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White Paper: CIO Perspective of the Utility Core Data Network of the Future

Introduction:

The premise is that the core data network of the future for electric utilities can no longer be built as elements of separate and distinct, vertically integrated “system silos” focused on singular applications. Will Smart Grid deployments guide the utilities through a significant business and technology transformation leading to integrated, layered, and evolving communication infrastructure to service a wider variety of utility applications?

We tested this hypothesis via interviews with CIOs from major Investor Owned Utilities (IOUs), Electric Cooperative Utilities (CO-OP) and a large system integrator who has deep knowledge and experience in this space. All have deep experience in their field. Some have operational experience within the utility sector for over thirty years, while others have less than three years experience within the utility sector.

We proposed and will deliver anonymity to both the firms and the individuals we interviewed for contributions to this white paper. The utilities represented a cross section of east coast, west coast, southwest, and midwest utilities. They were all within the top two tiers, in terms of size.

Our background includes deep operational, management, and consulting experience and expertise within both the Utility sector and the Telecommunications sector. The principals on this team were Warren Darby, Dennis Mitrano, and Bill Rochfort.

We initially prepared a series of questions that guided each interview. The twists and turns within each interview led to having the questions answered in an order that varied from the structured set of questions. Approximately 2/3 of the interviewees received the questions in advance, thus allowing time for them to formulate consensus responses with their team for certain areas. The original questions are attached as Appendix A.



Question #1: In prioritizing the core utility network of the future, how would rate the importance of the following?

- a. **Having separate network for core utility operations**
- b. **Substation automation (benefits, technical issues, vendors)**
- c. **Software Management and Applications (distribution management system & SCADA)**
- d. **Communication (substation routing & switching)**
- e. **Automation Platforms & Controllers (RTUs/IEDs & substation platforms)**

Executive Quotes: “Even though reliability and security are the key drivers of the core network, it is just a matter of time before these networks will be converged due to larger scale and functionality needs.”

“During the next 5-7 years, we will see very much change in the network. There will be high importance in isolation of the network. This is more so than in any other part of the utility.”

As the introduction to this question, we established that each participant had an existing separate data network for core utility operations. This network is separate from the utility data network which supports the business operations of the utility. The core operations are the distribution management system (DMS), SCADA network, substation operations, etc. The business operations network supports email traffic, customer information systems, billing, finance, the repair and maintenance order systems, etc.

Although the responses did vary to this question, all participants ranked all five areas as from highly important to some as moderately important.

Regarding keeping the networks separate, only one utility stated that they would maintain completely separate networks in the future. This utility is also preparing to further isolate the data networks into sub networks depending on the needs of the utility. All other participants see the convergence of data between the two networks. One example is outage management. If an outage occurs, this utility can isolate the outage, automatically re-route power through the grid and notify affected customers. Clearly this requires an interface between the Customer Information System and the DMS.

All Utilities ranked the area of maintaining a separate network for core utility operations as very high importance for system reliability and security. As a clarification for those who discussed convergence, the data will be requested back and forth, but the networks will maintain their integrity in terms of access controls, authentication, firewalls, etc.



Substation automation was viewed by the majority of CIOs who had engineering focused responsibilities as a very high priority item. Those CIOs whose responsibilities were more focused on IT infrastructure viewed this topic as a moderate to high priority item. All viewed network security in this area as a critical function and placed a very high priority in this area.

Software Management and Applications for the DMS and SCADA systems was viewed unanimously as one of the highest priority items on this list. This is due to the basic core philosophy of operating the network to properly service customers today and into the future. An added layer to this argument is the NERC-CIP (Critical Infrastructure Project) requirements that all utilities rely upon and adhere to. There is more to this discussion in the next section.

Communications for substation routing and switching received inconsistent reviews in terms of its priority. The majority view it as important, but secondary in nature. There is a minority view that it is a very high priority. Those that view it as a high priority item deem it critical to providing consistent service or if the utility has a relatively large serving area deploying self-healing switch architecture.

Automation Platforms and Controllers are viewed as one of the highest priority items by most of the utilities. The systems integrator believes this is one of the areas targeted for large capital investment in the future. The minority utilities that viewed it as a secondary priority stated that their system is not highly automated today. However, this priority will shift to a high priority item once they introduce higher degrees of automation. (As a corollary, it is interesting to note that this CIO did rank the communications infrastructure for substation routing and switching as one of the highest priorities. The conclusion is relatively less automation implies higher reliance on communications among the substations.)

Existing Vendors Discussed: Schneider Electric, BPL Global, Black and Veach, SIAC, GE, Sensus Cisco, Fujitsu, Ciena and Juniper

Question #2: Regulatory Compliance

Executive Quote: Due to the complex requirements of NERC-CIP, we may seek professional services in network design. NERC-CIP is taking an exceptionally high priority.”

It is important to note that the original questions concerning regulatory compliance centered on equipment placed within the utility substation network. The original cited standards are the IEC 61850



and IEEE 1613. The concern was how these standards impacted the utility decision making when selecting vendors for their network. The responses received are summarized below.

In summary, all utilities must comply with the NERC-CIP standards for security and integrity of their communications systems. Most utility execs stated that they stringently follow NERC-CIP standards. The compliance with NERC-CIP standards is also a necessity due to the penalties and fines associated with failing an audit. While this is a threat, all CIOs stated that it is good for the industry to follow these standards.

Standards compliance also opens up communications among the utility industry given the proprietary nature of today's grid communications systems. At conferences and direct one-to-one communications, the utility execs collaborate on their ideas regarding the best methods of compliance. The National Institute of Standards and Technology (NIST), as mandated by the US Energy and Independence and Security Act (EISA) of 2007 is the most significant effort. NIST is first identifying which existing standards should be adopted for broader use within the Smart Grid, and then identifying newer standards to fill any gaps in industry standards. As example, with the utility industry grappling with the adoption of TCP/IP, NIST is focusing its efforts for widespread use of TCP/IP as the common denominator facilitating interoperability between fragmented automation systems in the utility network.

Regarding the IEC and IEEE standards, these are viewed a necessary guidelines, but not strict standards. A leading CIO called these standards guidelines that are nice to follow as they drive best practices. All utilities expect their vendors to be in compliance with these standards, but we got the sense that if a vendor had a solution which achieved the same result as the standard, their product would be accepted into the network. One CIO stated that they will integrate devices from lesser known vendors as long as they have a non-proprietary architecture.

Vendors in network compliance mentioned include GE and SecureWorks

Question #3: How will the electricity suppliers manage the monumental increase of data generated through smart devices, while ensuring confidentiality, integrity and availability?

Executive Quote: "The major opportunities are with the small to medium IOUs and CO-OPs. This part of the utility business segment cannot fully capitalize the AMI implementation and on-going support, and will need to outsource to thoroughly vetted cloud providers."



In asking this question, utility CIOs were quick to point out the distinction between grid automation and smart meters. The responses were different by geographical area. The western utilities were further along in deployment of smart meters (AMI – two-way communications) and allowing alternative sources of power to enter the grid at “N” places, than the mid west and eastern utilities.

The western utilities have deployed smart meters with AMI (Advanced Metering Infrastructure) to many of their constituents. These meters send data every 15 minutes. Even though it is a small amount of data, it adds up. As one CIO stated “when you have 2 million devices transmitting even a small amount of data, it is a lot of data.”

The remaining utilities are in a wait-and-see mode regarding placing smart meters at every residence. The Commercial and Industrial (C&I) customers already have these meters for load control and time of day pricing. Many utility CIOs do not see the customer generated demand for smart meters at the residential level. They acknowledge that they may be mandated by their respective PUC to implement these meters, but they cannot cost justify them at this point. Also stated is the universal service mandate for utilities. If they proceed with a smart meter deployment, they must plan to introduce them to all customers.

Even if they do not have AMI for residential customers, most utilities have AMR (Advanced Meter Reading) deployed within their network. This enables remote meter reading and data transmission is a necessity.

The current standard for data collection from the meter level is to use the wireless networks. This data is transmitted to a collection point and then traverses the network to the utility’s data center.

Another potential opportunity to increased data transmission is the introduction of renewable energy into the existing grid. As renewable energy sources proliferate at a cost effective basis, utilities will be required to accept this energy into the grid. This obviously implies multiple sources of metering data from various points within the grid. Hence the data requirements will increase from this source as well.

Without exception, all utilities are very concerned regarding data integrity and security. They all have processes in place to manage that data and maintain its integrity. The “monumental” increase in data was mentioned by one CIO as a steady growth in data. Thus it will not be an overnight step function increase. The data demands will grow over time. Hence the utility CIOs can manage the growth in this data and compare it to predictive modeling tools at their disposal.



One of the more advanced utilities have built a complete infrastructure to data integrity, including fiber based telecommunications infrastructure between buildings, wireless back up methods and an off-site data center located in a neighboring state. Main data systems have mirrored databases, etc.

A major concern posed by one CIO is the system capacity in the case of a network connection failure. Once the data collections begin to get behind, the length of time for the current networks to catch-up poses a potential problem. If the networks are designed for a certain amount of data transmission plus some overhead, and there is a multiple hour outage, the systems may be backed up for an unacceptable period while the data buffers clear themselves.

An option raised is to have this increase of data managed by cloud based applications. Although the larger IOUs will most likely keep this data within their own infrastructure, there is an opportunity for the smaller to medium utilities to include cloud based applications within their network architecture. Those who do will have access to the latest tools and software to be able to service their customers and maintain data integrity on a large scale. Plus the smaller utilities will be able to do this at a lower cost than keeping the data management in-house.

Vendors mentioned in this section include: IBM and Oracle,

Question #4: When visualizing the core network of the future, which applications will ride that secure, unencumbered network?

Many of the interviewees answered this question well before we scheduled it. That being said, most did not comment on the Consumer/Commercial control of appliances issue until the question was raised.

Clearly, utility control applications will traverse the core data network of the future. These will be maintained in a separate and secure data network.

Most agreed that non-grid applications will not traverse the secure, unencumbered network. These applications will traverse the traditional business services network. Although, as noted above, many applications will communicate with core data network applications via a data request and data deposit mechanism.

Almost all utilities have stated that the AMI applications will ride over a wireless (cellular) network. The one exception was unsure because they have not implemented this technology within their



network. This is mutually exclusive from the secure data network of today's future. The clear reason for wireless is coverage. It is infeasible to have Ethernet applications connecting to every metered device.

As far as consumer control (and C&I), most participants believe that this lies outside of the domain of the core utility data network. Many utility CIOs and the systems integrator believe that that better consumer oriented firms (such as Sony and Microsoft) are better equipped to offer consumers the presentation modules to be able to interpret the data from the utility and to act on that data. For example, do they want to program their AC unit to turn-off from 5:00 PM to 6:30 PM? Will they program their dishwasher or dryer not to operate between the hours of 4:00 PM and 9:00 PM?

Most consumers are not asking for this control today. If they do, the utilities will play an integral role in delivery of electric power. However they do not plan to offer services well beyond the meter. In other words, they may offer time of day pricing rates from their website, but not offer to control appliances within the home. One utility has begun an AMI pilot that is tied to new technology for electric vehicles. They have developed an ID system within the service territory that links the car to the utility client allowing for charging their vehicle anywhere within the utility footprint.

Question #5: Should electricity suppliers consider an outsourced design, deployment and management of the network?

Executive Quotes: "Our outside vendors are a critical source for constantly improving best practices in the areas of network architecture, implementation planning, and on-going maintenance of the communications network."

"We welcome vendors. In considering outsourcing for network design work, we should not only consider 'what makes sense' but also 'what makes better sense'".

"For deregulation purposes, we want to drive every dime out of the organization."

We received different responses to this question.

Most utilities believed that they would consider assistance (hence outsourcing in their parlance) in the network design. This assistance would come from a professional services firm in the areas of ensuring that they comply with today's standards and have the capability to comply with most of tomorrow's standards. Legacy systems are a good example where professional services play a major role. Utilities



are under more pressure now to constantly improve IT operational functionality. They have to get a very accurate read on technology migration with cost controls.

Beyond that, most utilities were hesitant to say that they would outsource the deployment and management of the network. In fact, while some waived on the deployment perspective, none waived on the management of the network.

There were a couple of utilities who stated that they would not outsource any part of the network. The issues were cultural within the utility. They were a predominant engineering based organizations. Further, they believed that (and we agree) outsourcing requires a different skill set from managers. Managers must be able to clearly state their needs and manage the outsourcer to meet those needs. Last, the obvious issue of job loss was raised as well.

It is interesting that the systems integrator has a 180 degree different perspective than the larger utilities. They believe that design may be held as an internal function, while deployment and management may be outsourced. However if you view the market as 3,500 utilities – most of which are small – this perspective make a great deal of sense.

We were conducting interviews with some of the largest utilities in the United States. Of course their perspective is to keep everything in-house. However the smaller utilities do not have the capital resources to build the infrastructure to offer all the services that are coming in the future and may have to “lease” these services.

Question #6: Which industry trade organizations are generally most valued by CIOs?

This question was deemed to be a simple question, but delivered unexpected responses. The two that had multiple responses are position within the top three. The most popular responses were:

1. Knowledge Utility Executive and Conferences
2. UTC
3. EEI
4. Energy Central
5. Gartner Group



6. EPRI
7. NERC
8. Distributech Conference

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I look forward to talking with you!



Appendix A

CIO Interview Questions for Discussion

1. In prioritizing the core utility network of the future, how would rate the importance of the following:
 - i. Having separate network for core utility operations
 - ii. Substation automation (benefits, technical issues, vendors)
 - iii. Software Management and Applications (distribution management system & SCADA)
 - iv. Communication (substation routing & switching)
 - v. Automation Platforms & Controllers (RTUs/IEDs & substation platforms)
2. Regulatory Compliance
 - i. How do the IEC 61850 and IEEE 1613 Standards impact your evaluation and selection of communications networking devices installed in substations?
3. How will the electricity suppliers manage the monumental increase of data generated through smart devices, while ensuring confidentiality, integrity and availability
4. When visualizing the core network of the future, which applications will ride that secure, unencumbered network:
 - i. Utility control – mission critical distribution network for the grid
 - ii. Network operations/management – carrying non-grid applications such as email, voice, broadband data
 - iii. Advanced Metering Infrastructure – includes LAN to collect individual meter usage data and WAN to collect aggregate usage data for processing and response
 - iv. Consumer/commercial control of appliances /devices – HVAC, fire, security, refrigeration, outdoor lighting, medical monitoring
 - v. Other applications?
5. Should electricity suppliers consider an outsourced design, deployment and management of the network?

Simple question – what industry trade organizations are generally most valued by CIO's and why?