Smart Grid: Implications for Convergence

Brett Kilbourne

Deputy General Counsel

Utilities Telecom Council

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UTC Study of Utility Communication Needs -

SUMMARY

- Reliable, robust, secure and ubiquitous communications networks are essential to the efficient and reliable future of energy and water utilities and other critical infrastructure industries
- Efforts to introduce greater intelligence into utility networks has escalated communications demands
- A mix of private communications networks and commercial communications services will be required to ensure reliable energy and water utilities in the 21st Century

Key Requirements

- High Reliability
  - Reliability = time a network remains operational and useable
  - Network reliability crucial to ensure continued functioning of grid
  - Utilities design core networks to at least four nines (99.99%)
- Higher-Capacity or Bandwidth
  - Evolving need for complex two-way communications requires more bandwidth
    - Especially core communications central to mission-critical functions that maintain the stability of the electric grid
  - Wide-area backhaul / last-mile access can't rely on existing narrowband wireless
    - One-way or relatively slow speed wireline networks

Key Requirements

- Low Latencies
  - Latency = delay in sending and receiving communications
  - Core and operations networks require high latency
    - Unpredictable levels of latency threaten core operations
  - Acceptable level of latency for utilities?
    - Typically in the low millisecond range (~ 3-10 ms)
    - Depends on specific application and magnitude of risk to operational reliability

Key Requirements

- Ubiquitous Coverage
  - Utilities require full cover over expanse service territories
    - Even isolated and sparsely populated
  - Particularly wireless communications
    - Maintain connectivity with critical assets – to maintain reliability
    - Field force – for safety and efficiency
- Tight Security Measures
  - End-to-end protection of network from physical and cyber attacks
  - Security concerns rise as two-way digital technologies pose increased risks
    - Potentially millions of end points to the network
    - Each of which could be breached and misused
  - New NERC-CIP and NIST requirements coming

Key Requirements

- Uninterrupted Back-Up Power
  - No interruption due to power outages
    - Can’t wait for distribution of warehoused generators
  - Restoration is difficult and dangerous without communications
  - Utilities use some combination of multiple-hour battery supplemented generation
    - On site fuel storage or fuel connection provided

Network Requirements

Application	Bandwidth	Latency	Reliability	Security	Backup Power
AMI	10-100 kbps/node, 500 kbps for backhaul	2-15 sec	99-99.99%	High	Not necessary
Demand Response	14kbps- 100 kbps per node/device	500 ms-several minutes	99-99.99%	High	Not necessary
Wide Area Situational Awareness	600-1500 kbps	20 ms-200 ms	99.999-99.9999%	High	24 hour supply
Distribution Energy Resources and Storage	9.6-56 kbps	20 ms-15 sec	99-99.99%	High	1 hour
Electric Transportation	9.6-56 kbps, 100 kbps is a good target	2 sec-5 min	99-99.99%	Relatively high	Not necessary
Distribution Grid Management	9.6-100 kbps	100 ms-2 sec	99-99.999%	High	24-72 hours

Issues and Answers on Smart Grid

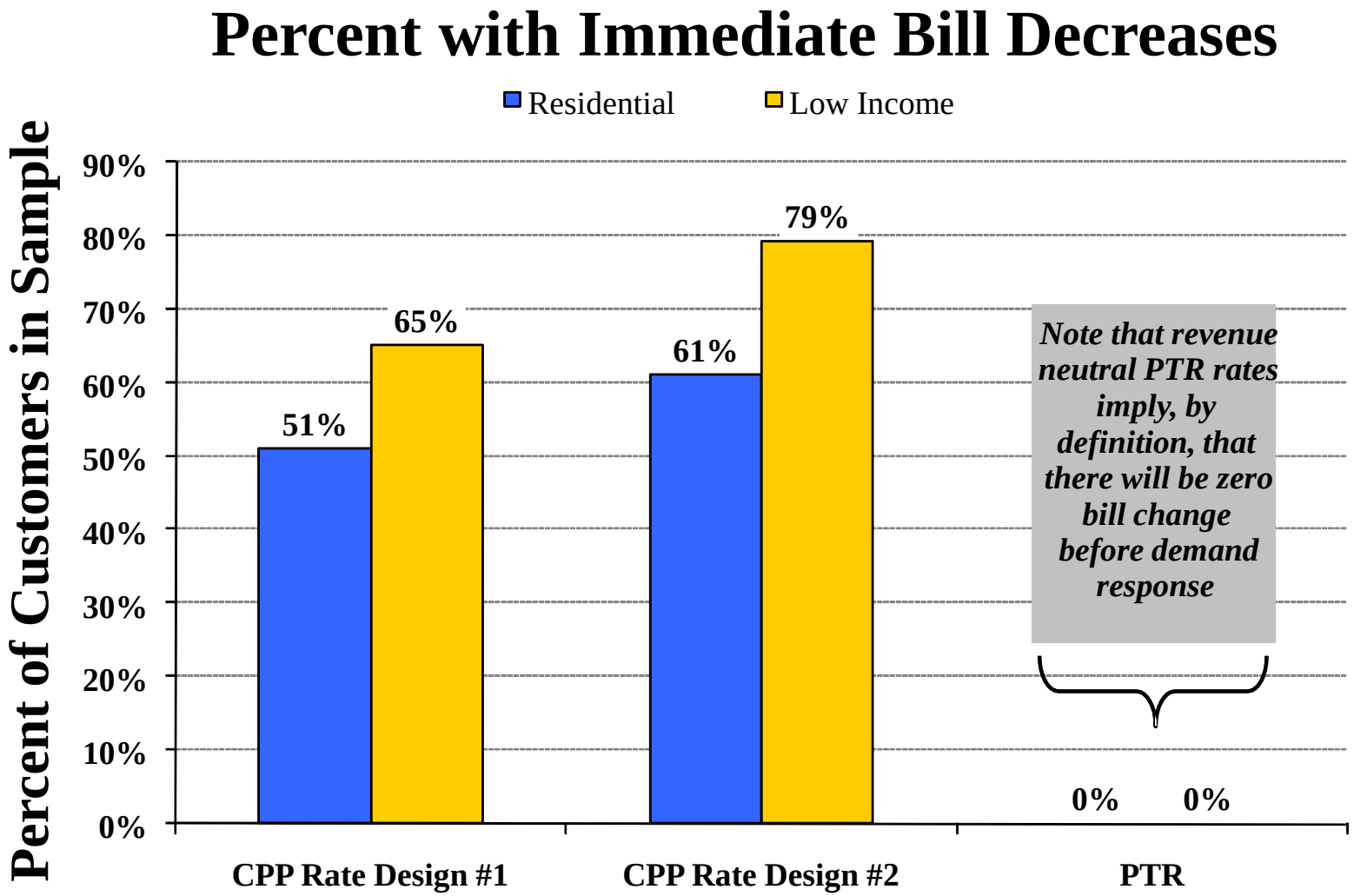
- Cost benefits
  - *"Don't do it, it costs too much"*
  - Studies / PUC decisions based on fact that benefits to consumer outweigh costs
- EMF from meters
  - *More "Currents of Death" (EMF allegations from the 80s)*
  - Evidence shows emissions less than a WiFi signal at a cyber cafe
- Meter accuracy
  - *"My bills doubled"*
  - Studies confirm accuracy, ignored rate design and weather impacts
- Impact on low income
  - *"Raise rates, actually cut off customers, can't respond, food or A/C?"*
  - Studies reveal majority low income customer benefit and/or respond

Low Income Customers Respond

Table 1. Summary of Low Income and Average Customer Response to Dynamic Prices[2]

Program Results	Low Income Peak Reduction	Average Peak Reduction	Low Income vs. Average
BGE 2008: Known Low Income vs. Known Average Customer	*Varies depending on rate type; low income customers respond similarly to average customer*		100%
CL&P's PWEP Program: Known Low Income vs. Known Average Customer	*Varies depending on rate type; low income customers respond similarly to average customer*		100%
CL&P's PWEP Program (PTP high): Hardship vs. Average	13%	20%	67%
Pepco DC (price only): Low Income vs. Average Residential[1]	11%	13%	85%
PG&E SmartRate 2008: CARE vs. Average	11%	17%	66%
PG&E SmartRate 2009: CARE vs. Average	8%	15%	50%
California SPP: Low Income vs. Average	11%	13%	84%
California SPP: CARE vs. Average	3%	13%	22%

Low Income Customers Benefit Even w/o Shifting



Issues and Answers on Smart Grid

- Dynamic pricing / critical peaks
  - *"Too few critical peak hours to make a difference"*
  - Critical peaks determine when utilities spend $Billions on G, T & D
- Cyber security
  - *"12 year old terrorists will play with grid"*
  - Utilities recognize these risks and are working to enhance security
- Shifting risk to consumers
  - *"Wait until used and useful"*
  - At the end of day, consumers bear all prudent costs and risks
  - Meters start providing benefits when installed
- Privacy
  - *"Provides info on when to rob me or when to attack me"*
  - Utilities follow rules, granular data not wanted by utilities

NARUC Resolution

July 26, 2000

- Privacy interests should be given substantial weight in claims for access to and use of customers information
- To the extent practical, customers should be permitted to choose the degree of privacy protection re information outflows and inflows
- Unless a customer grants explicit, affirmative informed consent, customer-specific information about his or her utility service should only be used in connection with rendering or billing for that service or other services requested by the customer, and that such information should not be otherwise available to affiliates or third-parties, unless by Commission order.

Colorado Privacy Rules

- Utilities authorized to collect and use customer data to provide regulated utility service
  - Allow collection of data at new level of granularity
  - May create new, previously unanticipated markets
- Distinguish consumer data privacy use
  - Consumer data re utility service vs. developing markets for unregulated services to utility customers
- Delineates between 3rd parties
  - Customer authorized 3rd parties vs. 3rd parties working directly with a utility in regulated utility services
- Data access requirements limited by installed equipment
  - Collection requirements limited to existing meter capability
  - Does not extend to capability or potential capacity of the meter but that is not collected or not stored

Colorado Privacy Rules

- Data wanted beyond “standard customer data” paid for by consumer
- Utilities not required to install more advanced meters
  - Meter selection is a management decision when made in ordinary course of business (special installations charged to customer)
  - BUT no unreasonable discrimination among customers
  - No need to install analog meters if no longer being installed (for privacy concerned customers)
- No need for utilities to foster business plans of other commercial enterprises

Colorado Privacy Rules

- No utility liability for disclosures
  - When disclosures in compliance with PUC rules and ultimately complying with customer requests
- No authority for Commission to limit or modify obligations arising from legally valid subpoenas
- Customer typical or estimated average monthly bill disclosable to someone having a purchase or sale interest in the property
- Requirement to maintain disclosures records

Issues and Answers on Smart Grid

- Technology changing too rapidly
  - *"Utilities aren't prepared for rapid technology changes"*
  - Installed devices don't stop, replacement depends on incremental value
  - Utilities could do rapid replacements, but the incremental value must be shown to exceed the costs

- Opt-Out - Remote meter reading
  - *"Just skip me"*
  - Huge savings in costs (meter readers, special meter reads, emissions)

State Opt-out Decisions

- Central Maine Power ordered to implement Opt-out program
  - Keep analog meter or disable transmission function in smart meter
  - Customers pay one time charge
    - $40 for analog meter / $20 for receive only smart meter
  - Customers pay monthly charge
    - $12 for analog / $10.50 for receive only smart meter

- PG&E Proposal Approved by CA PUC (2/2012)
  - $70 one time charge and $10 per month -- generally
  - $10 one time charge and $5 per month – low income customers

RF Power Density in the Everyday Environment

In microwatts per square centimeter (µW/cm2)

Source: Richard Tell Associates, Inc.

FM radio / TV broadcast station signal	**0.005 microwatts**
SmartMeter™ device at 10 feet	**0.01 microwatts**
Cyber cafe (Wi-Fi)	**10-20 microwatts**
Laptop computer	**10-20 microwatts**
Cell phone held up to head	**30-10,000 microwatts**
Walkie-Talkie at head	**500-42,000 microwatts**
Microwave oven, two inches from door	**5,000 microwatts**

RF Exposure from Smart Meters

- UTC participated in field measurements of Smart Meters and the associated pole mounted collector devices.
- These measurements shows levels well within FCC guidelines for general population exposure to these signals.
  - Measurement at 1 foot is 9.9% of the FCC limit
  - Measurement at 3 feet is 2.5 % of the FCC limit
  - Measurement at 10 feet is 0.5% of the FCC limit

RF Exposure from Smart Meters

- UTC and EEI prepare report addressing RF issue, in addition to meter accuracy and security
- Conclusions regarding RF Exposure:
  - Exposure levels drop significantly with distance and even further in living spaces due to the attenuation effects of building materials
  - RF exposure from the rear of a metering location ~10 times due to shielding and signal patterns (Notably below FCC limits)
  - Smart Meter exposure results in 125 to 1250 times less exposure than a cell phone and 5 to 50 times less than a microwave oven
  - In practice Smart Meters cause minimal RF exposure to the consumer, typically well under 10 % of the FCC exposure limits.
    - Common operational parameters for power (250 mWatt - 1 Watt), duty cycle (2%-5%) and distance (10 feet) from the transmitter

Questions?

Thank you!

Brett.kilbourne@utc.org