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Field Area Network Demo

Smart Grid Informational Webcast
November 25, 2013

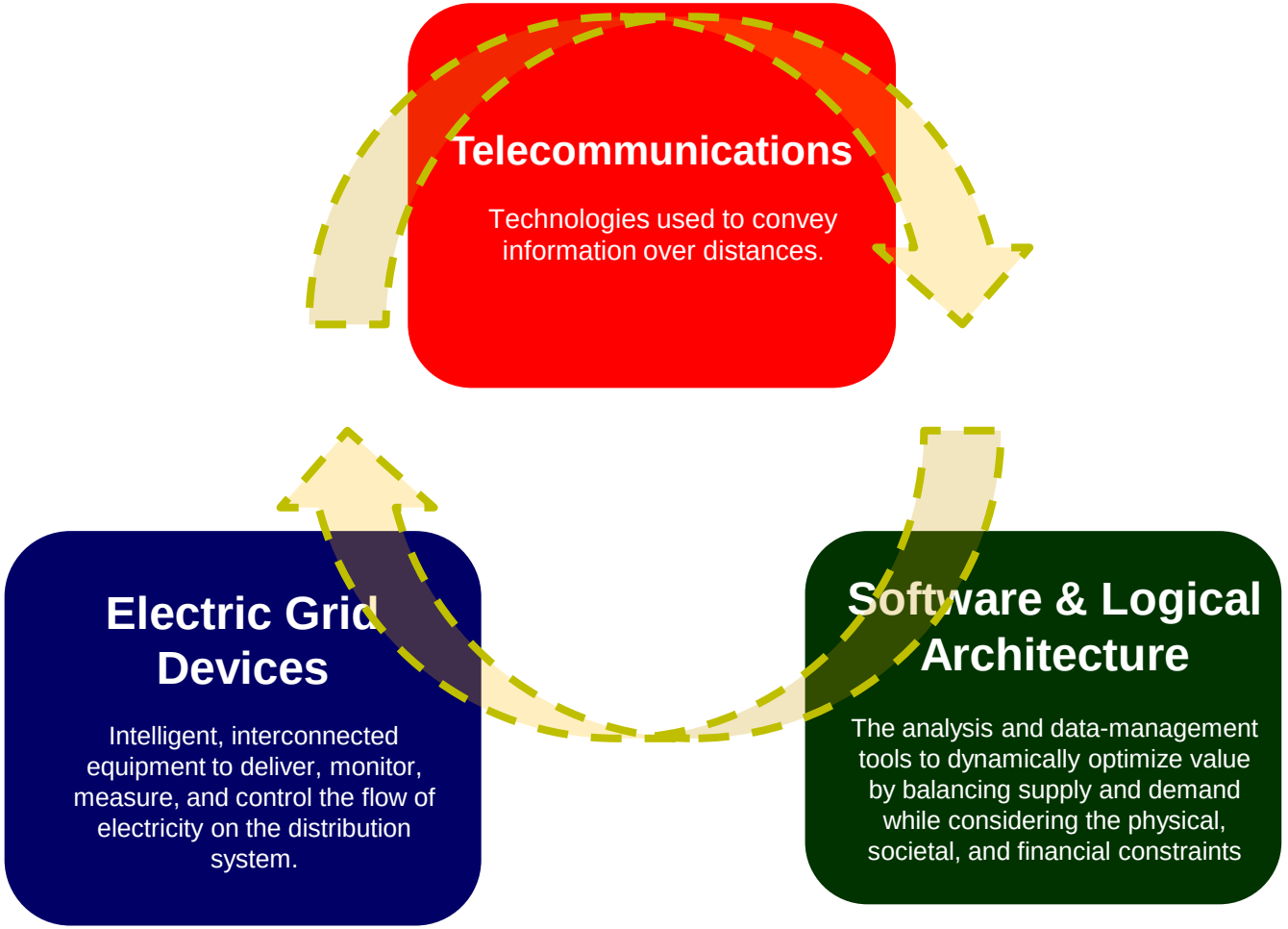
Tim Godfrey
Senior Project Manager
Smart Grid Communications

Agenda

- Introduction to the Field Area Network
- Value Proposition
- Project Update
- Project organization and plans

Introduction

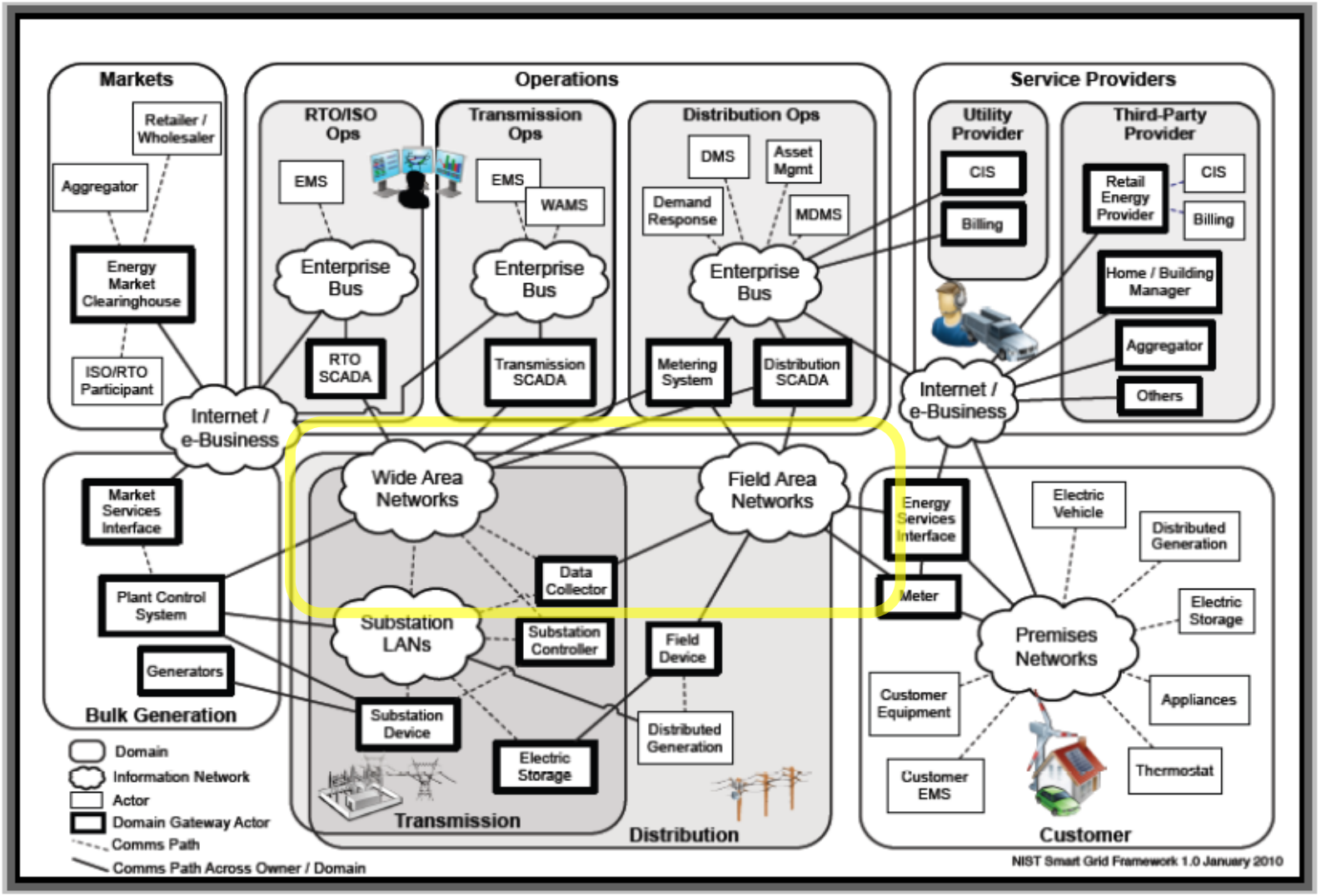
Smart Grid Technology - Conceptual Layout



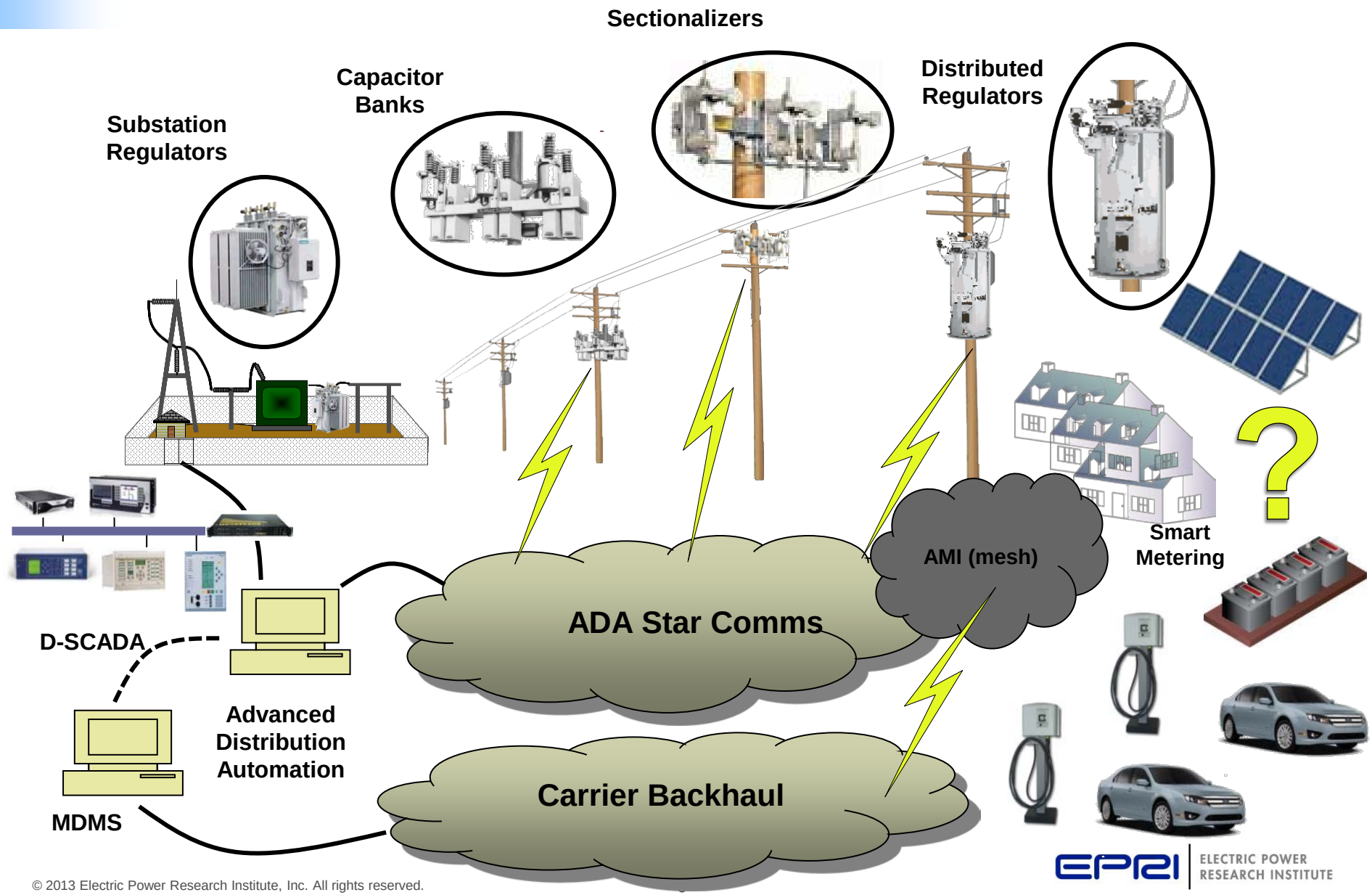
A modern grid includes 3 primary components: 1.) electric grid devices, 2.) telecommunications infrastructure, and 3.) the software and logical architecture to enable measurement, control, and optimization.

Graphic courtesy of Duke Energy

NIST Conceptual Reference Diagram for Smart Grid Information Networks



Current Approach and Challenges



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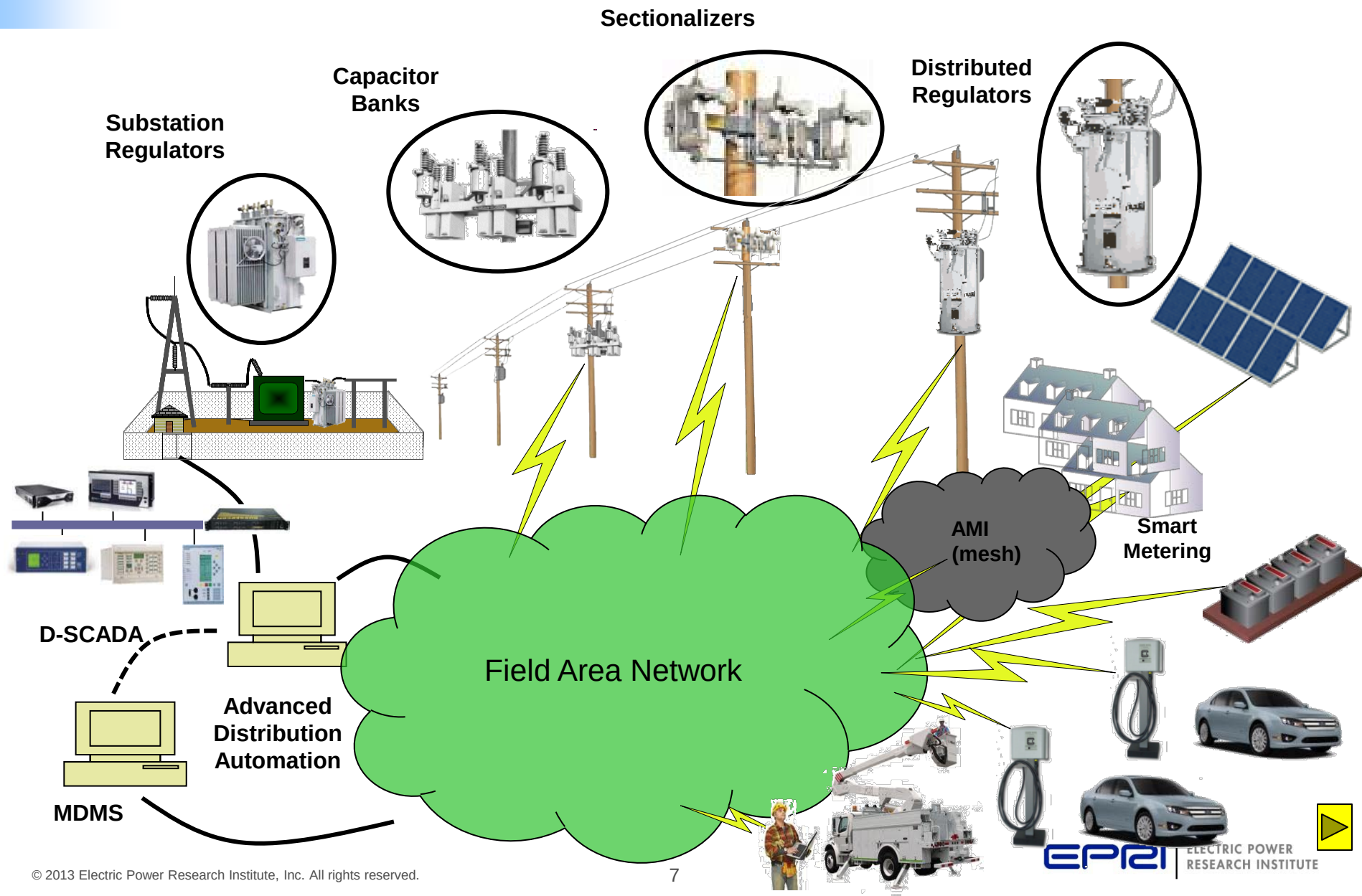
Field Area Network



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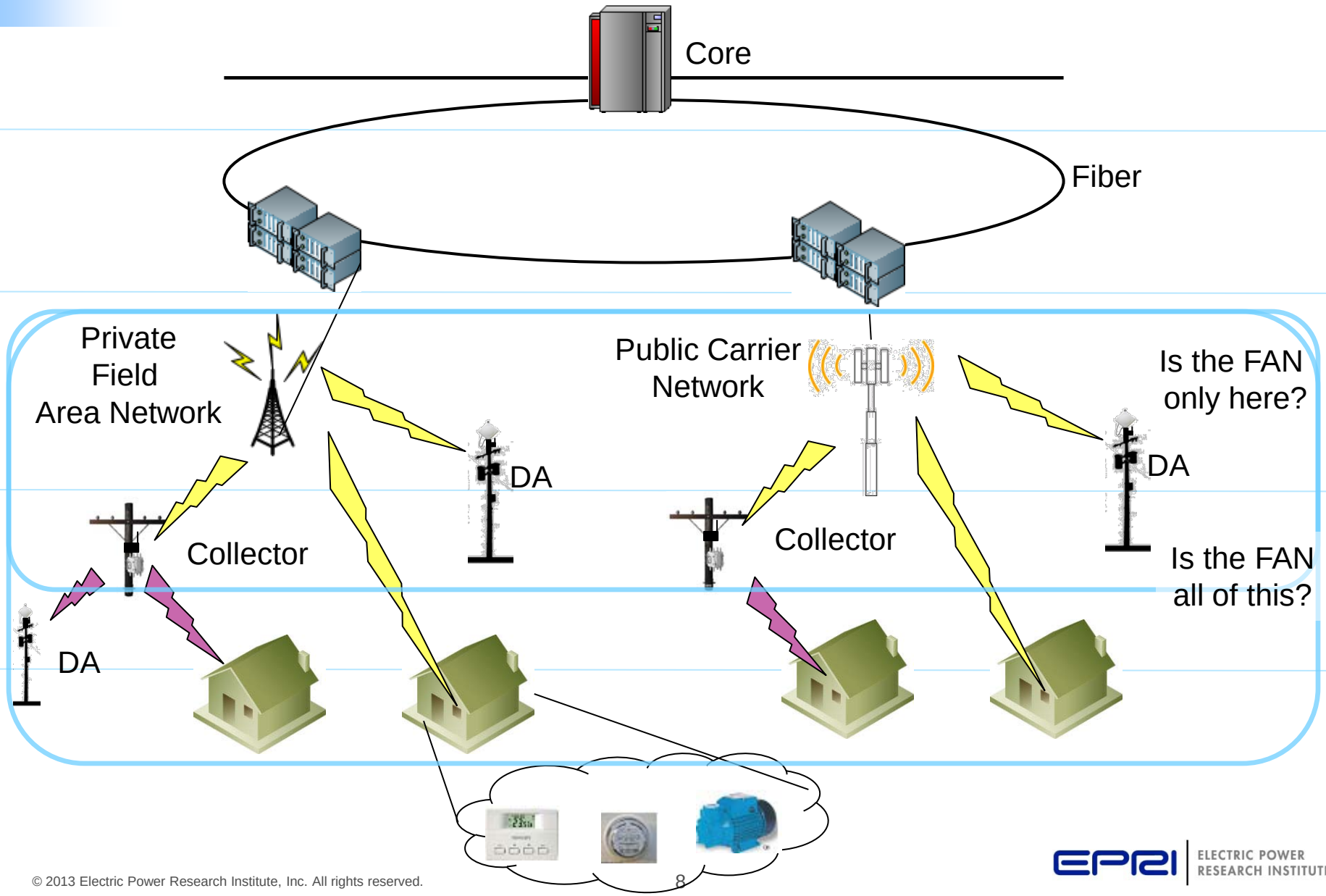
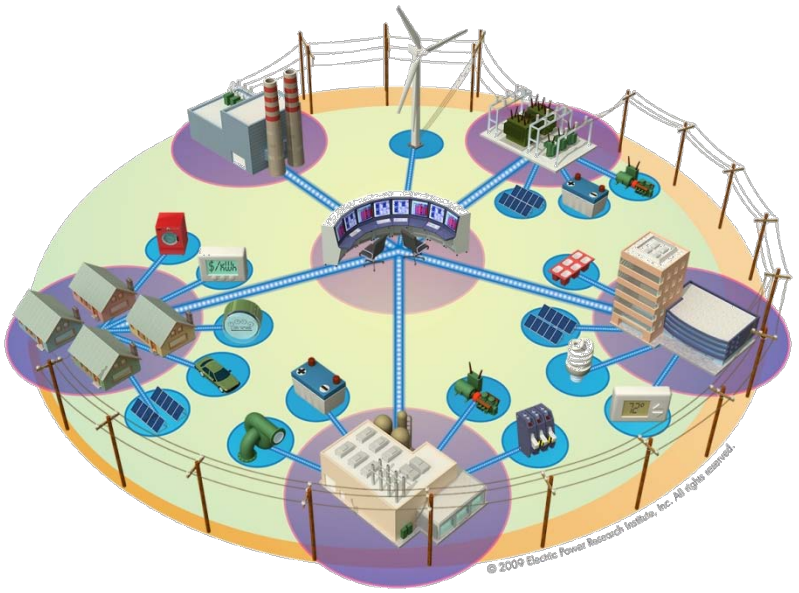
The FAN in the communications hierarchy



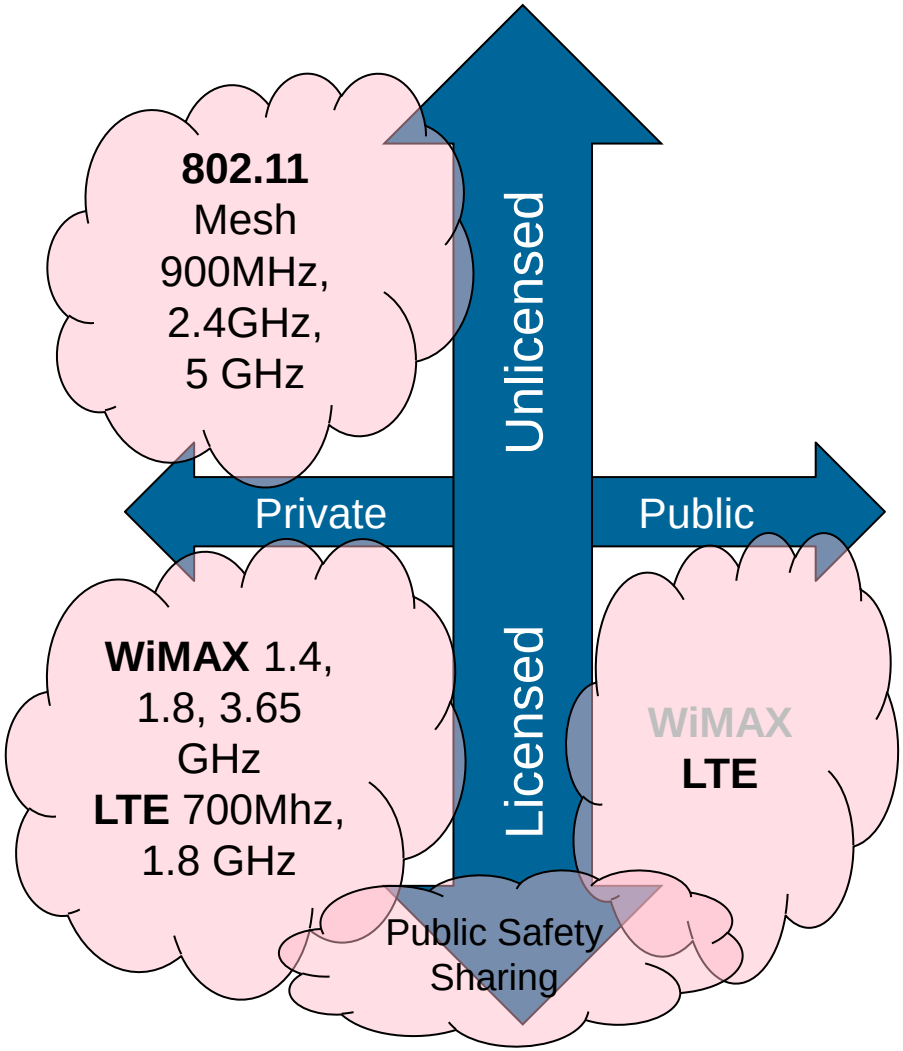
What is a Field Area Network (FAN)?

- A unified network supporting multiple utility applications
  - Possibly multiple technologies, but still a single integrated network.
- High performance - able to support DA and ADA
- Scalable to support growth and emerging needs: DER, PV, EVs
- Integration/Convergence of existing services – AMI backhaul, LMR voice, etc



Open Questions

- What is the reliability and performance of various technology options?
  - Private cellular architecture
  - Unlicensed (mesh or point-to-point)
  - Lightly licensed
  - Public Safety Sharing
- What is the reliability and performance of commercial carriers?



Field Area Network (FAN) Demonstration Project

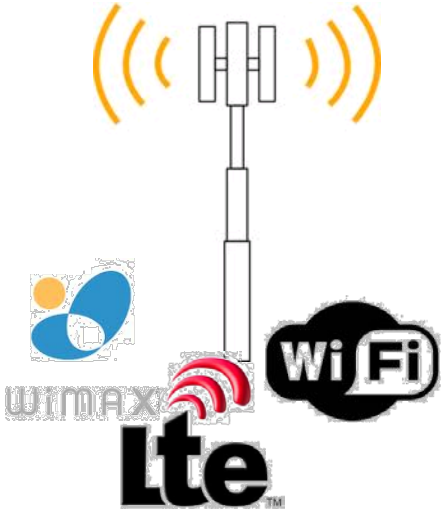
Objective: Answer open questions about the FAN

Approach:

- Multiple member utilities collaborate on the design, implementation and analysis of FAN pilot projects using a variety of technologies and approaches
- Conduct a Vendor Forum series where FAN vendors make presentations and have Q&A with members
- Participate in Interoperability Plugfests for FAN technologies with industry alliances

Value Proposition

FAN Demo – Benefits of Participation

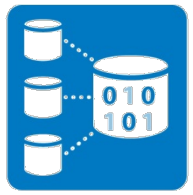


- Share experience and learning related to reliability and performance characteristics the various technology options

- Share experience and learning related to business case, financing, spectrum options, and cost/benefit analysis of network deployment

- EPRI services related to the FAN
  - Planning and estimating network deployment
  - Communications Assessment Workshop

FAN Demo – areas of new learning

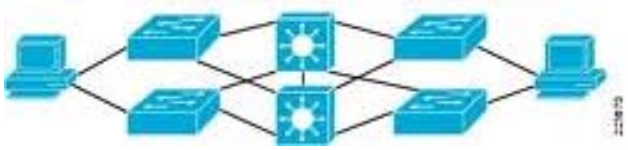


- Application Integration
  - Integration with core networks and IT systems
  - Integration of workforce communications (Data, Voice, Video)
  - Interoperation between Distribution and IT/Telecom

- Network Management
  - QoS and Priority provisioning for critical applications
  - Cyber Security best practices

99.999%

- Collaboration on FAN network reliability for different applications
  - Cost / benefit, Metrics, Reliability
  - Assessment of failure impact and mitigation
- Carrier Evaluation - meeting utility requirements
  - Including hybrid network scenarios
- FAN Evolution (Spectrum, Scalability, Future Proofing)



FAN Demo Project Update

Background of research plan

- Members developed list of topics and priorities
- Different members have different areas of focus
- Different members are at different stages of their projects
- Currently 7 members: 6 host sites, and 1 participant

Topics and Member Plans

		SRP	Duke	H-One	UI	GRE	NPPD	HQ
1	Securing the FAN	☑	☑					
2	High reliability network architecture	☑	☑	☑	☑	☑		☑
3	QoS w/ impaired network conditions			☑			☑	
4	AMI vs. broadband FAN technologies for DFA				☑			☑
5	Network Entry w/ large # of devices joining		☑			☑	☑	
6	Long-term reliability (monitoring and metrics)		☑			☑		☑
7	QoS on shared networks, w/ multi-applications		☑	☑		☑	☑	☑
8	Distributed vs. centralized processing		☑					
9	Application Integration & analytics: Using new data		☑					☑
10	Network management systems and techniques							☑
11	FAN for Field Force: Data/Voice							
12	Reliability of public carrier networks.		☑			☑		
13	Determining requirements for private networks	☑		☑	☑	☑		☑
14	Best practices: organizational structures for FAN							
15	Propagation Studies, and verification of accuracy	☑		☑	☑			☑
16	Integrating applications beyond electric delivery	☑						
17	Best practices for connecting devices to the FAN	☑	☑		☑	☑		
18	Sharing Networks with Public Safety						☑	
19	Operation in the 3.65 GHz band	☑						

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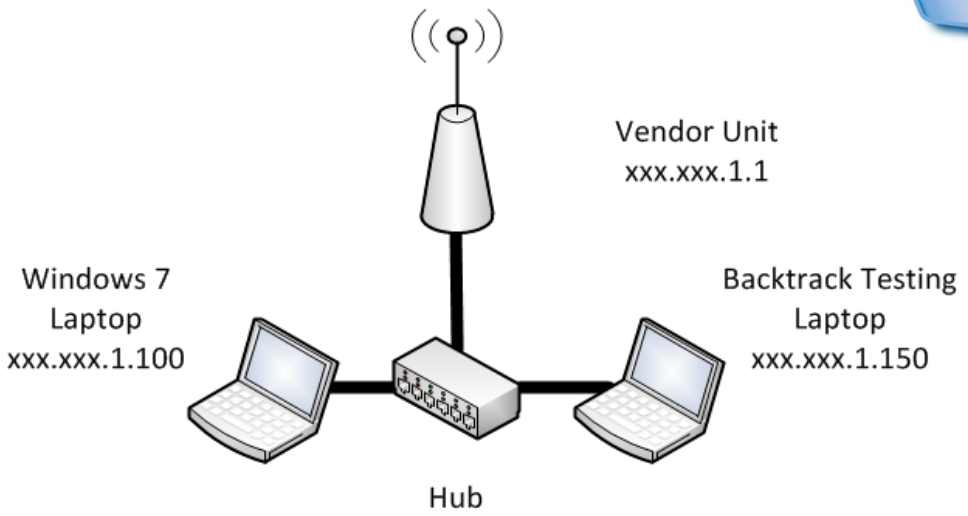
FAN Penetration Testing

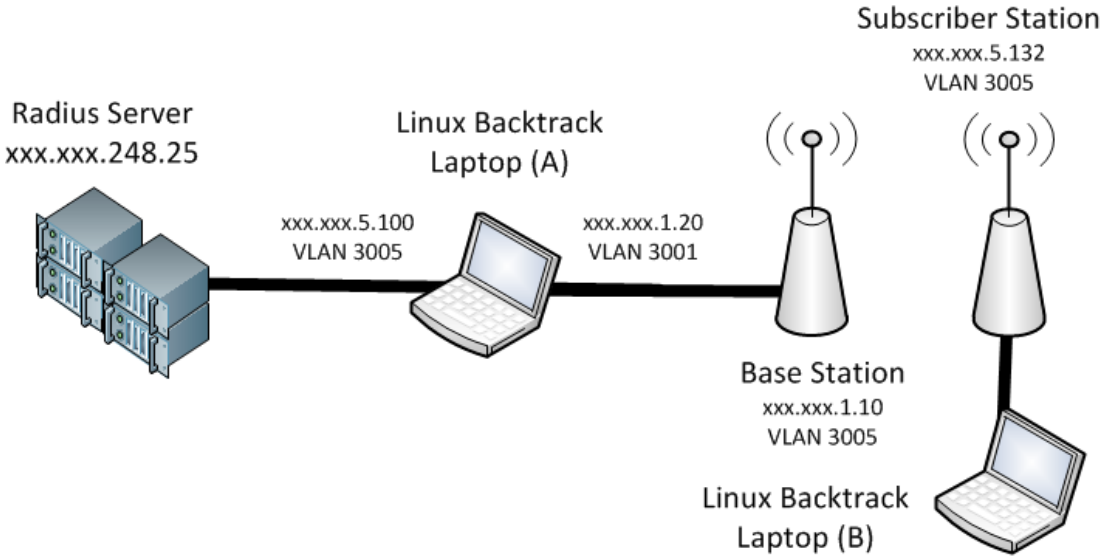
Phase I

- Test Plan – Fall 2012
- Onsite Testing - January 2013
- 3 Vendor Units
  - 2 Subscribers
  - 1 Base Station
- 47 Tests
  - Complete 4
  - Failed 19
  - Passed 24

Phase II

- Test Plan – May 2013
- Onsite Testing – June 2013
- 3 Vendor Units
  - 2 Subscribers
  - 1 Base Station
- 17 Tests
  - Complete 2
  - Failed 10
  - Passed 5





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SRP FAN Pilot Project

SRP, in partnership with EPRI, launched a FAN Pilot in May 2012 with the following objectives:

1) Implement base stations at three locations
2) Define requirements, integrate, and test 2-way communications for various end user applications
3) Assess technology (WiMAX vs. LTE, RF spectrum & cyber security)
4) Evaluate alternative public/private models
5) Assess the business case
6) Develop strategy & proposal

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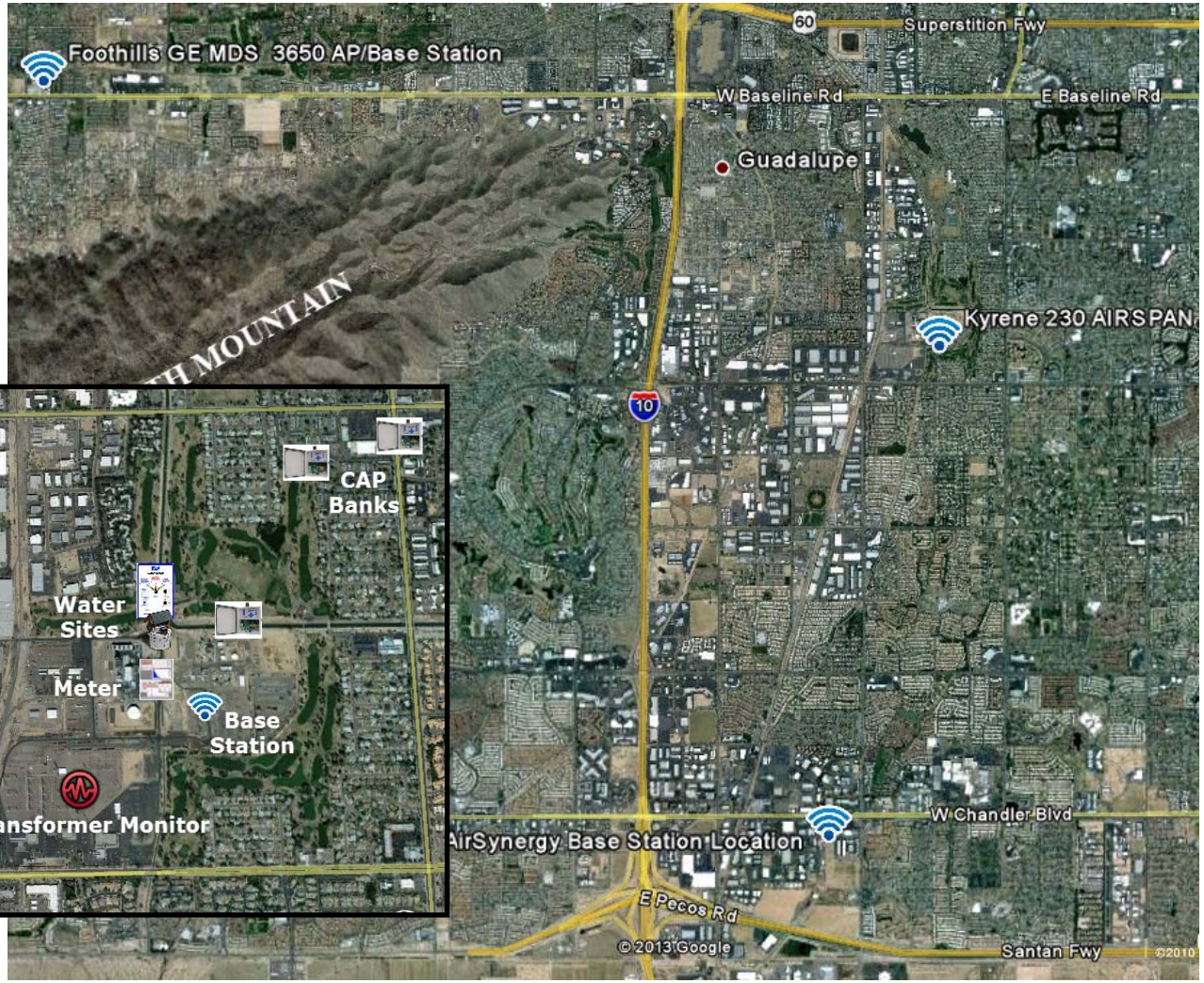
FAN Deployment Status

Network operational since Feb 2013



End User Applications

- Applications in scope

  Distribution Feeder Automation
  Power Quality Metering
  Remote Fault Indication
  VOLT/VAR Management
  Transformer Monitoring
  Water Gate Keeper Control
  Water SCADA & Measurement
  Wireless IP Security
  Mobility

- Defined use cases, integrated devices & tested
- Demonstrated successful integration & identified application benefits





Topics and Member Plans

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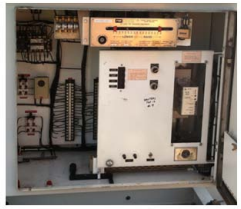
Business Objectives for Networks in Advanced Distribution System

- Create and implement a telecom network that facilitates the following:
  1. **Single unified network capable of supporting multiple uses/users with differentiated priorities and Quality of Service**.
  2. **Cost-effective implementation; leverage existing assets where possible.**
  3. **Meet the application requirements of the ADS project.**

Intelligence Added to the Trial Area



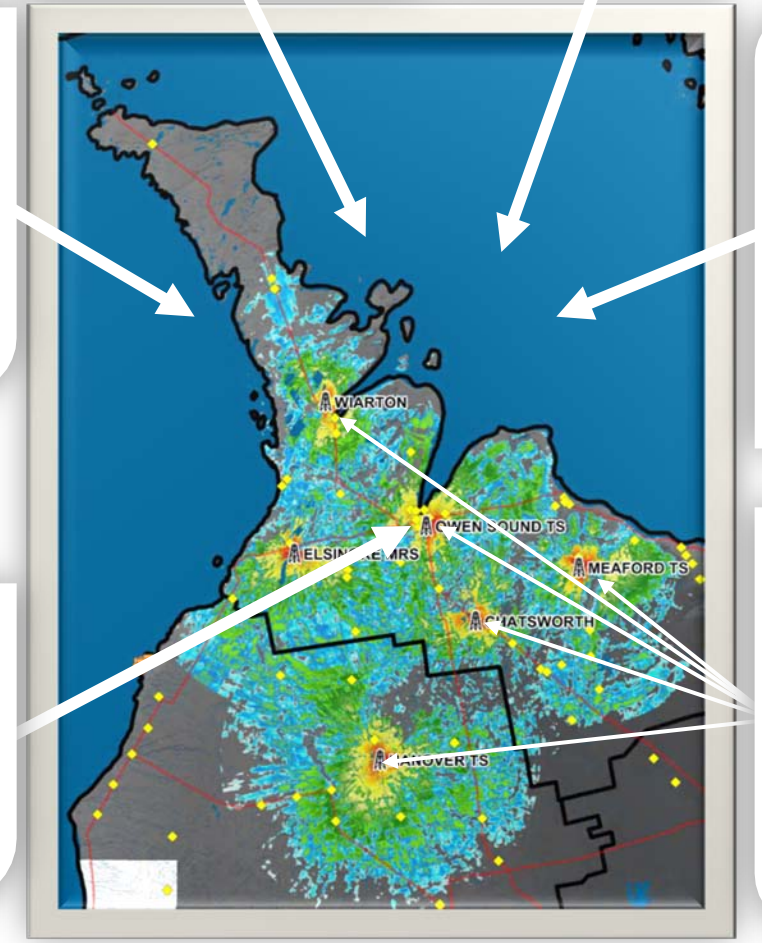
Old Controller

New Controller

44 kV Regulating Station Controller Upgrade

44kV Joslyn VBM Switch

27 kV Gridshield Recloser w/ RER620 Controller



8 kV Capacitor Bank w/ M6280 Controller

New WiMAX CPE's

Factory Built & Commissioned

New Protection, Control & Telecom Building

New WiMAX Base Towers

ADS Network Development Cycle

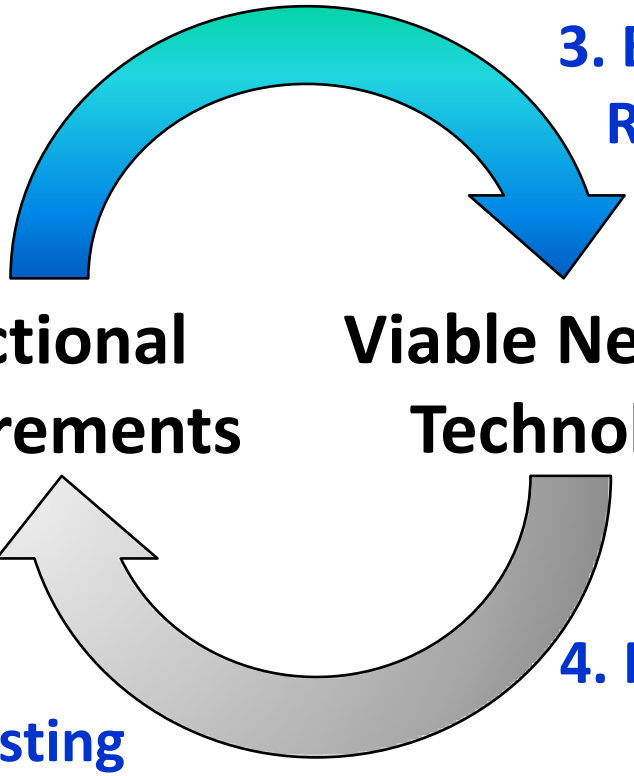
1. IEC61850 GOOSE

2. Detailed Technical Requirements

- Ethernet (Layer 2)
- Layer 2 Multicast
- Low Latency

3. Evaluate / Map Requirements

- What can achieve TR?
- Business model?



- Private WiMAX Network w/L2CS

4. Network Product Development

- Enable L2CS
- Profile B ASN (distributed)

5. Network Testing

- ADS P1R1 pilot area
- Lab Tests

Topics and Member Plans

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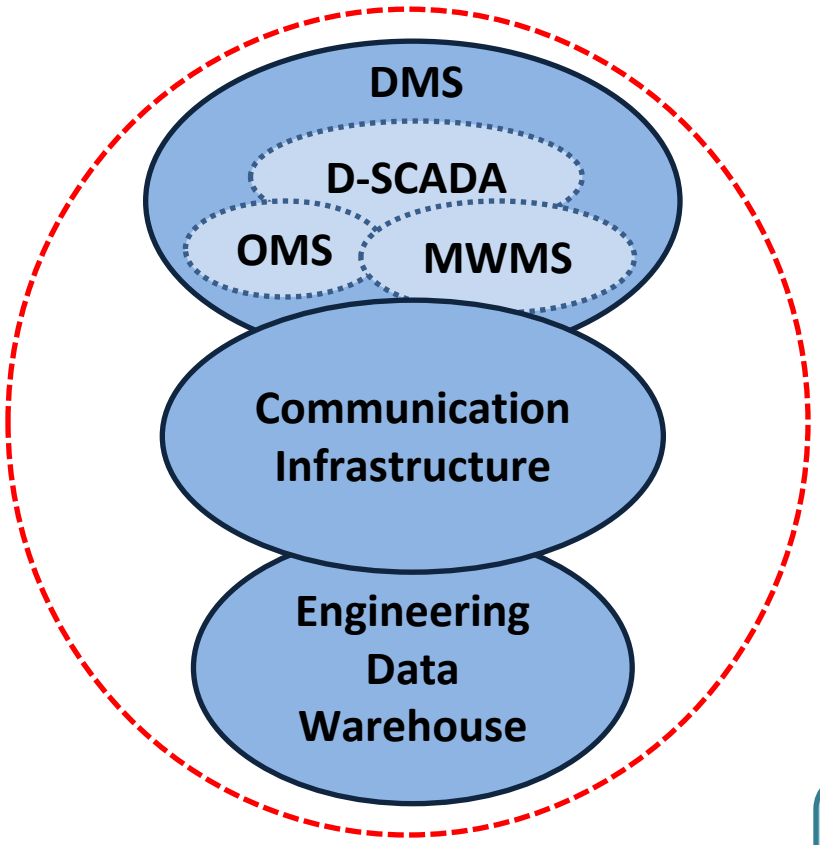
Automation Vision

Common Core Systems



Enabled Applications

FLISR/Auto Switch
- Visibility
- Control
- Data Visualization

Volt/VAR
- Power Factor Control
- Voltage Drop Control
- Energy Efficiency

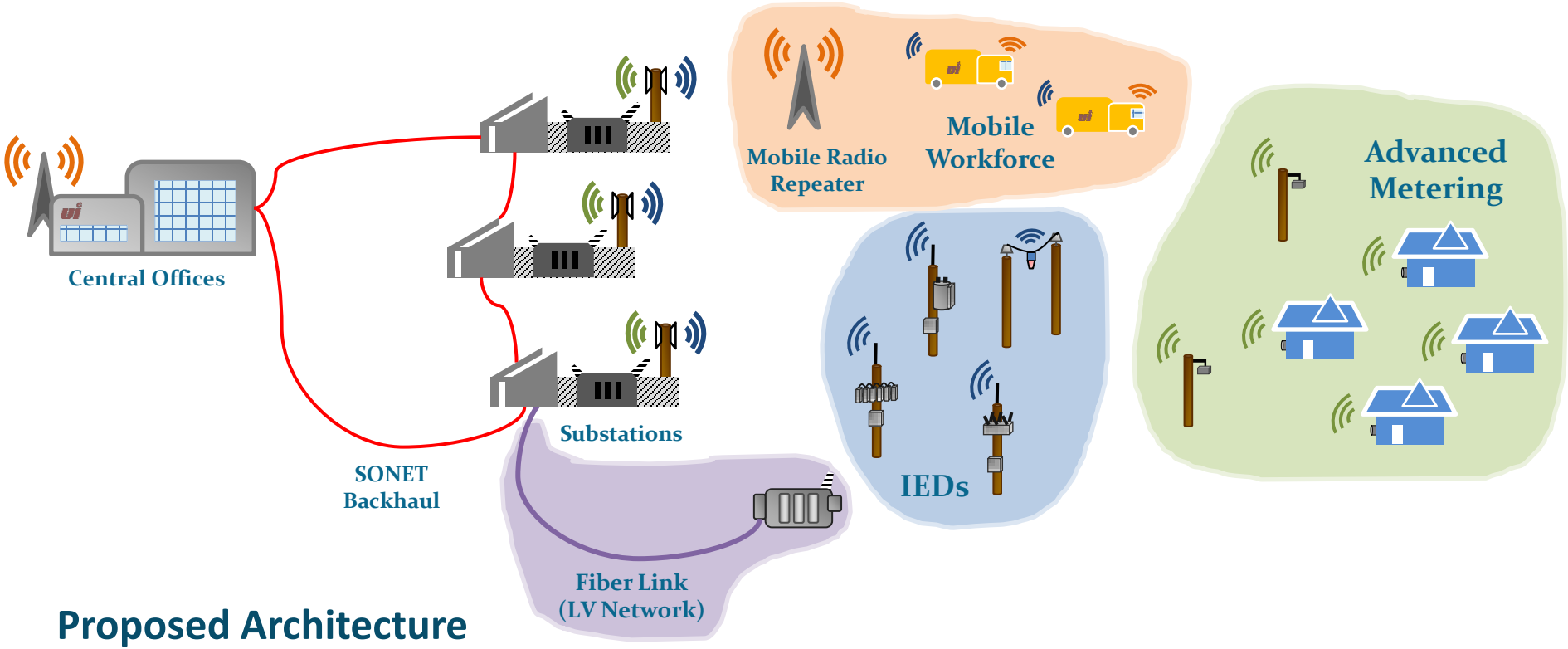
DG/Islanding
- Monitor
- Control
- Dispatching

Storm Restoration
- AMI-OMS Integration
- Mobile Enhancements
- Outage Analysis

Planning/Design
- Study and Simulate
- What-If Scenarios
- Aid in Design

The United Illuminating Company

Communications



Proposed Architecture

- Fiber-Optic Backhaul
- Field Area Network (FAN)
  - 900 MHz Spread Spectrum for AMI
  - Hybrid RF Network for IEDs
  - Fiber-Optic for Low Voltage Networks
- Scalable, Low Latency, High Throughput, QoS

Networks

MDS iNET Series

Secure IP/Ethernet

Technical Specs

- IP/Ethernet Radio
- 902-928 MHz ISM
- FHSS
- 512/256 kbps
- 8-15 miles range (typical fixed)
- RC4-128 encryption
- RADIUS, EAP/TLS, etc. authentication
- Power Consumption
  - 7 W transmit
  - 2.8 W receive

Landis+Gyr

Installed Base

- ~120,000+ Customer Meters
- ~4,100+ Repeaters/Collectors

Overview

- 904-927.9 MHz
- Mesh Network

The United Illuminating Company

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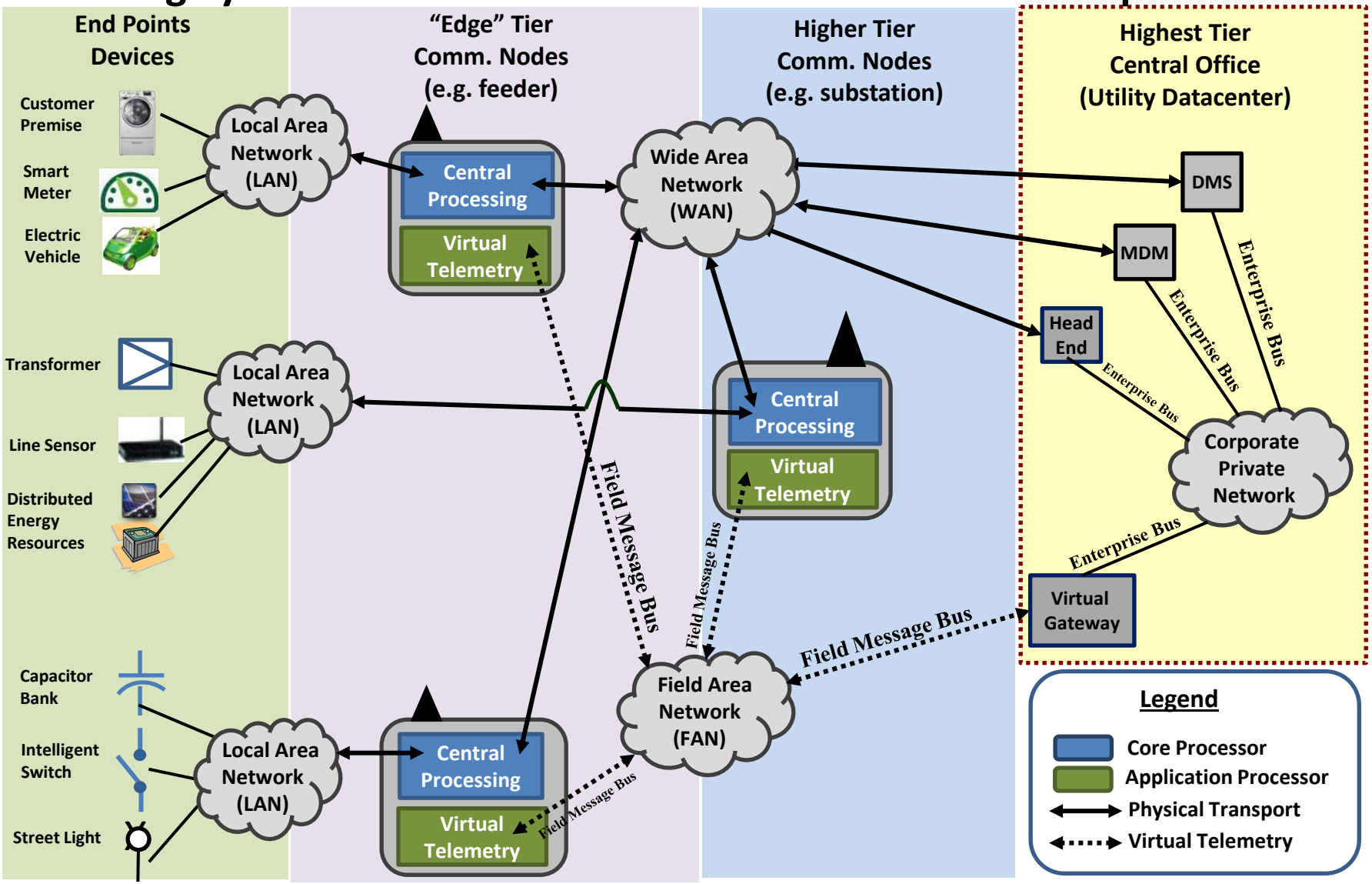
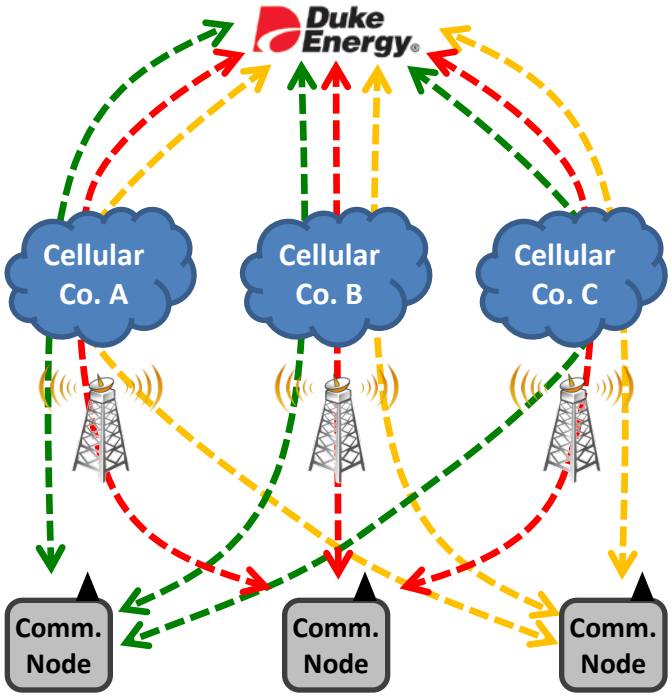
Goal: Multi-Tier Communications Node Architecture Can Retrofit to Existing Systems and Allows Modular Rollout of Future Capabilities



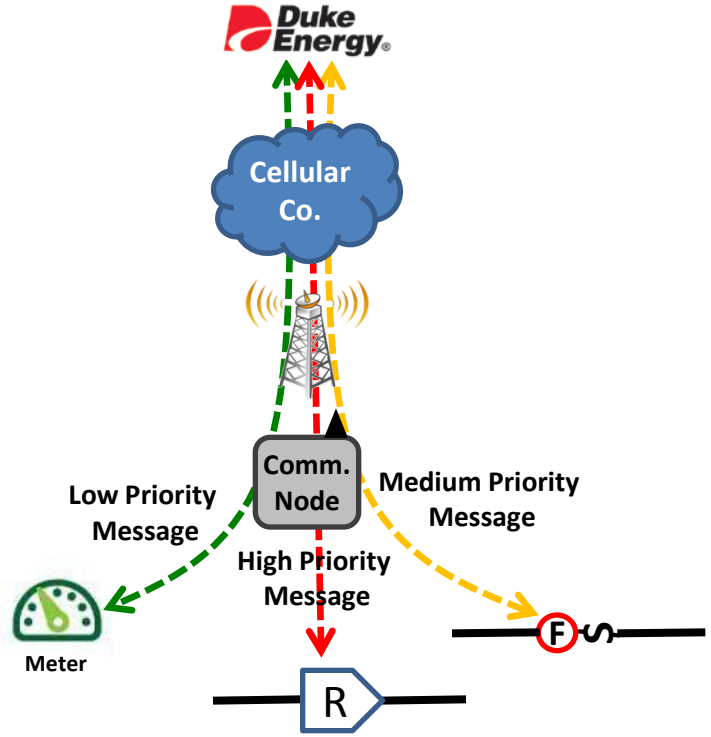
Goal: Reliability and Enhanced Communications Capabilities

Multi-Cellular Capability with Gobi 3G



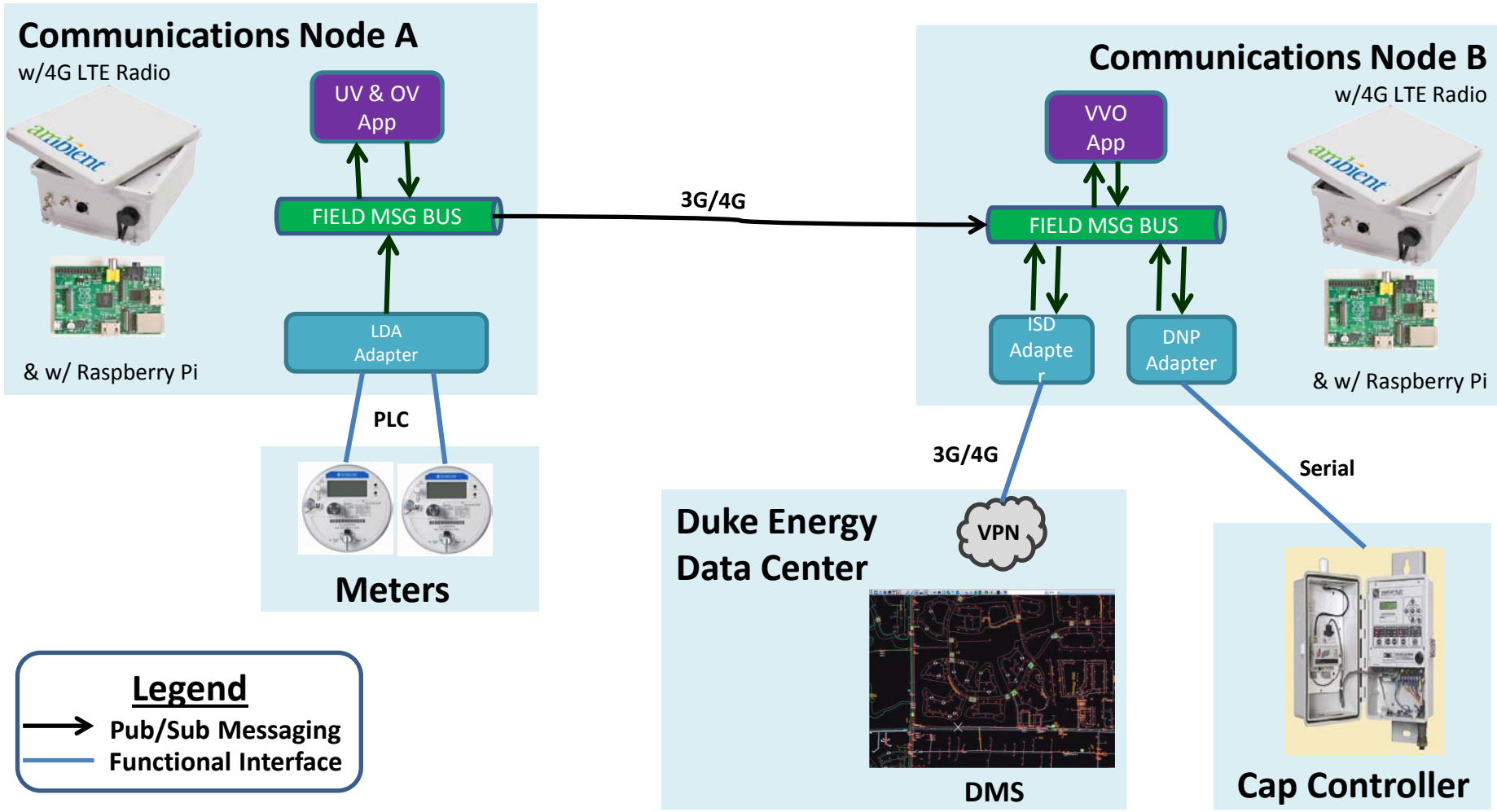
- Strengthen telecom infrastructure and improve cost by switching providers based on QoS or cost.
- Preserve private network and security across multiple cellular providers.
- Allow peer-to-peer traffic.

Message Prioritization with LTE

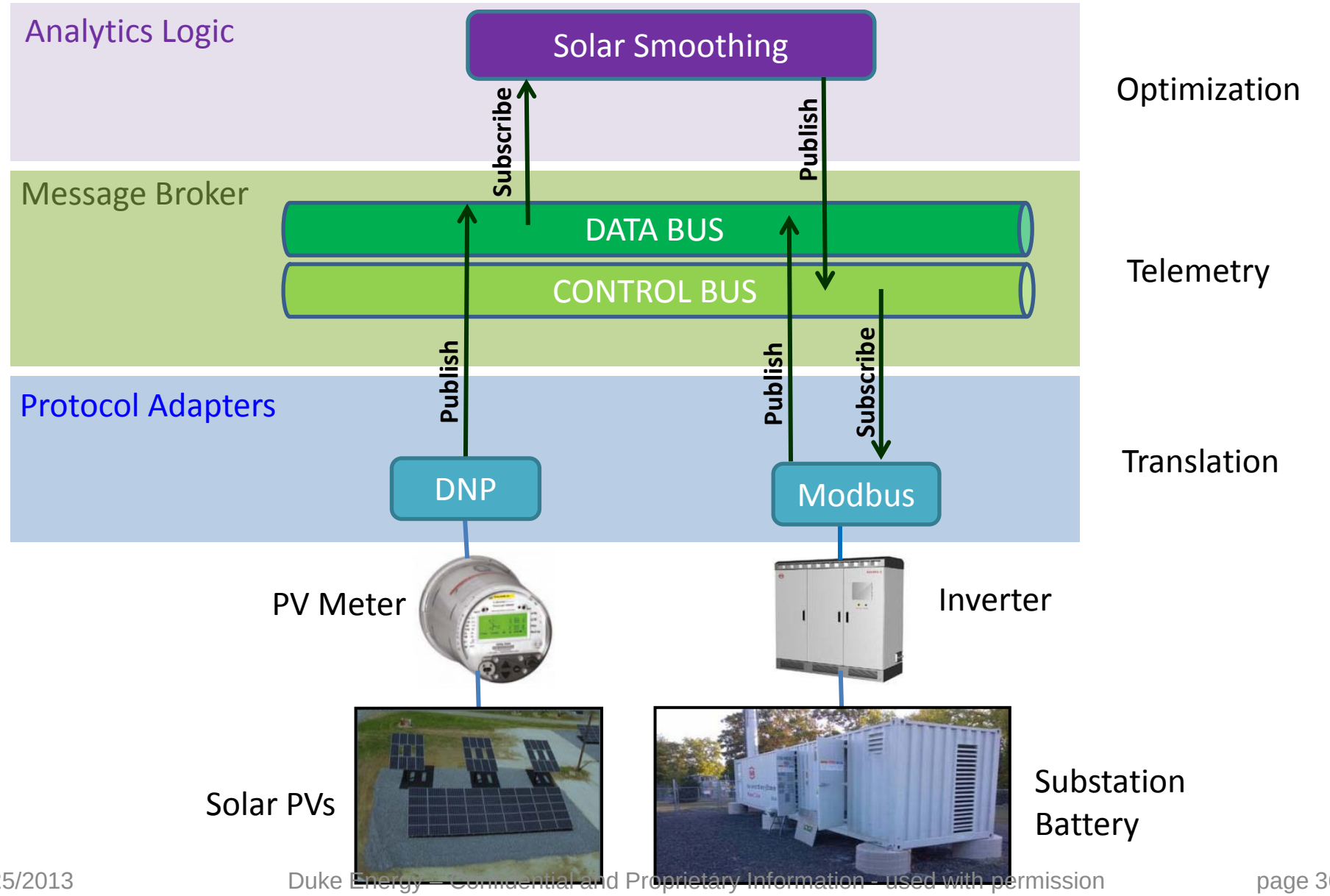


- Improve likelihood that critical messages are sent/received through message prioritization
- Ensure telecom infrastructure can identify high/medium/low priority messages.
- Strengthen telecom infrastructure and cost by prioritizing messaging needs.

Peer-to-Peer VVO Application at McAlpine Test Area



Solar Smoothing Application at McAlpine Test Area



Other Members Update

- Great River Energy
  - Pilot FAN deployment in Connexus Energy (distributor) area
  - Evaluating spectrum options for private network

- Nebraska Pubic Power District
  - Evaluating shared public safety network (700 MHz LTE)

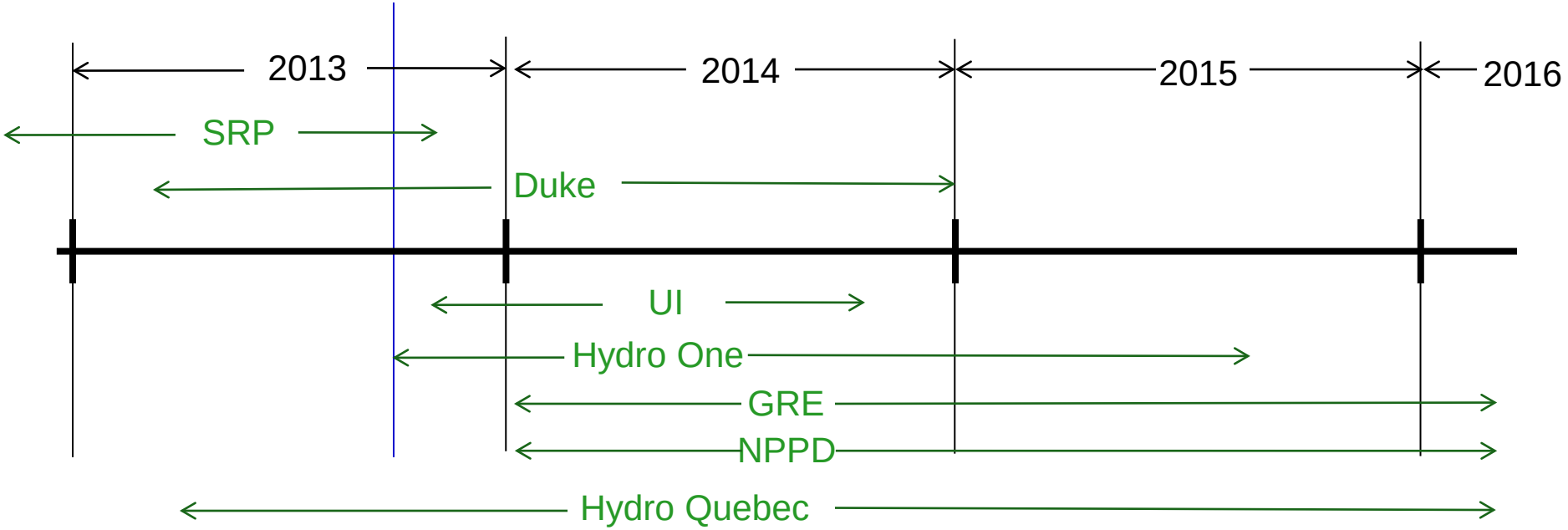
- Hydro Quebec
  - Comprehensive FAN program (STAR Project)
  - WiMAX and cellular network performance characterization
  - Grid application traffic characteristics and capacity analysis
  - Long term field performance studies

FAN Demo project organization and plans

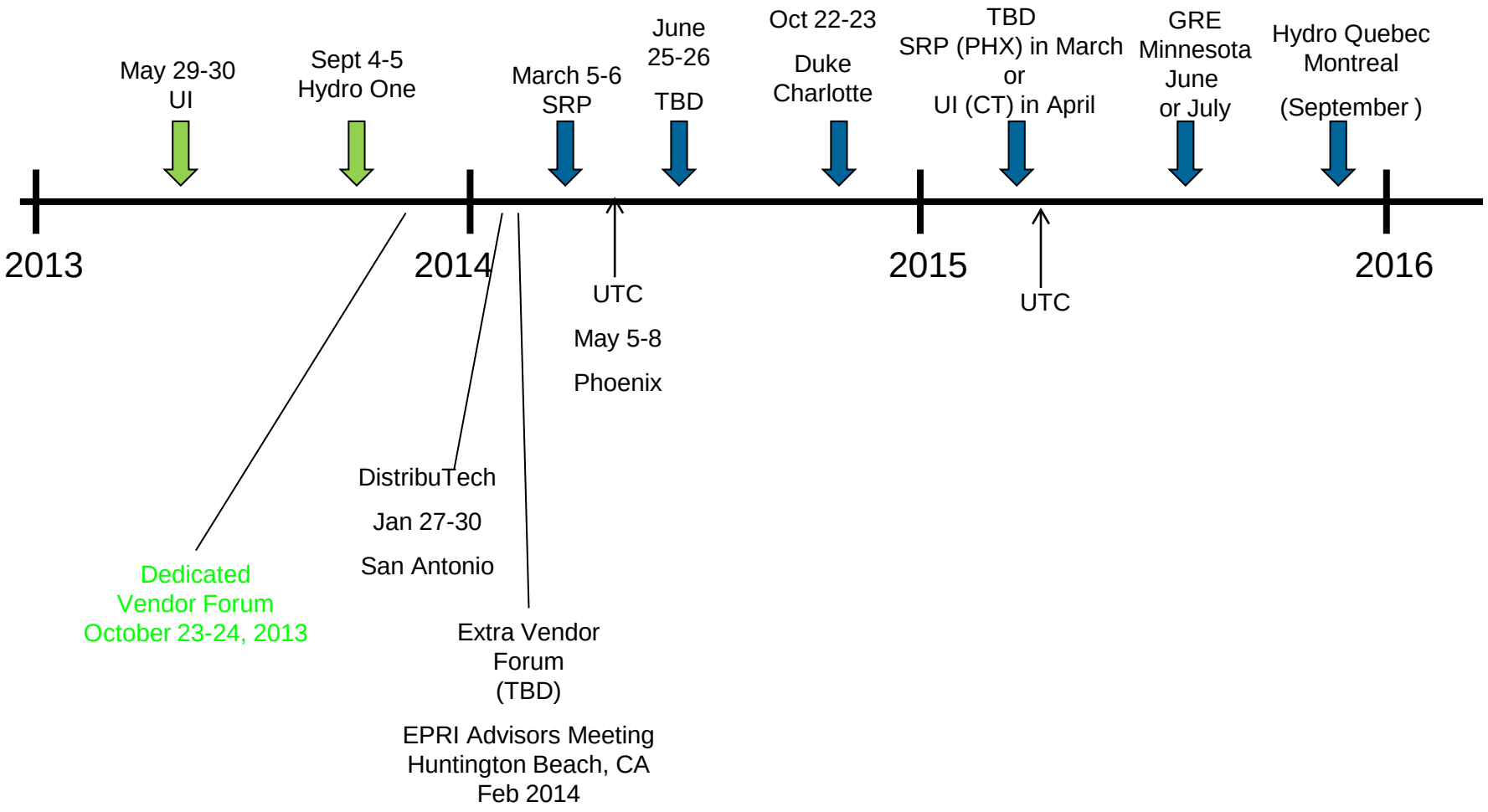
Collaborative Demonstration Model

- Practical Results from Actual Deployments
- A Variety of Scenarios
- Opportunity to be Host-Site or Participant
- Use Common Methodology so Results are Transferrable
- Multi-Year to accommodate Industry Evolution

Site Projects Timeline



FAN Demo meeting schedule and location



Host-Sites and Participants & Costs 3-Years (2013-2015)

Task	Participants	Hosts
Guidebook (FAN)	X	X
CBA Methods	X	X
Meetings, Vendor Forum, Plugfests	X	X
Annual Reports/Case Studies	X	X
FAN Comm's Assessment Workshop (On-Site)	X	X
Host site CBA/Financial Analysis		X*
Host site RF Modeling		
Host site Security Assessment		
Host site Reliability & Performance test plan		
Pricing Tier 1	$50k/year ($150k)	$125k/year ($375k)
Pricing Tier 2	$34k/year ($102k)	$85k/year ($255k)
Pricing Tier 3	$20k/year ($60k)	$50k/year ($150k)

- At Least one task in depth, prioritized on an individual basis with each Host site

Questions?

It is not too late to get involved!

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