CEC Load Management Standards Workshop: Enabling Technologies & Communications

Thursday, June 19, 2008

PIER project:

Requirements Engineering for the Advance Metering Infrastructure and the Home Automation Network (AMI-HAN) interface

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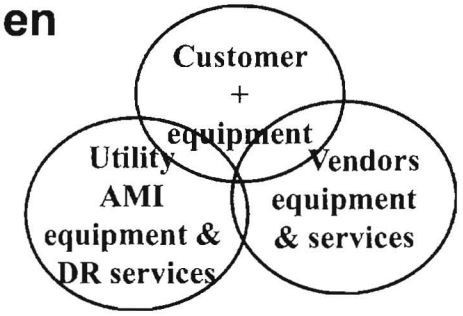
What is Requirements Engineering?

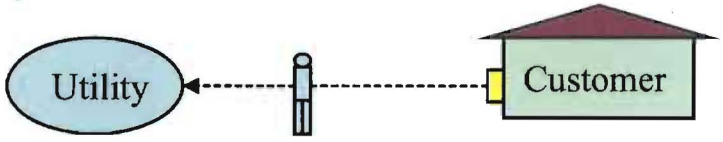
- **Requirements Engineering is:**
  - A discipline for developing requirements or criteria of a solution in order to
    - Implement the solution or evaluate proposed solutions
  - A process of analysis, modeling, standardizing of information in the solution space
    - Modeling examples: context diagrams, system interface tables, use cases
- **Requirements Engineering is used to:**
  - Define software specifications (initial use)
  - Indentify product requirements and features
  - Specify interfaces in complex systems
- **Requirements Engineering & Utilities:**
  - Utilities are using requirements engineering more and more to define their new increasingly complex systems
    - e.g. SCE AMI use cases
    - e.g. UtilityAMI OpenHAN task force use cases

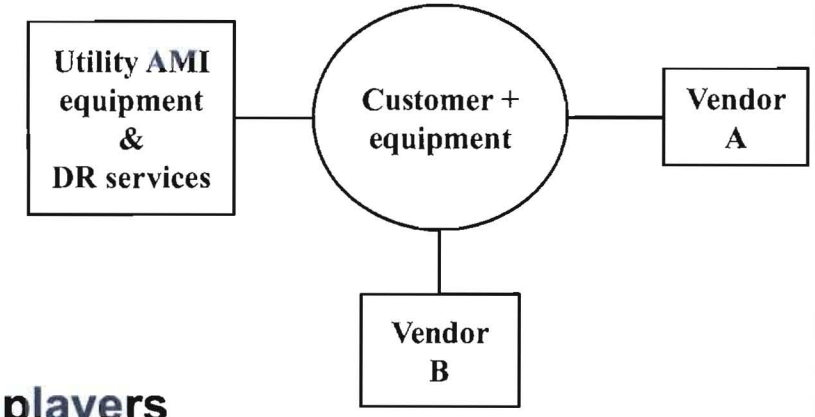
Our Requirements Engineering Process

- **Starting point: We analyzed UtilityAMI OpenHAN use case material**
- **Developed initial use cases exploring interaction between**
  - The customer and their equipment, and the utility AMI system
- **Explored boundaries and ownership**
  - Venn set diagrams



- **Modeled different configuration options to satisfy all types of customers**
  - Context diagrams
  - Use Cases of different configurations
  - Graphical Scenarios

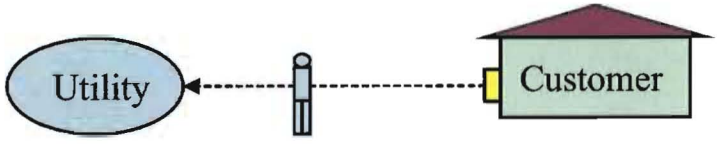




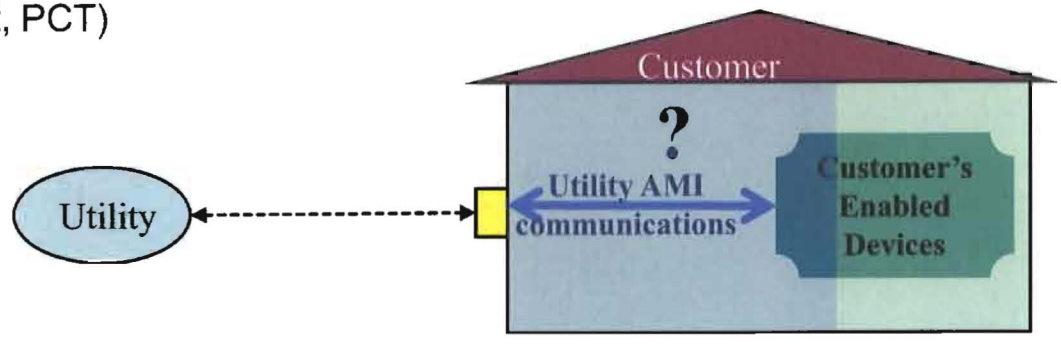
- **Modeled rights and obligations of main players**
  - Activity semantic models for right/obligation pairs
- **Developed policy guidelines**
  - NOTE 1: PIER report for this project will be published soon
  - NOTE 2: Handout slides at the end have examples of context diagrams , use cases and semantic activity models

Why Focus on AMI-Customer Interface?

- **AMI, an essential technology for enabling customer participation in DR**
  - introduces a paradigm shift in the relationship between the customer and their utility:
    - **From a simple arrangement with a clear boundary:**
      - The utility and the meter on the outside of the home



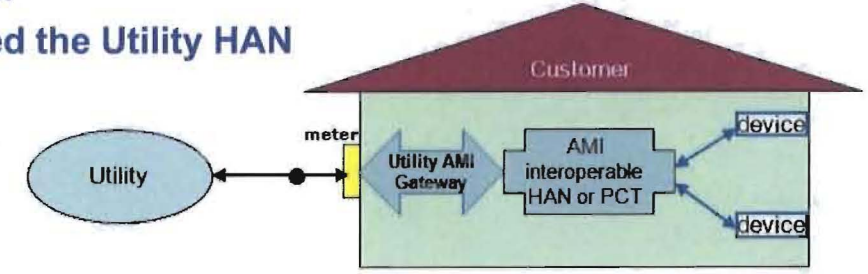
    - **To up close and personal:**
      - The utility talking to enabled devices in the home (e.g. programmable communicating thermostat, PCT)



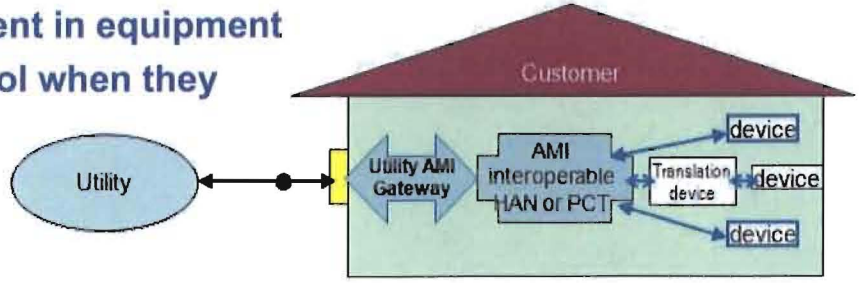
- **How this interface is conceived and implemented**
  - **will have a big impact on how many customers participate effectively in DR**

Defining Configurations to Promote Customers DR

- **Customers who want the utility to handle all the details**
  - **Solution: Utility Program Option - based on UtilityAMI OpenHAN**
    - Customers enroll in utility DR program
    - Utility sets up AMI-HAN interface called the Utility HAN
    - It's two-way communications
    - Customer equipment is automatically registered with the AMI system



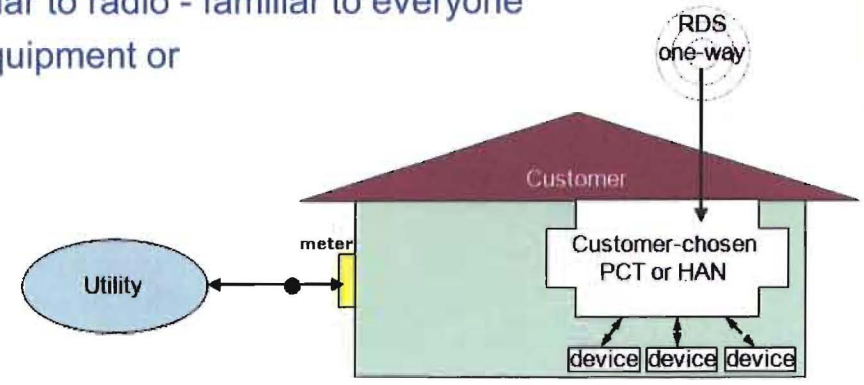
- **Customers with existing equipment who do not want to lose their investment**
  - **Solution: Utility Program Extended Option**
    - Explicit addition of a communications translation device if needed
    - Responsibility of customer to provide translation device
    - Customer does not lose their investment in equipment using different communication protocol when they participate in utility DR programs



Defining Configurations to Promote Customers DR

- **The rest of the utility customers:**
  - Customers who do not trust 'technology', want to use something familiar
  - Customers who do not want the utility intruding in their home, but want to participate
  - Customers who want to do it themselves - pick the equipment and set everything up

  - **Solution: Open Market Option:**
    - 1-way communication system - utility still on the outside of the customer premise
    - Broadcast communications used are similar to radio - familiar to everyone
    - Customers have complete control over equipment or configuration used in automated DR



Policy Guidelines for the Utility AMI Customer Interface: Recommended Rights & Obligations

R1. Customers have the right to
receive price (periodic and real-time) signals and reliability signals
without enrolling in utility programs and
without registering their equipment with their utility.

O1. Utilities are obligated to
provide broadcast price and reliability signals received by customer equipment that is
neither registered with the utility
nor used in a utility program.

R2. Customers have the right to
choose if and how they will program their programmable communicating devices
to respond to price and reliability signals.

O2. Vendors of programmable communicating devices are obligated to
provide a means of setting the device to not respond to signals,
and a means of overriding programming.

Policy Guidelines for the Utility AMI Customer Interface: Recommended Rights & Obligations

R3. Customers have the right to
purchase, rent or otherwise select from any vendor any and all devices and services used for energy management or other purposes in their premise.

O3. Utilities are obligated to
provide an AMI communication system that uses an open communication protocol and does not unduly restrict customer choice of customer equipment or services that support performing DR.

R4. Vendors have the right to
compete in an open market to sell HAN related systems, devices and services to all utility customers.

O4. Utilities are obligated to not restrict customers enrolled in utility programs, to equipment that only uses the AMI communication protocol.

Policy Guidelines for the Utility AMI Customer Interface: Recommended Rights & Obligations

R5: Utilities have the right to
offer DR and energy management services to customers
which utilize the informational and communication capabilities of their AMI system.

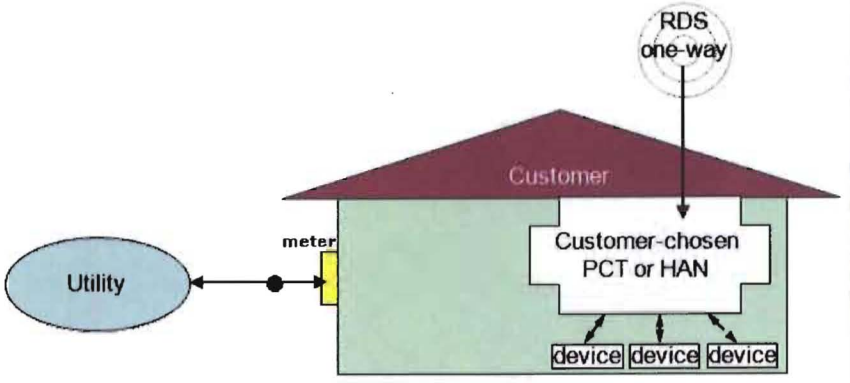
O5. Customers are obligated to
maintain their equipment used in utility programs in good working order
and to provide any communications translation device if needed.

R6. Customers have the right to
participate in utility sponsored programs and at the same time,
use equipment, not involved in the utility program, that receives price and reliability signals.

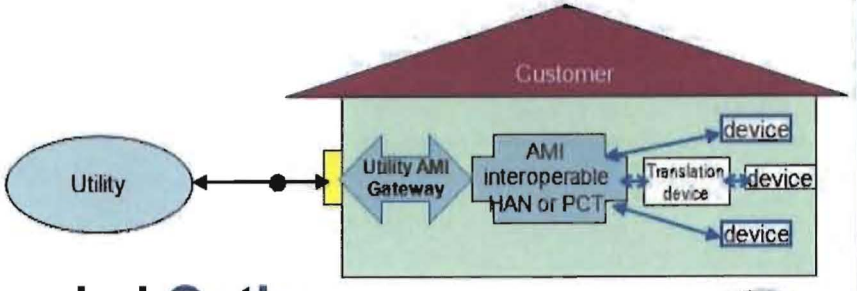
O6. Utilities have an obligation to
provide price and reliability signals through their AMI two-way signal system
and through a one-way signal system.

Recommended Configuration Options & the Rights They Support

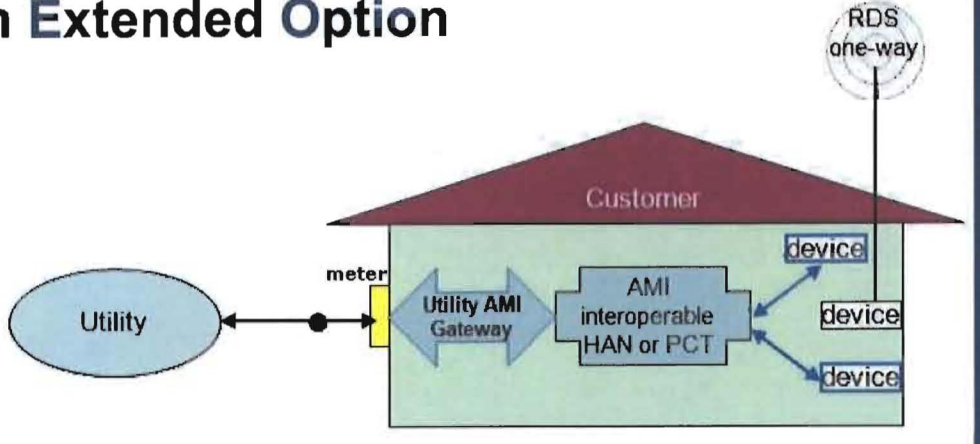
- **Open Market Option**
  - Supports Rights 1, 2, 3, 4



- **Utility Program Extended Option**
  - Supports Rights 2, 3, 4, 5



- **Open Market + Utility Program Extended Option**
  - Supports Rights 1, 2, 3, 4, 5, 6



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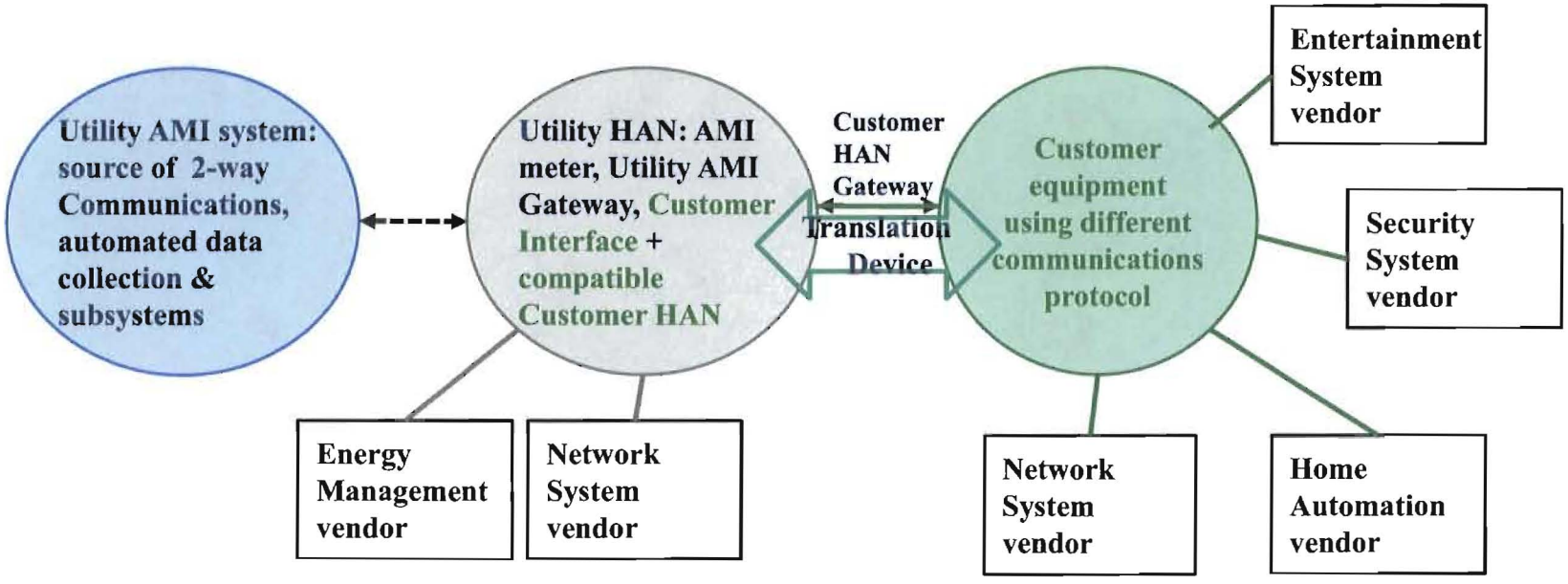
Thank You

Handout Slide: Utility Program Extended Option Context Diagram

Slight modification to Utility Program:

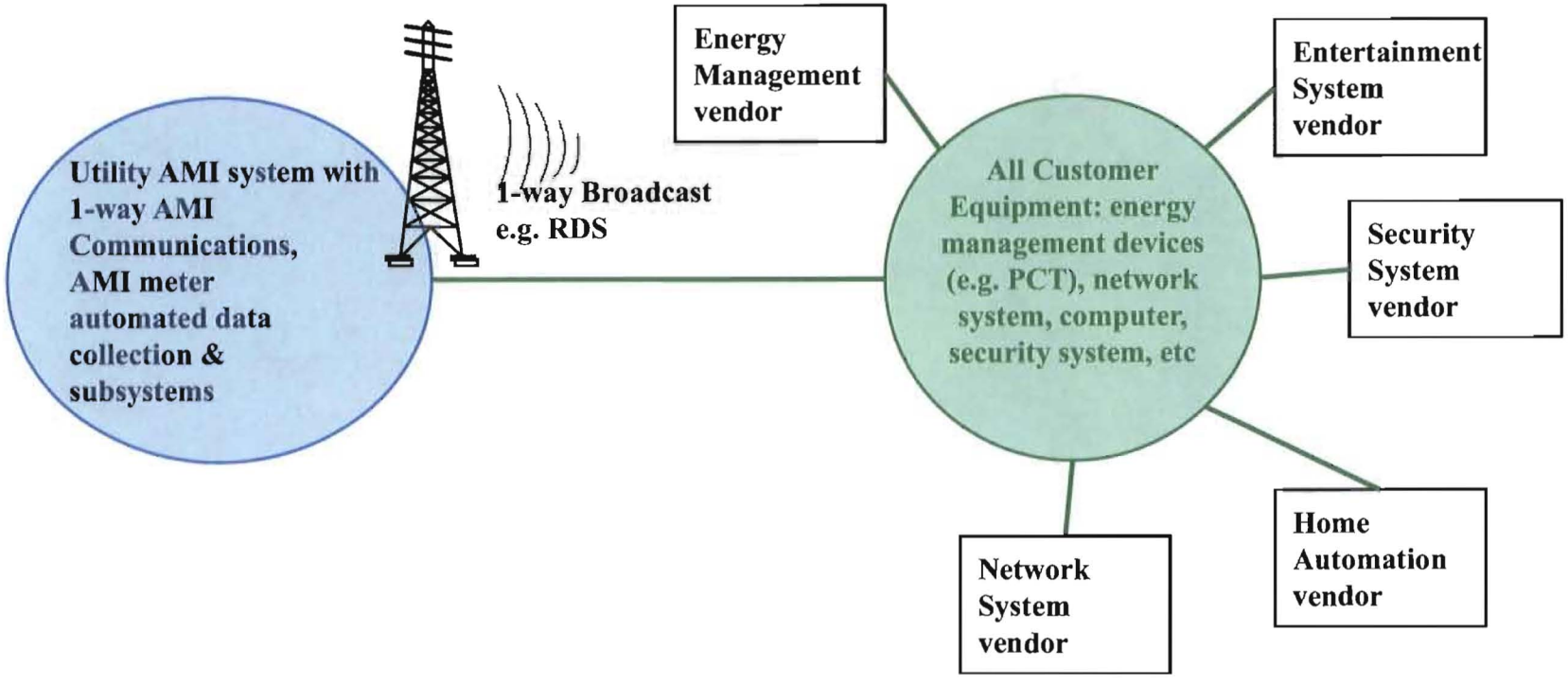
- Explicit addition a communications translation device to the Customer HAN Gateway
  - Allows customer equipment using different communication protocol to receive AMI 2-way signal
  - Responsibility of customer to provide this device if needed
- Customer does not lose their investment in equipment using different communication protocol when they participate in utility DR programs



Handout Slide:
Open Market Option Context Diagram

Alternate configuration developed by project team:

- Clear boundary between utility and customer, with utility on outside of home
- Could use a communications system familiar to everyone who has ever listened to a radio
- Customers have control over what equipment configuration to use for participating in automated DR



Handout Slide:
Activity Semantic Model: Right/Obligation 1

Semantic Activity Model 1	Right 1	Obligation 1
Actor	Customer	Utility
Action	receive	provide
Object	real-time price & emergency signals	real-time price & emergency signals
Purpose (optional)	save money, avoid outages	manage loads & avoid outages
Target (optional)	enabling technologies (e.g., PCT)	enabling technologies (e.g., PCT)
Method (optional)	without enrolling in a program or registering equipment	using 1-way broadcast (e.g. RDS) system that does not require enrollment or registration

Handout Slide: Use Case Example

Use Case ID: 1.1.1a
Use Case Name: Program RDS-enabled device to recognize correct RDS signals
Primary Actor: California residential electricity customer; referred to as Customer
Secondary Actor: Programmable communicating device with RDS communications capability; called Device
System: California investor-owned utility & their systems, referred to as Utility
Preconditions: Utility's AMI system including the one-way price & reliability RDS signaling is operational.
Utility's RDS system only carries the default dynamic price rate.
Customer is on the default dynamic price rate.

Scenarios:

Step #	Performed by	Action performed
1	Utility	Sends Customer current bill which contains the utility-location identifier for programming an RDS-enabled device to recognize the correct RDS signals
2	Customer	Enters the utility-location code into the RDS-enabled device and if required, activates the RDS capability in the Device
3	Customer	Programs how the device should respond to the signal. NOTE: This step is optional and voluntary. If the customer does not program the device, it will use factory defaults.
4	Utility	Sends default dynamic price RDS signal
5	Device	Receives signal and performs check to see if the signal contains the utility-location code entered by the customer. If it does, it responds as programmed by the customer.

Step #	Performed by	Action performed
1	Utility	Sends Customer current bill which contains the utility-location identifier for programming an RDS-enabled device to recognize the correct RDS signals
2a	Customer	Does nothing because Customer does not want the Device to receive and respond to RDS price or emergency signals.
3	Customer	Does not program the Device
4	Utility	Sends default dynamic price RDS signal
5	Device	Does nothing