

AMI AND SMART GRID DEPLOYMENT: GEOGRAPHIC SEQUENCING BY BENEFIT MAXIMIZES UTILITY ROI

A sequenced deployment of advanced metering infrastructure (AMI) and smart grid infrastructure by benefit-ranked geographic area can maximize utility return on investment (ROI). Geographic sequencing ensures the earliest capture of benefits and matches deployment phases with technology capabilities.

The benefits of AMI and smart grid technology deployment are not achieved equally across a utility's service territory. Identifying benefits that are achieved disproportionately allows utilities to prioritize technology deployment to locations where value can be achieved quickly. For example, initial deployment of AMI in areas of high meter density may allow greater return on "hard-to-access," "safety" and "reduction in estimated bills" benefits. Remote disconnect technology may be most cost-effective where there are significant concentrations of apartment populations with high turnover. Smart grid equipment such as faulted circuit indicators (FCI) and automated switches should be sited first in areas of the distribution system with the lowest reliability.

Some geographic areas will realize more benefits from AMI or smart grid implementation than others. Deploying technology first to these areas will expedite the business case payback while bringing more rapid benefits to customers. This doesn't necessarily mean that one shouldn't deploy to areas where lower benefits are achieved; rather one would sequence deployment to capture maximum benefits early in the program.

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Segmentation and Scoring Methodology

Utilities typically develop a business case and implementation roadmap before deploying AMI technology or smart grid infrastructure. The business case and roadmap can be further enhanced using a geographic segmentation and scoring methodology. The steps include:

1. Dividing the utility service territory into geographic segments.
2. Defining attributes that reflect the benefits sought from the technology implementation.
3. Scoring each geographic segment meeting the benefit threshold.
4. Ranking and mapping the segments by benefit score to examine potential deployment sequences.

Let's apply this methodology to specific AMI and Smart Grid examples.

AMI Deployment Sequencing

1. Divide the utility service territory into geographic segments.

The deployment methodology centers on analysis of benefits at a geographic level. The first step is to divide the utility service territory into appropriate geographic sub-elements, or segments. The segments might be as large as operating or work areas or as granular as the area encompassing each zip code. The identification of the "right" segment is less important than the consistent application of segment analysis across the service territory.

2. Define attributes that reflect the benefits sought from the technology implementation.

The strategic and tactical benefits sought from AMI differ for each utility, and are established in the business case. To assess the occurrence of these benefits within each geographic segment, a utility must define premise-level attributes that reflect each key benefit. The benefit achieved by reducing estimated bills, for example, may be reflected by the number of estimated bills generated for each premise within the service territory. The financial benefit achieved by implementing remote disconnect meter technology may be reflected in the number of cut-off for non-pay disconnect orders issued for each premise.

3. Score each geographic segment meeting the benefit threshold.

A scoring system is developed that utilizes threshold values, combined with weights that reflect the level of importance of each benefit.

For each benefit attribute, a threshold value is established to identify the frequency of attribute occurrence at which it is beneficial to utilize AMI technology. How many "cut-off for non-pay disconnect orders" must be issued for a single premise before implementation of a remote disconnect becomes cost-effective? The threshold value for installation of a remote disconnect device might be two disconnect orders per year. Thus any geographic segment that averages two or more disconnect orders per premise meets the benefits threshold and receives a value of "1." Any geographic segment with less than two disconnect orders per premise does not meet the threshold and receives a value of "0."



Low to high importance is captured in a 1-5 weighting system. For example, if the remote disconnect benefit is the highest priority to the utility, it is weighted as high, or 5. Each geographic segment that exceeds the benefit threshold value (receiving a value of 1) moves forward for weighted scoring. Thus, any segment averaging two or more disconnect orders per premise receives a total remote disconnect benefit score of 5 (1x5).

4. Rank and map the geographic segments by benefit score to examine potential deployment sequences.

By combining the threshold values and the weights for each benefit, a benefit score is assigned to each geographic segment.



A composite score for each segment is then calculated across all benefits, and the geographic areas are ranked accordingly. The composite scores for each segment are used to rank the business case impact of utility service territory segments.

Geospatial mapping of the segments by score is used to examine potential deployment targets. Ranking and mapping results are balanced with respect to deployment costs, which may also vary from one geographic segment to another. Qualitative factors, such as political and regulatory drivers, are also considered when determining the final deployment plans. Combining these aspects allows the utility to achieve the most economical deployment that expedites the ROI.

AMI: A Foundation for Smart Grid

Much of the benefit to implementing a smart grid infrastructure relies on the capture of data granular and timely enough to communicate the status of the utility distribution system to process-intelligent controls for network equipment. AMI can potentially capture meter-level activities and data for smart grid applications, for example:

- SCADA voltage telemetry data at feeder breakers in the substations can indicate the quality of the power supply to the distribution network, but voltage information at service transformers and customer delivery points is necessary to discern circuit or transformer level problems for more effective Volt/Var control.

- Substation breaker and reclosure operations can be used to evaluate the large-scale extent of an outage, but meter-level outage and restoration notification events are necessary to optimize outage restoration efforts.
- Emergency load response activities such as load shedding can alleviate potentially catastrophic system concerns, but at a significant cost to customer satisfaction and company image. Demand response distributed to the individual premise allows utilities to achieve expected load reductions without sacrificing customer satisfaction.

Implementation of a meter data management system and integration of AMI data with distribution management systems (SCADA/DMS), distribution automation systems, and other systems provide the information and intelligent control necessary to facilitate the operation of the smart grid.

Smart Grid Deployment Sequencing

Information obtained from utility meters via AMI technology provides a foundation for the achievement of smart grid benefits. Therefore, the same methodology used to optimize AMI deployment can also be used to optimize smart grid technology deployment.

A scoring system comparable to that used for AMI is implemented. Attributes reflecting each benefit are defined. For example, improving overall reliability of the utility distribution system is a key driver of smart grid infrastructure deployment. Utilities track various metrics about reliability such as the number of outages that occur on feeders and circuits. The benefit achieved by deploying FCIs or automated switches will be greatest on less reliable feeders.

Threshold values and scoring weights are applied to prioritize each geographic segment based on benefits potential. How poor must reliability be on a feeder before implementation of smart grid infrastructure is beneficial? The top 1% of unreliable feeders or those feeders with CAIDI values exceeding utility thresholds might be identified as candidates for initial deployment of FCIs and automated switches. This threshold value is combined with a benefit weighting; given that reliability is a critical driver for the utility business, reliability is likely weighted high, or 5. Similar to AMI technology scoring, this scoring methodology is applied for all smart grid benefits, across proposed deployment segments.

Scores for the smart grid infrastructure benefits achieved in each segment are calculated and a composite score for each segment is

determined. Segments are ranked and mapped based on individual and composite benefit scores. The ranking and mapping results, considered along with deployment costs and other key factors, suggest a deployment sequence that maximizes achievement of benefits in the timeliest manner.

Conclusion

Geographic benefits-ranking seeks to improve utility ROI from AMI/smart grid technology, by sequencing deployment for early benefits capture. It taps the variation in benefits by geographic area. In some geographic segments, the threshold value is exceeded for many benefits, while in other segments the threshold value is exceeded for some or few of the benefits. Assuming for illustration purposes that costs and other factors are equal across segments, deployment occurs first in those geographic segments receiving the highest benefits scores. Implementation continues in those geographies with “mid-range” benefits scores. Deployment concludes with the segments achieving “low” or no scores.

Improving the timeliness of benefits capture increases the net present value of the business case. It aligns benefits capture with the capital spend required to put the system in place, while also reducing the amount of benefit discounting that occurs when benefits realization is not correctly prioritized. Implementing a structured evaluation system allows a utility to identify a deployment sequence for both AMI and smart grid technologies that optimizes benefits achievement.

About the Author

Jeff Evans is a Principal Consultant with Enspira Solutions, supporting advanced metering solution initiatives for utility clients. His background includes 15 years of utility experience at Exelon Energy Delivery in customer service operations and information technology. While at Exelon, he led various metering and AMR initiatives within the ComEd and PECO service territories. Jeff holds a Masters of Business Administration and a Bachelor of Science in Mechanical Engineering.