eMeter Executive Brief:

Advanced Metering Information Systems

Introduction

eMeter's mission is to help utilities maximize the value of their advanced metering infrastructure ("AMI") and fixed network AMR[1] investments.

Most utilities that have deployed an AMI realize that there is a gap between a utility's existing IT infrastructure and the systems and tools provided by advanced metering systems and suppliers. This gap exists because most utility information systems have been built around monthly meter reading cycles and to manage simple mechanical meters. These systems have not had to contend with the new complexity driven by electronic metering and communications systems delivering data every day. Traditional AMI solutions stop at data collection and network management leaving a gap that has generally been filled with a custom, proprietary integration by the AMI equipment supplier and a utility IT team. All too often these integrations provide only meter readings for monthly billing and fail to take advantage of the AMI's full capabilities. A flexible, multi-function Advanced Metering Information System ("AMIS") is required to bridge the gap and fully integrate the AMI with utility business processes.

Without integration an advanced, automated, metering infrastructure may just be a substitution of technology for manual meter reading. And that doesn't make the business case.

While there are some meter data management systems on the market, until now none has addressed the essential requirement that AMI data, and metering assets and services that generate it, be managed in an integrated, holistic manner. Existing asset management solutions aren't able to generate the Key Performance Indicators and Business Process Monitoring demanded by the new complex meter assets including communications modules, new measurement capabilities and configurations. Current business processes for maintaining mechanical meters aren't able to handle the new complexities of an AMI system.

Without an AMIS the costs of operating and maintaining an AMI go up, while many of the desired benefits are not realized; together, these factors can break the business case.

This paper will further describe the challenges posed by an advanced metering infrastructure, how a new class of information systems can address those challenges generally, and how eMeter's solution specifically helps a utility realize the benefits of an AMI.

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[1] Throughout this paper we will use Advanced Metering Infrastructure or "AMI" to refer to systems that provide on-line, fixed network-based remote meter reading. This term includes systems that are conventionally referred to as Automated Meter Reading systems.

The Challenge

By definition an advanced metering system produces far more information than conventional metering and meter reading processes. However, most utility systems have been implemented to support only the basic business processes associated with revenue cycle services (monthly billing and off-cycle reads). The limitations of existing systems implementations and processes represent a major barrier to realizing the benefits of an AMI system as illustrated in Figure 1. And yet it's not practical to discard or re-implement these major systems and investments to leverage an AMI solution.
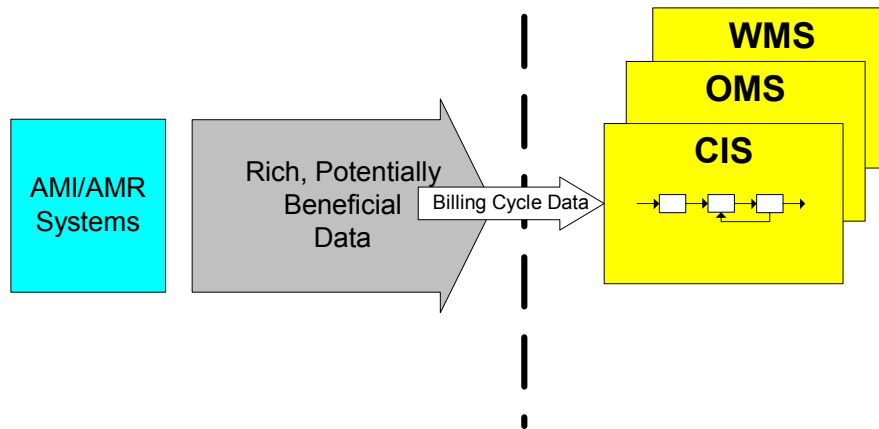

Figure 1 – Limitations due to integration with legacy applications

This challenge is compounded when multiple non-interoperable AMI technologies are deployed and the utility must also maintain certain manual meter reading processes. Figure 2 illustrates the problem of integrating multiple solutions with the many different utility applications. Not only are there many redundant interfaces that must be developed and maintained, but even with these interfaces in place, the individual AMI systems each have their own operating and management requirements.
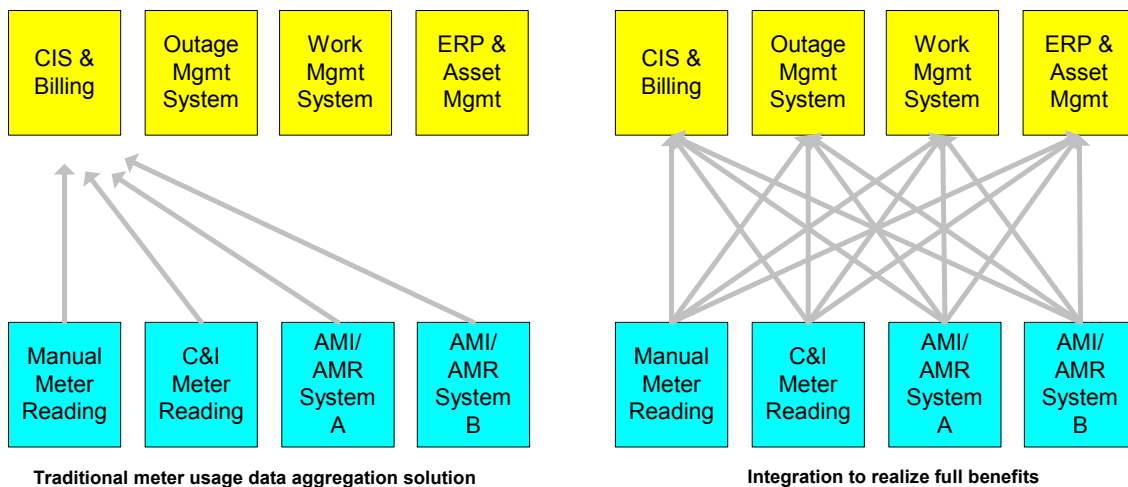

Figure 2 – Multiple Technologies imply a web of independent interfaces

The Solution: Advanced Metering Information System

An Advanced Metering Information System ("AMIS") bridges the gap between each of the meter and data collection technologies and all the potential utility applications.

While the AMI and data collection systems focus on reading meters and coordinating communications with network endpoints, the AMIS provides centralized metered usage data, system asset and administrative data, and automated business process management tools to manage the *entire* AMI solution and meet operating cost and performance objectives.

The AMIS allows a common interface into each legacy application, independent of the AMI system, and makes information available across the enterprise to utility users, customers and partners.
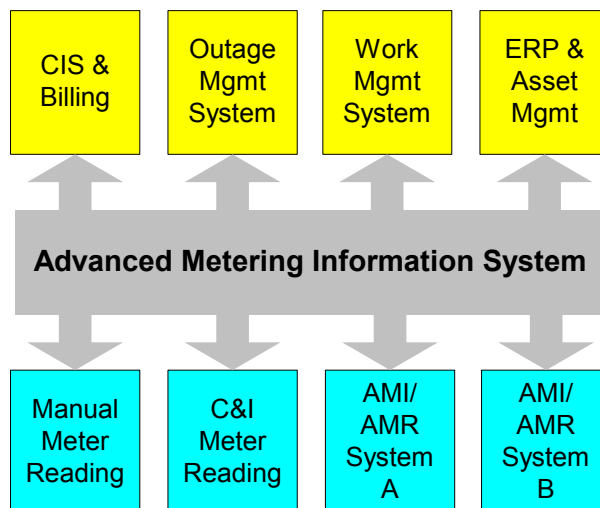
CIS & Billing	Outage Mgmt System	Work Mgmt System	ERP & Asset Mgmt

Advanced Metering Information System

Manual Meter Reading	C&I Meter Reading	AMI/ AMR System A	AMI/ AMR System B

Figure 3 –AMIS Links AMI/AMR Systems to Utility Applications

Power Information Platform™ by eMeter

The *Power Information Platform™ by eMeter ("PIPe™")* software was developed as an AMI technology-independent AMIS designed to support all aspects of small and large-scale AMI implementations. The *PIPe* completes a utility's AMI using a Common Information Model specifically designed to capture the complex relationships between assets, premises, customer accounts, users, applications and services that must be managed in any successful AMI program. Incorporating automated business processes and workflows, the *PIPe* maintains these relationships throughout the dynamic environment of an AMI deployment and the routine moves and changes of customers, meters, and services. Through its unique Business Process Management capabilities, the *PIPe* also supports the implementation of customer energy programs such as demand response, critical peak pricing and other energy related marketing activities.

"Best Fit" *PIPe* Implementation

eMeter offers several ways for a utility to reap the benefits of a *PIPe* implementation:

Licensed AMIS
If a utility is deploying or has deployed a large-scale AMI network the *PIPe* may be licensed, configured, and installed in a utility data center with eMeter providing implementation services and software maintenance/support.

Managed AMIS
For utilities that seek to build assets but reduce operating expenses, eMeter offers a "managed implementation" where the *PIPe* is licensed, configured and operated from a utility or third party data center with system operation administered by eMeter experts under a services contract.

PIPe-on-demand
eMeter offers an Application Service Provider ("ASP") option delivering *PIPe* services from its Managed Data Center on a subscription basis allowing even small-scale AMI programs to realize the benefits of an enterprise-class AMIS.

Outsourced AMI Operations
eMeter is a leader in full turnkey AMI business process outsourcing ("BPO"). Leveraging the *PIPe*, eMeter can augment the utility team to support all the one-time startup processes including materials requirements planning and logistics, field installation management, as well as on-going data collection and AMIS operations.

Other complimentary services from eMeter include:

AMI Operations Support
In addition to its AMIS offerings, eMeter offers world-class operations of most major AMI solutions on the market today. Over eight different metering and communications solutions are pre-integrated with the *PIP*e, including multiple wireless technologies, power line carrier, Internet and telephony. eMeter's AMI operations services support residential, commercial and industrial customers based on the utility's preferred AMI and meter provider.

Professional Services
eMeter supports the utility's AMI implementation with its extensive professional services ranging from business case and regulatory services to technology and systems integration. eMeter's AMIS implementations focus on managing the total cost of ownership of an AMI through automating support and maintenance processes. With the *PIPe* the utility not only realizes the benefits of an AMI, but minimizes the on-going cost of operations and risk of achieving the desired results.

Utility Benefits

Ensure a Return on AMI Investment
As noted above, the challenges of fully leveraging the rich information available from an AMI are overcome when a utility uses an AMIS. With an integrated AMIS, no longer will management ask, "Why can't I use the outage information?", or "Why am I still sending people out for special reads?" The AMIS supports the processes to use the AMI information and realize the benefits forecast in the business case and helps capture the data to document the savings. With an AMIS these processes are complimentary and integrated with existing CIS and utility systems without forcing major upgrades or wholesale replacements which destroy the ROI.

Minimize Total Cost of Ownership
The O&M costs of an AMI over its lifecycle generally exceed the upfront capital costs and may dominate the cost side of the business case. An AMIS is essential to controlling and managing these costs. The AMIS automates O&M processes across multiple AMI technologies with a common management platform, integrating them with existing utility best-practices and systems, and making data available throughout the enterprise. This reduces the "change management" and transition costs, but more importantly, minimizes the on-going cost of operating an AMI. And by using a common integration platform the IT support is minimal.

Strategic Value
With an AMIS the utility is not limited to a single AMI technology and as new enhanced capabilities and solutions are brought to market, the AMIS provides the infrastructure to "snap in" these systems offering new utility and customer services. With a flexible, standardized approach to operating and managing an AMI, the utility can further leverage its investments in AMI and best practices developing synergies through mergers and acquisitions. A utility may even provide AMI operations and management services to other utilities using its flexible, AMIS-based solution.

Risk Management
With an AMIS such as the *PIPe,* the utility minimizes implementation risk by leveraging over 100 person-years of experience deploying and operating AMI solutions. A *PIPe*-managed AMI implementation includes comprehensive process maps and a deployment roadmap that covers all the bases – no surprises.   During the rollout the AMIS provides the tools to quickly and easily resolve process and data exceptions so that they don't slow deployment – and add to the cost.   After deployment, with the ability to fold in new AMI systems, the utility avoids a "big bang" conversion and upgrades or migrates as needed, when needed.

eMeter brings to its utility partners, in addition to the proven *PIPe,* highly specialized knowledge and skills, best practices from projects and utilities around the country and deep technology insight from relationships with a wide range of meter and communication providers. eMeter also brings field-hardened operating expertise from daily collection and management of data from customers representing over $3 billion in annual electricity revenues.

PIPe Technology

The *PIPe* is a multi-functional AMIS built with a scalable, N-tier, distributed architecture that includes secure web-based services and interfaces. Adapters are configured to integrate with utility legacy systems using a mixture of real-time and batch techniques as appropriate. Adapters to metering and data communications systems translate proprietary, technology-specific data into open, generic XML-based formats. The eMeter Message Bus moves data from collection to repository and coordinates processing by Java-based application modules along the way.

The solution can operate in either a UNIX/Linux or Windows-based environment, or a combination. Oracle database technology powers both the AMI Management Database as well as the Metered Usage Data Repository. The AMI Management Database maintains the complex relationships between meter and network assets, service premises, customer accounts, rates and tariffs, system provisioning and configuration, application services, and user privileges to name a few. The Metered Usage Data Repository stores the data collected and processed from the meters, including daily and real-time register readings, interval usage data, event logs, outage history, as well as derived data such as billing determinants and aggregations and Key Performance Indicators.

The robust architecture not only ensures performance as the system scales, but also provides "5 nines" reliability with server fail-over and hot-standby capabilities. Online backups and archiving are standard and hot-upgrades make the *PIPe* a true 7 x 24 x 365 solution.
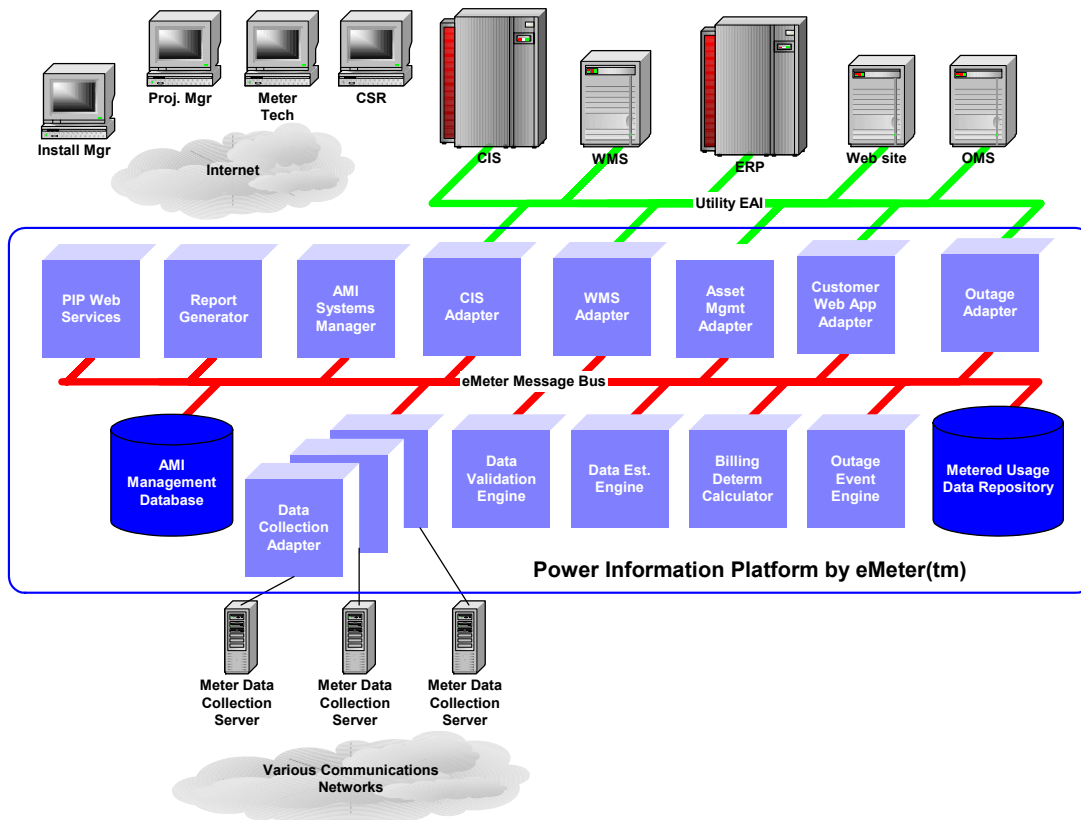

Figure 4 – Power Information Platform^{TM} Architecture

PIPe Features

The *PIPe* is structured with several modules to enable a flexible implementation as plans and requirements evolve, new processes are implemented, and equipment is installed. *PIPe* modules are of three types: Core System, Applications, and Interface Adapters.

Core System

- Meter Data Management System: includes the meter usage data repository and AMI management database; manages data collection from the AMI systems,

- Web Viewer: provides user access for utility and/or partner personnel,

- AMI Systems Manager: monitors AMI software and systems, including data communications; coordinates data synchronization with utility systems to ensure all have consistent, reliable, and accurate data,

- *PIPe* Message Bus: the middleware infrastructure that enables easy, robust linking of all the system elements, including batch or real-time event handling,

- Report Generator: generates management and operator reports, with a focus on Key Performance Indicators, and Business Activity Monitoring

- Data Validation Module: validates and identifies exceptions in data retrieved from AMI meters, and

- Service Manager: creates and tracks field service orders required to resolve meter or communications problems of AMI systems, maintains a audit trail on all business activities and processes.

Application Modules

- Outage Event Manager: filters, processes, and reports outage event data reported by AMI meters, includes synchronization with OMS or DMS circuit node databases,

- Asset Manager: manages meters, data communication modules, communication nodes, and other AMI system assets,

- Data Estimation Module: estimates values for missing data based on utility-approved algorithms for billing cycle reads, daily data presentation reads, or both,

- AMI Diagnostics & Error Flag Manager: manages and processes error flags reported by AMI meters and communication nodes and automatically generates field orders,

- Usage Data Exception Manager: checks reported usage data for items such as excess usage on inactive account, meter reset, and other potential problems,

- Energy Diversion Manager: checks meter reads, flags and exceptions and reports situations that may indicate energy theft,

- On-Demand Meter Read Module: enables utility personnel to read a any meter from any AMI system on demand, from a single interface,

- Transformer Load Manager: uses "virtual meter channels" to calculate peak loads on distribution transformers to identify potential overload and underutilized situations, and

- Installation Manager: manages meter installation processes, ranging from scattered individual meters to large-scale deployments, includes materials forecasting and logistics support, field work scheduling and coordination and process management and data capture interfaces.

Interface Adapters

- Billing Adapter: links the AMI system to the utility's billing system, including daily data synchronization,

- CIS Adapter: links the AMI system to the utility's CIS system, including daily data synchronization,

- Outage Adapter: links the AMI system to the utility's outage management system,

- WMS Adapter: delivers field orders to work management systems and captures result data,

- ERP Adapter: generates equipment and service purchase requests, communicates materials movements and location updates, provides asset status summaries for financial reporting,

- Data Collection Adapter: links different meter data collection systems (wireless, telephone, power line carrier, etc.) to the Meter Data Management System, and

- Custom Adapters: the eMeter Message Bus technology makes the generation of custom adapters straight-forward and provides access to all of the data and services of the *PIPe* for future, perhaps yet to be envisioned, applications

Summary

An AMIS supports successful advanced metering from pilots and commercial/industrial programs to large fixed-network rollouts and helps utilities achieve specific goals that include:

- Meeting cost and performance goals for AMI meters and associated communications networks and systems,

- Resolution of scalability, reliability, and security issues,

- Seamless data management and integration with utility systems,

- Dependable communications management and systems maintenance,

- Support of implementation best-practices and procedures, and

- Efficient operations and coordination with several utility departments

In the end, the purpose of an AMIS is to help a utility meet its strategic objective - realizing the full potential of its AMI investment.