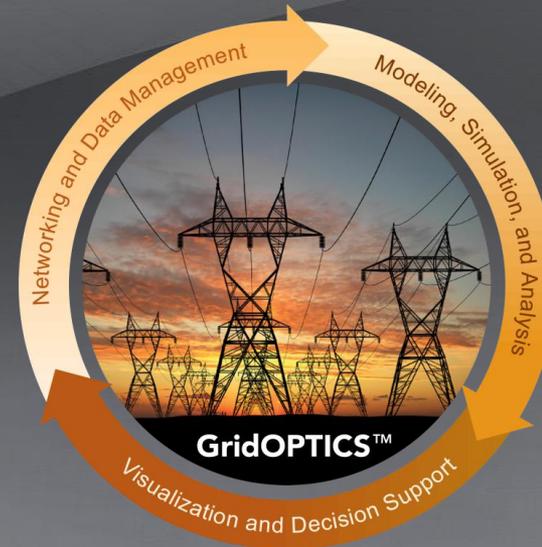




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Energy Day @PNNL
September 1, 2015



FPGI: A 5-Year Journey to Deliver GridOPTICS™, and the Journey Continues...

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*The legends **PROTECTED INFORMATION** and **PROPRIETARY INFORMATION** apply to information describing Subject Inventions as defined in Contract No. DE-AC05-76RL01830 and any other information which may be properly withheld from public disclosure thereunder.*

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We recognized the need for a holistic analytics approach 5 years ago...



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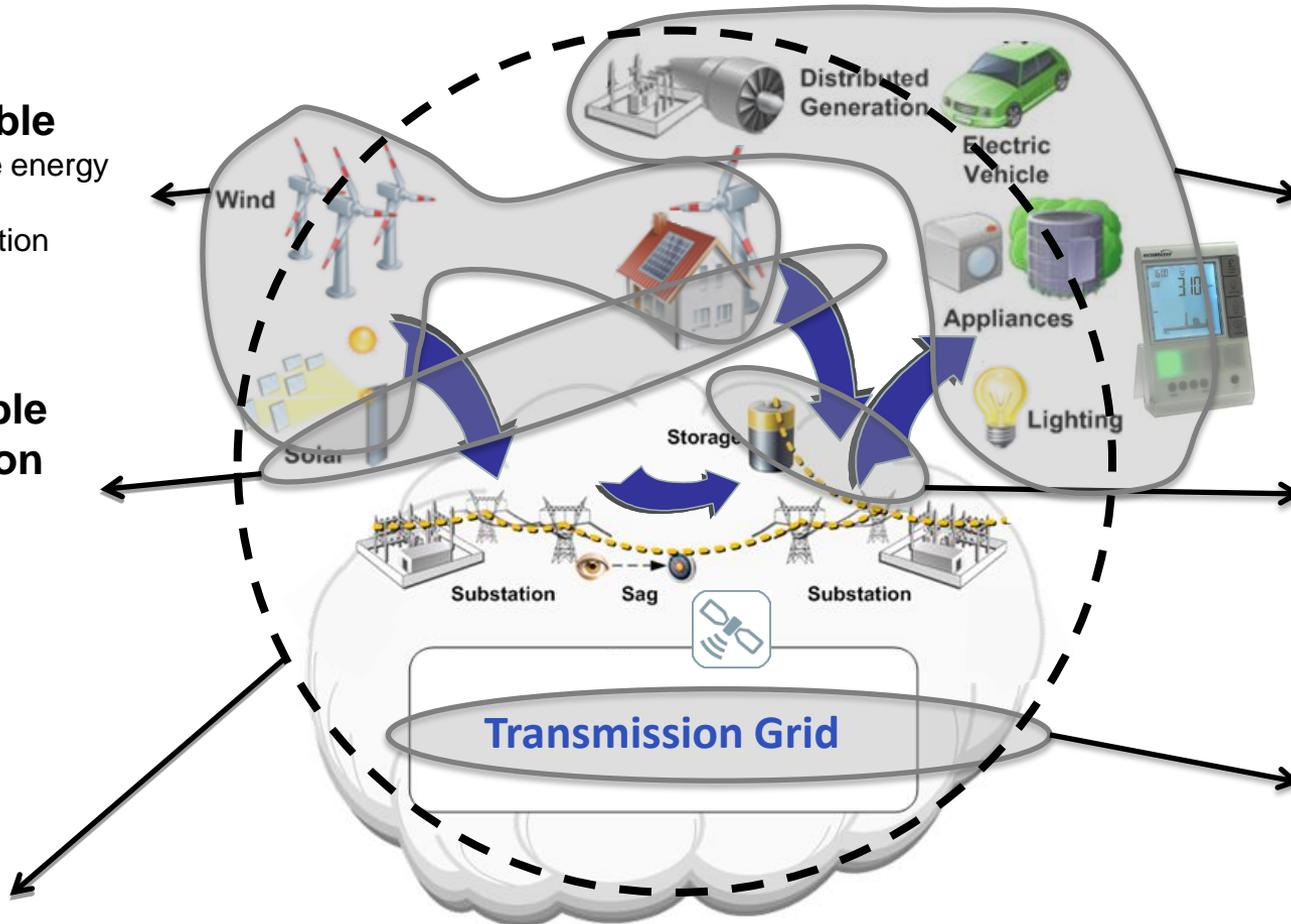
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Renewable

(Renewable energy technology, interconnection standards)

Renewable Integration

(Renewable Integration Modeling)



Smart Grid

(Deployment of smart devices, empowering customer involvement and innovation)

Storage and Storage Integration

(Deployment of cost-effective storage)

Transmission Reliability

(Advanced measurement and control technology, e.g., synchrophasors)

Future Power Grid Initiative (Holistic Approach)

With end-to-end grid in mind, address questions:

- What can we use the data for (what data network is required)?
- How will we address the complexity in order to understand the grid?
- How will we run such a complex grid?



Grid Integration
Grid Modernization
Big Ideas

Power grid fusions require new analytical capabilities

Drivers

Fusion #1:

power grid + data network

Bring big data to applications
Enable “all-hazard” analysis

Fusion #2:

operation + planning + market

Minimize overhead in communication
Improve responses w/RE & smart loads

Fusion #3:

transmission + distribution

Model end-to-end grid
Understand emerging behaviors

Requirements

Bigger Data

Bigger System

Bigger Model

Needs

Data

Computation

Visualization

FPGL aims to deliver GridOPTICS™

(Grid Operation and Planning Technology Integrated Capabilities Suite)



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What is it?

(GridOPTICS™ vision)

- ▶ A suite of methodologies and software modules designed to:
 - Accelerate the development and adoption of new **analytical tools** for the power grid facing new **complexity, stochasticity, and dynamics**, through **open-source software** and **interoperability**.

GridOPTICS™ supports 3 fusions:

- ▶ Manages interdependency between power **grid** and **data** network
- ▶ Bridges **operation** and **planning** to enable more seamless grid management and control
- ▶ Integrates **transmission** and **distribution** in end-to-end grid modeling and simulation capable of handling 10^9 devices with uncertainty

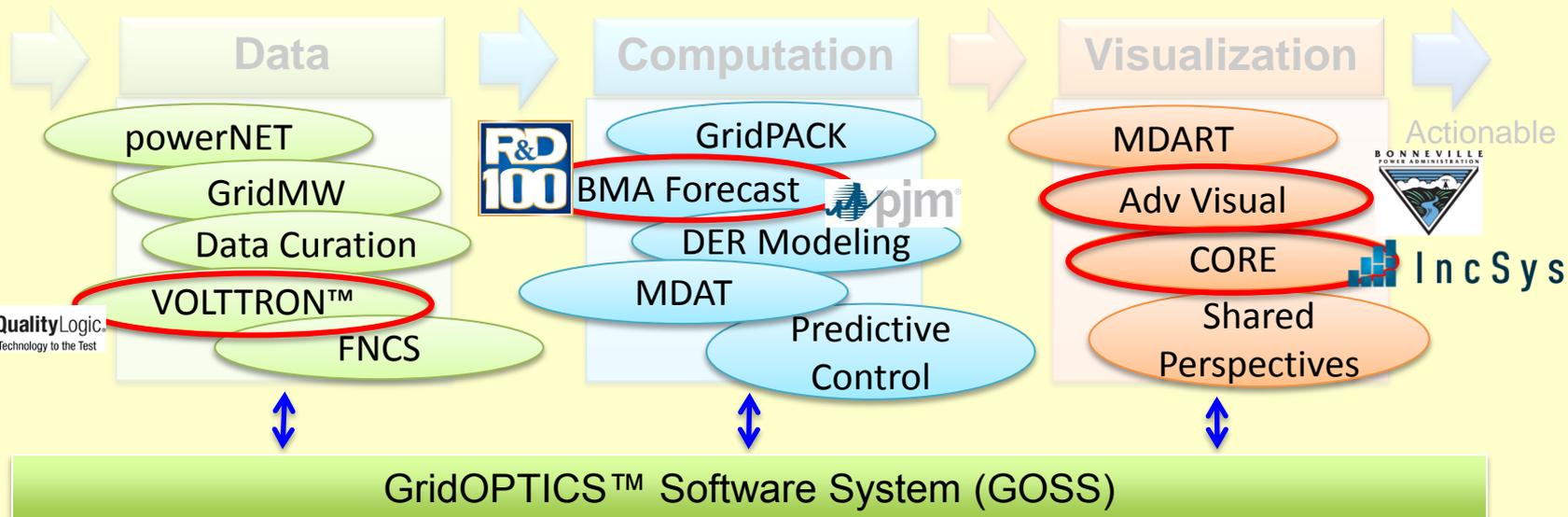
The current status of GridOPTICS™

A computing architecture for holistic grid analytics

- ▶ GridOPTICS™: provides essential building blocks, ready for transition.
- ▶ Compatible with high performance computing
- ▶ Enable software interoperability

Applications

GridOPTICSTM



Open source software packages as foundation of GridOPTICS™

GridPACK™



Software framework

–

Enables access to computers with more memory and processing power

–

Provides for simulation of models that contain vast networks and high levels of detail

VOLTTRON™



Distributed control and sensing software platform

–

Makes it possible to build applications to more efficiently manage energy use

FNCS

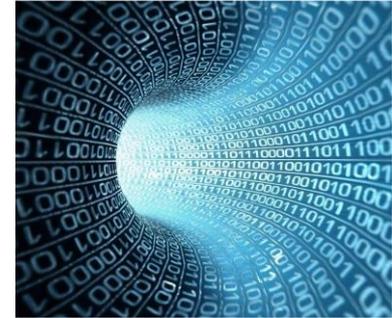


Framework for Network Simulation: a federated Co-simulation platform

–

Combines simulation of transmission, distribution, and communication to model and design smart grid tools & control

GOSS



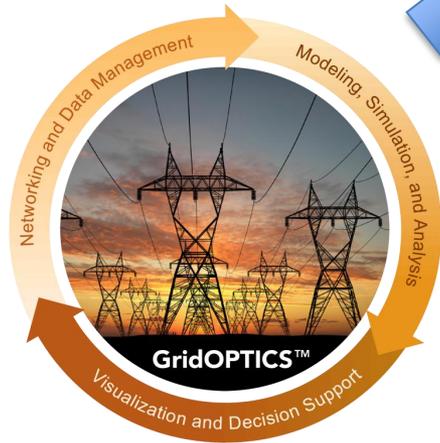
GridOPTICS™ Software System—a middleware framework

–

Integrates grid applications with multiple sources of data; enhances development of grid management applications

The journey continues to sustain the development of GridOPTICS™

Internal PNNL investments



Federal Agencies



Electricity Delivery & Energy Reliability



Energy Efficiency & Renewable Energy



Office of Science



Homeland Security



U.S. DEPARTMENT OF DEFENSE



Industry Stakeholders/Partners



GridOPTICS™ workshops bring together researchers, vendors, and practitioners

▶ Theme (progression)

- 1st workshop, 2012: Identify challenges
- 2nd workshop, 2013: Frame vision
- 3rd workshop, 2014: Develop use cases
- 4th workshop, 2015 (upcoming): Find solutions
 - Time: Wed-Thurs, Sept 2-3, 2015
 - Location: Richland, WA

▶ Expected Outcomes of the 4th workshop

- Form a consortium to sustain the community for power grid analytics including data, computing, and visualization.
- Disseminate latest development on data, computing, and visualization for power grid applications.
- Build an accepted, grid-specific computing architecture to accelerate the adoption of new analytical technologies by industry stakeholders.

Future Power Grid Initiative: deliver next-generation concepts and tools for transforming grid operation and planning

1

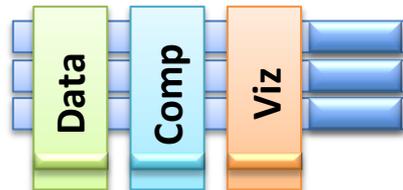
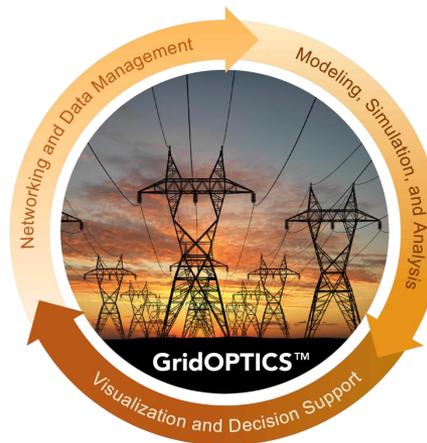
Networking and Data Management

2

Modeling, Simulation, and Analysis

3

Visualization and Decision Support

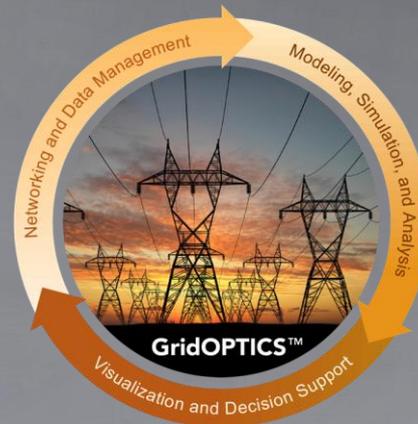


Journey continues...

- ▶ Alignment with National Agenda
 - Grid Modernization
- ▶ Support and transform industry practices
 - Reliability
 - Efficiency
 - Resiliency
 - Renewable



Questions/Comments?



<http://gridoptics.pnnl.gov/>