

Advanced Power Metering in North America



Tomer (Tom) D. Tamarkin, USCL Corporation Electricity 2006 Eilat Israel November 15-17 2006

USCL Corporation First, there were blackouts





USCL Helping Consumers And **Utilities...**

"... because a kilowatt saved is a kilowatt earned".



Hello. I am Tom Tamarkin with USCL Corporation. I'm from California.

California has a problem. At brief but predictable times, we use more power than we can produce and deliver.

California has reelected its governor. His intent is to solve the problem.

The vision is to turn California ratepayers into customers.



California Governor Arnold Schwarzenegger and Israel's Prime Minister Ehud Olmert discuss energy conservation and announce various related trade agreements with Emily, & Tom Tamarkin of USCL Corp.





Israel's Binyamin Netanyahu discusses variable rates and the reduction of critical peak demand Sunday, Nov 12, 2006 in Palo Alto, California with Tom Tamarkin





IEC's Meter Department Needs No Introduction



USCL Corporation is developing advanced power meters for utility companies such as Southern California Edison (SCE), which is using "a 2-way communications infrastructure with 5 million intelligent metering devices (...) to create lasting value for our customers and our operations".



- Enable Energy Smart Customers
 - Integrated information from utility
 - Outage & service information
 - Payment options (e.g., pre-payment)
 - Support rate option innovations
- Manage Distributed Resources
 - Economic dispatch of load resources
 - Dispatch of load for grid management
 - Intelligent net metering
 - Distributed energy resources
- Operational Efficiencies
 - Field communication links to distribution
 - Revenue cycle improvements
 - Situational data in near real-time
 - Wholesale retail markets integration

A Contraction of the contraction



Advanced Metering Infrastructure (AMI) Cooperation between Industry and Utilities









Billing & Customer Service	Customer Interface	Delivery	Energy Procurement	Field Services / System Recovery	Installation & Maintenance
Multiple clients read demand and energy data automatically from customer premises	Customer reduces demand in response to pricing event	Distribution operator curtails customer load for grid management	Real-time operations curtails (or limits) load for economic dispatch (ES&M)	AMI system recovers after power outage, communications or equipment failure	Utility installs, provision and configure the AMI system
Utility remotely limits or connects/ disconnects customer	Customer reads recent energy usage and cost at site	Distribution operators optimize network based on data collected by the AMI system	Utility procures energy and settles wholesale transactions using data from the AMI system	-	Utility maintains the AMI system over its entire life- cycle
Utility detects tampering or theft at customer site	Customer uses pre-payment services	Customer provides distributed generation	-	-	Utility upgrades AMI system to address future requirements
Meter reading for gas & water utilities	Multiple clients use the AMI system to read data from devices at customer site	Distribution operator locates outage using AMI data and restores service	-	-	-

Produced by Southern California Edison



AMI Technology Assessment at Southern California Edison





Produced by Southern California Edison



Produced by Southern California Edison





- Conforms to all applicable ANSI specifications including data and communications
- Time of Use (TOU) Rates
- Peak Demand Rates
- Class of Service Rates
- Dynamic & Real-Time Pricing
- Critical Peak Pricing





EnergyCite Class 200 Residential Meter from USCL Remote Functions

- Wide Area Network data and multimedia telecommunications
- Service Outage & Restoration Reporting
- Theft of Power Reporting
- Remote Service Connect & Disconnect
- Remote Demand Current Limiting



EnergyCite Class 200 Residential Meter from USCL Power Quality Supervision

- Over voltage & under voltage reporting.
- Damaged neutral reporting
- Power factor monitoring and reporting, distribution-grid and subscriber side
- Reverse power measurement for net metering of solar power etc.
- WAN to LAN wireless gateway. 802.15.4 ZigBee compliant. 2.4 GHz and 902-928 MHz





EnergyCite Class 200 Residential Meter from USCL Multifunctional Capabilities

- WiFi & WiMax migration path for USCL AMI WAN communications C12.22 compliant and tcp/ip
- Subscriber-Side Billing. Billing calculation is performed internally by meter for all types of complex tariffs.
- Prepayment of service
- Remote Programmability of meter real time run software/firmware
- Wireless LAN to in-premise devices; i.e., EMS-2020, HA thermostat interface, etc.



Feedback of Information for Enhanced Consumer Awareness



Professor Sarah Darby, Environmental Change Institute, University of Oxford, England, points out the fact that there are three types of feedback to domestic consumers:

- real-time direct feedback within the consumer's premise,
- indirect feedback via billing, and
- inadvertent feedback as a by-product of technical, household or social changes.



Increasing Energy Efficiency using Information Feedback



Feedback has a significant role to play in raising energy awareness and reducing consumption by 10% to 20%, depending upon prevailing conditions. As Dr. Darby points out, "the highest savings - in the region of 20% were achieved by using a table-top interactive cost and power consumption - display unit and an indicator showing cumulative cost of operating electric loads..."

"Making it obvious: designing feedback into energy consumption," Dr. Sarah Darby, Real-time Energy Feedback Forum, Toronto, Canada, May 17, 2005.



The EnergyCite meter communicates bidirectionally via ZigBee radio protocol to the EnergyCite EMS-2020 In-Premise Display as well as other LAN connected devices.

The EMS-2020 software can also run on various PDAs such as the Palm Tungsten in combination with the EnergyCite meter and internal WAN to LAN gateway.

This screen displays the real-time burn rate, accumulated monthly use and estimated end-of-the-month bill in dollars and cents. A horizontal bar changes from green to yellow to red as the real-time power draw increases

The EMS-2020 allows the home or business owner to establish a budget. If the budget is in danger of being exceeded, the unit can be set to sound an alarm The vertical bar at the right shows the predicted end-of-month usage as a percentage of that budgeted.

The EMS-2020 software can also operate on a pc with communications to the EnergyCite meter enabled by a USB connected ZigBee-based EnergyCite radio transceiver module.

Domestic Feedback and Control Infrastructure

Real-time energy use feedback:

- Running cost
- Current rate information
- Accumulated cost

Monitor and display of other energy and utility commodities:

- Natural gas
- Liquid propane gas
- Fuel oil
- Water

Data collection for thermostats and smart appliances using ZigBee wireless mesh network

ZigBee Technology

- Needed to control loads within the residence and commercial buildings – a *complete* open *global standard* for reliable, cost-effective, low-power, wirelessly networked *monitoring and control* products
- If ZigBee is inside every meter, then ZigBee is the lowest cost means of:
 - Transferring meter data to the utility
 - Transferring load control and rate information out
- Result is a set of recognizable, interoperable solutions

 Optimized for timing-critical applications and power management

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possible

- Time to Join Network: <30ms
- Sleeping to active: <15ms
- Channel access time: <15ms
- Full Mesh Networking Support

- Network coordinator
- **Full Function node**
- **Reduced Function node**
- **Communications flow**

---- Virtual links

ZigBee Data Transmission

Who is Supporting the ZigBee Alliance?

- Eight promoter companies
 - Chipcon (TI), Ember, Freescale, Honeywell, Mitsubishi, Motorola, Philips and Samsung
- A rapidly growing list (now over 200) of industry leaders from 29 countries spanning 6 continents committed to providing ZigBee-compliant products and solutions
 - Companies include chip suppliers, wireless IP providers, OEMs, test equip manufacturers and end users

EnergyCite Form 2S Class 200 meter with optical probe interface and demand re-set switch

USCL optical interface probe used for in-house meter set up and emergency field data collection in the event of WAN failure

The EnergyCite meter contains an internal 2 pole 200 Ampere relay (for 110 V power in North America) that implements remote service connect and disconnect.

Open area on gray collar allows for the internal mounting of AMI communications modules including the USCL ZigBee LAN to WAN gateway. A unique EnergyCite enclosure feature allows effective PLC communications to in-premise 120 volt circuits

Detailed view of internal PCB mounting collar with facility to mount AMI modules and optional battery for extended last gasp communications at upper left

Three phase meters are in development. The unique EnergyCite meter base has been designed to support 2S and poly phase configurations. The use of robust blades and busses insures superior ANSI conformance on bus power dissipation

EnergyCite specially designed current transformers insure the ultimate in accuracy, full resolution at low power, immunity from saturation and exceeds ANSI core, insulation and connection wire requirements. The use of 2 CTs for 2S meter provides power factor differentiation of subscriber side and distribution network as well as broken neutral connection and segment voltage analysis

USCL Meter Development

USCL's U. S. meter development is headed by Victor Kolesnichenko PhD , shown here at a USCL research workshop.

USCL Meter Development

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USCL mechanical engineer, David Wuester, conducting a design review

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