UNDERSTANDING

SMART METER
—— TEXAS ™ ——

Version 2.0

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SMART METER
—— TEXAS ™——

Document History

Revision Number	Revision Date	Comments
v1.0	11-1-2013	First release of Understanding SMT
v1.5		Edited the document to make it consistent with the Fall 2014 release of SMT including the Third Party access functionality, redesign related to Customer usability, and ability for ROR to provide access to SMT API and SMT FTPS to vendors on their behalf.

ACKNOWLEDGEMENTS

Executive Summary

Smart Meter Texas™ (SMT) is an interoperable information system which stores electric meter usage data received from participating Texas Transmission and Distribution Service Providers[1] (TDSPs) and provides access to meter usage data to Customers, Retail Electric Providers (REPs), and authorized Third Parties. In addition to acting as a common, interoperable interface for access to smart meter data, SMT enables In-Home Devices to be installed and connected to the Customer HAN[2] and enables Third Parties to communicate with Customers through their In-Home Devices. SMT also provides a convenient and easy to use process whereby Customers can grant Third Parties access to their usage information and give them permission to communicate with their In-Home Devices. By making these standardized services available to all REPs and Third Parties serving Customers in Texas and to all Customers with smart meters in the competitive regions of Texas, regardless of the TDSP service territory in which they are located or the REP or Third Party they are served by, SMT is a first-of-kind smart grid solution that is relevant and applicable to other jurisdictions.

SMT is the product of a collaborative stakeholder-driven process initiated by the Public Utility Commission of Texas (PUCT), designed to support the Advanced Metering System (AMS) deployment in the Texas competitive electricity market by leveraging the wealth of Customer usage data made available by smart meters and the associated AMS communications and information technology infrastructure. Although uniquely designed and developed for the Texas electricity market, SMT is relevant to other jurisdictions that have smart meter deployments and desire to implement the Green Button initiative. SMT provides a broad range of benefits to many market participants. Chief among these benefits are improved access and utilization of energy data. By providing timely access to energy usage data, Customers can better manage their energy consumption to lower their monthly energy expenditures and benefit from new

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[1] The participating Texas TDSPs are AEP Texas Central Company and AEP Texas North Company (jointly "AEP"), CenterPoint Energy Houston Electric, LLC ("CenterPoint"), Oncor Electric Delivery Company LLC ("Oncor"), and Texas-New Mexico Power Company ("TNMP") collectively referred to as the "Joint TDSPs".

[2] The Customer HAN is an energy home area network that is created using the HAN communication protocol, ZigBee SEP v1.0, located in the smart meter that is installed at the Customer premise (see definition of HAN in Section 2).

smart grid products (e.g., bill alerts, usage summary, pre-paid service, peer compare, etc.) offered by REPs and Third Party service providers. REPs and Third Parties benefit by having one common exchange point to download Customer energy usage data regardless in which TDSP service territory the Customer is located in. Without SMT, the TDSPs, REPs, and Third Parties would have higher operational costs resulting from the development and operation of multiple data portals, multiple interfaces, and from the lack of standardization. By removing the inefficiencies, redundancies, and lack of interoperability from the process, costs for electricity service are lowered for all, including Customers.

An additional key smart grid benefit realized by the implementation of SMT is the provision of a single communications interface used for the initial installation of In-Home Devices and for Third Parties to communicate with Customers' In-Home Devices. The ability to communicate with In-Home Devices has enabled the development of innovative retail products like programmable communicating thermostats, billing information updates sent to In-Home Devices, innovative pricing products, and demand response programs. The HAN communication support provided by SMT has increased the rate of In-Home Device adoption and types of In-Home Device-related services available in Texas while reducing the overall cost of In-Home Device product development and deployment. Also, the experience gained in the development of the SMT HAN support model resulted in a refinement of the ZigBee Smart Energy Profile v1.x and enabled the creation of standardized HAN Application Programming Interfaces (APIs) for In-Home Device installation and communications. This standardization has provided Texas Customers with a greater selection of available In-Home Devices than any other electric market in the US.

The genesis of SMT can be traced back to 2007 when the PUCT scheduled workshops under its Project #34610 to create a stakeholder-driven process tasked with addressing implementation issues related to the deployment of advanced meters. Participating stakeholders in this process (which came to be known as the "Advanced Metering Implementation Team" or "AMIT"), included representatives from the Joint TDSPs, REPs, PUCT staff, consumer advocates, advanced meter manufacturers, In-Home Device manufacturers, HAN service providers, solutions vendors, and the Electric Reliability Council of Texas (ERCOT). During the course of

this consensus-driven, collaborative process, stakeholders defined business processes and requirements that would be required to support the deployment of smart meters, including retail market transactions, the exchange of Customer meter usage data, wholesale settlement among market participants, communications with In-Home Devices, and Customer education. Those business processes and requirements related to the exchange of Customer meter usage data and communications with Customer In-Home Devices formed the initial design basis for SMT.

SMT development began in 2008 and, by the end of 2010, a base set of functionality was available, including access to smart meter usage information and HAN functionality, which enabled Customers to manage their energy consumption, reduce their energy costs, and take advantage of new smart energy products and services.

The process of developing SMT followed widely recognized smart grid methodologies like the IntelliGrid Methodology for Developing Requirements for Energy Systems and the GridWise Architecture Council's (GWAC) Interoperability Layered Categories, known as the GWAC stack. SMT development was also consistent with each of the National Institute of Standards and Technology (NIST) guiding principles for identifying interoperable smart grid standards for implementation. SMT satisfies the NIST architectural goals for the smart grid and the NIST IR 7628 Guidelines for Cyber Security. By following these and other industry methodologies, best practices, and standards, SMT provides registered and authorized users access to energy usage and other related data through standardized and secure interfaces.

This document is designed to provide a comprehensive understanding of SMT, including the context in which it was developed, the methodology used for its design and development, the functionality it provides to users, the benefits that have been realized from its deployment, and the use of smart grid standards utilized to ensure that SMT is an interoperable solution. In addition, this document provides interested parties with access to key SMT artifacts (i.e., business requirements, use cases, context diagrams, etc.).

By making information about the SMT solution publicly available, this document aspires to extend the value of the solution in the following ways:

- *To demonstrate a model for the development of similar customer- and market-enabling solutions in other jurisdictions*

- *To demonstrate a model for using one common interface across multiple utilities to access consumer energy usage data*

- *To serve as a guidebook for REPs and Third Parties wanting to understand the functionality and value of the SMT solution for their businesses*

- *To demonstrate an interoperable implementation of the Green Button initiative*

- *To demonstrate a model for using one common interoperable interface to communicate with Customer In-Home Devices over multiple utility AMS communication networks*

- *To testify to the potential power of a consensus-based, stakeholder-driven approach to smart grid solution development, producing an interoperable solution that meets the needs of all stakeholders.*

Table of Contents

Table of Tables

Table of Figures

1 Introduction

SMT is an interoperable smart grid solution that provides access to smart meter information and enables communication with Customer In-Home Devices using the TDSP AMS communication network. SMT hosts a common data repository storing Customer usage information and technical information related to the smart meter installed at the Customer's premise. SMT provides registered and authorized users access to this information through standard and secure interfaces. In addition, SMT enables communication with Customer In-Home Devices by providing Customers and Third Parties a standard method for connecting In-Home Devices to the Customer HAN and providing Third Parties the ability to send messages to a Customer In-Home Device.

This document is designed to provide a broad understanding of SMT, including the context in which it was developed, the methodology used for its design and development, the functionality it provides to users, the security needed to provide secure user interfaces and protect Customer data, and the use of smart grid standards utilized to ensure that SMT is an interoperable solution.

The following provides an overview of each of the sections of this document.

2   Acronyms and Definitions – this section provides definitions of acronyms and terms used in this document.

3   Background and Context – this section provides background and context information related to the Texas policy and regulatory directives that spurred the development of SMT and the Texas competitive electric market structure showing how critical it was for SMT to be interoperable. In addition, this section describes the history of SMT, the benefits provided by SMT, and how the development of SMT paralleled with the national effort to develop smart grid standards.

4   **Methodology** – this section describes the consensus-driven process used to develop the SMT business requirements[3].

5   **Functionality** – this section introduces the SMT conceptual model and provides detail on the key functions of SMT – data repository, access meter data, Third Party access, HAN functionality, and education.

6   **Registration and User Roles** – this section describes the secure registration process users must pass through to create an account on SMT and the roles assigned to different types of users to ensure security and privacy.

7   **Interfaces** – this section describes the three different interfaces provided to users for accessing the SMT functionality and the type of access granted to each user depending upon their assigned role.

8   **Use Cases** – this section describes the use case and storyboard process used to identify SMT actors and business requirements.

9   **Security** – this section describes the variety of tools and techniques used to ensure security and privacy of Customer data and secure the SMT interfaces.

10 **Use of Industry Standards** – this section discusses how the SMT design and implementation followed widely recognized smart grid methodologies, guiding principles, architectural goals, best practices, and smart grid and web standards to make it an interoperable smart grid solution.

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[3] The final SMT business requirements are filed in Project #41171 Repository of Advanced Metering Implementation Documents
http://interchange.puc.texas.gov/WebApp/Interchange/application/dbapps/filings/pgSearch.asp

11 **Testing** – this section describes the testing that was done to validate the SMT functionality, including In-Home Device testing.

12 **Operational Support** – this section describes the system support for SMT and the Help Desk supporting SMT users.

2 Acronyms and Definitions

2.1 **Acronyms**

Acronym	Term
AMIT	Advanced Metering Implementation Team
AMS / AMI	Advanced Metering System / Advanced Metering Infrastructure
API	Application Programming Interface
BP	Business Process
BR	Business Requirement
CenterPoint	CenterPoint Energy Houston Electric, LLC
CSV	Comma Separated Values
ERCOT	Electric Reliability Council of Texas
ESIID	Electric Service Identifier
FTPS	File Transport Protocol Secure
FAQs	Frequently Asked Questions
GUI	Graphical User Interface
GWAC	GridWise Architecture Council
HAN	Home Area Network
HB	House Bill
JDOA	Joint Development and Operating Agreement
LSE	LodeStar Enhanced
NIST	National Institute of Standards and Technology
Oncor	Oncor Electric Delivery Company LLC
PGP	Pretty Good Privacy
ROR	REP of Record
REP	Retail Electric Provider
PUCT	Public Utility Commission of Texas
RFP	Request for Proposal
RMS	Retail Market Subcommittee
SDO	Standards Development Organization

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Acronym	Term
SSO	Standard Setting Organization
SGIP	Smart Grid Interoperability Panel
SMT	Smart Meter Texas™
TNMP	Texas-New Mexico Power Company
TX SET	Texas Standard Electronic Transaction
TDSP	Transmission and Distribution Service Provider

2.2 **Definitions**

Term	Definition
Activity Diagram	A graphical representation used to describe the business and operational step-by-step workflows of components in a system.
Advanced Metering Implementation Team	A group of market participants, including representatives from the Joint TDSPs, REPs, PUCT staff, consumer advocates, advanced meter manufacturers, HAN manufacturers, HAN service providers, solutions vendors, and ERCOT who participated in PUCT Project #34610 Implementation Related to Advanced Metering.
Advanced Metering System or Advanced Metering Infrastructure	A utility system that measures, collects, and analyzes energy usage using advanced electric meters, through various communication technologies. This infrastructure includes hardware, software, communications, customer service systems, meter data management software, metering system, network distribution business systems, etc.
AEP Texas Central Company and AEP Texas North Company (AEP Texas)	Two TDSPs that are operating companies of AEP serving a total of almost 1 million retail electric customers in portions of west Texas and south Texas including areas along the Texas gulf coast southwest of Houston.
Agreement Key	An alphanumeric security code provided in an email invitation to a Friend that is needed for the Friend to view their friend's smart meter usage information.
Application Programming Interface	A protocol intended to be used as an interface by software components to communicate with each other.
Account Authorization Code	An alphanumeric security code created by SMT for a Customer account that a Customer may give to a Third Party who wants to send an agreement invitation to the Customer. A Business Account will have an Account

Term	Definition
	Authorization Code for each Administrator.
Business Account	An SMT account associated with one or more ESIIDs for a user who is a Business Customer.
Business Customer	An electric Customer who is a business company with one or more ESIIDs.
Business Process	An activity or set of activities designed to produce a specific output. Business Processes describe large groupings of work (functionality / capabilities) that will be available (created or impacted) as a result of a project.
Business Requirement	High-level statements of the goals, objectives, or needs of a project.
CenterPoint Energy Houston Electric, LLC	A TDSP serving 2.1 million retail electric customers (1.9 million residential customers) in a 5,000-square-mile electric service territory in the Houston, Texas metropolitan area.
Comma Separated Values	A common file format in which the data is presented as a list of fields that are separated by commas. CSV files are typically opened with an application or spreadsheet software, such as MS-Excel.
Customer	A Residential or Business Customer with a premise connected to one of the Joint TDSP's distribution system and has a smart meter installed.
Electric Reliability Council of Texas	The independent system operator that operates the electric grid and manages the deregulated market for 75 % of the state of Texas.
Electric Service Identifier (ESIID)	A 17 or 22-digit number used to identify a unique point of electric service delivery to a premise (home or business) and is found on the Customer electric bill.
Energy Data Agreement	An Agreement between a Customer and a Third Party granting the Third Party the ability to view and download usage information, meter information, and premise information for one or more of the Customer's ESIIDs.
File Transport Protocol Secure	An extension to the commonly used File Transfer Protocol (FTP) that adds support for the Transport Layer Security (TLS) and the Secure Sockets Layer (SSL) cryptographic protocols. FTP is a standard communication protocol used to transfer files from one host or to another host over the internet, built on a client-server architecture and uses separate control and data connections between the client and the server.
Frequently Asked Questions	A set of question and answers on the SMT web portal relating to SMT, smart meters, In-Home Devices, customer accounts, reading reports and using

Term	Definition
	data, and importing files.
Friend	A person who has been granted access by a Residential Customer to view that Customer's smart meter usage data.
Graphical User Interface	A type of user interface used by the SMT web portal that allows users to interact with SMT using images for the tasks of gathering and producing information.
GridWise Architecture Council	A team of industry leaders who are helping to identify areas for standardization in the smart electrical grid that allow significant levels of interoperation between system components and to outline a philosophy of inter-system operation that preserves the freedom to innovate, design, implement and maintain each organization's portion of the electrical system.
Home Area Network	In Texas, an energy related network using the ZigBee Smart Energy Profile v1.0 protocol for communicating with In-Home Devices within the Customer premise. The HAN, in the context of this document, is created by the smart meter that has the ZigBee SEP v1.0 protocol and is installed at the Customer premise.
In-Home Device	A device (e.g. in-home display, programmable communicating thermostat, smart appliances, etc.) that communicates on the Customer HAN. Sometimes referred to as a HAN Device.
In-Home Device Agreement	An Agreement between a Customer and a Third Party granting a Third Party the ability to add or remove an In-Home Device on the Customer HAN.
In-Home Device Services Agreement	An Agreement between a Customer and a Third Party granting a Third Party the ability to send messages to a Customer's In-Home Device.
Interoperability	The capability of two or more networks, systems, devices, applications, or components to interwork, and to exchange and readily use information— securely, effectively, and with little or no inconvenience to the user. The Smart Grid will be a system of interoperable systems; that is, different systems will be able to exchange meaningful, actionable information in support of the safe, secure, efficient, and reliable operations of electric systems. The systems will share a common meaning of the exchanged information, and this information will elicit agreed-upon types of response. The reliability, fidelity, and security of information exchanges between and among Smart Grid systems must achieve requisite performance levels. [4]

[4] NIST Framework and Roadmap for Smart Grid Interoperability Standards, Release 2.0

Term	Definition
Joint Development and Operating Agreement	An agreement between the Joint TDSPs to share in the development, hosting, maintenance, and operation of SMT.
Joint TDSPs	The TDSPs AEP Texas, CenterPoint, Oncor, and TNMP, who are part of the JDOA.
LodeStar Enhanced	An ERCOT specified file format (CSV like) for TDSPs to provide data to ERCOT for loading smart meter usage data into the settlement process.
Oncor Electric Delivery Company LLC	A TDSP serving more than 3 million retail electric customers in an electric service area that includes the Dallas-Fort Worth metroplex and portions of east, central and west Texas.
Pretty Good Privacy	A data encryption and decryption standard that provides cryptographic privacy and authentication for data communication and storage.
REP of Record	The Customer's current REP in the ERCOT settlement system.
Residential Account	An SMT account associated with one or more ESIIDs for a user who is a Residential Customer.
Retail Electric Provider	An entity that sells electric energy to retail customers in the competitive regions of Texas but does not own or operate generation assets. REPs register with the PUCT and lists of registered REPs are located on the PUCT website.
Public Utility Commission of Texas	The entity created by Texas legislation to provide statewide regulation of the rates and services of electric and telecommunications utilities and implement respective legislation.
Request for Proposal	A solicitation made by a company interested in procurement of a commodity, service or asset, to potential suppliers to submit business proposals. It usually includes requirements for the commodity or service, and may dictate to varying degrees the exact structure and format of the supplier's response.
Retail Market Subcommittee	An ERCOT subcommittee functioning as a forum for the resolution of retail market issues that directly affect ERCOT and the ERCOT protocols.
Standards Development Organization	Professional societies, industry and trade associations and membership organizations that develop standards within their area of expertise in processes marked by openness, balance, and transparency, and characterized by due process to address contrary opinions.
Standard Setting	A broader universe of organizations and groups—formal or informal—that

Term	Definition
Organization	develop standards, specifications, user requirements, guidelines, etc.
Smart Meter Texas™	An internet-based interoperable smart grid solution hosting a common data repository, providing access to smart meter information, providing a method for Customers to grant Third Parties access to their usage data and In-Home Devices, and providing an interoperable method for HAN communications using the TDSP AMS communication network.
Third Party	A company that offers energy efficiency and In-Home Device services to Customers. Third Parties include REPs when REPs are offering energy efficiency services to Customers who do not buy electricity from them (i.e., not the ROR). REPs are considered Third Parties to all Customers, including the ROR Customers, when the REP is offering In-Home Device services to Customers.
Texas-New Mexico Power Company	A TDSP serving 230,000 retail electric customers in a diverse electric service area that includes north-central and west Texas and an area along the Texas gulf coast south of Houston.
Texas Standard Electronic Transaction	The procedure used in Texas to transmit standard electronic data transactions that enable and facilitate the processes of customer choice in the deregulated Texas electric market.
Transmission and Distribution Service Provider	An entity that has owns and operates electrical transmission and distribution facilities and is regulated by the PUCT.

3 Background and Context

Texas has been a frontrunner in the deployment and testing of smart meter technology and has been an early adopter of legislation and regulation related to the access of smart meter usage data. The Texas deployment of smart meters began in 2008 and, as of August 31, 2014, over 6.8 million[5] smart meters have been installed by the Joint TDSPs. Between 2005 and 2007, the Texas legislature and PUCT adopted legislation and regulation that resulted in smart meters being deployed and smart meter data being easily accessible by Customers and their REPs beginning in 2010. A brief explanation of the Texas electric market and a history of the development of SMT, as an interoperable solution meeting the legislative and regulatory requirements, are presented in this section.

3.1 Texas Policy and Regulatory Directives

In 2005, the Texas legislature directed the Public Utility Commission of Texas (PUCT) to: (a) report on the efforts of TDSPs in Texas to deploy advanced meters and their associated infrastructure, (b) identify any barriers to deploying advanced meters, and (c) provide recommendations to address such barriers[6]. As a result of this directive, the PUCT staff opened a rulemaking on advanced metering[7] in July 2005. The PUCT and market participants worked on the Advanced Metering rule for almost two years and, in May 2007, the rule was adopted. The advanced metering rule[8] defined the minimum functionality an advanced metering system must provide for a TDSP to receive cost recovery and to achieve the benefits outlined in the Texas law. In the 2007 legislative session, the Texas legislature passed a bill (HB 3693) expressing their intent that net metering and "advanced meter data networks be deployed as rapidly as possible."[9] Following the adoption of the advanced metering rule and the passage of Texas HB

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[5] From the TDSP Monthly AMS Compliance Reports for Oncor Electric Delivery - Project No. 36157; CenterPoint Energy Houston Electric, LLC - Project No. 36699; AEP Texas Project No. 37907; and TNMP - Project No. 39772
[6] Texas HB 2129
[7] PUCT Project #31418 Rulemaking Relating to Advanced Metering
[8] PUCT Substantive Rule §25.130 - Advanced Metering
[9] Texas HB 3693

3693, the PUCT opened up an implementation project[10] relating to advanced metering in the fall of 2007. The purpose of this project was to address many implementation issues and changes needed in the Texas retail and wholesale markets as a result of the deployment of advanced meters, including access to smart meter usage data and communications with the Customer home area network (HAN).

3.2 Texas Electric Market

To understand the different parties involved in the development and use of SMT and to show how SMT is an interoperable solution meeting the needs of the diverse market participants, it is useful to understand the Texas electric market structure. In 1999, the Texas Legislature passed legislation that required the creation of a competitive retail electricity market that would give Customers the ability to choose their retail electric providers beginning in January 1, 2002. This legislation affected approximately 6.7 million retail customers (i.e., residential, business, and industrial) whose premises were in the service territories of the Joint TDSPs. The main functions of the vertically integrated electric power market – generating power, transmitting electricity over power lines to customer premises, and selling electric power to end-use customers – were split into three distinct and separate business entities. Table 1 provides a brief summary of the functions of each business entity in the competitive Texas electric market.

Table 1: Functions of Unbundled Electric Companies

Entity	Function
Power generation company	• Own, operate, and build electric power plants • Sell power into a competitive wholesale electric market (i.e., to ERCOT, through bi-lateral agreements with REPs and power marketers)

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[10] PUCT Project #34610 Implementation Related to Advanced Metering and Staff Memorandum outlining the Project at http://interchange.puc.state.tx.us/WebApp/Interchange/Documents/34610_32_570990.PDF

Transmission Distribution Service Provider (TDSP)	- Regulated by the PUCT - Own, operate (in coordination with ERCOT), and build transmission and distribution lines - Transport electric power to all electric customers within its defined service area - Provide metering services - Install smart meters at residential and small business customer premises - Bill retail electric providers for power delivery
Retail Electric Provider (REP)	- Purchase wholesale electric power for re-sale to retail customers - Interface with the retail customer (e.g., marketing, billing, providing various services, etc.) - Offer competitive prices and service offerings to retail customers in any of the Joint TDSP service areas

Figure 1 shows a simplistic view of the Texas electric market structure with the relationship between the different entities.
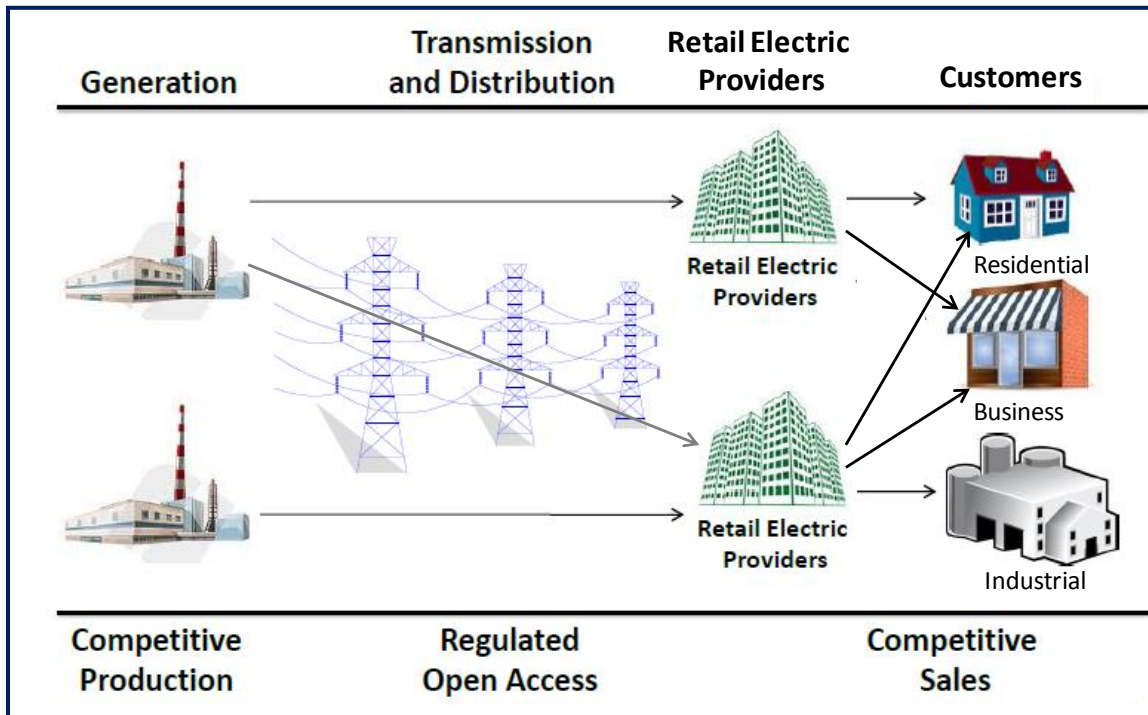
Figure 1: Texas Electric Market Structure[11]

This type of market structure complicates and presents unique challenges to the effective exchange of smart meter information between the market participants. For example, the entity that owns and reads the smart meter, the TDSP, is not the same entity that interfaces with the retail customer, the REP. The REP needs the Customer smart meter usage information for billing, product development, and supply risk management. Another complicating factor is that a REP may have Customers in multiple TDSP service areas and will need to interface with those TDSPs to receive the smart meter usage information. All of these complications and the requirements of the market participants were addressed in a collaborative process that resulted in the interoperable SMT solution.

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[11] This Figure 1 includes all the retail customers who are part of the Texas competitive market structure; however, SMT is currently only applicable to residential and business customers.

3.3 **SMT History**

The history of SMT can be divided into four distinct periods, which are discussed in detail in the following sections:

3.3.1 SMT business requirements definition and specification: from 2007 through early 2009

3.3.2 SMT technical development: from late 2008 through early 2010

3.3.3 SMT Launch: early 2010

3.3.4 SMT Releases: 2010 through 2014

3.3.1 SMT Business Requirements Definition and Specification

In the fall of 2007, workshops were scheduled by PUCT Staff to create an independently facilitated, stakeholder-driven process to address issues identified by the stakeholders related to the deployment of advanced meters. The stakeholders (known as the "Advanced Metering Implementation Team" or "AMIT"), included representatives from the Joint TDSPs, REPs, PUCT staff, consumer advocates, smart meter manufacturers, In-Home Device manufacturers, HAN service providers, solutions vendors, ERCOT staff, and Solutions Cube Group LLC, the independent meeting facilitator. AMIT met frequently in regularly scheduled meetings over the course of the next nineteen months and, by May 2009, AMIT had completed a comprehensive set of business requirements[12] that became the basis for the design of SMT.

Through the consensus-driven process, AMIT concluded that the optimal implementation of the business requirements was one common application for all the Joint TDSPs. The Joint TDSPs implemented this decision by entering into a joint venture. In 2009, CenterPoint and Oncor signed a Joint Development and Operating Agreement (JDOA) to cooperate in the funding, development, hosting, operation, and maintenance of a common data repository, web portal, and call center. Following the PUCT approval of their advanced metering deployment plans, AEP and TNMP became parties to the JDOA in January 2010 and July 2011, respectively.

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[12] The final SMT business requirements are filed in Project #41171 Repository of Advanced Metering Implementation Documents http://interchange.puc.texas.gov/WebApp/Interchange/application/dbapps/filings/pgSearch.asp

3.3.2 SMT Technical Development

In December 2008, a Request for Proposal (RFP) was issued to qualified systems integration vendors for the development, hosting, operation, and maintenance of a common web portal, including a Texas-based call center and data repository. A competitive selection process was used to evaluate the responses received as a result of the RFP and, in March 2009, IBM was selected for the work. The technical development of what was now called Smart Meter Texas (SMT) continued throughout 2009, using the AMIT web portal business requirements as the blueprint for SMT functionality and AMIT priorities as the sequencing for the release of each function. In addition to the design work, security audits and penetration tests were performed by outside security firms.

The JDOA TDSPs continued to participate as stakeholders in AMIT, providing a link between AMIT and the SMT team[13] whereby AMIT received status updates on the development of SMT and any required clarification of business requirements was addressed through the AMIT collaborative process.

3.3.3 SMT Launch

By mid-2009, the JDOA TDSPs began holding meetings with REPs and other stakeholders to describe SMT's interface specifications and to educate the REPs on how to gain access to SMT. All REPs needed to understand the SMT business processes if they wanted to utilize the 15-minute usage data from their Customers who had smart meters.

To facilitate a smooth launch of SMT in early 2010, an integration and testing plan was developed to support the initial set of REPs wanting to integrate their systems with SMT. Testing templates and integration guides were developed and refined during the initial 2010 integration effort and then made available to other REPs that wished to integrate with SMT.

On January 31, 2010 the initial infrastructure of SMT was launched, including the joint data repository, the infrastructure to receive smart meter usage information from the TDSPs, the

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[13] The SMT team included the JDOA Committee, Joint TDSPs, IBM, and the SMT project manager, with support provided by Solutions Cube Group LLC

infrastructure to deliver to REPs 15-minute usage data using the SMT FTPS site, and a web portal for Customers and REPs to view and export smart meter usage information. On March 15, 2010, the full launch of SMT occurred and a second release followed soon after on August 8, 2010. The second release of SMT made all of the following functionality available to users:

- Customers and REP users could view and export information about the meter – information available includes the TDSP who owns the meter, the ESIID[14] associated with the premise, meter number, meter manufacturer, model, number of phases, installation date, interval setting, HAN protocol, Smart Energy Profile, etc.

- Customers and REP users could view and export premise information – information available includes the TDSP who serves the premise, ESIID associated with the premise, service voltage, premise status, premise address, meter read cycle, etc.

- Residential account users could share their usage data with Friends – Residential account users could invite up to five (5) friends or family members to view their usage data and Residential users could accept invitations to view usage data of up to five (5) friends.

- Customers, REPs, and TDSPs could add and remove In-Home Devices on the Customer HAN.

- Customers, REPs and TDSPs could view details on In-Home Devices that were installed – includes the type of In-Home Device, the name of the In-Home Device, the MAC address, and installation code.

- REPs and TDSPs could send HAN messages including load control, text, and pricing using HAN APIs.

- Regulatory users could register and create accounts on the SMT web portal –once registered would have view-only access the SMT.

- Reports on SMT statistics were generated automatically – and made available to TDSPs and Regulatory users to view and download.

- REPs could re-brand SMT for their websites – when a Customer views usage data on a REP website, an API data request is sent to SMT and the results are displayed on the REP's website.

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[14] A statewide, unique number identifying a point of electric service delivery to a premise (home or business)

3.3.4 SMT Releases

SMT became operational in early 2010 with a base set of requirements to meet a core set of functionality. The SMT functionality was prioritized by AMIT using the established consensus-driven process to guide the system integrators in their development work. Follow-on releases occurred that upgraded the SMT system and provided additional functionality identified during the original system specification, but considered to be of a lower priority. AMIT continued to work on defining the SMT Third Party access functionality and targeted the release of this functionality for the end of 2014. Figure 2 shows the timeline of the modifications to SMT providing progressive functionality. The version numbers in this timeline do not strictly adhere to the numbering scheme used by the SMT development team, as some versions were internal development milestones without a public release.
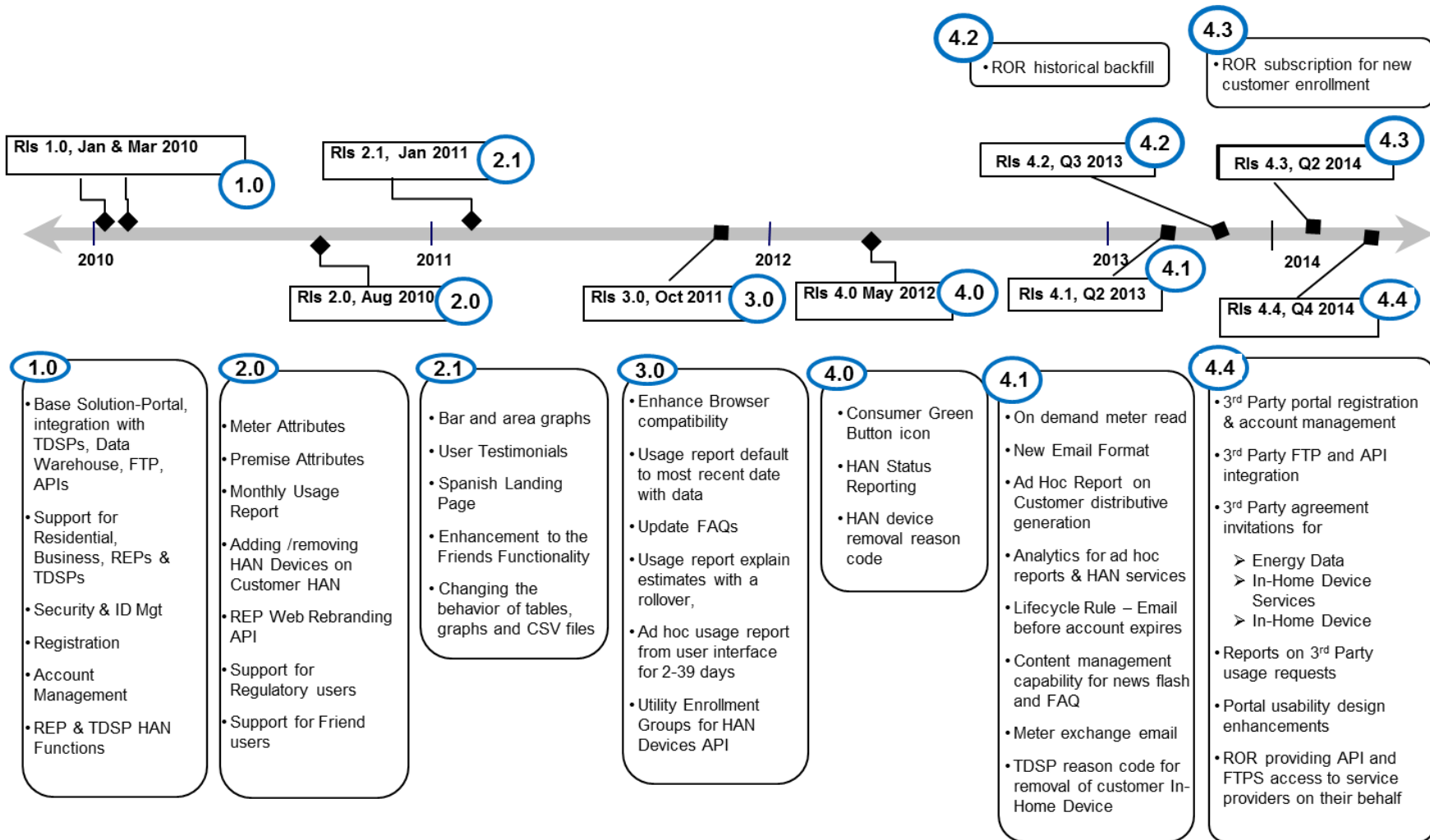
Figure 2: Timeline of SMT Releases

3.4 SMT Benefits

SMT is a key component for realizing many of the benefits provided by the TDSPs' investment in AMS. Without the capabilities of SMT, the AMS benefits would be greatly reduced. The SMT solution is focused on delivering two major functionalities, the delivery of electric usage data and enabling HAN communications. Each of these functionalities enables a range of benefits attributed to smart meters.

3.4.1 Improved access and utilization of energy data

The SMT web portal is a repository for energy usage data which can be accessed by Customers, the REP of Record (ROR), and Third Parties. The commonality of SMT to all the Joint TDSP's smart meters ensures that Consumers, RORs, and Third Parties receive consistent and timely information about Customer electric usage.

Access to usage data enables Customer to better manage consumption and lower their monthly electric bills. Customers are able to view their usage in both graphical and tabular formats for easy comparisons. The usage data can also be downloaded in common file formats to be analyzed using widely available software tools. Research focused on Customer behavior has shown that providing consumption information to end users improves energy efficiency and lowers Customer spending on electricity. REPs benefit by having one common portal to download the energy usage data that is required for business operations. Prior to the creation of SMT, the TDSPs were considering individual solutions for the delivery of smart meter data to the REPs. Without SMT, the TDSPs, REPs, and Third Parties would have higher operational costs resulting from the development and operation of multiple data portals, integration with multiple interfaces, and from the lack of standardization. The higher operational costs would be passed on to Customers, resulting in a higher cost for electric service. REPs and Third Parties also benefit from the use of a standardized data format by the TDSPs in delivering metered usage data. This standardization reduces operational costs for REPs and Third Parties which can be expected to result in savings to Customers.

SMT also provides a convenient and easy to use method for Customers to share and control access to their electric usage data. By gaining access to Customer usage data, Third Party companies can use that data to provide electric market services related to improved efficiency, demand response, greenhouse gas reduction, and improved utilization of renewable generation. The combination of a central clearinghouse of smart meter data and the access available to Customers, REPs, and Third Party service providers will enable the evolution of new electric services.

3.4.2 Creation of a common HAN interface

With variability in the Joint TDSPs geographical locations, business requirements, and deployment time lines, each TDSP deployed advanced meters from different meter manufacturers leveraging various types of communication networks. The interoperability of SMT has resolved any issues related to the differing deployments by providing a common interface that uses standard methods for installing In-Home Devices and communicating with Customer In-Home Devices. SMT has several important features available for Customers and Third Parties to make use of In-Home Devices in conjunction with the smart meter usage data. SMT provides a common interface to send standard HAN messages to Customer In-Home Devices and provides a standard method for installing and removing In-Home Devices on the Customer HAN. SMT HAN support functions provide Customers and Third Parties with simple tools to manage and control access to Customer In-Home Devices.

In-Home Devices enable or expand several of the benefits associated with smart meters. In-Home Devices can play an important role in the delivery of electric services such as programmable communicating thermostats, billing information updates sent to In-Home Devices, innovative pricing products, and demand response programs.

SMT provides a set of common HAN messages sent using the HAN APIs that enable Third Parties to communicate with Customer In-Home Devices regardless of which TDSP service territory the Customer is located. Without the HAN support provided by SMT, the rate of In-

Home Device adoption and types of HAN related services available in Texas would be reduced and the costs would be higher.

Other benefits provided by SMT are the end-to-end In-Home Device testing program and the lessons learned that were shared with national smart grid standards groups. The work done by the SMT team in the development and testing of the SMT HAN functionality resulted in a refinement of the ZigBee Smart Energy Profile v1.x, the creation of standardized HAN APIs, and the creation of a standard test script to test the interoperability of In-Home Devices under development. This standardization and testing has stimulated the In-Home Device market and provided Texas Customers with a greater selection of In-Home Devices than in any other electric market in the US.

3.5 SMT and National Smart Grid Standards Development

The collaborative work of AMIT, resulting in the business requirements that became the basis for the design of SMT, occurred in late 2007 through 2009. This was a little before and concurrent with the national effort to identify and develop interoperable smart grid standards. Figure 3 is a timeline showing how the development of SMT fits in with national smart grid policy and regulatory directives and the national smart grid standards effort.
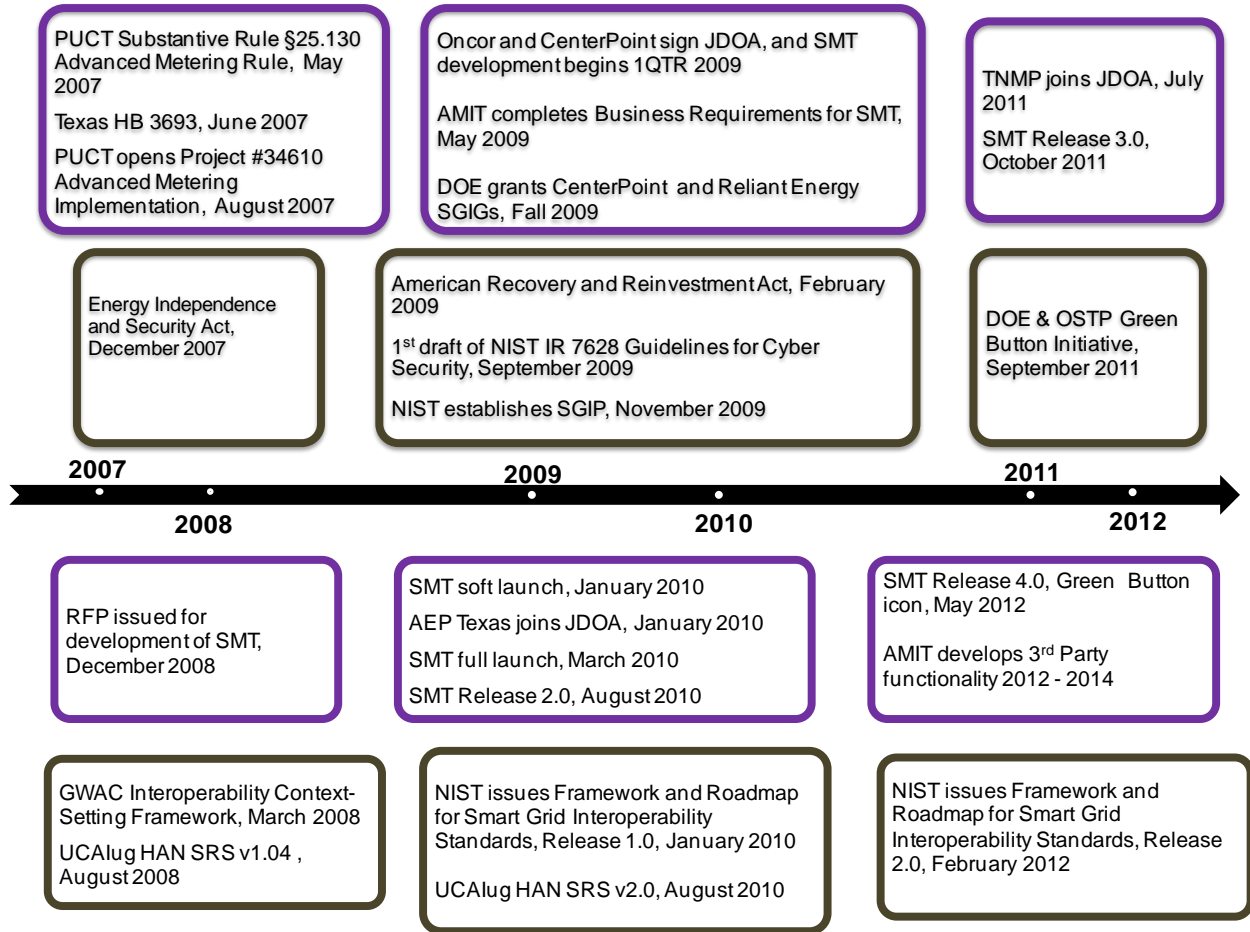
Figure 3: Timeline of SMT and National Smart Grid Standards Development

PUCT Substantive Rule §25.130 Advanced Metering Rule, May 2007

Texas HB 3693, June 2007

PUCT opens Project #34610 Advanced Metering Implementation, August 2007

Oncor and CenterPoint sign JDOA, and SMT development begins 1QTR 2009

AMIT completes Business Requirements for SMT, May 2009

DOE grants CenterPoint and Reliant Energy SGIGs, Fall 2009

TNMP joins JDOA, July 2011

SMT Release 3.0, October 2011

Energy Independence and Security Act, December 2007

American Recovery and Reinvestment Act, February 2009

1st draft of NIST IR 7628 Guidelines for Cyber Security, September 2009

NIST establishes SGIP, November 2009

DOE & OSTP Green Button Initiative, September 2011

2007

2008

2009

2010

2011

2012

RFP issued for development of SMT, December 2008

SMT soft launch, January 2010

AEP Texas joins JDOA, January 2010

SMT full launch, March 2010

SMT Release 2.0, August 2010

SMT Release 4.0, Green Button icon, May 2012

AMIT develops 3rd Party functionality 2012 - 2014

GWAC Interoperability Context-Setting Framework, March 2008

UCAIug HAN SRS v1.04 , August 2008

NIST issues Framework and Roadmap for Smart Grid Interoperability Standards, Release 1.0, January 2010

UCAIug HAN SRS v2.0, August 2010

NIST issues Framework and Roadmap for Smart Grid Interoperability Standards, Release 2.0, February 2012

4 Methodology

4.1 AMIT Meeting Attributes and Design Process

The functionality of SMT was developed in independently facilitated meetings attended by a broad set of stakeholders[15] who formed the AMIT. The project work done by AMIT was done using a consensus-driven process with oversight provided by the PUCT. In the AMIT meetings, the stakeholders participated by sharing viewpoints and working towards consensus regarding SMT's functionality. The AMIT meetings had the attributes of openness, balance of interest, due process, a process for appeals, and consensus. The AMIT meetings were open to any interested party and publically announced on the PUCT Project #34160 website and through emails sent to those on the AMIT listserv. All meeting attendees were encouraged to participate and share their views on the topic at hand. No view was discounted and each issue was thoroughly discussed or researched until a consensus was reached by the participants.

The process used by AMIT to determine the design and functionality of SMT substantially conformed to the methodology set forth in the IEC 62559 IntelliGrid Methodology for Developing Requirements for Energy Systems standard (see Section 10.2). This process included defining high-level business processes, creating context diagrams, identifying actors and their roles and interactions, defining projects, and creating and prioritizing business requirements with the help of use case scenarios.

4.2 Consensus Building Process

The open nature of the AMIT meetings involving stakeholders with varying viewpoints required the adoption of a governance process. During meetings, whenever a consensus on a particular item of discussion could not be reached, the item was delegated to a group of stakeholders who

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[15] AMIT included Joint TDSPs, REPs, PUCT staff, consumer advocates, smart meter manufacturers, HAN device manufacturers, HAN service providers, solutions vendors, and ERCOT staff. The AMIT meetings were facilitated by Solutions Cube Group LLC

volunteered to research the issue and report back to AMIT with a recommendation on one or more possible resolutions. Once a recommended solution was developed, the assigned group would report back to AMIT. AMIT would review the recommendation and would either incorporate the resolution into the project documents, or assign further work to the stakeholders who were working on the issue. The use of this process allowed AMIT to defer issues that could not be readily resolved and maintain progress, while still providing a mechanism to address and resolve difficult issues.

4.3 Identifying Business Processes

The AMIT work began with defining high-level business processes that described the general functional requirements for implementing smart meters in Texas. The Joint TDSPs were already planning and deploying smart meters and AMIT provided a forum to ensure that the deployment of the TDSP AMS met the needs of the market participants. Each of the high-level business processes described a group of associated capabilities related to the implementation of smart metering that were critical to the successful deployment of the TDSP's AMS.

- **BP-001 Access Meter Data** – transfer of meter data between Customers, TDSPs, REPs and ERCOT. Access to interval usage and historical data and standardization of security and data formats
- **BP-002 Fulfill Service Orders** – routine meter services such as reading, move in/out, disconnect/reconnect and Customer switching retailers. In Texas these services involve interactions between TDSPs, REPs, and ERCOT
- **BP-003 Provide Customer Service** – processing applications, resolving questions and complaints, providing order status, outage restoration information and access to usage data
- **BP-004 Settle Wholesale Market** – provide ERCOT with meter data necessary to settle the wholesale market
- **BP-005 Provide Usage Data** – providing usage data to Customers and REPs. This was originally a separate business process, but was later incorporated into BP-001
- **BP-006 Deploy Meters** – initial and ongoing deployment activities for smart meters

- **BP-007 Establish Communications between the Advanced Metering System (AMS) and Home Area Network (HAN)** – add/ remove In-Home Devices and send and receive messages to In-Home Devices using a secure communications link
- **BP-008 Educate Consumers** – Customer education regarding AMS, controlling usage (customer driven) and lowering costs, and other benefits of AMS

4.4 Creating Context Diagrams

In addition to the high level business processes, AMIT created context diagrams for each of the identified projects, including one for the overall AMS environment.   The context diagrams identified the external entities, their high level conceptual "inputs" and "outputs," their applicability to the specific project that was being diagramed, and the applicability of each of the

high   level   business   process   to   that   project.

CONTEXT DIAGRAM
AMS Environment – "Big Picture"

- BP-001 Access Meter and Usage Data
- BP-002 Fulfill Service Orders
- BP-003 Provide Customer Service
- BP-004 Settle Wholesale Market
- BP-006 Deploy Meters
- BP-007 Establish Communications between the AMS and HAN
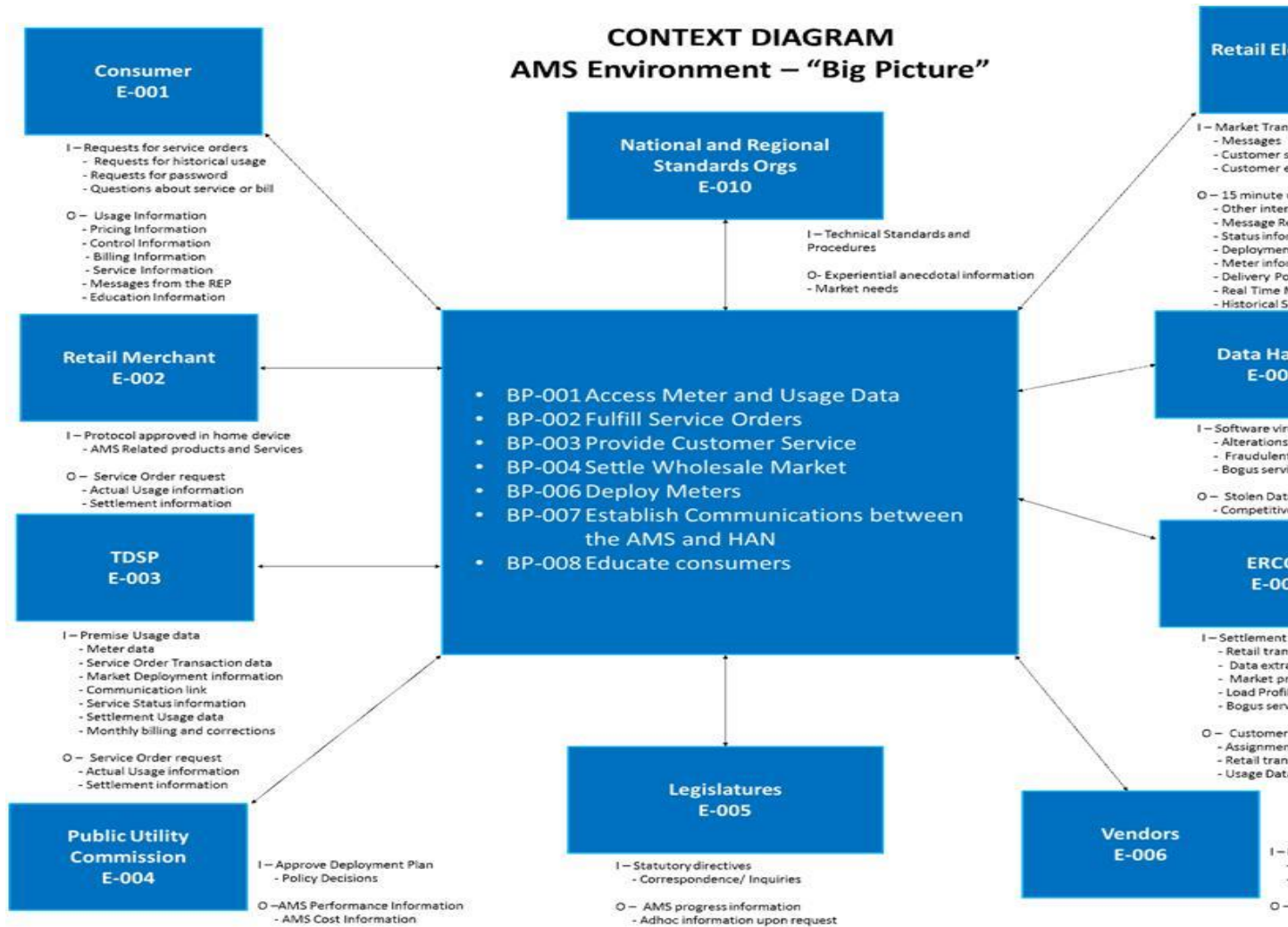- BP-008 Educate consumers

Figure 4 is the context diagram for the entire AMS environment, including the identified external entities (i.e., Consumer, Retail Merchant, TDSP, PUC, National and Regional Standards organizations, Legislatures, REP, Data Hacker, ERCOT, and Vendors) and the business processes that are applicable to the AMS environment.
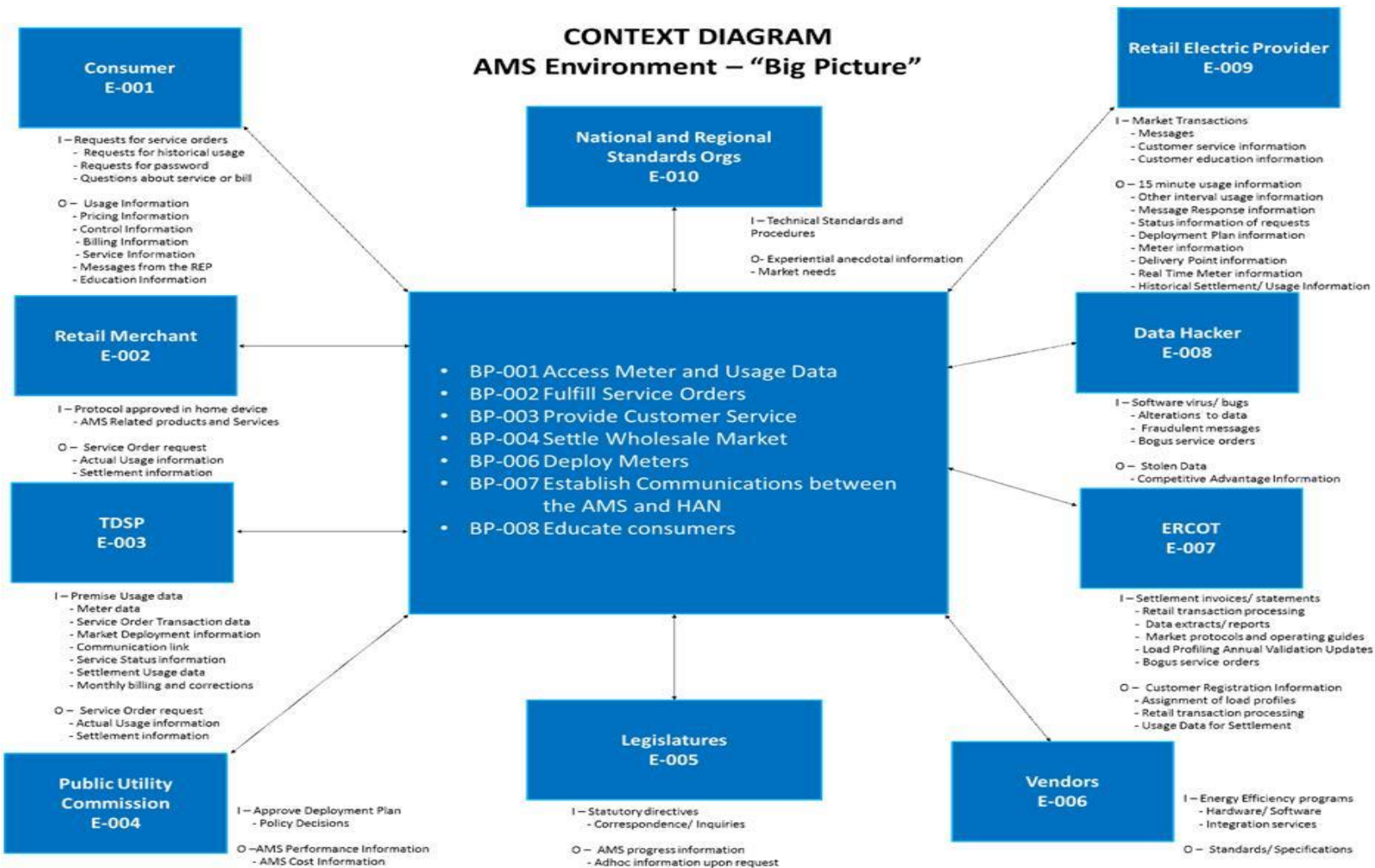
CONTEXT DIAGRAM
AMS Environment – "Big Picture"

Consumer
E-001

I – Requests for service orders
  - Requests for historical usage
  - Requests for password
  - Questions about service or bill

O – Usage Information
  - Pricing Information
  - Control Information
  - Billing Information
  - Service Information
  - Messages from the REP
  - Education Information

Retail Merchant
E-002

I – Protocol approved in home device
  - AMS Related products and Services

O – Service Order request
  - Actual Usage information
  - Settlement information

TDSP
E-003

I – Premise Usage data
  - Meter data
  - Service Order Transaction data
  - Market Deployment information
  - Communication link
  - Service Status information
  - Settlement Usage data
  - Monthly billing and corrections

O – Service Order request
  - Actual Usage information
  - Settlement information

Public Utility
Commission
E-004

I – Approve Deployment Plan
  - Policy Decisions

O – AMS Performance Information
  - AMS Cost Information

National and Regional
Standards Orgs
E-010

I – Technical Standards and
Procedures

O – Experiential anecdotal information
  - Market needs

- BP-001 Access Meter and Usage Data
- BP-002 Fulfill Service Orders
- BP-003 Provide Customer Service
- BP-004 Settle Wholesale Market
- BP-006 Deploy Meters
- BP-007 Establish Communications between
  the AMS and HAN
- BP-008 Educate consumers

Legislatures
E-005

I – Statutory directives
  - Correspondence/ Inquiries

O – AMS progress information
  - Adhoc information upon request

Retail Electric Provider
E-009

I – Market Transactions
  - Messages
  - Customer service information
  - Customer education information

O – 15 minute usage information
  - Other interval usage information
  - Message Response information
  - Status information of requests
  - Deployment Plan information
  - Meter information
  - Delivery Point information
  - Real Time Meter information
  - Historical Settlement/ Usage Information

Data Hacker
E-008

I – Software virus/ bugs
  - Alterations to data
  - Fraudulent messages
  - Bogus service orders

O – Stolen Data
  - Competitive Advantage Information

ERCOT
E-007

I – Settlement invoices/ statements
  - Retail transaction processing
  - Data extracts/ reports
  - Market protocols and operating guides
  - Load Profiling Annual Validation Updates
  - Bogus service orders

O – Customer Registration Information
  - Assignment of load profiles
  - Retail transaction processing
  - Usage Data for Settlement

Vendors
E-006

I – Energy Efficiency programs
  - Hardware/ Software
  - Integration services

O – Standards/ Specifications

Figure 4: AMS Environment Context Diagram

Developing context diagrams for each project helped to narrow the focus of the project work and to identify the applicable business processes and external entities. For the Web Portal Project, AMIT determined that some of the external entities were out of scope and only three of the eight business processes were applicable. Figure 5 is the context diagram for the Web Portal Project.

The context diagram's external entities were the starting point for identifying the actors associated with SMT. AMIT used the use case process to develop a more specific list of actors and their roles. The use case process helped to determine the type of SMT functionality each actor could access. A more thorough discussion of actors and their roles is found in Sections 8.1 and 6.2, respectively.
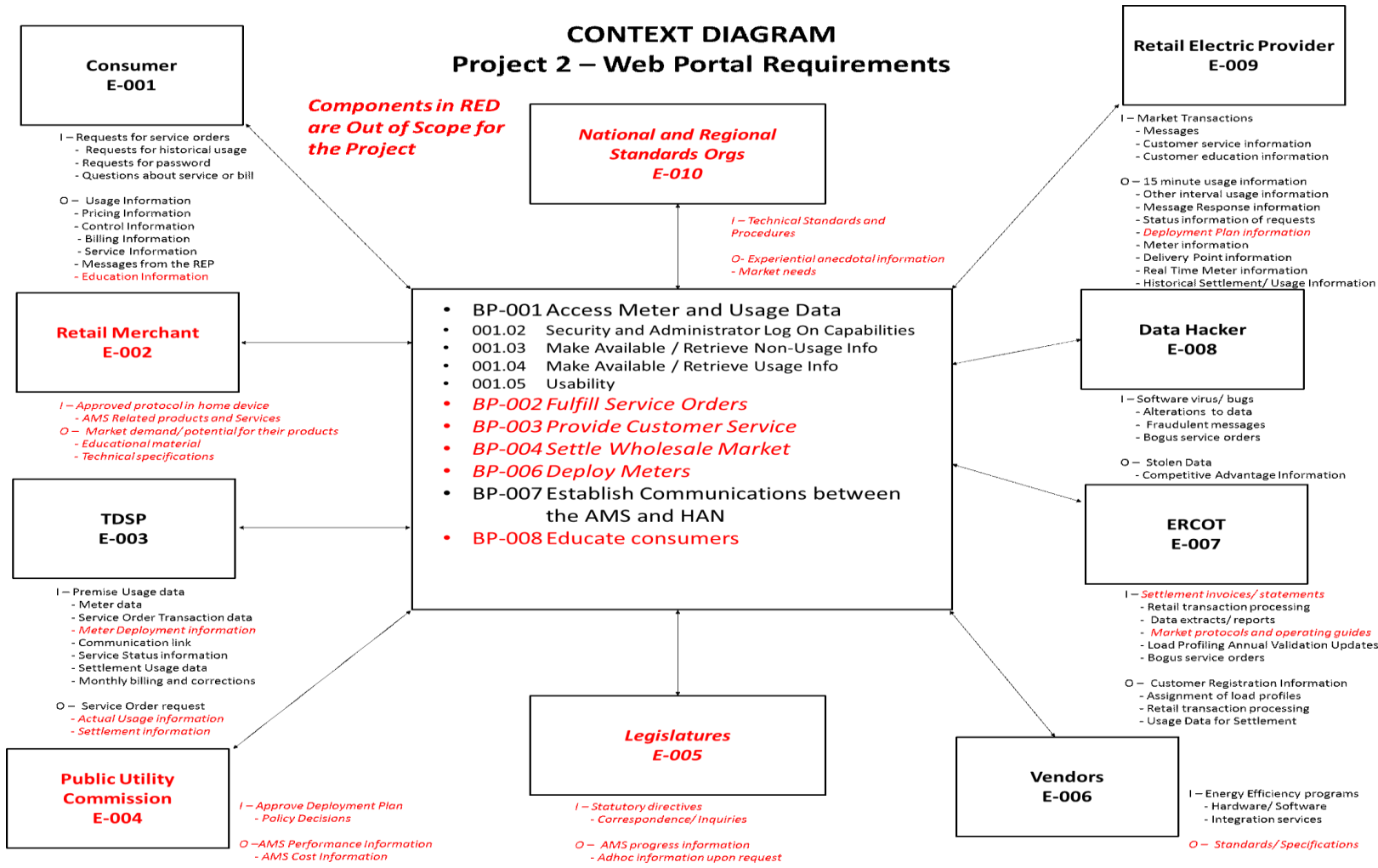
Figure 5: Web Portal Project Context Diagram

4.5 **Defining Projects**

After the high-level business processes were identified, AMIT created six projects to develop solutions that would perform these functions.   Each project included functionality and requirements from one or more of the identified business processes.   The six projects are identified in Table 2.

Table 2: AMIT Projects

Project #	Project Name	Description
1	Interim Project	An interim solution to provide REPs smart meter usage data prior to the launch of SMT.
2	Web Portal	A depository for smart meter usage information that is available to Customers, REPs, and authorized Third Parties
3	ERCOT Settlement	The ability for ERCOT to perform retail settlement using 15-minute usage data rather than a load profile of monthly usage data
4	Home Area Network (HAN)	Determining standard processes for the installation and communication with In-Home Devices
5	Retail Market Interface	Identifying changes that deployment of smart meters would have on ERCOT retail transactions
6	Education	Identifying education needs for Customers and other market participants

The creation of a web portal for the access of smart meter data was the primary project that resulted in the SMT solution. However, many of the issues addressed in the other projects were interrelated and, to varying degrees, the functionality and requirements associated with the HAN, Retail Market Interface, and Education projects were included in the SMT design. The most strategic and beneficial outcome of the Web Portal project work was the development of a

comprehensive set of business requirements for a common web portal, which came to be known as Smart Meter Texas[TM].

4.6 Developing Business Requirements

To further develop the functionality and technical requirements associated with the AMIT projects, AMIT used a use case-based process (see Section 8) to ensure that a robust set of requirements were developed. Through the facilitated, stakeholder-driven process, AMIT created a set of use case scenarios which expanded the original business process functions into well-defined requirements. The requirements went through multiple reviews and edits and AMIT provided input into the prioritization of each requirement for implementation.

In addition to the core business functions and requirements that were defined in the Web Portal project, the HAN project defined a set of business processes and requirements related to the deployment of In-Home Devices. As this project developed the HAN business requirements, the HAN project's inter-relatedness with the Web Portal project became clear. Additional requirements related to the HAN were added to the web portal business requirements and prioritized as to when they would be delivered.

The work done in the Retail Market Interface project and the Education project also added additional business requirements to the web portal requirements. The need to change access to usage data at a premise when a Customer moves out or switches their REP are examples of retail market activities that became web portal requirements. In addition, the work in the Education project prompted the addition of several requirements related to Customer education and help with using SMT.

Table 3 provides examples of web portal business requirements that were influenced by the work done in the HAN project, the Retail Market Interface project, and the Education project.

Table 3: Examples of Web Portal Business Requirements

Id	Requirement
Example Business Requirements (BRs) related to HAN functionality	
BR- 025	Ability for the common Web Portal to facilitate communication to and from Provisioned HAN Devices over the AMS network.
BR - 025.001	Ability for an authorized user to send a single message through the common Web Portal to multiple Provisioned HAN Devices and receive a response from each HAN Device.
Example BRs related to retail market activities	
BR- 031.001	Ability for REP of record access to all the functions associated to the ESIID to be automatically revoked when the REP is no longer the REP of record due to a switch or move out.
BR - 044	Ability to terminate all users access to premise specific information whenever the TDSP is notified a Customer has moved out of a premise, via Texas SET transaction, including any authorization for 3rd party access and permissions to usage history, HAN control (e.g., the Letter Of Authorization (LOAs) associated with the user's ESIIDs, supplemental user access, primary ESIID assignment, etc.)
Example BRs related to education	
BR- 034	Ability to have online help on the web portal that explains how to use functions of the web portal.
BR- 034.001	Ability to maintain and display (add, modify) web portal specific FAQs.

4.7 **Technical System Design**

As the functionality and requirements were refined, various business and technical approaches for supporting a meter data web portal were discussed. Potential approaches included having each TDSP develop their own portal, a single system portal that accessed the TDSP databases,

and an ERCOT-hosted system with meter data updates sent by the TDSPs. Consensus was reached on a solution in which the Joint TDSPs would jointly own and operate a common portal and data repository that would receive data from each of the TDSPs' meter data systems.

After the consensus was reached on the technical approach and during the SMT development phase, AMIT continued to provide additional input into the development process, providing feedback on the development of the portal user interfaces and refining the requirements for the In-Home Device interfaces. During this phase of development, graphical representations of the use cases were developed. High level story-boards and more technical process flow diagrams were used to communicate the developed SMT functionality and provide traceability back to the business requirements. The use cases were also used to provide a comprehensive vision to the system integrators during SMT system development phase.

4.8 **SMT Process Prioritization**

AMIT conducted an additional exercise once the initial system requirements were developed and the system design was underway. The AMIT stakeholders were surveyed and asked to rank a set of processes by both their benefit to Customers and their benefit to the Texas market. The stakeholder survey data was used to create an overall prioritization; the results are seen in Figure 6. This provided the AMIT members a useful check to ensure the functionality that was being developed for the initial and subsequent SMT releases aligned with the value to both the market and Customers. AMIT understood that, from a technical standpoint, a progression of development was required and that some lower-valued functions would be delivered earlier since they supported components of the larger system.
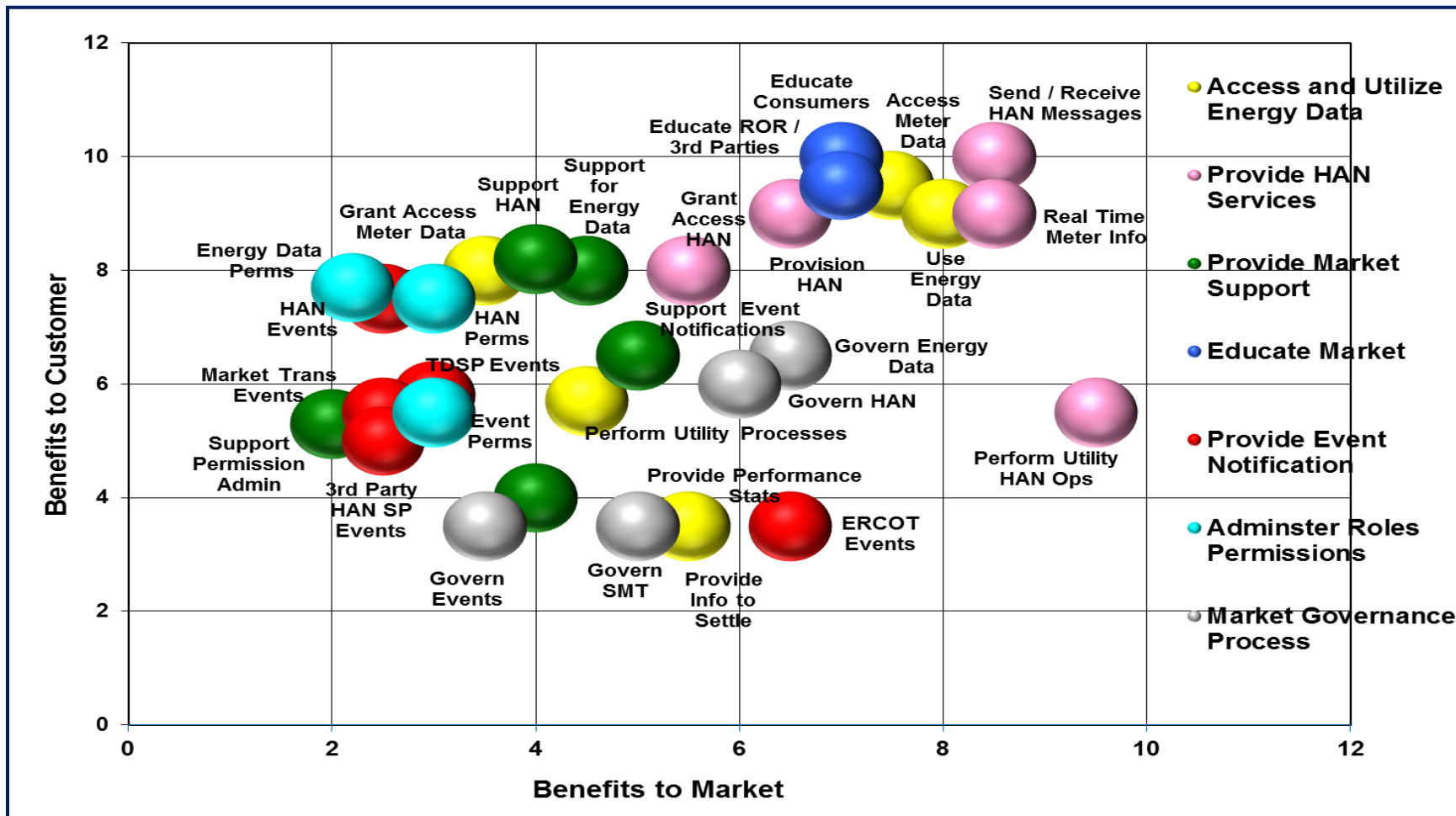
Figure 6: Process Prioritization Evaluation Results

4.9 SMT Deployment and Operations

After the launch of SMT in early 2010, AMIT stakeholders continued to meet to refine requirements for future system releases and define future functionality, such as the In-Home Device support and Third Party access. A change request process was initiated by AMIT to ensure that requested functionality was well vetted by the market participants. SMT was designed to change as the needs of the Texas market participants changed, and the process used to address those changes has been an evolving process. The initial change request process has evolved and new change requests will be initiated under the governance of the ERCOT Retail Market Subcommittee (RMS) through the Advanced Metering Working Group. RMS is an ERCOT subcommittee that serves as a forum for resolving retail market issues that directly affect ERCOT and retail market participants. Requests for changes to SMT would be submitted to the RMS Advanced Metering Working Group and would flow through the existing RMS approval process. If approved they are sent to the JDOA TDSPs for further review. Once a request is initiated and approved by RMS, the JDOA TDSPs perform a cost analysis on the requested change. The SMT team develops story-boards to convey how any new functionality will operate and works with the SMT Development Oversight team to review and provide input on design prior to moving forward on development and deployment. The JDOA TDSPs retain the ultimate authority for approving or rejecting any proposed modifications to SMT and the PUCT oversees the development of any remaining functionality to be provided by SMT.

5 Functionality

SMT is an internet-based information system developed as an interoperable solution to standardize the smart meter information exchange between multiple market participants using secure communication channels. SMT is the common interface for accessing energy usage information and for HAN communications that use the Joint TDSPs' AMS communication networks.

5.1 SMT Conceptual Model

To enable smart grid functionality and interoperability, NIST encouraged the use of a conceptual model as a "tool for identifying actors and possible communications paths"[16]. Figure 7 is the SMT conceptual model showing the communications and data transfers between the various market participants as they relate to energy usage information and HAN communications.

SMT crosses several of the smart grid domains including the Customer, Service Provider (i.e., RORs and Third Parties), and Transmission and Distribution (i.e., TDSPs) domains. The Operations (i.e., ERCOT) domain is marginally involved for those retail market transactions, such as a Customer moving in or out of a premise or a Customer switching their REP, which affects a SMT user's authorization related to data access. Each of these smart grid domains has particular data requirements and a need for varying levels of access security. The conceptual diagram identifies the data requirements of each party and helps identify the need for multiple secure interfaces for the access of that data.

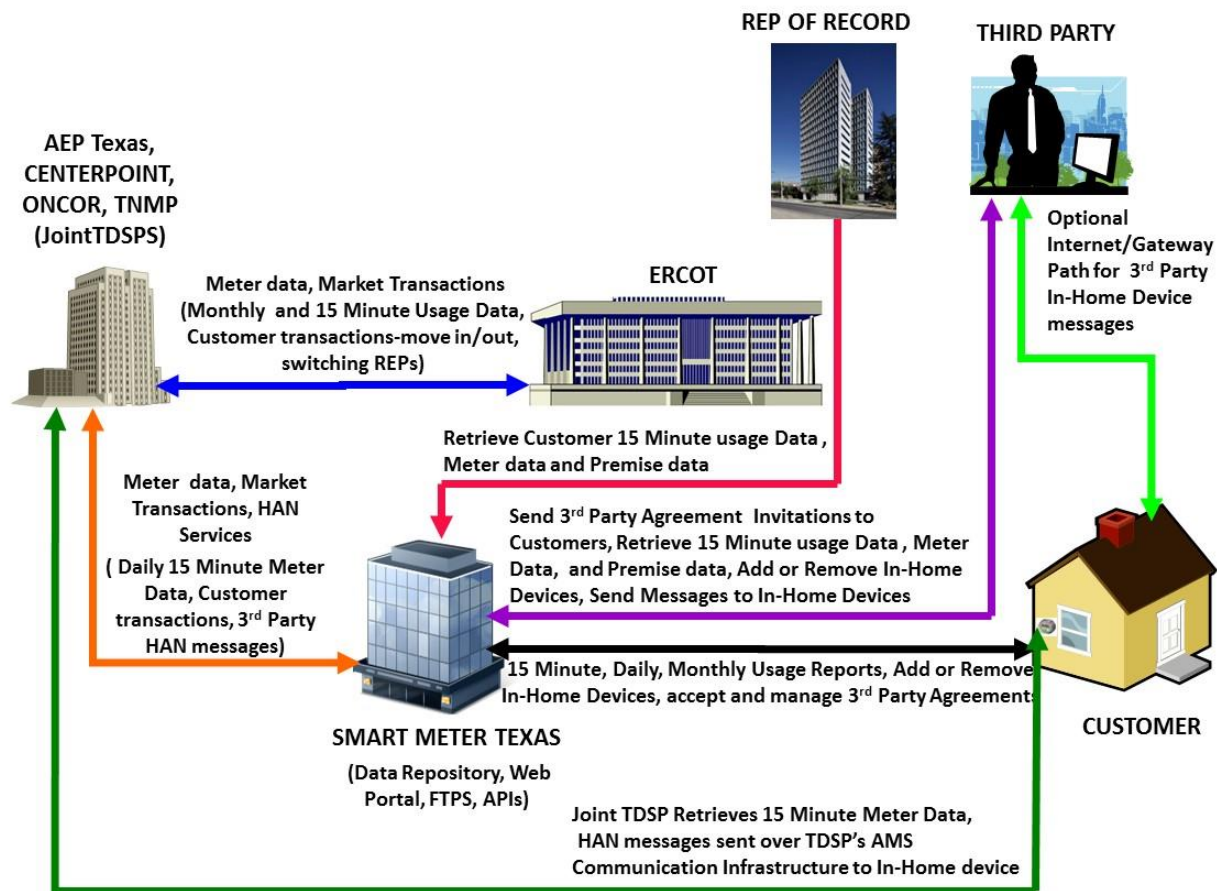[16] Page 43 of the NIST Framework and Roadmap for Smart Grid Interoperability Standards, Release 2.0

Figure 7: SMT Conceptual Model

5.2 **SMT Functions**

The high-level conceptual model identified the SMT users and their interactions, which formed the basis for determining the functionality of SMT. As discussed in Section 4.3, AMIT developed eight high-level Business Processes that described the functionality and capability that are necessary to meet the market participants' needs for communication and information exchange. Of these eight Business Processes, Access Meter Data, HAN Communications, and Educating Customers were determined to be most applicable to SMT and set forth the base functionality that should be provided by SMT. A core feature supporting the SMT function of

providing interoperable access to smart meter data is the hosting of a common data repository storing all the Joint TDSPs smart meter data. An additional key functionality provided by SMT is a convenient, easy-to-use process enabling Customers to grant Third Party access to their usage data and permission to communicate with their In-Home devices. These functions are discussed in the following Sections:

5.3 Data Repository

SMT provides easy and efficient access to Customer energy usage data to a variety of SMT users because SMT hosts a common data repository for the smart meter information of all the Joint TDSPs. When the Joint TDSPs complete their smart meter deployments, the common data repository will store smart meter usage information for approximately 7 million residential and small business customers for a maximum of seven years.

On a daily basis, several times a day, the TDSPs collect a daily midnight register read and the prior day's recorded interval usage data from the smart meters they own. This data is transmitted from the smart meters back to the TDSPs using the TDSP meter communications networks (wired and wireless) designed for this purpose. The TDSPs store the meter usage data in their meter data management systems and perform a standard validation, editing, and estimation process[17] ("VEE") on the data before preparing standard formatted files for transmittal to SMT and ERCOT. In some cases, communications errors with individual meters may require the TDSP to estimate usage intervals. Any estimated data is marked with a status code indicating that it is estimated data. Future data uploads by the TDSP will replace these estimated data

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[17] TDSPs use VEE requirements as specified in the Uniform Business Practices (UBP) standard

records with actual data when it becomes available. Each day by no later than 11 p.m. on the day following the recorded usage, the TDSPs submit files in the LodeStar Enhanced (LSE) format that contain the VEE processed data to both ERCOT and SMT for all their smart meters. SMT separates the information by each REP of Record (ROR) or Third Party, and stores the files in the appropriate ROR or Third Party FTPS folder. SMT also loads the data into the data repository for SMT web portal access by all users. Figure 8 is a diagram of the flow of usage data from the Customer smart meter to the TDSP, SMT, and ERCOT, and the flow of the data within SMT to the data repository and the ROR and Third Party FTPS folders.
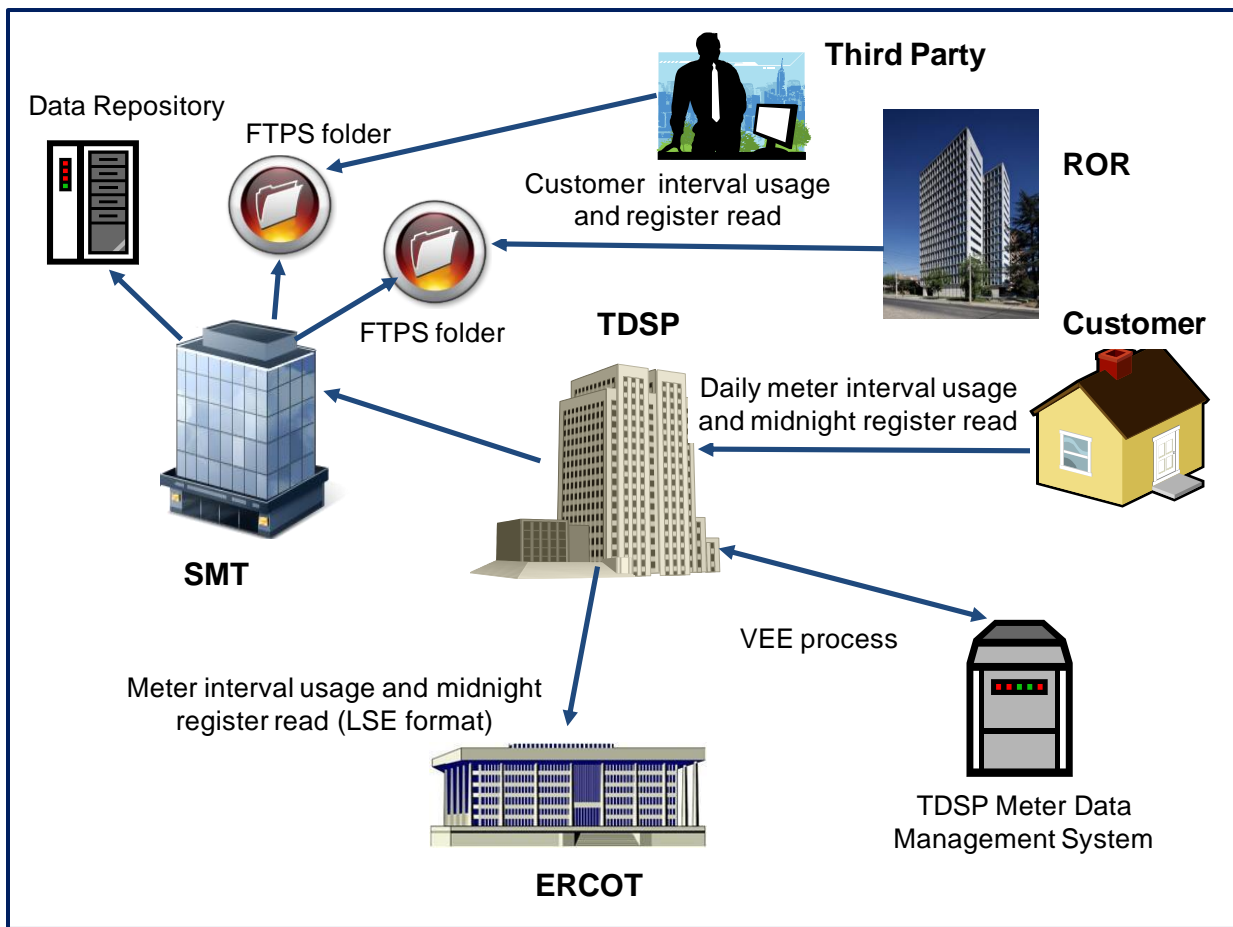
Figure 8: Meter Usage Data Flow

5.4 **Meter Data Access**

Texas was an early adopter of legislation and regulation requiring access to Customer electrical usage information. The Texas Public Utility Regulatory Act (PURA) states that "all meter data, including all data generated, provided, or otherwise made available, by advanced meters and meter information networks, shall belong to a customer"[18] and the PUCT Advanced Metering Rule 25.130 requires that access to smart meter data be granted to Customers, the Customer's REP, and other entities whom the Customer authorizes. The following are key provisions in the PUCT Advanced Metering Rule regarding access to smart meter data.

- An AMS shall provide or support the following minimum system features in order to obtain cost recovery through a surcharge…the capability to provide 15-minute or shorter interval data to REPs, Customers, and the independent organization or regional transmission organization, on a daily basis, consistent with data availability, transfer and security standards adopted by the independent organization or regional transmission organization.[19]

- An electric utility shall provide a Customer, the Customer's REP, and other entities authorized by the Customer read-only access to the Customer's advanced meter data, including meter data used to calculate charges for service, historical load data, and any other proprietary Customer information. The access shall be convenient and secure, and the data shall be made available no later than the day after it was created.[20]

- An electric utility shall use industry standards and methods for providing secure Customer and REP access to the meter data.[21]

- A Customer may authorize its data to be available to an entity other than its REP.[22]

In early 2010, SMT made smart meter usage data available to Customers and the Customer's Retail Electric Provider (i.e., REP of record, ROR). In 2011, on a national level, the Green Button initiative challenged utilities to give Customers access to their energy usage information

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[18] PURA 39.107(b)
[19] PUCT §25.130 (g)(1)(G)
[20] PUCT §25.130 (j)(1)
[21] PUCT §25.130 (j)(3)
[22] PUCT §25.130 (j)(5)

by downloading it in an easy-to-read industry standard format. SMT implemented the concept of the Green Button initiative more than a year before the issuance of the Green Button challenge.

5.4.1 Customer Usage Information

To access meter data, a user must have a valid SMT account. To create a SMT account, the user must pass through the SMT secure registration process (see Section 0). SMT provides the following Customer usage information to authorized users:

- On demand meter reads
- 15-minute interval usage
- Daily usage
- Monthly usage

SMT provides Customers, RORs, Third Parties who are authorized by a Customer, and TDSPs the ability to request an on demand (i.e., intra-day) meter register read. SMT will calculate and display the kWh consumption amount between the intra-day register read requested by the user and the last midnight register read that is in the SMT database. This information provides a near-real-time view into a Customer's electrical consumption. Users access this functionality on the SMT web portal.

The 15-minute interval, daily, and monthly reports may be viewed online in a graph and a data table for the period of time selected by the user. These reports may also be conveniently exported in either the Green Button format or the CSV format. The SMT Green Button allows users to export 13 months of energy usage data in 15-minute intervals into the industry standard XML format. Any report a Customer chooses to export will be sent to them in a file attached to an email sent to their email address. A Customer may request a maximum of the previous 13 months of 15-minute interval and Daily usage data and the previous 24 months of monthly usage data.

RORs primarily receive their Customer's usage data in files posted in a folder on the SMT FTPS site. However, RORs may also request ad hoc Customer usage reports on the SMT web portal or

using a usage API. Depending upon the size of the requested report, the ROR may retrieve the report from a FTPS folder or from a file attached to an email sent to the REP company email address. RORs may access up to seven years of Customer usage data. The most recent four years of usage data may be accessed through the web portal or requested using a usage API. Three additional years of data, stored offline, may be accessed through a special request. In, addition, RORs who have vendors that perform various services (e.g. billing, EDI, demand response, etc.) on their behalf may grant these vendors access to the ROR Customer usage information in the ROR FTPS folder or by using the ROR's SMT API access. SMT has a secure process that validates the request to grant the vendor access, allows the vendor to create a user account associated with the REP as the company entity, and works with the vendor to configure and accomplish the FTPS and API integration.

A Third Party may access a Customer's usage information only after a Customer has authorized[23] the Third Party to receive their usage data. Third Parties may request Customer usage reports on the SMT web portal or through a usage API. The requested report will be sent to the Third Party's folder located on the SMT FTPS site. Due to security reasons, Customer usage information will not be sent to a Third Party by email. Third Parties who have an agreement with a Customer to access Customer usage data over a period of time (i.e., one month up to one year) may request scheduled reports that export requested data (i.e., daily 15-minute usage, daily meter read, monthly) for up to three months at a time or up to a year for monthly data; however, the request may not extend beyond the term of the agreement with the Customer. For example, scheduled daily 15-minute usage reports will be created once a day and will show usage for the prior day. These reports may be scheduled on the web portal or through a usage API and will be sent to the Third Party's FTPS folder. In addition, Third Parties may request a maximum of 12 months of historical usage data for their Customers.

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[23] A Customer grants a Third Party access to their usage information by entering into an Energy Data Agreement with the Third Party (see Section 5.5.4)

5.4.2 Premise and Smart Meter Information

In addition to usage information, Customers, the ROR, and Third Parties who are authorized by the Customer to access usage information, may also view, print, and export, in CSV format, information about the premise (e.g., the TDSP who reads the meter, ESIID, voltage, address, etc.) and the smart meter (e.g., meter manufacturer, last meter test date, installation date, HAN protocol, firmware version, etc.) installed at the premise. However, the Third Party will not have access to the meter number.

5.4.3 Market Transaction Synchronization

A party's access to smart meter information may be affected by certain market transactions. Examples of these market transactions include a Customer moving in or out of a premise, disconnection and reconnection of a smart meter, replacement of a smart meter, and changes to a Customer's ROR. These transactions are recorded and communicated between TDSPs, ERCOT, and REPs through Texas Standard Electronic Transactions (TX SET). To ensure that these transactions are reflected in SMT, the TDSPs send SMT a daily market transaction file that SMT uses to adjust the relationships between the ESIID, Customer, ROR, and Third Party, if applicable. Market transactions that affect relationships in SMT as listed in Table 4.

Table 4: Market Transactions Effect on SMT Accounts

Market Transaction	Customer Account	REP Account	Third Party Account
1. Customer moves into a premise	Customer may add the ESIID of the smart meter to their account.	The smart meter (ESIID) is automatically added to the ROR account.	Third Party must send Customer a new agreement and Customer must accept agreement.
2. Customer moves out of a premise	The ESIID is removed from the Customer account.	The ESIID is automatically removed from the ROR account and the REP will lose access to the Customer's usage information.	All Third Party agreements associated with that ESIID are automatically terminated and any In-Home Devices are removed from the HAN.
3. Meter	The ESIID will still be	The ESIID will still be	The ESIID will still be

Market Transaction	Customer Account	REP Account	Third Party Account
disconnect and reconnect	associated with the Customer account but will show no usage during the period of disconnection.	associated with the ROR account but show no usage during the period of disconnection.	associated with any Third Party Agreements but will show no usage during the period of disconnection.
4. Replacement of a smart meter	The ESIID will remain the same but the meter number will change. SMT will automatically change the meter number associated with Customer's account to reflect the current meter number. The Customer will continue to have access to the smart meter usage data and the SMT service will be uninterrupted. Existing In-Home Devices will automatically be re-added to the Customer HAN and the Customer notified. Customer may have to reboot the In-Home Device(s) to regain functionality.	The ESIID will be linked with the new meter number and this association will be reflected in the ROR meter information. The ROR will continue to have access to the smart meter usage data and the SMT service will be uninterrupted.	No change to the Third Party agreements. The Third Party does not have access to the meter number.
5. Customer switches to another REP	The ESIID and meter number are associated with the Customer premise and Customer will see no change in their access to usage information.	The former REP will lose access to the Customer's usage information and the new REP or ROR will gain access to it.	No effect on the Third Party agreements.

5.5 Third Party Access

A key functionality of SMT is providing a convenient and easy-to-use process for Customers to grant Third Parties access to their energy usage information. Providing this functionality is seen as critical to bringing the benefits of the smart grid to Customers. By enabling Customers to

grant Third Parties access to their smart meter usage information, innovative energy efficiency products can be offered to Customers that will give Customers more insight and control over their energy usage and bill.

In addition, SMT provides a convenient and easy-to-use process for Customers to grant Third Parties the ability to add In-Home Devices to the Customer's HAN and to communicate with the Customer's In-Home Devices.

5.5.1 Customer Privacy Protection

Ensuring the privacy of Customer data and protecting against unauthorized access are major components of the SMT security controls (see Section 9.3 and Section 10.7). Unlike TDSPs and REPs, Third Parties are not subject to PUCT customer protection rules and SMT's ability to protect the privacy of Customer data ends once a Customer has granted a Third Party access to their data. However, SMT has a defined registration process for Third Parties (see Section 6) that limits the risk of a rogue user creating a Third Party account. During the registration process, each Third Party user must agree to the SMT Terms and Conditions, which require the user to agree that their access to, including viewing, downloading, and use of Customer consumption data, is limited to data that the Third Party is authorized to access and only for the term of the authorization.

In order to encourage Third Party participation in Texas and to let the competitive market determine each Third Party's success, the requirements on Third Parties related to Customer data privacy and protection are voluntary. The Customer has the primary responsibility to determine if there is a need for data protection and the ability of the Third Party to provide that protection. To help Customers evaluate a Third Party's ability to protect their data and to make an informed decision on releasing their data to that Third Party, SMT allows a Third Party to distinguish itself by (1) voluntarily providing a link to their privacy policy and (2) voluntarily attesting to meeting the requirements of a national privacy seal. During the initial Third Party registration process, the Third Party is given the opportunity to provide this information or they may provide it at a later time by editing their company profile; however, the Third Party is not required to provide

this information to create an account on SMT. If the Third Party provides this information it will be available to the Customer in any agreement invitation correspondence sent to the Customer so the Customer may investigate and evaluate the Third Party.

In addition, SMT allows Customers, who have agreements with Third Parties, to rate the Third Party's services. The average Customer rating of the Third Party is provided to a potential customers on the agreement invitation so the Customer may judge whether or not they want to enter into an agreement with that Third Party.

5.5.2 Third Party Definition

A Third Party, in the context of SMT, is a service provider offering Customers in the competitive regions of Texas energy efficiency products and services that may use Customer smart meter usage information or In-Home Devices. The definition of Third Party includes REPs when a REP requests usage data from Customers who do not buy electricity from that REP (i.e., not the ROR). In addition, the definition of Third Party encompasses all parties, including the Customer's ROR, who want to offer products and services related to In-Home Devices.

5.5.3 Agreement Invitation Process

Third Parties who want access to Customer electric usage information or to SMT HAN functionality must have the Customer's permission to do so. SMT provides a convenient, well-documented process whereby a Third Party may request a Customer's permission and the Customer may accept or reject the request. SMT grants the Third Party access once a Customer accepts a Third Party's request.

5.5.4 Third Party Agreements

A Customer grants a Third Party permission to access to their usage data, add In-Home Devices to the Customer's HAN, or send messages to the Customer's In-Home Devices, by accepting an invitation to enter into one of three types of agreements with the Third Party (see Table 5). The Customer must enter into separate In-Home Device Services agreements for each In-Home Device they want the Third Party to access. By following the SMT Third Party agreement

SMART METER
—— TEXAS ™——

invitation process, a Third Party may invite a Customer to enter into one of these three agreements and a Customer may accept, reject, or allow the invitation to expire by taking no action.

Table 5: Third Party Agreements

Agreement	Description
Energy Data Agreement	• Authorizes a Third Party to access a Customer's energy usage data, meter information, and premise information • The term of the agreement may be for a one time access or with duration of 1 month up to 1 year • The agreement may include all of the ESIIDs in the Customer's account or just specific ESIIDs • A Customer may enter into an unlimited number of Energy Data Agreements
In-Home Device Agreement	• Authorizes a Third Party to add or remove an In-Home Device on the Customer's HAN • Has no term but is automatically terminated if either the Customer or Third Party removes the In-Home Device or the Customer moves out of the premise • A Customer may enter into a maximum of 5 In-Home Device Agreements per smart meter
In-Home Services Agreement	• Authorizes a Third Party to send specific types of messages based on SEP 1.0 to a Customer's In-Home Device • An agreement can specify any combination of simple text, pricing and/or load control message types • Has no term but may be terminated by either the Customer or Third Party and is automatically terminated if either the Customer or Third Party removes the In-Home Device or Customer moves out of the premise

Agreement	Description
	• A Customer may enter into a maximum of 5 In-Home Device Services Agreements per smart meter.

5.5.5 Prerequisites to the Agreement Invitation Process

Prior to sending an invitation to a Customer requesting the Customer's permission for access, a few prerequisites must be satisfied by both the Customer and Third Party.

A Third Party must complete the following prior to sending an agreement invitation to a Customer:

1. Obtain the appropriate credentials and certificates for API and SMT FTPS connectivity prior to registration with SMT.

6 Register and create an account[24] on the SMT web portal (see Section 6 Registration)

3. Obtain certain information (e.g., ESIID(s), Customer Account Authorization Code or email address, In-Home Device information[25], Cusstomer name, etc.) from the Customer.

The Third Party may obtain the required information from the Customer using a variety of means (i.e., face-to-face meeting, email, phone call, etc.), all of which are outside of the SMT agreement invitation process. The Customer's ESIID, Account Authorization Code, and existing In-Home Device, if any, information may be obtained by the Customer on their SMT account. If a Customer does not have an SMT account, then their ESIID may be found on their electric bill and the In-Home Device details may be obtained from the In-Home Device installation materials. An Account Authorization Code is not required if the Customer does not have an SMT account.

6.1.1 *Agreement Invitations*

The Third Party user will create the agreement invitation by entering the information received from the Customer into a form on the SMT web portal or through an agreement invitation API. SMT will validate the information prior to sending the agreement invitation to the Customer's email address. The Customer is not required to have an SMT account to receive an agreement invitation but is required to register and create an SMT account prior to accepting an agreement invitation.

The email invitation includes the following details related to the agreement:

- Agreement type (i.e., Energy Data, In-Home Device, or In-Home Device Services)
- Energy Data Agreement duration (i.e., one time access for 15 minute, daily, or monthly usage data, continuous access from 1 month up to 12 months) and the ESIIDs included in the agreement

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[24] A REP who has an SMT account will not have to create a separate account but will automatically have access to SMT Third Party functionality.
[25] The Third Party will have the In-Home Device information if the Third Party provides the Customer with the In-Home Device.

- Links to the Third Party's web site and privacy policy, if provided

- A national privacy seal, if the Third Party has attested to meeting the national privacy seal requirements, and privacy seal logo, if provided

- Any Customer ratings of the Third Party's services, if available

The agreement invitation sent to the Customer remains active for a period of 30 days. The Third Party can resend an existing agreement invitation once during the 30-day invitation period as a reminder, if the Customer has not responded. If the Customer has not responded within the 30-day invitation period, the invitation expires and a new agreement invitation has to be created.

6.1.2 Customer Acceptance of an Agreement Invitation

If the Customer has an SMT Account, the Customer may accept the invitation to enter into an agreement by clicking on the "Accept" button in the email. The SMT login page will be presented to the Customer and, after the Customer logs in, SMT presents an agreement acceptance confirmation page (see Figure 9). If the Customer does not have an SMT account, the Customer may accept the invitation by clicking on "Register for an SMT Account". The SMT home page is presented to the Customer for the Customer to register and create an account on SMT. The Customer must have an SMT account in order to accept an agreement invitation.

Once a Customer accepts an agreement invitation, SMT will create an agreement between the Customer and Third Party that will remain active until the agreement expires (Energy Data Agreement only) or is terminated. Both the Customer and the Third Party will receive an email confirmation that the agreement has been accepted and created.
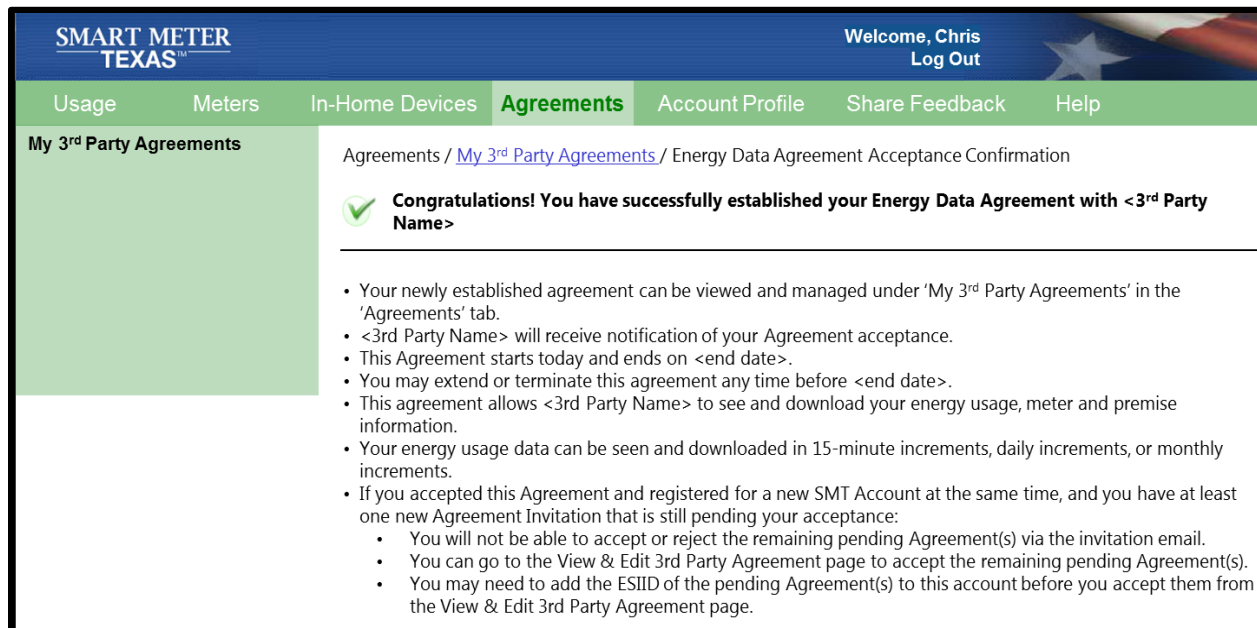
Figure 9: Agreement Acceptance Confirmation

6.1.3 *Customer Rejection of an Agreement Invitation*

A Customer may reject an agreement invitation by clicking the Reject button in the email. SMT will present a screen confirming the Customer's rejection and give the Customer the option to indicate why they are rejecting the agreement invitation (see Figure 10). Both the Customer and the Third Party will receive an email notification that the agreement invitation was rejected.

Figure 10: Agreement Rejection Confirmation

6.2 HAN Functionality

The PUCT Advanced Metering rule required that the TDSP AMS deployment support the "capability to communicate with devices inside the premises, including, but not limited to, usage monitoring devices, load control devices, and prepayment systems through a home area network (HAN), based on open standards and protocols that comply with nationally recognized non-proprietary standards such as ZigBee, Home-Plug, or the equivalent."[26]. To satisfy this requirement, the TDSPs installed smart meters with the ZigBee SEP v1.0 HAN communication protocol. However, with variability in the Joint TDSPs geographical locations, business requirements, and deployment time lines, each TDSP deployed advanced meters from different

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[26] PUCT §25.130(g)(1)(J)

meter manufacturers leveraging various types of communication networks. SMT resolved any issues related to the differing deployments by developing standard HAN APIs that contain standard ZigBee SEP messages.

A user must have authorization to access the SMT HAN functionality. A residential user automatically has authorization to access the SMT HAN functionality. If the user is a Business customer, TDSP, or Third Party and has the role of an administrator, they have access to the HAN functions and other users must receive authorization from an administrator associated with their organization. In addition, Third Parties must have active In-Home Device or In-Home Services Agreements with Customers to utilize the SMT HAN functionality (see Section 5.5.4).

Table 6 lists the HAN functions that may be accessed by each of the different SMT users through the SMT interfaces that provide access to the SMT HAN functionality.

Table 6: Access to SMT HAN Functions

SMT Interface	HAN Function	SMT User
Web Portal	Grant / Revoke HAN Access	Residential Customer, Business Customer Administrator, Third Party Administrator
	Add / Remove an In-Home Device	Customer, Third Party, TDSP
	View In-Home Device Status or History	Customer, Third Party
	View HAN Messaging History	Third Party
	Search and list In-Home Devices	Customer, Third Party, TDSP
	View In-Home Device Details	Customer, Third Party, TDSP
	Request HAN Message Log Report	Third Party
	Request report on In-Home device statistics (i.e., # of In-Home devices,	TDSP, Regulatory

SMT Interface	HAN Function	SMT User
	and # of HAN messages sent)	
	Request history of usage reports requested by a Third Party	Customer, TDSP, Regulatory
	Request report on # of Third Party Agreements rejected and reason for rejection	TDSP, Regulatory
FTPS	Receive HAN Message Log Report	Third Party
HAN APIs	In-Home Device Agreement request	Third Party
	In-Home Services Agreement request	Third Party
	Add / Remove an In-Home Device	Third Party
	Update Utility Enrollment Group	Third Party
	Send Price Signal	Third Party
	Send / Cancel Simple Text/Display	Third Party
	Send / Cancel Load Control Event	Third Party
	Cancel All Load Control Events	Third Party

6.2.1 Adding or Removing an In-Home Device

Customers may add and remove In-Home Devices on the Customer HAN and Third Parties may add and remove In-Home Devices once they have an In-Home Device Agreement with the Customer. Once the Customer accepts an In-Home Device Agreement, the process of adding an In-Home Device to the Customer HAN is automatically initiated by SMT.

 A Customer may add or remove an In-Home device only through the SMT web portal. A Third Party may use the SMT web portal or the SMT HAN APIs to perform these functions. TDSPs

also have capability to add and remove In-Home Devices within their territories in order to provide support for Customers.

In order to add an In-Home Device the following information is requested:

- In-Home Device description (optional): name of the device (e.g., downstairs Thermostat, Kitchen Display, etc.)
- Type of In-Home Device (required): selected from a drop down menu
- MAC address (required): the device address provided by the device manufacturer and should be easily accessible (e.g., on the device, the device packaging, with the installation instructions, etc.)
- Installation code (required): the installation code is provided by the device manufacturer and should be easily accessible (e.g., on the device, the device packaging, with the installation instructions, etc.).

A Customer or Third Party with an In-Home Device Agreement may remove an In-Home Device at any time without the permission of the other party. The Customer may remove an In-Home Device by selecting the "Remove In-Home Device" button on the SMT web portal. The Customer is given the option of either keeping or terminating the In-Home Device Agreement. A Third Party may remove an In-Home Device using either the SMT web portal or the HAN APIs. Third Parties must select a reason for removal from a pre-defined list.

Customers or Third Parties may view a list on the SMT web portal of the In-Home Devices that have been added or removed from the Customer's HAN as well as a history of all failed requests to add or remove In-Home Devices. Customers may also view In-Home Device details (e.g., MAC address, installation code, etc.) to provide to Third Parties when entering into Third Party In-Home Device Services Agreements.

6.2.2 In-Home Device Messages

Third Parties may send messages to a Customer's In-Home Device after the Customer agrees to enter into an In-Home Device Services Agreement with the Third Party. A Third Party initiates

communication with a Customer In-Home Device by sending a ZigBee SEP v1.0 message using the SMT HAN APIs. SMT will send the HAN message to the Customer's TDSP which then delivers the HAN message through the TDSP AMS communication network to the Customer's HAN which delivers the message to the In-Home Device. Third Parties may view a history[27] or status of HAN messages sent to devices and may create enrollment groups to send the same message to multiple In-Home Devices.

6.3 **Education**

An additional function of SMT is to educate Customers about their electric usage and teach them how to use and access SMT functionality. The Help functions and education features provided by SMT include help for individual features (see Figure 12 and Figure 13), a Help section (see

Figure 11)that includes Frequently Asked Questions (FAQs), user guide, important links, contact information, SMT terms and conditions, and information about security and privacy. In addition, on the Customer SMT home page there are links, located above the Customer login box, for information about SMT, contact information, FAQs, and security information.

SMT also provides users with broadcast messages (e.g. related to planned SMT outages, new SMT features, weather alerts, etc.). These messages are located on the Customer SMT home page and as text in a yellow bar at the top of certain SMT pages (see Figure 12).

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[27] This includes all messages ever sent to the HAN device

Figure 11: SMT Help Features

6.3.1 Help Function

On the SMT web portal pages there are numerous Help icons ⊙ that provide additional information about a feature on the page. In
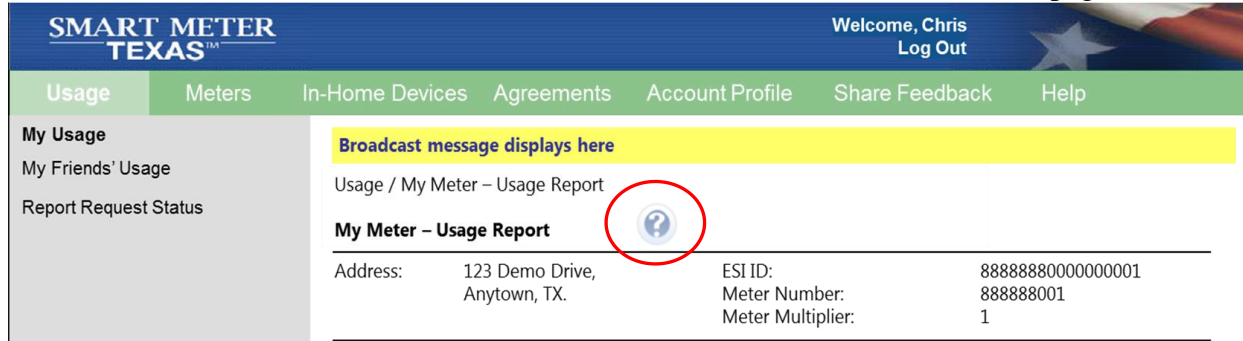
Figure 12, the Help icon ⊙ is next to "My Meter – Usage Report" allowing the user to get additional information on this feature. Figure 13 shows the result of clicking on the Help icon

⊙ giving the user additional information about the usage report. In addition, most of the fields and labels in SMT contain tool tips that display a brief description when the user rolls their mouse over the field or label.
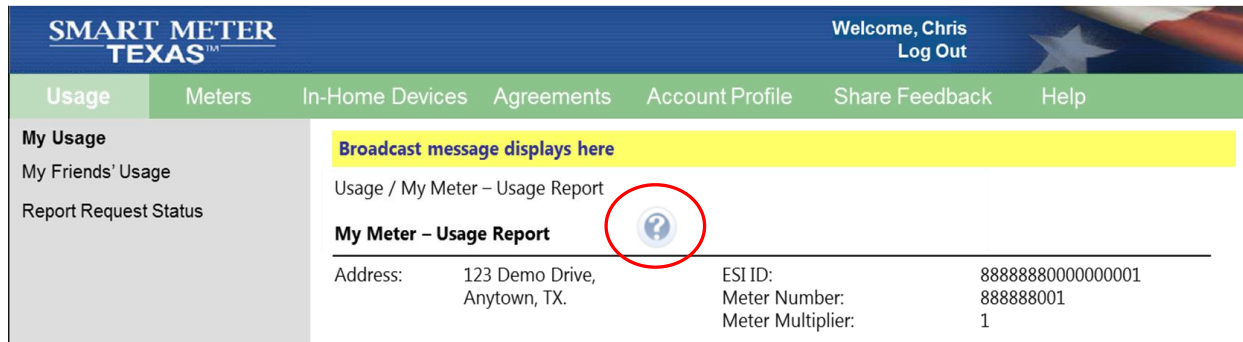
Figure 12: Help Icon ⊙ Example
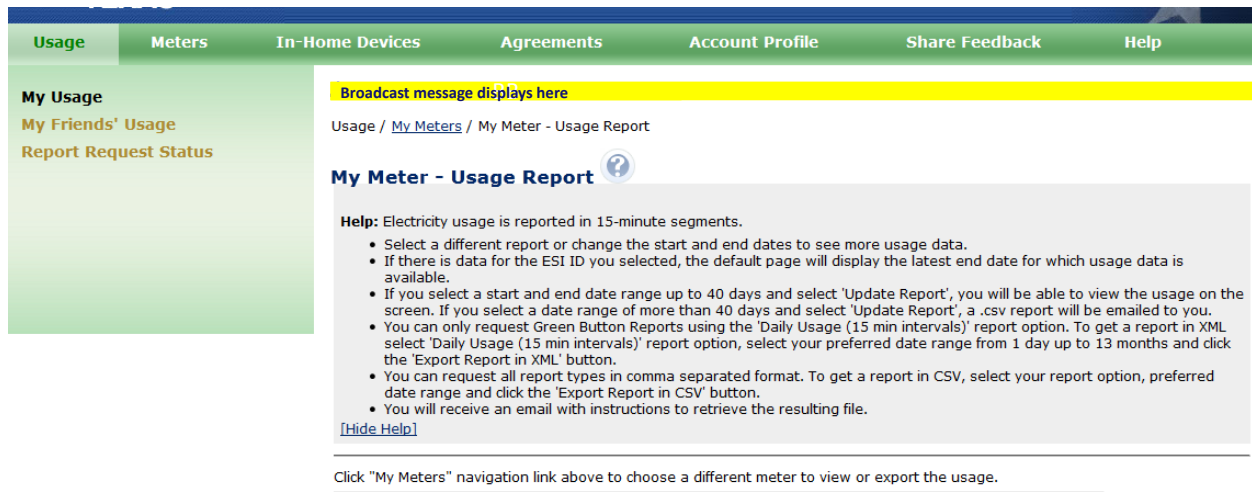
Figure 13: Help on the Usage Report

6.3.2 FAQs

On the Customer SMT home page, as well as on the user's home page after the user has logged into SMT, Customers may access a list of Frequently Asked Questions (FAQs) that cover a range of topics including:

- About Smart Meter Texas
- About Meters
- About Usage
- About In-Home Devices
- About Agreements
- About My Account
- About Reading Reports and Using the Data
- About Importing Files

6.3.3 User Guides

Users with a Residential or Business account may also download the SMT User Guide, in English or Spanish, which provides detailed, step by step instructions for all of the activities Customers can perform on the SMT web portal. A separate user guide is available to REP, Third

Party, and TDSP, users, which provides detailed information and instructions on accessing the SMT functionality available to such users.

A SMT In-Home Device Guide and In-Home Device Operation Support Model may be downloaded by Third Parties who are interested in providing Customers products that use the SMT HAN functionality. The In-Home Device Guide is a comprehensive document describing the SMT HAN functionality and how to access it. Included in the guide are an explanation of the roles each user has related to the SMT HAN functionality, how to connect an In-Home Device to the Customer HAN, how to send messages to an In-Home Device, the kinds of messages that may be sent to In-Home Device, a HAN API starter kit, and how to test In-Home Device. The HAN API Starter Kit describes the soapUI that can be used to invoke the SMT HAN Web Service interface and includes the following:

    a. soapUI project – Contains XML interface definitions that can be used by the soapUI application

    b. SMT's UAT/Staging SSL Certificate

    c. SMT HAN Interface Security - Describes the interface functions

6.3.4 SMT Help desk

SMT maintains a SMT help desk that allows all users to call and ask for assistance with all aspects of SMT functionality. The help desk may be contacted by calling 1-888-616-5859. The SMT help desk can help users:

- Setting up an SMT account
- Logging into their account
- Change their password
- Addressing other SMT account specific questions
- Directing users to their REP for questions related to their electric service or bill
- Access data at the FTPS site (RORs and Third Parties only)
- Answer questions about the SMT API (RORs and Third Parties only).

6.3.5 Other Help

Customers are referred to the ROR should they have questions about their service or bill, understanding their usage reports, addressing missing or incorrect data in their account or usage reports, or want ideas on how to save electricity. Important links are provided to the websites of the Joint TDSPs, PUCT, and ERCOT to help Customers learn more about these organizations and what their responsibilities are related to the delivery of electricity to consumers.

6.4 General SMT Usability Solutions

To increase the usability of SMT and the accessibility of its functions, SMT provides users with a language preference choice and the SMT web portal is compliant with the requirements for Internet accessibility as set forth in the Federal Rehabilitation Act, Section 508, Electronic and Information Technology[28]. During the registration process, the user may set their language preference to either English or Spanish. Customers may also select the preferred language on the SMT home page prior to logging into their SMT account. SMT user documentation is provided in English and Spanish and the SMT portal pages are displayed in the user's language preference. SMT implemented the Federal Rehabilitation Act, Section 508 to enable users with disabilities to access and use the SMT functionality in a manner comparable to that provided to individuals without disabilities. The SMT web portal was specifically implemented to support common ADA tools which enable the translation of portal text into voice. Extensive testing of the web portal by sight impaired people validated its accessibility, as did an ADA audit undertaken in 2012.

In addition, SMT accommodates the effect daylight savings time has on energy usage data. On the spring day that daylight savings begins, SMT displays and graphs 92 intervals of energy usage data with the 2:00 a.m. hour missing. For the fall day that daylight savings ends, SMT will display 100 intervals of energy usage data with the 1:00 a.m. hour repeated.

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[28] http://www.section508.gov/summary-section508-standards

In 2014, an effort was undertaken to improve the overall Customer user experience on the SMT web portal. A consumer insights professional[29] was retained to conduct a heuristic evaluation of the overall SMT site usability and compare SMT against industry standards and best practices. In addition, the design changes that were recommended and implemented were tested through in-depth interviews with both residential and business customers. Design changes as a result of these interviews were incorporated into SMT release 4.3 to further improve the user experience.

[29] Shannon Graf

6 Registration and User Roles

7.1 Registration

SMT uses industry standard practices to provide a secure web portal registration process that validates the authenticity of the user and protects against unauthorized access. All users must provide general information (e.g., user name, email address, user ID, etc.) during the registration process. Additional information is also requested (see Table 7) in order to validate the authenticity of the user and to create a company account for Business Customers, REP's, and Third Parties.

Table 7: Additional Registration Information

Account Type	Additional Information
Customer	• Preferred language (English or Spanish; default is English) (residential customer only) • ESIID (for one smart meter, other ESIIDs, if applicable, may be added) • Meter Number • Customer's current REP
Friend	• Preferred language (English or Spanish; default is English) • Agreement Key (contained in the email invitation)
REP	• DUNS Number
Third Party	• DUNS Number • Company URL (optional) • Privacy Policy URL (optional) • Upload company logo (optional) • Attest to meeting the requirements of a national privacy seal (optional)

A Residential Customer may invite up to five Friends to view their usage data. Once invited to do so, a Friend must register and create an account on SMT to view usage data from a Residential account holder's smart meter.

The first user to set up an account for a Business Customer, REP, or Third Party must set up the company account and the first administrator account. Prior to establishing a Company account, a Third Party must obtain security credentials and connect to the SMT FTPS. The company account contains the company-level information and provides a mechanism to associate certain SMT users with a company or an organization (i.e., PUCT). The following information is required for all company accounts:

- Company name
- Company primary address (address, city, state, zip code, country)
- Preferred contact phone number
- Company account email address (for SMT communications to all company administrators)

In addition, REPs and Third Parties may provide the following optional information:

- Provide link to company privacy policy
- Provide Company URL and logo
- Attest to meeting the requirements of a national privacy seal

Company accounts have users who are assigned by their company to have the role of either an administrator or user. A company account may have up to four administrators. Once a company account has been established, the company name will appear on a list for other administrators and users to select and begin the registration process. As part of the secure registration process, additional administrators and users must be approved by an existing administrator and assigned certain permissions prior to accessing the SMT web portal functionality. A REP company account must be approved by a TDSP administrator prior to SMT activating the REP company account. SMT will request this approval from a TDSP administrator automatically when the REP company account had been set up. A Third Party company account must be approved by the SMT team prior to SMT activating the Third Party company account.

Prior to the launch of SMT, a company and an administrator account were set up for each of the Joint TDSPs and the PUCT (i.e., Regulatory user). Additional TDSP or Regulatory administrators and users may select their company name from a list to begin the registration process on SMT.

During the registration process, each user must agree to the SMT terms and conditions, which set forth the terms and conditions for use of the SMT website. The terms and conditions incorporate industry best practices related to using a website and user privacy. The SMT privacy policy is included in the terms and conditions which is easily accessible under the Security link on the SMT home page.

7.2 **Roles**

As part of the registration process, users will be allowed access to SMT functionality depending upon their role. The categorization of the user roles and their associated access to the SMT functionality is guided by the following generic role definitions:

- **Individual Account** - An individual, not associated with a company that has a need to see or retrieve data from the web portal. An Individual Account can be a Residential Customer, a Friend, or both – all with a single user ID and password.

- **Company Account** - a profile containing information about a company (i.e., TDSP, REP, Regulatory, Third Party, or Business Customer). Administrators and users are associated with the company account.

- **Administrator** - an employee or representative of a company that is assigned the role and responsibility for setting up and managing the company profile, managing (i.e., approve, terminate) other company users requesting access to SMT, and managing (i.e., grant and revoke) permissions to company users to access usage information or HAN functionality associated with the company account.

- **User** - An individual that has permission to see or retrieve data from SMT that is associated with a company. Users are granted access by one of the company's Administrators.

Company accounts provide a consistent way of handling security roles for users within an organization. Company accounts are also used to associate usage data and In-Home Device access to organizations.

Residential Customers and Friends do not belong to a company account as there is no separate company level information to track. A Residential user may only access usage data from smart meters and In-Home Devices that are associated with their account and, if invited by a Friend, may view usage data from a Friend's smart meter. A Friend may only view usage data from a Residential Account when invited by the Residential Account holder to do so.

A Business account may only access usage data from the smart meters and In-Home Devices associated with their company. A TDSP account will have access to meter, usage, premise, and In-Home Device information for the ESIIDs that are served by that TDSP. Other TDSP companies will not have access to that same data. In a similar manner, each ESIID is associated with a specific REP and other REP companies, who are not the ROR, will not have access to that ESIID's usage data unless the Customer grants such access through an Energy Data Agreement. Third Party accounts only have access to usage data from Customers who have entered into Energy Data Agreements with that Third Party and access to Customer In-Home Devices with those Customers who have entered into an In-Home Device or In-Home Device Services Agreements.

SMT roles consider both the company type and user type. A TDSP Administrator has a different set of permissions and functionality than a REP Administrator. Both Administrator types have a set of related functionality with respect to their company (e.g., approving new company users). Differences are present due to the different functions that TDSPs and REPs exist to serve (e.g., a TDSP Administrator is required to authorize the creation of new REP accounts). Table 8 lists the specific set of SMT functions that an account, based upon their role, may have access to.

Table 8: SMT Functions by Account Roles

Account Type	Functions
Residential	• Edit personal profile information (i.e., name, phone, email address,

Account Type	Functions

Account	password, security question, Account Authorization Code)
	• Add and delete smart meters to their accounts, based on ESIID
	• Add or delete In-Home Devices
	• View and download usage data
	   - Graphical and tabular data
	   - 15 minute usage intervals, daily reads, and monthly usage
	• Manage Friends
	   - Invite up to 5 Friends to view usage data
	   - Delete a Friend's access to the user's usage data
	   - Add or delete smart meters that a Friend can view
	   - Accept invitations from up to 5 Friends to view their usage data
	• Accept or reject Third Party agreement invitations
	• Manage Third Party agreements (e.g., extend Energy Data Agreement, terminate agreements, etc.)
	• Search and list all agreements Customer has with Third Parties
	• View history of usage reports that have been run by Third Parties
	• Rate a Third Party that the Customer has an agreement with
	• Share feedback on Customer's experience with SMT

Friend Account	• Edit personal profile information (i.e., name, phone, email address, password, security question)
	• Accept invitations or end access to view their Friend's usage data
	• View usage data for a Friend's smart meter
	   - Graphical and tabular data
	   - 15 minute usage intervals, daily reads, and monthly usage

Business Account	**User** • Edit personal profile information (i.e., name, phone, email address, password, security question) • View the company profile • Access usage, meter, and premise information for the smart meters that are associated with the company • View, add and remove In-Home Devices for the smart meters that are associated with the company, if given permission by a company administrator • Search and list all agreements company has with Third Parties • View history of usage reports that have been run by Third Parties • Rate a Third Party that the Customer has an agreement with

Account Type	Functions
	• Share feedback on Customer's experience with SMT
	Administrator • Edit personal profile information (i.e., name, phone, email address, password, security question, Account Authorization Code[30]) • Edit the company profile • View, add and remove smart meters for the company • Access usage, meter, and premise information for the smart meters that are associated with the company • View, add and remove In-Home Devices for the smart meters that are associated with the company • Accept or reject Third Party agreement invitations • Manage Third Party agreements (e.g., extend Energy Data Agreement, terminate agreements, etc.) • Search and list all agreements company has with Third Parties • View history of usage reports that have been run by Third Parties • Approve/decline new Business administrators or users requesting access to SMT and grant them energy data or HAN permissions • Suspend/re-instate/revoke company user accounts that have previously been granted access to SMT • Rate a Third Party that the Customer has an agreement with • Share feedback on Customer's experience with SMT

REP Account	**User**
	
	 • Edit personal profile information (i.e., name, phone, email address, password, security question)
	 • View Customer usage, premise, or meter data associated with the REP, if granted access by the REP Administrator
	     - Search and view data online
	     - Request ad-hoc reports which will be created by SMT and then stored in the REP's FTPS folder
	 • Display a list of Customer smart meters associated with the REP

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[30] Each Business Account Administrator will have their own Account Authorization Code

Account Type	Functions

	Administrator
	
	• Edit personal profile information (i.e. name, phone, email address, password, security question)
	• Edit the company profile
	• Add and remove DUNS numbers for the REP company
	• Approve/decline new REP administrators or users requesting access to SMT and grant them permissions
	• Suspend/re-instate/revoke REP administrator or user accounts that have previously been granted access to SMT
	• View Customer usage, premise, or meter data associated with the REP
	   - Search and view data online
	   - Request ad-hoc reports which will be created by SMT and then stored in the REP's FTPS folder
	• View, list, and export Customer usage, premise, and meter information for Customers associated with the REP

Third Party Account	User
	
	• Edit personal profile information (i.e., name, phone, email address, password, security question)
	• If given permission by an administrator:
	   - Initiate relationships with Customers through Energy Data Agreements, In-Home Services Agreements, and In-Home Device Agreements
	   - Initiate an Energy Data Agreement extension request
	   - Add and remove In-Home Devices for any Customers who have entered into an In-Home Device Agreement with the Third Party
	   - View and export energy data (i.e., usage data, meter information, premise information) for Customers who have entered into an Energy Data Agreement with the Third Party
	   - Send messages to In-Home devices for Customers who have entered into an In-Home Device Services Agreement with the Third Party
	   - Terminate Energy Data or In-Home Device Services agreements with Customers
	   - View, list, and export Customer Agreements
	   - View In-Home Devices
	   - View status of requested reports

Account Type	Functions

	• View usage data
	   - View data online
	   - Request custom reports which will be created by SMT and then stored in the Third Party's FTPS folder
	• Display a list of Customer smart meters associated with the Third Party

	Administrator • Edit personal profile information (i.e., name, phone, email address, password, security question) • Edit the company profile • Initiate relationships with Customers through Energy Data Agreements, In-Home Device Services Agreements, and In-Home Device Agreements • View, list, and export Customer Agreements • Add and remove In-Home Devices for any Customers who have entered into an In-Home Device Agreement with the Third Party • View and export energy data (i.e., usage data, meter information, premise information) for Customers who have entered into an Energy Data Agreement with the Third Party • View status of requested reports • Send messages to In-Home Devices for Customers who have entered into an In-Home Device Services Agreement with the Third Party • Terminate Energy Data or In-Home Device Services agreements with Customers • Approve/decline new Third Party administrators and users requesting access to SMT and grant them permissions. • Suspend/re-instate/revoke Third Party user accounts that have previously been granted access to SMT • Grant or Revoke permissions to Third Party Users to access energy data for Customers who have entered into an Energy Data Agreement with the Third Party • Grant or Revoke permissions to Third Party Users to send messages to In-Home Devices for Customers who have entered into an In-Home Device Services Agreement • Grant or Revoke permissions to Third Party Users to add In-Home Devices for Customers who have entered into an In-Home Device Agreement

Account Type	Functions

TDSP Account	**User**
	
	• Edit personal profile information (i.e., name, phone, email address, password, security question)
	• View the TDSP company profile
	• Add and remove In-Home Devices for the smart meters that are associated with the TDSP, if a TDSP administrator has granted the user HAN authorization
	• View Customer usage data
	    - View data online
	    - Request custom reports which will be created by SMT and then stored in the TDSP's FTPS folder
	• Display a list of Customer smart meters associated with the TDSP
	• View premise and meter information

	Administrator • Edit personal profile information (i.e., name, phone, email address, password, security question) • Edit the company profile • View, list, and export Customer usage, premise and meter information • Add and remove In-Home Devices for the smart meters that are associated with the TDSP. • Grant or Revoke In-Home Device access permission to users associated with the TDSP • Approve/decline new TDSP administrators and users requesting access to SMT • Approve/decline new REP company accounts requesting access to SMT • Approve/decline a REP request to add a new DUNS number to the REP company account • Suspend/re-instate/revoke a REP DUNS number • Suspend/re-instate/revoke TDSP user accounts that have previously been granted access to SMT functionality • At the request of a ROR, remove a meter from a Customer's SMT account • View statistical reports on Third Party activity
Regulatory Account	User

Account Type	Functions
	• Edit personal profile information (i.e., name, phone, email address, password, security question) • View Customer energy usage data • View statistical reports on SMT usage • View statistical reports on Third Party activity
	Administrator • Edit personal profile information (i.e., name, phone, email address, password, security question) • Edit the company profile • View Customer energy usage data • View statistical reports on SMT usage • View statistical reports on Third Party activity • Approve/decline new Regulatory administrators and users requesting access to SMT functionality • Suspend/re-instate/revoke Regulatory user accounts that have previously been granted access to SMT

8 Interfaces

SMT has three interfaces that provide users with access to SMT functionality and data. The interfaces are a graphical user interface (GUI) delivered through a web browser using a secured web connection, a secured file transport protocol (FTPS) site, and an application programming interface (API). Users have differing levels of access to these interfaces depending on their user entity and role.

8.1 Web Portal

The web portal is the GUI for all users of SMT and provides a straightforward, user friendly access point to SMT. The home page for the portal provides a login section for registered users, a link for new users to create an account, information about SMT functionality, and user education materials (e.g., FAQs, etc.), contact information, and SMT terms and conditions. Figure 14 shows the SMT landing page.
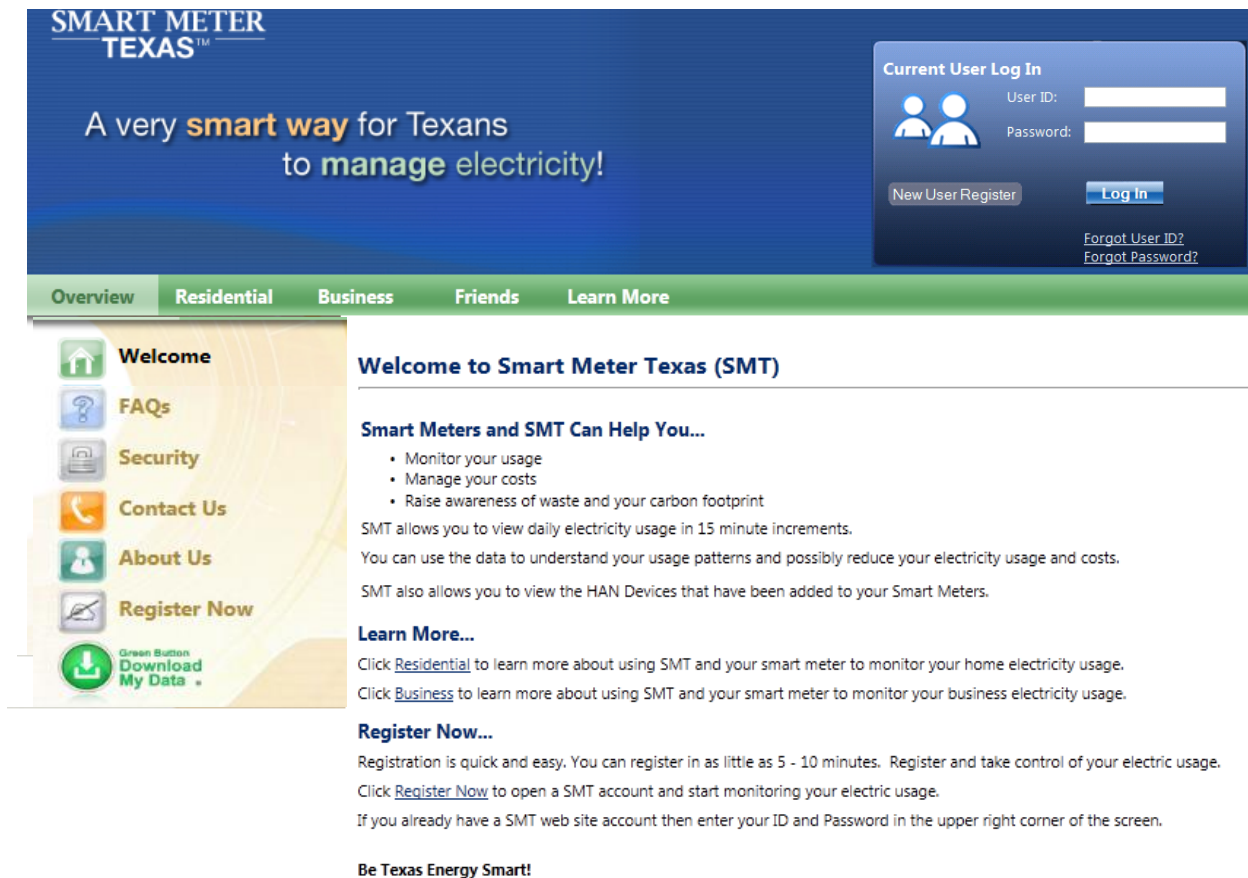
Figure 14: Customer SMT Landing Page

The web portal provides different functionality to registered users depending on the type of account they have, and for Customers and Friends the web portal is the only interface these users have to access SMT functionality. The types of SMT functions that are available to each type of user on the SMT web portal are listed in Table 8.

All new users of SMT register and create an account by accessing the web portal and entering the requested information appropriate to the type of account they are creating (see Table 7).

The primary function of the web portal for Customers is to provide access to their usage data. Data is displayed on the SMT web portal in both a graphical and tabular format and the user can

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select 15 minute interval data, daily reads, or monthly usage data. An example of a residential user's usage data as displayed by SMT is shown in Figure 15.
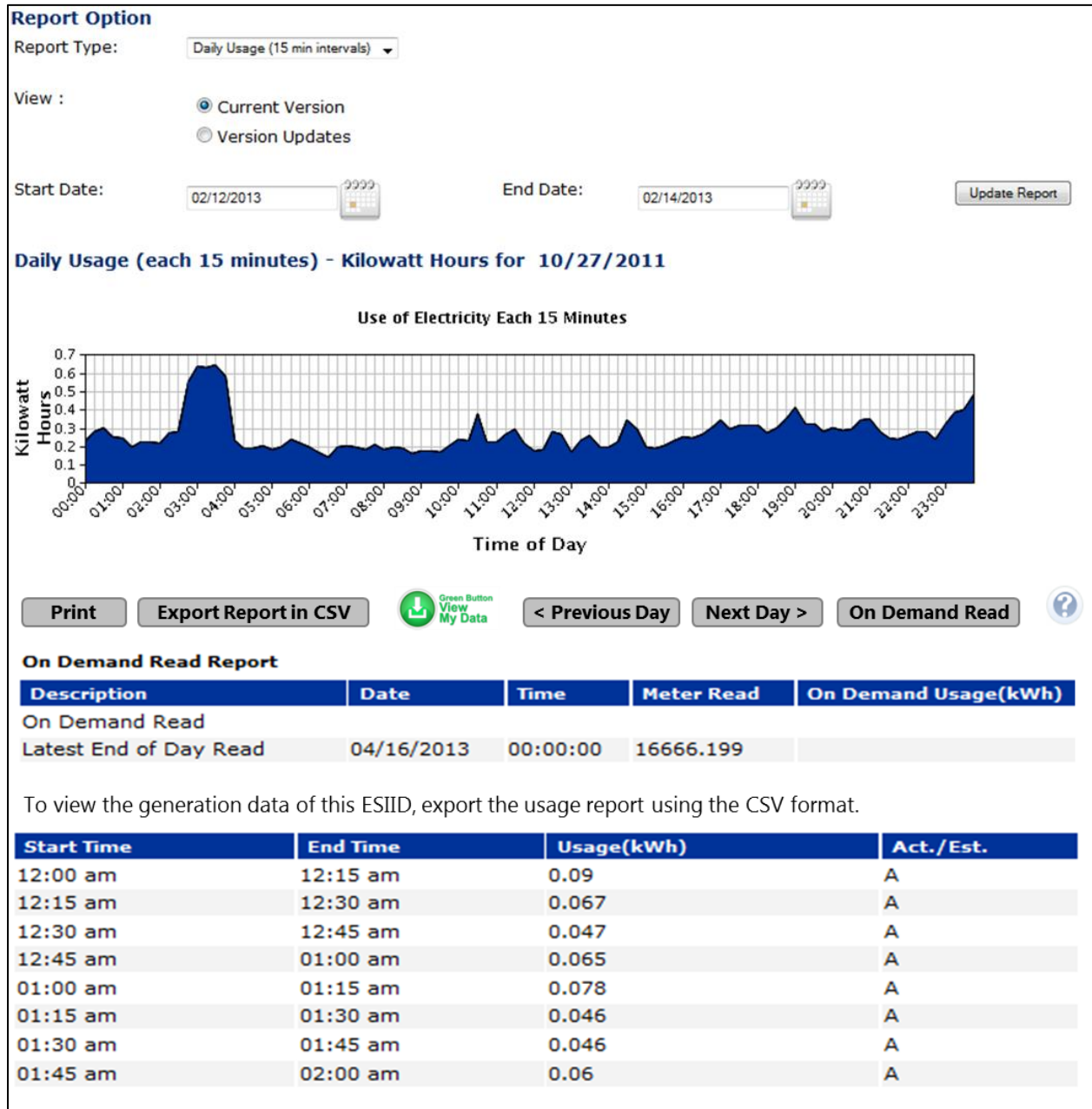
Figure 15: 15 Minute Interval Data

An example of a residential user's daily usage is provided in Figure 16.
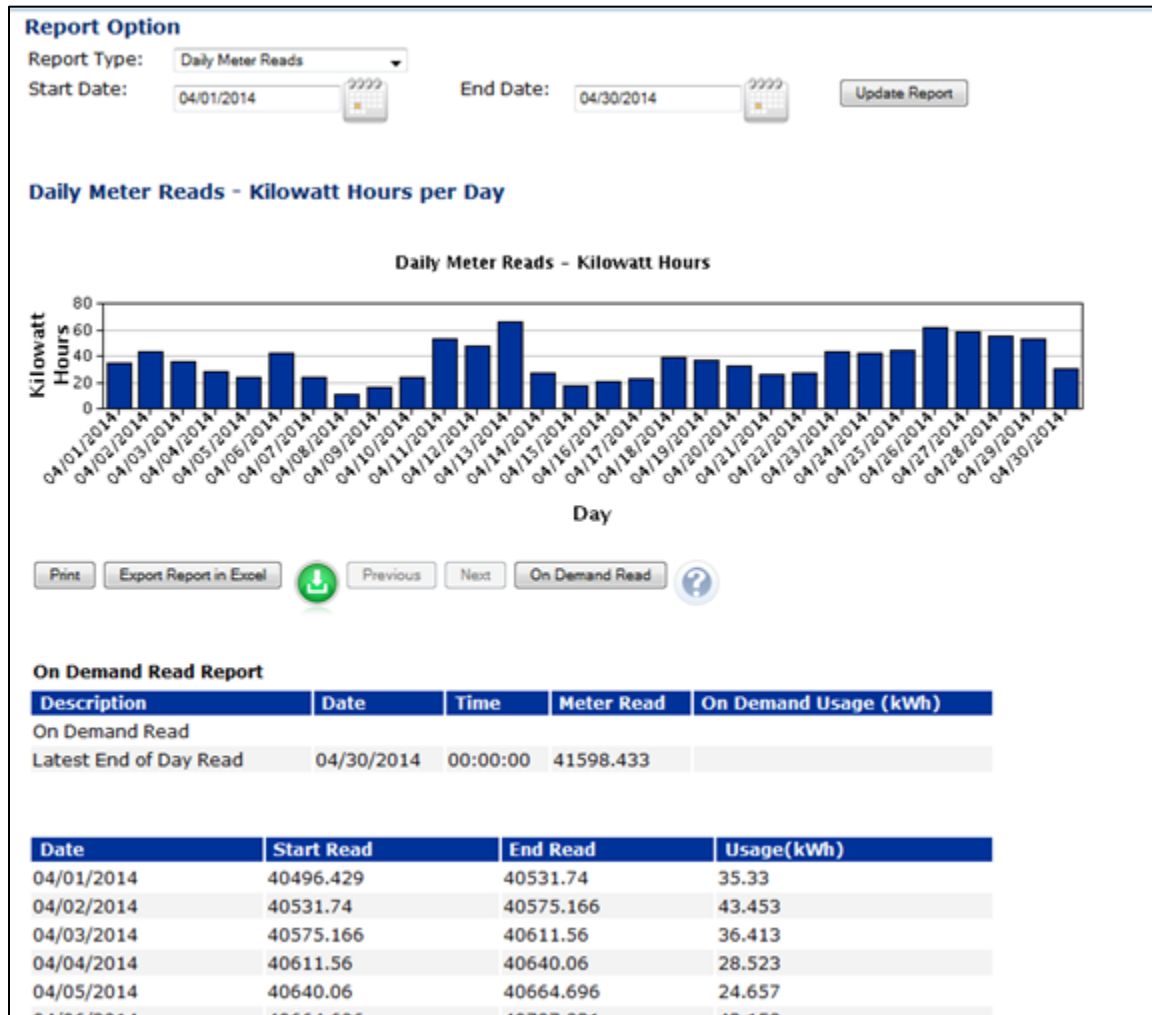
Figure 16: Daily Read Usage Report

A residential user's monthly usage data is shown in Figure 17.
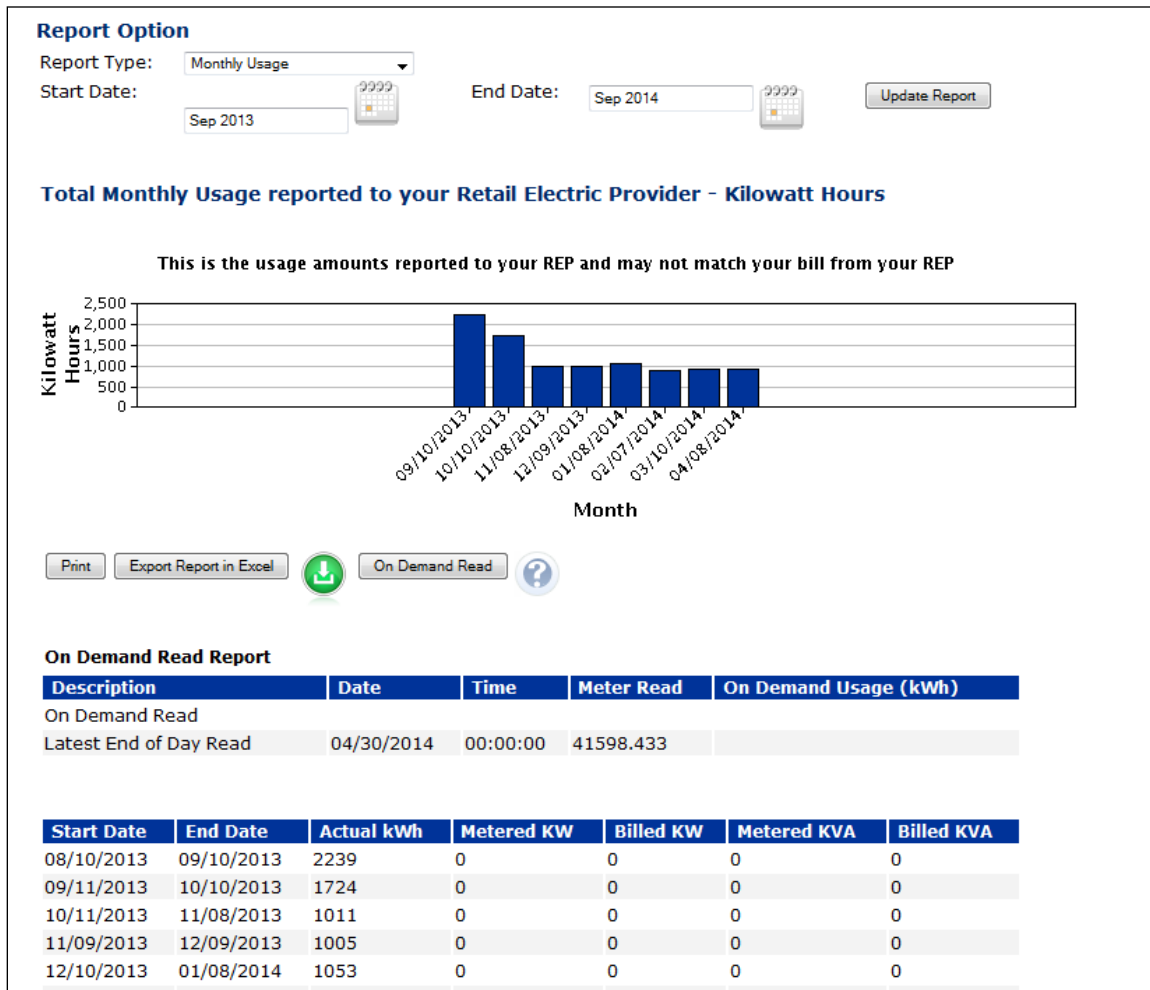
Figure 17: Monthly Usage Report

In addition to allowing Customers to view their usage data, the portal is also the means by which they connect In-Home Devices to their HAN. A Customer may use the SMT web portal to enter the In-Home Device MAC address and installation code which are typically printed on the In-Home Device or the installation materials. This information is passed from SMT, back to the TDSP and then down to the Customer HAN created by the smart meter, which then completes

the connection process. The connection process provides a secure method to ensure that only the Customer or an authorized Third Party can connect In-Home Devices to the Customer's HAN. An example of a Customer's In-Home Device setup screen is shown in Figure 18.

Figure 18: In-Home Device Setup

Registered Business Customers have the same general web portal functionality as Residential Customers but with some differences. Business Customers have two account types, administrator and user, with some functions unavailable to the Business user account. Business Customers may also have a large number of smart meters to monitor and the SMT web portal provides tools to search for specific meters when viewing usage or creating reports. The SMT web portal also provides the interface for the Business account management functions.

Through the web portal the TDSPs, REPs, Third Parties, and Regulatory users each have account management functions for their administrators to manage the user accounts for their company. The TDSPs, REPs and Third Parties may also view meter usage data for meters associated with their company, view lists of their associated smart meters and request usage reports for multiple meters that are created by SMT and then stored in the company's FTPS folder.

Customers, RORs, and Third Party users may also use the web portal to request an on-demand meter read. The on-demand read request results in SMT sending a data request to the

Customer's TDSP for an updated meter read. TDSPs respond by sending the most recent intra-day meter reading back to SMT and SMT will calculate and display the consumption since the last midnight register read held by SMT.

8.2 **Secure FTP**

On a daily basis the Joint TDSPs collect a daily read and the recorded interval usage data from the smart meters that they have installed. The TDSPs prepare data files to transmit to the SMT for each ROR. The data files are encrypted using Pretty Good Privacy (PGP) and are formatted using the LodeStar Enhanced (LSE) format that is used by ERCOT. The files submitted to SMT are separated by the DUNS number of the individual REPs. These files are transmitted using FTPS and stored in folders for the individual REPs who may then use FTPS to retrieve them. Each REP will have a folder for each DUNS number associated with their REP account. Each data file may contain up to 50,000 ESIIDs, so a REP with a large number of Customers will receive multiple files. As an example, a REP with one DUNS number and 75,000 Customers in each of the four TDSP service territories will have 8 data files uploaded to the FTPS on a daily basis. Data files are retained on the FTPS site for 10 days. The availability of the data once loaded to the SMT FTPS site is on the order of a few minutes.

REPs and Third Parties may use both the web portal and the API to request ad-hoc or scheduled usage reports (Third Parties only) for selected ESIIDs and date ranges. These reports are created and then stored in the requestor's folder on the FTPS site.

REPs, Third Parties, and TDSPs access the FTPS site using software known as a FTP client that enables the login and transfer of files over a secured data connection (see Figure 19). REPs and Third Parties receive a FTP user ID and password from SMT operations and install a FTPS client certificate from Verisign. REPs and Third Parties then generate a PGP key pair and provide the PGP public key and SSL public certificate to SMT host administrators. When logging on to the SMT FTPS server, the REP or Third Party enters their user ID and password to authenticate. The FTPS client and server will then establish an encrypted SSL session.
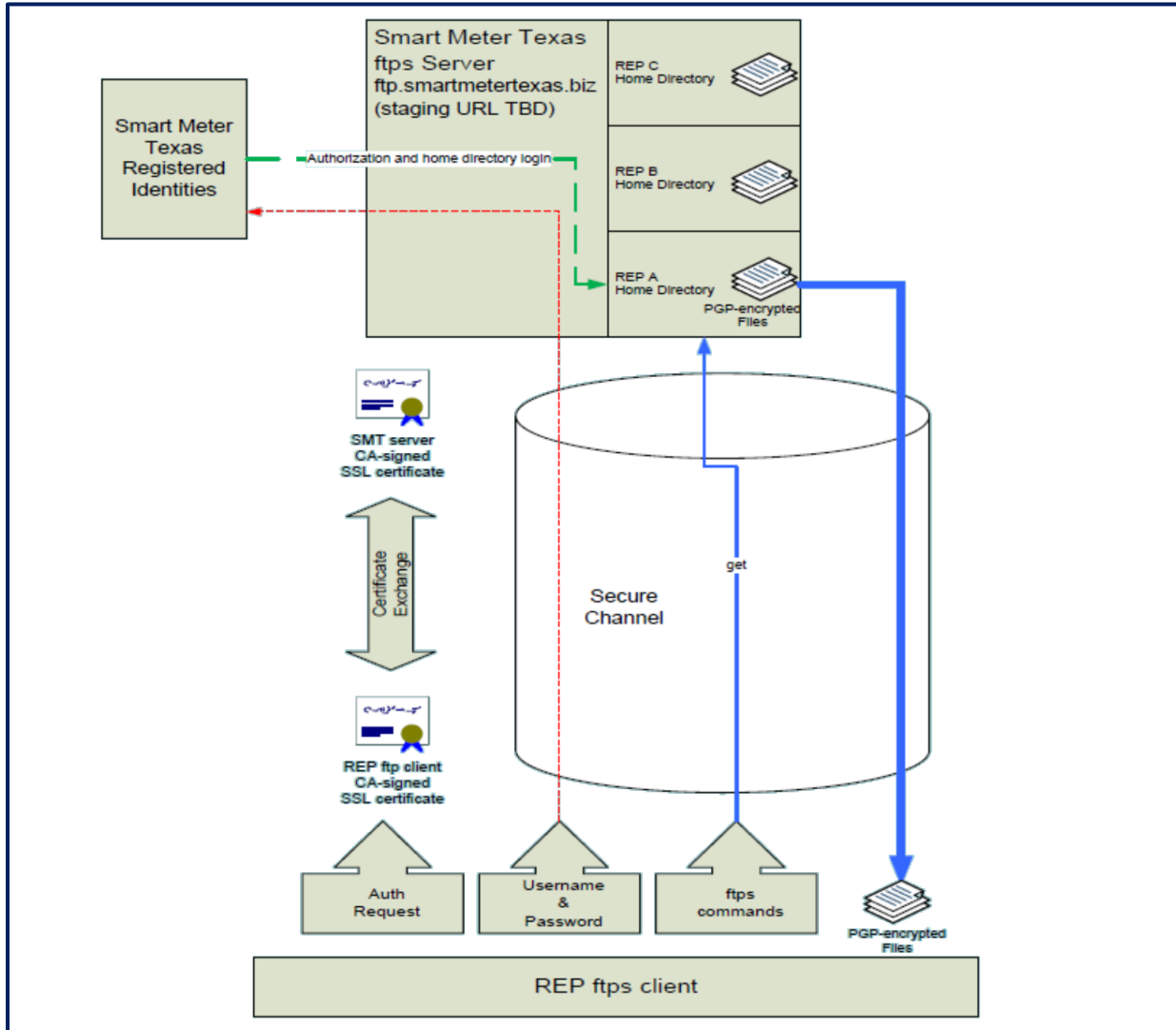
Figure 19: FTPS Interface

8.3 Application Programming Interface (API)

The purpose of the API interfaces are to provide a machine to machine communications channel for REP and Third Party systems to interact with SMT. API messages can be sent from a REP or Third Party system to SMT without requiring the user to login to the interactive web portal.

The API is based on the Simple Object Access Protocol (SOAP). The messages are formatted using Extensible Markup Language (XML) over a secured web connection. These messages are in text and follow strict formatting rules. REPs and Third Parties who communicate with SMT using an API do so through a two-way Secure Sockets Layer (SSL). SMT requires user credentials to be passed as part of the SOAP message. The user credentials are used to identify the user with their SMT system account. The SMT system validates the request sender and verifies that the account is authorized to access the data being requested.

RORs and Third Parties are provided with the API guide when they register for a SMT account and go through a testing procedure to validate that their system is communicating correctly using the SMT APIs. There are four different categories of APIs available: usage APIs, re-branding API, agreement invitation APIs, and HAN APIs.

The usage APIs provide functionality for RORs and Third Parties to request ad hoc energy usage data reports for their Customers. Third Parties may also request scheduled usage reports using the usage API.

The re-branding API provides functionality for RORs and Third Parties to display SMT usage data through their own portal. A Customer viewing data on the ROR or Third Party's portal will trigger a data request that is submitted to SMT through the API interface. The results of the data request are then displayed on the ROR or Third Party's portal. This process is seamless to the Customer.

The agreement invitation API provides an alternate way for Third Parties to send agreement invitations to one or more Customers.

The HAN APIs provide functionality for a Third Party, who has Customer authorization, to add or remove In-Home Devices on the Customer HAN and to communicate with those In-Home Devices. The HAN APIs use standard ZigBee SEP v1.0 messages that add or remove In-Home Devices, send or cancel text messages for display on In-Home Devices, send a price signal, send or cancel a load control message, or cancel all load control messages. A Third Party can send a

ZigBee SEP v1.0 message to up to 10,000 addresses at a time using the HAN API. An address can be either an ESIID or an individual In-Home Device.

9 Use Cases

AMIT used a use case-based process to identify actors, create business and system requirements, and to communicate the functionality required for SMT. Some systems development projects simply brainstorm a list of requirements based on the perceived functionality. A system with a diverse set of stakeholders makes it increasingly likely that such a process will miss some requirements because of miscommunication or a failure to envision various system interactions. A more comprehensive approach is the use case-based process. A use case is a sequence of events that describes one way to use a particular system. It is a story about how a particular user (actor) of a system accomplishes a goal.

9.1 Actors

Actors are people, systems, devices, companies or organizations that make decisions and interact with the system under design. It is helpful to have an understanding of the set of actors that were used and considered by the AMIT workshops because it provides information about the scope of interactions that SMT was designed to accommodate. The description for actors often provides additional context about the use case and assumptions being made.

The set of actors evolved during the course of the SMT system development. The AMIT workshops began with the assumption that a web portal was an appropriate system to provide meter usage data to Customers, but did not make assumptions regarding the ownership and operation of the web portal. Use cases created in later workshops recognized the actual implementation of the SMT web portal with the most recent use cases identifying SMT by name. The final list of actors listed in Table 9 became the set of SMT users, devices and systems associated with SMT.

Table 9: SMT Actors

Actor	Actor Type	Description
Residential Customer	Person	An electrical Customer of a REP who has a smart meter installed at their premise by one of the Joint TDSPs. Residential Customers typically have only one meter.
Friend	Person	A family member or friend of a Residential Customer who is authorized by the Residential Customer to view their usage data on the SMT web portal
Business Customer Administrator	Person	A person who works for a Business company who is an electric Customer of a REP and who has management rights associated with the company's usage data, HAN functionality, and grants permissions to other Business users to access to SMT functionality.
Business Customer User	Person	A person who works for a Business company who is an electric Customer of a REP and who must be approved by their company administrator to access SMT and be given permission by the administrator to access certain SMT functionality associated with the company.
REP Administrator	Person	A person who works for a REP and who has management rights associated with the REP's Customer usage data, HAN functionality, and grants permissions to other REP users to access SMT functionality.
REP User	Person	A person who works for a REP and who must be approved by their REP administrator to access SMT and be given permission by their REP administrator to access certain SMT functionality associated with the REP's Customers.
Third Party Administrator	Person	A person who works for a Third Party company and who has management rights associated with the Third Party's Customer usage data, HAN functionality, and grants permissions to other Third Party users to access SMT functionality.

Actor	Actor Type	Description
Third Party User	Person	A person who works for a Third Party company and who must be approved by their Third Party administrator to access SMT and be given permission by the administrator to access certain SMT functionality associated with the Third Party's Customers.
TDSP Administrator	Person	A person who works for one of the Joint TDSPs and who has management rights associated with that TDSP's Customer usage data, HAN functionality, and other TDSP users access to SMT functionality.
TDSP User	Person	A person who works for one of the Joint TDSPs and who must be approved by their TDSP administrator to access SMT and be given permission by the administrator to access certain SMT functionality associated with the TDSP function.
Regulatory Administrator	Person	A person who works for the PUCT and who has management rights to grant other PUCT users' access to SMT functionality.
Regulatory User	Person	A person who works for the PUCT and who must be approved by a PUCT administrator to access certain SMT functionality.
In-Home Device	Equipment	A device (e.g., in-home display, programmable communicating thermostat, smart appliances, etc.) that communicates on the HAN.
TDSP AMS Network	Systems & Equipment	A communication technology system installed by a TDSP that provides two-way communications to and from the smart meter.
Smart Meter	Equipment	An advanced meter with the capabilities specified in the PUCT §25.130.
SMT	System	A system composed of a common data repository, web portal, FTPS folders, and APIs providing access to usage

Actor	Actor Type	Description
		data, communication with HAN devices, and education to users.

9.2 **SMT Use Cases**

The process of defining and creating use cases results in a more complete set of requirements because:

- It is done from the actor's point of view, so it is easier to tell what interactions or steps are really necessary.
- It follows a complete path for completing a task from start to finish.

A use case may have many parts, but there are always a few basic ones, listed here in order of importance:

- The **goal** of the scenario, which is usually its name (e.g., "Customer uses web portal to view meter usage data").
- The **narrative.** A short text describing the story.
- The **actors**. An actor is anything in the system that communicates or makes a decision. It may be a person, a device, a piece of software, an organization, or anything else that acts on its own and can have goals and responsibilities.
- The **steps**. A numbered list of discrete events that tell the story in detail. Each step identifies an actor, what the actor is doing, what information is being passed, and identifies to whom the information is sent.

Typical steps for the creation of a use case are:

1. Decide on the scope for the use case scenario.

2. List the actors and select one actor as the primary actor, whose goal will determine when the scenario is done. Additional actors may be identified during the course of writing the use case.

3. All actors are stakeholders, but there may be stakeholders who are not actors. The interests of all stakeholders must be satisfied for the scenario to be complete.

4. Identify assumptions and preconditions. What has to happen before the use case can start? Knowing this will help to identify requirements and preconditions.

5. Write the steps. As each step is written, identify the requirements and write them down. The requirements identify what the system will have to do to satisfy the goal of the use case. Requirements may also indicate: how quickly, reliably, safely, compatibly, securely, etc. the system must be to accomplish the step. Requirements can also identify changes in business processes for different stakeholders.

6. Check to see if all the stakeholders were satisfied, and in particular, if the primary actor reached its goal.

7. (Optional) Identify alternate use case scenarios. At any step where something unexpected happens, it may be useful to identify an alternate set of steps. This could be a recovery from an error condition or anything that results in a significant variation from the primary use case scenario. The alternate scenarios may halt the main success scenario, while others may rejoin it later in the sequence of steps.

The AMIT workshops used this basic process to document the requirements that defined the functionality needed for SMT to be successful. Use cases provide an excellent tool to communicate the rationale behind a set of requirements because the requirements are linked to use case steps in the context of achieving a business process.

Section 14: Appendix A provides an example of a use case developed by AMIT and Table 10 lists all the use cases that were developed by AMIT to define the SMT functionality.

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Table 10: SMT Use Cases

Use Case	Use Case Description
Customer Focused Use Cases	
Initial Residential Customer Log In	The Residential Customer first time to the web portal.
Residential Customer changes temporary password	After initial registration a temporary password is sent to the Residential Customer's email address to Log On to the Web Portal.
Residential Customer Sets up ESIID(s)	Residential Customer has completed initial registration and to continue with the Web Portal services the Customer needs to set up ESIID(s) associated with their premise.
Residential Customer authorizes a supplemental user to view their ESIID(s)	Residential Customer has the ability to grant authority to supplemental user to view all their ESIID(s) information. (Usage, HAN, and event notification).
Supplemental user receives email with link from the primary user that access has been granted to view their ESIID(s)	The Primary Residential Customer has given access to their ESIIDs to a supplemental user and a link is sent by the web portal for the supplemental user to log on and view the ESIIDs.
Modify Supplemental users access	Primary users can modify the supplemental user's access by either deleting the user all together or changing their access to their viewing capabilities. (Usage, HAN, and Event Notification)
Residential Customer view ESIID(s) to which you have supplemental access	Residential Customer can view the ESIID(s) to which they have been granted access to from another Residential Customer.
Residential Customer Grants Access to Third Party	Residential Customer has the option to allow authorization to a Third Party to view their usage data.
Review/Revoke Third Party	Residential Customer can change, review, and revoke access of a Third Party that has authorization currently to view the Residential Customer's usage data.
Residential Customer views usage information	Residential Customer can view usage history on the web portal.

Use Case	Use Case Description
Residential Customer views premise and meter data information	Residential Customer can view their premise and meter data information on the Web Portal.
Residential Customer PINGs the meter	Residential Customer can ping the meter to get back the most current reading or a power status from the meter.
Change Password	Residential Customer has an option to change their password if needed.
Change Residential Customer Profile	Residential Customer can change or update their profile information.
Residential Customer forgets password	Residential Customer user does not remember their password and a temporary password is sent to them.

Use Case	Use Case Description
Residential Customer needs help using Web Portal	Residential Customer has questions about using the web portal the web portal; help function will answer questions concerning the Customer needs.
Event notifications	Residential Customer can select event notifications they would like to receive by email or decline the event notifications emails.
Business Customer Focused Use Cases	
Non-Residential Customer Admin initial Log On to the Web Portal	Non-Residential Customer Admin first time to the Web Portal.
Non-Residential Customer Admin changes temporary password after registration	After initial registration a temporary password is sent to the Non-Residential Customer's Admin email address to Log On to the Web Portal.
Non-Residential Customer Admin sets up ESIIDs	Non-Residential Customer Admin sets up ESIIDs associated with their premises.
Non-Residential Customer Admin Authorizes Third Party to view account	Non-Residential Customer Admin has the option to allow authorization to a Third Party to view their usage data.
Change/Review/Revoke Third Party	Non-Residential Customer Admin can change, review, and revoke access of a Third party that has authorization currently to view the Non-Residential Customer's usage data.
Change Non-Residential Customer Admin Profile	Non-Residential Customer Admin can change or update their profile information.
Select Event Notifications	Non-Residential Customer Admin can select event notifications they would like to receive or can decline event notification emails.
Non-Residential Customer Admin ability to approve/reject a Non- Residential Customer user	Non-Residential Customer Admin can approval or reject a user request to register on the Web Portal.

Use Case	Use Case Description
request to register	
Non-Residential Customer Admin ability to view, change, assign, and maintain roles and permissions to Non- Residential Customer User accounts	Non-Residential Customer Admin can manage the Non-Residential Customer User account with the abilities to view, change, assign and maintain roles and permissions.
TDSP and SMT Use Cases	
TDSP User creates their new web account	A TDSP User is setting up their web account for the first time.
TDSP User changes their password	After receiving the temporary password from initial entry, TDSP user changes the password.
TDSP User Requests to be a TDSP Admin (primary admin)	This will allow a user to request designation as a TDSP Admin.
TDSP User Updates the maintenance message	TDSP plans a maintenance outage and needs to update the message to notify all web users.
Troubleshoot issues	SMT simulates 'REP' role or customer role to trouble-shoot issues.
SMT updates broadcast message	SMT updates the broadcast message that power was restored as of day/time.
TDSP User updates Third Party List	TDSP User receives notification of a new Third party, ABC Company, and adds it to the list.
TDSP User verifies Third Party List	TDSP User reviews the Third party list on the web portal on a periodic basis.
TDSP User Manages LOAs	TDSP User takes all existing historical LOAs that currently exist, and enters them into the web portal.
TDSP User logs on to website	Approved TDSP user needs to use the website.

Use Case	Use Case Description
TDSP User selects user role	A user selects their role as a TDSP user during registration.
SMT maintains the Help Information	SMT needs to update portal help text and/or FAQs.
TDSP User changes profile attributes	TDSP User needs to modify their personal profile.
REP Focused Use Cases	
Assignment of REP Administrators	REP manager assigns up to 4 employees the role of Web Portal administrator
REP Administrator Registration	To allow a user to designate their role as an REP Administrator in the Web Portal
Logon to the Web Portal	The authorized User logs on to access Web Portal data
Assigning roles and granting REP users permission	REP Administrator assigns roles and permission to each REP user
Select Event Notifications	The REP Administrator will choose which notifications they will receive and what email address the notification will be sent to.
Access List of REP Users	To provide the capability for the REP Administrator to view, change, monitor and maintain REP Users roles and permissions
REP User initial registration	To allow a user to register as a REP User in the Web Portal
Logon to the Web Portal	The authorized User logs on to access Web Portal data
REP User Modifies their user profile	REP User modifies items in their current User Profile
Access usage data for one ESIID	REP user accesses usage data for one ESIID and views the data on the web portal

Use Case	Use Case Description
Access meter and premise data for one ESIID	REP user accesses meter attribute and premise information for one ESIID and views them on the web portal
REP pings the AMS meter for real time information.	Customer calls the REP with a service issue and Customer Service Representative (CSR) pings the AMS meter to help resolve the issue.
HAN Focused Use Cases	
REP Load control event	REP sends one HAN message over the AMS to one or more Premises, which have one or more controllable loads. The messages are generated on-demand and will be treated as confidential information to be transmitted over the TDSP AMS.
REP sends a load control event request	REP initiates a load control event by sending load control messages to HAN Devices over the TDSP AMS.
REP sends a cancel load control message/event	REP cancels the load control event by sending a cancellation message to one or many ESIIDs over TDSP AMS. In addition to an end mass control message, a REP may send an ad-hoc cancellation message to a single ESIID as needed.
The Customer opts out of the load control event.	Customer either opts out during the event or by selecting black-out dates as planned due to special occasions or commercial intolerance.
A price message is sent once per day	A price message is sent once per day (e.g., midnight) and includes time of use prices for the next 24 hours to one or many premises with one or many HAN Devices.
Price signal is sent every 15 minutes	REP sends price message at the beginning of each 15 minute interval to one or many premises with one or many HAN Devices.
Critical price signal	REP sends a critical price message on demand.

Use Case	Use Case Description
Text message sent to a subset of premises/HAN devices	REP sends a message (numerical or text) over the AMS to designated premises every hour of the day. Premises may have multiple HAN devices capable of receiving such a message.
Text Message broadcast to all available premises/HAN devices	REP sends a message (numerical or text) over the AMS to all available premises i.e. broadcast. Premises may have one or more HAN devices capable of receiving such a message.
HAN Devices request AMS meter data	One or more HAN Devices pull AMS meter data (e.g., data stored locally on the AMS meter such as current kwh usage, last meter read recorded, current demand, etc.).
HAN Devices Respond	One or many HAN Devices at the Premise send information (i.e., current HAN device load consumption, HAN Device status, etc.) through the AMS to the REP of record based on message received.
HAN Devices Send Message	On or more HAN Devices at the Premise send information (i.e., current load consumption, HAN Device status, etc.) through the AMS to the REP of record.
HAN Devices Message Fails	One or more HAN Devices at the Premise attempts to send information (i.e., current load consumption, HAN Device status, etc.) through the AMS to the REP of record but message delivery fails at TDSP HAN Interface.
Re-establishing HAN device provisioning/communication with the new ESI following an AMS Meter exchange use case	TDSP /Utility metering maintenance will occasionally require a meter exchange. When AMS meters are exchanged, any HAN device provisioned to the former AMS meter will lose communication to the ESI, become de-provisioned, and AMS network communications to the HAN device will be lost. Following an AMS meter exchange, HAN device(s) must be re-provisioned/join to the new AMS meter. The purpose of this use case is to provide a venue for re-provisioning/joining HAN devices which lost communications with the ESI, de-provisioned during a meter exchange, with minimal consumer customer/REP inconvenience.

Use Case	Use Case Description
REP Ordered HAN Devices – Professional Install	The process of installing and Provisioning a REP ordered HAN Device with a professional HAN Installer through the TDSP HAN Interface.
REP Ordered HAN Devices – Self Install	The process of installing and Provisioning a REP ordered HAN Device through the TDSP HAN Interface (THI) over an AMI Network.
Retail Off-The-Shelf Devices + Professional Install	The process of Provisioning a retail purchased HAN Device from installing to Provisioning. The Customer may only want to receive AMS Meter information and may choose to Register or not Register the HAN Device with a particular REP program.
Retail Off-The-Shelf Devices + Self Install	The process of Provisioning a retail purchased HAN Device from installing to Provisioning. The Customer may only want to Provision the HAN Device to receive AMS Meter information and may choose to Register or not Register the HAN Device with a particular REP program.
A HAN Device is De-Provisioned	This use case details the process of De-Provisioning a Provisioned HAN Device.
Third Party Use Cases	
SMT Registered Consumer Initiates Pilot	A SMT registered Consumer intends to participate in the Third Party Pilot project and initiates the Third Party relationship through SMT which creates an e-mail to the Smart Meter Texas Production Support team.
Consumer Requests Information	A Consumer participating in the Third Party Pilot requests information on existing Third-Party relationships.
Consumer Terminates Third-Party Relationship	A Consumer participating in the Third Party Pilot terminates an existing Third-Party relationship.
Third-Party Establishes API with SMT	A Third-Party participating in the pilot coordinates with the SMT Production Support team to set

Use Case	Use Case Description
	up API access.
Third-Party Requests Information on Consumer Relationships	A Third-Party participating in the pilot requests information on their existing consumer relationships.
Third-Party Accesses Consumer Data	A Third-Party participating in the pilot accesses their consumer data from SMT via API.
Third-Party HAN Provisioning	A Third-Party participating in the pilot utilizes SMT to Provision Customer HAN Devices.

9.3 **Storyboards**

A modified version of use cases were also used by AMIT. These were known by AMIT as 'storyboards' and closely resemble a widely accepted systems development tool known as an Activity Diagram. The storyboards are visual representations of a sequence of steps which are similar to a use case's list of steps. The storyboard indicates the flow of actions and information among a set of actors. The storyboards generally include a brief set of steps in a list format and can also indicate references to other important information such as requirements, business processes and interfaces (see Figure 20). AMIT favored the storyboard because they were well suited for presentations and group discussions.

Figure 20: Storyboard Example

10 Security

10.1 Introduction

With the increasing presence of information technology used in the power utility industry, the need to secure those technologies has become more important now than ever before. SMT is cognizant of this need and employs a high level of security. The services provided to SMT's users are rooted in common information security technologies and practices to ensure all transactions and Customer data are protected.

SMT uses a wide array of tools and techniques to ensure security is deeply ingrained in the provided services and associated infrastructure. SMT is a web portal and because it is accessible through the internet, it is susceptible to many threats. These threats pose a security risk to SMT, risk that is subsequently overcome through the strategic application of mitigation measures. These mitigation measures can be grouped into the categories of user interface, services and integrations, user data, and web portal infrastructure.

10.2 Threats

An important step in effectively securing SMT is to identify the applicable threats and mitigate them. SMT's primary functionality is centered on providing smart meter usage data through web based services to Customers, REPs, and authorized Third Parties. SMT receives meter usage data through an interface with the Joint TDSPs. The primary point of attack against SMT is the collection of technologies that make up the web portal interface. Malicious activities against the web portal can come from a variety of sources. Threat agents may use a variety of methods when attempting to attack the web portal, including but not limited to, Distributed Denial of Service (DDoS), brute force attacks on login credentials, Structured Query Language (SQL) injection, cross site scripting (XSS), and exploiting insecure information systems. Threat agents may utilize indirect methods instead of a direct attack on the web portal's standard interfaces. These attacks can include email fraud that results in unauthorized access, social engineering

attempts, or compromising an asset by obtaining physical access. Natural disasters can also act as a threat to the web portal.

Recognizing the variety and types of potential attacks from threat agents, SMT has implemented a number of technologies and processes to mitigate the attack risk.

10.3 Mitigation

To effectively mitigate threats and vulnerabilities, SMT has implemented a robust and encompassing security model. This model reflects state laws, industry-independent regulation, applicable guidelines from national organizations, and business-consistent IT security measures. Many of the security features come through a strategic partnership with the solution provider that leverage their secure web technologies and capitalizes on the solution provider's extensive industry experience. Additional mitigation measures are the use of industry standard practices, many of which are provided by the National Institute of Standards and Technology (NIST).

10.3.1 User Interface

Many of the techniques applied to mitigate threat agent attacks directly address the potential vulnerabilities that are derived from a user's interaction with the SMT web portal. The web portal is presented to the user over a secured communication channel using Hyper Text Transfer Protocol (HTTP) over Secure Sockets Layer/Transport Layer Security (SSL/TLS), known as HTTPS. The HTTPS connection ensures that malicious actors are not able to eavesdrop on the information passed between the user's web browser and the SMT web server. SMT also isolates the web server from the backend information systems using a separate secured line of communication which is also encrypted using SSL/TLS. This ensures that users are not able to directly access the backend systems and that both communication channels are encrypted. Additionally, the internal connection provides a control point which can be used to apply

additional security measures. This use of HTTPS and internal isolation are identified in NIST Special Publication (SP) 800-95[31], a Guide to Securing Web Services.

10.3.2 Services and Integration

SMT also uses a private and encrypted connection between the SMT web portal and TDSP information systems utilizing a Virtual Private Network (VPN) connection. Using a VPN connection between information systems mitigates threats derived from observing the traffic between two information systems. NIST SP 800-47, *Security Guide for Interconnecting Information Technology Systems*[32], indicates that a VPN connection is appropriate between the SMT web portal and the TDSP information systems and validates the use of a VPN connection as a security control to mitigate risk.

An important service for business transactions between the SMT and Third Parties, REPs, and TDSPs is the ability to transfer files. SMT operates a File Transfer Protocol (FTP) server over SSL/TLS by utilizing the FTP Secure (FTPS) communication protocol. Using the FTPS connection ensures an encrypted connection that safeguards the contents of the files being transferred. To further protect data being transferred to and from the FTP server, the files themselves are encrypted with Pretty Good Privacy (PGP). The combination of FTPS and PGP ensures that data coming into and leaving the web portal is secured both at rest and in transit. Since SMT is a common data depository for four TDSPs, a further security precaution taken is the segmentation of the files into entity owned directories, providing the ability to control access to files. The combination of these security controls provides a high degree of security and mitigates the risks of data theft.

10.3.3 User Data

As a part of SMT's commitment to protect user data and ensure maximum levels of privacy, SMT ensures that a file or message containing user data must be encrypted when transferred

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[31] http://csrc.nist.gov/publications/nistpubs/800-95/SP800-95.pdf
[32] http://csrc.nist.gov/publications/nistpubs/800-47/sp800-47.pdf

between internal system boundaries. This control measure provides a reasonable level of security to a user's data. In order to protect SMT's web portal users, a one way password hashing algorithm is in place to mitigate risk associated with leaked passwords. Password hashes provide security due to their irreversible one way cryptographic function. In the unlikely event that the web portal's password database has been compromised, the attacker will only have the hash, not the clear text password. Hashing user passwords is a recommended practice as outlined in draft publication NIST SP 800-118, *Guide to Enterprise Password Management*[33].

10.3.4 Web Portal Infrastructure

The complete network of information systems that comprise the SMT web portal must be protected from threats as well. The recommendations provided in NIST publication 800-44v2, *Guidelines on Securing Public Web Servers*[34], have been carefully evaluated and implemented to secure SMT's network infrastructure. Multiple firewall layers isolate internal resources to mitigate the risk that comes from exposing the internal network to external users. The architecture ensures the maximum protection available for the network by preventing direct access to internal systems, mitigating a significant portion of vulnerabilities relative to public facing information systems.

Network segmentation is a crucial part of ensuring security across all information systems. Virtual Local Area Networks (VLAN) provide this segmentation by logically separating networks into manageable groups. VLANs provide isolated network groups that greatly enhance security while mitigating risk. SMT uses VLANs and has configured many distinct segments to protect each network. In addition to VLANs, the network has been configured into multiple zones. Each zone is further separated by a firewall to allow granular control of the flow of information, ensuring a high level of security.

SMT utilizes a system to continuously monitor the infrastructure for security related events. Multiple information systems on the network provide security event information that is used to

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[33] http://csrc.nist.gov/publications/drafts/800-118/draft-sp800-118.pdf
[34] http://csrc.nist.gov/publications/nistpubs/800-44-ver2/SP800-44v2.pdf

correlate the security status of the operating environment. This real time picture of the network provides an unprecedented capability to quickly identify and mitigate threats. The monitoring system ensures security throughout the network by correlating information which is used to protect information systems and users.

On a regular basis, SMT undergoes independent vendor security reviews on all new design and functional implementations. Following SMT's first year of operation, SMT underwent an end-to-end security review and future end-to-end security reviews will be planned. The independent security reviews are conducted by a wide variety of vendors with different skill sets in order to ensure a thorough and comprehensive review.

10.4 SMT and NIST IR 7628

The NIST IR 7628, *Guidelines for Smart Grid Cyber Security*[35] is a three volume report developed using a consensus process by the Cyber Security Working Group of the Smart Grid Interoperability Panel (SGIP). The NIST IR 7628 provides an analytical framework to help utility industry organizations to develop or evaluate cyber security policies and strategies to assess risk and identify the appropriate cyber security requirements for their systems. SMT's development began prior to the development of the NIST IR 7628 document, but AMIT was aware of the cyber security work being done by the SGIP and this industry guidance was helpful in the final evaluation of SMT's security requirements.

AMIT identified the set of security requirements for SMT listed in Table 11. The SMT security requirements also satisfy NIST IR 7628 security requirements as shown in the third column of the table. Additionally, other NIST IR 7628 requirements are satisfied by SMT system

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[35] http://csrc.nist.gov/publications/nistir/ir7628/introduction-to-nistir-7628.pdf and
http://csrc.nist.gov/publications/nistir/ir7628/nistir-7628_vol1.pdf

architecture and policy, but were not specifically identified in the original SMT business requirements and are outside the scope of this document.

Table 11: SMT Security Requirements

SMT Requirement ID	Requirement	NIST IR 7628
BR- 017.010	Ability to block access to a user and force a password reset, via email, if they enter the incorrect password 4 times within 5 minutes.	SG.AC-8 Unsuccessful Login Attempts
BR- 017.011	Ability to require a user to respond to a confirmation email, sent to the user's e-mail address they are registering with, to validate the email address is correct before allowing them to move forward with the registration process (e.g. send and receive a confirmation).	SG.AC-2 Remote Access Policy and Procedures SG.AC-15 Remote Access
BR- 017.016	Ability to require a user to change their temporary password after the first log-in with their temporary password.	SG.AC-21 Passwords
BR- 061	Ability to purge any user ID after a period of 13 months of inactivity (i.e., not logged on to the web portal). Includes all user ID types.	SG.AC-3 Account Management
BR- 028.024	Ability to restrict TDSP access only to data associated with the ESIIDs within that TDSPs territory (e.g., meter data, premise data, usage data)	SG.AC-3 Account Management SG.AC-6 Separation of Duties SG.AC-7 Lease Privilege
BR- 031	Ability to establish and maintain security controls associated with portal access for REP of Record.	SG.AC-3 Account Management
BR- 028.010	Ability to grant and/or block access to certain data based on security level (e.g. Customer role, REP role, Admin role, etc.)	SG.AC-3 Account Management SG.AC-6 Separation of Duties SG.AC-7 Lease

SMT Requirement ID	Requirement	NIST IR 7628
		Privilege
BR- 031.002	Ability to allow REP of Record access to usage data, meter attributes, and premise information for ESIIDS that are currently served by that REP.	SG.AC-3 Account Management
BR- 017.017	Ability to utilize security (e.g., CAPTCHA) procedures during the user's initial registration. Includes the ability to cancel the registration process to the web portal requiring the user to start the registration process over, after 3 unsuccessful attempts to correctly enter the CAPTCHA.	SG.AC-2 Remote Access Policy and Procedures SG.AC-15 Remote Access
BR- 028	Ability to provide appropriate level of security depending on who is accessing the ESIID data on the common web portal.	SG.AC-3 Account Management SG.AC-6 Separation of Duties
BR- 017.003	Ability to allow a minimum of at least 6 characters and no more than 24 characters letters and numbers, case sensitive, in the password. Additionally, the password cannot be the user name.	SG.AC-21 Passwords
BR- 017.007	Ability to set up and store a user specified password security question and answer	SG.AC-2 Remote Access Policy and Procedures SG.AC-15 Remote Access
BR- 017.002	Ability to allow up to a minimum of 5 and a maximum of 100 alphas / numbers / special characters, except slashes and single and double quotes, in the user id	SG.AC-2 Remote Access Policy and Procedures SG.AC-15 Remote Access

11 Use of Industry Standards

The process of developing and implementing SMT followed widely recognized smart grid methodologies, guiding principles, architectural goals, best practices, smart grid standards and web standards. During the development of SMT, many documents were produced and lessons were learned and these were shared with national smart grid SDOs and SSOs through AMIT member participation in these organizations.

Use of standards was an important requirement of the PUCT Advanced Metering rule. PUCT §25.130(j) (3) required that "an electric utility shall use industry standards and methods for providing secure Customer and REP access to the meter data."[36] In order to meet this requirement, interested market participants came together as the Advanced Metering Implementation Team ("AMIT") under the PUCT initiated Project #34610 Implementation Project Relating to Advanced Metering (see Section 3.3). AMIT embarked on a consensus-driven process resulting in the development of an interoperable framework whereby timely smart meter usage information was readily available and communication with Customer

Interoperability is a critical smart grid governing principle necessary for the development of successful standards. This concept was initially described by the GridWise Architecture Council in a 2005 whitepaper and used by NIST to identify smart grid standards for implementation. The following definition of interoperability is found in the NIST Framework and Roadmap for Smart Grid Interoperability Standards, Release 2.0.

"**Interoperability**: The capability of two or more networks, systems, devices, applications, or components to interwork, and to exchange and readily use information—securely, effectively, and with little or no inconvenience to the user. The Smart Grid will be a system of interoperable systems; that is, different systems will be able to exchange meaningful, actionable information in support of the safe, secure, efficient, and reliable operations of electric systems. The systems will share a common meaning of the exchanged information, and this information will elicit agreed-upon types of response. The reliability, fidelity, and security of information exchanges between and among Smart Grid systems must achieve requisite performance levels."

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[36] http://www.puc.texas.gov/agency/rulesnlaws/subrules/electric/25.130/25.130.pdf

In-Home Devices was enabled. In order for SMT to be interoperable, its development and implementation utilized best practices and industry standards. The following are the guiding principles, architectural goals, best practices, smart grid standards and web standards that were used in the SMT development work and incorporated in its implementation. Each of these industry standards and SMT's conformance with them are discussed in detail in the following Sections.

Section 11.1	GWAC Interoperability Layered Categories 4-8
Section 11.2	IntelliGrid Methodology for developing requirements for Energy Systems
Section 11.3.1	NIST Guiding Principles for identifying interoperable smart grid standards
Section 11.3.2	NIST Architectural Goals for the Smart Grid
Section 11.4	Green Button Initiative
Section 11.5	PCI and NERC CIP cyber security standards
Section 11.6	ZigBee Smart Energy Profile
Section 11.7	NAESB Third Party Access to Smart Meter-based Information
Section 11.8	UCAIug Home Area Network System Requirements Specification
Section 11.9	Web Standards

11.1 GWAC Interoperability Layered Categories

SMT is a large, integrated, complex system of systems and, because it involves the interaction of multiple market participants and their systems, it requires different layers of interoperability to produce standard processes and procedures related to smart meter data access and communication with In-Home Devices. The layers of interoperability have been categorized by the GridWise Architecture Council ("GWAC") into the eight layers listed in Figure 21[37] that

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[37] GridWise® Interoperability Context-Setting Framework, March 2008, page 5

comprise a vertical cross-section of the degrees of interoperation necessary to enable various interactions and transactions between systems and participants on the smart grid. Each layer is dependent upon and is enabled by the interoperability of the layer below it. This eight-layer stack provides a context for determining interoperability requirements and defining exchanges of information between the participants.
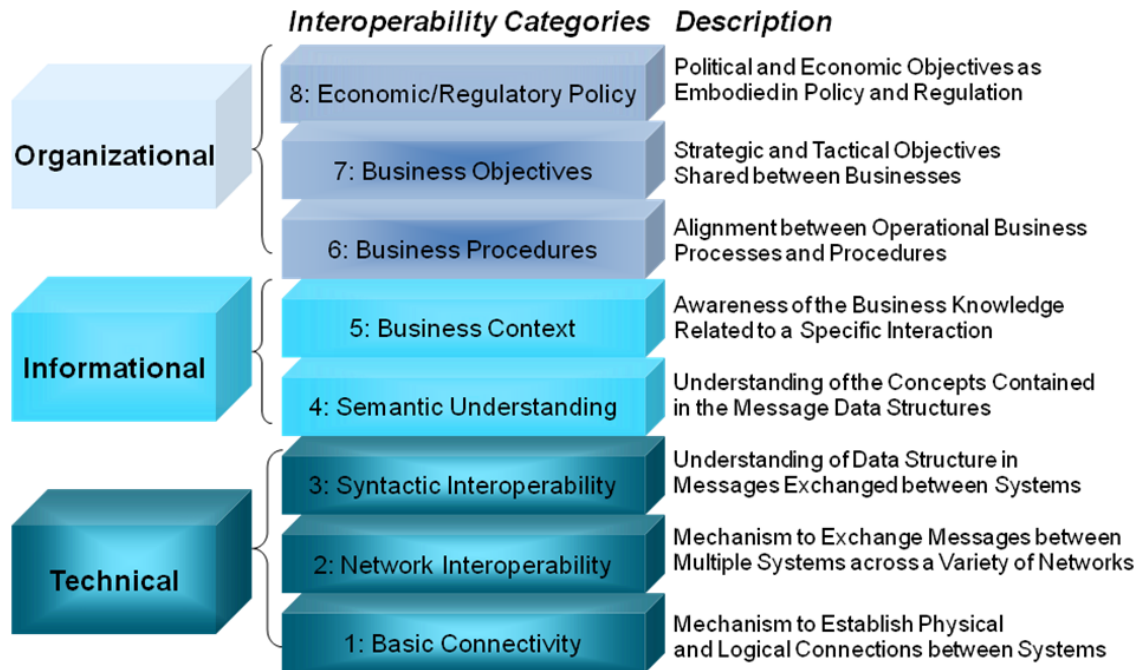
Figure 21: GWAC Interoperability Layered Categories

The nature and complexity of the Texas market structure and the need for SMT to be an interoperable solution resulted in the use of all eight interoperability categories. This section however will only focus on the layered categories 8 through 4. Economic and Regulatory Policy, category 8, set the context and need for the development of an interoperable solution by the introduction of new policies and the passage of new laws and regulations. The remaining interoperability categories (i.e., layers 7 through 4) were addressed by the multiple market participants who participated in the AMIT discussions and the SMT team who built SMT using the web portal business requirements supplied by AMIT. SMT was a success because the multiple market participants engaged in negotiation, compromise, and agreements within and

between the interoperability layers 7 through 4. The following Table 12[38] shows the applicability of the GWAC "stack" to the SMT framework.

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[38] The format of this table is from Section 5 Examples of Applying the Framework of the GridWise® Interoperability Context-Setting Framework, March 2008, page 36

Table 12: SMT Framework

Interoperability Category	Tools, Systems, Key Actors	Interoperation across organizational boundaries where agreements must be reached
ORGANIZATIONAL		
8: Economic / Regulatory Policy Political and economic objectives as embodied in policy and regulation	Lawmakers (e.g., federal, state, international, etc.) Policy makers (e.g., FERC, National Association of Regulatory Utility Commissions (NARUC), Public Utility Commissions, White House Office of Science and Technology Policy (OSTP), etc.) Government organizations (e.g., Department of Energy (DOE), NIST Smart Grid Interoperability Panel (SGIP), etc.)	The following are examples of different policy, regulatory, and economic objectives that influenced the development of SMT. - In 2005 in HB 2129, the Texas legislature in directed the Public Utility Commission of Texas ("PUCT") (a) to report on the efforts of TDSPs in Texas to deploy advanced meters and their associated infrastructure, (b) to identify any barriers to deploying advanced meters, and (c) to provide recommendations to address such barriers. - In 2007, the Energy Independence and Security Act ("EISA") declares the policy of the US is to support a smart grid. - In 2007, in HB 3693, the Texas Legislature encouraged smart grid networks be deployed as rapidly as possible. - In 2007, PUCT adopted the Advanced Metering rule setting forth the requirements for TDSP advanced metering deployments. - In 2007, the PUCT Advanced Metering Implementation Project (Project #34610) was initiated to defined requirements for a data depository, data exchange between market participants and interfaces for the successful deployment of In-Home Devices. - In 2009, the American Recovery and Reinvestment Act (ARRA) funded $3.3 billion

Interoperability Category	Tools, Systems, Key Actors	Interoperation across organizational boundaries where agreements must be reached
		for DOE Smart Grid Investment Grants (SGIG).
		- In 2011, the White House Office of Science and Technology Policy issues a challenge[39] to the electric industry to provide electricity Customers with easy access to their energy usage data in a consumer-friendly and computer-friendly format via a "Green Button" on electric utilities' website
7: Business Objectives Strategic and tactical objectives shared between businesses	Policy Makers ERCOT, TDSPs, REPs Hardware and Software Technology Vendors In-Home Device Manufacturers Smart Meter Manufacturers Consumer Advocates Smart Grid service providers	The following lists various market participant objectives where negotiation, compromise and agreement had to be reached in order to achieve the objectives. - DOE funds SGIG projects for CenterPoint Energy (a TDSP) and Reliant Energy (a REP). - AMIT is formed through Project #34610 and includes TDSPs, REPs, PUCT staff, consumer advocates, advanced meter manufacturers, In-Home Device manufacturers, HAN service providers, solutions vendors, and ERCOT. - TDSPs want to deploy smart meter technology and receive cost recovery on their investments. - Customers, PUCT, DOE, and White House Office of Science and Technology Policy want Customers to have easy access to their electric usage information. - TDSPs, ERCOT, and REPs want to improve the smart meter data transport between them by establishing or defining a standard mechanism for data transport, format, communication, and acquisition. - AMIT wants to define the functions of the TDSP

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[39] http://www.whitehouse.gov/blog/2011/09/15/modeling-green-energy-challenge-after-blue-button

Interoperability Category	Tools, Systems, Key Actors	Interoperation across organizational boundaries where agreements must be reached
		web portal as required by the PUCT Advanced Metering System rule and prioritize the functions
		- PUCT, DOE, and White House Office of Science and Technology Policy wants to achieve measurable benefits for Customers based on new actions that the Customer or others can take using the advanced metering system features.
		- PUCT wants the number of Customers taking service on smart meter based retail products to increase.
		- AMIT wants to standardize the means for market participants to engage in communication with In-Home Devices using the TDSP AMS communication network.
		- PUCT, REPs, TDSPs want to provide Consumer education about how and when they consume energy, the cost of that energy and what they can do to lower their bill.
		- Third party service providers want access to Customer usage information and to communicate with Customer In-Home Devices.
		- In spring 2009, AMIT agrees on a set of 85 business requirements for the design of a web portal that provides easy access to smart meter information and a means to communicate with Customer In-Home Devices.
		- In first half of 2014, Third Party access to Customer usage information and communication with Customer In-Home Devices is enabled through SMT.

Interoperability Category	Tools, Systems, Key Actors	Interoperation across organizational boundaries where agreements must be reached
6: Business Procedures Alignment between Operational Business Processes and Procedures	AMIT SMT APIs, SMT FTPS site Lodestar Enhanced file format XML and CSV format Hardware and Software Technology Vendors	- The format for usage data to be received by ERCOT, REPs, Third Parties, and Customers is determined. - TDSP's use the LSE file format for Customer usage data files sent to ERCOT and REPS. - A SMT FTPS site is set up for REPs and Third Parties to retrieve their Customer's smart meter usage data. - Standard usage APIs are created for REPs and Third Parties to request ad-hoc usage reports and for Third Parties to request scheduled usage reports. - Standard HAN APIs are created for Third Parties to add/remove In-Home Devices on a Customer's HAN and to communicate with those In-Home Devices. - AMIT and the SMT team develop notification procedures and education materials. - GUIs are developed and tested for the SMT web portal. - Customers may export usage data in an XML or CSV format.
INFORMATIONAL		
5: Business Context Awareness of the business knowledge related to a specific interaction	TDSPs Solution provider AMIT Consumer insights professional	- In 2008, AMIT agrees on the technical design for a common web portal. - A competitive RFP process for the development of the common web portal results in the selection of a solution provider. - Oncor and CenterPoint negotiate a Joint Development and Operation Agreement for the development and support of SMT.

Interoperability Category	Tools, Systems, Key Actors	Interoperation across organizational boundaries where agreements must be reached
		- AEP and TNMP join the JDOA after the approval of their smart meter deployment plans. - AMIT defines a change request process for modifications to SMT. - AMIT and SMT team prioritize the functions of SMT for development in SMT releases. - A security audit is performed on SMT. - An evaluation of the overall SMT site usability was conducted and upgrades to the Customer site were undertaken to improve the user experience
4: Semantic Understanding Understanding of concepts contained in the message data structures	Industry Alliances and Standards Bodies	ERCOT LSE file format ZigBee SEP v1.0 FTPS API CSV XML Green Button Initiative

11.2 **IntelliGrid Methodology**

Although AMIT did not formally adopt the IEC 62559 IntelliGrid Methodology for Developing Requirements for Energy Systems[40] to design SMT, the process that was followed by AMIT directly corresponds to the proscribed methodology of that standard. The IntelliGrid methodology was originally developed as part of the IntelliGrid Architecture developed by the

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[40] IEC 62559 Publicly Available Specification http://webstore.iec.ch/webstore/webstore.nsf/Artnum_PK/38920

Electrical Power Research Institute (EPRI), as a means to implement the "IntelliGrid vision" of the automated, self-healing, and efficient power system of the future. It has been used in several major smart meter and smart grid projects by utilities across the US and has been shown to provide significant value to the organizations who utilize it. The IntelliGrid Method is summarized in Figure 22 and

Figure **23**.

AMIT's application of the IntelliGrid methodology corresponds to the significant process elements. The focused nature of developing a data repository and web portal for SMT meant that some portions of the IntelliGrid method could be deprecated while still achieving the overall benefits for following the methodology.

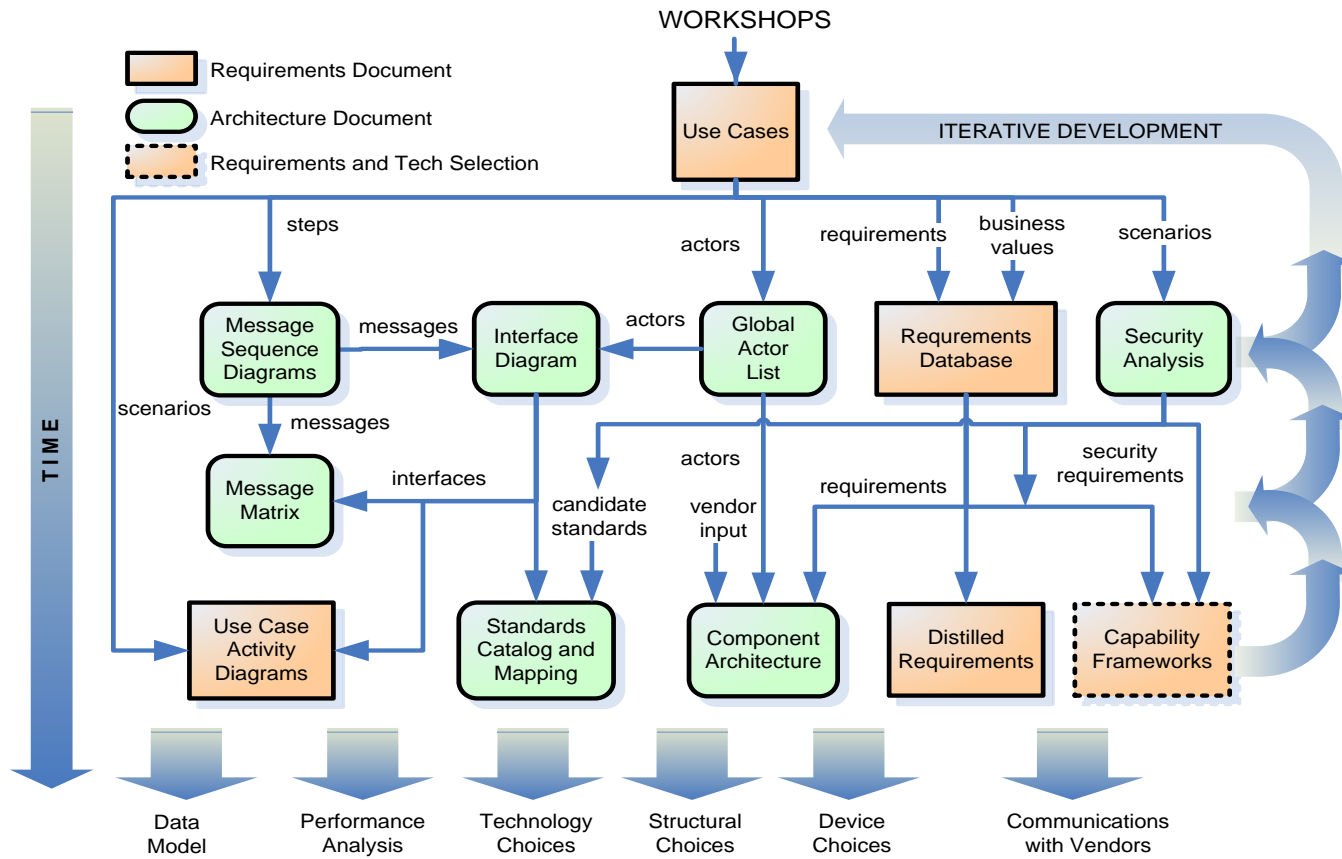SMART METER
— TEXAS™ —

Figure 22: Requirements and Systems Architecture Process[41]

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[41] IEC/PAS 62559 Figure 11, Section 8.
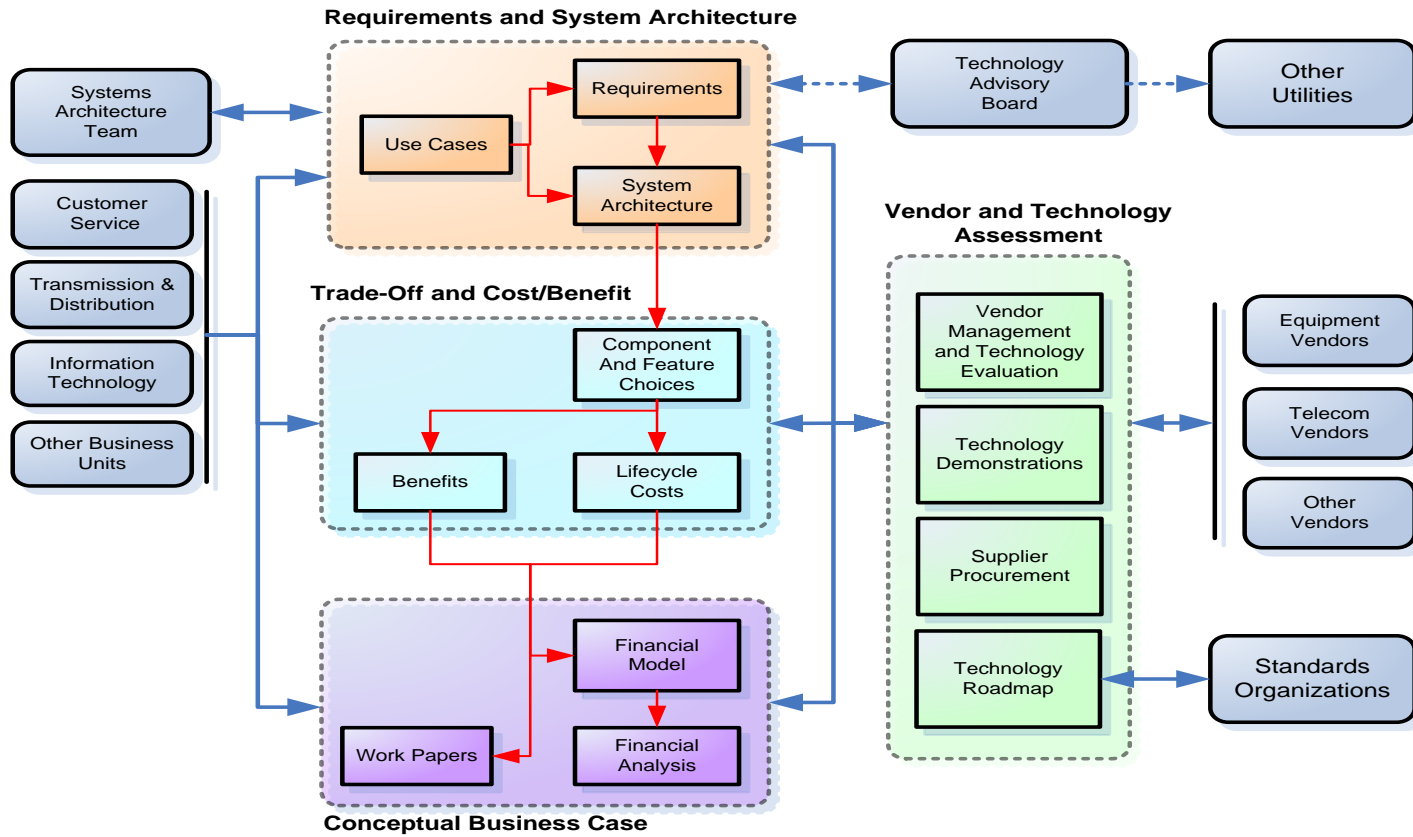
Figure 23: Technology Selection, Business Case and Deployment Process[42]

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[42] IEC/PAS 62559, Figure 12

Figure **22** illustrates the initial requirements definition and systems architecture development processes, while
Figure **23** illustrates the later steps of business case analysis, technology selection, and deployment.

The first step of the IntelliGrid methodology is to determine business and regulatory drivers to clearly identify what financial problems or regulatory compliance issues are being addressed. The next step is to choose the focus areas that apply to the specific utility automation project. AMIT had clear direction from the PUCT Advanced Metering Rule and identified the core business processes as well as sub dividing the work into separate focus area projects.

The following are the next steps in the IntelliGrid Methodology:

- Identify Candidate Technologies
- Define a High-Level Business Case
- Refine Process for Your Organization
- Identify Stakeholders
- Establish a Project Team
- Select Teams

These steps complete what IntelliGrid terms Phase 1, to determine business needs and plan projects. The creation of AMIT and its defined projects were focused on specific technical activities and needs in Texas related to the deployment of smart meters. Since AMIT was a public, open process, the project teams were less rigid than that of a single business entity. Team members came from the various businesses, organizations and other participating stakeholders and were to a large degree self-selected. The initial AMIT workshops were focused on project scoping and satisfied the general intent of IntelliGrid's Phase 1.

Phase 2 of the IntelliGrid process is for stakeholders to define user requirements with use cases. In the AMIT projects that resulted in the creation of SMT the market participants developed numerous use cases (see Section 9) to describe the envisioned high level processes for Customers, TDSPs, REPs, and Third Parties. The use cases provided the workshop team members with a narrative framework to define the requirements. The IntelliGrid standard also

includes using the use cases and requirements to develop additional diagrams that provide more detail for system design. These diagrams include activity diagrams which are graphical representations of use cases and are similar to the storyboard diagrams that AMIT began to use in later workshops. Other diagrams are interface and message sequence diagrams which provide a level of detail that was not appropriate for the AMIT workshops, but were later created by the selected system developer.

The final phase of the IntelliGrid methodology is technology selection and development. This was largely outside the scope of the AMIT workgroup and these activities were performed by the system developer as part of taking the AMIT use cases and requirements and developing the SMT solution.

11.3 NIST Guiding Principles and Architectural Goals

In the NIST Framework and Roadmap for Smart Grid Interoperability Standards[43], NIST provided fifteen guiding principles[44] to be used for identifying whether a smart grid standard is interoperable and eleven architectural goals[45] for the smart grid. Even though SMT was developed prior to the issuance of the NIST Framework and Roadmap, SMT and its development is consistent with each guiding principle and satisfies the NIST smart grid architectural goals. The following is a detailed discussion of how SMT conforms to each of the NIST guiding principles, satisfies the architectural goals, and achieves interoperability in its implementation.

11.3.1 NIST Guiding Principles for Identifying Interoperable Smart Grid Standards for Implementation

1. <u>Is well-established and widely acknowledged as important to the Smart Grid.</u>

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[43] NIST Framework and Roadmap for Smart Grid Interoperability Standards, Release 1.0
(http://www.nist.gov/public_affairs/releases/upload/smartgrid_interoperability_final.pdf) and Release 2.0
[44] Pg. 64 of the NIST Framework and Roadmap for Smart Grid Interoperability Standards, Release 2.0
[45] Ibid, page 39-40.

Historically, in the competitive regions of Texas, electric meters were read once a month and Customers were informed of their usage in a bill received by the Customer up to thirty days after the usage was recorded. Customers had no insight into how and when they used electricity and had no way to know what their monthly bill would be until the bill was received. The installation of smart meters has provided the means for electricity usage to be recorded and reported in increments of 15-minutes. SMT was developed as an interoperable solution for consumers to access their electricity usage information on a day-after basis, providing them with a much better understanding of how and when they use electricity. In addition, SMT broke new ground by enabling communication with Customer In-Home devices, and providing a convenient and easy way for Customers to share their usage data with Third Parties. This access to timely usage information and communication with In-Home devices, coupled with innovative Third Party products leveraging usage information and HAN communication, enables Customers to manage their electricity in an informed manner.

Customer access to electricity consumption is widely acknowledged as important to the success of the smart grid. The Texas law, the PUCT substantive rules, the DOE, and the White House Office of Science and Technology Policy (OSTP) all stress the necessity of Customers having access to their electricity usage information and the ability to share that information with Third Parties service providers.

In the Texas Public Utility Regulatory Act ("PURA") it states the following:

"All meter data, including all data generated, provided, or otherwise made available, by advanced meters and meter information networks, shall belong to a Customer, including data used to calculate charges for service, historical load data, and any other proprietary Customer information. A Customer may authorize its data to be provided to one or more retail electric providers under rules and charges established by the commission."[46]

The PUCT Advanced Metering Rule requires the following:

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[46] PURA 2011 Section 39.107(b) (http://www.puc.texas.gov/agency/rulesnlaws/statutes/Pura11.pdf)

"An electric utility shall provide a Customer, the Customer's REP, and other entities authorized by the Customer read-only access to the Customer's advanced meter data, including meter data used to calculate charges for service, historical load data, and any other proprietary Customer information. The access shall be convenient and secure, and the data shall be made available no later than the day after it was created."[47]

The DOE and the White House Office OSTP initiated the Green Button initiative. The Green Button initiative is a challenge to the electric utility industry to "empower residential consumers to better manage their electricity consumption by allowing them and authorized Third Parties access to their electricity usage information on demand through a standardized data access architecture."[48]

SMT has been in operation since January 2010 and has gone through over four successful revisions. SMT is used as a data repository for the Joint TDSP's smart meter usage information for over 6.8 million Customers. By August 2014, SMT was accessed by 84 REPs with 642 users and over 61,640 Customers with 8,603 In-Home Devices[49]. By the end of 2014, Third Parties will have access to SMT functionality.

SMT is a well-established interoperable standard used by many market participants and meets the requirements of the Texas law, PUCT substantive rules, and the Green Button initiative. In conclusion, SMT meets the NIST guiding principle of being well established and widely acknowledged as important to the smart grid.

2. Is an open, stable, and mature industry-level standard developed in a consensus process from a standards development organization (SDO)

The business requirements and framework for SMT were developed by AMIT, which is a standards-setting organization ("SSO"). This term is defined by NIST as "the broader universe

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[47] PUCT §25.130(j) (http://www.puc.texas.gov/agency/rulesnlaws/subrules/electric/25.130/25.130.pdf)
[48] Introducing Green Button Association for Demand Response and Smart Grid webinar January 20, 2012 (http://www.nist.gov/smartgrid/upload/1-20-12_Green_Button_Webinar_-_Wollman_and_Irwin.pdf)
49 Source: AMWG_Monthly_Market_Reports_and_Formats_9_11_14_v1_0.ppt
(http://www.ercot.com/calendar/2014/09/20140923-AMWG)

of organizations and groups—formal or informal—that develop standards, specifications, user requirements, guidelines, etc."[50] In addition, the process that AMIT used to develop the SMT business requirements meets the requirements of a voluntary consensus standards body, as defined by OMB Circular A-119[51], and had the following attributes: 1) openness, 2) balance of interest, 3) due process, 4) a process for appeals, and 5) consensus. AMIT was open to all interested market participants and included representatives from TDSPs, REPs, PUCT, consumer advocates, technology vendors, etc. The meetings of AMIT were conducted such that all opinions could be openly expressed and that each issue was discussed or researched until a consensus was reached by the participants. See Sections 4.1 and 4.2 for a further discussion on how the AMIT meetings were conducted.

3. Enables the transition of the legacy power grid to the Smart Grid

The legacy power grid provided monthly usage information to Customers up to a month after consumption. SMT provides usage information on a day after basis and near real time basis through the on demand register read function. SMT enables real time access to usage information by enabling communications with Customer In-Home Devices.

4. Has, or is expected to have, significant implementations, adoption, and use

The Joint TDSPs deposit all of their Customer's 15-minute usage data in the SMT data repository and when all the smart meters are deployed over 7 million Customers will have access to their usage data as soon as the day after consumption. In addition, 84 REPs receive 15-minute usage information for their Customers and by the end of 2014 authorized Third Parties will have access to usage information. Over 61,640 Customers have registered on SMT and are currently using the functionality of SMT. Table 13 provides statistics on the use of SMT as of August 2014.

Table 13: SMT Statistics

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[50] Page 61 of the NIST Framework and Roadmap for Smart Grid Interoperability Standards, Release 2.0
[51] OMB Circular A-119, Federal Participation in the Development and Use of Voluntary Consensus Standards and in Conformity Assessment Activities, February 10, 1998, http://www.nist.gov/standardsgov/omba119.cfm.

Statistic	Number
Smart meters integrated to SMT data warehouse	6,833,099
Number of Business Accounts	2,725
Number of Residential Accounts	58,915
Number of REP Companies	84
Average Customer logins per month	30,000
Number of In-Home Devices deployed	8,603
Number of messages sent to In-Home Devices	7,655

As a result of having access to Customer's 15-minute usage information, innovative products[52] are being developed and offered to Customers providing Customers with information and tools to manage their electricity usage. Vendors are developing and deploying In-Home Devices, pre-payment plans, time-of-use, and load control plans —and are offering these plans to Customers. Analysis of Customer usage information is being provided through emails, portals, gadgets, and In-Home Devices. Energy management services are being provided, and Customers may sign up to receive bill and usage alerts. By the end of 2014, Third Parties will have access to Customer usage information, when authorized by a Customer, and will be able to offer additional innovated products.

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[52] The presentations - Texas Paves the Way in Smart Metering and Smart Meter Functionality Implementation Update – are filed in PUCT #41171 Repository of Advanced Metering Implementation Documents
http://interchange.puc.texas.gov/WebApp/Interchange/application/dbapps/filings/pgSearch.asp

5. Is supported by an SDO or standards- or specification-setting organization (SSO) such as a user's group to ensure that it is regularly revised and improved to meet changing requirements and that there is a strategy for continued relevance.

SMT is supported, maintained, and revised by AMIT, an SSO (see governing principle #2). SMT has had four successful releases since its launch in 2010 (see Figure 2). SMT has a defined change request process to address any changes requested by market participants that has evolved over time (see Section 4.9).

6. Is developed and adopted internationally, wherever practical.

The SMT business requirements were developed by AMIT but are available to any interested party and have been shared with Google, the California Public Utility Commission, Origin Energy, an Australian utility, and other entities from around the world including Japan, Russia, Norway and others who have been referred to the AMIT project site located on the PUCT website. The SMT business requirements were supplied to OpenSG's OpenADE for use in their work on Third Party access to consumer usage information.

7. Is integrated and harmonized, or there is a plan to integrate and harmonize it with complementing standards across the utility enterprise through the use of an industry architecture that documents key points of interoperability and interfaces.

SMT has multiple points of interoperability between the TDSPs, ERCOT, REPs, Third Parties, and Customers and each party may access SMT functionality through one of three defined interfaces (i.e., a GUI, FTPS site, and APIs). Figure 24 illustrates each point of interoperability and the three interfaces.
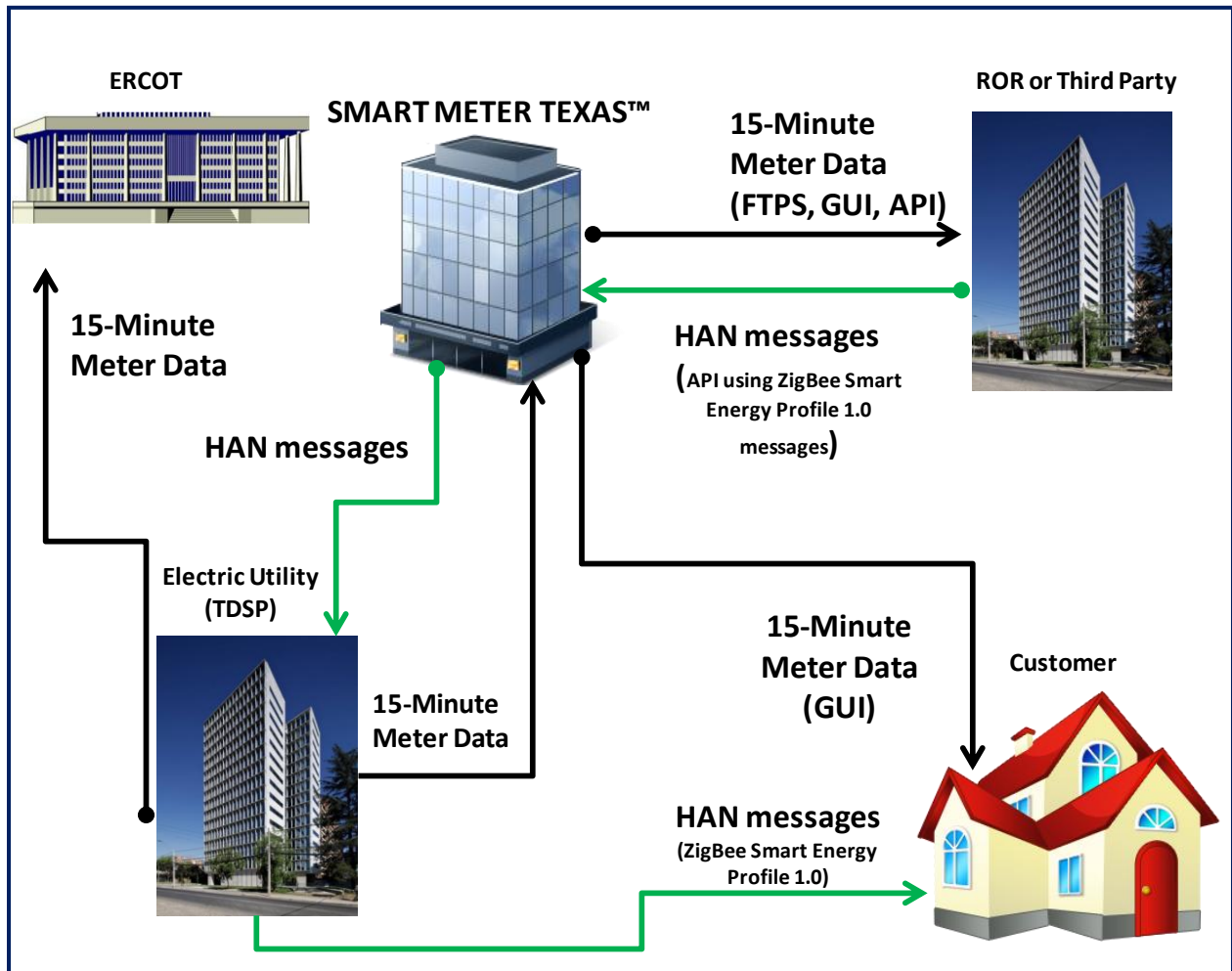
Figure 24: SMT Key Points of Interoperability and Interfaces

Since interoperability results in the exchange and use of information in a secure and effective manner with little or no inconvenience to the user, AMIT agreed to use the existing ERCOT LodeStar Enhanced ("LSE") file format for the energy usage information transmitted to ERCOT and the FTPS site for REP and Third Party access. Use of this existing format minimized the cost to the TDSPs and ERCOT.

The TDSPs chose different smart meter manufacturers (i.e., Itron, Landis+Gyr, and SmartSynch) for their smart meter installations, however, all the meters utilized the ZigBee Smart Energy Profile (SEP) v1.0 as the In-Home Device communications and information model. There was no standard utilized by the TDSPs for implementing the ZigBee SEP v1.0 functionality so the

market participants worked together to create a common implementation of the SEP and to develop standard APIs enabling users to send HAN messages (e.g., text, load control, and pricing) to any In-Home Device installed in any of the TDSP's service territory regardless of the meter manufacturer or the communications technology installed.

SMT implemented the concept of the Green Button initiative a year prior to the issuing of the Green Button challenge. In 2012, shortly after the challenge was issued, a Green Button icon was added to several SMT web portal pages. The Green Button on SMT enables Customers, with little effort, to download their energy usage information into the standard XML format. Customers can then easily load the information into other programs or share their usage information with Third Parties to help them manage their electricity use.

8. Enables one or more of the framework characteristics as defined by EISA[53] or enables one or more of the six chief characteristics of the envisioned Smart Grid[54].

SMT enables the following EISA Smart Grid Functions:

- The ability to develop, store, send and receive digital information concerning electricity use, costs, prices, time of use, nature of use, storage, or other information relevant to device, grid, or utility operations, to or from or by means of the electric utility system, through one or a combination of devices and technologies.

- The ability to develop, store, send and receive digital information concerning electricity use, costs, prices, time of use, nature of use, storage, or other information relevant to device, grid, or utility operations to or from a computer or other control device.

- The ability to measure or monitor electricity use as a function of time of day and to store, synthesize or report that information by digital means.

- The ability of any appliance or machine to respond to such signals, measurements, or communications automatically or in a manner programmed by its owner or operator without independent human intervention.

SMT enables the following DOE Smart Grid characteristics:

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[53] Energy Independence and Security Act of 2007 [Public Law No: 110-140] Title XIII, Sec. 1305.
[54] U.S. Department of Energy, Smart Grid System Report, July 2009.

- Informed participation by Customers by giving Customers access to their 15-minute electrical usage no later than the day after consumption and provides a standard mechanism for HAN devices to be installed in the Customer home for access to real time usage information.

- New products, services, and markets by providing REPs and authorized Third Parties access to a Customer's usage data and a standard mechanism for two way communication to HAN devices in a Customer's home.

9. Addresses, or is likely to address, anticipated Smart Grid requirements identified through the NIST workshops and other stakeholder engagement.

AMIT representatives are very active in the development of national smart grid standards. Several AMIT representatives participate in and hold key positions of leadership in several SGIP Priority Action Plans (PAPs), NAESB task forces, the UCAIug OpenSG users group, the SGIP Smart Grid Testing and Certification Committee, the SGIP Implementation Methods Committee, the SGIP governing board, and the ZigBee Alliance. By participating in the development of national smart grid standards, AMIT representatives are aware of smart grid standards that might be useful in the Texas market and could be utilized by SMT. When the Green Button initiative was launched, AMIT used the change request process to add the Green Button icon into a new release of SMT.

10. Is applicable to one of the priority areas identified by FERC[55] and NIST:

- Demand Response and Consumer Energy Efficiency;

- Wide Area Situational Awareness;

- Electric Storage;

- Electric Transportation;

- Advanced Metering Infrastructure;

- Distribution Grid Management;

- Cyber security; and

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[55] Federal Energy Regulatory Commission, *Smart Grid Policy*, 128 FERC ¶ 61,060 [Docket No. PL09-4-000] July 16, 2009. See http://www.ferc.gov/whats-new/comm-meet/2009/071609/E-3.pdf

- Network Communications.

SMT is applicable to the Demand Response and Consumer Energy Efficiency, Advanced Metering Infrastructure, and Network Communications priority areas.

a. Demand Response and Consumer Energy Efficiency: SMT provides Customers with their energy usage information on a day after or real time basis and enables HAN messages to be sent to Customer HAN devices. One of the HAN messages that can be sent using the SMT HAN APIs is a load control message. Access to usage information helps Customers gain an understanding of how they use electricity and allows service providers to provide various products to Customers helping them manage their energy consumption.

b. Advanced Metering Infrastructure: SMT is a common data repository housing all the smart meter usage information for four TDSPs.

c. Network Communications: SMT enables standard HAN messages to be sent to Customer HAN devices through APIs sent to the TDSPs who transmit the HAN messages over their communications network, to the smart meter and then to the HAN device.

11. Focuses on the semantic understanding layer of the GWAC stack, which has been identified as most critical to Smart Grid interoperability.

In order for usage information to be provided to ERCOT, REPs, Third Parties, and Customers and to enable In-Home Device communication, an understanding of the needs of the parties and of the information transferred was critical. To achieve this clear understanding, the work done by the collaborative effort of AMIT determined what data would be available, how it would be available, the format the data would be in, and to whom it would be made available. Many use cases were developed to help the parties understand and clarify the relationships, responsibilities, and information transfer between the parties. Consensus was reached on the data formats to use in transferring the usage information. The parties agreed to use the existing LSE format for the

energy usage data in the file the TDSPs send to ERCOT and SMT. The XML and CSV formats are used when a user exports energy usage information from the SMT web portal. Since all the smart meters utilize the ZigBee SEP v1.0 HAN communication protocol, the parties came to a consensus on the implementation of the SEP in the TDSP smart meters so that standard HAN APIs could be developed and the HAN communications would be interoperable with all the Joint TDSP's smart meters.

12. Is openly available under fair, reasonable, and non-discriminatory terms.

The SMT business requirements are freely available at no charge to any interested party and all the documents related to the work done by AMIT are available in PUCT Project #41171[56] Repository of Advanced Metering Implementation Documents. This document was developed to provide other electric industry participants with an understanding of the interoperable SMT solution and to provide access to key artifacts (i.e., business requirements, use cases, etc.).

Use of SMT is accessible at no charge to Customers, RORs, Third Parties, TDSPs and Regulatory users.

13. Has associated conformance tests or a strategy for achieving them.

SMT has gone through extensive testing with the TDSPs, REPs, Third Parties, and In-Home Device manufacturers (see Section 12). Standardized work sessions were held for REPs and Third Parties on the FTPS and API integration that enables access to Customer's energy usage information and to communicate with Customer In-Home Devices. A series of Texas ZigFests were held to allow In-Home Device manufactures and REPs to test the installation and communication with In-Home Devices. Standard test scripts were developed for this testing process using standard HAN message APIs.

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[56] http://interchange.puc.texas.gov/WebApp/Interchange/application/dbapps/filings/pgSearch.asp

14. <u>Accommodates legacy implementations.</u>

Since ERCOT utilized the LSE data format for transfers of energy usage information from the TDSPs, this same format is used in the files that RORs and Third Parties retrieve from their folders on the SMT FTPS site.

15. <u>Allows for additional functionality and innovation through:</u>

- Symmetry – facilitates bidirectional flows of energy and information.

- Transparency – supports a transparent and auditable chain of transactions.

- Composition – facilitates building of complex interfaces from simpler ones.

- Extensibility – enables adding new functions or modifying existing ones.

- Loose coupling – helps to create a flexible platform that can support valid bilateral and multilateral transactions without elaborate prearrangement.

- Layered systems – separates functions, with each layer providing services to the layer above and receiving services from the layer below.

- Shallow integration – does not require detailed mutual information to interact with other managed or configured components.

SMT allows for additional functionality and innovation through:

- Symmetry – enables communication with Customer In-Home Devices through standard HAN APIs

- Composition – allows REPs and authorized Third Parties to innovate with HAN products through the use of internet gateways and to display usage information on their own portals through the use of the rebranding API

- Extensibility – through the change request process SMT can add new functions or modify existing ones.

In conclusion, SMT and its development and implementation are consistent with each of the NIST guiding principles for identifying interoperable smart grid standards for implementation.

11.3.2 NIST Architectural Goals for the Smart Grid

In the NIST Framework and Roadmap for Smart Grid Interoperability Standards, Release 2.0, NIST expanded the list of architectural goals to the following eleven goals. SMT satisfies each of these goals as shown in the following discussion in Table 14.

Table 14: NIST Smart Grid Architectural Goals

Goal	Goal Definition	SMT Compliance
Options	Architectures should support a broad range of technology options—both legacy and new. Architectures should be flexible enough to incorporate evolving technologies as well as to work with legacy applications and devices in a standard way, avoiding as much additional capital investment and/or customization as possible.	The SMT business requirements are technology independent allowing for flexibility in implementation. SMT utilizes the legacy LSE format for the usage data files but the SMT business requirements don't restrict the use of other formats. If some of the TDSPs adopt the ZigBee Smart Energy Profile (SEP) v2.0 in the future, SMT and AMIT will follow the guidance set forth in PAP 18: SEP 1.x to SEP 2.0 Transition and Coexistence Guidelines and Best Practices to minimize the expense and stranding of existing In-Home Devices.
Interoperability	Architectures must support interfacing with other systems. This includes the integration of interoperable third-party products into the management and cyber security infrastructures.	SMT provides convenient, easy to use interfaces for TDSPs, REPS, Third Parties, Customers, and Customer In-Home Devices to exchange energy usage information and HAN messages through several standard interfaces: a web portal, FTPS, and APIs. (See Figure 24.)
Maintainability	Architectures should support the ability of systems to be safely, securely, and reliably maintained throughout their life cycle.	SMT's underlying system architecture is built on a robust and mature set of software systems with enterprise level hardware systems. The widespread use of these underlying software and hardware components across many industries ensures continued vendor

Goal	Goal Definition	SMT Compliance
		support, broad industry knowledge base, and evolving best practices.
Upgradeability	Architectures should support the ability of systems to be enhanced without difficulty and to remain operational during periods of partial system upgrades.	SMT has the ability to be upgraded through a defined change request process with minimal inconvenience to users. SMT has had multiple releases since it began operation in 2010. (See Figure 2 and NIST guiding principle #5) SMT maintenance and new releases are conducted as much as possible during off-peak hours and detailed planning is done to make the duration as short as possible. Market participants are notified of any pending interruption of service due to maintenance or installation of new releases.
Innovation	Architectures should enable and foster innovation. This includes the ability to accommodate innovation in regulations and policies; business processes and procedures; information processing; technical communications; and the integration of new and innovative energy systems.	SMT enables and fosters innovation as evidenced by the new energy management products being offered to Customers associated with usage information and In-Home Devices (see NIST guiding principle #4). When the DOE and the White House Office of Science and Technology Policy initiated the Green Button Initiative, SMT incorporated the Green Button icon on Customer pages in the SMT web portal. If the ZigBee SEP 2.0 HAN communication protocol is adopted by the TDSPs in the future, the APIs may be modified to reflect this change. Additional innovation will be enabled when Third Parties are granted access to SMT functionality by the end of 2014.
Scalability	Architectures should include architectural elements that are	SMT was initially developed as a common data repository for

Goal	Goal Definition	SMT Compliance
	appropriate for the applications that reside within them. The architectures must support development of massively scaled, well-managed, and secure systems with life spans appropriate for the type of system, which range from 5 to 30 years.	CenterPoint Energy and Oncor and was later expanded to include AEP Texas and TNMP. It is segregated so that each TDSP has access to only the meter data of their Customers. Access to usage information initially was only given to Customers and their ROR. By the end of 2014, SMT will be expanded to include Third Parties giving them the opportunity to offer innovative energy management products to Customers.
Legacy	Architectures should support legacy system integration and migration.	SMT supports the use of the LodeStar Enhanced (LSE) file format for transmitting energy usage information since this format was currently in use by ERCOT and the TDSPs.
Security	Architectures should support the capability to resist unwanted intrusion, both physical and cyber. This support must satisfy all security requirements of the system components.	SMT has the capability to resist unwanted cyber intrusion through the use of common information security technologies and practices and it satisfies the NIST IR security requirements for this type of system. (See Section 10)
Flexibility	Architectures should allow an implementer to choose the type and order of implementation and to choose which parts of the architecture to implement without incurring penalties for selecting a different implementation.	The functionality of SMT was developed in stages in accordance with the priorities determined by AMIT.

The SMT business requirements are technology independent allowing for flexibility in implementation. For example, the LSE format was chosen by AMIT for transmitting usage information, but this does not limit other implementers from choosing another format. Also, all or a portion of the business requirements may be implemented depending upon the needs of the market participants. SMT |

Goal	Goal Definition	SMT Compliance
		provides energy usage information and the ability to send HAN messages to Customer In-Home Devices. Other implementers may choose to only provide access to energy usage information.
Governance	Architectures should promote a well-managed system of systems that will be enabled through consistent policies over its continuing design and operation for its entire life cycle.	SMT is managed through the TDSP Joint Operating Agreement and a defined change request process initially governed by AMIT, an SSO, and once SMT entered into a steady state, governed by an ERCOT subcommittee with a structured working group and a defined approval request process. (See Section 3.3 and NIST governing principle #5)
Affordability	Should enable multivendor procurement of interoperable Smart Grid equipment through the development of mature national and international markets. Architecture should fundamentally enable capital savings as well as life cycle savings through standards-based operations and maintenance.	The TDSPs using SMT have installed meters using three different meter manufacturers and are utilizing different communications technology; however, SMT accepts and stores the usage information regardless of the meter manufacturer or communication technology. In addition, SMT is able to send standard HAN messages to all the smart meters regardless of the manufacturer or communication technology utilized by a TDSP. A considerable expense was avoided by the TDSPs, RORs, and Third Parties by having one common point of access for Customer meter information and In-Home Device communication instead of multiple TDSP solutions. In addition, a considerable expense was avoided by ERCOT and the TDSPs through the use of the existing LSE format for usage information. REPs,

Goal	Goal Definition	SMT Compliance
		Third Parties, and Customers are able to select In-Home devices from multiple vendors due to the interoperability provided by SMT.

SMT satisfies the NIST architectural goals for the smart grid.

11.4 **Green Button Initiative**

In 2011, the OSTP and Department of Energy (DOE) challenged the electric utility industry to launch a Green Button Initiative that would give consumers access to their energy usage information by downloading it in an easy-to-read industry standard format. SMT implemented the concept of the Green Button initiative over a year prior to the issuance of the Green Button challenge. Shortly after the challenge was issued, SMT strategically placed a Green Button icon on several portal pages. On the SMT web portal, Customers can request 13 months of 15-minute usage data in the industry standard XML format and a file will be emailed to the Customer. Customers may then easily load the information into programs that help manage their electricity use or share their usage information with Third Parties who want to provide energy management

services   to   Customers.

Figure 25 shows the Green Button icon on the SMT Customer home page.
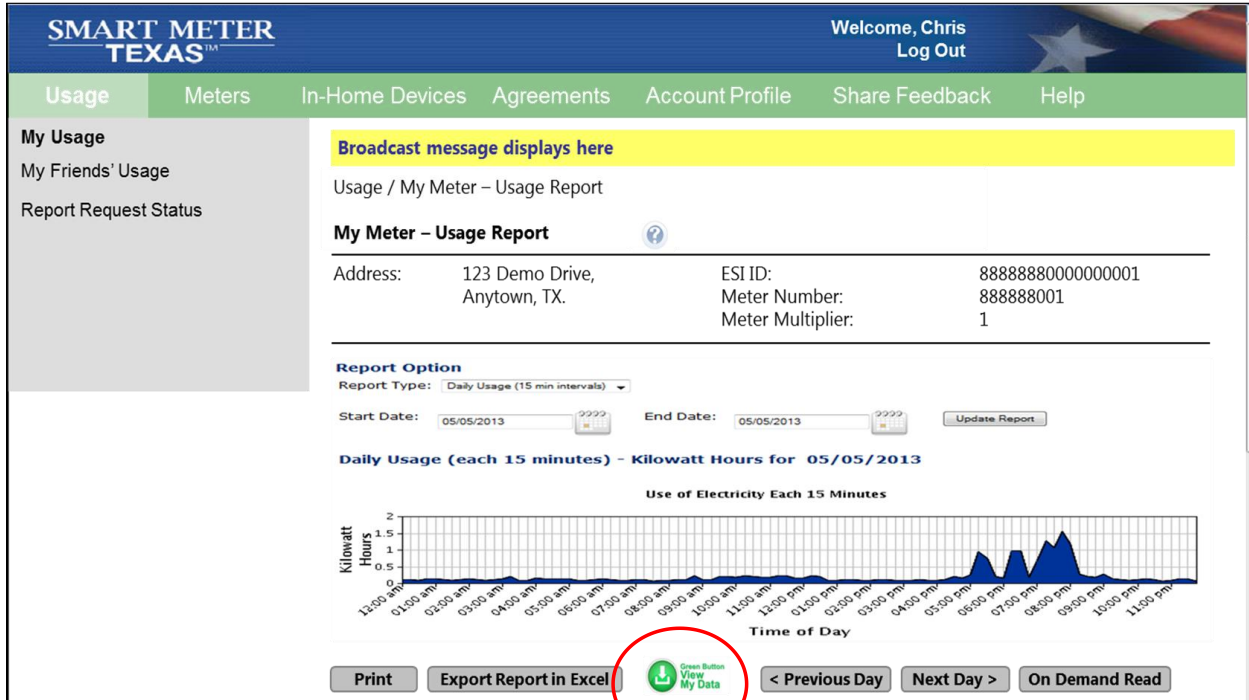
Figure 25: Green Button

11.5 **PCI and NERC CIP Security Standards**

During the development of the SMT business requirements, AMIT created a task to evaluate both the Payment Card Industry Data Security Standard (PCI DSS) and the NERC Critical Infrastructure Protection (CIP) standards to determine which, if any, of these standards apply and what requirements applied to SMT. The NERC CIP standards have continued to evolve with the forthcoming version 5 being applicable to the bulk electric system which does not include SMT. The task group identified cyber security standards best practices and specific requirements for SMT from their review of these standards. At a high level, the requirements are:

1. Build and maintain a secure network
    a. PCI Requirement – Install and maintain a firewall configuration to protect critical data

  b. PCI Requirement – Do not use vendor supplied system defaults for system passwords and other security parameters

  c. NERC CIP 005-1 – Electronic Security Perimeter

2. Protect critical data

  a. PCI Requirement – Protect stored critical data

  b. PCI Requirement – Encrypt transmission of critical data across open, public networks

3. Identify critical cyber assets

  a. NERC CIP 002-1 – Critical Cyber Asset Identification

4. Maintain a vulnerability management program

  a. PCI Requirement – Use and regularly update anti-virus software

  b. PCI Requirement – Develop and maintain secure systems and applications

  c. NERC CIP 007-1 – Systems Security Management

5. Implement strong access control measures

  a. PCI Requirement – Restrict access to critical data by business need-to-know

  b. PCI Requirement – Assign a unique ID to each person with computer access

  c. PCI Requirement – Restrict physical access to critical data

  d. NERC CIP 006-1 – Physical Security of Critical Cyber Assets

6. Regularly monitor and test networks

  a. PCI Requirement – Track and monitor all access to network resources and critical data

  b. PCI Requirement – Regularly test security systems and processes

7. Maintain an information security policy

  a. PCI Requirement – Maintain a policy that addresses information security

  b. NERC CIP 003-1 – Security Management Controls

8. Conduct cyber security awareness and training programs

  a. NERC CIP 004-1 – Personnel and Training

9. Preparation for and recovery from cyber incidents

  a. NERC CIP 008-1 – Incident Reporting and Response Planning

  b. NERC CIP 009-1 – Recovery Plans for Critical Cyber Assets

Each of the above elements provided input and direction to the SMT system architecture and to the development of SMT's security policies. Although these standards do not directly apply to a system like SMT, the application of their cyber security best practices was appropriate for SMT.

11.6 **ZigBee Smart Energy Profile**

The PUCT Substantive Rule §25.130 Advanced Metering included specific requirements related to the HAN in order for a TDSP to receive approval and cost recovery for their AMS deployments (see Table 15). The Joint TDSPs deployed smart meters that included the ZigBee Smart Energy Profile 1.0 (SEP 1.0) firmware to partially satisfy these requirements and SMT provided the functionality to enabled the communication requirements of the rule.

Table 15: PUCT Advanced Metering Rule HAN Requirements

Rule Reference	HAN Requirement
25.130(g)(a)(B)	two-way communications
25.130(g)(a)(E)	the capability to provide direct, real-time access to Customer usage data to the Customer and the Customer's REP
25.130(g)(a)(F)	means by which the REP can provide price signals to the Customer
25.130(g)(a)(J)	capability to communicate with devices inside the premises, including, but not limited to, usage monitoring devices, load control devices, and prepayment systems through a home area network (HAN), based on open standards and protocols that comply with nationally recognized non-proprietary standards such as ZigBee, Home-Plug, or the equivalent
25.130(g)(a)(K)	the ability to upgrade these minimum capabilities as technology advances

11.6.1 ZigBee SEP 1.0

ZigBee is a high level wireless communication protocol based on the IEEE 802.15.4 wireless standard network. ZigBee uses small, ultra-low power digital radios to create a wireless network connecting different devices together for secure communications. SEP 1.0 is an interoperable

public application software developed by the ZigBee Alliance[57] that enables In-Home Device interoperability regardless of the device manufacturer. SEP 1.0 provides a set of functionality for HANs designed to meet the requirements established in the OpenHAN System Requirements Specification[58]. Functionality provided by SEP 1.0 are real-time electrical usage data, pricing support, text messaging, direct load control, and demand response capability. Real-time electrical usage is supplied to In-Home Devices directly from the smart meter and the remaining SEP 1.0 capabilities are enabled by the SMT APIs.

11.6.2 SEP Upgradeability

The ZigBee Alliance continues to upgrade the capabilities of SEP with versions 1.x and 2.0. Versions in the 1.0 family are backwards compatible and will coexist with SEP 1.0 In-Home Devices on the HAN. Additional capabilities included in SEP 1.1 are over the air (OTA) upgrade, pricing options for blocks/tiers, support for multiple energy services interfaces and trust center swap out capability. SEP 2.0 is a further development of the SEP and includes several key features such as support of multiple MAC/PHY layers, multiple security protocols, and requirements from the OpenHAN 2.0 System Requirements Specification[59]. SEP 2.0 is a significant upgrade to the SEP and was one of the 37 standards[60] identified by NIST as relevant to the smart grid because it is technology independent, IP based, and useful for many smart grid applications. However, SEP 2.0 is not backwards compatible with the SEP 1.x family and cannot coexist with SEP 1.x In-Home Devices.

Since Texas will have a significant deployment of smart meters and In-Home Devices that include the SEP 1.0 firmware before SEP 2.0 is commercially available, several members of AMIT worked within a SGIP Priority Action Plan (PAP) to address this upgradeability issue. PAP 18 was established in 2011 to specifically address SEP 1.x to SEP 2.0 migration and coexistence. Several AMIT members participated and one of the AMIT members led the effort.

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[57] Several members of AMIT participate in the ZigBee Alliance and are on the ZigBee Alliance board of directors

[58] UtilityAMI 2008 Home Area Network v1.04 (produced by the Utility Communications Architecture International Users Group (UCAIug))

[59] UCAIug Home Area Network System Requirements Specification v2.0

[60] Page 96 of the NIST Framework and Roadmap for Smart Grid Interoperability Standards, Release 2.0

The result of the PAP 18 effort was a white paper[61], which included a set of recommendations and best practices for the migration of SEP 1.x firmware to SEP 2.0. If and when the TDSPs decide to upgrade the SEP firmware in the smart meters the recommendations and best practices in the PAP 18 white paper will minimize the cost of the migration and the disruption of the Customer HAN.

11.7 NAESB Third Party Access to Smart Meter-based Information

Third Party access to Customer usage information is a key benefit of the smart grid encouraged by Texas law, the PUCT, DOE, and the White House OSTP. Allowing Third Parties access to Customer usage information provides energy efficiency benefits to Customers through innovative Third Party products and services. Due to privacy concerns, market participants requested that NAESB develop voluntary best practices for the disclosure of Customer smart meter information. One of the AMIT members led the effort and several other AMIT members participated in the Data Privacy Task Force resulting in the voluntary NAESB standard REQ.22 - Third Party Access to Smart Meter-based Information Model Business Practices (MBPs).

SMT adopted many of the model business practices in this standard. SMT conforms to the high level principles in the standard related to the ease of granting Third Party access and the accessibility and transparency of the SMT privacy policy. SMT provides an easy to use, traceable method for Customers to grant Third Parties access to their usage information. SMT's privacy policy is clearly stated in its Terms and Conditions, which are accessible through a link which is strategically placed on the SMT web portal and in communications to Customers regarding Third Party access. In addition, Third Parties may voluntarily attest to meeting the requirements of a national privacy seal and provide a link to their privacy policy, both of which are provided in Third Party communications with the Customer.

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[61] The "SEP 1.x to SEP 2.0 Transition and Coexistence White Paper" is a work of the Smart Grid Interoperability Panel PAP 18 Working Group, Document Number: 2011-008, Version: 1.0, © 22 July 2011 by the SGIP.

The NAESB model business practices for Third Party access to usage information are grouped into ten (10) privacy categories which are discussed in the following sections.

11.7.1 Management and Accountability

Business practices in this category relate to internal policies and best practices on the disclosure of smart meter-based information to Third Parties. SMT conforms to these business practices by allowing only the Customer to authorize a Third Party access to their usage information by entering into an Energy Data Agreement with the Third Party. The NAESB model business practice related to recording and retaining records on the disclosures of information to Third Parties is also part of the SMT process. SMT creates reports documenting how many Energy Data Agreements have been entered into by Customers and how many usage reports are requested by Third Parties. TDSPs and Regulatory users may view these reports and Customers may view reports on the number of usage reports a Third Party requests for their data.

The model business practice governing unauthorized access by a terminated employee is in the SMT design. Administrators for each type of user (i.e., Business Customer, REP, Third Party, TDSP, and Regulatory) have the ability to terminate access by any user that is associated with their company account, thus avoiding unauthorized access by a terminated employee.

11.7.2 Notice and Purpose

Business practices in this category relate to providing a clear notice to Customers that their usage information will not be disclosed to a Third Party unless the Customer authorizes such disclosure, providing understandable and easily accessible privacy policies, and providing understandable authorization terms and conditions. SMT has adopted these business practices.

SMT has easy to understand Customer User Guides that explain how a Customer may authorize a Third Party to access to their usage data. In the email invitation sent to the Customer, it informs the Customer that if they accept the email invitation they are authorizing the Third Party to have access to their energy data and encourages the Customer to review the Third Party's

privacy policy, if provided. The following is in the email agreement invitation that a Customer receives:

"This agreement allows < 3rd Party name> to see and download your energy usage, meter and premise information."

"If available, you are encouraged to review their privacy policy as it relates to how they manage your information before accepting this agreement.."

The email invitation includes all the authorization terms and conditions, a link to the Third Party's privacy policy, if such link is provided by the Third Party, and a link to SMT's privacy policy. In addition, SMT allows a Third Party to state whether they meet the requirements of a national privacy seal.

11.7.3 Choice and Consent

Business practices in this category relate to obtaining and verifying the Customer's authorization or withdrawal of authorization through a clear, concise, understandable, and easily accessible method. A Customer's authorization is obtained and verified by SMT when the Customer accepts an email invitation to enter into an Energy Data Agreement with a Third Party. The Customer may withdraw their authorization at any time without the consent of the Third Party by terminating the Energy Data Agreement on the SMT web portal.

11.7.4 Collection and Scope

The business practice in this category limits the Third Party's collection of smart meter information to only the information and for the stated purpose as set forth in the Customer's authorization. SMT will only allow a Third Party access to a Customer's usage information for the period of time set forth in the Energy Data Agreement. SMT will terminate the Third Party's access immediately following a Customer's termination of the Energy Data Agreement.

11.7.5 Use and Retention

The business practices in this category relate to a Third Party's retention of Customer smart meter information. A Third Party data retention policy is out of scope for SMT.

11.7.6 Individual Access

The business practices in this category relate to providing Customers access to their smart meter information. Providing Customers access to their usage information is one of the primary functions of SMT. SMT provides this access through the SMT web portal so Customers can view and export their data.

11.7.7 Disclosure and Limiting Use

The business practices in this category relate to disclosing Customer usage information to authorized Third Parties, disclosing aggregated usage information, not disclosing the usage information of a previous resident, and disclosing usage information to a law enforcement agency or court of law.

SMT has a defined process for Third Party access to Customer usage information and only allows a Third Party access when an Energy Data Agreement is active between the Third Party and the Customer. When a Customer moves into a premise, that information is conveyed to SMT through a daily file of market transactions sent by each TDSP and SMT will block a new resident's access to the previous resident's usage information. SMT website Terms and Conditions, which all users must agree to prior to accessing SMT functionality, states that SMT will only disclose Customer usage information to a governmental agency or entity when required to by law, regulation, rule, or court order.

11.7.8 Security and Safeguards

The business practices in this category relate to the use of information privacy protections, performing a risk assessment related to unauthorized access, developing a comprehensive set of

privacy use cases to track smart meter information, and measures to protect the accuracy of the data.

SMT adheres to best practices as defined by PCI and NERC CIP cyber security standards (see Section 11.4) for protection of Customer privacy. SMT has implemented a number of technologies to mitigate the risk of unauthorized access (see Section 10). The PUCT Advanced Metering rule required that "an independent security audit of the mechanism for Customer and REP access to meter data *[be]* conducted within one year of initiating such access and promptly report the results to the commission."[62] This security audit had been conducted.

Extensive storyboards have been created that detail the flow of smart meter information to Third Parties beginning with the Customer authorization through the Energy Data Agreement and ending with the termination of the Energy Data Agreement or when a Customer moves out of a residence. To protect the privacy of the Customer information, usage reports requested by Third Parties are sent to the Third Party's SMT FTPS folder rather than by email.

The accuracy of the usage information is a function of the TDSPS and is out of scope for SMT.

11.7.9 Accuracy and Quality

The business practices in this category relate to the accuracy and quality of the usage information. The TDSP is responsible for the accuracy and quality of the usage information and SMT is responsible for making the data available; therefore this category is out of scope for SMT.

11.7.10 Openness, Monitoring, and Challenging Compliance

The business practices in this category relate to providing Customer education and establishing complaint procedures to address Customer disputes regarding disclosure of smart meter information to Third Parties. Prior to implementation of the SMT Third Party access function,

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[62] PUCT §25.130(j)(3)

Customers will be notified and the Customer User Guides will be updated. Establishing complaint procedures is done through Texas law or PUCT rules and is out of scope for SMT.

In addition to adopting many of these model business practices for the SMT functions related to energy usage information, SMT has adopted as many as are applicable to the SMT HAN functions.

11.8 UCAIug Home Area Network System Requirements Specification

In 2008, the UCAIug HAN System Requirement Specification (SRS) v1.04 was initially developed to set forth the requirements for a Customer energy HAN that is able to engage in secure two-way communications between HAN service providers and Customer In-Home Devices. One of the stated purposes of the HAN SRS was as follows:

> "Utilities and other Service Providers interested in establishing two-way communication with home area networks are encouraged to utilize and reference this document when evaluating and/or procuring smart grid systems that interact with HANs".

AMIT reviewed the HAN SRS to get an overview of the requirements for the Customer HAN, various In-Home Devices, and HAN communications. AMIT created additional use cases on how an In-Home device would be added or removed from a Customer HAN and how a Customer enrolls their In-Home device in a service provider program. The use cases identified In-Home Device and smart meter security codes needed to securely join the In-Home Device to the HAN. These use cases were presented to the UCAIug HAN Task Force along with use cases and requirements from other companies when the HAN task force began to work on an updated version of the HAN SRS. The HAN task force was led by an AMIT member and other AMIT members participated and contributed to the work. Version 2.0 of the HAN SRS was released in August 2010 and included an expanded discussion of architectural considerations, a detailed discussion on In-Home Device commissioning, registration, and enrollment, and new requirements related to each of these processes.

SMT enables the process described in version 2.0 of the HAN SRS[63] of adding an In-Home Device to the Customer HAN (i.e., commissioning and registration). Once a Customer has accepted an In-Home Device Agreement with a Third Party, SMT will automatically initiate the process of adding an In-Home Device to the Customer HAN. In addition, SMT enables the enrollment of Customer In-Home Devices in Third Party programs, a process discussed in the HAN SRS, through the In-Home Device Services Agreement. Once an In-Home Device Services Agreement is in place between a Customer and Third Party, SMT enables a Third Party to send messages to a Customer's In-Home Device using one of the standard HAN APIs.

11.9 Web Standards

The SMT portal uses several common web technologies to ensure a broad compatibility with users' web browsers to ensure a common appearance while still maintaining security. The portal follows recommendations from the World Wide Web Consortium (W3C) with respect to the use of Extensible Hypertext Markup Language (XHTML) and Cascading Style Sheets (CSS). The portal also follows industry best practices for JavaScript that conform to standards developed by Ecma International (formerly the European Computer Manufacturers Association). Other standards for the delivery of web pages and naming conventions conform to documents published by the Internet Engineering Task Force (IETF).

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[63] UCAIug Home Area Network System Requirements Specification v2.0

12 Testing

12.1 **SMT System**

12.1.1 Internal Testing

SMT is a collection of enterprise systems that have largely been out of scope for discussion in this report. The system developer and integrator was largely responsible for ensuring that the underlying architecture of SMT was fully tested and met the system requirements.

Test conditions for SMT were developed by referring to the source documents that AMIT created, in addition to documents created during the detailed system development. Sources for the test conditions include:

- AMIT Business Requirements
- SMT User's Guide
- SMT Design Documents
- SMT Functionality Matrix
- SMT 1.1 and 2.0 Dashboard.

Each functional release of SMT is tested against a number of test conditions, with each subsequent release requiring fewer tests to validate the new functionality. New releases include testing to verify that existing functions have not been interrupted. In addition, SMT has undergone numerous independent vendor security reviews by a wide variety of vendors (see Section 10.3.4).

12.1.2 External Testing

SMT is designed to interact with a large number of external entities. The development of a standardized set of interfaces has enabled uniform testing and acceptance procedures.

REPs and Third Parties are provided with documentation and technical support to develop system integrations for using both the FTPS and APIs. For FTPS, proper configuration of the security mechanisms are the primary goals. Steps for FTPS configuration include:

1. Obtain FTPS client security certificate (self-signed)
2. Provide public PGP key to SMT (self-signed)
3. Obtain credentials and addresses for SMT staging environment
4. Coordinate download testing with SMT.

The APIs require similar security measures and also add additional technical complexities associated with the correct creation, transmission and receipt of SOAP XML messages. SMT provides user guides to REPs and Third Parties to help them integrate with SMT.

12.2 In-Home Devices

AMIT workshops and early TDSP testing of meter deployments indicated a gap between SMT as the common In-Home Device interface for Third Parties and the differences between the Joint TDSPs' implementation of the HAN functionality. The various smart meter and In-Home Device vendors had different interpretations of ZigBee SEP v1.0 specifications, resulting in a lack of interoperability. To bridge this gap, AMIT worked to clarify the HAN requirements and the Joint TDSPs worked with smart meter and In-Home Device vendors to produce a common implementation of ZigBee SEP v1.0.

Oncor and CenterPoint sponsored a series of ZigBee test events in Texas known as 'ZigFesTx'. The purpose of the ZigFests was to resolve any SEP v1.0 implementation differences and to produce an interoperable HAN communication functionality using SMT as the common interface. The ZigFests were performed using two testing stages. Early testing involved using pre-production In-Home Devices with ZigBee's standardized SEP 1.0 test processes. Later testing occurred with production hardware using security certificates in an end-to-end test through the SMT web portal, the TDSP metering head end systems, and down to the smart meters. The use of multiple meters and multiple devices in a simulated production environment enabled rapid progress in resolving any interoperability issues. The ZigFest tests were the first opportunity for many In-Home Device manufacturers to work in a live environment with smart meters. The tests also allowed participants to quickly find and resolve firmware issues in both meters and In-Home Devices. The tests identified the different interpretations of SEP v1.0 and

opportunities for new features. Any issues that could not be resolved were sent to the ZigBee Alliance and new features were incorporated into ZigBee SEP v1.1.

The TDSPs test, verify functionality, and report on In-Home Devices which work with their smart meters. The TDSPs regularly update the list of functional devices and provide the list in the monthly ERCOT RMS Advanced Meter Working Group (AMWG) meetings. The list is posted on the ERCOT website under the AMWG meetings.

13 Operational Support

13.1 System Support

A number of advanced enterprise systems operating on high reliability server hardware ensure that SMT's functionality is continuously provided to the Customers, REPs, Third Parties, TDSPs, and Regulatory users.

The SMT vendor support team provides continuous network monitoring and intrusion protection. Quarterly scans of internet facing IP addresses are performed and the results are reported to the TDSPs. Any discovered vulnerabilities are discussed and addressed by the JDOA and vendor support team. Additionally, the TDSPs can conduct independent security audits as they see fit to provide an additional level of oversight.

System compliance monitoring is another responsibility of the SMT vendor support team. System security policies and technical device configurations are maintained in software tools that scan quarterly for compliance. Non-compliance issues are resolved based on their severity or documented as exceptions and included in policy updates. The system policy is reviewed and refreshed every 18 months.

SMT application monitoring addresses:

- Application server unavailability
- Failure of key functionality
- System storage usage monitoring and alerts
- Incident ticket notifications by email and text
- Daily registration reports including registrations, In-Home Devices, etc.
- Daily manual system health check procedures and reports

SMT hardware monitoring includes:

- Internal systems that provide SMT functionality

- Network event monitoring

- Health check scans to measure compliance against the security policies

SMT is a 24x7 application with occasional maintenance windows that typically occur during low usage periods (i.e., Saturday 2:00 a.m. until noon on Sunday). All maintenance is conducted during off-hours as best as possible and detail planning occurs to make maintenance periods as short and efficient as possible.

While there are no contractual service level agreements for data delivery or historical data, soft targets have been established. These soft targets are:

- Files received by 7 p.m. are posted to the SMT FTP server by 11 p.m. that day

- Files received by 7 p.m. are posted to the SMT data warehouse by 6 a.m. the next day.

SMT vendors have service level agreements for monthly server availability and for acknowledgement and resolution time for issues that occur based on the issue severity.

SMT sends notifications to the Texas market listservs (RMS) to indicate when SMT will be unavailable. Planned maintenance notifications are made at least 3 days prior. SMT web portal outages lasting longer than 15 minutes will be reported to the market and if any interruption is planned to occur to market facing services, 30 day, 10 day, 2 day and 1 day notices are sent.

The SMT JDOA reviews monthly and annual GUI reporting statistics and tracks key metrics including:

- Number of users in all roles by associated TDSP
- Growth of users in all entity roles
- Number of ESIIDs and meters
- Number of In-Home Devices.

13.2 **Disaster Recovery**

SMT system disaster recovery is supported through change control processes that ensure that system changes are replicated across the primary and secondary systems, and a backup strategy

that minimizes the loss of data during a system transition to the secondary data center. SMT's backup data center is located out of state, providing a significant geographical separation to help protect against localized environmental disasters. SMT has a well-documented plan that quickly restores the functional capabilities of SMT and then allows the system to gracefully transition back to the primary center at the appropriate time. SMT performs annual live testing of its disaster recovery strategy to ensure that it operates as designed and meets the design goals for system availability.

13.3 **SMT Help Desk**

SMT operates a call center to assist users by phone and email to answer common questions and provide technical support for all Customers, REPs, and Third Parties. The help desk provides support for all types of interactions with the SMT web portal, including account registration, account lock out, and data retrieval. In some cases users needing assistance will be directed to other appropriate contacts for assistance with a problem that is outside the scope of SMT's functionality. Typically this may be to direct users to their REP, a Third Party, TDSP or a hardware device vendor.

The help desk support materials are regularly reviewed to ensure that consistent support is provided and to identify new question topics that require the development of new support materials.

The help desk has the following service level objectives:

- Help desk average speed to answer - target is 90% of calls within 60 seconds
- Help desk abandon rate - abandon call rate target is less than 6% of calls.

14 Appendix A: – Example Use Case

14.1 Example Use Case

Included here is a detailed example of a well-documented use case. AMIT workshop stakeholders developed this and similar use cases, reaching consensus on the steps and discussing the business and system requirements necessary to achieve the described scenario.

14.1.1 Use Case Description

14.1.1.1 Use Case Title

Retail Off-The-Shelf Devices + Self Install

14.1.1.2 Use Case Summary

The process of adding a retail purchased HAN Device, from installation to web portal enrollment. The Customer may only want to install the HAN Device to receive AMS Meter information and may choose to enroll or not enroll the HAN Device with a particular REP program.

14.1.1.3 Use Case Detailed Narrative

The use case is triggered by the Customer acquiring a HAN Device from an indirect source [i.e., not from the REP] and wanting to install it at the premise.

An AMS Meter is installed and the AMS Network is communicating with the ESI is a pre-condition for this use case. AMS Meter and premise information must be captured during AMS Meter installation by TDSP / Utility for use in Provisioning a HAN Device. Specifically, the AMS Meter information that is needed to address the ESI at the premise through the AMS Network is available to the TDSP. The AMS Meter at time of deployment is assumed to have no

pre-commissioning of HAN Device networking details. The HAN Device is assumed to have no knowledge of security credentials for the AMS Meter HAN communications link.

To begin the Provisioning process, the Customer must identify themselves to their REP/ Common Web Portal with their unique Customer id [e.g. Customer account, premise address, meter number, etc.]. This information given to the REP / Common Web Portal must uniquely identify the Customer, the Customer premise and the specific AMS Meter for that premise. The Customer must provide the necessary HAN Device networking details [e.g. MAC address, Installation Code] to the REP / Common Web Portal. These HAN Device networking details will be used by the ESI to Provision the HAN Device to the AMS Meter. The Customer has several ways to contact the REP to begin the installation process including:

1. logging into REP web site and loading the HAN device networking details

2. phone—live agent or IVR; the exception path for IVR would lead to a live agent

3. logging into a third party website, with a national database for registration

4. initiating the process through an appropriate retail channel

The Customer will contact their REP (prior to Common Web Portal implementation) or logon to the Common Web Portal (after implementation of the Common Web Portal) to begin the Provisioning process. This process will be complete when the HAN Device is successfully Provisioned to the customer's ESI and the HAN Device indicates it is joined to the ESI. In addition, after the implementation of the Common Web Portal, the Common Web Portal will update the list of Provisioned HAN Devices with the new HAN Device and Customer will provide a unique descriptive label to identify the HAN Device in the Common Web Portal. Additionally, if the Customer wants to Register the HAN Device for a particular REP program, the Customer will contact their REP. Once the REP / Common Web Portal receives the Provisioning request from the Customer, the request is communicated by way of an accessible interface such as a Common Web Portal or a standard API (WSDL or Web Service Definition Language) over the AMS Network to the ESI. The mechanism used for joining a HAN Device to the ESI is the ZigBee Smart Energy procedure (see ZigBee Smart Energy Profile r14, section

5.4.2.1). The ESI must be configured with security credentials derived from installation codes of the HAN Device before the HAN Device can attempt to join the AMS Meter's Smart Energy HAN communication link. The appropriate HAN Device security credentials will be submitted to the appropriate ESI via the AMS Network.

Once the ESI is prepared to allow the appropriate HAN Devices to join, the Customer simply powers on the HAN Device and follows the HAN Device manufacturer's instructions. The HAN device will perform a secure transaction to join to its preconfigured ESI. Following a successful join, the HAN Device is considered Provisioned and could engage in two-way communication through the ESI over the AMS Network.

14.1.1.4 Business Rules and Assumptions

1. This use case is typically for Residential Customers.
2. AMS Meter is installed at the premise and the AMS Network is communicating with the ESI.
3. The AMS Network has an accessible interface available to REPs or 3rd parties to communicate with the ESI.
4. HAN Communication in the premise is using the Smart Energy protocol.
5. All HAN Devices and the ESI must come from the manufacturer with valid security credentials loaded, that were issued by an authorized party as required by the Smart Energy specification.
6. HAN Devices have no knowledge of ESI security credentials when they are deployed.
7. The AMS Meter information, which is obtained during installation of the AMS Meter, is available.
8. HAN Devices, with the specifications listed above, are available for a Customer to purchase at a retail outlet.
9. HAN Devices are packaged with manufacturer's instructions on how the Customer can initiate the joining process.
10. Customer has access to HAN Device network details (e.g. MAC address, Installation Code).
11. Customer has access to customer information (e.g. Customer account, premise address, meter number).

12. The Common Web Portal will provide an indication that a HAN Device is Provisioned to the ESI and provide a means to label the HAN Device.

13. The HAN Device will provide an indication of the success or failure to the Customer of the Provisioning outcome with the ESI.

14. This use case shall conform to applicable national standards for Smart Energy and HAN applications as those standards develop.

15. Definitions

Provisioning - Establishing a secure communication link between the ESI and a HAN Device such that communications to and from the HAN Device can be delivered over the AMS Network. This encompasses commissioning, beaconing, discovery. Provisioning on its own does not provide any link or communication between the HAN Device and the REP back office.

Registration - Process of enrolling a HAN Device in a program in the REP CSS. Provisioning is a pre-condition of registering a HAN Device. Registration is out of scope for this use case.

De-Provisioning – Process of terminating the HAN Device communication with the AMS network through the ESI. This De-Provisioning process is out of scope for this use case and will be covered in another use case. See Tasks 157 and 172.

De-Registering – Process of terminating the HAN Device's enrollment in a REP program. De-Registering is out of scope for this use case.

14.1.2 Actors

Actor Name	Actor Type (person, equipment, system, etc.)	Actor Description
AMS Meter	Equipment	An advanced meter with the capabilities specified in the PUCT §25.130
AMS Network	Equipment	A TDSP system that provides two-way communication system to / from the THI
Common Web Portal	System	A web portal which allows authorized users access to Customer usage, meter attributes, premise information, HAN Device information and enables communication with HAN Devices.
Customer	Person	Customer of REP who has an AMS Meter installed at their Premise.
CSS	System	A Customer service system –a system that provides the ability to view Consumer-specific information regarding billing, tariffs, programs, metering, interval usage, and HAN Devices, etc.
HAN Devices	Equipment	Equipment owned by the Customer and installed in the Customer premise capable of two-way communication with the THI
REP	Business	Retail Electric Provider - An employee of the REP, or agent of a REP, who is authorized to send/receive messages to/from a HAN Device. In some areas, this function may be handled by the Utility.
Retailer	Business	[to be defined]
TDSP / Utility	Business	Transmission and Distribution Service Provider (ERCOT) or Utility (non-ERCOT) responsible for the AMS Meter and AMS Network

Actor Name	Actor Type (person, equipment, system, etc.)	Actor Description
ESI	System	TDSP Energy Services Interface – Provides security and, often, coordination functions that enable secure interactions between relevant Home Area Network (HAN) Devices and the TDSP (Utility) and REP. Permits applications such as remote load control, monitoring and control of distributed generation, in-home display of Customer usage, reading of non-energy meters, and integration with building management systems. Also provides auditing/logging functions that record transactions to and from HAN

14.1.3 Step by Step analysis of use case

14.1.3.1 Scenario Description

Triggering Event	Primary Actor	Pre-Condition	Post Condition
Customer purchases a HAN Device at a retail outlet and wants to install it in their premise.	Customer	• AMS Meter is installed at the premise and the ESI is communicating (2-way) with the AMS Network • HAN Device comes pre- packaged with the HAN Device networking details accessible to the Customer and includes the manufacturer's instructions for joining to the ESI. • Customer or REP has access to the AMS Network via the Common Web Portal or an API	HAN Device is Provisioned to the ESI and able to participate in 2-way communication over the AMS Network. Optionally, the HAN Device may be Registered with a REP program.

14.1.3.2 Steps for the Scenario

Step #	Actor	Description of the Step	Additional Notes
#	What Actor, either primary or secondary is responsible for the activity in this step	Describe the actions that take place in this step. The step should be described in active, present tense.	Elaborate on any additional description or value of the step to help support the descriptions
1	Customer	The Customer acquires a HAN Device and decides to connect it to the ESI.	The HAN Device must have valid security credentials loaded. HAN Device has the HAN Device networking details accessible to the Customer/Installer and includes the manufacturer's instructions for joining to the ESI.

Step #	Actor	Description of the Step	Additional Notes
2	Customer	Prior to Common Web Portal implementation: The Customer contacts the REP and gives the REP the HAN Device networking details (e.g. MAC Address, Installation Code) and the Customer account information (e.g. customer ID, premise address, meter number, etc.) and a unique descriptive label describing the HAN Device. After Common Web Portal implementation: Customer logs on to the Common Web Portal and inputs the HAN Device networking details (e.g., MAC Address, Installation Code) along with a unique descriptive label describing the HAN Device.	Methods for contacting the REP can include: • REP web site • Phone • Live agent • IVR • Third party, national database for registration • Retailer
3	REP / Common Web Portal	Prior to Common Web Portal implementation: REP verifies the Customer's identity. After Common Web Portal implementation: Common Web Portal verifies Customer's identity.	

Step #	Actor	Description of the Step	Additional Notes
4	REP / TDSP / ESI	The HAN Device provisioning process is initiated by the REP / Customer. The REP / Customer identifies the target devices (HAN Devices and AMS Meter) and provides the necessary information (e.g. customer information, meter information, and HAN Device networking details) to the TDSP TDSP validates REP/ Customer access, customer information, and meter information. The TDSP enables the Provisioning process by sending the necessary information via the AMS Network to the ESI	Method is preferably by way of an accessible interface such as a Common Web Portal or standard API (WSDL). The TDSP will store the HAN Device security credentials. Exception case: If the number of HAN Devices exceeds the allowed amount, then REP/Customer/ HAN installer is notified.
5	AMS Network / ESI	The AMS Network (this may be the ESI) generates security keys using the HAN networking details.	
6	Customer / HAN Device	The Customer simply powers on the HAN Device and initiates the joining process per the HAN Device manufacturer's instructions.	Different HAN Devices may employ different methods to initiate the joining process such as simply powering the device on or by pushing one of multiple buttons.
7	HAN Device / ESI	Upon initiating the join process, the HAN Device will scan for ESIs to join. It is possible the HAN Device may be in range of more than one ESI and will attempt to join the first ESI it finds. However, only the ESI that has the correct security credentials for this specific HAN Device will allow the HAN Device to join.	Exception: If an ESI receives a request from a HAN Device it does not recognize it will not allow the HAN Device to join to it. The HAN Device will try other ESIs until it is allowed to complete the join process.

Step #	Actor	Description of the Step	Additional Notes
8	ESI	ESI validates the HAN Device, and if successful, initiates a more secure link for future communications.	The THI controls the process whereby the AMS Meter and HAN Device exchange information and completes mutual authentication. The ESI security keys will allow the ESI to identify the correct HAN Devices to allow onto the AMS Network. ESI encrypts all traffic between HAN Devices and the ESI during the join process, prior to the establishment of security keys based on certificate information.
9	HAN Device	Communicates with ESI to accept the new secure link and secure communications for all additional information	
10	HAN Device / Customer	The HAN Device will provide feedback to the Customer on successful or unsuccessful Provisioning.	If unsuccessful, the HAN Device should provide an appropriate feedback to the Customer.
11	ESI	ESI communicates, to the Common Web Portal, the successful provisioning of a HAN device.	
12	Common Web Portal	The Common Web Portal updates the list of Provisioned HAN Devices and pending Provision requests by changing the status from pending to Provisioned.	Completion of the Provisioning process and the update in the Common Web Portal is desired in less than one minute

Step #	Actor	Description of the Step	Additional Notes
12 (optional)	Customer	Customer contacts REP and requests that their Provisioned HAN Device be Registered with a REP program. Customer gives the REP the HAN Device descriptive label identifying the HAN Device, if more than one HAN Device is	
13 (optional)	REP / Common Web Portal	REP verifies in the Common Web Portal that the HAN Device is Provisioned and completes the Registration of the HAN Device with the appropriate REP program in the REP	