The Intelligent Grid and Advanced Metering

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“To be recognized as America’s Leading Energy Delivery Company... and more”

- Public company traded on the New York Stock Exchange (CNP)
- Headquartered in Houston, TX
- Operating 3 business segments in six states
  - Electric transmission and distribution
  - Natural gas distribution
  - Interstate pipelines and natural gas gathering
- Serving nearly 5 million electric / gas customers
- $17 billion in assets
- $8.5 billion in revenue
- More than 9,000 employees
- Over 130 years of service to our communities
CenterPoint Energy – Houston Electric

- Chartered in 1882
- 5,000 square-mile service area
- 1.86 million metered customers
- 73.6 billion kilowatt hours delivered yearly for about 60 certified competitive retailers
- Transmission and Distribution System
  - 3,640 miles of transmission lines
  - 34,000 miles of medium voltage lines
  - 8,000 miles of “backbone” medium voltage lines
  - 225 substations

CenterPoint’s Challenge:
Effectively monitor and control millions of line devices and miles of delivery wire which if laid end to end almost circle the earth twice around the equator.
Current Electric Utility Environment

- Increase shareholder value
- Increasing costs
  - Labor
  - Gas – Overall rates
  - Copper, aluminum, steel – Transformers / conductors
  - Vehicle Fuel
  - Taxes and franchise fees
- Continued regulatory pressure to decrease rates
- Regulatory reliability concerns / awareness
  - Northeast blackout
  - Hurricane impacts
- Increasing Deregulated Texas Electric Market Demands on performance
- Increased management / accounting controls – Sarbanes / Oxley
- Aging workforce – both internal and field (Knowledge / Skill Transfer costs)
- Electric Utility Energy Market Changes
- Rapidly Changing Customer Needs

The overall utility environment is demanding higher performance in an ever increasing cost environment.
"Rapidly Changing Customer Needs"

“The greatest challenge facing electric distribution is responding to rapidly changing customer needs for electricity. Increased use of information technologies, computers, and consumer electronics has lowered the tolerance for outages, fluctuations in voltages and frequency levels, and other power quality disturbances. Source: “Grid 2030” A National Vision for Electricity’s Second 100 Years, p 7

Electro-Mechanical Era → Digital Era → Convergence Era

Customer expectations begin to change

Customer expectations

1960’s 1970’s 1980’s 1990’s Today

Utility “Smart Grid” strategies converge on changing customer expectations.
Intelligent Grid Roadmap

The CenterPoint Energy Intelligent Grid Roadmap aligns with the DOE’s “Grid 2030” and EPRI’s IntelliGrid Framework

Self Healing Grid Objectives

― “The self healing grid is an important building block of the smart power delivery system”

Preventive

Identify and repair intermittent grid problems to minimize outages

Real Time Sensing & Responding

Quickly react to disturbances to minimize impact

Continuous Monitoring

Dynamically optimize the performance and robustness of the system

Event Avoidance

- Remote Load Profiling / Mgmt
- Grid Event Diagnostics
- Advanced Data Analysis
- Grid Condition Sensing & Predictive Response

Self-Healing Grid

- Improved Asset Mgmt / Visibility
- Real time Grid Condition Monitoring
- Automated Grid switching, etc.
- Meter as a Sensor
- Transformer Load Mgmt
- Condition Based Crew Dispatching
- Grid Event Detection and Location

Automated Meter Infrastructure (AMI)

- Meters
- Meter Interrogation
- Meter Connect / Disconnect

CenterPoint Energy

INTELLIGENT GRID ROADMAP
What Makes the Grid “Intelligent”

*Advanced meters as grid sensors.....

...And a robust communications network are the cornerstone to the Intelligent Grid....

The analytics engine is the “Intelligent Brain” that will continuously receive (“Sense”) grid sensor data and will convert data to information and transmit (“Respond”) instructions to grid field devices.
An Effective Communications Architecture that aligns with grid assets

- The backhaul communications network strategy is multi-tiered….
  - Tier 1 - Major backhaul: Data Center to the substations
  - Tier 2 - Minor backhaul: Substations to the IG device or meter relay (Utility Grade BPL)
  - Tier 3 – Wireless Meter Data Collector communicates with the meter
  - Tier 4 – Meter to ZigBee wireless connections to home energy management devices
Intelligent Grid “Utility Grade” Tier 2 Architecture

**BPL is used as a utility grade data backhaul medium…..**

To meet the utility requirements, the communications architecture requires fewer BPL repeaters to achieve the necessary bandwidth.

Utility Grade BPL Network - MV Circuits Only…. (Fewer BPL Repeaters are spaced farther apart)

Meter data collectors, utility sensors, switches for utility automation

Traditional BPL to The Home (BPL repeaters at every transformer to provide capacity and access)
The main advantage for BPL lies in the fact that a significant portion of the network infrastructure already exists and...

...given the pervasiveness of the electric grid, BPL network technology allows the utility to overlay a robust communications layer on the existing electric grid to enable equipment, i.e., meters, to serve as critical grid sensors.
Meter and In-Home Communications
Meter and In-Home Communications

Energy Management and Conservation via a Zigbee connection to home devices
2007..... Pilot Deployment Status

CenterPoint Energy is working with IBM to test the end to end integration of the advanced metering and Intelligent grid components.

AMS
- Installed 9,853 advanced electric and 100 of 500 gas meters.
- Integrated advanced metering software.
- Integrated OpenWay Cell Relays into the BPL network.
- Established 2-way communications to the meter.
- Tested ZigBee HAN functionality.

Communications
- Fiber / Microwave backhaul to 3 substations complete.
- 20 BPL circuits (with battery backup) are communicating (99.5%+ reliability and averaging 5mbps).

Intelligent Grid Testing
- Connectivity to automated switches, voltage regulators, etc.

2004
- Economic Viability & Technical Testing

2005
- Small Scale Pilot w/ IBM

2006-2007
- Pilot Deployment w/IBM
- Full deployment predicated on necessary approvals
Technical Results from Pilot Deployment to Date

**Metering**
- Advanced meter network communicating via BPL with readings down to five (5) minute intervals
- Established 2 way communications to the electric and gas meters

**Intelligent Grid**
- Established communications via BPL to line devices.

**BPL (Network Communications)**
- Consistently achieving average 5+mbps and averaging 800 - 1,000 feet between repeaters.
- BPL repeaters are not needed at every transformer.
- Substations are an integration point for BPL circuits. No fiber runs down distribution circuits.
- Chosen BPL technology minimizes need for utility “Make Ready”. Significant cost avoidance.
- Worked closely with ARRL leadership to mitigate any BPL misconceptions and/or noise issues.
- Chosen technology emits little or no noise.
- Strong Design, Construction, and Installation standards / processes are important for efficient design and build.
Overall Observations / Take-aways to Date

- Alignment with a strong technology / business integrator, like IBM, is key (assessing alternative and emerging technologies, experience with large, complex system rollouts, and integration capabilities)

- Engage executive leadership and stakeholders early

- Showcase the strategy and technology deployment components to convey “automation” vision (CNP Technology Center)

- Strategy development and deployment is a business unit centric strategy that uses technology as an enabler. It’s a business operations technology “Pull” and not an IT “Push”.

- Advanced metering deployment strategy should be integrated into an overall “Intelligent Utility Network” and data communications strategy to leverage meter as an end-point for grid and network management.

- Robust multi-tiered communications strategy is necessary to handle the data.
Utilities are at a crossroads…..
Fact: According to the DOE Grid 2030 report, in the next 20 years, the U.S. will spend $450B on electric infrastructure; just to meet load growth.

We have a choice…

Perpetuate a traditional 20th Century Solution OR Invest in a 21st Century system that facilitates the digital age, improves reliability and security, enables productivity and economic growth, enables efficient use of electricity and promotes consumer services.
The Intelligent Grid and Advanced Metering

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IBM

November 13, 2007
Blind Men and the Elephant

This will transform my business

How much will this cost again?

Wonder if the CIO knows how big this is?

The consultants said the benefits would be around here
AMI is the foundation for the Intelligent Utility Network (Smart Grid) vision.
Benefits are driven by the **applications** that provide value to the customer and the utility.

**Distribution Operations / Reliability**
- Outage detection and restoration
- Identifying "single-light-out" situations
- Asset optimization
- Asset loading
- Emergency response
- Emergency load shedding

**Demand Management**
- Time-based pricing (TOU, CPP)
- Energy profiling and analysis
- Online energy audits / analysis
- Load control extensions

**Customer Service**
- Better customer information for CSRs
- Reduced customer call volumes

**Revenue Enhancement**
- Cash Flow
  - Fewer estimated bills
  - Shorter billing cycles
- Loss Identification
  - Tamper Alarms
  - Load balancing
  - Move-in detection
- Loss Response
  - Load limiting
  - Remote and virtual disconnect
As costs of infrastructure decline the systems that provide applications will rise in importance and value.
The richness and reach of these applications will drive significant value for the utility and customers.
The Pervasiveness of the Challenge

1. Load Control Devices
2. Displays
3. Meters
4. Installers
5. LAN
6. Asset Maintainers
7. WAN
8. Data Collection Systems
9. Meter Data Management System
10. IT System Operators
11. Integration with Existing Distributor Systems
12. External Data Provision

Retailers
Consumers

GIS
ERP
OMS
CIS
Integration between the AMI field systems and enterprise applications enables a complete “re think” of the enterprise application framework.

AMI Field Systems and Networks

Field System A

Network X

Field System B

Network Y

Field System C

AMI Field Systems and Networks

Network Mgt

Operations Support

Customer Support

VEE

ODS

Deployment Management

Asset Management

Framing

MDMS Basic Functional Context

Customer Enterprise systems

CIS

Financials

Field Operations

Outage

Business Analytics

Core Function

Provided in all viable systems

Customer Specific

Variable based on customer enterprise strategy

Differentiated

Strategic area of development
SOA – A Strategic Necessity

Visibility & Control

BPM
Policy
Services directory
Partner linking runtime
Publish xml
XML
HTTP

Candidate services:
meterPing
meterRead
lineCheck
loadHistory
turnOn
turnOff
powerOn?
outageAnalytic
usageAnalysis
meterChange
meterDeploy
rtuCheck
rtuChange
rtuDeploy
sensorCheck
sensorChange
transformerCheck
transformerChange

Business Services Delivery

Services runtime
HTML / XML / JAVA
HTTP

Partners:
ERCOT
Banks
Retailers
Reps
CSRs
Processes
Computers
Browser-enabled devices
HAN Appliances

Functions and Data sources

Contact Center
Mobile data
OAS
DMS
EMS
CIS
CCS Elec
CCS Gas
Work Mgt.
GIS
Legacy EAI
T-analytics
D-analytics
Enterprise Analytics
MDM
Master data
Sensor processing bus (ESB)
Historian
T-sub analytics
D-sub analytics
Meter data processor
Sensor data processor
Communications network
Systems Management (Tiv)

Legacy EAI

HAN devices

Grid devices

2-way mesh access to HANs:
thermostats
appliance controls
in-home displays
2-way Mesh access to:
meters -- electric,
water, gas,
transformer sensors

Systems Management (Tiv)

HTML / XML / JAVA
HTTP

Partners:
ERCOT
Banks
Retailers
Reps
CSRs
Processes
Computers
Browser-enabled devices
HAN Appliances

Candidate services:
meterPing
meterRead
lineCheck
loadHistory
turnOn
turnOff
powerOn?
outageAnalytic
usageAnalysis
meterChange
meterDeploy
rtuCheck
rtuChange
rtuDeploy
sensorCheck
sensorChange
transformerCheck
transformerChange

Publish xml
XML
HTTP

Contact Center
Mobile data
OAS
DMS
EMS
CIS
CCS Elec
CCS Gas
Work Mgt.
GIS
Legacy EAI
T-analytics
D-analytics
Enterprise Analytics
MDM
Master data
Sensor processing bus (ESB)
Historian
T-sub analytics
D-sub analytics
Meter data processor
Sensor data processor
Communications network
Systems Management (Tiv)
The imperative of “Open”

- The “Open” movement is enabling infrastructure interoperability to help companies respond to ever-changing business needs.

- Open standards and new process standardization efforts reduce business complexity and better integrate work teams with the information they need in order to innovate.

- New IP practices are shaping innovation models that serve to differentiate new ideas while driving for more open, collaborative innovation.
Realizing the value of Smart Meter innovation

- AMI is the foundation for the Intelligent Utility Network (IUN)
- To achieve the benefits of IUN a smart meter, a smart utility and a smart customer are required
- A smart meter is a strategic application enabler (i.e. a means not an end)
- The “value applications” support an informed and empowered customer (smart customer) and a situational aware and proactive utility (smart utility)
- The proven strategy of open standards will drive cost of implementation down and drive innovation up