RF Mesh AMR Implementation

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Overview

- I. Russian AMI Experience
- II. AMI Communications Technologies
- III. AMI Network Demonstration

Each section:
30 min. presentation
15 min. Q & A
10 min. break
Company facts

- 1,487,224 residential customers
- 1,883 employees
- 72 offices – payment centers
- Annual consumption (2007)
  - 3,065 million kWh
- Annual turnover – energy (2007)
  - 172 million USD
Main business

- Electricity billing, payment collection and processing;
- Monitoring and control of the electricity consumption;
- Monitoring of the client base;
- All kind of electric installation works, especially installation and technical service of the electricity meters;
How to control consumption?

1. **Ordinary.**
The meter reader visits each customer every year (1/2 year).

2. **Extraordinary**
According to the different special cases (f. ex. The non-agreed connection) - extra visit of the reader or even of the engineer.
Difficulties

- In-house losses
- Non-payment
- Non-regular payment
- Monitoring staff costs
- Exceeding of ordinary consumption
AMR drivers

- Non-technical loss elimination
  - Reduce theft
  - Increase payment control
- Technical loss control
  - Transformer loss monitoring
  - Transmission loss monitoring
- Billing improvements
  - Decrease collection interval
  - Increase total collections
- Human factor reduction
Problems with AMR in general

1. High price
2. Admittance difficulties
3. High maintenance price
Project #1

AMR via PLC
Old part of St. Petersburg (700 flats)

Failed because of bad net condition.
Project # 2

New part of the city - 5019 flats

Positive effect:

Stabilized cash flow
95 % in-time payment (was 75%).
Negative sides of PLC

- Highest dependence of net conditions.
- High price
- High installation price
- High maintenance price
- Difficulties of admittance.
- Not possible to use for the monitoring of other utilities
Why RF mesh?

- Significantly better experience with RF than with PLC in Russian environment
- Ultimately, technology agnostic – need for reliable data delivery at lowest cost
- Selected RF mesh from Eka Systems for lowest estimated cost of ownership
True RF mesh AMI

- Self organizing – no manual network node provisioning
- Ad hoc – no manual network hierarchy assignment
- Peer-to-peer – no multiple node types, such as coordinator, router, end device, etc.
- Self healing & redundant – distributed intelligence to re-route
- Multi-hop: no hop limits, no meter to gateway mapping
Connectivity

- RF system operating at 2.4 GHz
- Reliability of Bluetooth – stable, proven, robust
- License free band in Russia
- 20 milliwatts of transmit power – range of 500m in free space
- External antenna options add flexibility
Pilot project

27,000 single phase meters

293 three phase meters

25 gateways

EkaNet RF mesh AMR system

1 Eka server

billing and monitoring software
Technical highlights

- No hard limit of meters per gateway (1400+ in deployment)
- Multi-tier systems security
- Gateway redundancy – each node can go to multiple gateways
- Option to add battery nodes for multi-utility metering
Typical building

Install time – 2 hours
Install team – 3 electricians
Example of self organization

- Gateways - 1
- Relays - 19
- Meters - 736
Mesh of Multiple Buildings
Important System Features

Technical
- Plug & play - (self-configuring, no provisioning of meter-nodes required)
- Bidirectional (enables numerous functions such as demand reset, and remote upgrades)
- Under-glass – resistant to vandalism

Data storage (security)
- Time synchronization (accurate time-of-use)
- Data storage at meters and gateways prevents data loss
- Secure 128 bit encryption

Labor factor
- Easy-to-install (no need in high-qualified technicians)
- Easy-to-work with (limited number of high-qualified personnel)
Cost Advantages of EkaNet

- No limitation on number of hops
- No network address requirement for nodes
- No hierarchical network architect
- Nodes can communicate with any gateway
- No specific limitation on number of nodes per gateway (network performance and economics are key drivers)

*Over a 10 year life of an AMR system, the above features play a decisive role in keeping to a minimum the annual cost of network management*
AMI cost of ownership

- Total cost of ownership often missed in AMI decisions
- Corporations with only a few thousand employees maintain large IT departments to manage data communications
- The true cost of installing, managing and maintaining a network of several hundred thousand AMR points is not well understood or fully appreciated by many utilities
Summary of part I

- After pilots, selected wireless mesh AMR system for 27,000 meter extended pilot with plans to roll out 1,400,000 points
- Self configuring system leads to rapid and cost effective installation, performed by electricians
- Self organization features of system lead to significant cost savings in operating and maintaining the system over its useful life
- Cost of installing, operating and maintaining large AMR networks is significant and not well understood by utilities
AMI Network Demonstration

- Eka Systems Company overview
- Technology overview
- Product overview
- Network demo
Eka Corporate Snapshot

- **Business**: Global supplier of Smart AMI networking solutions for investor-owned and publically owned utilities
- **Company**: Founded 2000, staff 70, HQ in Maryland
- **Market Focus**: Smart Networks for the Utility Industry serving Smart Grid & Advanced Metering Infrastructure for Electric, Water, Gas
- **Key Differentiators**: Technology & solution performance, reliability, scalability and cost efficiency
- **World Class Investors**: Angeleno Group, Rockport Capital Partners
- **Global Customers**: UGI/Griffiss/Fairfax County/Tampa/San Marcos (USA) Lenenergo/Murmansk/Ko lenergosbyt (Russia), EMELEC (Ecuador), Singapore Power Grid (Singapore)
- **Partners**: 

![Logos of various companies]

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Eka Systems Highlights

- Leader in bringing operational efficiency to the energy industry
  - Smart Grid wireless sensor & device networking
  - AMI and home area networking
  - Distribution automation

- Developed most robust, secure, self-managing Smart Network architecture
  - Handles complex/massive data demands
  - Supports next-gen utility services
  - EkaNet™ platform

- Proven installations around the world
  - Large-scale utility metering
  - Multi-tenant sub-metering
Turnkey Solutions Provider

- Smart Networks
- Smart Grid
- Distribution Automation
- AMI
- AMR
- Energy Management
- Home Area Networking
Turnkey Solutions Provider

- Networked meter interfaces
  - Designed for all major meter manufacturers
- Standards and Protocols
  - IP/Ethernet, SQL, ANSI, GPRS, CDMA
  - Radio – ISM band, Standards-based & proprietary
- Wireless Nodes – external or embedded
  - Electric meters – residential, commercial, industrial
  - Electrical residential sub-meter
  - Gas meters – residential & commercial
  - Water meters – residential & commercial
Wireless Gateways
- Indoor or outdoor
- Bridge between the Internet and the local wireless network
- Application software communicates to Gateway via Ethernet, WiMAX, cellular modem, satellite or other long-haul wireless connection

Network Manager
- Easy to use software solution for setting up, configuring and monitoring EkaNet wireless networks
- Advanced network management features and installation & maintenance tools

Data Manager
- Data visualization supports/interfaces to MDM systems

Field Tool
- Facilitates rapid rollout and system deployment
- Maintenance and troubleshooting tools
Technologies – Best-in-Class

- Application level: Upgrades, Meter particulars reporting – S/N, channel configuration etc.
- Segmentation & merging: Multiple Gateways, selecting & switching between Gateways
- Resource management: Dense/sparse neighborhoods, traffic management
- Routing: No centralized authority, forward & reverse routing
- Network maintenance: Link evaluation, dynamic switching of routes
- Network formation: No manual addressing, co-ordinate programming etc.
Architecture

- **True** Smart Mesh Networking
  - No limitation on number of hops
  - No network address required for Nodes
  - No managed hierarchical network architecture
  - Nodes can route for and to any other node
  - Nodes can reach any Gateway
  - No specific limitation on number of Nodes per Gateway
  - Network performance and economics are key drivers

“True mesh networks lead to robust, low-cost, scalable sensor networks”
Applications

- Smart Network
- Smart Grid
  - AMI
  - Distribution Automation
  - Demand Response
    - Home Area Networking
    - Load Control
    - Industrial Energy Management
- AMR
Applications

- Smart Network
  - **Comprehensively secures** entire network with a design-to-disposal approach securitizing all components
  - **Scales by design** from thousands to hundreds of thousands of endpoints without intervention or hierarchy
  - **Manages itself** by self-configuring and automating functions on many levels
  - **Supports future applications** necessary to serve the needs of evolving utilities
Applications

- **Advanced Metering Infrastructure**
  - Provides insight into infrastructure demands and growth
  - Reduces traditional IT costs - faster ROI
  - Self-managing architecture to handle complex data demands & massive scale
  - Enables next generation utility services
  - Fuels new service standards
  - Proven reliable
Applications

- Distribution Automation
  - Bi-directional control & data networking
  - Reliability
  - Up-time assurance
  - Detects potentially critical faults
  - Forward looking planning tool
  - Foundation for next generation T&D information infrastructure
Applications – Demand Response

- Home Area Networking
  - T-Stat control
  - Pricing signals
  - Smart appliance management
- Load Control
  - HVAC switches
  - Water heaters
  - Pool pumps
- Industrial energy management
  - Advanced TOU
  - Pricing signals
  - Grid level event management
Applications - AMR

- Fixed network or mobile solution
- Integrates electric, gas and water meters
- Provides 15 minute interval data for each meter Node
- Automatic time sync capability
- Cost-effective multi-brand meter solution
- Evolution to Smart AMI
Smart Network Products

- Water and Gas Nodes
  - Node for Residential Gas Meters
  - Node for Water Meters
- Electrical Nodes
  - Residential Electric Meters
  - C&I Electric Meters
Smart Network Products

- Wireless Gateway
- Wireless Network Field Tool
- Mobile Collector
- Network Manager
- Data Manager
Gas and Water Nodes - Overview

- Battery-powered endpoints
- Designed for AMI applications
- Fully integrated for two-way communications
- Compatible with residential and C&I meters
- New deployments and retrofits
- Indoor/outdoor and pit installations
- Durable all purpose enclosures
  - Intrinsic safety compliance for gas
  - Pit installation ready for water
Gas and Water Nodes - Overview

- One hop Node, communicates with electric Node and relay
- Two-way communications
- Self-configuring, self-healing - no human intervention when deployed
- Data delivery security
Wireless Gateway

- Reliably & securely connects back office to the wireless network
- “Backhaul agnostic” - compatible with standard protocols & hardware (cellular, Ethernet, DSL, fiber, private backhaul)
- Supports all Nodes
  - electricity, water & gas meters
- Provides simple, remote configuration of meter Nodes
- Ideal for AMI and sub-metering
Wireless Network Field Tool

- “Go Anywhere” Compact Diagnostic Field Tool
- Site surveys of wireless connectivity during network installation and commissioning
- Analyzes meter Nodes, pulse Nodes, Relays & Gateways
- Enables rapid network rollout & system deployment
- Pinpoints optimal Relay and Gateway locations
- Valuable maintenance & trouble shooting tool
Network Manager

- An engineer’s view into Smart Network monitoring and your AMI infrastructure
- Provides for the seamless collection, end-to-end transport and secure database storage of all the meter data within wireless network
- Engineered for precision monitoring
- Provides utilities with a graphical view of their entire Smart Network
- Connects to and communicates with Wireless Gateways through standards-based connections
- Configures, controls and manages all Gateways and Meter Nodes
Network Manager

- **Key Benefits**
  - Optimized for easy management and control of the entire network
  - Produces meter data reports with less effort and manual intervention
  - Enables on-demand meter reads
  - Securely manages the storage of all data in a central database

- **Features**
  - Connects to and communicates with Gateways through native IP or other standard connections
  - Configures, controls and manages all Gateways and meter Nodes
  - Meter Node status checks
  - On-demand meter reads
  - Automatic Smart Network and wireless Node configuration
  - Securely manages and stores all data in a central database
  - Advanced power management
  - Configures and displays alarms
EkaNet Network Manager

**Software Specifications**
- LINUX® – UNIX® OS
- WINDOWS® 2000 / XP / 2003
- MySQL database standard
- Automatic gap filling of data
- Configured for mirrored data centers
- JAVA® standalone application

**Application Specifications**
- Provides setup control and configuration of wireless network
- Allows selection of data channels, data recording and reporting intervals
- Graphical User Interface
- User selectable interval data recording
- TCP / IP
- Monitor state of meters in network
- Secure administration defined access to Nodes within the EkaNet Smart Network
- Extendable to manage gas & water meters and other sensors
Network Manager Demo

- **27,000** single phase meters
- **293** three phase meters
- **25** gateways

**EkaNet RF mesh AMR system**

- **1 Eka server**
- **billing and monitoring software**

Diagram:
- EkaNet wireless mesh meter-node network
- Application Server
- Database
- Network Manager Client
- Utility CRM Database
- Utility CRM Application
- Utility Billing Application

- Electric meters with embedded Eka modules
- Wireless Gateway
Thank You

With Questions or for further information please contact:

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