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Improving the Test Process

How Utility is assured success of its AMI implementation program?

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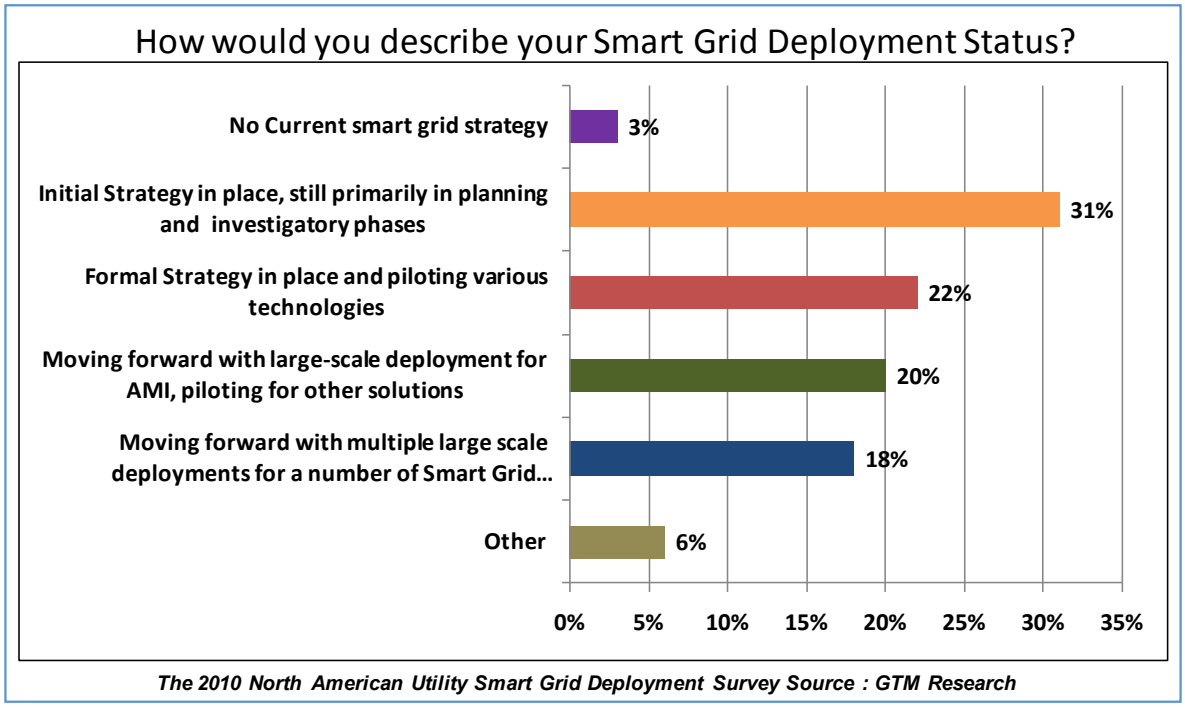
Domain-specific testing is becoming more and more relevant in today's world where the software time to market is a key factor in its success. Before a software product is launched, the next version is already available in the market. With a time-constrained application development cycle, it becomes imperative that System Integration testing focuses on business relevant testing and ensures optimum coverage and at the same time high quality software. Today software testing services are increasingly focused on having in-house SMEs and domain experts who know the business and can work in a dynamic software development cycle to meet the risks arising from lean requirements and design elaboration and documentation, shortened review cycles and reduced SME bandwidth availability. This is especially challenging if the domain brings with it technology challenges. Smart Meter or Advanced Metering Infrastructure is the buzz word in the utility domain.

Introduction to Advanced Metering Infrastructure

In the utility sector, advanced metering infrastructure (AMI) is burgeoning as a method for providing measurement of energy for the 21st century. Within the last year, more than 25 million meters worth of AMI business in North America, valued at more than $2 billion, has been put out for bid. This compares to the installed base of roughly 80 million meters operating under automated meter reading (AMR), a precursor to AMI. [1]

Governmental projections show that by the year 2025 there will be 2 billion more people inhabiting our planet, consuming more energy. Energy demand will rise by 54 percent. Electricity demand in the U.S. is expected to grow by 141,000 megawatts in the next decade, while only 57,000 megawatts of new resources have been identified. Environmental, legal and social pressures already constrain where and how fuels are obtained, generation plants are built and transmission lines are located. Without action, any energy shortage will become markedly worse. [2]



The 2010 North American Utility Smart Grid Deployment Survey Source: GTM Research

Utilities all over the world are either implementing or have plans to transform their business by embracing Smart Metering or AMI. The core of the Utility business is its Meters. Meters are the source of all measurement and basis for any intelligent analysis. "Advanced metering is a metering system that records customer consumption [and possibly other parameters] hourly or more frequently and that provides for daily or more frequent transmittal of measurements over a communication network to a central collection point."[1].

AMI also provides more flexibility to the customer by providing them with the information of volume of their utility usage at different times during the day. Key drivers for AMI are:

- AMI (Advanced Metering Infrastructure) is one of the key focuses in the Utility Industry all over the world today. It is defined as a system that will be capable of collecting data from Electric/Water/Gas Meter remotely at a defined interval.
- Governments all over the world have directed and are encouraging utility companies to implement AMI.
- AMI automates a lot of current manual operations - like meter data collection, TURN On, Turn Off, Service Transfer, Outage Management , Tampering & Theft detection, etc. This provides the Utility sector a huge return on investment by adopting lean operations and drastically cutting down costs.
- Utility companies also see huge spurt on their customer experience by enabling them with hassle- free self-service features and providing the customer with usage history and trend analysis. Value added services like analysis and best practices on reducing usage and promoting savings can be offered. The foremost use of the AMI technology is that it can be used to promote concepts for saving energy. This is achieved by providing incentives or lower rates when a customer uses less energy (say less use of A/C) during the hours of peak demand. This can prove to be huge saving of non-renewable energy sources. This is the primary reason why governments are ready to invest in the AMI projects.

Challenges in AMI implementations

AMI implementations are massive transformation programs which typically require a timeframe of between 3-5 years for a full-scale rollout depending on the customer base of the utility. The following are key challenges in any AMI implementation:

Cost

Deploying smart meters requires huge capital investment and hence it is crucial that the utility company is confident of successful implementation.

Data Privacy

There are many concerns related to privacy of consumption data being raised as Smart Meters are installed at more and more locations. The meters' data can be mined to reveal details about customers' habits like when they eat, how much television they watch and what time they go to sleep. The retention and storage of this data make it vulnerable to security breaches as well as government access.

Technology Transformation

The imminent rollout of smart metering in the short to mid-term future will requires vital investments in information technology for setting up turnkey projects for smart metering network and application infrastructure.

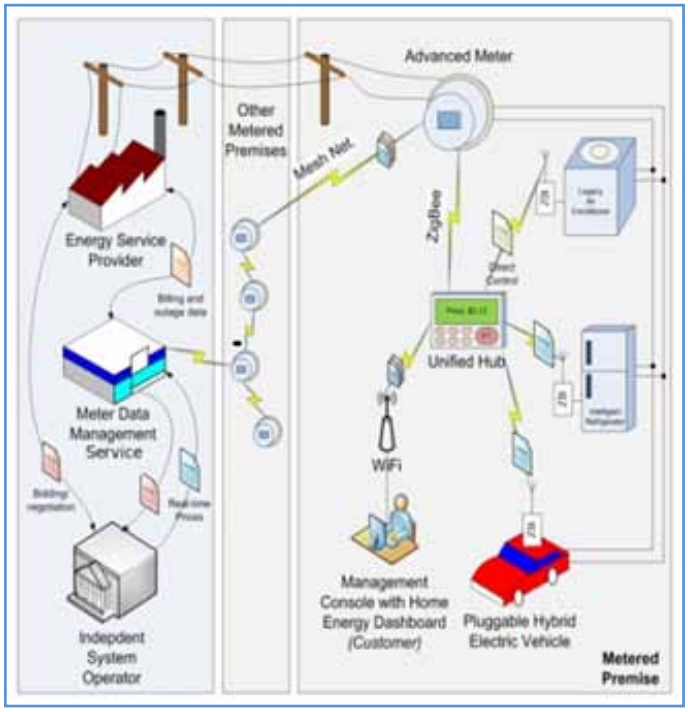
It will be necessary to build up components like

- Mass deployment of smart meters
- Meter reading databases and applications
- Data warehouses and analytic tools & data migration programs
- Customer interfacing applications and portals
- Integration with existing systems

These components and underlying infrastructure will be critical success factors for generating maximum success from smart meter rollout programs.

AMI implementation brings with it a transformation in the entire utility business process, and impacts the entire span of utility operation & stakeholders. Hence validation of AMI implementation becomes a very crucial task. It becomes imperative that the utility validation partner in these kinds of programs understands the business domain, and ensures that the application not just conforms to the business requirements but is also able to meet other criteria (e.g., performance, data quality & security, application security).

Advanced Metering Infrastructure Landscape



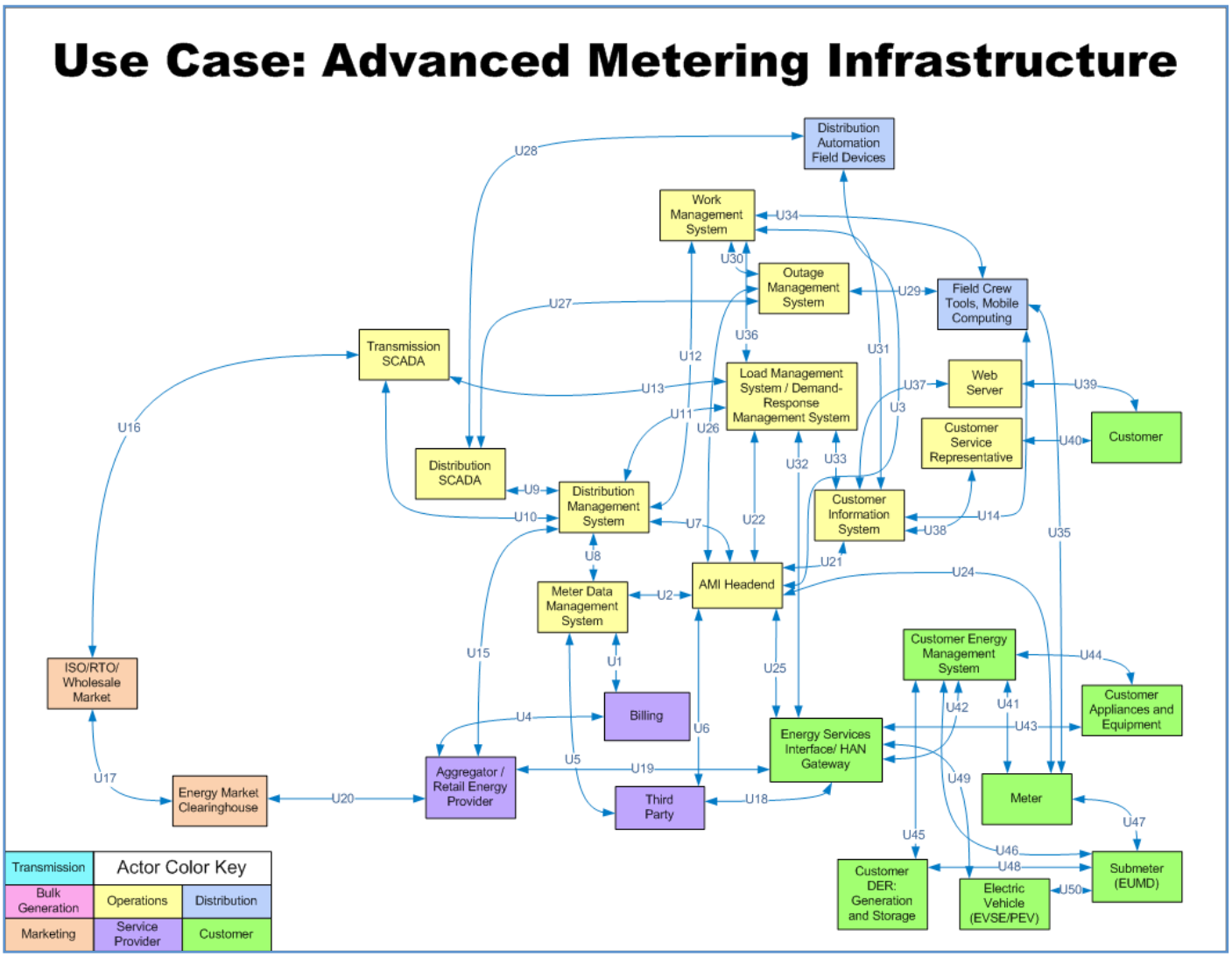
Source: http://seclab.uiuc.edu/web/component/content/article/37-education/81-ami-security.html

Key validation challenges and how domain knowledge plays a vital role

AMI implementation programs typically are huge programs with multiple programs running in parallel to achieve the overall objective. The key challenges are:

Dynamically changing requirements

Testing based on Business Requirements Document, or on design documents becomes irrelevant when it comes to AMI validation. As is the case with any large transformation program, the carefully crafted requirements document, which is signed off and approved after much deliberation, becomes obsolete from the day the project picks up steam. The role of the decision/consensus document or the deviations approval document come into the picture, which is where these decisions are documented and



Source: http://collaborate.nist.gov/twiki-sggrid/bin/view/SmartGrid/CsCTGArchi-Usecase-AMI-Diagram

implementation go-ahead is decided. In these situations, where there is no detailed documentation for these quick decisions taken by the team, it is imperative that the QA organization is agile enough to assess impacts both on the technology front and underlying implications to the business and the impact on downstream functionality.

Deployment of Smart Meters

The deployment of smart meters in such a huge volume demands a very highly organized system with properly managed inventory control. If this mass deployment is required to be carried out by a third party vendor, the challenges increase as co-ordination and synchronization between the inherent systems can be very complex. A mass deployment project also requires a lot of investment in training of the meter operators, inventory management and safety

Testing of a complex billing system post AMI implementation

The billing system by itself is of a complex architecture with its various types of service plans, tiers of use and categories of customers. Along with the introduction of interval data, that can be as frequent as every 15 minutes, this doubles its complexity.

- Calculation of the billing determinants during a previously announced rebate time
- Calculation of the billing determinants during a previously announced critical peak time
- Calculation of billing determinants for on-demand billing requests which might be for a shorter or longer period than the regular monthly bill.
- Adjustments of bills based on the previous billing period's balances/overcharges
- Failover case testing of Smart Meters

These are the main factors which added to the complexity of testing.

Testing of new product implementation- MDMS

MDMS stands for Meter Data Management System which is responsible for storing and providing the interval data for each of the Smart Meter connected to its network. The MDMS product has to be crafted to fit the existing billing system and still has to be robust to handle the interval data at each meter/account level. In other words, the new product has to be customized to fit the existing billing framework and has to extract and provide the billing determinants in such a way that the billing system can readily consume it to produce the bill. This involved a lot of challenges from the design phase through to the end of the testing phase. A lot of configuration changes had to be done to make the interface work. The lessons learned taken from the product side from such a big implementation should be standardized and form the baseline for future AMI implementations.

Data Migration and Data warehouse testing

Smart Meters introduce interval meter readings, which necessitates that this voluminous data is handled carefully and utility IT systems have the ability to store the data and save historic data. Data migration and data warehouse testing are key projects to a successful implementation of the AMI initiative. However, functional knowledge is required as this data (meter interval data, usage, billing determinants, etc.) is critical and the source of all analytics.

Validating Web Portal upgrades

One of the main drivers of AMI implementation is to enhance the customer experience. Upgrading the website to ensure that a customer switching to Smart Meters can experience the benefits of the initiative. The key validation areas are:

- Customer - My Account
- Understanding Usage & Bills
- Rate plans
- Payments & credits
- Reports & analytics
- New initiatives like energy audit, demand response & demand-side management.

Integration Challenges

AMI implementation is a vast transformation program running over a span of 3-7 years. It is a huge project and needs to be implemented in phases. It is very important that the AMI program is broken down and taken up one after another. However, this brings with it some integration challenges. While new systems are being implemented (like MDMS), legacy applications (CIS), datawarehouse and portal upgrades take place. It becomes a challenge to ensure integration points are not failing. Interdependencies of various systems cannot be identified just based on the requirements document, and a tester should be equipped with domain knowledge. This will ensure that the integration points are well defined and all relevant data is flowing to & fro from different systems to ensure the end-to-end business scenarios. A domain expert can also highlight the need for availability of upstream or downstream functionality and ensure that the project timelines are synchronized and kept.

Test Data Management

Planning, creation & managing test data at an overall program level is a very key task. Most test scenarios cut across various applications and unless test data is planned upfront, testing is bound to end up as a total failure. The typical cliché of Garbage In Garbage out holds true without proper test data planning. Much effort is required in coordinating with different departments: from CRM to get the right customer accounts for testing different scenarios, to Billing to schedule bills, to Payment & Credits to update payment/defaults based on the scenario to be tested. Utmost care is to be taken to ensure the test data is valid at the time of testing.

Understanding what batch jobs are required to update the status of scenarios and which department has to be notified about the same saves a lot of last minutes glitches.

Conclusion

Domain testing is an imperative in a complex domain intensive area like Advanced Metering Infrastructure. Requirements based testing does not help, as there are many unwritten rules which can be tested thoroughly only by someone who understands the business domain. The systems need to be tested for end-to-end scenarios which cut across the entire Utility application landscape. For such challenging systems, understanding the domain and validating end user scenarios need intensive domain knowledge coupled with technology skills.

References

[1] http://www.nextgenpe.com/article/The-Critical-Role-of-Advanced-Metering-Infrastructure-in-a-World-Demanding-More-Energy/

[2] http://www.itron.com/pages/solutions_detail.asp?id=itr_016422.xml

[3] http://collaborate.nist.gov/twiki-sggrid/bin/view/SmartGrid/CsCTGArchi-Usecase-AMI-Diagram

[4] http://seclab.uiuc.edu/web/component/content/article/37-education/81-ami-security.html

> biography

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During her stint of 10.5 years she has handled various engagements. Some of her responsibilities in past are listed below:

- *Test manager & process consultant for one of the world's largest integrated energy companies.*
- *Test Manager & Sub Vendor QA Manager for a leading European Airlines Alliance. Handled multiple stakeholders' coordination - IT sub vendor and all 19 airline alliances.*
- *PMO & QA Manager for UK's largest airline.*
- *PMO for a Global GDS provider.*

Babulal Prasath
Babulalprasath has been working in a leading US Utility's AMI implementation program as Test Analyst. He has been involved in all phases of testing of the AMI implementation project starting from AMI implementation vendor selection by product testing, pilot roll out of smart meters, mass roll out, MDMS implementation and integration with legacy system and currently is involved in future implementations of AMI program. He has a very good knowledge on CIS business domain and AMI application architecture as a whole. He has been the primary member and has played a pivotal role in mentoring a big team at onsite. He also has worked on testing projects of banking domain with one of Infosys vital clients.