

Using AMI to Realize the Smart Grid

David G. Hart

July 2008



What is AMI?

Advanced Meter Infrastructure (AMI)



- Smart meters with two way communications
- Self configuring
- Self healing
- Offer new functionality such as:
 - Interval data
 - TOU data
 - Home automation
 - Service connect/disconnect

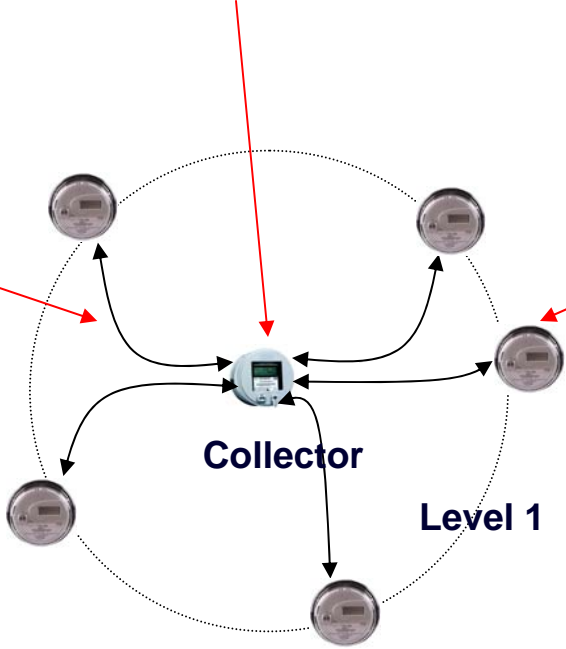
Steps

- 1. Collector looks for unregistered nodes
- 2. Collector registers level 1 nodes

A3 Meter with WAN interface is the Collector

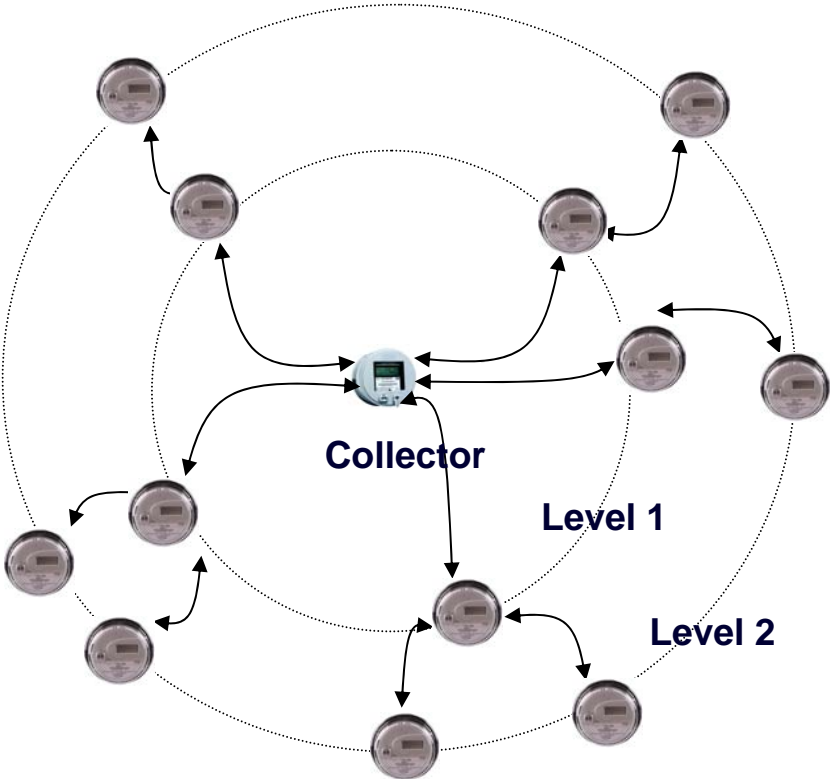
A3 Meter or REX Meter acts as a node in the Mesh Network

Each path is qualified !



Steps

- 1. **Collector looks for unregistered nodes**
- 2. **Collector registers level 1 nodes**
- 3. **Collector interrogates level 1 nodes to find level 2 nodes**



AMI Network

AGI

DR



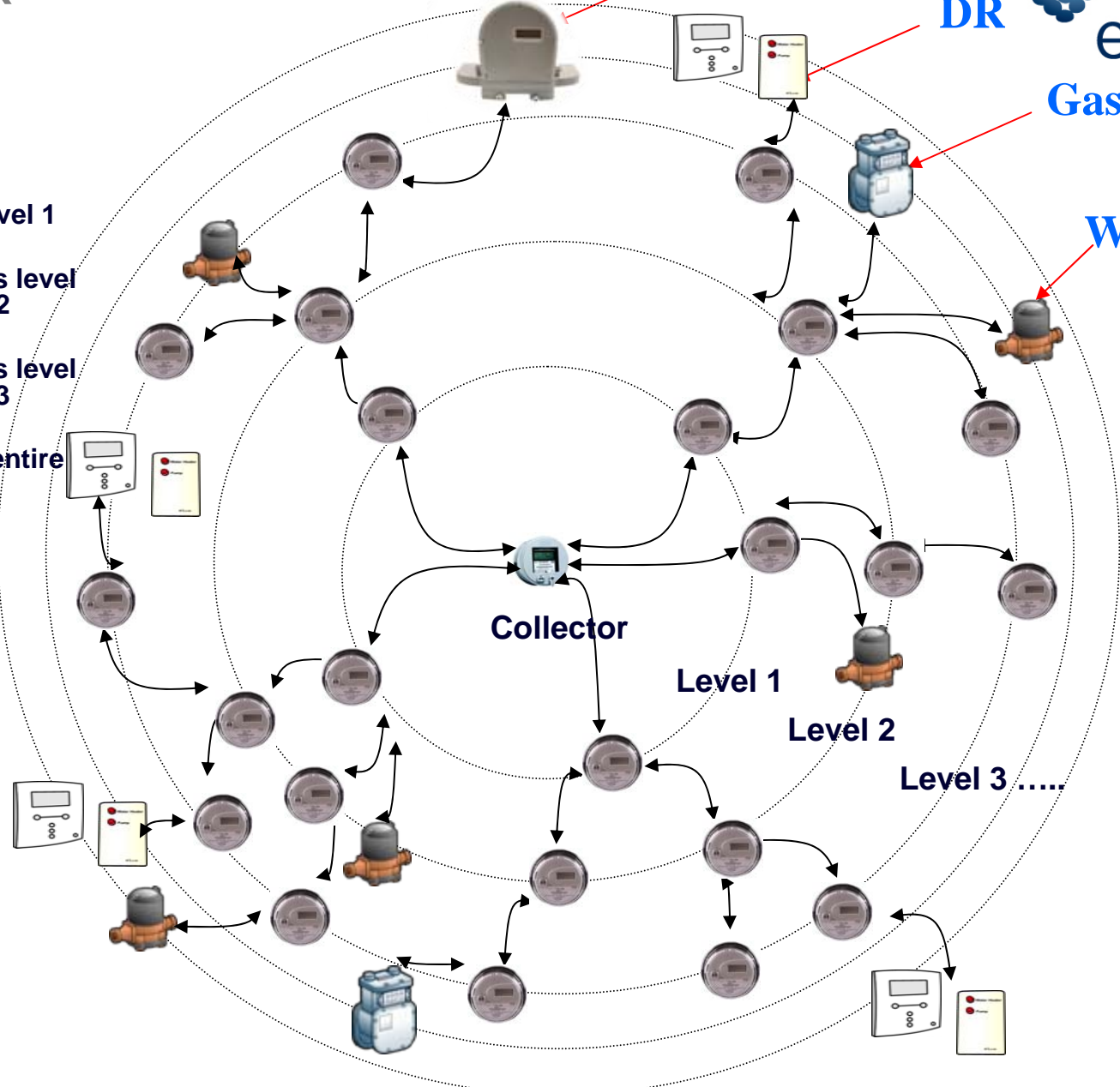
elster

Gas

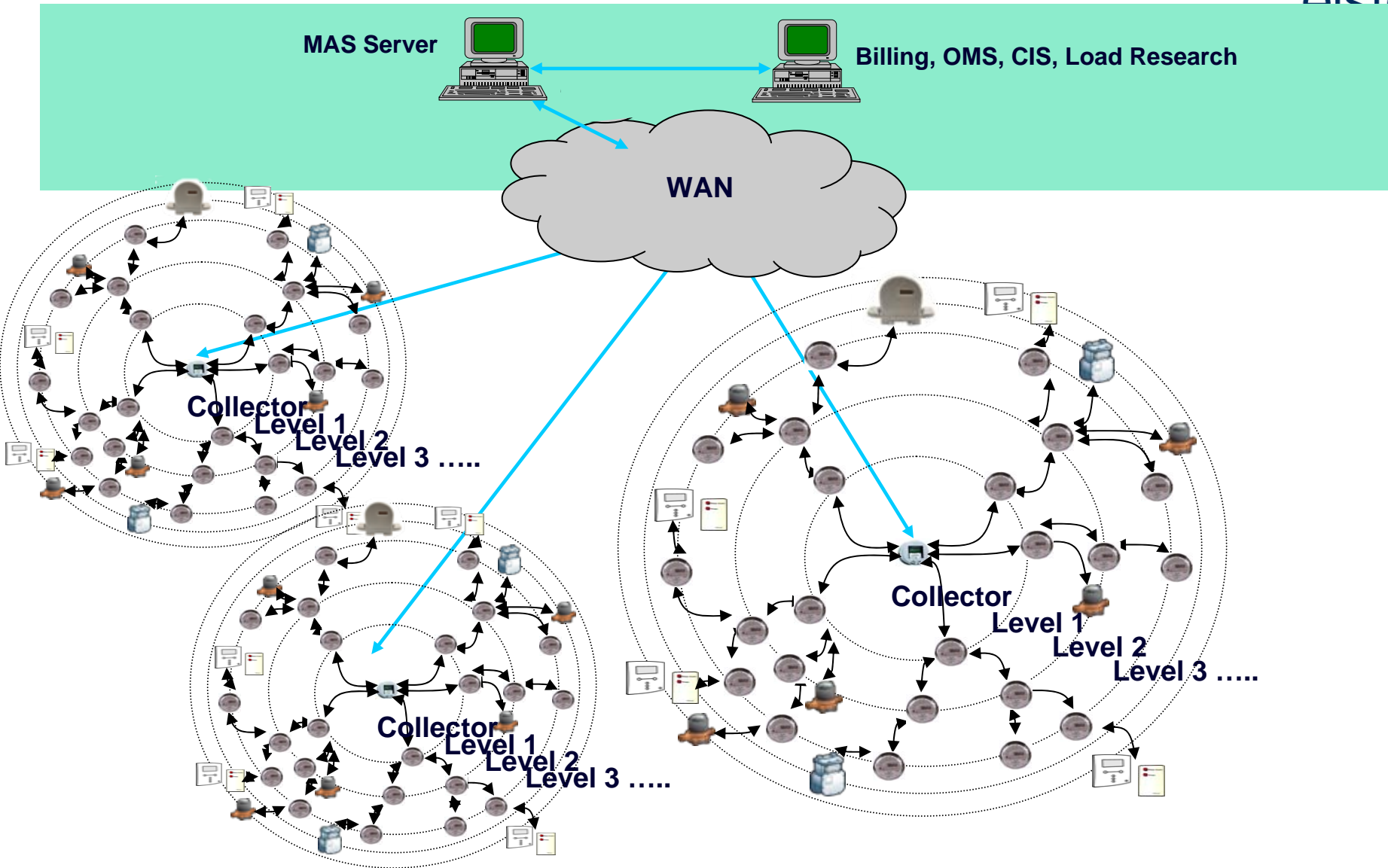
Water

Steps

1. Collector looks for unregistered nodes
2. Collector registers level 1 nodes
3. Collector interrogates level 1 nodes to find level 2 nodes
4. Collector interrogates level 2 nodes to find level 3 nodes
5. Collector builds out entire network



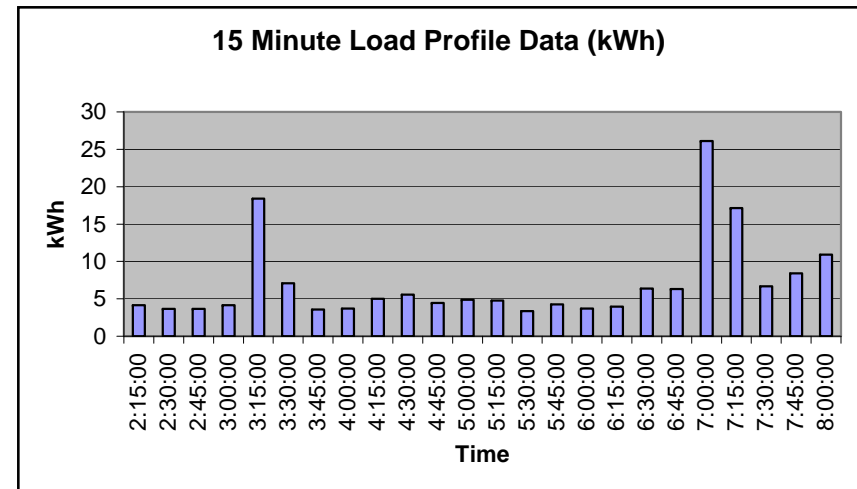
AMI Network



Meter Functionality

Meter calculates:

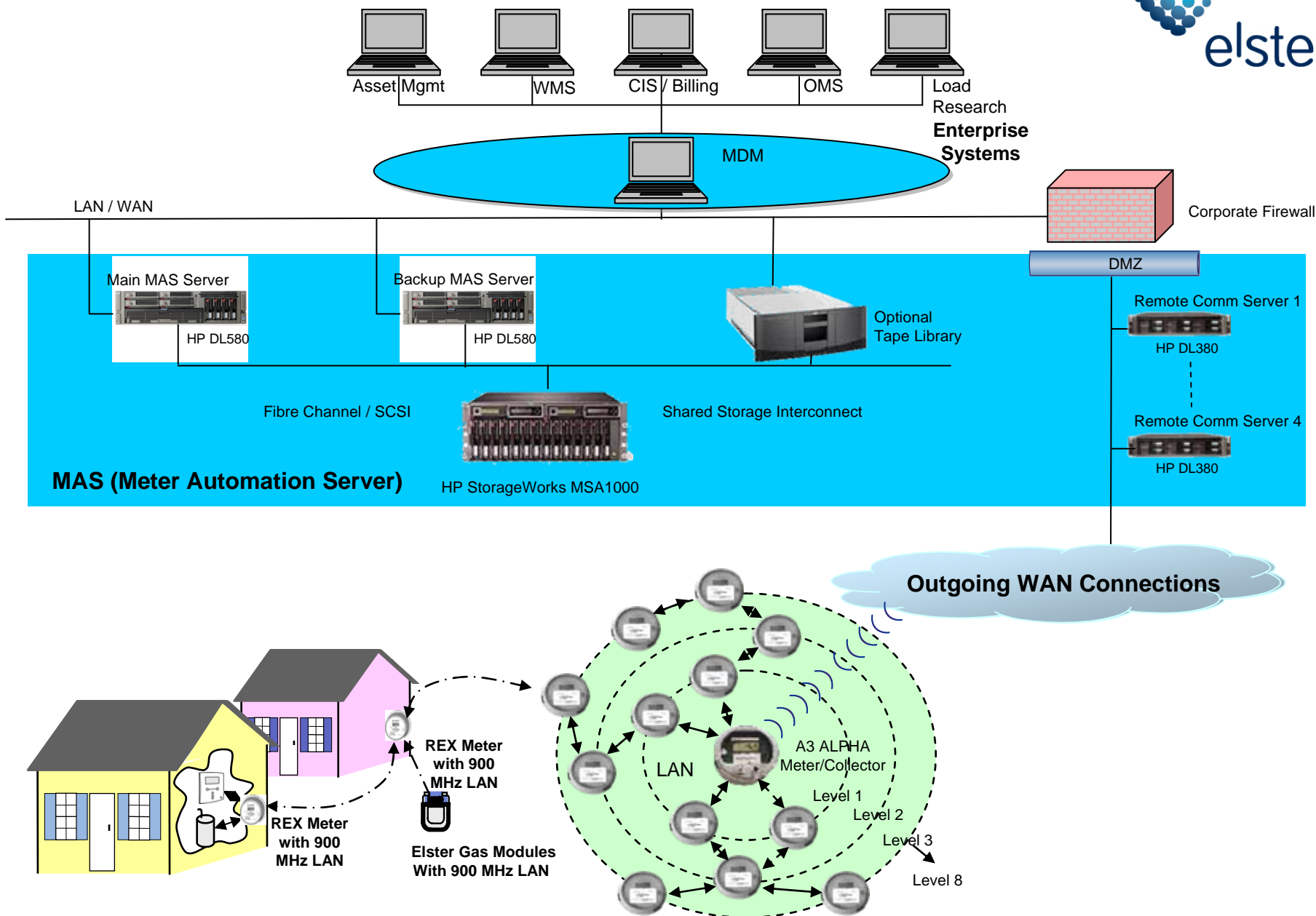
- kWh-delivered
- kWh-received
- kWh-delivered+received
- kWh-delivered-received (not available as a demand source)
- Alternate energy sources (VARh and VAh available Q4 '08).
Firmware will be upgradeable remotely
- Interval data
- Demand data



Meter Data	
Tier A kWh	1949
Tier B kWh	748
Tier C kWh	7319
Tier D kWh	718
Tier E kWh	767
Total Received kWh	0
Total kWh	11501
Max Demand 1	2.37
Max Demand 2	2.37
Voltage	242.43



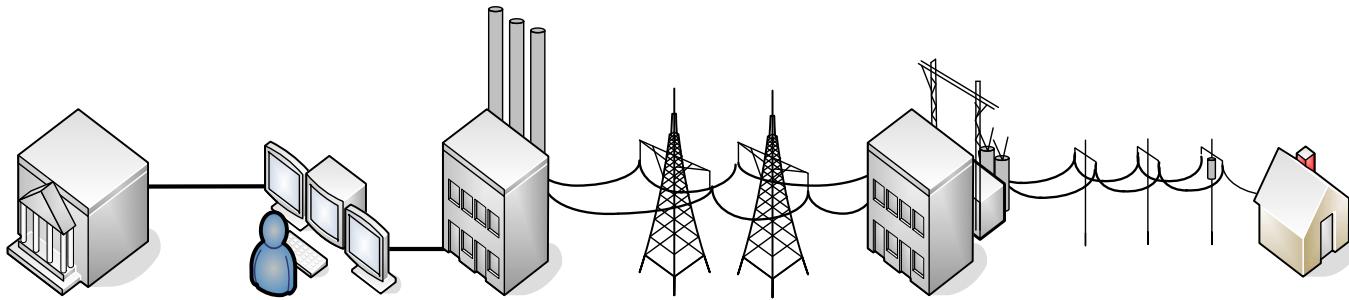
AMI - Architecture Overview



What is the Smart Grid?

Elster is a member of EPRI's IntelliGrid Program

Supporting the Power Delivery System of the Future



Uses open standards-based architecture

Integrates data communications networks and intelligent equipment

Provides the methods, tools, best practices and recommendations for specifying “intelligent” systems to promote:

- Interoperability
- Flexibility
- Expandability
- Effective security for data and system management

Vision of Smart Grid

- Self healing distribution power grid
- Grid free of disturbances such as sags, swells, interruptions
- Secure operation
- Accommodates a wide variety of generation options
- Optimizes Asset Utilization and O&M expenses

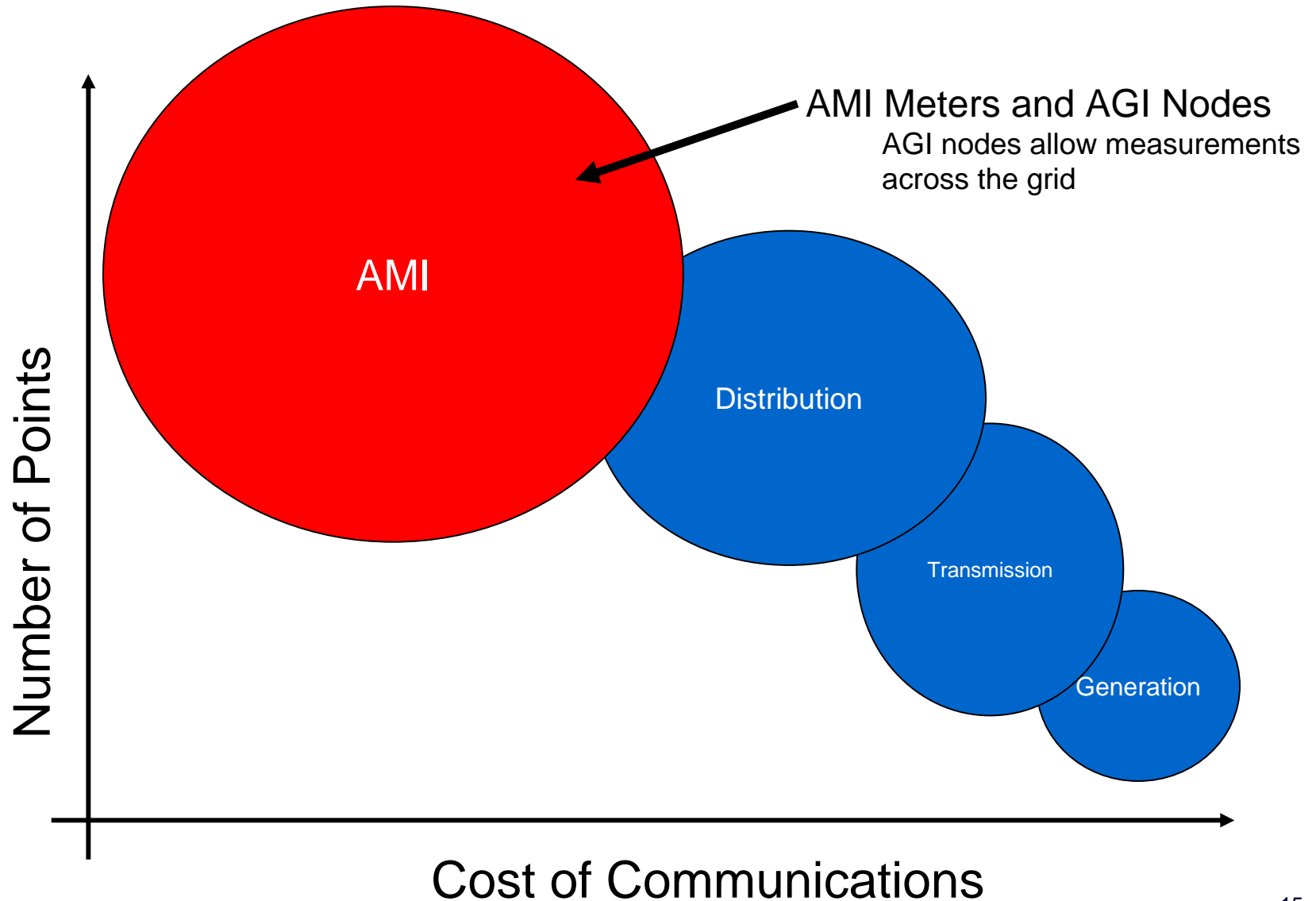
How does AMI help realize the smart grid?

Elster's View of the AMI and the Smart Grid

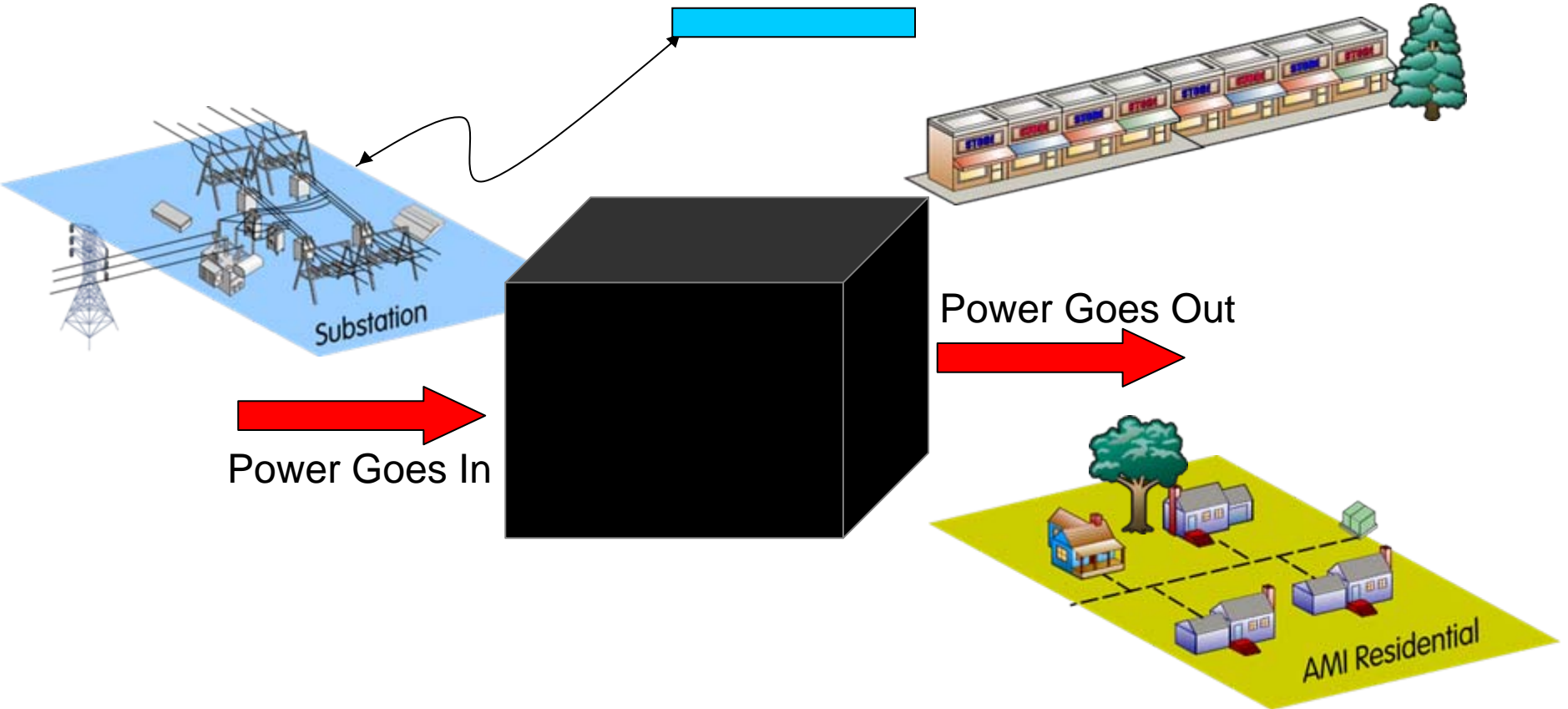
- There is no single definition of Smart Grid
 - Many define Smart Grid from 50,000 feet
- AMI is a key part of the Smart Grid but not the only part
 - Start by leveraging AMI infrastructure
- AMI vendors need to partner with utilities and key technology partners to realize components of the smart grid

$$\text{Smart Grid} \cap \text{AMI} = \text{AGI}$$

AMI Allows for more economical remote sensing



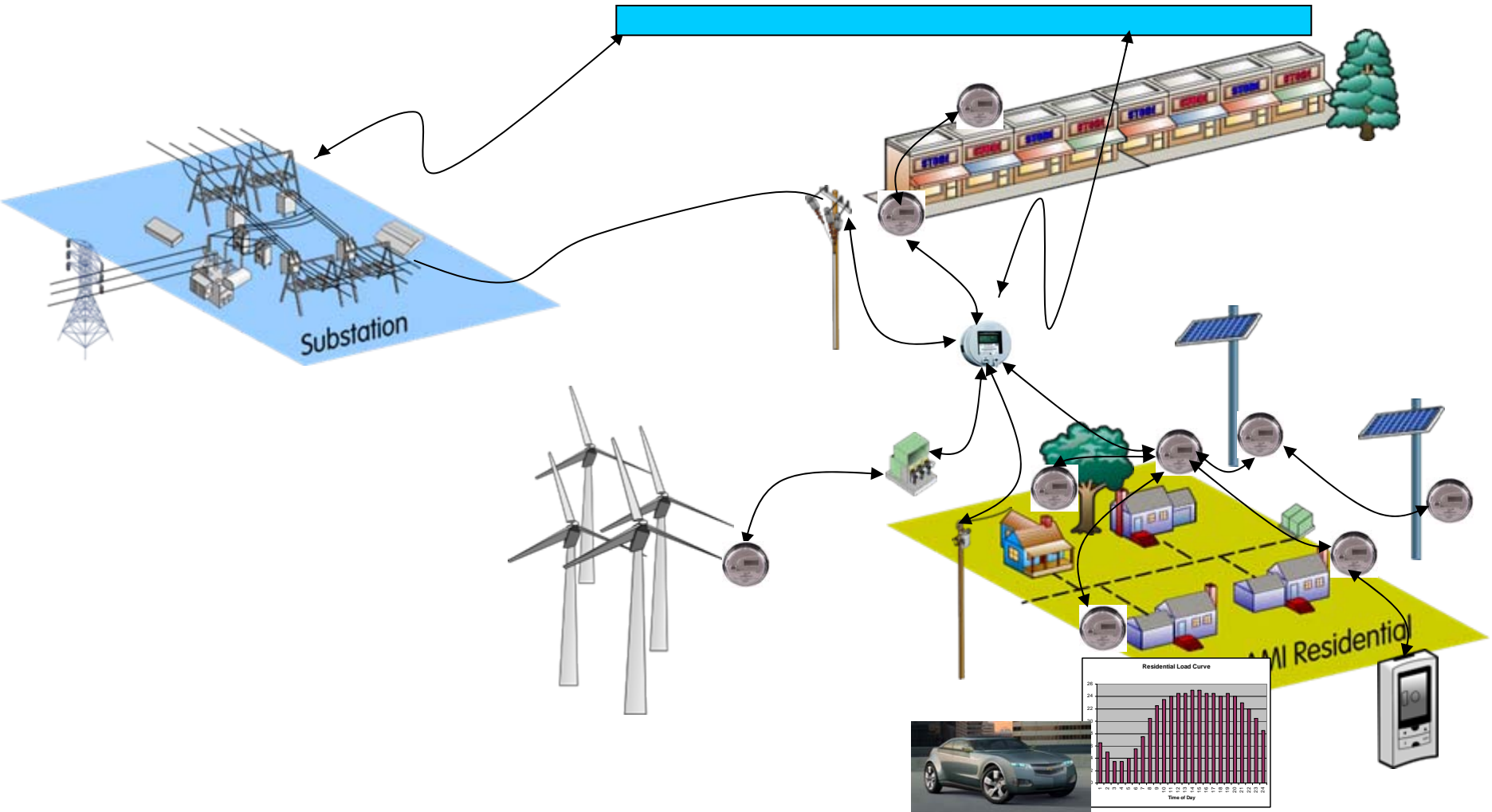
Power Grid Today



Smart Grid Tomorrow



DMS Billing O&M Planning Customer Service



- *We should not think of AMI endpoints as traditional revenue meters but as Advanced Grid Infrastructure (AGI) nodes.*

Today an AMI device or endpoint looks like:



Tomorrow AMI endpoints will **also** look like:

AGI Endpoints



MV Overhead Line
Sensor Node



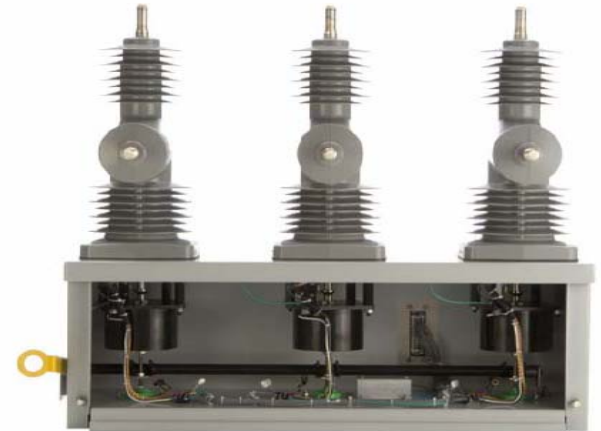
LV Distribution
Transformer Node



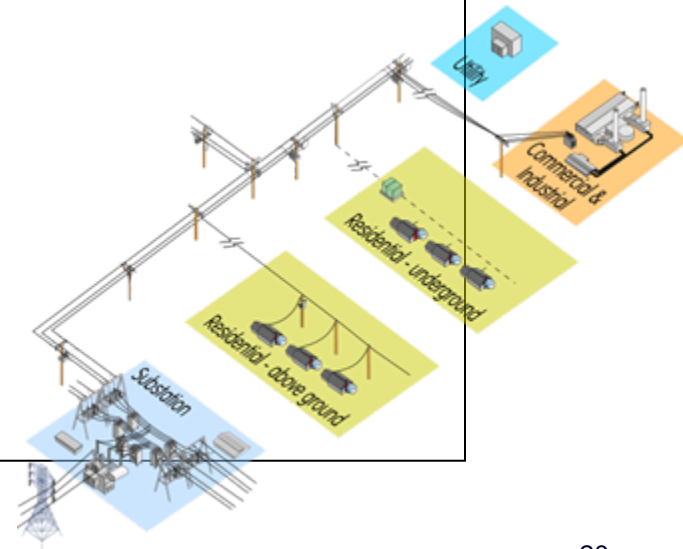
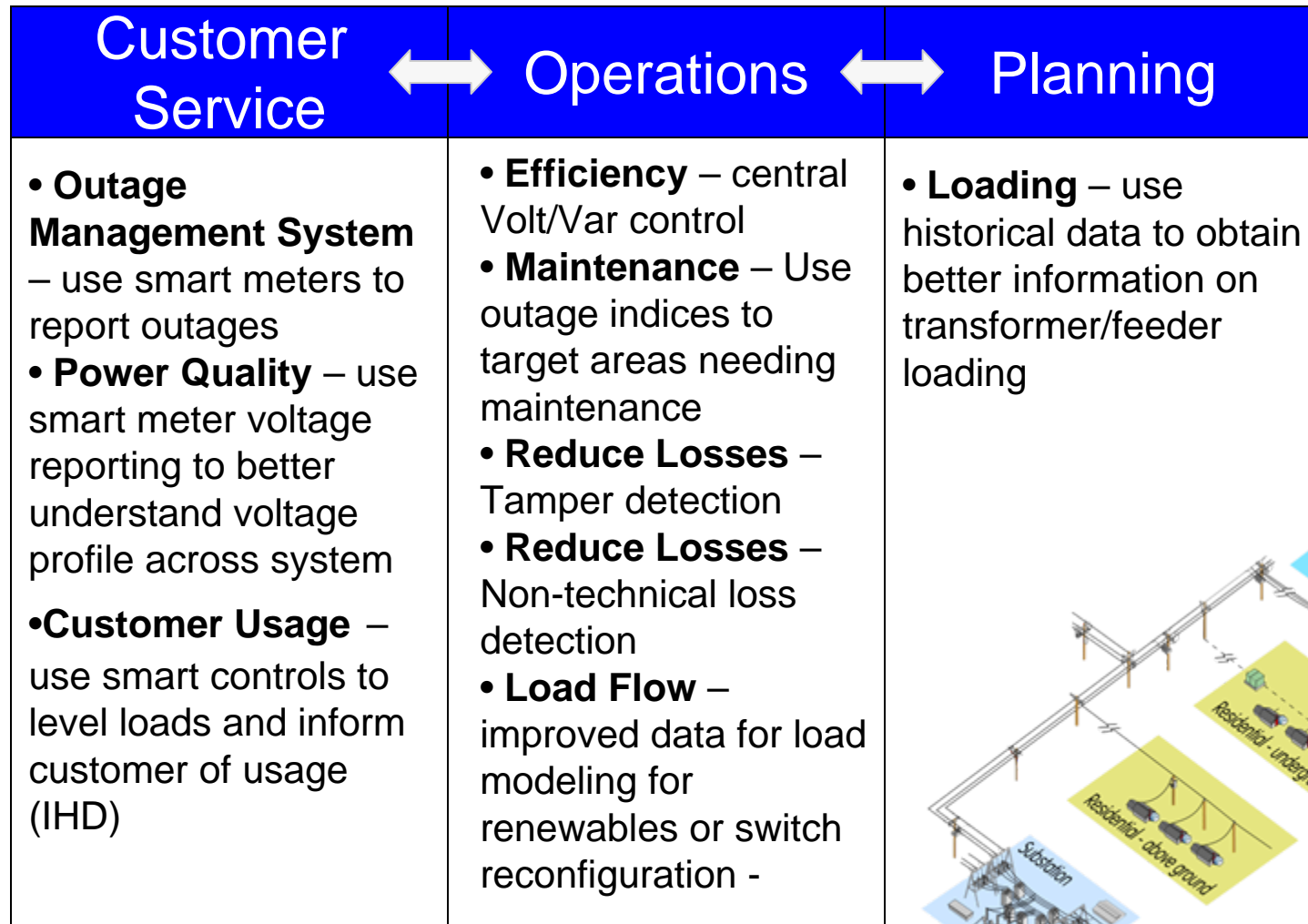
MV Underground Line
Node



Thermostat



MV Recloser Node

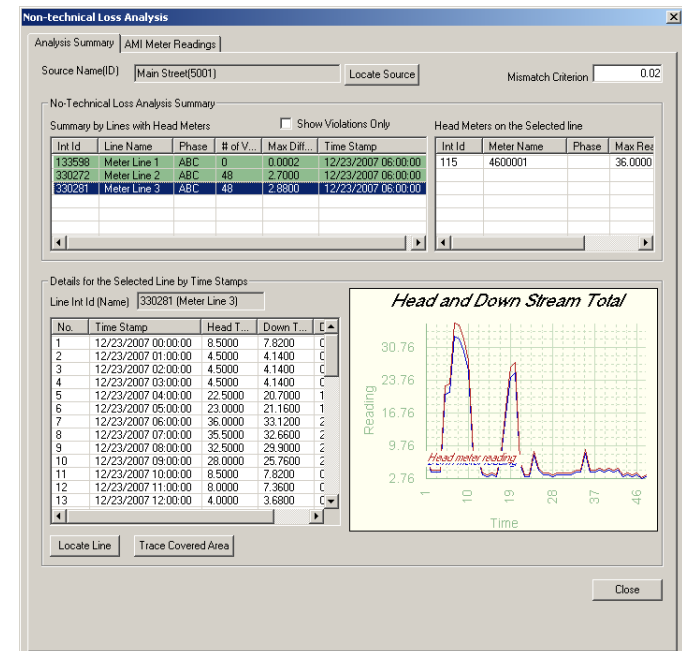
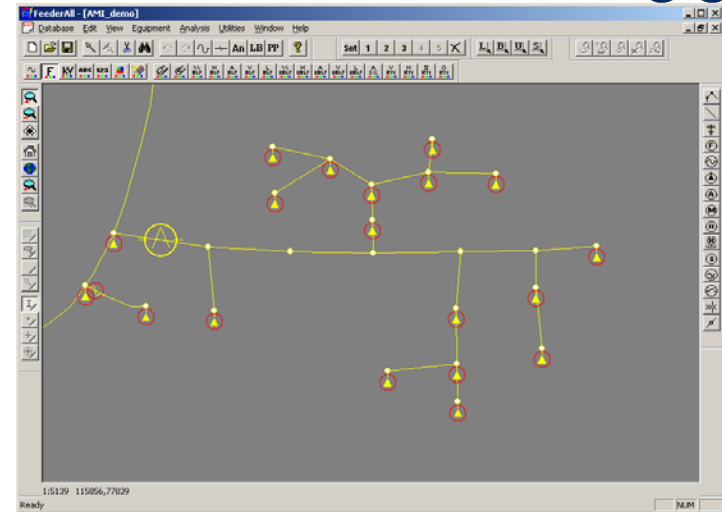


Some Examples

Pilot for Loss Detection



- Joint utility/Elster/ABB pilot to demonstrate loss detection
- ABB FeederAll allows user to model electrical network
- Head and load meters are modeled in the network
- Elster meter data is imported from files
- User initiated trace shows the loads and circuit covered by a head meter
- Dynamic trace detects head meters downstream from an upstream head meter
- Downstream head meter reading is subtracted
- Difference indicates losses



Thermostats with Load Control



- Deployed in the field
- Expands the basic Energate thermostat to provide:

- event status information

LOAD CONTROL DEVICES			
⊗	EVENT	START	END
	THERMOSTAT	NONE	NONE
⊗	POOL PUMP	12:04	2:34
	WATER HEAT SWITCH 4	2:00	4:00
	ANY EVENT	4:00	10:00

EXIT

- energy use information

ENERGY USE		TOU RATE A \$\$\$	
NOW: 3.726 KW		BREAKDOWN	
TOTAL ENERGY 560 KWH		RATE KWH	
ESTIMATED COST \$ 39.20		A:	88
		B:	89
		C:	383

EXIT



Conclusions

- AMI will become a key part of the smart grid
- AMI has the potential to **provide significant missing measurements** in distribution power system applications, providing solutions matching real-time conditions throughout the distribution network
- AMI provides the capability to:
 - **verify and improve real-time per phase unbalanced load flow**
 - **outage and restoration notification**
 - **Understand load flows on the distribution grid**
 - **Improve planning**
 - **Improve maintenance**
 - **Inform customers of usage**
 - **Initiate load conservation**
- If you believe the future requires more energy generation, better control and conservation are also required

Thank You !

