NEXT GENERATION
SMART METERING / INTELLIGENT GRID
Implementation Taking Hold Worldwide

Andrew Gillen
Echelon Corporation
Metering Is At a Generational Turning Point

- From electro-mechanical to digital
- From isolated to networked
- From basic measurement to rich base functionality
- From limited to flexible tariff plans
- From single application to a flexible network platform
- From fixed function to remote upgradeability
- From dumb electrical networks to an intelligent grid
There has been no clear and consistent use of the terminology within the industry

AMI and smart metering are, in fact, not limited
- More than just two-way communications
- More than just kWh monthly and interval metering data
- More than just supporting meter reading applications
- Can not retrofit comms modules to existing electro-mechanical meters
What AMI and Smart Metering Looks Like

- Network (IP)
  - GPRS, 3G, WiMAX, Fibre, RF Mesh

Intelligent Grid must have key ingredients

- Management Center
- Network with network OS
- Intelligent Devices
- Customer Relationship System
- Outage Management System
- Billing System
Next-Generation Smart Metering Has Already Taken Hold in Many Parts of the World
“… Enel will save 500 million euros in operational costs a year, which repaid the investment in four years,”
— Vincenzo Cannatelli, Enel's head of distribution and markets

VATTENFALL

“… during the tender process, a generation change in technology took place…”
— Göran Lundgren, CEO of Vattenfall distribution

NUON

“… will not only be able to improve our efficiency and lower our costs to the benefit of our shareholders, but also improve our quality, reliability, and responsiveness to the benefit of our customers.”
— Paul Corton, CEO of Continuon Netbeheer
## NES Reference Projects Worldwide

- Vattenfall (SWE): 700K
- E.ON (SWE): 370K
- NUON (NL): 35K
- Linz AG (AUT): 75K
- ELRO (DK): 40K
- Duke (USA): 65K
- EAC (RUS): 250K
- Intergal (AUS): 5K
For Success, Design Center Must Change From the Smart Meter to the Smart Grid

- Next-generation utility systems are *networked systems that contain meters*, not just *metering systems*
  - Meters are the most common connected device today, but not the only connected device in the future

- The network is the core component of a successful advanced metering deployment and on-going smart grid expansion
  - Security and scalability need to be “network-grade” and designed in from the ground up
  - Expandability and flexibility are essential to “future proof” the system

- Must focus on a system platform, not only communications
Vattenfall Group

- Europe’s fourth largest generator of electricity and the largest generator of heat
- Vision: To be a leading European energy company
- Operations in Sweden, Finland, Denmark, Germany and Poland
- Electricity generation, transmission, distribution, sales and trading
- Heat generation, distribution and sales
- More than 32,000 employees
- Turn-over 13,697 MEUR (2005)
- Vattenfall AB is wholly owned by the Swedish State
“...during the tender process, a generation change in technology took place…”
— Göran Lundgren, CEO of Vattenfall distribution
### Smart Grid Components & Targeted Benefits

#### “Intelligent” Communication Infrastructure

- **Substation Automation**
  - Improved reliability
  - Remote breaker operation
  - Improved Voltage Regulation
  - Automated Emergency load reduction
  - Improved asset management

- **Distribution Automation**
  - Improved reliability
  - Improved PQ
  - Improved system efficiency (Volt / Var Management)
  - Emergency load reduction
  - Reduced equipment inspections
  - Self Healing capability
  - Improved asset management
  - Reduction of technical losses due to better modeling

- **Smart Metering / AMI**
  - Remote meter reading
  - Remote connect / disconnect
  - Prepaid metering
  - More billing options (weekly, bi-monthly or monthly)
  - Auto On site outage reporting
  - Meter accuracy improvement
  - Reduced energy theft
  - Improved public safety

- **Behind the Meter Applications**
  - Energy Efficiency
  - Peak Load Mgmt
  - Demand Response Rates
  - CO2 Offset from peak reduction
Societal Benefits Enabled by a Smart Grid

- Initial estimated impact (US, 2010): 35 – 187 billion kWh annual energy savings
- Equivalent to reducing 23 – 120 million metric tons of CO₂
- Equivalent to taking 4 to 20 million cars off the road

Source: EPRI
<table>
<thead>
<tr>
<th>Customer Benefits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Remote initiation, transfer, and termination of service</td>
</tr>
<tr>
<td>Automatic disconnection and reconnection</td>
</tr>
<tr>
<td>Prepaid metering</td>
</tr>
<tr>
<td>Individualized pricing and additional payment conveniences</td>
</tr>
<tr>
<td>Energy efficiency programs and energy savings for residential and nonresidential customers</td>
</tr>
<tr>
<td>Load control initiatives</td>
</tr>
<tr>
<td>Elimination of Meter Access Plan and estimated meter reads</td>
</tr>
<tr>
<td>Increased power quality</td>
</tr>
</tbody>
</table>
Who is Duke Energy?

- Fortune 500 Company, based in the U.S.
- Assets over $48 billion
- 3.9 million customers
  - 5 states: North Carolina, South Carolina, Indiana, Ohio and Kentucky
  - 500,000 retail gas customers
  - 47,000 square miles of service area
- Top-tier electric utility
- Top 5 for U.S. generating capacity
  - (~28,000 MW)
- 150+ years of service
- Traded on NYSE as DUK
- Stock dividends for 80+ years
Solution Models - IP Meter

- Integrated Meter and Comms Module – all IP to the meter from the Management system
- Public wireless network (Verizon) to connect to Meters from NES
- 65,000 meters to be deployed in the US as initial phase of AMI rollout
Duke’s Vision and Strategy Statement for their Utility of the Future Team

Vision Statement for the Utility of the Future Project
- Our vision is to transform the operation of our electric power grid by creating a networked infrastructure capable of delivering and receiving information from intelligent devices distributed across our power system, automating components of the distribution system and leveraging the network for improved operational efficiencies and improved customer satisfaction.

Strategy Statement for the Utility of the Future Project
- Our strategy is to investigate, select and deploy intelligent devices across our distribution system which will measure, protect and automate the grid, combined with a communication system linking the intelligent devices in a networked fashion, creating opportunities for system wide load response, enhanced outage management, better asset management, more efficient operations, and empowering customers to use electricity more efficiently.
Beyond the Meter

- In Home Displays
- Renewable Integration
- PHEV
- Smart Meter
- Whole House Energy Manager
- Smart Thermostats
- Home Automation
- Mobile Support

UCM
AMI and Smart Metering is Evolving; Bringing Utilities to New Levels

Business process change key to delivering ROI

Manual meter reading
- Monthly kWh reads

Automatic Meter Reading (AMR)
- One-way or two-way
- Monthly kWh reads
- Interval data
- Basic theft detection
- Outage/Restoration Detection

Advanced Metering Infrastructure (AMI)
- On-demand reads
- Programmable load intervals
- Bi-directional and net metering
- TOU, RTP, CPP pricing options
- Demand response
- Gas & Water metering

Smart Meters
- Solid-state platform
- Integrated communications
- Integrated disconnect switch
  - Remotely disconnect
  - Remotely connect
- Power quality data
  - Voltage readings
  - Current readings
  - Power Factor
  - Frequency
  - Detailed power outage data
- Advanced theft detection
- Remote programmable
- Remotely upgradeable
- Internal expansion port
  - Future functionality

Smart Grid
- Energy Management Services
  - Residential, Commercial
- Home Area Network gateway
  - PLC (i.e., LonWorks®)
  - RF (i.e., Bluetooth)
- Web-based applications
  - Demand Response
  - Prepayment
  - Load Control
  - Revenue Protection
- Distribution
  - Load profiling/engineering
  - Phase balancing
  - Transformer optimization
  - Energy forecasting
  - Outage detection and GIS
  - Restoration automation
  - Work Force Management
  - Automated Field Dispatch
  - Asset Management

ECHELON®
Summary

- Next-generation systems are the future of metering and the utility industry
  - Creates a paradigm shift in the industry
  - Creates a new tool for generation planning
  - Only enabled by using truly smart meters
  - Requires a network-centric approach to reliability, security, and scalability

- Next-generation systems deliver substantial benefits to utilities and consumers
  - Dramatically more beneficial than just AMR with two-way communications

- Next-generation systems enable in-home applications

- Next-generation systems provide the infrastructure for meeting today’s requirements and the platform for delivering future applications

- The utility of the future needs to take a system level approach today in design and deployment of the intelligent grid infrastructure that will support tomorrow’s business
Thank You