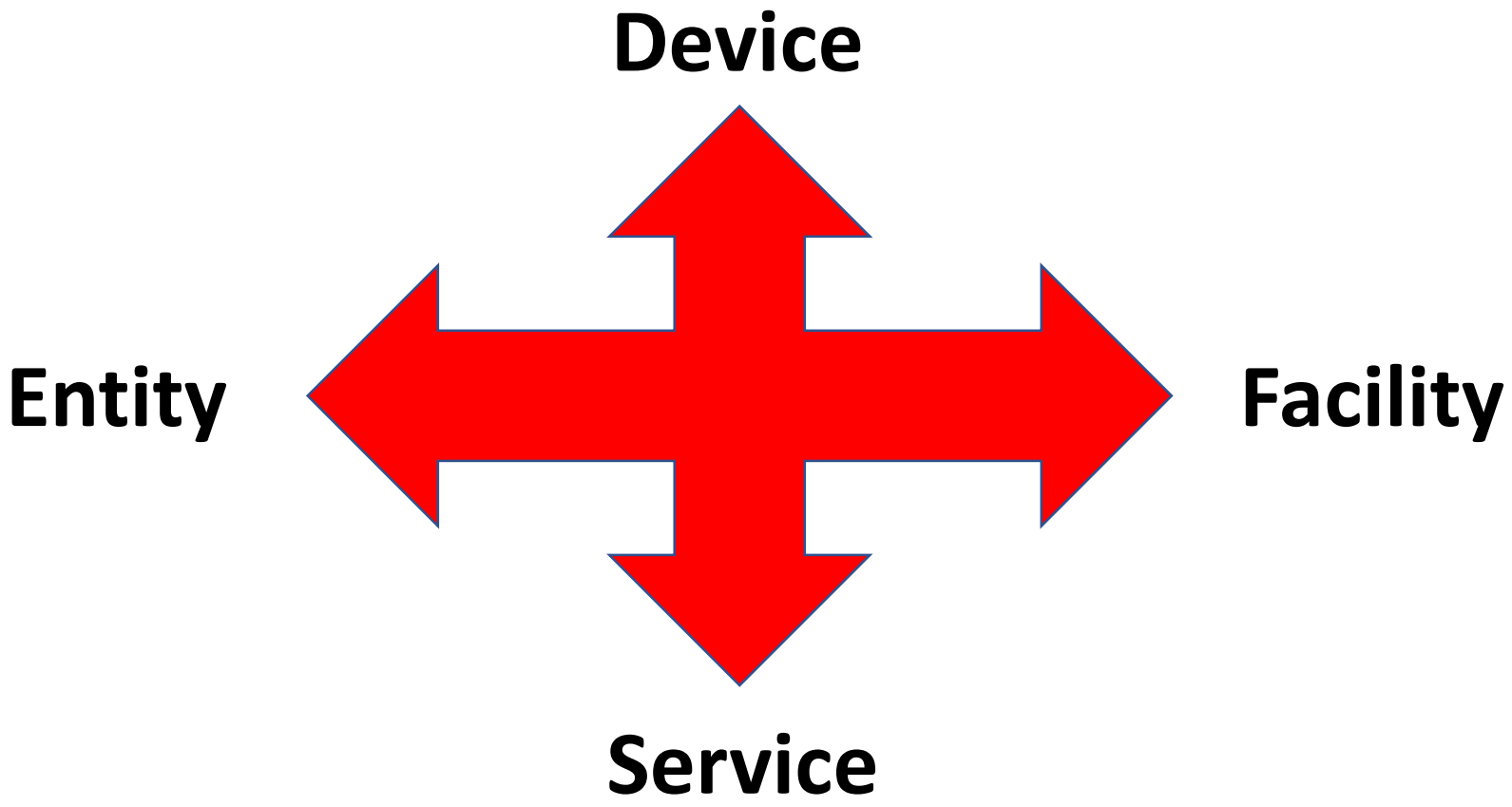
iPhone combines three products — a revolutionary mobile phone, a widescreen iPod with touch controls, and a breakthrough Internet communications device with desktop-class email, web browsing, maps, and searching — into one small and lightweight handheld device. iPhone also introduces an entirely new user interface based on a large multi-touch display and pioneering new software, letting you control everything with just your fingers. So it ushers in an era of software power and sophistication never before seen in a mobile device, completely redefining what you can do on a mobile phone.

- Widescreen iPod
- Revolutionary Phone
- Breakthrough Internet Device
- High Technology

THE PATH

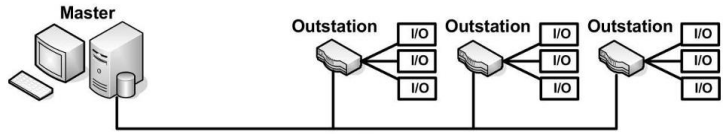
Smart Devices,
Smart Facilities,
& Interoperable Services

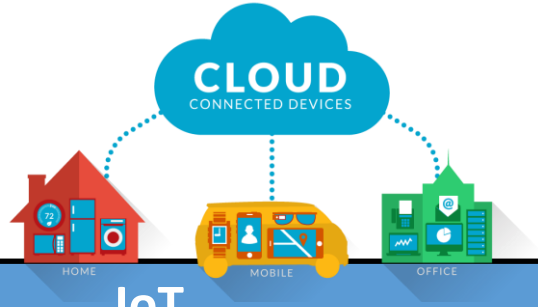




Smart Devices

Open source, hardware and vendor-neutral, protocol agnostic IoT platforms have been successfully deployed at large-scale.



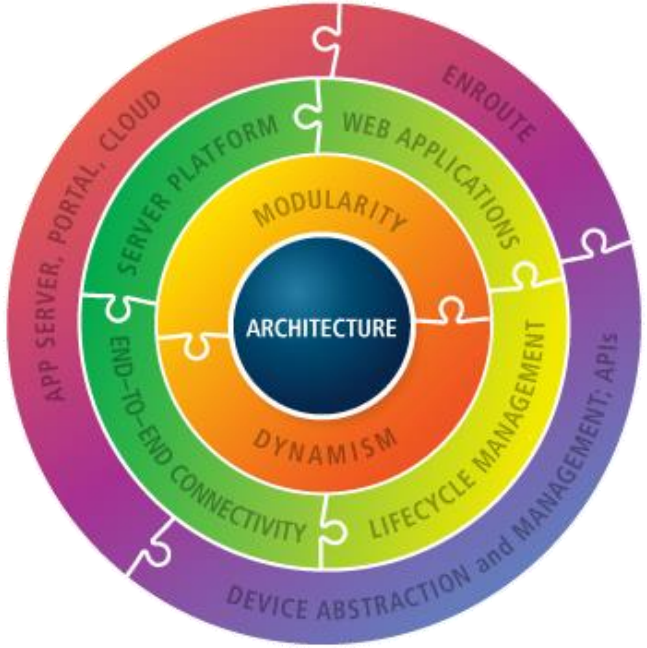


Traditional SCADA	IoT from sensor & switch to controller and cloud
Monitor hundreds or thousands of devices.	Monitor, manage, register, activate, and deploy millions of devices.
Vertical application stovepipes; typically standalone.	Solutions designed to share core functions – messaging, calendaring, communications, security, etc.
Developer needs to consider entire functionality stack.	Developers focus on specific apps or services and can access “off-the-shelf” enabling functionality.
Master-slave.	Local and remote control. Anywhere-to-anywhere.
Special-purpose hardware and software.	COTS solutions easily incorporated into new hardware products and software services.
Dedicated communication infrastructure.	Multiple communication pathways.

SMART DEVICES

OSGi™ Alliance

- **Well-established** ecosystem with millions of deployed devices.
- Specifications, reference implementations, **test suites and certification**.
- Supports **remote management** and interoperability of applications and services over a broad variety of devices.
- **Distributed or federated** service models.
- **Core platform specifications and APIs** needed to create an open service gateway platform to support third-party developed services.



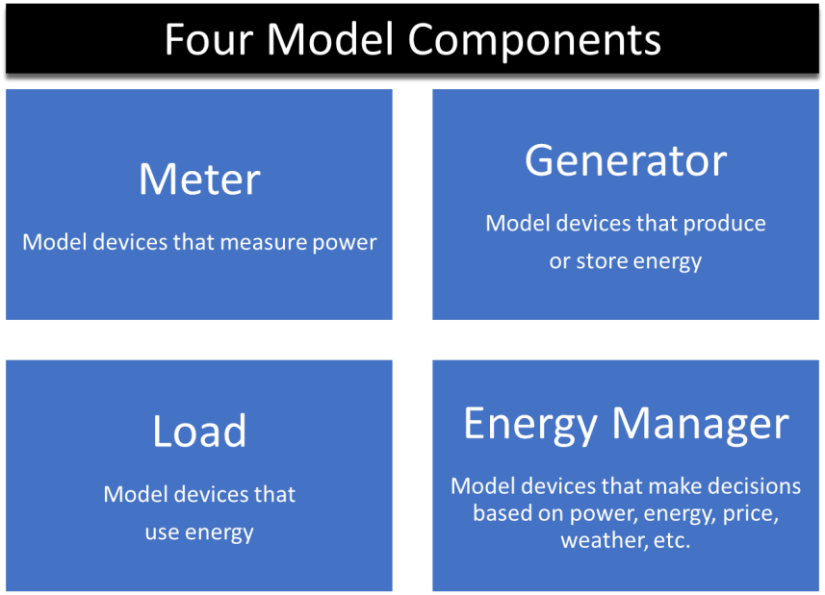
SMART FACILITIES

Well-documented **Information Model**

industry standard **Data Models** (SunSpec/OASIS/Open ADR/SEP2)

legacy **BAS protocol** support.

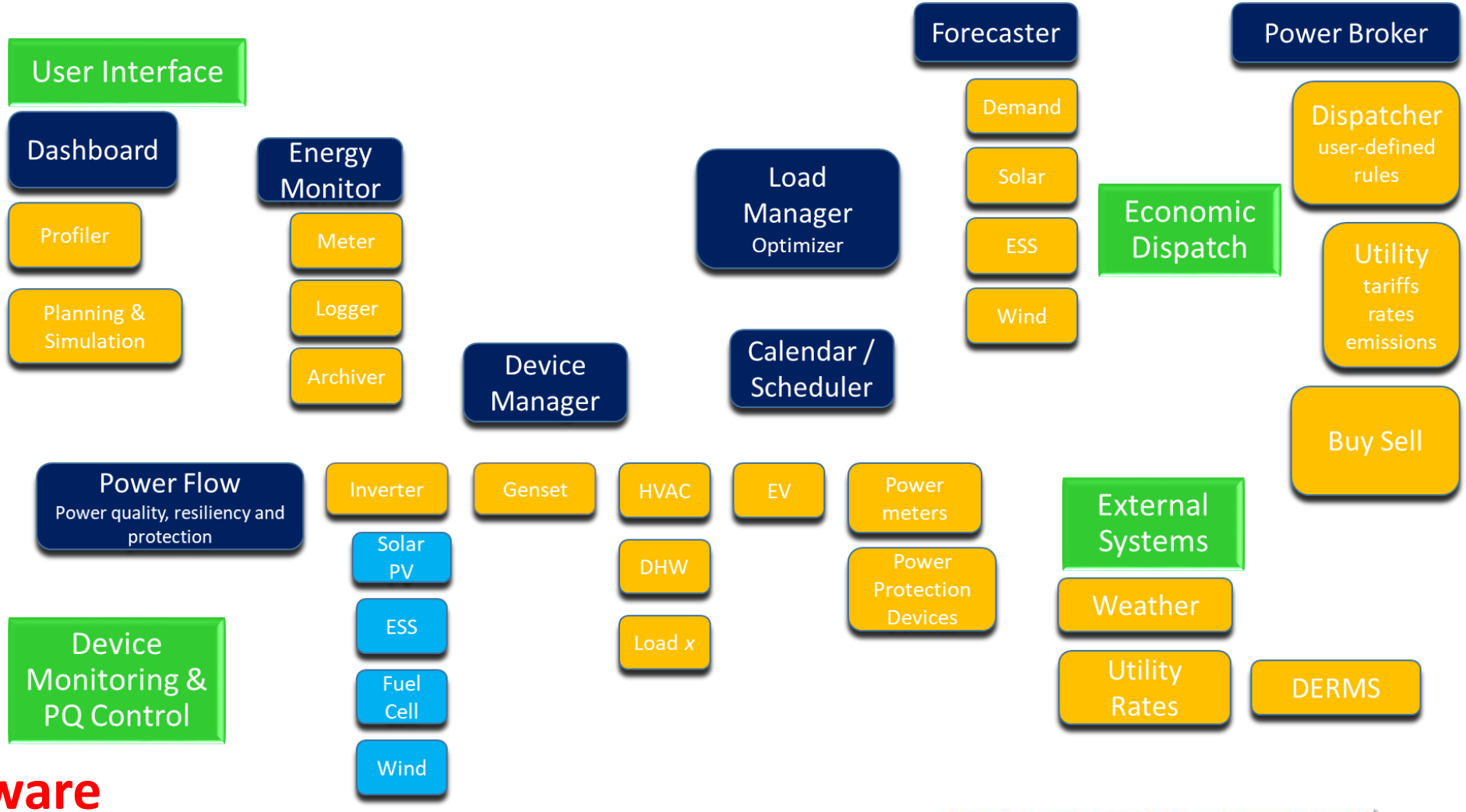
ASHRAE 201
Facility Smart Grid Information Model (FSGIM)



Facility anything from single or multi-family home, to commercial or institutional building, to industrial facility, campus or special-purpose district.

- Energy and controllable load monitoring
- On-site generation and energy storage management
- Generation and load aggregation
- Next-day and same day forecasts for load, load shed and on-site generation
- Automated Demand Response and Direct Load Control
- Support for SEP2 Group Management

INTEROPERABLE SERVICES

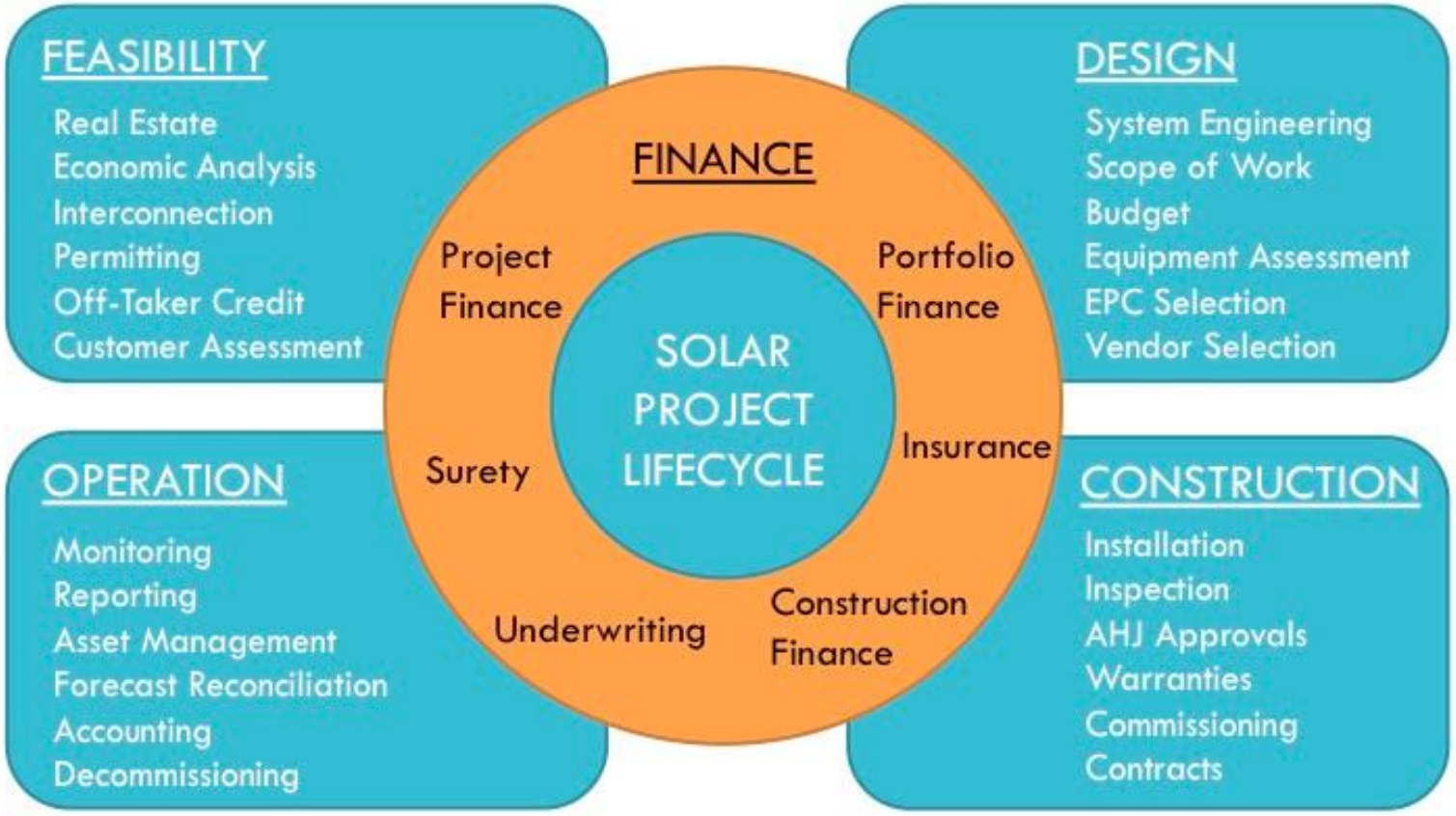


Decompose monolithic software solutions into micro-services at every scale.

INTEROPERABLE SERVICES

Modern Grid
not just power flow
and transactive
energy.

includes **product and services supply chain** throughout **entire lifecycle**.

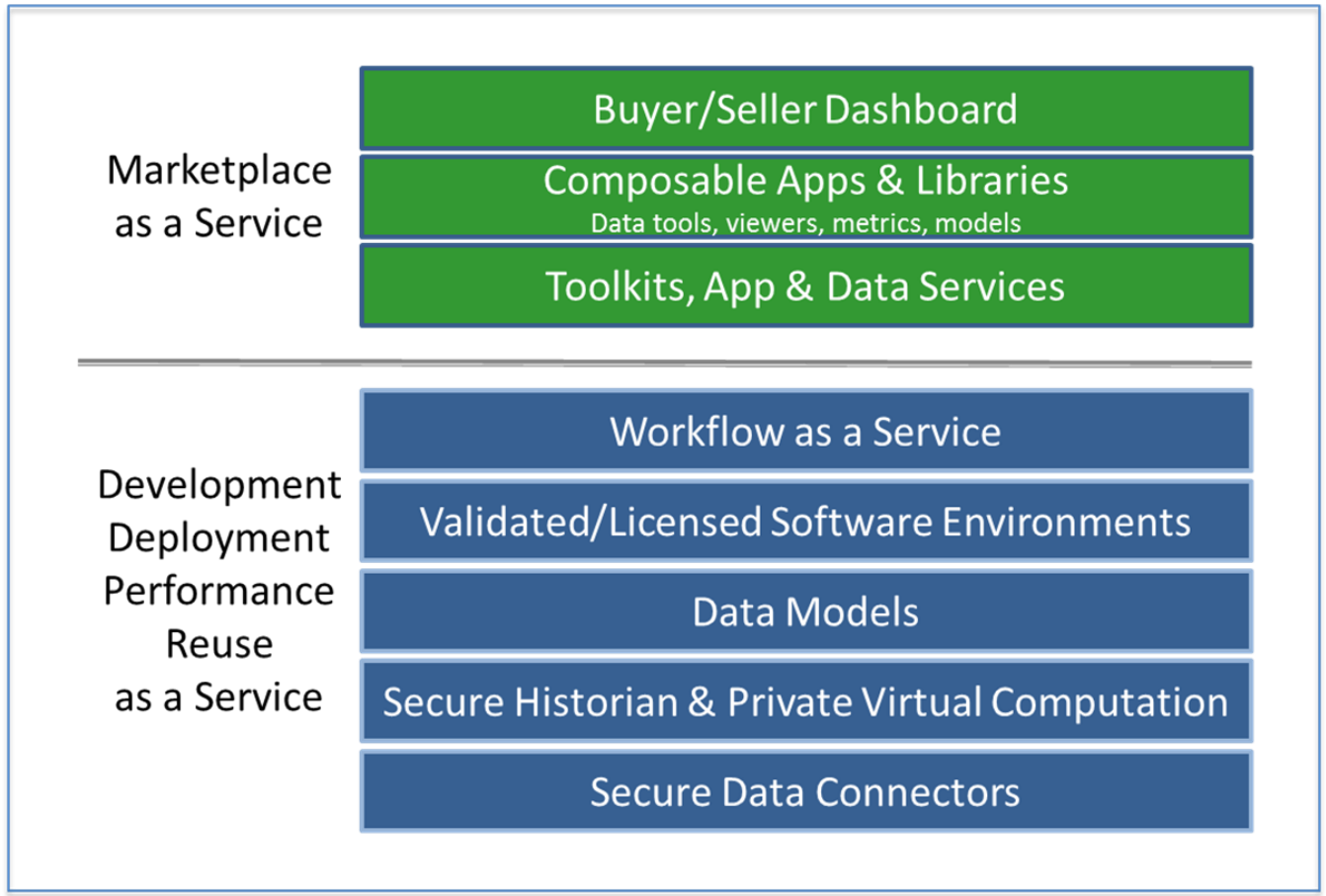


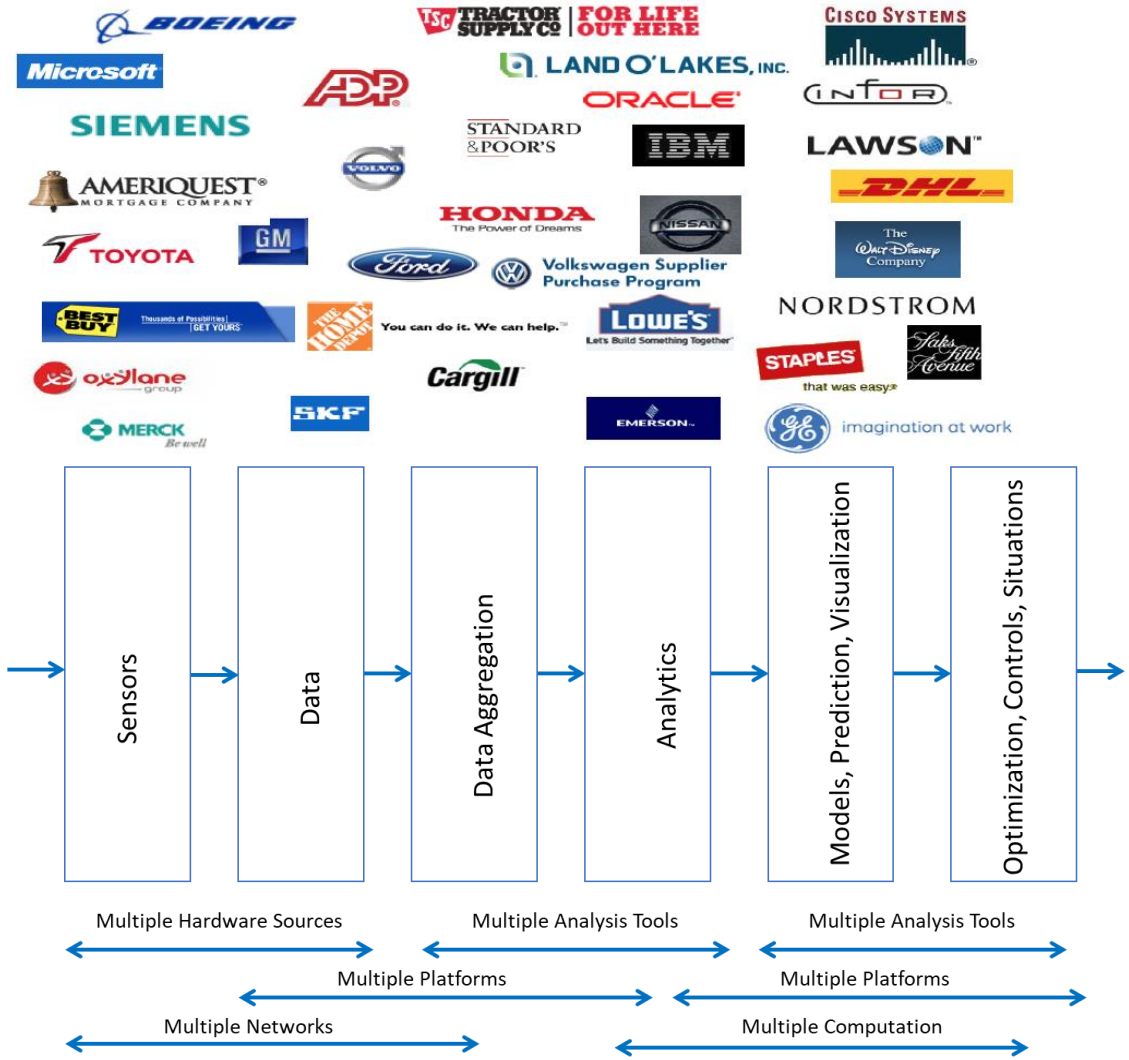
Interoperable Services

OAGi — Open Applications Group

Open Applications Group
Open Standards that Open Markets™

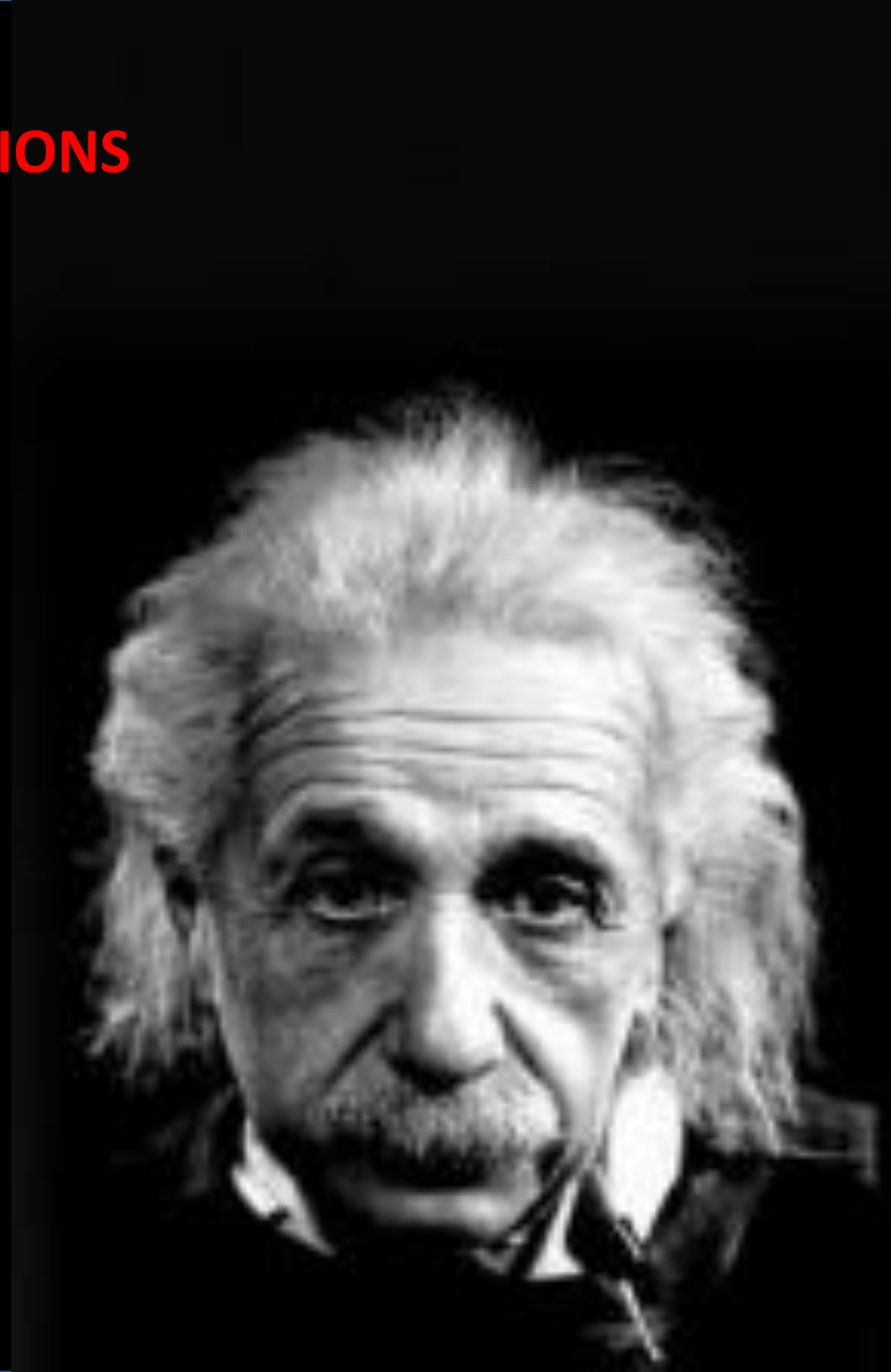
- **Well-established** ecosystem with proven scalabilty
- Specifications, reference implementations, **test suites and certification**.



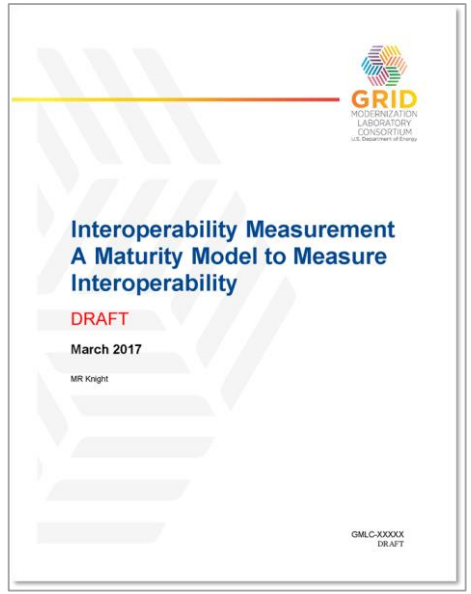


Tools, Roadmaps and Demonstrations

Everything
should be made
as simple as possible
but not simpler.



Tools and Roadmaps



Smart Devices/Modular Architectures

- OSGi has well-proven IoT tools for device registration, configuration, update, large-scale deployment, etc.
- OSGi clear and comprehensive specifications, reference implementations, test suites and certification.
- Eclipse Foundation has an open source OSGi Smart Home implementation.

Smart Facilities/Comprehensive DER Information Model

- ASHRAE 201 Smart Grid Facility Information Model provides clear and comprehensive information exchange standard.
- Consistent with CIM and DER/DR data models.
- Full suite of services – real-time monitoring, forecast and publish load shed, generation, and storage capacity at distinct time intervals, scheduled and ad hoc event management.

Interoperable Services/Open Standards and Tools for A2A, E2E, B2C

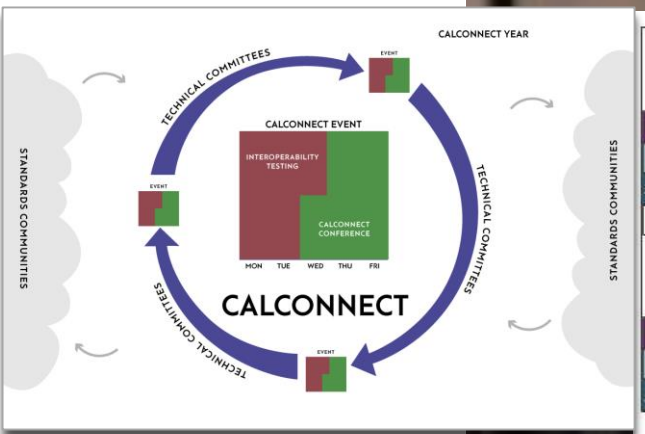
- OAGi has proven, well-developed, and testable methodologies to enable any-to-any, enterprise-to-enterprise, business-to-consumer interoperable services
- Used in chemical and oil & gas industry

DEMONSTRATION

Straw Man suggestion

Interoperable schedule across geospatial and temporal scales.

Exchange actual and forecast load schedules at each geospatial scale – facilities, Load Serving Entities, TSOs, and RTO/ISOs – at operational and planning time horizons.



	Hour Beginning (MWs)											
	12a	1a	2a	3a	4a	5a	6a	7a	8a	9a	10a	11a
	00	01	02	03	04	05	06	07	08	09	10	11
Day-Ahead Demand Forecast more info>>	22358	21311	20249	19632	19223	19131	19377	19513	19738	20132	20466	20705
Hour-Ahead Demand Forecast more info>>	22865	20931	20031	19430	19137	19246	19611	19321	19478	19999	20500	20935
Actual Demand	22254	20894	20056	19435	19225	19338	19689					

	Hour Beginning (MWs)											
	12p	1p	2p	3p	4p	5p	6p	7p	8p	9p	10p	11p
	12	13	14	15	16	17	18	19	20	21	22	23
Day-Ahead Demand Forecast	20999	21219	21551	22019	22628	23485	24555	25539	26488	27419	26442	24409
Hour-Ahead Demand Forecast	21349	21719	22141	22673	23497	24513	25094	25901	27047	28186	27087	25005
Actual Demand												