**WG3 Meter Functional Specification Subgroup**

**Functional Requirements for the AMI System**


Summary

On February 25th, representatives from the investor owned utilities, system vendors and other interested parties participated in a conference call to establish the functional requirements that define the AMI (automated metering infrastructure) system capabilities to be economically evaluated in the business case. Table 1 lists all of the participants identified from the conference roll. Several other individuals that could not be identified also participated actively or as observers.


Defining Functional Requirements

The actual hardware and software that define both the cost and capability of an AMI system are driven by three distinct sets of definitions (Figure 1).

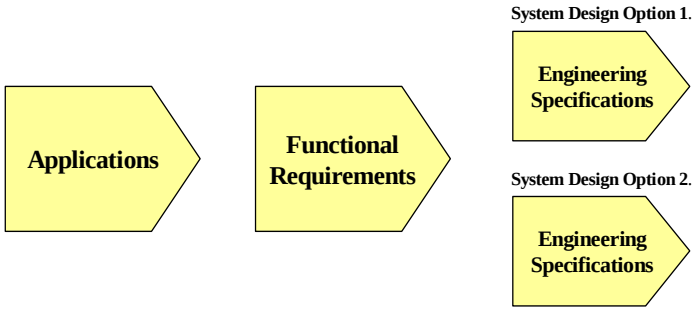



**Figure 1. AMI System Design Stages**

Applications define the highest level of AMI system capability. Applications provide an integrated view of how data collection, data processing, and communication work together to accomplish a specific objective. For example, pages 3-4 of the Joint Assigned Commissioner and Administrative Law Judge Ruling (ACR) list a variety of rate options, system (e.g. remote meter reading and outage management) and information applications. An RTP rate implies a certain level of interval data collection, data processing and communication capability that is quite different than a flat or inverted tier rate. The ACR, September 19th and November 24th rulings and Vision Statement provided the applications considered during our workgroup session.

Functional requirements define the common set of data collection (interval and other data), data processing and communication capabilities necessary to support the preferred list of applications, which in turn determine the cost of the AMI system. Functional requirements should provide

sufficient information to allow translation into engineering and other detailed system specifications. While the preferred rate and system applications may differ in how they combine, process and communicate data all may share common hardware and system components. The purpose of the functional requirements is to identify the common system capabilities necessary to support the preferred rate and system applications.

The cost to provide these common AMI system capabilities is separate and distinct from the cost to implement any specific rate option or system application (ACR footnote #3). The applications included in this specification are the minimum necessary to implement the functions described in the February 25th ACR. Additional specific applications could be added to the extent they are found to be cost-effective to development of the business case or essential components of customer service.

Engineering specifications translate the functional requirements into detailed hardware and software components. The same set of functional requirements may translate into engineering specifications that produce entirely different system designs in each utility service territory. For example, engineering specifications for one system design may specify that all interval data be stored in the meter, while another may specify that interval data be stored in a 'concentrator' that serves multiple meters. While each system design option has different cost, reliability, and system operating implications, all system designs should provide the capability to fully support the functional requirements and thereby also support the minimum application set.

AMI System Objective

According to the ACR, AMI systems should provide metering and communication capability to support a wide variety of economically justified rate and associated customer service options. The ideal AMI system should maximize the amount of demand response that can be achieved cost effectively. The specific mix of rates, programs and customer service functions that will eventually satisfy this cost effective ideal is not known a priori. Consequently, the AMI system should be designed with the flexibility to anticipate and support a wide variety of potential rate structures and customer service options that the Commission may approve over the useful life of the AMI system.

## Workgroup Results

### 1. Implementation Scope.

The ACR and previous Commission rulings clarify that full scale implementation will provide all customers in all rate classes with AMI capabilities and the option to choose between dynamic and static rate structures.

The ACR, however, does differentiate potential rate offerings for different groups of customers, specifically: (a) very large customers (> 1 MW), (b) large customers (200kW to 1 MW), and (c) residential and small commercial customers (<200kW). This differentiation has implications for both the level of interval data (e.g. 15, 30 or 60 minute data) collected from each customer and the types of applications eventually supported.

The workgroup suggests the following additional clarifications:

- Implementation should anticipate that while all classes of customers (residential, agricultural, commercial and industrial) will be addressed, it is not economically, technically or practical to guarantee implementation on 100 percent of the customer sites. There will be a small percentage of customers for whom installation of AMI is not practical or economic given geographic remoteness, population density or other technical constraints. The utility business case should identify these exceptions and also identify what alternatives will be provided to assure support for dynamic pricing and other services supported by AMI.
- The scope of implementation needs to be clarified to identify whether the definition of "all classes of customers" includes (1) direct access customers and (2) customers that own their meters.
- Additional metering system differentiation may be necessary to address recording interval and other technical issues for medium size commercial / industrial customers with demands between 20kW and 200kW. See recommendations under 1b for a more complete explanation.
- Specific types of metered accounts such as billboards, street lighting and other similar applications may be excluded or targeted for more limited metering capability.
- It is also recognized that no single meter, meter system design or communication technology may be suitable to serve all customer segments within a single utility service area. In some cases multiple systems, employing a variety of metering and communication technologies may be necessary.
- Combined electric and gas utilities may include basic gas metering in their AMI business case. Estimated costs for gas and electric meters will provide comparable functionality.

In each case the utilities will clearly identify the criteria for each decision, any exclusions and number of customers affected.

## 2. Technology Preferences.

No single metering or communication technology is preferred one over the other. Technology choice should be driven by functional, engineering and economic performance. Technology choice and engineering features should be left to individual utilities. Meter system functional specifications assume compliance with all net metering, safety, data accuracy and other legal requirements not directly addressed by the ACR.

## 3. System Design.

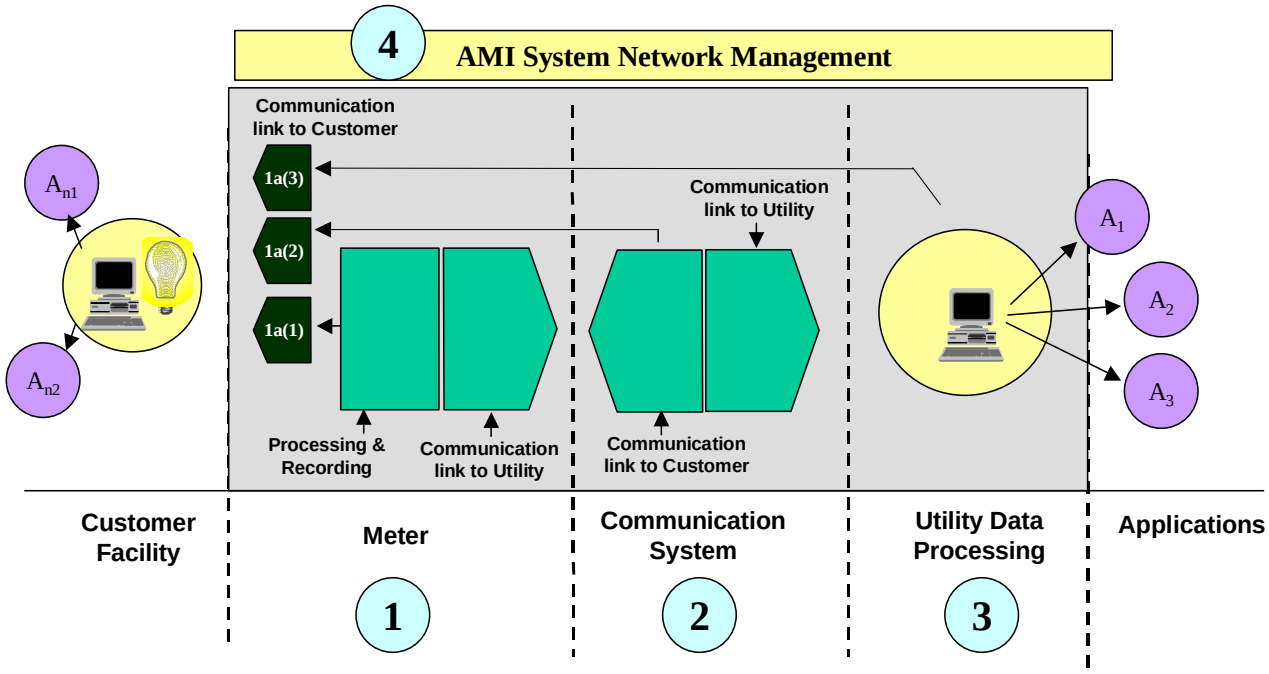
AMI systems can require the integration of multiple metering, communication and data processing technologies. While minimum functional requirements narrow the technology choices for each system component, the actual technologies selected and how they are combined into a system still requires substantial engineering, economic and operational judgment. Customer mix, geography, transmission/distribution and other electric system design features, as well as customer service philosophy can substantially affect which metering and communication technologies a utility selects and how they combine them into a

fully functional AMI system. As a consequence, there is no single best AMI system design. It is likely that each of the participating utilities will choose different AMI system components and designs as the basis for the business case.

## 4. System Functional Requirements and Additional Subgroup Recommendations.

AMI systems combine three integrated components that define distinct data collection and data communication functional requirements. Figure 2 graphically depicts the three AMI system components and how they relate to both customer and system applications. Table 1 provides an overview of the system functional requirements.

**Figure 2. AMI System Components**



| System Component | Description / Discussion | Issues Requiring Clarification |
|---|---|---|
| **1. Meters** | Meter systems generally include a variety of sensing, recording, processing and communication capability. At a minimum, the meter system must provide capability to sense and record various electric operations and then communicate information back to the utility. Basic functional capabilities should include capability to:<br>**x** collect and store interval data (see issues)<br>**x** provide processing at the meter or within the system, where necessary, to support essential customer service and system operating applications.<br>x provide optional capability to support customers with direct or other real-time access to meter data<br>x provide capability to remotely access (download or otherwise communicate) meter data to support customer billing, system operation and customer service and educational applications | The resolution of interval data collected is usually determined by the specific rate, information or system application to be supported.<br>While the ACR specifies different potential combinations of rates targeted to three distinct classifications of customers, Appendix A specifies that interval data will be collected at a minimum of 15-minute intervals.<br>The resolution of interval data collected will affect AMI system specifications and cost.<br>The utilities recommend a clarification of interval data recording to differentiate between the customer classifications. There is consensus on the largest C/I and smallest Residential customers, however there is a lack of consensus regarding the breakpoint C/I customer in the middle. See 1b for Subgroup recommendation.<br><u>Recommendation by the Function Subgroup</u><br>Meter system functional specifications assume compliance with all net metering, safety, data accuracy and other legal requirements not directly addressed by the ACR. |
| 1a. Communication Link to the Customer | Meter systems may also include capability to<br>(a) allow customers to use supplementary equipment to connect to and access real-time information directly from the meter (hard wired KYZ port)<br>(b) communicate information wirelessly in real-time from the meter directly into the customer facility, or<br>At a minimum, the AMI system should provide capability to communicate information to the customer through other hardwire, wireless, internet, paper or other means in less than real-time.<br>Direct, real-time access to meter data may be useful in supporting energy management, energy monitoring or other customer display applications. This is particularly true for the largest C/I customers.<br>Any communication from the meter directly into the customer facility | There is consensus that all customers may need or can use access to their energy usage information. However, there is no consensus regarding either the customer need for or technology necessary to support real-time access to meter data. There is consensus on two points: (1) a real-time link would raise the cost of the meter and (2) the largest C/I customers have a more established need for this type of information than small C/I or residential.<br><u>Recommendation by the Function Subgroup</u><br>x Require hard-wire or wireless options for accessing real-time data from the meter for the largest C/I customers<br>(1) For >200 kW under AB1X29, real time is defined as a hard wire option through a KYZ port at the meter or through a utility provided Internet link that provides a minimum 24 |

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| | should be governed by non-proprietary, open-protocol communication standards.<br><br>Access to less than real-time meter data through other means may be particularly useful to all types of customers to support educational, facility management and other functions. | hour turnaround.<br>(2) For <200 kW, utilities should identify options that are at a minimum compatible with the same interval recording detail listed in the recommendation under 1b. bullet #2.<br>x Communication from the meter directly into the customer facility should be governed by non-proprietary, open-protocol communication standards.<br>x Allow utilities to specify or make available real-time access to other customers either with economic justification or as a customer charge option.<br>x Require utilities provide customers with several different options to gain access to less than real-time meter data. |
| 1b. Processing and Recording | What is processed and stored at the meter, in local nodes or concentrators that aggregate multiple meters, or in the utility data processing system is determined by the overall system design and basic tradeoffs between the cost of communication and cost and value of data collection and storage. Collecting and processing interval data centrally for all meters on a daily basis, maximizes potential information value by providing immediate access to detailed system operating data and provides great flexibility to quickly change and implement new rate designs.<br><br>However, there is a tradeoff that must be made between how often and at what level of detail data is collected. Specifically, collecting interval data from all meters daily versus less frequent collection of only the register data necessary to support the customer rate involves a tradeoff in communication, data processing and data storage costs versus application support.<br><br>The collection, communication and storage of interval data or the same interval recording detail may not be identical or even required for all customers. Rate designs (e.g. RTP, interruptible and demand rates) and system applications (e.g. load survey, outage reporting, etc.) may require different levels of interval data collection and then only from subsets of customers.<br><br>Meter recording and data transmission capabilities will be driven by three | <u>Recommendation by the Function Subgroup</u>:<br>x Adopt the 15-minute interval data recording level already in place and specified in for the largest C/I customers.<br>x Require the utility AMI meter and system design explicitly address what level of interval data will be established as the default for all other customers below 200 kW. Design requirements should address each of the following:<br>(1) Existing and anticipated rate design/tariff requirements for interval data<br>(2) Existing and potential markets for demand response both at the retail and wholesale level as well as potential aggregation to support ancillary services and other reliability programs, and<br>(3) Utility system operational needs for support of outage management, load survey, customer education and bill inquiry resolution.<br>x Furthermore, utility AMI system designs should be required to provide and/or explicitly address capability to remotely redefine the time boundary or other register |

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| | factors –<br>(1) Billing determinants necessary to support the customer rate.<br>a. Centrally processed 15 minute interval data can be collected from each meter and centrally processed to support almost all possible rate designs, however<br>b. Locally processed aggregated meter register data can be used to support most tiered, time-of-use (TOU) and Critical Peak (CPP) rates. To retain flexibility, AMI system designs should provide and/or explicitly address capability to remotely redefine the time boundary or other register collection parameters.<br>(2) Information necessary to support customer billing inquires and system operating and service functions. While customer billing may not require the collection of interval data, selective access to interval data may be necessary to support customer billing inquiries, load survey, system planning, outage management and customer educational applications.<br>(3) Customer information and educational applications - Interval level data in the form of a daily load curve can be instrumental in educating customers regarding how they use energy and what they can do to better manage their energy bill. If interval data is not collected and stored centrally, provision must be made to store data locally sufficient to support anticipated applications and to remotely access this data on demand. See (2). | collection parameters. |
| 1c. Communication Link to the Utility | Communication capability from the meter to the local node/utility can be supported by a variety of communication methodologies and either integrated or linked system designs. How often data is uploaded from the meter is a dependent upon the system design and the tradeoffs inherent in various system operating and customer service applications. Alarm functions that trigger automatic communication from the meter to the utility may allow less frequent polling and data collection from the remaining meters population. | No significant issues. |

| System Component | Description / Discussion | Issues Requiring Clarification |
|---|---|---|
| **2. Communication System** | The communication technology choice and system design will be driven by (1) decisions regarding processing and recording, (2) assumptions regarding customer participation and the mix of rates and programs and (3) timing needs of selected system operating and customer service applications.<br><br>Because of the uncertainties regarding customer participation and the eventual mix of rate designs and program, the actual volume of data transport that needs to be supported is also uncertain. | <u>Recommendation by the Function Subgroup</u>:<br><br>x Communication systems technologies should be capable of being economically scaled up or down in response to anticipated customer participation levels.<br><br>x Utilities will be obligated to provide AMI to all customers in all classes, to support as yet undecided rate options. As a result, some minimum level of communication infrastructure must be available 100 percent of the time. Utility business cases should clarify both the design and economic justification for what is proposed. |
| | | |
| **3. Utility Data Processing** | Interval and register data must be validated and edited, at a minimum, in accordance with CPUC billing quality standards. Data must also be integrated into a master customer database to support billing and other utility system functions.<br><br>As with Communication system requirement, there are uncertainties regarding customer participation, the eventual mix of rate designs and program, and consequent data processing requirements. As a result, data processing systems should be capable of being economically scaled up or down in response to anticipated customer participation levels. | No significant issues. |
| **4. AMI System Network Management** | Network management capability must be provided to manage meter data collection schedules, meter and communication system alarms and all other system maintenance and operating functions. | <u>Recommendation by the Function Subgroup</u>:<br><br>To guarantee open information exchange between legacy, future utility systems and potential third-party customer applications, AMI designs should anticipate and separate information exchange requirements into hierarchical categories to accommodate interoperability. |

## Table 1. WG3 Meter Functional Specification Subgroup

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