

EPRI

ELECTRIC POWER
RESEARCH INSTITUTE

Intelligrid Research Area 2010 Portfolio (PS161C)

2Q 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**

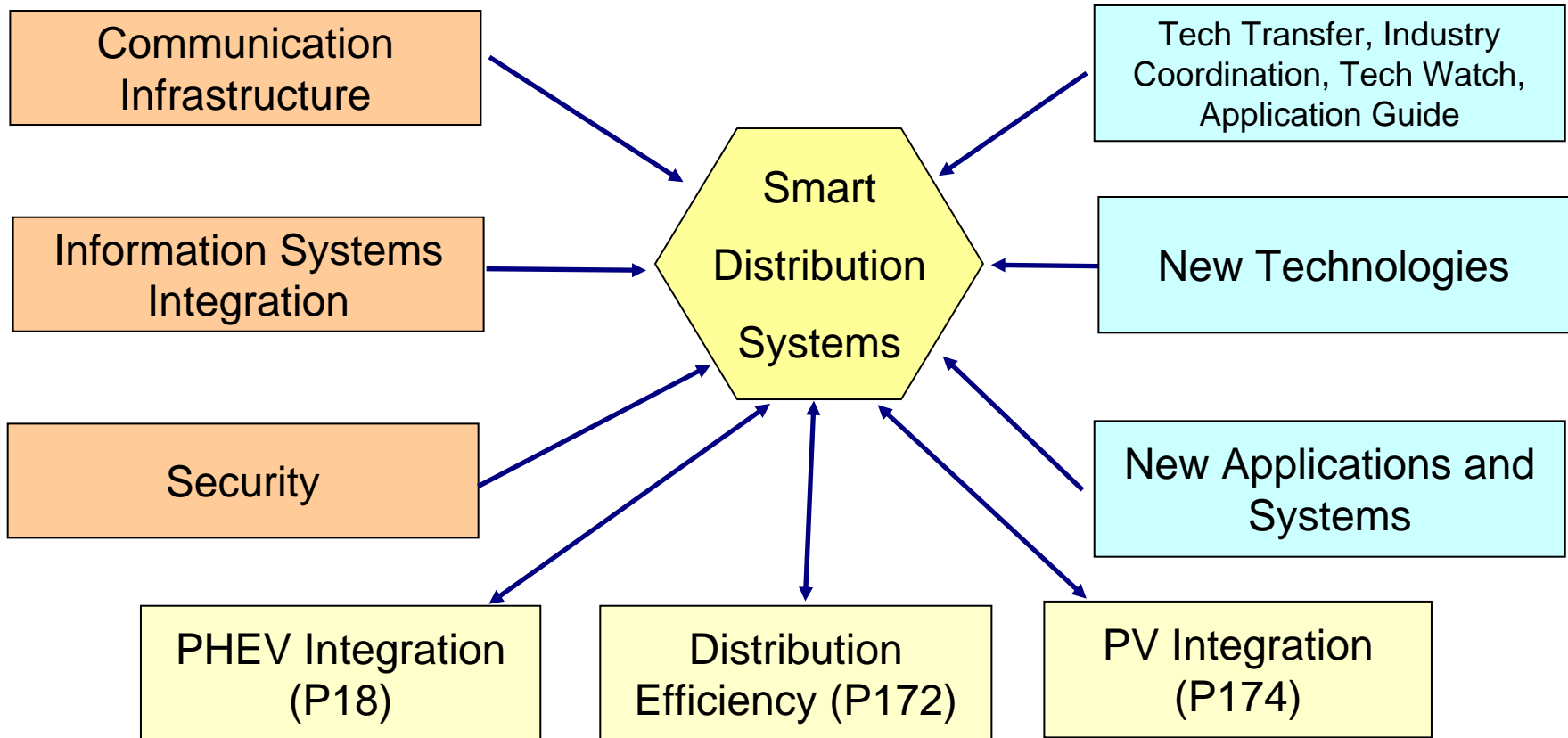
P161.004 – Communication Technologies
for Smart Distribution Applications

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 protection, automation, management, PQ/voltage support, integration of DERs (i.e. small-scale PV, distributed storage), etc.
 - Physical media: TP, 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

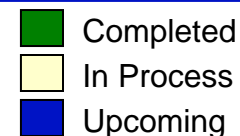
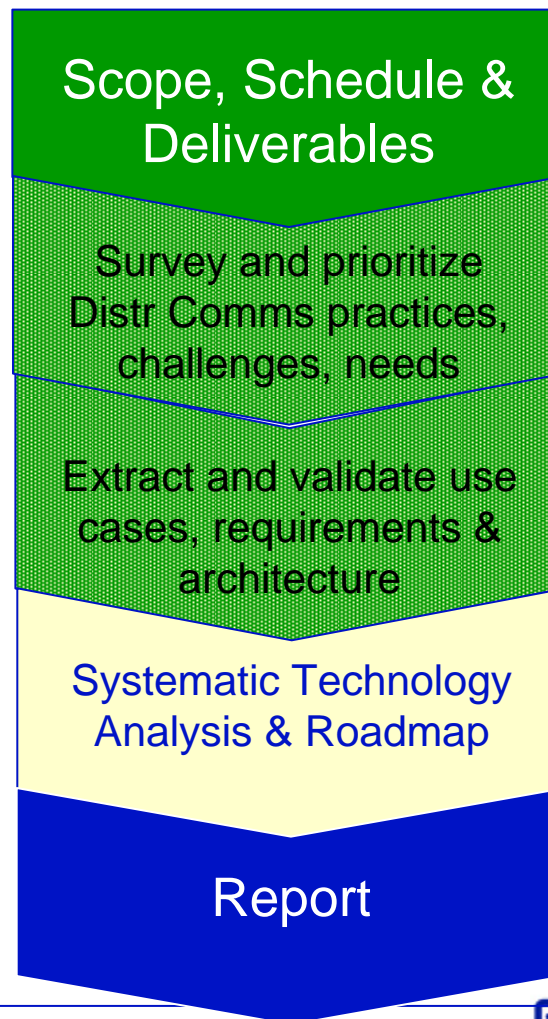
Completion Date

- Guidebook – mid-2010

The Big Picture

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

Key Tasks and Milestones



Status

Completed fieldwork for two (of five) case studies; other three are scheduled for May-June, 2010

Done for first study, second in progress.

Analysis and report writing scheduled for July, 2010

Publication scheduled for mid-August, 2010

Case Study – Field Work

- Finished
 - Alabama Power / Southern Company
 - Hawai'i Electric Company (incl. HELCO and MECO)
- Up Next (May/June)
 - ESKOM (South Africa)
 - Electricite de France
- In discussion
 - Mid-western IOUs
 - SDG&E
 - LIPA

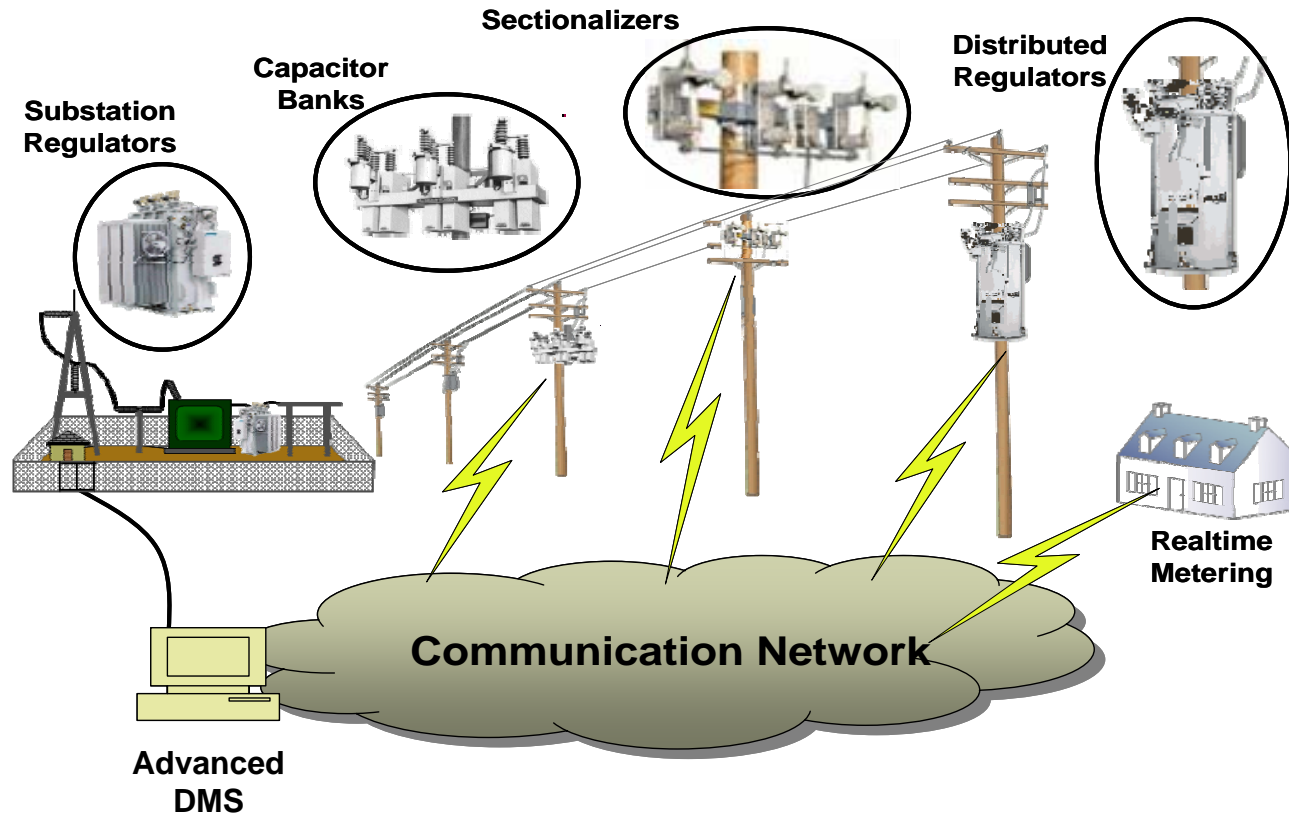
P161C.004 – Communication Technologies for Smart Distribution Applications - Guidebook

- Empirical study of exemplary systems
 - Interviews and site visits with 4-6 utilities
 - Cover substation and feeder-based applications
 - Document application logic, devices, data flows
 - Extract best practices, lessons learned, future needs
- Analytic study of distribution comms architecture
 - Aligns with main government-industry frameworks
 - OpenSG Comms framework and efforts
 - P161C-005 Distribution CIM program
 - NIST PAP2 (wireless), NIST PAP15 (PLC)
 - Architecture: comms domains, interfaces, interop req'ts
 - Map exemplary systems (above) to the model
 - Extend to Advanced Distribution applications

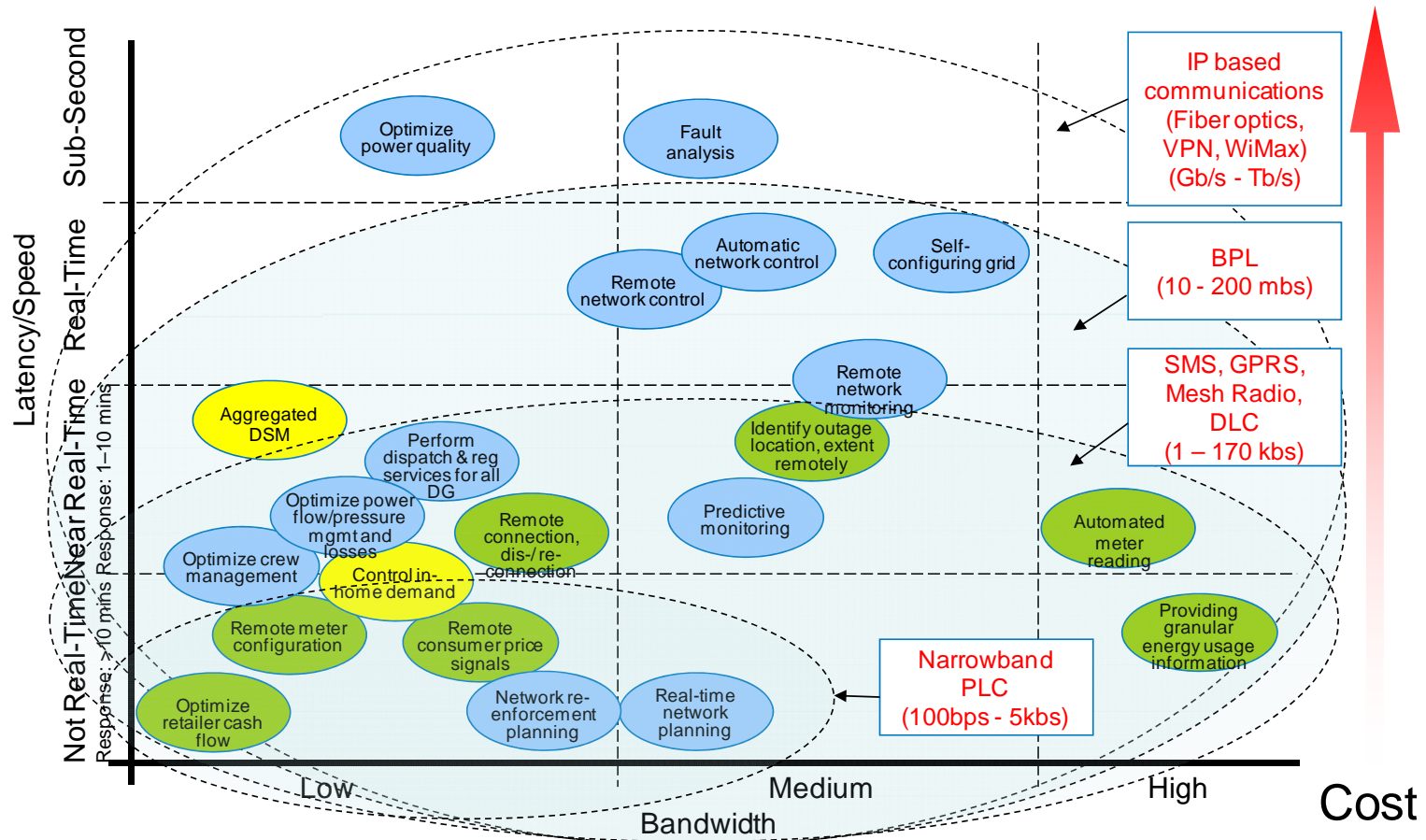
P161.004 – Communication Technologies for Smart Distribution Applications - Guidebook

- Document present state of affairs
 - Intra-substation comms 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 comms 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)

Value

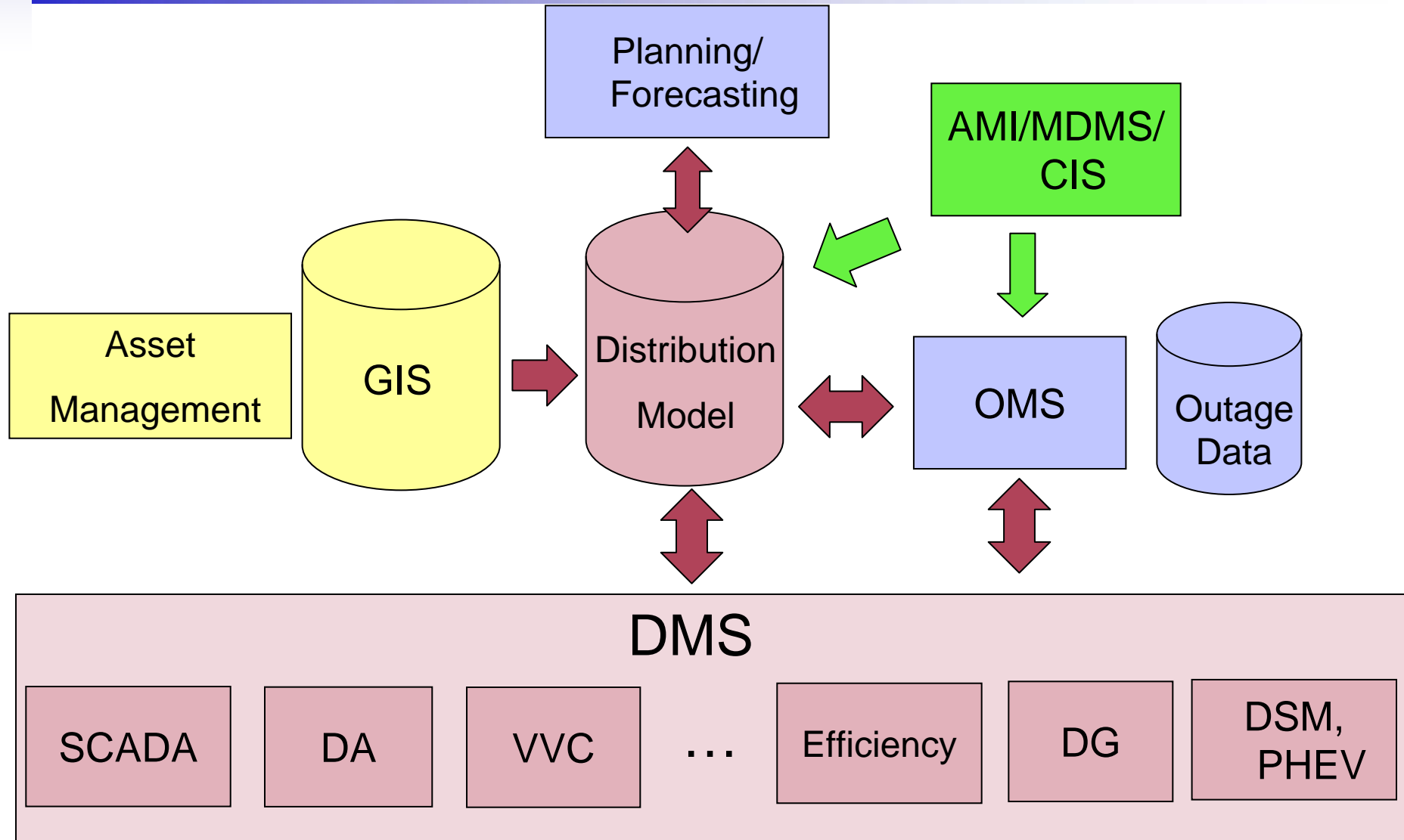
P161.005 – Enterprise Information Sharing for Smart Distribution Applications

- 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

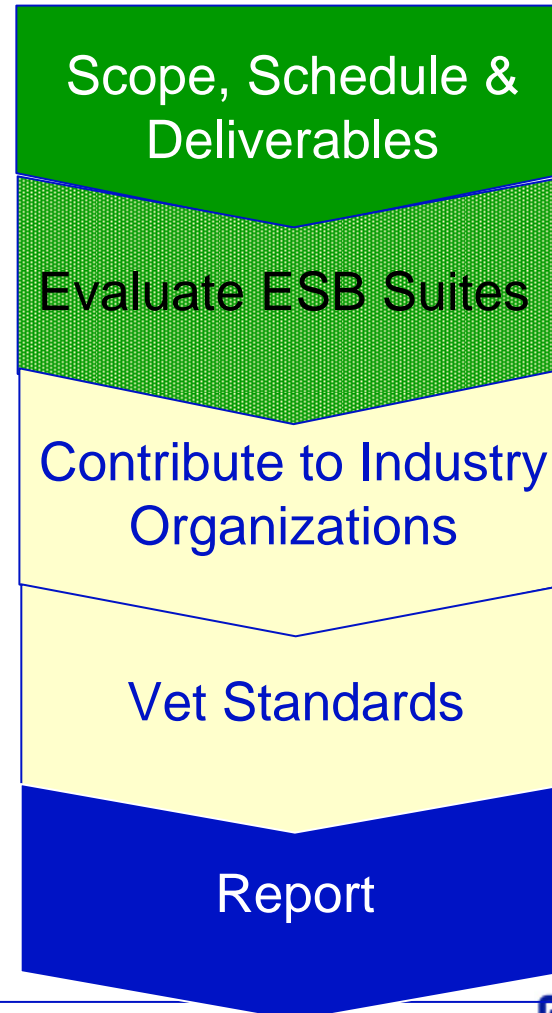
The Big Picture

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

Key Tasks and Milestones



Status



Extracted features of four leading ESB technologies, began evaluation.

As part of both base (EdF) and Supplemental SOWs.

As part of both base (EdF) and Supplemental SOWs.

Publication scheduled for December, 2010

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 Application Integration (EAI) suites.
 - Application and system integration best practices.
 - The judicious use of the Common Information Model (CIM) for information exchange.

Enterprise Service Bus – P161.005

- What companies will we be comparing?
 - Tibco
 - WebSphere
 - webMethods
 - Oracle (WebLogic)
 - Others?
- Extend/expand IEC 61968 – 1 – 1 (Enterprise Service Bus Implementation Profile)
- Supports NIST PAP 8



161C - Supplemental Projects

Supplemental – Distribution Communication Technologies

- 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
- Submitted paper to IEEE SG Comms Conference
 - Co-authored with NIST networking lab engineers

Supplemental – Distribution Communication Technologies

- Launch Advanced Distribution Communications practice
 - In-depth analysis of next-gen comms technologies
 - PLC: Homeplug GP/AV2, G.hn/G.hems, coexistence
 - Wireless: IEEE 802.11/WiFi for FAN, 3/4G cellular
 - Research wireless carrier plans to support wide scale Machine-to-Machine (M2M)
 - Research radio spectrum issues, policy developments, implications for utilities
 - Establish a roadmap for Distribution Communications technologies

Supplemental – Enterprise Integration

- Develop EPRI Interoperability Lab
 - OpenSG – CIM Harmonization and Interoperability
 - Multispeak Harmonization and interoperability
 - CIM Part 9, 2nd Edition Interoperability Test
 - CIM Part 4-13 2nd Edition Interoperability Test
 - CIM Part 3, 1st Edition Interoperability Test
 - CIM Part 6, Maintenance and Construction Interoperability Test
- Strong interest from four IOUs, three more prospects
 - SOW enables TC funding
 - Co-ordinated with Multispeak and IEC efforts

Supplemental – Enterprise Integration

- 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: Context

- Challenges of Inter-Operability (IOP) Testing
 - IEC relies on user organization to oversee conformity testing
 - Delays in testing are slowing down progress in NIST PAP's
 - Need interoperability testing that:
 - Is credible
 - Covers all applicable aspects of conformity
 - Is cost effective
 - Is timely and responsive to user needs
- OpenSG has established Conformity Working Group
- NIST has established the Smart Grid Testing and Certification Committee

EPRI CIM Interop Project: Desired Outcomes

- Establish interoperability test standards
- Establish a path for organizations to become interoperability testing providers
- 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: Establish Interoperability Test Standards

- EPRI to work with Open SG Conformity Working Group and NIST SGTCC to develop a standard testing methodology
 - Develop first draft policies, procedures, goals, certification criteria
 - Pilot process and apply lessons learned
 - Establish certification oversight
 - Facilitate establishment of certification organizations
- This testing methodology would be applied in a consistent manner for all interoperability projects regardless of who does them.

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.

EPRI CIM Interop Project: Critical Mass for Pilot Run

- Potential utility partners:
 - Consumers Energy
 - SCE
 - PG&E
 - AEP
- Vendors
 - Oracle
 - Tibco
- Consulting organization
 - SISCO
 - UISOL
 - Kema
 - CIMple Integrations
 - Deloitte
 - Xtensible Solutions

Together...Shaping the Future of Electricity