

Intelligrid Research Area 2010 Portfolio (PS161C)

3Q Advisors Call

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Intelligrid - Distribution (Program 161) *2010 Research Portfolio Structure*

Tech Transfer PS161A

**Infrastructure for Intelligent
Transmission PS161B**

**Infrastructure for Intelligent
Distribution PS161C**

**Infrastructure and Technology
for Advanced Metering,
Integrating Demand Response
and Energy Efficiency PS161D**

**Security Issues for the Power
System Communication,
Information, and Control
Infrastructure PS161E**

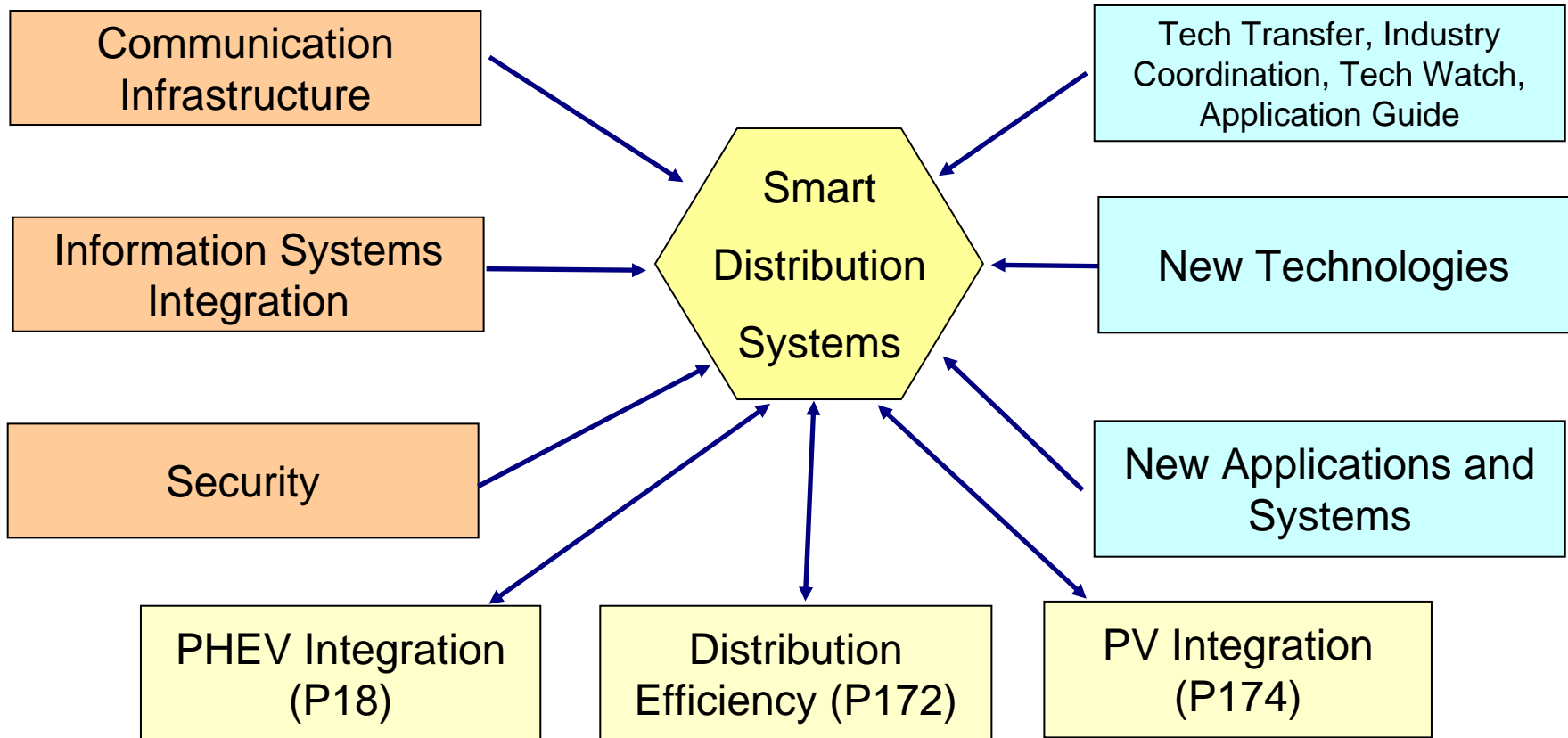
P161.004 – Communication Technologies
for Smart Distribution Applications

P161.005 – Enterprise Information
Sharing for Smart Distribution
Applications

Developing the Smart Distribution System

Infrastructure (P161)

Applications and Technology (P124)



Value

P161C.004 – Communication Technologies for Smart Distribution Applications

- What are we doing in 2010?
 - Documenting the present and near-future state of distribution communications
 - Applications: Distribution management, automation, PQ, voltage support, integration of DERs (i.e. small-scale PV, distributed storage), etc.
 - Physical media: copper, wireless, fiber
 - Protocols: vendor proprietary, DNP3, IEC 61850, IP suite
 - Integration: substation-feeder; AMI support for distribution applications
- Why is it valuable?
 - Provides guidance for making sound decisions at all stages (planning, design, testing, implementation, operation) of developing a functional, secure, efficient, and manageable communications network supporting Distribution applications.

P161C.004 – Communication Technologies for Smart Distribution Applications

Objective

- Publish a detailed, systematic analysis of issues affecting the integration, interoperability, and performance of communication networks for distribution applications.

Deliverable

- Technical Update

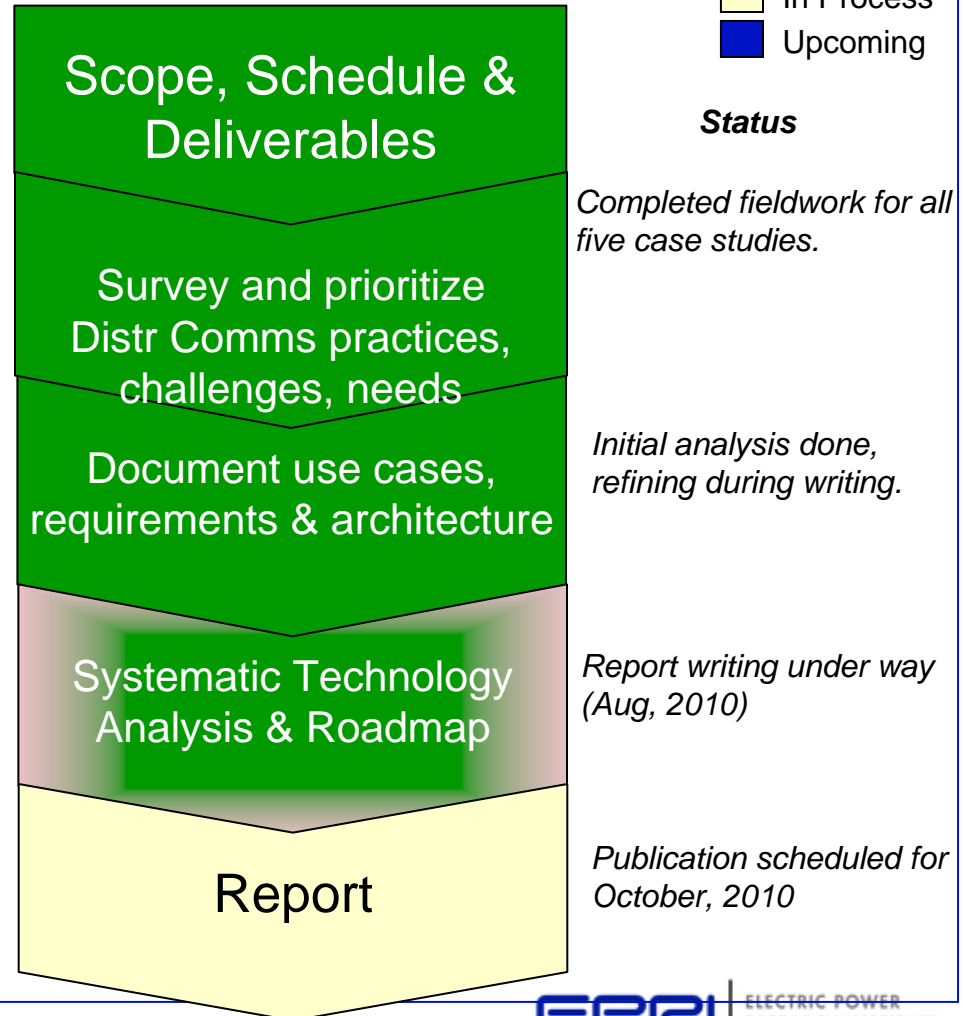
Completion Date

- Guidebook – October, 2010

The Big Picture

- Deliver industry-leading intelligence for planning, implementation and robust operation of Distribution communications networks.

Key Tasks and Milestones



Case Study – Field Work

- Finished
 - Alabama Power / Southern Company
 - Hawai’ian Electric Company (HECO, HELCO, MECO)
 - ESKOM (South Africa)
 - Électricité de France
 - Consolidated Edison

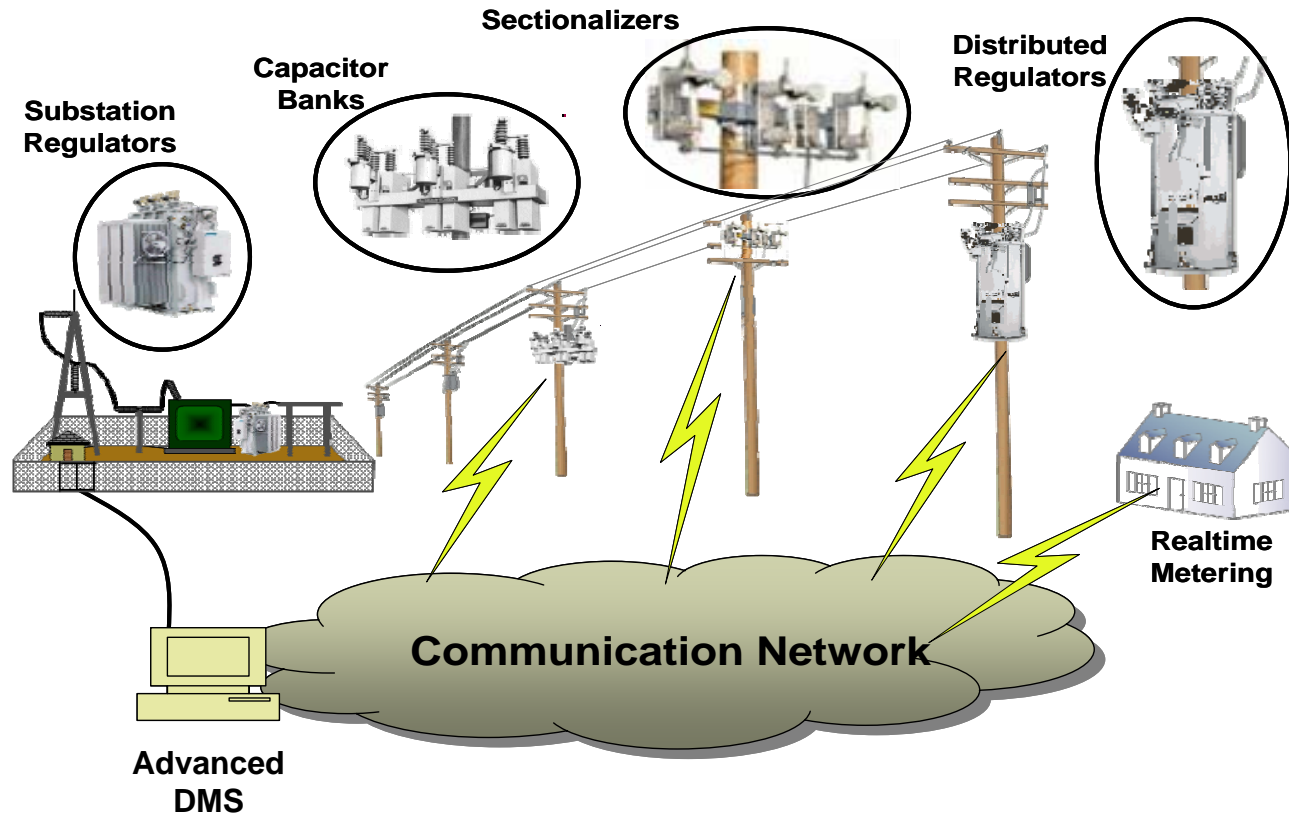
P161C.004 – Communication Technologies for Smart Distribution Applications - Guidebook

- Empirical study of exemplary systems
 - Interviews and site visits with 5 utilities
 - Cover substation and feeder-based applications
 - Document application logic, devices, data flows
 - Extract best practices, lessons learned, future needs
- Analytic study of distribution communications architecture
 - Aligns with main government-industry frameworks
 - OpenSG Communications framework and efforts
 - P161C-005 Distribution CIM program
 - NIST PAP2 (wireless), NIST PAP15 (PLC)
 - Architecture: domains, interfaces, interoperability
 - Map exemplary systems (above) to the model
 - Extend to Advanced Distribution Applications

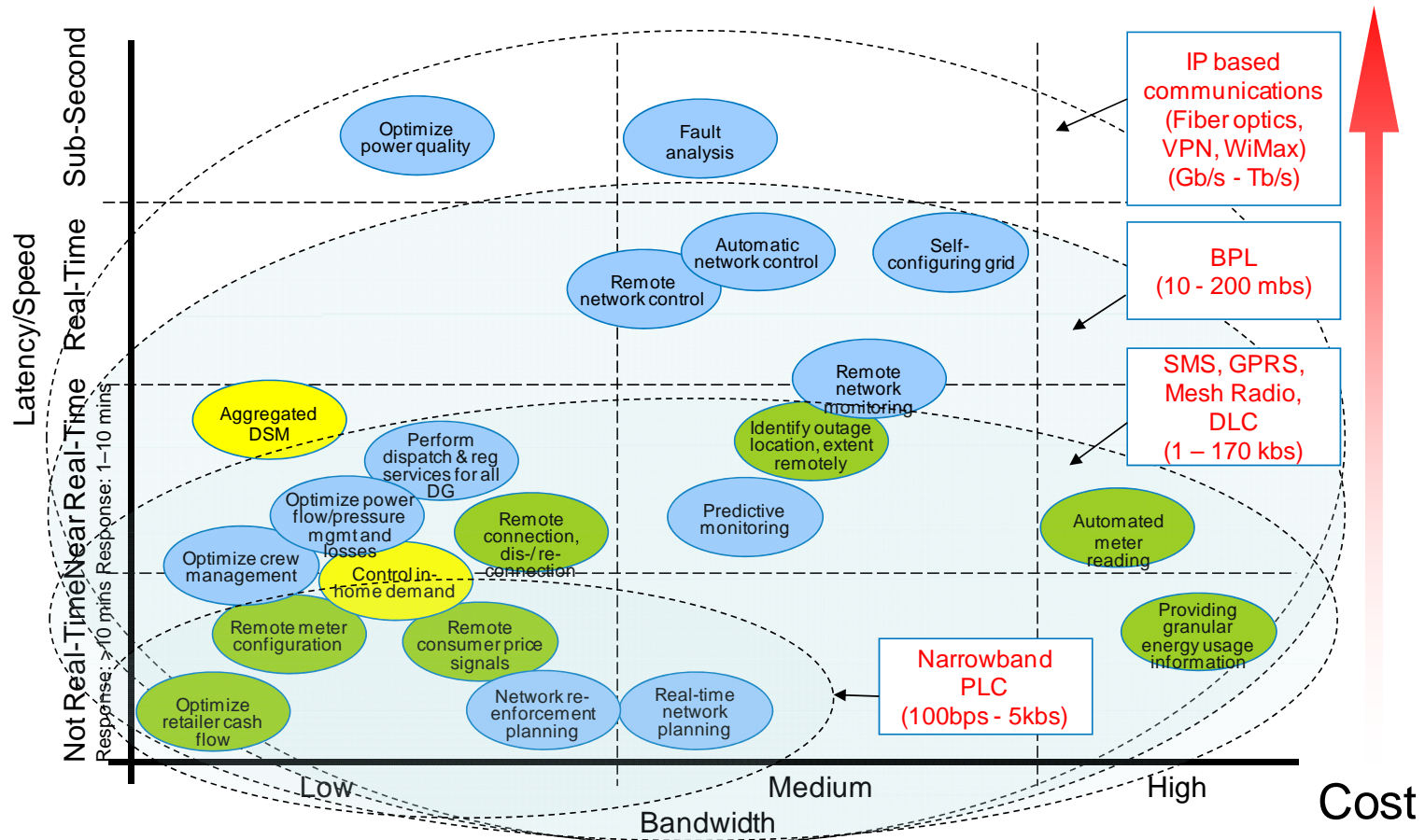
P161.004 – Communication Technologies for Smart Distribution Applications - Guidebook

- Document present state of affairs
 - Intra-substation communications and SCADA
 - Links with equipment along feeders
 - Wired (serial, Ethernet, PLC) and wireless (cellular, P2MP, mesh)
 - Use of DNP3, IEC 61850, and other protocols
- Explore distribution communication support from AMI systems
 - Initially, low-latency, non-critical information
 - i.e. device settings/status, DER demand/capacity
 - Distribution applications (sectionalizing, protection)
 - Examine latency, security, reliability, scalability
- Document use of public carrier systems in Distribution
 - Value: SCADA backhaul, area coverage, field operations support
 - Concerns: cost, reliability, technical scalability
 - Trend: “Second wave” AMI vendors partnering with carriers

P161.004 – Field/Distribution-Area Comms Baseline/Concept



P161.004 – Field/Distribution-Area Comms Analysis



Source: National Grid (with permission)

Co-simulation: Power & Communications Systems

- Create simulation-driven distribution comms modeling tool
 - Connect comms modeling with established Distribution tools (GridLAB-D, OpenDSS)
 - Add comms behavior to device characteristics
 - Model traffic, latency, etc. per distr control profile
 - Enable future scenarios, i.e. control high-penetration DER, granular Volt/VAr support, distribution PMUs
 - Build on NIST MATLAB model for wireless systems
- *Paper accepted: IEEE SG Comms Conference, Oct 2010*
 - Modeled a real distribution circuit using OpenDSS and NS-2
 - Simulated 1MVA PV array and 84 Community Energy Storage devices, 802.11-based control of voltage sag (clouds passing)
 - Co-authored with NIST networking laboratory engineers
 - Strong interest from academe, industry, utilities (OpenSG)

Advanced Communications Practice

- Proposed in 2Q10, to include a range of comms projects:
 - In-depth analysis of next-gen comms technologies
 - PLC: Homeplug GP/AV2, G.hn/G.hems, coexistence
 - *Setting up PLC testing lab for Electric Transportation group*
 - Wireless: IEEE 802.11 / WiFi for HAN and FAN, 3/4G cellular
 - *Finalized Wi-Fi Alliance Liaison Agreement*
 - *Chairing IEEE 802.16n “GRIDMAN” Task Group*
 - Research radio spectrum issues, policy, implications for utilities
 - *PS161A White Paper (September, 2010)*
 - Establish next-generation FAN reliability and resilience req'ts
 - Research wireless carrier Machine-to-Machine (M2M) plans

Value

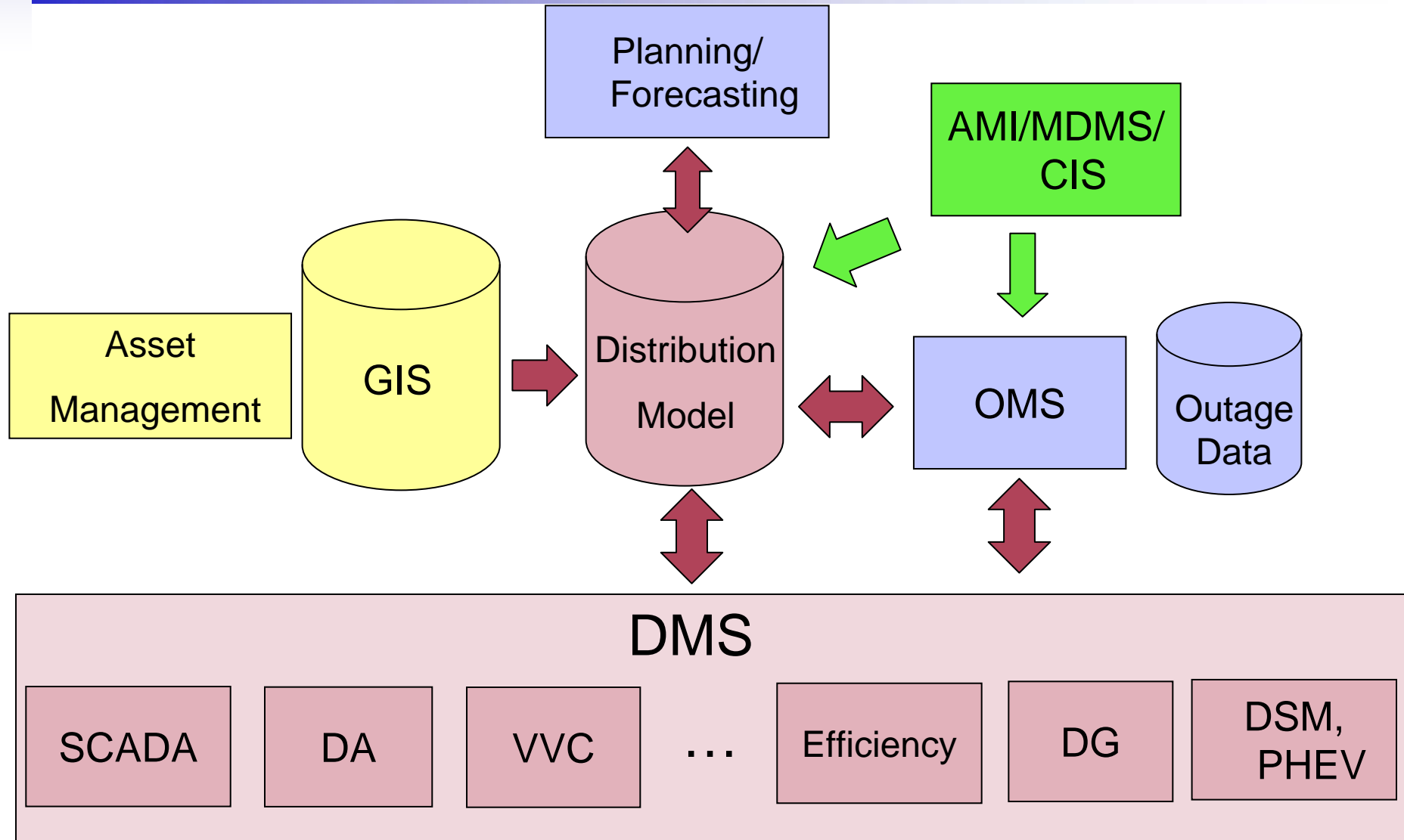
P161.005 – Enterprise Information Sharing for Smart Distribution Applications

- What are we doing in 2010?
 - Publishing a guidebook to Enterprise Service Bus (ESB) suites.
 - Compare and contrast ESB suites.
 - Provide high level implementation best practices.

Why is it valuable?

- Distribution system operators and information technology managers can use the knowledge produced in this project as guidance in procuring, installing, and maintaining an ESB suite appropriate for their utility's goals and objectives for system integration for distribution operations.

Active Distribution Management



P161.005 – Enterprise Information Sharing for Smart Distribution Applications

Objective

- Publish an Enterprise Service Bus (ESB) guidebook.

Deliverable

- Technical Update

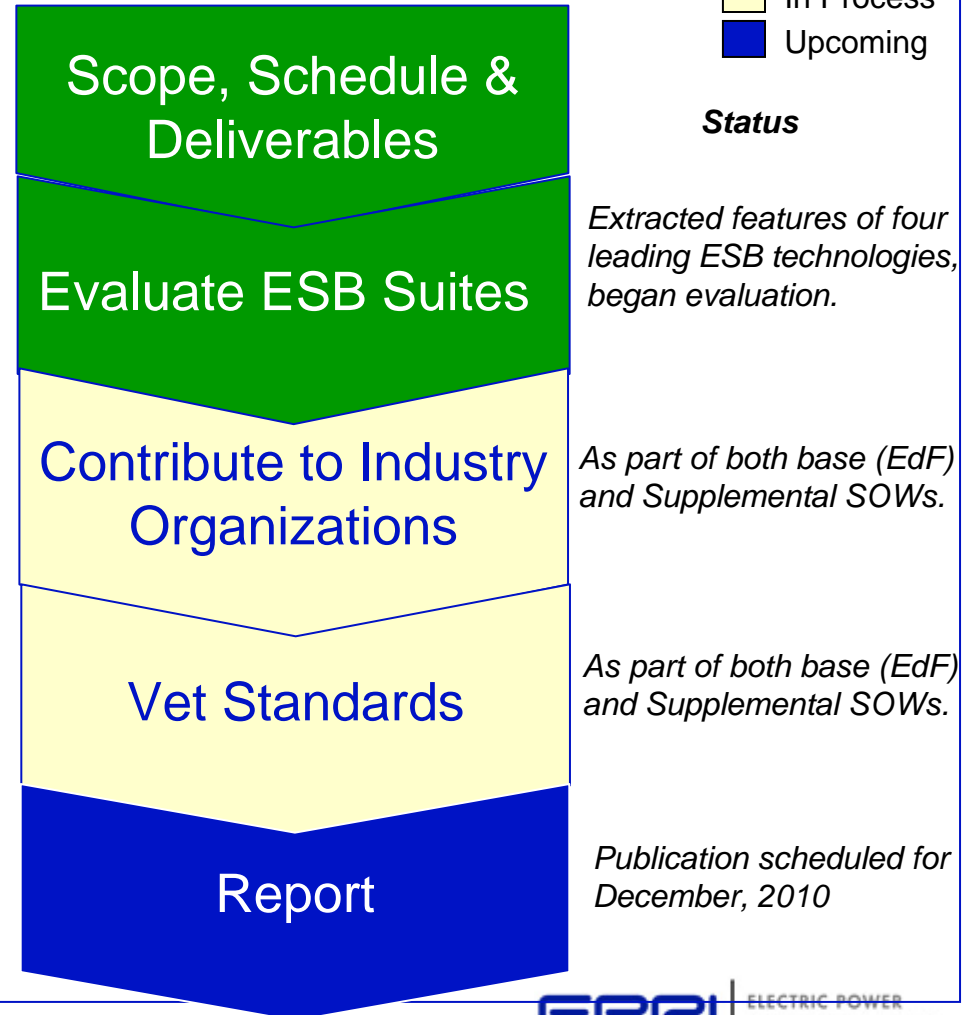
Completion Date

- Report – December 2010

The Big Picture

- Enterprise Service Bus (ESB) suites are software products that provide the capability to share data between applications within the enterprise.

Key Tasks and Milestones



Enterprise Service Bus - Functions

Category	Functions
Invocation	support for synchronous and asynchronous transport protocols, service mapping (locating and binding)
Routing	addressability, static/deterministic routing, content-based routing, rules-based routing, policy-based routing
Mediation	adapters, protocol transformation, service mapping
Messaging	message-processing, message transformation and message enhancement
Process choreography	implementation of complex business processes
Service orchestration	coordination of multiple implementation services exposed as a single, aggregate service
Complex event processing	event-interpretation, correlation, pattern-matching
Other quality of service	security (encryption and signing), reliable delivery, transaction management
Management	monitoring, audit, logging, metering, admin console, BAM

Enterprise Service Bus - Advantages

- Faster and cheaper accommodation of existing systems.
- Increased flexibility; easier to change as requirements change.
- Standards-based
- Scales from point-solutions to enterprise-wide deployment (distributed bus).
- Predefined ready-for-use service types.
- More configuration rather than integration coding.
- No central rules-engine, no central broker.
- Incremental patching with zero down-time; enterprise becomes "refactorable".

Enterprise Service Bus – P161.005 Deliverables

- Technical Report (Guidebook)
 - Overview, benefits, and cautions for Enterprise Service Bus (ESB) suites.
 - Application and system integration best practices.
 - The judicious use of the Common Information Model (CIM) for information exchange.
 - “Footprint” of leading ESB vendor offerings in comparison to open source products.

Enterprise Service Bus – P161.005

- What companies will we be comparing?
 - IBM WebSphere
 - Microsoft BizTalk
 - Oracle BEA Systems AquaLogic Service Bus
 - Oracle Fusion (including WebLogic)
 - Progress Software SonicESB
 - Progress Software SonicMQ
 - Red Hat JBoss
 - SAP
 - Tibco
 - webMethods (Software AG)
 - Open Source (2 or 3 of the leaders)
- Extend/expand IEC 61968 – 1 – 1 (Enterprise Service Bus Implementation Profile)
- Supports NIST PAP 7, 8 and 14.

Distribution Interoperability Testing – P161.005

Deliverables

- Status report on CIM covering
 - IOP tests conducted this year.
 - Status and scope of pending IOP tests.
 - Status of NIST TCC efforts.
- “Gap” analysis of CIM from a strategic perspective
- CIM strategic plan
 - EPRI support plan moving forward.
 - Research opportunities and other EPRI programs that directly or indirectly support CIM development.



161C - Supplemental Projects

Supplemental – CIM Development

- Perform end to end interoperability tests for several parts of OpenSG.
- Recommend best practices to:
 - Standard-Setting Organizations (SSO's)
 - Testing Organizations (TO's)
 - Certification Organizations (CO's)
- Work with the SGTCC, OpenSG Conformity and CIMug Testing groups.
- Develop EPRI Interoperability Lab
- Strong interest from four IOUs, three more prospects
 - SOW enables TC funding
 - Coordinating with MultiSpeak and IEC efforts

Supplemental – CIM Development

- Assist the industry in developing standard procedures for interoperability and conformity testing.
 - Establish a permanent EPRI interoperability testing lab in Knoxville.
 - Relieve bottlenecks in testing.
 - Provide flexible testing platform for facilitating virtual testing environments.
 - Extend the capability of the Relay Lab.
 - Provide a certification authority with agreed upon, standard testing methodology
 - Open up the testing process to other vendors.
 - Increase the throughput of the interop efforts.
 - Increase the credibility of the interoperability testing.

EPRI CIM Interop Project: Desired Outcomes

- Establish interoperability, conformance and laboratory certification test standards
- Establish a permanent test facility at EPRI, Knoxville
 - Solidify the confidence and credibility in the testing process
 - Reduce the cost of interoperability testing
 - Increase the number of interoperability tests that can be performed
 - Interoperability Testing, Conformity Testing, Protocol Testing, etc.
- Test pilot using the OpenSG and MultiSpeak® harmonization and interoperability projects

EPRI CIM Interop Project: Conformance Testing Pilot

- Test pilot will demonstrate the concept
 - Established processes and environment for multi vendor collaboration
 - Uses Virtualized Environments
 - Working AMI landscape integrated with multiple participants
Services deployed as listeners based on OpenSG services
 - Client applications deployed as callers based on OpenSG services
 - Transportation independent (ESB, Web Services, JSB, etc.)
 - Loose-coupling
 - Payload creation and extensions require interoperability testing
 - Application and device vendor independent.

Supplemental – CIM/MultiSpeak® Harmonization

- Harmonize CIM Part 13 (Distribution Model Exchange) and CIM Part 9 (Meter Reading and Control) and MultiSpeak®.
 - Develop a mapping document.
 - Perform an interoperability test.
- Develop a translator between CIM Part 9 and 13 and MultiSpeak®.
- Develop a guide for the implementation and use of MultiSpeak® in an ESB environment.

Supplemental – CIM/MultiSpeak® Harmonization

- UCA sponsored interoperability test in Europe in early 2011.
- EPRI is participating as a vendor using OpenDSS.
- Use the results of the mapping and the translator developed in this supplemental to participate in the interoperability test.

Together...Shaping the Future of Electricity