Customer-Owned Grid Connected Devices
The Need for an Open Architecture
Duke Energy, at a glance

- **Total assets:** ~$114 billion
- **Market capitalization:** ~ $48 billion
- **U.S. generation capacity:** ~ 58 GW
- **Electric customers:** 7.2 million

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Largest Utility in the United States (1)

Diversified Generation Portfolio (2) (MWh output)

<table>
<thead>
<tr>
<th>Year</th>
<th>Coal</th>
<th>Nuclear</th>
<th>Natural Gas</th>
<th>Oil</th>
<th>Hydro</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>35%</td>
<td>5%</td>
<td>38%</td>
<td>1%</td>
<td>3%</td>
</tr>
<tr>
<td>2015</td>
<td>24%</td>
<td>3%</td>
<td>38%</td>
<td>3%</td>
<td>35%</td>
</tr>
</tbody>
</table>

(1) Total assets, US generation capacity, and electric customers as of Dec. 31, 2012; market cap as of February 2013

Many manufacturers of major appliances and other end-use devices have launched product lines with wireless communications and advanced control software, known as “smart appliances” or “grid connected devices”.

These appliances and other grid connected devices (e.g. plug in electric vehicles, smart thermostats, and home energy management systems) have the potential to increase a customer’s ability to monitor and manage their energy use – increasing customer convenience and providing the opportunity to reduce monthly electricity bills.

However, to maximize the value of grid connected devices, customers need the flexibility to access and manage their devices through a system or provider of their choice.

Utilities also need a cost-effective, ubiquitous way to communicate with and manage grid connected devices to facilitate local system optimization and effective Demand Response programs.
Today, manufacturers in multiple industries are developing “proprietary” architectures that require a customer to use their cloud-based service, which limits the customer’s ability to manage all of their devices in a flexible and holistic manner.

Additionally, it will be difficult for most utilities to effectively manage demand response programs and maximize distribution-level optimization if doing so requires the utility to interface with multiple proprietary architectures (which may also lead to stranded or redundant systems resulting in higher costs for all customers).

“Proprietary” architectures do not allow devices to easily “talk” with those from other brands. They also require customers and utilities to interact with multiple “clouds” or user interfaces.
Utilities can satisfy peak demand by:
- Purchasing on open market
- Building peaking power plants
DR is a much less expensive option than the above 2 options
Supply – Demand imbalance occur all times of year

So why are utilities so concerned about this issue?
Many Scenarios Exist for End Use Connectivity

<table>
<thead>
<tr>
<th>Wide Range of Devices</th>
<th>Various Participation by Utilities and Customers</th>
<th>Demographics and Regional Differences</th>
</tr>
</thead>
<tbody>
<tr>
<td>High energy consumers (HVAC, hot water heater)</td>
<td>Customer participation will vary (single appliance, suite of appliances)</td>
<td>Different levels of “smart grid” deployment</td>
</tr>
<tr>
<td>Low energy consumers (refrigerator, clothes washer)</td>
<td>Utility programs will vary (single/multiple appliances, price or interrupt signal)</td>
<td>Various communication platforms - zigbee, wifi, PLC, etc</td>
</tr>
<tr>
<td>Evolving energy consumers (plug-in electric vehicles)</td>
<td>Timing will vary (program availability may not occur until a “winning technology” emerges)</td>
<td>Different penetration levels of customer broadband</td>
</tr>
</tbody>
</table>

No single design or solution can accommodate all of these variations
A communications node is the physical control, logical, and telecommunications hub for the grid.

**COMMUNICATIONS NODE**
- Linux OS
- Java and C+ supported
- 256+ MB memory
- Powerful processor
- Network mgmt capabilities
- DNP3
- Integrated security

**Renewables**
- Distribution System
- Transformer
- WAN
  - Public Wireless Carrier
  - 3G/4G
- Sensor
- Capacitor Bank
- Recloser
- Streetlight System
- ETHERNET
- SERIAL

**Customer Premise**
- Smart Appliances
- PEV
- Smart Meter
- Legacy Meter
- RF or PLC
- 3G/4G, WiFi, GPS
- Ethernet, Serial
- PLC, 900Mhz ISM
A Call To Action – Take a Leadership Role in the Grid Connected Device Debate

- The EPA has allowed “proprietary” architectures to qualify for ENERGY STAR® incentives for refrigerators, and is in the process of defining grid connected criteria for other customer-owned devices such as HVAC systems, pool pumps, and water heaters.

- Other industries, such as providers of plug in electric vehicles and home energy management systems, are also developing their own connectivity specifications.

- Utilities have a responsibility to offer cost-effective programs to customers. However, this will be difficult if proprietary based solutions become the de-facto standard for grid connected devices.

- Utilities should seize the opportunity to partner with manufacturers and service providers to maximize customer benefits through open architectures.

- To date utilities have been reacting to events shaping this market; It is imperative that utilities become proactive in defining the “grid connectivity” specifications that will impact our customers and influence the design of utility programs.