Improving Smart Meter Deployment with Spatial Business Intelligence*

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Geospatial technologies have evolved from specialist applications to a key part of many utilities business processes, from tracking assets to feeding outage management and capacity planning systems. Continuing developments in geospatial technology, data and end user adoption are enabling utility personnel to tap spatial data for improved decision-making: spatial business intelligence.

With the growing focus on smart metering and increasing demands to meet projected business case goals, a utility's ability to deploy smart meters throughout its territory is critical. Utilities can leverage geospatial technology to increase deployment speed and quality, ensure meter installers and vendors hold up their side of the bargain, and be confident in the advanced metering infrastructure (AMI) system and networks' ability to handle the cutover. Spatial business intelligence can make the difference between hitting the company's smart metering goals or not.

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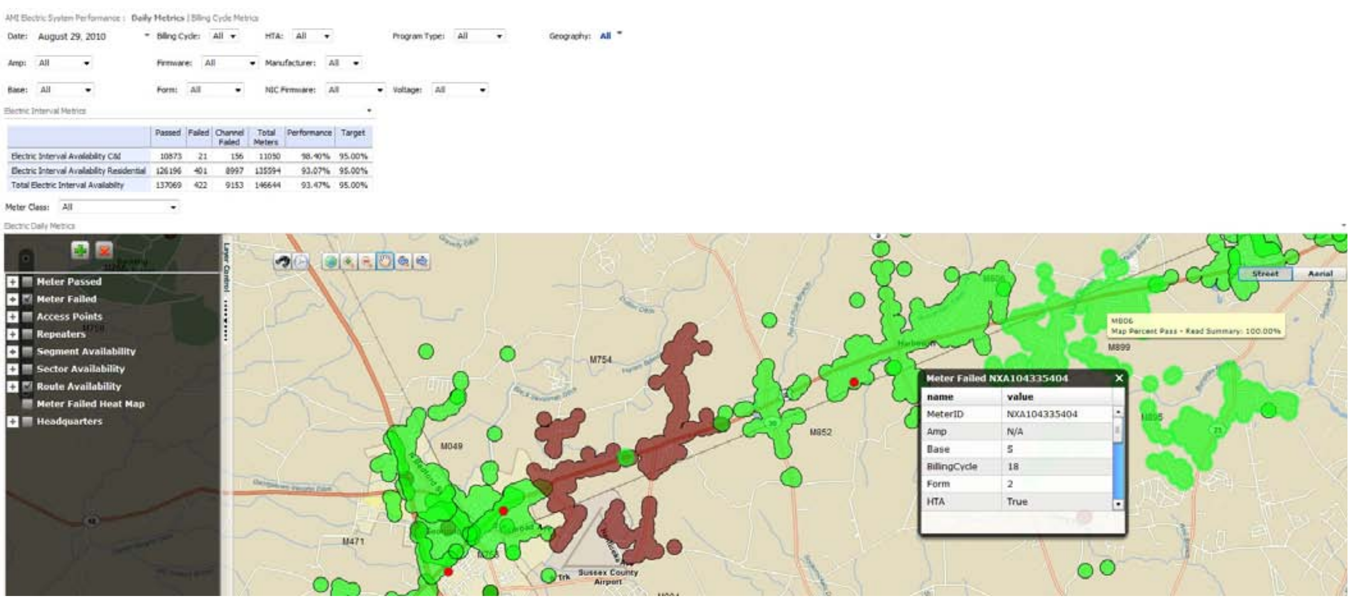
CRITICAL DEPLOYMENT QUESTIONS

Critical questions utilities ask include:

- How can I quickly determine whether my smart meter program is measuring up to the original benefits ascribed in the business case?
- How should test phases be implemented in the deployment process, and as a contract gate for full deployment?



An example dashboard from Enspiria Solutions' ESIntial tool displays an AMI data delivery metric page. The map view shows meter reading routes thematically mapped, colored by percentage of AMI data delivered for the meters within each route.

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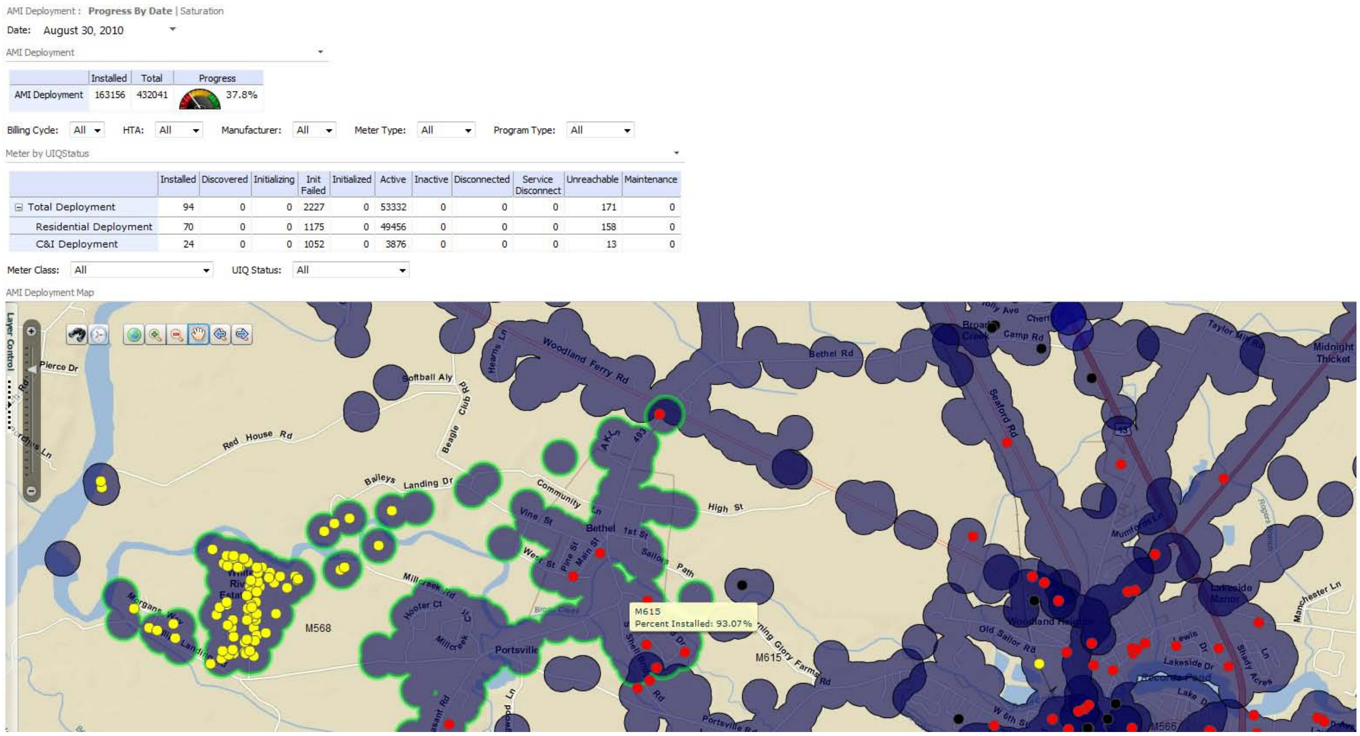


An example dashboard shows the percent saturation of meter reading routes by AMI meters installed vs. planned locations to be installed. A subset of the AMI meters is colored by AMI status values.

- What meters are not meeting expected performance criteria (e.g., by manufacturer, customer class, firmware, geography)? Where am I having chronic problems?
- How many meters have been deployed to each area? How many are talking to the AMI? How many customers are billing from the new meters? And for all of these questions: How does this count match vs. the original schedule?
- When is my network saturated with new smart meters and ready to cut over to billing? How can I verify my network?

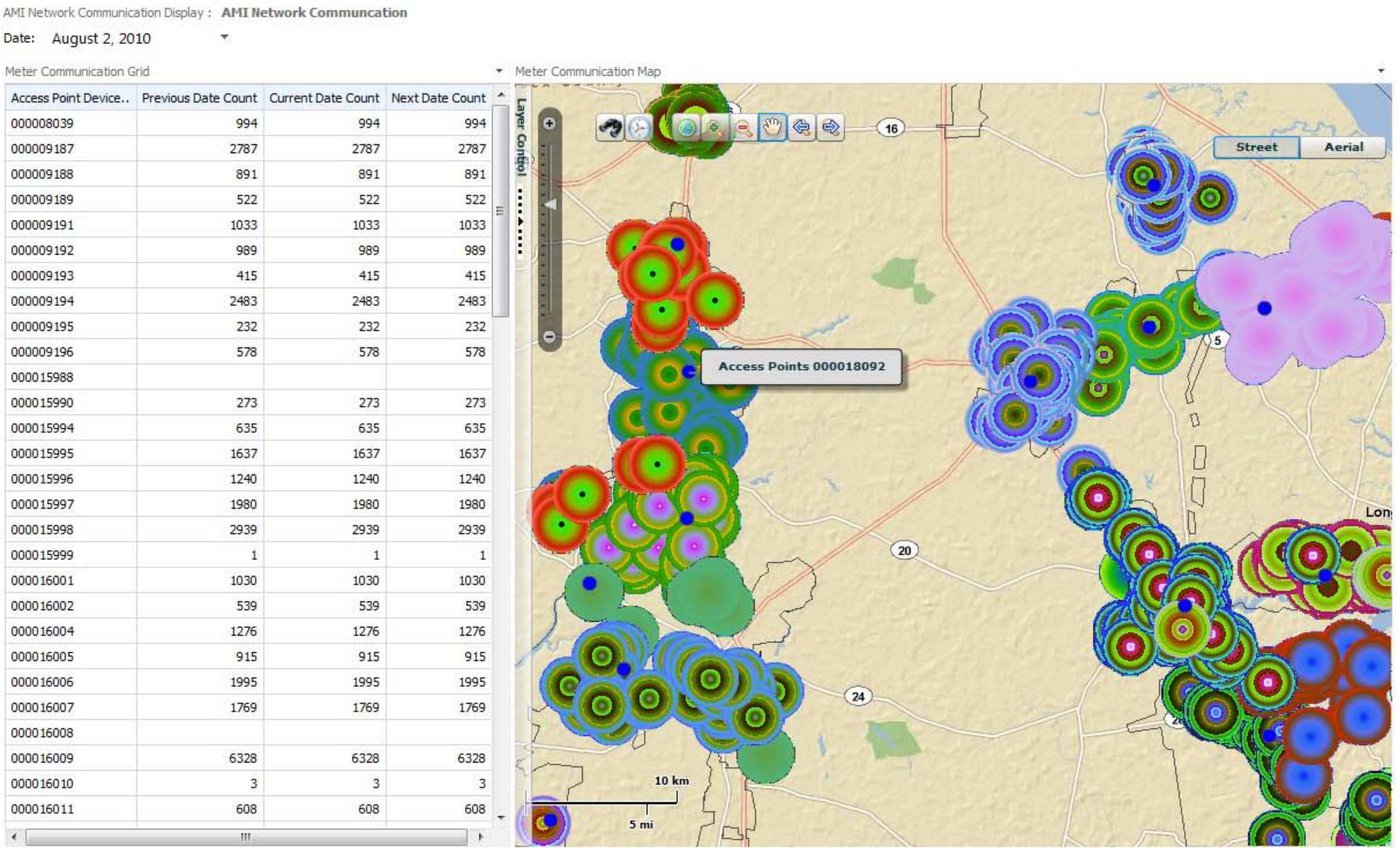
Utilities use spatial business intelligence to answer these questions in a rigorous, timely manner and to ensure successful smart meter deployments.

FIELD TEST PERFORMANCE MANAGEMENT

Accurately assessing AMI performance during testing and deployment is critical for today's smart grid projects. Field test performance management requires mechanisms for validating that the deployed AMI technology performs as expected and is important at various stages of smart meter deployment, including:

- **Field acceptance testing (FAT):** Initial tests on a small subset of AMI meters; FAT can test shortlisted AMI technologies prior to final selection
- **Sector testing:** Applies to a larger set of deployment meters such as 50,000-100,000 meters to ensure the AMI system scales beyond the initial FAT meter deployment and maintains performance levels from initial test phases.
- **Segment testing:** Typically conducted for several hundred thousand meters, again, to ensure the system scales and maintains performance as specified in service-level agreements.

An automated business intelligence (BI) solution that evaluates AMI data can provide audit quality reports of system performance and contractual metrics in support of these



Access Point Device..	Previous Date Count	Current Date Count	Next Date Count
000008039	994	994	994
000009187	2787	2787	2787
000009188	891	891	891
000009189	522	522	522
000009191	1033	1033	1033
000009192	989	989	989
000009193	415	415	415
000009194	2483	2483	2483
000009195	232	232	232
000009196	578	578	578
000015988			
000015990	273	273	273
000015994	635	635	635
000015995	1637	1637	1637
000015996	1240	1240	1240
000015997	1980	1980	1980
000015998	2939	2939	2939
000015999	1	1	1
000016001	1030	1030	1030
000016002	539	539	539
000016004	1276	1276	1276
000016005	915	915	915
000016006	1995	1995	1995
000016007	1769	1769	1769
000016008			
000016009	6328	6328	6328
000016010	3	3	3
000016011	608	608	608

An example dashboard shows colored heat maps of meter communication paths. AMI network equipment and the AMI meters communicaating via that equipment are shown in the same colored circles. Time series features can be used to play the communication paths over time to ensure the meters fail over to nearby equipment and then reform to original equipment during and after fail over tests.

deployment stages, in addition to being rapid and simple to use. Expanding the BI capabilities to include a spatial component provides invaluable views of the contractual metrics. Problematic locations can be identified using the spatial views, and thematic layers can show views of the data provided by the AMI meters as follows:

- **Data availability:** Are the meters providing all of the expected data? If not, can the spatial view be used to determine inadequate network coverage?
- **Data accuracy:** Are the meters providing accurate data compared to temporary manual meter reading processes?
- **Event/alarms tracking and trending:** Are meters returning expected (outage and restoration, firmware upgrade confirmation messages) or unexpected messages (NIC and other errors)? Can the spatial view be used to determine correlations between events and alarms from neighboring meters and AMI network equipment?

During FAT, performance management concentrates on the service point spatial level allowing the AMI test team to analyze individual meter issues and localized issues within the meter population. In sector and segment testing and full-deployment phases, the BI tools can be used to augment and validate the AMI system reporting capabilities, and the spatial analysis can be expanded to an aggregated area level (meter reading route, zip code, service territory).

DEPLOYMENT TRACKING

Large deployments come with their problems: multiple phases (including installation, data communication verification, billing cutover), thousands of meters deploying weekly or monthly, and the network infrastructure to support all of the communication. And all the while, reporting requirements to stakeholders are increasing in frequency and level of detail.

Spatial BI tools for smart meter deployment tracking can provide the necessary visibility and insight to fix issues quickly before they impact project success. Spatial BI provides a snapshot of whether the deployment is behind, ahead or on schedule in specific deployment areas. Deployment, reading and billing can be tracked, for example, by meter reading route, zip code or operating headquarters. This allows decisions to be made on whether to reallocate installation resources to areas falling behind schedule.

Often a certain saturation level (percentage of installed meters vs. a target) is required in an area to cut over to AMI billing of those customers. The spatial view provides at a glance views of which areas are close to meeting those thresholds. Other core BI functionality can be used to slice the saturation statistics further as follows:

- **Customer type:** Cut over to AMI billing for only a specific saturated set of meters within the area?
- **Firmware:** Should a specified saturation of firmware be installed across the meters within the area to cut over?
- **Data availability metrics:** Overlay contractual metrics for the area; only allow billing cut over if the metrics are met by the meters within the area.

Spatial Business Intelligence:

- Uses geospatial technology and data to clarify, streamline or improve utility job tasks and business processes and to improve utility decision-making.
- Merges geographic information systems (GIS) and business intelligence (BI) technologies.

NETWORK OPTIMIZATION, FAIL OVER TESTING

With focus on smart meter deployment, one might think things get easy following installation. This isn't the case. Smart meters aren't quite as smart if they stop communicating back to the office. A utility must ensure that the network supporting the smart meters will continue to operate effectively during and after deployment.

Two focuses should be:

- Ensuring the self-healing network capabilities to allow network fail over should an AMI network device (tower, access point, repeater) become inoperable, and
- Ensuring the proper radio frequency communications, system fail over and system performance will maintain operational and contractual performance requirements after the as-built AMI network and smart meters are fully deployed.

To test the network's self-healing capabilities, it must be broken via fail over testing. Yet it is difficult to see what happens; getting lists of meter/module and AMI network devices with connectivity details written on a spreadsheet gives little visibility into the network healing performance or possible problems. Raw numbers show how many, but not where or if the changes made were correct. By combining a spatial view of this raw data, along with the ability to view this data temporally, viewing before and after results through color-coded meters and communication devices generates more clarity.

Spatial views may be generated to support entrance criteria for the AMI vendors' network optimization processes. For the areas targeted for optimization, it is important to assess:

- Are they saturated with AMI meters to a sufficient level?
- Are they delivering data at or above the contractual metric level?
- Do they have expected firmware levels?

The same spatial views may be used during and after the network optimization processes to ensure expected performance levels are maintained or at least returned to the same or higher pre-optimization levels.

During fail over testing (turning off network devices or their internal routing mechanisms), it is important to see that meters fail over to a new point of communication. This can be tracked during the purposeful fail over tests using time series spatial data to show meters in normal state, failed over to a new communication point, and finally (after the network is returned to normal state) the reformed network state.

Spatial business intelligence can provide valuable insight and visibility normally not afforded by other systems. By combining operational and tracking datasets into a spatial context during smart meter deployment projects, risk can be reduced and business value generated.

About the authors

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