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Rajit Gadh – "**WINSmartgrid** ***- Wireless Internet Smart Grid"***
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UCLA's Smart Grid Energy Research Center is developing an advanced communications platform and service that integrates wireless and mobile communications capability, sense-and-control technology, and, distributed intelligence, for enabling the creation of a Smart Grid. The key research platform - Wireless Internet Smart Grid or WINSmartGrid™ – is being developed with the intent to provide a quantifiable scalable service for servicing energy market applications such as Demand Response, Voltage/Frequency markets, Smart Buildings, EV Integration and Microgrids.

The UCLA WINSmartGrid™ is a mobile communications network platform technology that allows electricity operated appliances such as plug-in automobile, washer, dryer, or, air conditioner to be wirelessly monitored, connected and controlled via a Smart Wireless hub. The WINSmartGrid™ technology creates at its lower-layers an intelligent network that enables connection of sensor-enabled or controllable devices such as appliances, solar rooftops or smart meters to a web service that receives live feeds from utilities and external sources on information such as instantaneous price of power, future prices, etc., and sends control signals to various WINSmartGrid™ linked controllers which in turn dynamically switch on/off appliances based on rules. Important attributes of this system include low-power, distributed intelligence, plug-and-play, two-way communication, open-architecture for integration with sensors, devices, networks and appliances and standards-based interfaces.

This technology enables a direct link between utilities and consumers allowing offerings of incentive-based consumption of electricity during off-peak hours, enabling power storage aggregated battery-operated electric vehicles, or transmit power to the grid during off peak hours.

The WINSmartGrid™ architecture is based on our advanced technology called the ReWINS (Reconfigurable Wireless Interface for Networking of Sensors <u>http://winmec.ucla.edu/rewins</u>) that has been developed in the Wireless Media Lab and WINMEC Program in UCLA. WINSmartGrid™ has a layered architecture in which hardware is managed and abstracted via the Edgeware, the control signal origination, data management/movement, user interfaces and messaging are managed by the Middleware, whereas the Centralware stores the rules-based intelligence that form the policies that drive much of the system. Such a layered architecture results in ease of integration with the existing infrastructure, enhanced scalability and plug-and-play.

The Edgeware is a combination of software and firmware that forms the low-level connectivity to devices such as temperature monitors, humidity sensors, motion detectors or controllers. A variety of monitors/sensors may be exploited by WINSmartGrid™ including temperature, humidity, current, voltage, power, shock, motion, chemicals, etc. The Edgeware executes control of the wireless networks that connect to the WINSmartGrid™ hub. The WINSmartGrid™ hub supports wireless protocols such as Zigbee (SEP 1.0), Bluetooth, WiFi, GPRS and other RF standards. The Edgeware allows the creation, setup, management, control and utilization of a two-way hierarchical and low-power network.

The Middleware sits between the Edgeware and the decision making smart services or Centralware. The Middleware provides functionality commonly need such as data filtration, aggregation and messaging, extracting meaningful information from raw sensor data, or sending a control signal to the correct destination such as a device or a controller.

The Centralware resides primarily in the cloud, but may also exist within the network. It receives real-time price feeds and other data from the utilities, has a basic set of knowledge-based rules on control decisions, and makes the high-level decisions that need to be executed. The WINSmartGrid™ Centralware also has the capability to connect to other Intelligent Web services to collaborate on decision making about the control decisions.

Once the Centralware makes the decisions, the Middleware is informed about the control decisions via actions, which then maps and routes these control decisions to the Edgeware, which in turn converts those decisions to low-level control signals for the appropriate controller.