Smart Grid Alliance of the Americas

Review for International Seminar

NRECA International
March 2, 2014

International Seminar Presentation

- **What is the Smart Grid Alliance of the Americas?**
- **What Projects Have We Done?**
- **What Have We Learned?**
- **What Issues Should be Considered When Selecting an AMI system?**

Smart Grid Alliance for the Americas

- **NRECA received a grant from the Department of State in 2011 to sponsor a series of demonstration projects with cooperative utilities in Latin America**
- **The primary goal was to form a group of electric distribution utilities for the purpose of:**
  - **Increasing familiarity and understanding of smart grid technology and its use for improved commercial operations and system reliability**
  - **Present lessons learned from CRN smart grid demo project to inform the selection, design and implementation of the SGAA demonstration projects**
  - **Evaluate demonstration options with SGAA members, selecting those with widest applicability for knowledge growth and transfer**

SGAA “By the Numbers”

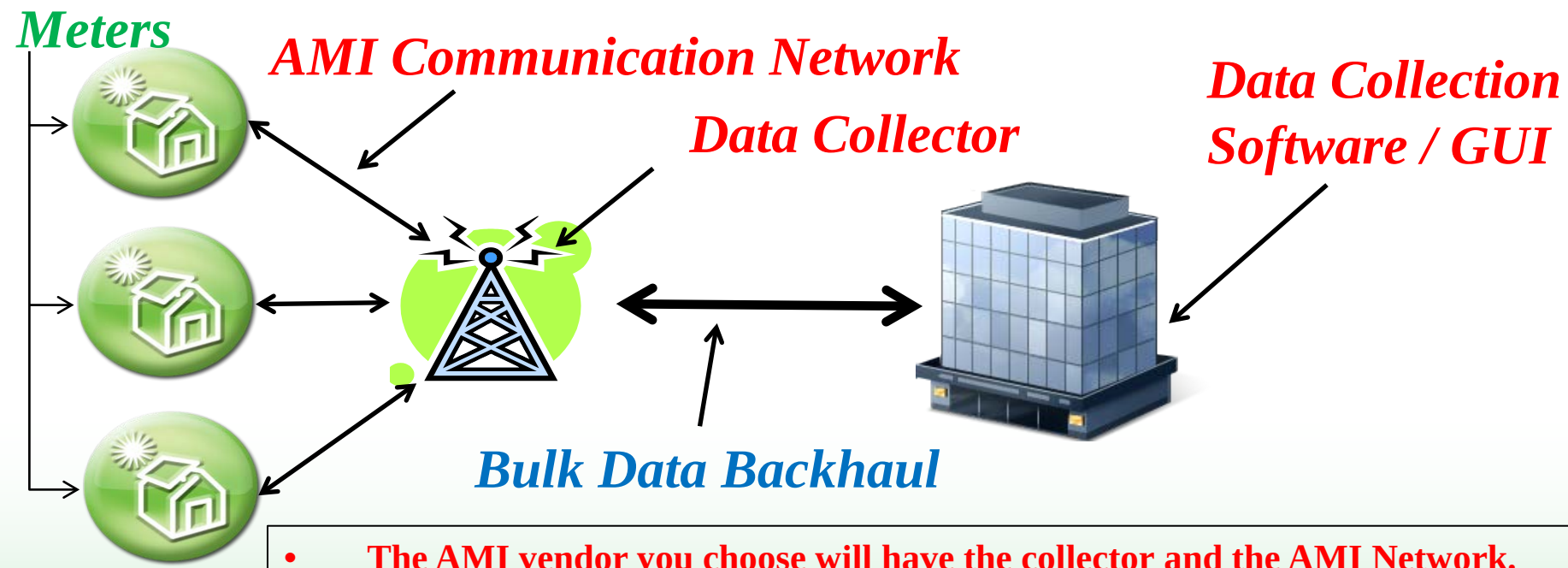
Cooperatives	Coopelesca, Coopeguanacaste, SOCOEPA and Roatan Electric	RF at Coopelesca & Coopeguanacaste PLC at SOCOEPA and RECO
Meters and Equipment	1,350 Meters Total 1 Data Collector and 1 Router for the RF systems. One Data Collector for the PLC systems.	350 each for Coopelesca and Coopeguanacaste, 500 at SOCOEPA and 150 at RECO.
“Extra” Material	~120 Meters per Coop and extra equipment	

AMI Communication Issues and Topics

- Typical configuration of AMI systems.
- Typical methods of meter communication.
- Comparison of meter communication methods.
- Issues to consider when selecting an AMI system.

AMI System Topology

All AMI systems have the same 5 basic parts:



- **The AMI vendor you choose will have the collector and the AMI Network.**
- **The Bulk Data Backhaul network is up to you.**
- **The Meters are comprised of a standard electronic meter and a AMI vendor specific communications module**

Communication Issues in AMI Systems

- **The choice of the communication system to be used between the Data Collector and the meter is difficult and clouded.**
- **Power Line Carrier (PLC) uses the power line to communicate with the meter and Radio Frequency (RF) uses one of a few different radio methods.**
- **The utility should primarily consider the desired functionality of and the available data in the meter in their decision between PLC and RF.**
- **The MOST IMPORTANT Communications issue to address is communications WITHIN your Utility…department must work together for AMI to succeed and thrive.**

PLC AMI systems

- **Deployment of AMI Data Collector is typically in substation or at delivery point.**
- **Injects a signal onto the power line through a coupling transformer or coupling capacitor.**
- **Meter read ‘fetch’ times vary from as quick as 1 second to as slow as 20 hours. However the slowest systems do record and report a ‘midnight read’ every day.**
- **Many support Load Profile, voltage readings and other optional data (blink, outage, etc) but some do not. Important to understand and discuss with internal team.**

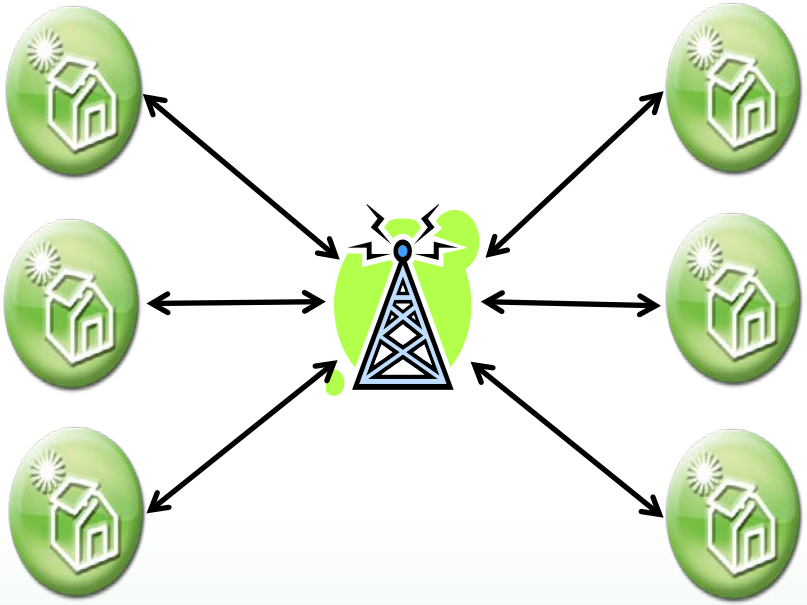
PLC AMI systems

PROS	CONS
Cost Effective: One data collector can serve thousands of meters	Less Bandwidth: The use of the power line limits speed of and volume of data that the system can carry.
Signal strength issues can indicate potentially bad spots on the distribution system.	Some users report interference from Variable Frequency Drives (VFD's), cell phone towers and capacitor banks.
No separate communication system is necessary to communicate with meters.	Some PLC systems require blocking units to be installed at capacitor banks and may need 'repeaters'.
Few regulatory issues.	

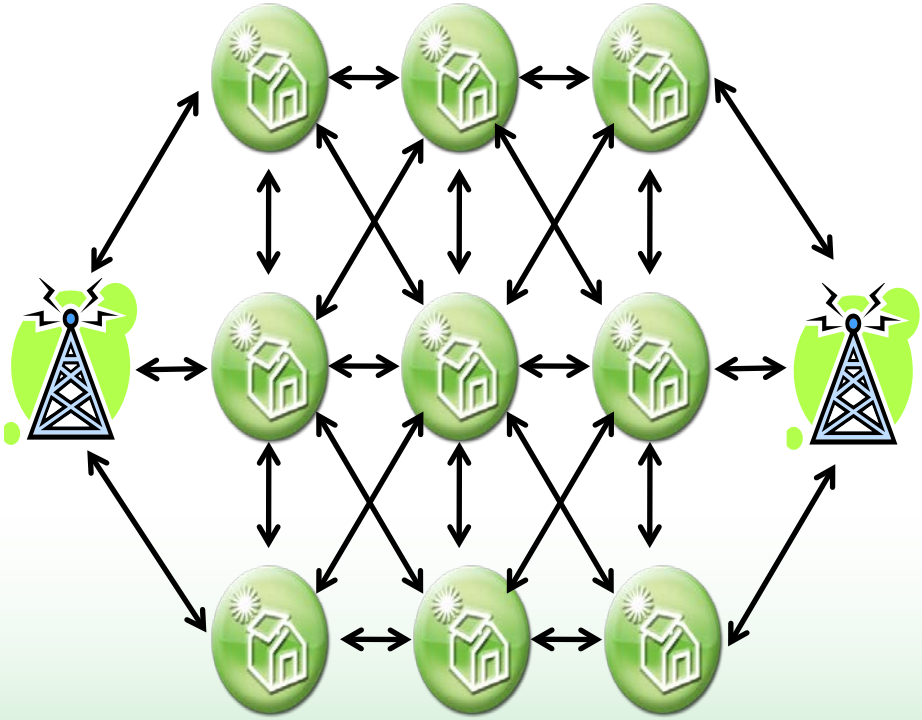
RF AMI systems

- **Deployment of the RF Data Collectors is typically out in the service territory.**
- **They use one of two RF methods: “Fixed” or “Mesh”**
- **Fixed systems tend to use higher power radios and licensed frequencies which can lead to fewer installations.**
- **Mesh systems tend to use lower power radios and unlicensed frequencies which can lead to more installations. Also some mesh systems deploy repeater radios to help with communications to marginal meters.**
- **Meter communication times are very fast.**
- **Support many more optional features such as Load Profile, voltage readings, theft detection, etc.**

Fixed and Mesh Networks



- Suitable for low density applications
  - Little infrastructure required
  - Can be licensed or unlicensed
    - Relatively high bandwidth
      - Typically very flexible
        - Simple to maintain



- Typically used in urban & suburban applications
- Lots of infrastructure
- Very flexible systems
- Not a great deal of bandwidth

Mesh RF AMI systems

PROS	CONS
Can be implemented in small pockets or regionally.	Depending upon density of consumers it may require a great number of collector or repeater radios.
If enough meters and radios (collectors and repeaters) are installed it will operate as ‘self healing’	Due to use of unlicensed frequencies it may experience interference or regulatory deterrents.
“Self Forms” by sensing new meters, new radios and new paths.	Requires staff to understand radio propagation rules.

Fixed Network RF AMI systems

PROS	CONS
Requires fewer data collectors due to using higher power radios.	Tower space may be difficult or expensive.
Licensed bands have less interference.	Congestion may occur if too many meters try to communicate at the same time.
Fewer data collectors require less infrastructure and maintenance.	Licensed radio operation requires annual fees and slightly more labor.
	Potential regulatory issues.

“Typical” Applications of Each Method

PLC	Mesh RF	Fixed Network RF
Very rural areas with low density or non connected service territories.	Suburban areas	Urban and suburban
Some have maximum number of meters per data collector.	In low density areas mesh can not work.	Building shadows have negative effects.

Cell Phone Modems AMI systems

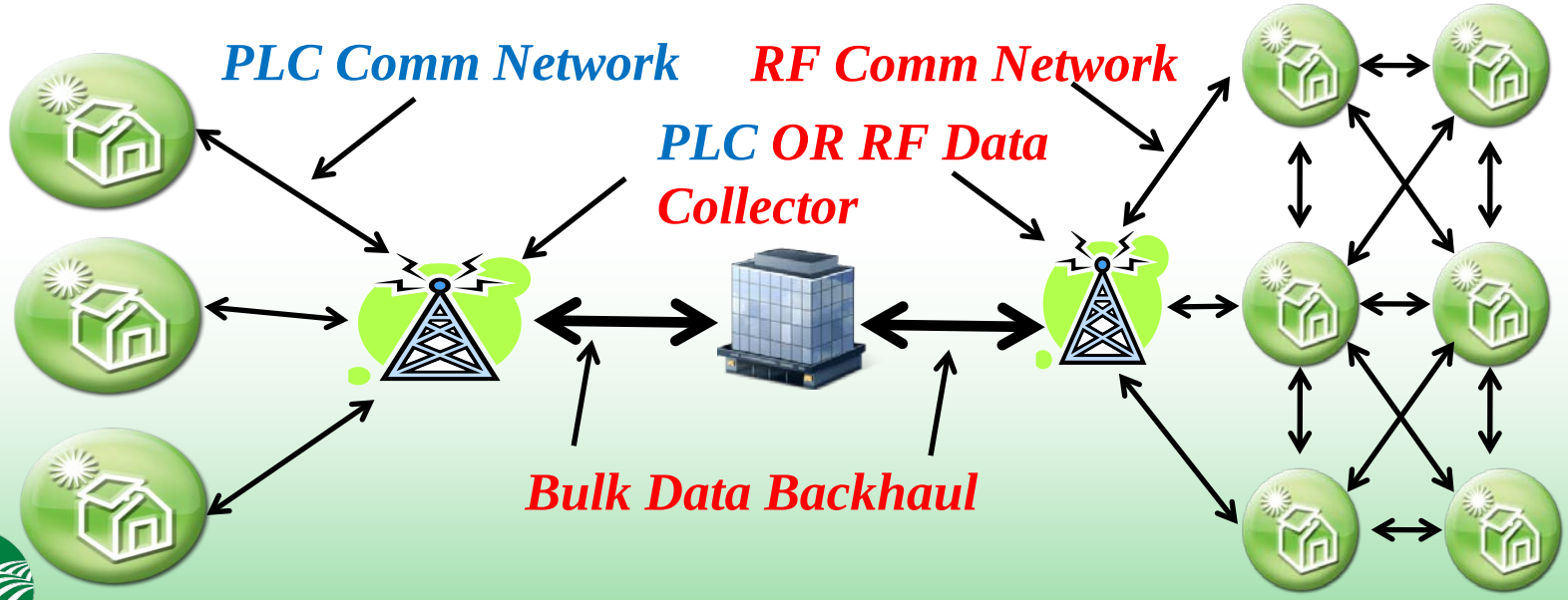
- **Less typical than PLC or RF communications. Many AMI vendors do not offer a Master Station that can use cell phone modems.**
- **Excellent choice for use with C&I customers along with a meter data collection software package such as MV90.**
- **No need for lease or purchase of tower space. But does have a monthly cost for each meter.**
- **Can become obsolete if cell phone companies upgrade their systems.**
- **Not recommended for ‘mission critical’ applications such as DA but metering should be OK.**
- **Less likely to include options such as disconnect, voltage readings, blink count, etc**

Important Questions to Ask Yourself

- How quickly do we need a meter read and what data do we need from each meter on a regular basis?
- Separate data 'requirements' from data 'possibilities'.
- What future Smart Grid applications to we want to deploy and how can they work with this system?
- How "Future Proof" is the proposed system?
- What data requirements do you have for your larger Commercial and Industrial customers?
- Should I consider a "Hybrid System"?

Hybrid AMI System

- **Many AMI vendors are offering a 'Hybrid' system today.**
- **Uses different kinds of meter communications and data collectors that all report to the same Master Station.**



Information You Should Have as You Consider AMI Systems

- **Answers to previous questions…Two slides up ^^**
- **Number of substations along with number of meters per substation broken into three phase and single phase counts.**
- **Square miles of served territory.**
- **GPS locations of meters.**
- **Are your CIS, BIS, Outage and other related systems Multispeak compatible?**
- **What ‘kinds’ of internet connections or back haul methods are available at your substations and in your service area.**

Issues to Consider During Selection of an AMI System

- **Creation of an internal "Team" to help define needs. This is the most important aspect of AMI project design, selection AND implementation…the team should be comprised of staff members from all departments of the utility.**
- **Regulatory issues – both present and upcoming.**
- **Customer needs. Do any of your customers want data from the system? Additional rates?**
- **Future growth of Smart Grid systems within the utility…is there some data or function in the AMI system that another system can take advantage of?**

Implementation Lessons Learned

- **Interdepartmental Communications are key to full success of any Smart Grid system including AMI. A strong team is key to greater success.**
- **Consideration should be given to study the full territory, not just areas for trials.**
- **When deploying RF systems install enough meters in an area so that their 'mesh' can form.**
- **Selection of the "Best" Vendor that will partner with your utility.**
- **Project scheduling is difficult due to regulatory requirements for testing, inspection and review.**
- **Consider contracting meter replacement.**

Data Management Lessons

- **Deployment of AMI technology facilitates a quantum increase in data available to the utility**
- **This creates data management, processing, validation and utilization challenges – how to manage so much data, and what to do with it**
- **Validation of data can present a significant challenge and requires bridges between the AMI system and other electronic data bases, such as customer information systems, outage management systems and others. These systems are called Meter Data Management (MDM) systems.**

Long Term Lessons Learned

- **Interdepartmental Communications are key to full success of any Smart Grid system including AMI. A strong team is key to greater success.**
- **Cost / Benefit Analysis of AMI system almost always falls short. Utility management should consider intangible benefits when considering AMI:**
  - **Making consumption data available to customers empowers them to make smart decisions in their power usage.**
  - **Fewer service calls and more accurate information for service calls. Better Customer Service**
  - **Better understanding of transformer loading and voltage profile.**
  - ***Recall SCADA implementation and think about AMI in terms of long term benefits.***

Questions ?? ?

Thank you for participating.

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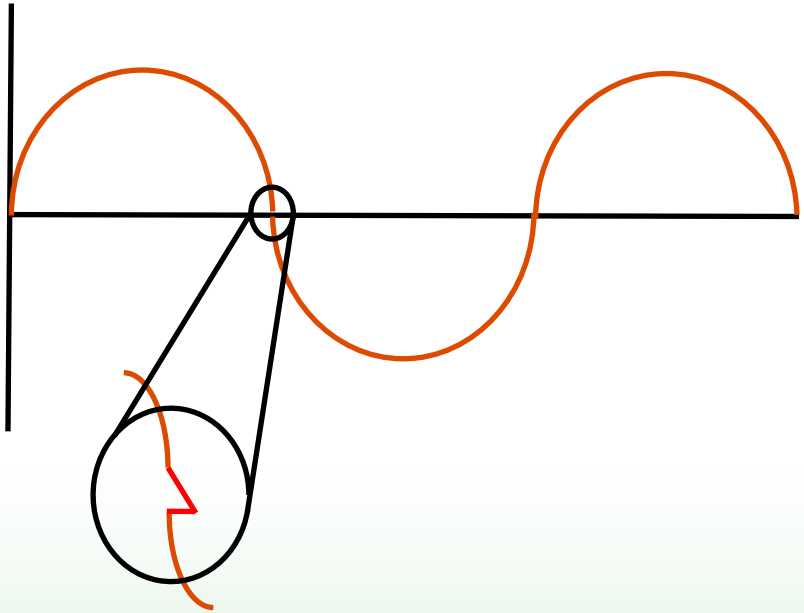
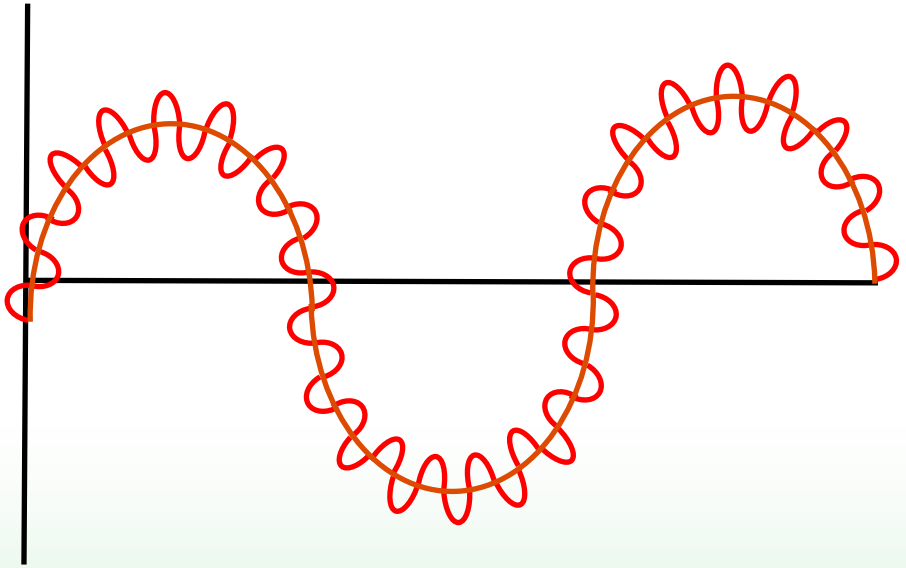
Power Line Carrier (PLC)
"Zero Crossing" and "Full Waveform" Injection



- Bit inserted at the 0 crossing point
- Cleanest part of the waveform
- Very limited bandwidth.



- Lots of "real estate" for communication signal
- Much more bandwidth than Zero Crossing based systems
- More capabilities due to higher bandwidth.
- Less noise tolerant than Zero Crossing based systems