System Overview:

The Power Information Collection Architecture is a collection of components whose purpose is to accurately collect and relate information about power quality and consumption to a consumer. These components designed to be modular, can operate individually or together as a suite of sensors and controls to empower the consumer with more accurate and up-to-date information about power usage. The four major systems seen in figure 1 compose the PICA system.



Figure : An overview of the PICA system.

The E-Meter is a smart metering device; capable of monitoring single or multi phase power installations, this device replaces the current “dumb” meter that exists on the exterior of most residential and commercial buildings. The E-Meter monitors how much power an entire installation (e.g. a home or business) consumes over a given period. The utility company collects this information and uses it for billing purposes. By introducing a smarter power meter, Team PICA can monitor reactive power, flicker voltage, phase angle, frequency, and, peak voltage in addition to total power consumption. Once collected, the power company can use this information to understand more completely, the health and status of the electric grid. A web interface then provides the consumer with an hour-by-hour overview of their power consumption. The E-Meter provides an LCD display on the outside to display the instantaneous power usage in kilowatt-hours.

The smart breaker is a solid-state replacement for the traditional magnetic arc-fault breaker found in many electric panels. Using MOSFET technology to mimic a fault-interrupter, these solid-state breakers can sense a fault in the circuit and respond intelligently. Each breaker includes status lights to indicate the status of the circuit (on, off, fault), and a sensor to provide more granular information on power usage. A SoC collects the information provided by the sensors and uses the instantaneous measurements to control the breakers before packaging and shipping the data to the system controller for transmission.

The MCU controls the transmission of data to the PICA base station over the Zigbee 802.15 radio link. The MCU receives data in TCP/IP packages from each subsystem and acts as a buffer and arbitrator for the Zigbee radio. Onboard, the MCU will store packages until the mesh-network comes up and then transmits packages until its buffers are empty. The prototype MCU comes from a WRT54G wireless router produced by Cisco sold under the name Linksys and targeted at the home networking market.

The PICA base station collects all the sensor data, collates, and displays it on a webpage, hosted on the base station itself. The consumer can access the webpage by attaching the PICA base station to a network router or directly to the NIC of a personal computer. The PICA base station acts as the collector node for the Zigbee mesh network. The base station could provide a control point for future smart devices in the home, such as a thermostat or other smart appliances. The base station connects to an in-home display that displays current usage information.