AMI and DA Convergence

Smart Grid Challenge

A utility’s distribution system is controlled by switchgear, which includes reclosers, sectionalizers, capacitor bank controllers and voltage regulators

- Installed in Substations and along the Distribution Feeder

➢ The Distribution Feeder is the “challenge”
- Many switchgear elements are controlled by intelligent electronic devices (IEDs)
- Automatic control of the distribution network elements is typically done using a dedicated SCADA system
- Today monitoring & control of remote IEDs requires:
  - Site visits by a technician
  - Installation of a private or public network

Most solutions today are expensive and insecure
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Evolution

- AMR: Simple, 1-way communications
- AMI: 2-way communications with account mgmt.
- DA: Simple SCADA
- DNP3, other protocols

Advanced Metrology
- AMI
- Shared WAN comms

Advanced Sensors
- AMI
- Gatekeeper
- IP AxisLink
- Secure Tunnel Server
- OMS
- Volt/Var

AMIG
- Integration Platform
- Sensors (AMI)
- Loss
- Volt/Var
- OMS
- Asset Mgmt

Shared Data Tightly Integrated
- Elster extends data model to cover AMI and DA.
- Integrates best-of-breed DA partners
- Integrated Business Case

IP based
- Elster delivers flexible communications architecture to support both DA and AMI

Common Security
- Elster delivers security architecture to cover DA.
- Develops best-of-breed DA partners

1990s

Today
Converging AMI with DA Drivers
Extending Visibility and Control

System Visibility
Utility has little or poor visibility beyond the distribution substation

Generation  Transmission  Distribution  Customer Premise
AMI and DA Convergence

Smart Grid Evolution

• Remote visibility and control of a distribution feeder system is a key component of an integrated Smart Grid

• Key Smart Grid challenges include:
  – Integrating stranded remote distribution components on the feeder into the existing SCADA systems
  – IED interoperability based on industry protocol standards
  – Integrated security
Converging AMI with DA Drivers
Distribution Automation Benefits

Benefits:

• Reduced operation and maintenance costs
• Improved reliability
• Power quality
• Improved information and control
• Increased network visibility

Better service!
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Advanced Grid Router Roles

IP Router functional requirements include:

- Leverage one WAN/FAN for both AMI and DA communications
- Provide a secure, encrypted, and authenticated communications
- Standards based interfaces to field network DA and AMI devices

Plus…

- Support for AMI & DA protocol routing (i.e., DNP 3.0, C12 protocols)
- Legacy DA device support including Discrete Input/Output control for existing and new equipment (RS232, Ethernet)
- Hardened form factor for outdoor feeder and 3rd party DA enclosure installations with battery backup
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Advanced Grid Router Examples

Itron
- GridRouter – Includes Linux-based O/S Software Developers Kit
- Supports IPv6, ZigBee & WiFi interfaces, Open O/S
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Advanced Grid Router Examples
AMI and DA Convergence
Advanced Grid Router Examples
Cisco 1000 series grid router network
AMI and DA Convergence
Advanced Grid Router Examples

ABB - Tropos wireless mesh WiFi grid router

**Tropos 1410**
Wireless Mesh Router & Wireless Bridge for field area networks

**FEATURES AND BENEFITS**
- 802.11b/g/n wireless mesh routers and bridges
- IPSec VPN and firewall in every device
- Ethernet or serial device connectivity
- DNP3, Modbus, SEL Mirrored Bits and IEC 61850 support
- Stand-alone and embedded versions
- Tropos Control network management
DA – AMI Network Convergence
Advanced Grid Router Examples

Robust, centralized wireless network management

ABB-Tropos Network Monitoring
AMI and DA Convergence
Advanced Grid Router Examples

Silver Spring Networks
• Supports device-to-device routing using a WAN Access Point coupled with DA bridges

Features
• Two-way 902-928 MHz FHSS communications
• One-watt transmitter
• Dynamic IP-based network discovery
• Time synchronization and management
• Continuous neighbor monitoring and route calculation
• Supports device-to-back office and device-to-device routing
• Over-the-air firmware upgrades
• Power outage and restoration notification and products
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Advanced Grid Router Examples

Silver Spring Network & application management
• Supports device-to-device routing
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Advanced Grid Router Examples

CalAmp
- Open Linux O/S
- Hardened communication platform
- Device-to-device routing
- Integrated Discrete Inputs/Outputs

Experience
The Advantage
- Internal web configuration, diagnostics and OTA updates
- Auto redial (always-on connection)
- ODP partitioned flash for custom applications
- GRE and IPsec tunneling, local IP, VPN client and WAN gateways
- Internal serial port for embedded devices
- Optional local and remote GPS for AVL and local mapping
- Wi-Fi option with tethered connectivity
AMI and DA Convergence
Advanced Grid Router Examples

Siemens – RuggedCom grid routers & IEEE802.16 WiMAX radios
  - Hardened communication platform
  - Internal web configuration
  - Device-to-device routing

Ruggedcom RX1400
Intelligent Node

RUGGEDCOM
RX1400 is a compact Layer 3 integrated switch and router – ideal for large scale, hierarchical networks, capable of transporting data from both modern Ethernet-based IEDs and from legacy or low cost serial IEDs.

RuggedMAX™ WiN7200 is a long range, secure, IEEE 802.16e-2005 mobile WiMAX broadband wireless platform
EnergyAxis IP AxisLink Platform
IP AxisLink Router/Gatekeeper/Gateway

Benefits:

- **Interoperable**: routes/tunnels industry standard IP-based & DA protocol messages
  - TCP/IP, UDP/IP, DNP-IP, Modbus-IP, IEC 61850
- **Adaptable**: supports legacy equipment with serial and discrete I/O control via DNP
- **Integrated security**
- **Connectivity**:
  - Ethernet, wireless
  - 3rd party radios

Install at DA control devices such as reclosers, load tap changers and capacitor bank controllers
AMI and DA Convergence  
Scenario Examples

- Bellwether meters provide voltage data to AMI head end via AMI network
- AMI head end receives voltage data from bellwether meters and EOL transformer monitors forwards this data to the target Distribution Management System application(s).
- Secure Capacitor and Voltage Regulator Control communications provided by AMI grid routers via a shared DA-AMI WAN backhaul

Volt/VAR with Bellwether Metering
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EnergyAxis IP AxisLink

MultiSpeak - CIM

DMS/SCADA

EnergyAxis Management System

DA Voltage Regulator

DA Recloser

Utility IED (DA IP endpoint)

IP AxisLink Secure Tunnel Server (STS)

Ethernet IP

Utility IED (EnergyAxis IP endpoint)

DA Capacitor Bank

IP AxisLink routers (EnergyAxis IP endpoint)
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Transformer Life Analysis

Issue: Utilities have little visibility down to transformers.
Problem: An emergency replacement of a transformer can cost up to $10,000, while a scheduled maintenance replacement is only $1,000.
Solution: Meters can be used as sensors. Meters on homes can be summed to get virtual transformer loading. Meter on the transformer can get actual loading (Rogowski coil sensors)
Transformer monitoring can:
• Be used to calculate shortened transformer life due to overloading
• Can be used to rebalance transformer loading

Note: The same transformer sensing capability can be used for theft detection.
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Transformer Asset Management

LV AGI Node

Distribution Transformer Monitoring

• Monitors distribution transformers
• Monitor voltage, transformer loading, outage
AMI and DA Convergence
Transformer Asset Management

LV AGI Node

Features

– Integrated with Alpha metering platform
– Standard product supports EA AMI LAN
– Fully integrated voltage and current metering
– Continuous current measurement range – Up to 1000A
– Safely and accurately measures 240 V distribution transformer secondary
– Adaptable current sensor assembly with integrated voltage attachment
– Flexible mounting options
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Transformer Life Analysis

Transformer Life Impact - Summary Stats

Heat Wave Week in July 2010

- Transformer Rating: 75.0 KVA
- Peak Demand: 133.2 KVA
- Peak Demand: 119.88 KW
- Overload: 48 %
- Load Factor Rating: 0.59
- Use Factor Rating: 1.78
- Outages: 0
- Total Outage Time: 0.0 Minutes
- Loss of Life: 6.45 %

Another Week in July 2010

- Transformer Rating: 75.0 KVA
- Peak Demand: 100.27 KVA
- Peak Demand: 90.24 KW
- Overload: 12 %
- Load Factor Rating: 0.5
- Use Factor Rating: 1.34
- Outages: 0
- Total Outage Time: 0.0 Minutes
- Loss of Life: 0.0 %

*Based on IEEE C57.92-1981 as a starting point*
AMI and DA Convergence

EnergyAxis IP AxisLink

Integrated SCADA and AMI IP-enabled routers

- Leverages one WAN solution for both AMI and DA communications
- Provides multiple secure IP connections to field network DA and AMI devices
- Provides support for combined AMI & DA protocol routing (i.e., DNP 3.0 and C12 protocols)
EnergyAxis IP AxisLink

Feeder Fault Detection

- Integrated within AMI communication infrastructure
- FCI fault information can be passed from AMI head-end to external OMS or DMS applications
- Improves reliability with fast, effective fault location and isolation
- Utilizes the IP AxisLink platform to monitor FCI status

IP AxisLink field device

Wireless Fault Circuit Indicator (FCI)
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For conservation voltage optimization / reduction

To Billing and Customer Information Systems

MDM

Connexo NetSense

SCADA / DMS

WAN

SCADA control system:
control load tap changers,
voltage regulators
icapacitor banks

Edge Router

RF NAN

• Voltage management solution uses voltage data from key monitoring points along the feeder
• Elster network is used to communicate with IEDs in the field to control voltage.
• Energy savings result from lowering voltage where possible. (For 120 V systems, 1V reduction results in ~0.8% reduction in energy)
Thank you