WiGRID – A Wireless Broadband Solution for Utilities

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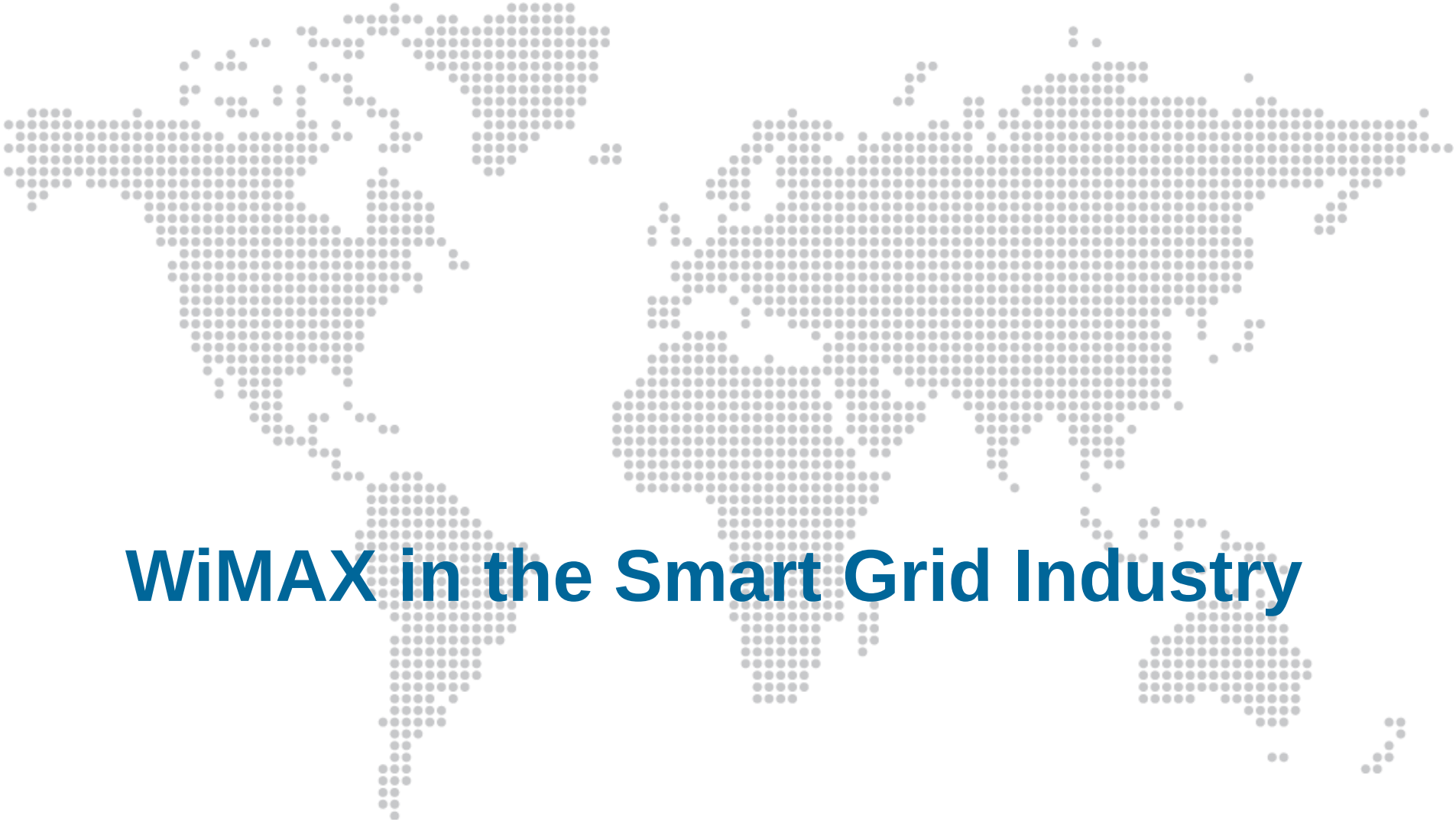
SGIP SMART GRID INTEROPERABILITY PANEL FOUNDING MEMBER



WiMAX in the Smart Grid Industry

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WiMAX Increasingly Used as Solution for Vertical Markets

- Smart Grid
- Rural Broadband
- High Speed Rail
- Aviation
- Oil & Gas
- Mobile Backhaul

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SMART GRID

Smart Grid Offers Unparalleled New Revenue Opportunities

WiMAX is the Optimal BWA Technology for Smart Grid

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WiMAX Applications

- Distribution Automation & Management
- Mobile Workforce Management
- Vehicle & Asset tracking
- Smart Meter Data Aggregation/Collection
- Demand Response
- Redundancy
- Security and Surveillance
- Remote Site Communications, Monitoring & Equipment Control

Two Paths for Utilities to Choose From

Partnership with Existing WiMAX Operator

Private Network Deployment

What is WiMAX Forum's Role?

WiMAX Forum's Involvement: 3 Pillars

Standards Development

Certification

Marketing

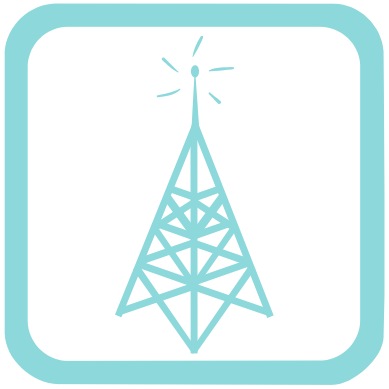
Provide Support for Utilities, Operators and Vendors

- WiMAX Forum formed the “Smart Grid Working Group” in March 2011 and first meeting was held in May 2011
  - Chartered to:
    - Capture the requirements of Utilities
    - Assess suitability of 802.16e for Smart Grid
    - Optimize 802.16e for Utility Applications
  - The initial goal was to develop a new WiMAX Forum technology (based on 802.16e).
  - This technology / new System Profile is called ***WiGRID***

What is “WiGRID”?

- WiGRID is a ***NEW WiMAX FORUM TECHNOLOGY*** based IEEE 802.16e for Utilities and Industrial applications.
- WiGRID is an ***ETHERNET*** technology designed for wide-area networking, primarily for Layer 2 networking.
- WiGRID is optimized for ***FIXED*** applications, but can also support Nomadic and mobility (if needed).
- WiGRID is **BACKWARDS COMPATIBLE WITH MOBILE WIMAX** equipment.
- WiGRID is designed to support ***UPLINK CENTRIC*** or ***SYMMETRIC*** applications.
- WiGRID ***COMPLEMENTS M2M*** Cellular technologies, designed as another wide-area “networking tool”. Does not displace or compete with majority of M2M usage.
- WiGRID ***LEVERAGES THE GLOBAL WIMAX ECOSYSTEM***, and takes advantage of the mass market mature device and base station silicon.

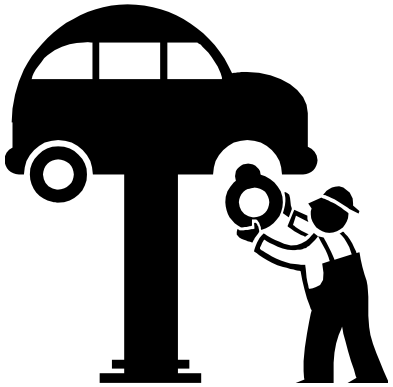
What WiGRID Isn't



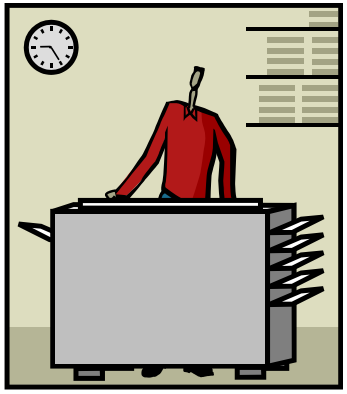
Cellular M2M Technology

Mobile Technology

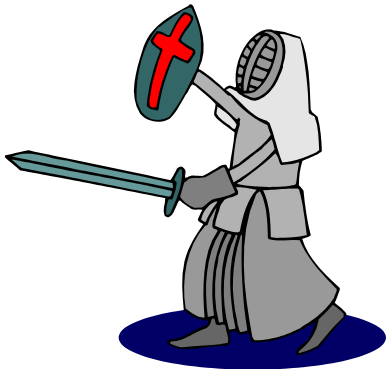
For SmartPhones and Tablets



Replacement for Wi-Fi, Zigbee, etc.



Another version of Mobile WiMAX



Competitor with LTE for Utilities

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Utility Requirements Document

- The **“WiMAX Forum® System Profile Requirements for Smart Grid Applications Requirements for WiMAX**”, T31-001-RXXXv01 is complete.
  - Development of a complete document took considerable time
  - Needed to get input from other Smart Grid Standard activity, Utility companies and vendors serving this industry. Getting critical mass was a slow process, but is there now.
  - Document identifies the key feature needs by utilities for their applications

Utility Requirements

Comparing Mobile WiMAX/3G and WiGRID

	WiMAX/802.16e and 3G for Mobile Broadband Network	WiGRID for Utility and Industrial Networks
Frequency Bands	• Primarily in licensed bands • Dedicated bands country by country	• No specifically allocated spectrum in the US. Some countries have provided spectrum to Utilities. • Can use “lightly” licensed or license-exempt spectrum • Smaller channel BWs
UL and DL Traffic	• DL traffic is dominant	• UL traffic is dominant
End-Users	• End-users will be mobile • Relatively few simultaneously active users per channel • DL files can be large	• Primarily fixed • In an AMI networks there can be 1000s of simultaneous users
Mobility	• Very important	• mobility not important • Nomadic useful for mobile workforce
Security	• Privacy concerns	• Privacy and user-behavior patterns • Protection against malicious network
Network Robustness	• Important	• Very important • Support for Relaying, Multi-hop, and self-configuring network
Latency	• Important for latency-sensitive applications: VoIP, rt Gaming, etc	• Must meet varied requirements for data payloads –3 or more sub-levels within UGS? (Low, Med, High)
Coverage	• Ubiquity very desirable	• Ubiquity is essential • Extended range and Multi-hop for rural coverage • Support for M2M and/or Relay for enhanced urban coverage

WiGRID PlugFest

VANCOUVER, CANADA | SEPTEMBER 10 - 14, 2012

Powertech

The Power of Trust. The Future of Energy.

WiGRID Plugfest

September 14th 2012

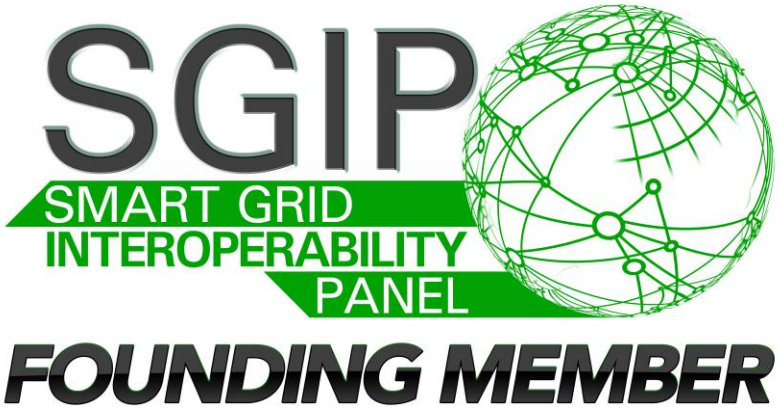
v1

1st

WiGRID PlugFest
VANCOUVER, CANADA | SEPTEMBER 10 - 14, 2012

- Five vendors and one test equipment manufacturer
- IOT Testing focused on;
  - Ethernet-only, standalone networks (no ASN-GW)
  - Extended Range Operation (up to 52km)
  - UL 64 QAM Operation
  - UL Centric TDD Frame Splits
  - Low Latency “UGS” networking
- Plan is to further optimize WiGRID with future releases of the technology that…
    - Increase Capacity / Spectral Efficiency
    - Reduce Latency
    - Improve Radio Network Robustness
    - Add “Self-Backhaul” and “Relay” capabilities
    - Self Optimize
    - Have better Interference immunity
    - Operate in smaller channels sizes and lower frequencies (200-400 MHz)
    - Reduce Utility Capital and Operating Costs

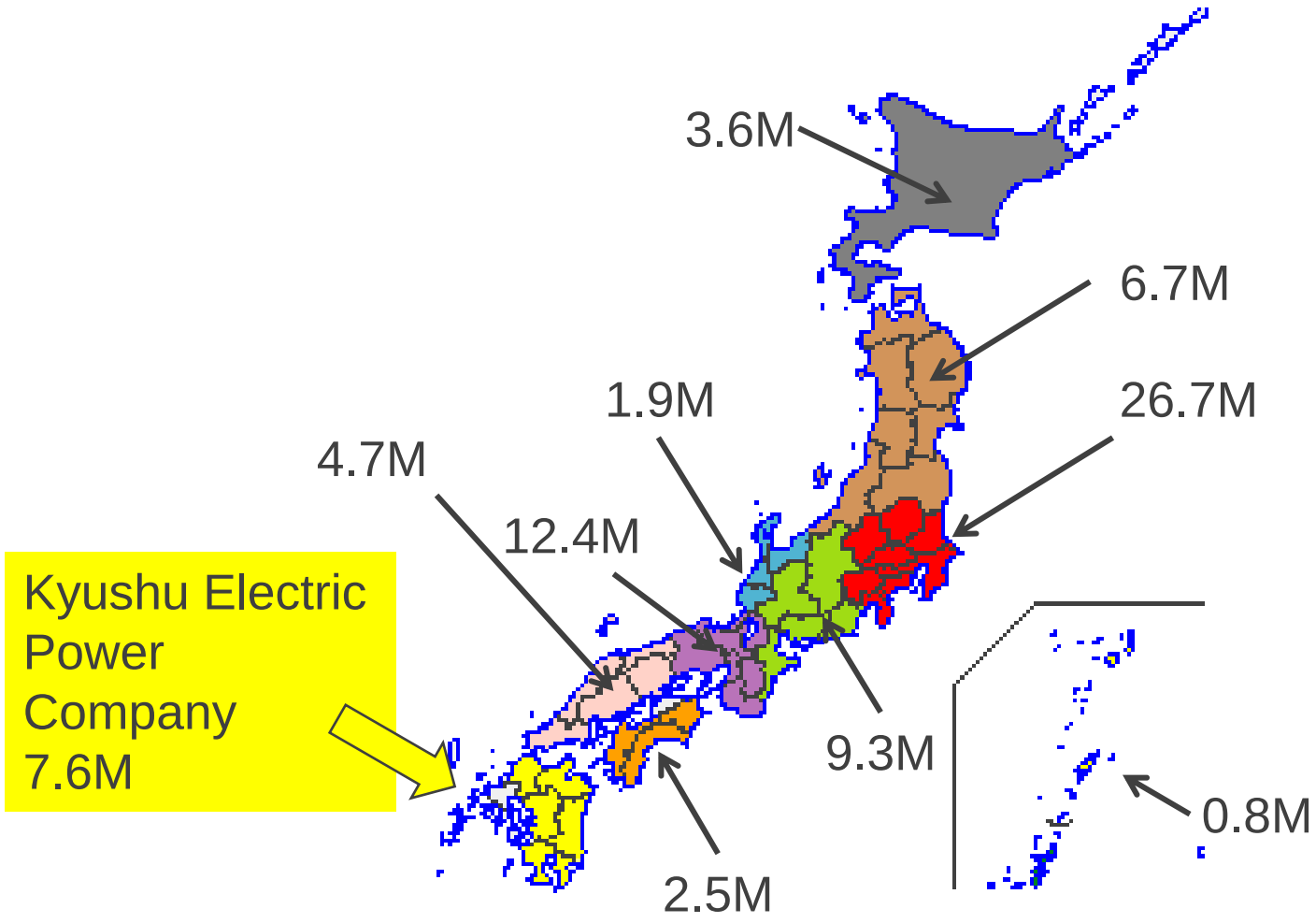
WiMAX Forum is an SGIP Founding Member



Case Studies

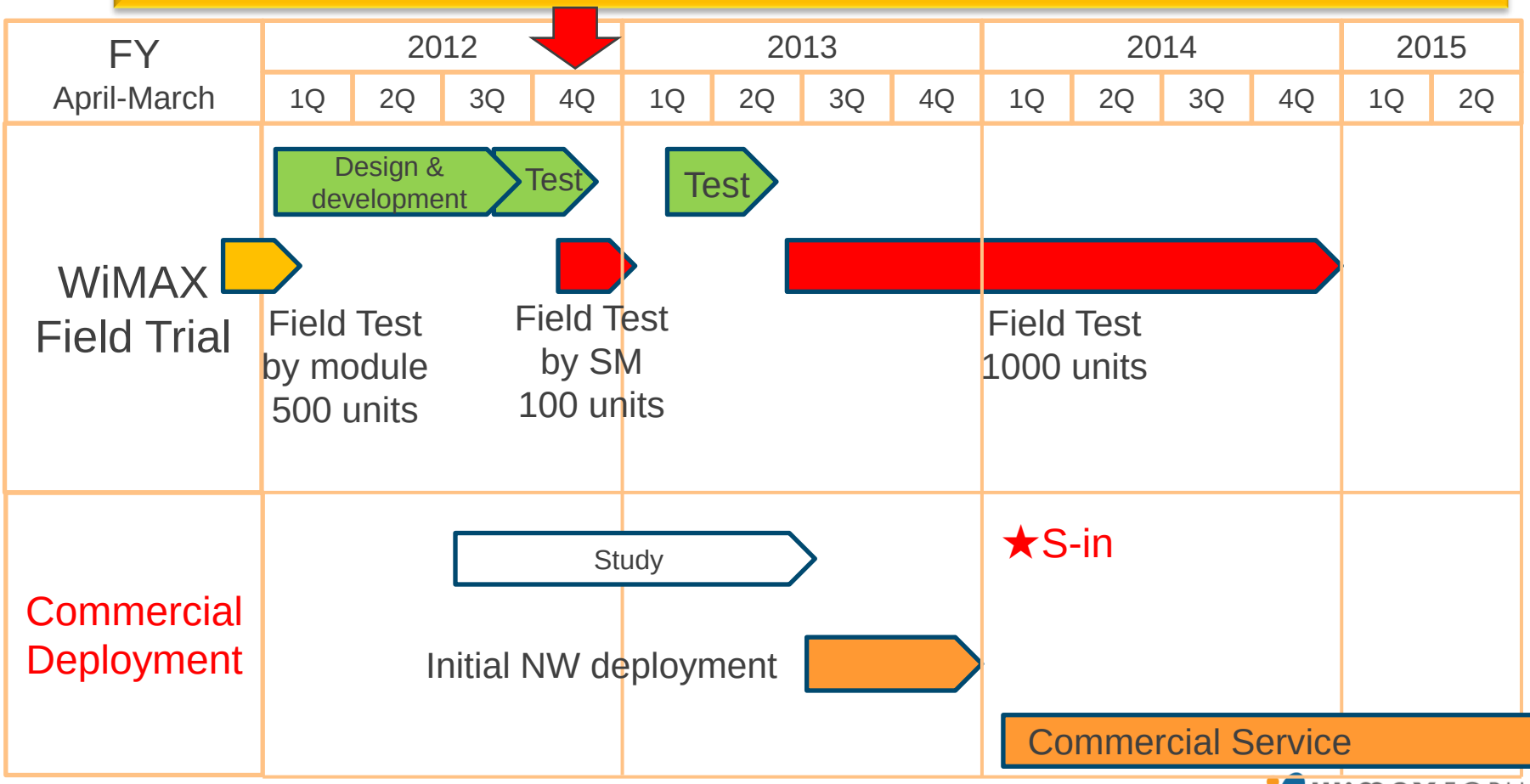
Electric Power Companies in Japan

Total number of consumer market : 76.3 M



Kyushu Electric Power Company WiMAX Smart Meter

- Announced that WiMAX will be used if field test is successful
- About 7 Million meters for 10 years deployment
- 2013～2015：about 0.3M meters/year
- 2016～：about 0.8M meters/year



Kyushu Electric Power Company WiMAX Smart Meter

- WiMAX Smart Meter field trial
  - UQ WiMAX NW and certified modules
  - Residential area test
  - Urban apartment test
  - Indoor testing

WiMAX testing in an actual meter box

(WiMAX module is mounted on a conventional meter, which is not a WiMAX embedded smart meter.)

WiMAX embedded Smart Meter developed by KDDI

- ✓ certified model different to the Kyushu field trial
- ✓ apply to TEPCO POC test

Case Study: City of Houston, Texas

- WiMAX remote control of over 2,500 traffic intersections and 1,500 school zone flashers
- WiMAX connectivity at over 500 city facilities
- WiMAX remote monitoring of 150,000 city water meters
- WiMAX connectivity to public schools
- WiMAX connectivity to over 300,000 residents in underpriviledged and underserved communities

Case Study: Center Point Energy, Texas

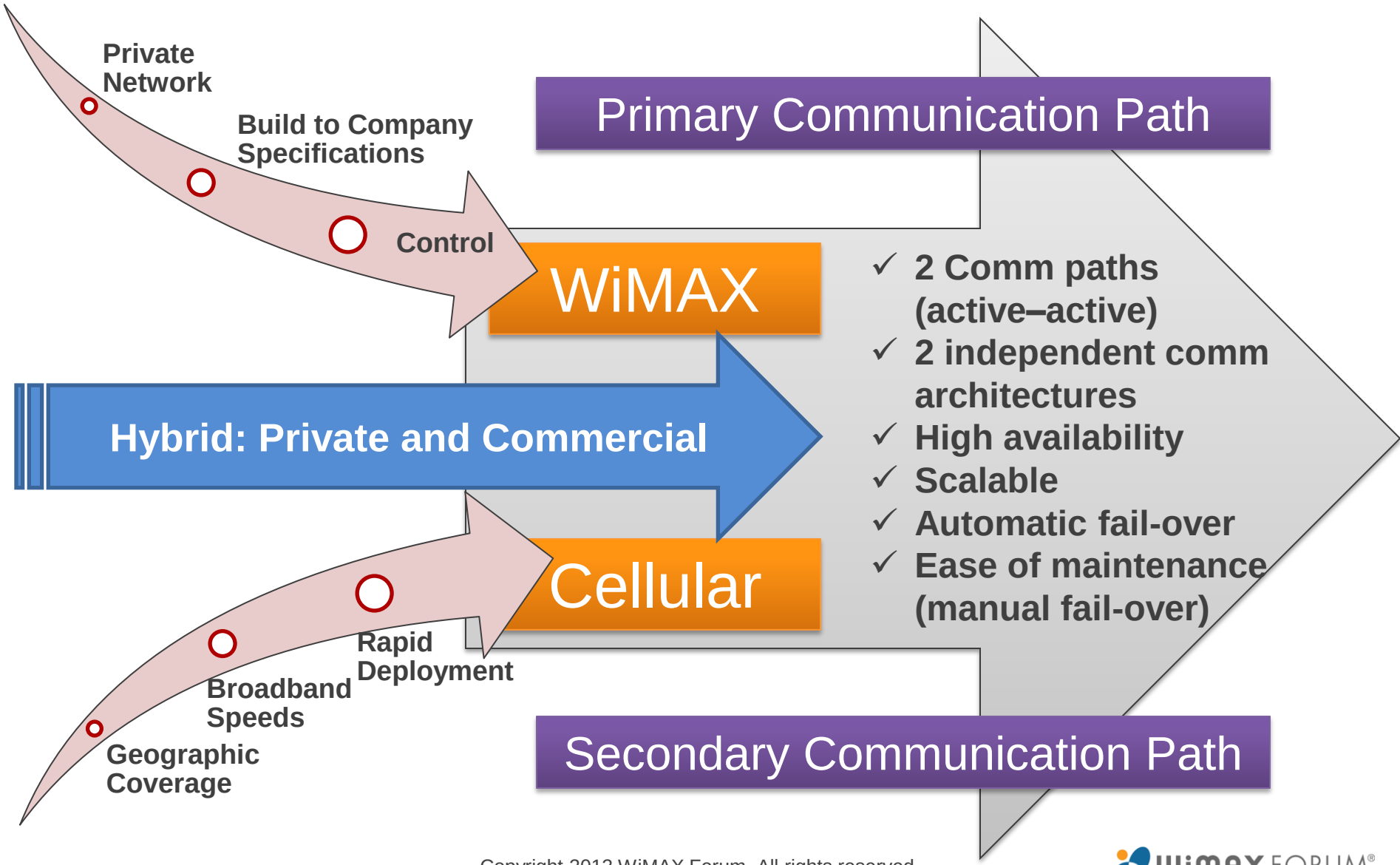
Purpose: Architect and build an end-to-end communications network to support the Advanced Metering System and Intelligent Grid system.

Timeframe: 42 Months

Objectives:

- Provide communications coverage to CNP's entire 5,000 sq. mile electric service area
- Deploy approximately 5,500 cell relays (meter data collectors) and 140 WiMax tower sites that communicate with 2,300,000 meters.
- Provide redundant two-way communications to end points, i.e., meters, grid devices.
- Utilize a dual communication (active-active) path architecture that is scalable to meet Smart Grid communication needs
- Provide required data throughput capacity
- Perform reliably, i.e., storm conditions
- Comply with cyber security std's.

Center Point: Hybrid Solution



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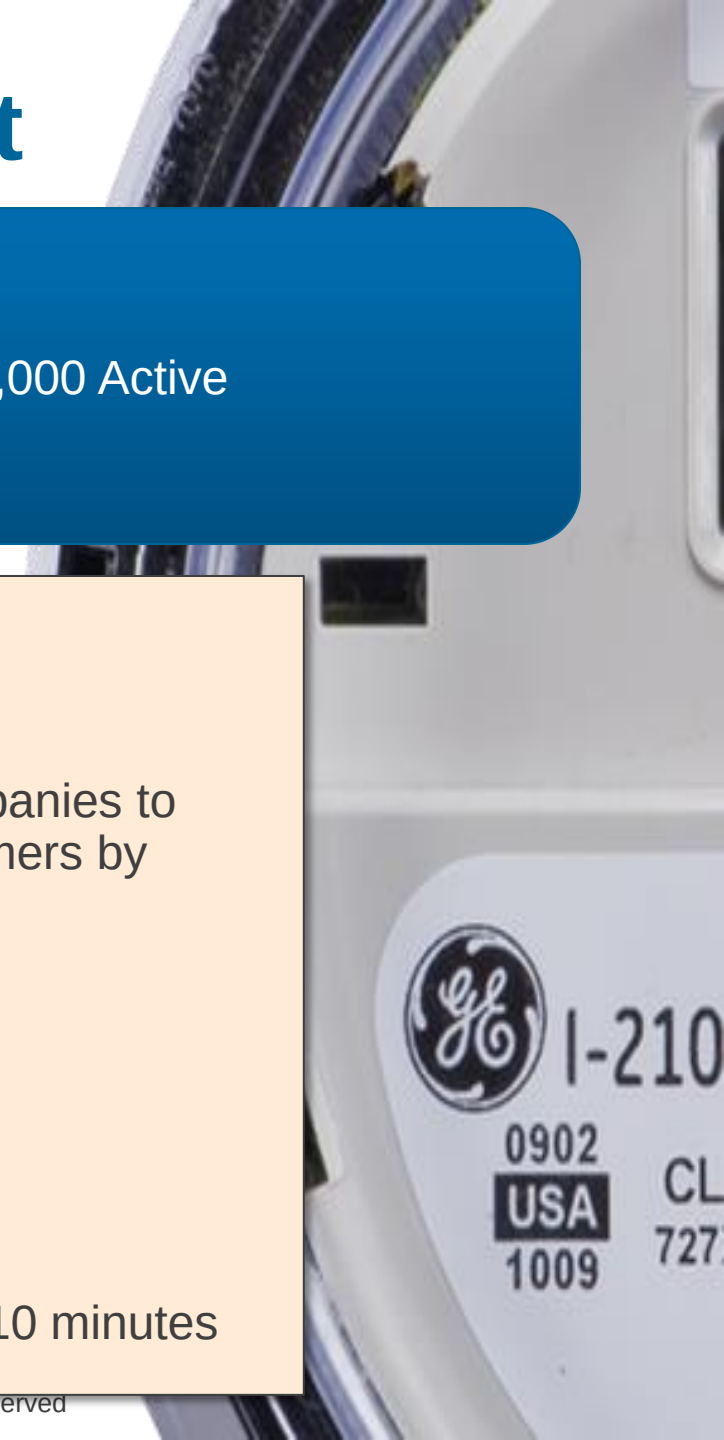
Case Study – SP Ausnet

- World's First WiMAX-Based Smart Metering
- 680,000 Smart Meters in Total – Currently at 320,000 Active
- Up to 40X More Devices per Sector



Project Driver:

Victorian Government mandated electricity companies to provide 2 way communications with their consumers by 2013

Delivering Challenging Requirements

1. 100% meter population Read in 2 Hours
   - ☼ Up to 8,000 meters per sector
   - ☼ 25,000 Daily Reads
2. 15,000 On-Demand Reads per day
3. 1000 meters Remotely Reconnect in Only 10 minutes

Case Study - SP AusNet
5 Factors for Smart Grid

SP AusNet™
A member of Singapore Power Group

- Delivered WiMAX Based Solution

1. Security – Inherently Secure, Protects Utility and Customers
2. Standards Based Technology – Leads to Lower Device Costs
3. System Reliability – Carrier grade, High Availability Features
4. Supplier Assurance – Assures Long Term Support, Reduces technology risk
5. Spectrum – Licensed Spectrum Eliminates interference caused system outages

Current Applications	Future Applications
Meter Data Aggregation and Collection	Distribution Automation
Load Control	Mobile Workforce Management – Field Mobility
Remote de-energize / energize	Thermal Imaging
Load Balancing	Security

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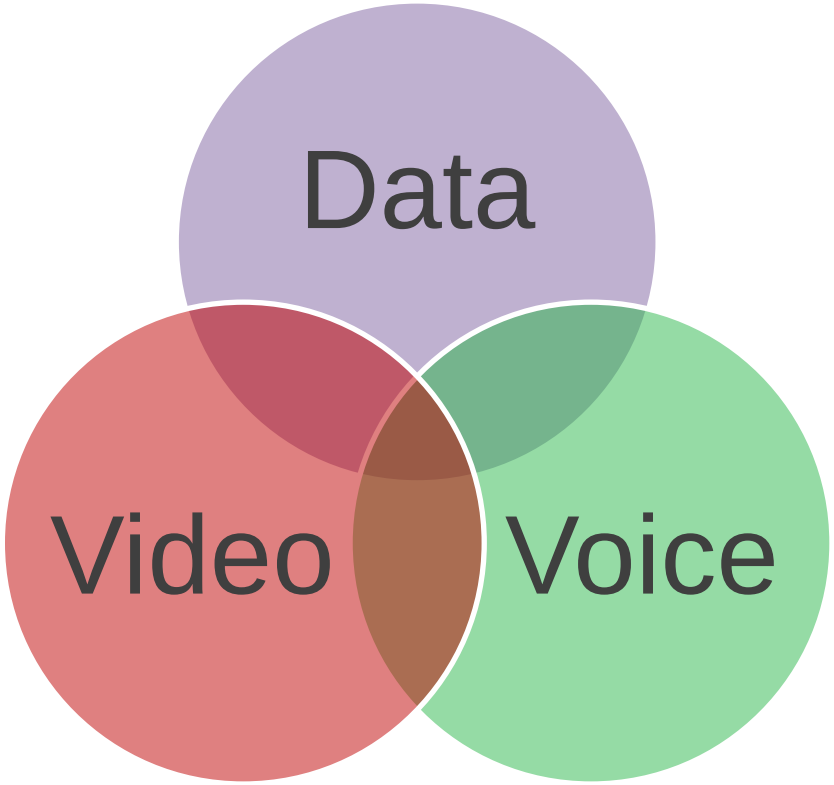
Mar del Plata, Argentina – Digital City

- Challenge:
  - 271 points to be connected
  - Mix of rural and urban
  - Support multiple services:
    - VoIP, Internet, Private Data and Video.
  - Support critical mission services
- Solution:
  - Mixed Smart Network with WiMAX wireless backhaul and access

- Area: 1.460 Km2
- Population: 616.612
- Beach: 36 Km
- Heavy Tourism

Mar del Plata

Multi-Service Network



Connections

- 11 Community Participation Centers (CPC)
- 60 Health Centers
- 36 Primary Units of Health Care (UPAS)
- 30 Police Stations and Department of Judicial Police
- 36 Municipal Nurseries
- 38 Elementary Municipal Schools
- 14 Adult Education Centers
- 46 Municipal buildings, cultural centers and libraries

Case Study: EDP no Brasil

EDP no Brasil

- 28 Cities
- 1.5 Million consumer units
- 4.6 Million clients
- 63 Substations
- 14.7 TWh of Distributed Energy
- 3,500 MVA installed power

Pilot City: Aparecida

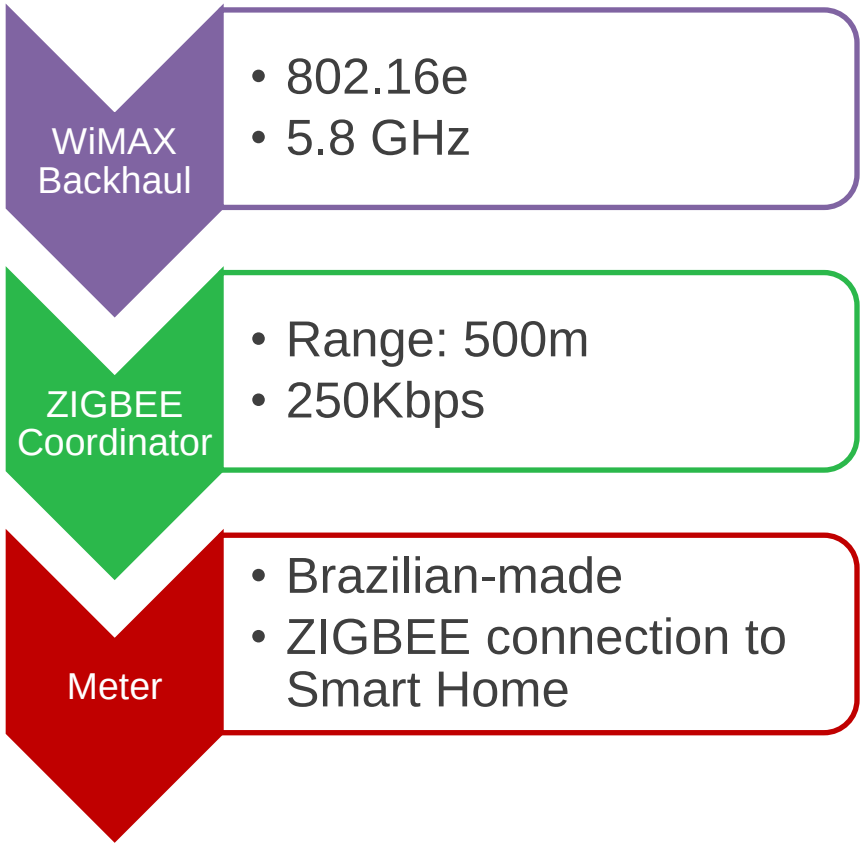
- 35,000 inhabitants
- 15,300 power customers
- 121 km^2
- Tropical Climate
- High HDI Level (0.804)
- R$9.988/person GDP

Aparecida Project

Applications

- Grid Management
- Loss Management
- Process Flags
- Metering Portal
- CCS Integration
- Tariff Management

Architecture



Other WiMAX Smart Grid Networks

- AusGrid
  - *4G WiMAX "Direct-to-the-meter" AMI*
  - *4G WiMAX Distribution Automation*
  - *4G WiMAX Mobile Workforce*
- Salzburg AG
  - Overlay across their grid that allows the transfer of real-time data all the way from the individual home /office meter to the network operation center
- PPL Electric (Harrisburg Pennsylvania)
  - Distribution management system
  - Secure WiMAX infrastructure
  - Integration with AMI and rest of the network
- A&N Electric Cooperative
  - Distributed Feeder Automation for Fault Detection, Isolation, and Restoration
- Eastern Nebraska Public Power District Consortium (ENPPDC)
  - Connect redundant operation centers to substations and downline devices using wireless communications, SCADA software, distribution automation software, intelligent reclosers and controls, automated regulator controls and irrigation load control devices