# Ambient Corporation Response to the New York Energy Highway RFI

**May 30, 2012**

# Ambient Corporation Submission to NY Energy Highway RFI

## Respondent Information


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Michael W. McCarthy
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As Director of Investor Relations & Government Affairs, Mr. McCarthy serves as Ambient Corporation's primary spokesperson in those areas that involve interaction with government officials and policy administrators at the federal, state and local levels. Additionally, he plays both strategic and tactical roles in those markets where Ambient is or planning to have its smart grid communications platforms & technologies deployed. Chief among his direct day-to-day management responsibilities are all related two-way communications activities that enable to Company to understand the emerging needs of a utility industry, how those needs might be affected by existing policy or policy changes such that Ambient's utility customers might maximize the performance of those technologies and applications. Additionally, he serves as the point person in supporting those key decision makers and their respective staff operating in the policy arena to better understand emerging smart grid technology trends, economics, and just where Ambient's products and services fit in such that they enable utilities to bring the benefits of an intelligent grid to ratepayers.

Mr. McCarthy joined Ambient in August 2011 where he serves the CEO as an adviser in the areas of investor relations & government affairs. He is a graduate of Michigan State University and holds a Bachelor of Science Degree in Public Affairs Management.

# Project Description

### Type of proposed project (generation, transmission or combination)

The type of project being proposed by Ambient Corporation is one through which utilities (gas and water as well as electric) across the State can both upgrade their infrastructure while at the same time delivering intelligence to those resources being vital services to industry, businesses and citizens through a utility's service region. Discussed in brief below, are the types of services that Ambient Corporation will supply to utilities, from the large investor owned to the smallest municipals or co-operatives that enable them to effectively modernize their grid infrastructure.

### Ambient System Overview

Ambient is aligned with those electric utilities leading the smart grid revolution, as well as those technology companies serving this growing market.

The smart grid node, designed by Ambient, is an open and flexible communications platform designed to insure interoperability and longevity of smart grid applications and communications networks on a cost-effective basis, regardless of environment or location. The communications nodes we produce can integrate a variety of applications without the need for further investment in multiple and redundant communications equipment platforms, saving a utility considerable deployment time, infrastructure and backhaul communications cost.

We provide a common, powerful and open communications link to connect and unify smart grid technologies such as smart meters, sensors, and wireless communications. To date, no other single solution or technology has provided the necessary flexibility in a cost-effective manner enabling a comprehensive digital communications platform while leveraging standards-based technologies.

As a result, we are helping utilities bring new energy solutions to their customers; from demand response and real-time pricing, to always-on system monitoring, new ways to harness sustainable energy sources across the grid and opt out programs addressing customers concerns due to radio frequency (RF).

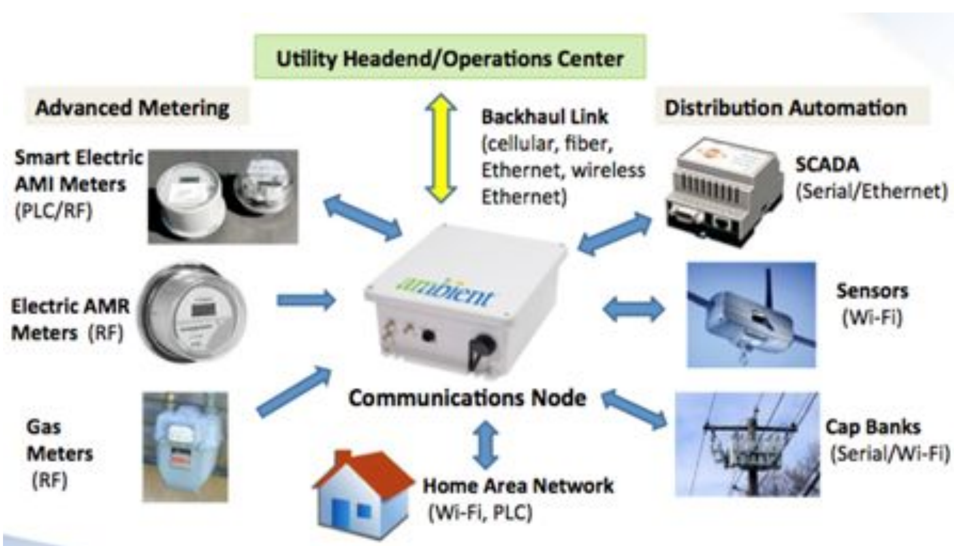
We are proud to be working with companies leading this industry and are committed to bringing our solutions to utility markets all across the world. Such companies include: ABB, Badger Meter Inc.; BelFuse; Duke Energy; Echelon; Itron; Qualcomm; S&C; Sierra Wireless; Sprint; Tollgrade; and Verizon Wireless, among others.

Ambient's communications platform includes the following:

**Ambient Smart Grid ® Communications Nodes**

Communications nodes are physical boxes that contain the hardware and software needed for communications and/or data collection. The node supports smart grid assets (distributed automation, distributed energy, advanced metering, in home devices, etc.) connecting end devices with a field area network (FAN) providing the flexibility and option of different communications backhauls and local connections. We configured our communications nodes to act as individual data processors and collectors that receive signals from other connected devices, enabling smart grid applications such as the distributed automation (DA) devices contemplated by the taskforce for this RFP. ***The field area network node allows utilities to mix and match utility end-points (DA device points as well as electric meters, gas meters, sensors, etc.) by leveraging various communication technologies (e.g. Wi-Fi, 900Mhz, power line carrier (PLC), cellular (1x, 3G, 4G) etc.) within a single piece of hardware.*** This flexibility pushes proprietary communication systems to the fringes of a utility's network, and does not lock in a utility to any given technology, application, or end-point vendor with their initial investment.

Below is a diagram that depicts how the node supports multiple devices/applications, in parallel, while also providing data storage (event and data logging), central processing unit (CPU) processing, data aggregation, and software applications (either utility based algorithms or other third party vendors through the software developers kits (SDK) or integrated development environment (IDE) development programs we offer). Listed interfaces are those commercially available today.



The communications node is supplemented and enhanced by our AmbientNMS®.

The Ambient Network Management System (AmbientNMS®) is a network management system that manages large numbers of communications nodes, devices and customers on a smart grid network. A utility can use the AmbientNMS to effectively manage its entire smart grid distribution system, providing valuable information over a single communications network. We customize AmbientNMS, providing a utility with the tools necessary to tailor its monitoring and processing and to act upon vast amounts of information on a real-time basis. AmbientNMS also provides the functionality to predict, and precisely control, the amount of data traffic to be used by individual devices and the communications network as a whole. Utilities can systematically push software updates to deployed communications nodes and other downstream devices.

Our integrated solution of the node and NMS is designed to meet the functional requirements of each connected or future application in parallel. Through this integrated design, with a proven 95,000-node deployment with Duke Energy over 5 years, we are able to support Duke in their grid modernization efforts, which are ongoing.

In terms of physical and environmental requirements, Ambient's node is a stand-alone "smart" communications device that would mount at the distribution device point.   Base station equipment could be used if the utility decided on this type of backhaul communications although current customers have mainly used public carriers to avoid cost, leverage the benefits of a large market place, such as reliability, continued investment, customer support centers. Ambient's communications node, because it is based on an open architecture and Internet protocol-based, is fully capable of integrating legacy assets now in the field (e.g. automatic meter reading (AMR) meters) as well as supporting the deployment of next generation technologies (e.g. advanced metering infrastructure (AMI) meters) and the development of applications which may be found productive in support of a variety of programs including, but not limited to, reliability, outage response and asset monitoring.

The node has the ability to be configured to act as a collection point and/or a repeater point. The node is a NEMA-4 rated enclosure and has been through rigorous independent industry testing to ensure the ability to withstand the utility environment.   With the ruggedized design the node can be hardwired directly into the low-voltage side of the electrical distribution system providing multiple benefits to the utility. Benefits include, but are not limited to things like voltage reads and monitoring which allow the node to provide situational wide awareness for distribution engineers on power outages.  When combined with the network management system a utility knows exactly when and where power has been lost and restored. The pictures that follow provide a visual on typical customer installations.


In a typical installation, the nodes hang on mounting brackets that bolts onto the utility pole.  Once the bracket is mounted, the node slips onto the bracket and is secured with two locking nuts.  The power cord draws power from one phase, but is connected to all three phases and the neutral to allow the node to read voltage characteristics from all phases.  Each node is preconfigured, and remotely accessible and upgradable eliminating any configuration work at install.

The Ambient node supports the standards-based Internet Protocol (IP) implementations seen on today's networks.  The internal sub-systems also use standard IP addressing allowing for easy integration and flexibility. This combination allows the node to easily become an extension of the utility's existing network and become the foundation for the future network, providing industry standard networking and security capability.

The node has the ability to connect many different backhaul technologies to meet the utility's needs, including:

LTE high peak speeds:
- 100 Mbps downlink —both indoors and outdoors
- 50 Mbps uplink

Low latency:

- < 5 ms user plane latency for small IP packets (user equipment to radio access network [RAN] edge)
- < 100 ms camped to active
- < 50 ms dormant to active

Scalable bandwidth:

- The 4G channel offers four times more bandwidth than current 3G systems and is scalable. So, while 20MHz channels may not be available everywhere, 4G systems will offer channel sizes down to 5MHz, in increments of 1.5MHz.

In terms of security, the Ambient Smart Grid system is a Linux-based platform that has the capability to provide security at many levels. Ambient actively participates in a variety of standards organizations including NIST's Smart Grid Interoperability Panel (SGIP) and IEEE, to contribute to and to track standards developments and requirements. Ambient uses industry best practices and standards at each level and interface of the system. This defense-in-depth approach is designed to optimize security by providing redundancy and by ensuring that the security of the system is not reliant upon one sole measure. Ambient has industry-specific expertise in smart grid security developments. Through our involvement with industry groups such as IEEE, SGIP, and the GridWise Alliance, we are helping to establish appropriate practices and standards. The Ambient Smart Grid Node is built using open and flexible building blocks.

Traffic between the respective head-end system and its end-points is encrypted by the server and the end-points.

The node itself is made to be as secure as possible with eliminating vulnerable protocols such as Telnet and only utilizing protocols such as SSH, encrypting traffic from end-to-end. The node also provides for AES256 encryption/decryption and more common features including, but not limited to, configurable mechanisms such as password complexity requirements.

In terms of system reliability, the node’s ability to leverage multiple backhaul connections allows the node to incorporate redundancy through multiple paths and the ability to monitor and reset local connections, applications or third party devices. The node also has the independent ability to reset itself should it be confronted with a situation or development requiring it to do so. An external battery will provide for power during sustained outages. To further improve redundancy and decrease backhaul cost, the nodes are able to support peer-to-peer communications via a standards based protocol.

**System Monitoring, Management and Administration**

System monitoring, management and administration are essential to insuring a utility can fully leverage the potential of its grid intelligence assets. The AmbientNMS is a system for monitoring and managing all connected nodes. AmbientNMS provides fault, configuration, performance, and security management of each node in a unified manor.

Ambient's management system can be utilized to collect and report a variety of data from the nodes, including network performance (such as cellular network signal strength), as well as power outages and data from connected applications where such application data is offered.

Ambient has developed several utility focused applications to take advantage of the communications platform that are worthy of consideration by the Taskforce as it seeks to strengthen the components of energy conservation and efficiency, important elements of the State's energy policy. These applications, simultaneously with the other services provided by the nodes, are described below.

Ambient has established and published a development framework that enables third parties to develop applications to run on its nodes. This helps to reduce the overall system costs to the utilities by reducing the amount of equipment that must be deployed in the field.

**Metering Applications (Advanced and Legacy)**

Metering is a significant application for utilities. Ambient's platform can support metering applications, mobile and fixed. By integrating traditional metering with other distribution system inputs a more complete picture of the electrical system can be created, monitored and acted upon.

Ambient has demonstrated the ability to integrate multiple metering solutions in its platform. The metering solutions integrated thus far include not only electrical metering systems, but also gas and water metering system. Thus, a single communications platform can be utilized to collect metering data from multiple sources. This is especially cost effective for those utilities, including municipal utilities, which provide multiple services.

Critical to supporting a business case, legacy-metering devices must be integrated with the smart grid communications node. Ambient has developed a solution to provide the ability to collect data from "bubble up" meters that have typically been classified as AMR meters. Today, the data from these meters is collected with "drive by" systems whereby a meter data collector drives routes once a month to gather the data. With the use of the Ambient solution, driving can be reduced dramatically lowering risk, reducing greenhouse gas contributions while providing more consistent and reliable reads. This continuous data stream can be used to determine outages as well as interval data. Thus, AMI type features can be derived from an AMR system thereby extending the life of the AMR meters.

**Outage Detection / Monitoring**

By default, the deployment of nodes that are monitored with the AmbientNMS provides an outage monitoring and management system. The nodes, which can be equipped with optional battery backup capability, can report power loss as well as provide a period of time during which additional diagnostics can be remotely carried out.

**Reduce Outages**

Outages can be reduced or avoided through proactive monitoring with the use of applications such as energy sensing/power quality monitoring and partial discharge.

**Reduce Response and Restoration Times**

The near instantaneous recognition of loss of power and accurate identification of locations that have lost power, the time to respond and restore power can be greatly reduced. This is extremely beneficial especially for restoration activities following storms or other large outage scenarios.

**Distribution Monitoring / Automation**

Along with the various distribution system monitoring applications and services developed by Ambient (described in other sections of this document), other third-party applications and systems can be integrated within the Ambient platform. One of the significant benefits to such integration is that intelligence can be distributed into the field that can take advantage of the ability to correlate information from multiple sources in the field and assign and take appropriate levels of actions in response.

**Grid Efficiency**

Most utilities report that a portion of the power they deliver over their distribution networks is lost due to a variety of factors. The causes for this loss, typically termed, “system loss”, is usually not known with any certainty. Reducing the system loss by even a small amount can result in tangible savings.

Ambient's Smart Grid platform is designed in part to address the system loss as part of the overall strategy of monitoring the distribution systems to improve the overall health and efficiency of the distribution systems. These benefits are delivered in the Ambient platform by way of several applications (described below) that can be run on the nodes simultaneously with the other communications services provided by the nodes.

**Volt/VAR Monitoring**

Energy sensing/power quality monitoring provides voltage, current, and power quality information at locations where the nodes are installed. The voltage and current data can be used for transformer performance and efficiency, loading on transformer, etc. The voltage, current, and power quality information can be used to monitor quality of power delivered and also for volt/VAR monitoring and control systems. This provides information along the distribution circuit and at the transformer level instead of just at the customer's meter locations.

**Partial Discharge Monitoring**

This is an application that provides an early warning system for underground residential distribution (URD) system to detect partial discharge signals that often indicate a problem on the underground cable system that can eventually lead to failure and outage.

**Asset Management**

Ambient's nodes support the ability to derive and/or be programmed with latitude/longitude information. This helps to identify accurately the location of the nodes as well as any equipment that is connected to them.

**Demand Response**

Ambient's platform can be a vital part used to support a robust demand response (DR) program. Unlike traditional one-way DR programs where a signal is sent but there is no verification of effectiveness of the signal, the Ambient platform and its two-way communications capabilities achieves near real-time verification of participation and effectiveness of the DR signal/request.

**SCADA / DNP3 Support**

The nodes can act as a DNP3 master and/or slave. This enables the use of the node as part of a distributed intelligence system by adding the nodes as front-ends to SCADA and other legacy devices.

## Size of proposed project, with expected capability in energy and capacity

The size and scope of the project in which Ambient Corporation would be focused addresses the points leading into and being served from nearly 1.3 million distribution transformers statewide (not including LIPA) that distribute electricity to a variety of ratepayer types throughout the state. In addition to serving those customers purchasing electricity, these smart grid assets can also be used to service gas and water utility customers.

## Proposed project location (NYISO zone, town, county)

Statewide.

## Fuel source and availability of fuel/infrastructure, as appropriate

Not applicable to this submission.

## Earliest date project can be operational

Project design, build, operation and transfer can begin immediately with project approval. Actual timelines will be influenced by, among other variables: the impact of topography in those regions where the nodes are deployed; weather conditions during the deployment period; and proficiency of linemen used to mount all communications nodes and install related applications technology.

## Experience, market availability and suitability of project technology

Duke Energy is actively deploying Ambient hardware and software technology for its deployment in Ohio. At this time there are over 95,000 communications nodes operating 24/7 in Duke Energy's Ohio service territory. In this deployment, Ambient is connecting hundreds of thousands of smart grid end devices, including 700,000 electric meters and 450,000 gas meters. Additionally there are another 3,000 communications nodes installed in the Carolinas for early field trials (EFT's), testing micro grid technology, customer engagement programs and other distribution asset technology.

Duke Energy is also using the AmbientNMS, a network management system, to actively monitor and communicate with all deployed communications nodes. The flexibility, scalability and ease of installation of our technology allows Duke Energy to deploy thousands of additional communications nodes each month.

The Ohio project is expected to yield significant benefit for Duke Energy. As noted in the published findings of an independent audit commissioned by the

Ohio Public Utilities Commission, MetaVu, Inc. has calculated a 20-year project NPV of approximately $380 million. Success-to-date has led to further collaboration and other potential opportunities.

At Duke's request, other applications and software solutions such as NMS integration with distribution and outage management system have been developed. Our technology is also profiled at Duke Energy's Envision Center demonstrating Duke's smart grid vision.

Appendix A is a white paper authored by Duke on the node architecture and its use in their smart grid deployment.

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## Project Justification

### How the proposed project could address the State's objectives and goals

Smart grid projects enabled by Ambient's technology provide substantial returns, as measured with both service and financial metrics. In a study prepared by MetaVu, Inc. for the Staff of the Public Utilities Commission of Ohio that was published on June 30, 2011, MetaVu estimated that the net present value (NPV) of operational benefits from Duke Energy's Ohio smart grid deployment to be $382.8 million in its base case, with a low case of $325.8 million and high case of $447.5 million.

This document is in the public domain. As it is quite large for inclusion in an Appendix, Mr. McCarthy will be happy to furnish it to the Taskforce upon their request.

## Financial

### Prospects of a private-public partnership

Not applicable to this submission.

### General financial structure and funding options

Utilities will include investments for grid modernization into their rate base.

In a study prepared by MetaVu, Inc. for the Staff of the Public Utilities Commission of Ohio that was published on June 30, 2011, MetaVu estimated that the net present value (NPV) of operational benefits from Duke Energy's Ohio smart grid deployment to be $382.8 million in its base case, with a low case of $325.8 million and high case of $447.5 million.

## Permit / Approval Process

### Federal, State and local permits needed to develop and operate the project

Not applicable to this submission.

### Permitting status, including NYISO interconnection status

Not applicable to this submission.

### Key uncertainties in federal, state and local project permitting, and suggestions for how such uncertainties can be addressed

Not applicable to this submission.

## Other Considerations, if Applicable

### Issues or challenges the proposal faces and suggestions for how these issues and challenges can be addressed for the project and future projects

The U.S. electric distribution grid is seen as being one of the largest and most complex systems ever designed and built in human history. Though the scale is somewhat smaller within the borders of the State of New York, the grid serving the industries, businesses, and citizens calling New York their home is no less complex. It was designed to distribute electricity in one direction – from generator to customer – within the context of optimizing capital investments and operating costs.

As both the United States and the State of New York step farther into the 21$^{st}$ century, the demands on the generation, transmission and distribution resources are changing rapidly. Yet the pace of investment stands still even though available technology is able to affect a full-scale grid modernization program.

Such a program that not only brings new capability to users of the grid, but intelligence to the owners and operators of the grid while bringing a dependable energy infrastructure seen as essential for economic growth according to Governor Cuomo. Without the benefit of vision and initiative from policy makers at the local, state and federal levels, electric distribution grids and the utilities that operate them will be challenged to meet the expectations of rate payers for improved reliability, reasonable costs, and new capabilities.

New York can position itself as the benchmark against which all other grid infrastructure upgrade programs are measured. Therefore it is imperative that the Taskforce, along with the resources being made available to it as a result of this RFI, educate the public and assist regulators, policy makers and investors to better understand the benefits of grid intelligence and the technology that enables it.

Additional Information - To the extent practicable, the following areas should be addressed:

## Property

### Ownership of the potential project location(s), and the extent to which the project would utilize existing rights-of-way and/or previously disturbed land

The utilities involved in the project would be the owners therefore no rights-of-way issues.

## Projected In-service Date and Project Schedule

### Timeline for development and financing of the potential project, culminating in the commercial operation of the project, that includes preliminary engineering and licensing, detailed engineering and design, permitting, procurement of major equipment, construction, testing and commissioning

Ambient would propose a Phase 0 kick off of 3-5 days which would line out the details to be accomplished, who would provide what, when where and how. This Phase 0 would translate into a statement of work (SOW) and would be utilized by our professional services team to implement under a design, build, operate and transfer (DBOT) program. Each delivery period would vary based on the complexity but typical timing would be 2-3 months for design, 6-18 months for build, and 6-12 months for operate with an agreeable transfer time between parties.

## Interconnection

### Potential interconnection point(s)

As Ambient operates on distribution side of the grid, no interconnection points would be necessary.

### Respondent's assessments of why such interconnection point(s) are optimum, from both an economic and reliability perspective

Not applicable to this submission.

### Respondent's assessment of whether the energy and/or capacity is deliverable to the bulk electric system

Not applicable to this submission.

## Technical

### Anticipated life of facility components

10 years.

### Quality and duration of original equipment manufacturer warranties construction

Ambient's hardware warranty is for one (1) year from time of manufacture. Ambient's software warranty is for ninety (90) days with a system level acceptance plan mutually agreed to by both parties.

### Opportunities for New York-based manufacturing and/or assembly of equipment

Ambient's current manufacturing leverages a long-term relationship with our key supplier based in Asia. Depending on the project needs an assembly/test of equipment may be developed and supported with local resources.

### Description of potential contractual arrangement(s) during construction

Not applicable to this submission.

### Availability of labor, materials and installation equipment

The linemen working for each utility install Ambient's communications nodes.

### Potential decommissioning options for removal of a project at the end of its life cycle, including designation of a potential responsible party from a cost and environmental perspective

Ambient's solution does not require a decommissioning plan as our life cycle development process plans for a new generation of product(s) to provide similar to functionality to further support the smart grid solution implemented.

## Operational

### Projected or guaranteed project availability and/or energy production over project life

Not applicable to this submission.

### Safety and emergency considerations

The technology produced by Ambient and deployed by the utility as part of their smart grid initiatives do not represent safety and emergency considerations beyond which the linemen installing the nodes have been previously trained.

## Socio-economic

### Potential benefits to and adverse impacts on the local economy

Benefits that accrue to local economies are those based on increased energy efficiency; improved reliability; ability to accommodate renewable energy sources and distributed generation more effectively; easier access to technological innovation as facilitated by a node platform that smooths out integration.

### Potential impacts on real estate and property values

A modernized grid that reduces outages, experiences faster utility response times, and distributes electricity more efficiently and with greater reliability will be a factor viewed as a positive among property owners in which such smart grid technologies are in operation.

## Impact on jobs, such as retention, creation of new jobs (temporary and permanent) and retraining opportunities

Installation and servicing of Ambient's smart grid technology platforms occur with the use of existing labor capital in place at the utilities deploying it.

## Public safety concerns

No public safety concerns as our product complies with all FCC requirements.

## Tourism impacts

To the extent that a reliable generation, transmission and distribution grid is in operation, the impact to those businesses supporting tourism in the State can expected to be positive.

## Aesthetic issues

None.

## Estimated impacts on real estate and property values

Not applicable to this submission.

## Environmental Justice considerations

Based on the reduced fuel needs of utilities as a result of greater efficiency and improved load management, the environmental impact is expected to be positive. Additionally, smart grid capabilities should also improve a utility's ability to integrate renewable energy sources such as solar and wind, as well as provide an infrastructure conducive to the proliferation of electric vehicles.

## Smart growth considerations

As smart grid increases the intelligence upon which a utility's capital decisions are made, such as the need for new generating capacity, a utility will gain access to information that enables such capital investment decisions to be made more judiciously and with greater intelligence.

## Financial

### The likely financial plan and potential funding sources that would be needed for project success, including long-term contracts, structure and duration required

Any such investment in a utility's infrastructure has been funded directly by the utility itself or with the assistance of State or Federal programs.

### Name of potential Project Sponsor(s), if applicable, and Sponsor(s) financial commitment to the project

Not applicable to this submission.

### Projected amounts of energy and capacity to be produced or delivered; identification of potential ancillary services and environmental attributes that may be available for sale or delivery

Smart grid projects such as those with which Ambient would be associated neither produce nor deliver electricity. They enable the utility to increase the efficiency of their own deployed assets and capital with the goal of helping them to reduce their capital intensity.

### Potential sources of project revenue—As examples, whether the project is currently or expected to be in a New York State Public Service Commission (PSC) proceeding, or whether it would require a power purchase agreement with a creditworthy counterparty, or would rely on power merchant sales

Not applicable to this submission.

### Projected range of pricing for project products (i.e., energy, capacity, ancillary services and environmental attributes, if applicable)

More details are required. The range can vary widely based on the overall scope of the smart grid program advocated by the Taskforce and approved by the New York State Public Service Commission. Ambient would be willing to work with the Taskforce to provide a pricing proposal for the project.

### Risks of price changes due to changes in prices for commodities, manufacturer quotations and other materials and services

The risks of such changes are subject to economic forces beyond Ambient's control. To the extent that volume purchase orders are signed and overall improvements in node manufacturing efficiency are realized, the State could benefit.

### Anticipated incentives, such as applicable tax incentives and impact on pricing

More data about project size is required.

### Options to reduce pricing and pricing uncertainty

Ambient is willing to engage in good faith negotiations with all its customers.

## Environmental

### Environmental benefit to region

Reduced consumption of fossil fuels to generate electricity used by the region. Greater ability of utilities to integrate renewable energy sources into their grids.

### Projected reductions in greenhouse gases

Ambient would be willing to work with companies focused in this market vertical to determine the impact of reduced greenhouse emissions as driven by implementing our solution. This is not a core competency of Ambient today.

### Wetlands, streams, forests and other natural areas that would be disturbed by the project

The installation of Ambient nodes takes place on the pole or at the pad mount, areas where the utility has a previously established presence.

### Environmental impacts of construction and operation

Not meaningful.

## Proposed mitigation measures project contract/request for proposal (RFP) status

Not applicable to this submission.

## Whether or not the project has been submitted to a New York State agency or authority in response to a Request for Proposals ("RFP") (identify the name of the agency or authority, name of the RFP and date of issuance) public outreach and stakeholder engagement

There has been no previous submittal to any New York State agency or any other New York State authority.

## Anticipated stakeholder groups and affected individuals

Rate payers of every classification; shareholders of investor owned utilities; residents served by municipal and co-operative electricity suppliers.

## Potential issues to be addressed

Not applicable to this submission.

## Public outreach plan

Ambient Corporation will support the Taskforce, various policy makers, regulatory bodies and utilities in providing information to localities as needed and previously agreed to with the objective that community members understand the need for a modernized energy generation, transmission and distribution infrastructure and the role of such a structure in the underlying strength of the economy in their region.

## Appendix A

# Duke Energy: Developing the communications platform to enable a more intelligent electric grid

David Masters
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Manager, Technology Development Duke Energy

February 1, 2011

Certain statements in this paper regarding our business strategy, plans and objectives reflect Duke Energy's aspirations with respect to developing, assessing and implementing an end-to-end digital grid system. Some aspects of the digital grid approach and architecture described herein may not be presently available as part of Duke Energy's current digital grid deployment, but these aspects, together with the other items discussed herein, represent Duke Energy's overall vision of the digital grid that we hope to realize in the near future.

## State of the industry

The energy industry is poised for a dramatic transformation as climate change, the rising costs of energy, increasing regulation and energy independence are all addressed. The singular approach of building new, centrally-located power plants to meet energy and capacity requirements can no longer be the sole solution. Renewable generation and energy efficiency must play a larger role. That is why we need a smarter power grid that will help us increase our use of renewable capacity, embrace the emergence of electric vehicles and distributed generation, and enable customers with the tools and technology needed to help manage through this type of environment. Striking the right balance to deliver energy that is affordable, reliable and clean will require the optimization and proactive management of the nation's grid infrastructure.

## Duke Energy's corporate vision

Duke Energy's vision for a connected, end-to-end digital grid that gives customers choices and control will create a sustainable energy future while working to reduce our carbon footprint. Efforts include our aspiration to cut our carbon emissions in half by 2030, by building more efficient power plants, developing robust energy efficiency programs, and supporting a balanced state and federal energy policy approach that encourages market-based controls of greenhouse gas emissions and the development of new, cleaner technologies. Together, these initiatives will allow Duke Energy to continue to meet our customers' energy needs in an environmentally sound manner, while keeping our product – energy – reliable and affordable.

To accomplish our vision, we are implementing technologies that will modernize our power grid infrastructure making it more receptive to the wide-scale adoption of renewable energy and supportive of new energy efficiency technologies and programs. We are investing $1 billion in digital grid technologies that are already beginning to transform today's century-old power delivery system into an advanced energy network that will allow for timely energy usage information and remote grid monitoring, automation and control. By deploying advanced energy technologies and modernizing our power grid, Duke Energy will give our customers more choice and control over how and when they use energy. This can help delay the need for new power plants and create a cleaner, lower carbon, energy- efficient world making it easier for Duke Energy and its customers to utilize new technologies in the energy market as they come available.

## Duke Energy's digital grid vision

### Definition

Duke Energy defines the digital grid as an end-to-end energy Internet powered by two-way digital technology. It is comprised of an Internet Protocol (IP) based, open standards communication network that allows for automation and the exchange of near real-time information as well as enabling the adoption of new technologies as they become available. Duke Energy's digital grid will have more efficient and reliable transmission and distribution systems; it will leverage energy efficiency programs to reduce wasted energy; it will integrate more distributed energy resources into our grid and decrease carbon emissions.

The functionality will be enabled by:

The implementation of a digital communications network.
Intelligent distribution grid devices (i.e. digital meters, sensors and self-healing technologies).
Dynamic pricing programs that include residential and commercial pricing options.
IT systems implementation and enhancements.
Customer options that include Home Area Network (HAN) capabilities and support for integration with plug-in electric vehicle (PEV) charging stations.

Digital grid technologies create a virtual “handshake” between Duke Energy and our customers – a powerful commitment to work together to use energy more efficiently, save money and create a cleaner, lower-carbon world.

# Duke Energy’s digital grid architecture

Managing the distribution grid in the 21st century necessitates monitoring electricity and the equipment that provides and supports its delivery as it passes millions of discrete points. Moreover, the need for distribution grid management is greatly increased by the potential for widespread adoption of
residential and commercial solar systems, PEVs and other distributed energy resources.

This required digital grid network must have the bandwidth, embedded sensing, control and software, both distributed and centralized, to collect, organize, and analyze an immense volume of information. This requires the two-way bandwidth necessary to link the real-time events detected (such as load and congestion, system stability and equipment health or outages) with the appropriate grid devices that
will respond to address those events both grid-wide and locally, to maximize and improve efficiency and reliability. This will require an integrated implementation strategy that adheres to a common infrastructure model since an incremental and disconnected approach proves too costly and ineffective. The communications network must make it easier to adopt new technologies and solutions, allowing us to take advantage of advancements in storage, micro-grids and distributed generation as well as adapting to other energy transformations in the future. This network will need to support local intelligence that provides autonomous, decision making controls as well as centralized notifications, overrides and inputs with situational awareness from multiple sources. The autonomous operations of the devices will need to take in to consideration factors that include: a customer’s preferences and actions, equipment operating parameters, weather, equipment failures, local and more wide-spread grid activities such as actions in other homes, neighborhoods, cities and states.

## Approach

Duke Energy is leading the industry’s digital grid transformation by assessing, developing and implementing an end-to-end digital grid system that lays the groundwork for an energy evolution where information and automation will enable customers and companies to work together to keep energy affordable, reliable and clean. Without the digital technology and local intelligence, sustainable energy efficiency is difficult to achieve.

Duke Energy expects the amount of energy data available to grow exponentially as we continue to deploy the digital technology. This increased volume of data means that a completely centralized approach to data collection is not practical. Where practical, the digital grid will aggregate and analyze data locally in order to convert the raw data into meaningful, actionable intelligence that other systems and applications can use efficiently. This one common communications infrastructure with distributed local intelligence is more flexible, cost effective and more capable than today's multiple, disparate, legacy networks.

What drove our approach?

In a world increasingly focused on improving efficiency and reliability while reducing the environmental impact of electricity use there has been a convergence of many internal and external factors that have influenced our multifaceted approach. Some of the key drivers and challenges are:

Drivers

- Meet our customers growing energy needs in a cost effective and sustainable way.
- Utilize technology advancements to change the way we do business in the future.
- Make it easier and faster to adopt new technologies as they become available.
- Incorporate proven technologies currently being used in other businesses or industries.
- Implement systems that afford Duke Energy the flexibility to grow and adapt without requiring a complete technology replacement.

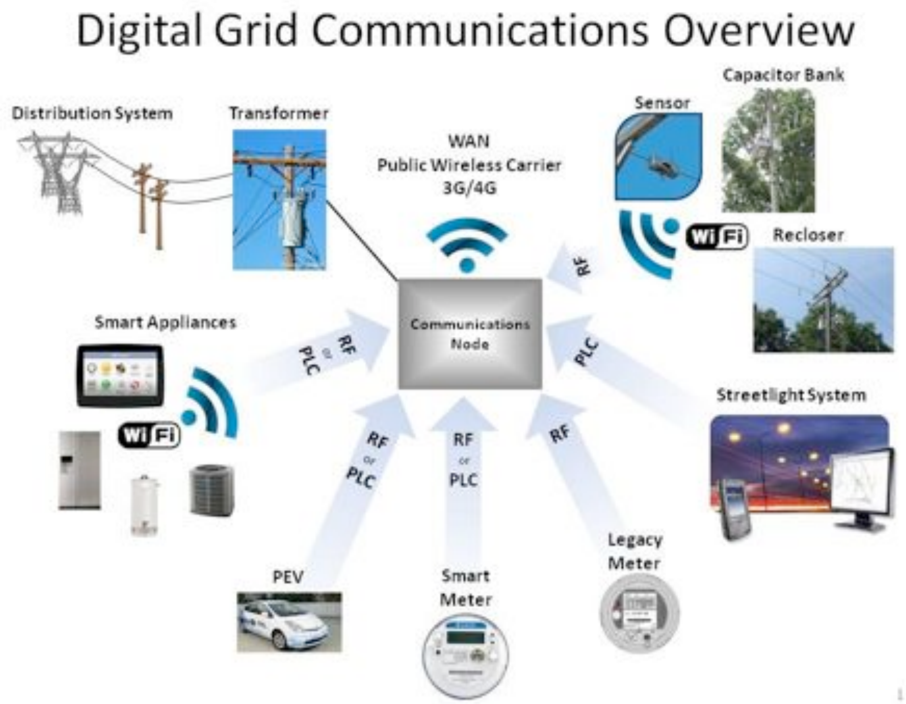
Challenges

- With the life of most utility assets being long and the evolution of the communications technology being rapid, embedding the communications technology into the utility assets makes it difficult to take advantage of new technology as it becomes available.
- Vendors and manufacturers are accustomed to building single-use solutions for a utility based upon a specific organizational requirement.
- Vendors and manufacturers new to the utility industry lack a broad understanding of utility operations and functions.
- A utility does not normally behave as an early adopter or developer of new technologies.

After evaluating systems deployed by other utilities and industries, we determined that the solutions currently being offered would not fulfill our key drivers or meet our requirements. Most proposed systems are based primarily on an automated metering solution that leverages proprietary radio technologies or protocols, limiting bandwidth and the capability to fulfill the vision for 2-way digital communications beyond metering.

Achieving the approach

Duke Energy's communication architecture vision is based on utilizing a communications node to transmit, locally aggregate and manage the deluge of data that results from implementing a digital grid. The digital grid communications overview diagram below illustrates the role the communications node plays and the relationship it has with other components on the distribution grid.




The communications node will manage the data of various applications (including, but not limited to: distribution automation, distribution management, mobile workforce, PEVs, smart metering and customer energy management) locally or will route data back to a centralized location or to other nodes on the distribution grid that may be in a key location for further analysis and action. All three options enable Duke Energy to apply and manage various energy management applications individually or in concert with others, providing the capability for optimization and management based upon a particular situation in any given area. Duke Energy has a unique architecture in that we are connecting public carrier WAN access to each distribution transformer while simultaneously having the communications node serve as a communications gateway to communicate, manage and operate various smart home, smart meter, and distribution devices.

This local aggregation affords Duke Energy the flexibility and management capabilities as it prioritizes data traffic, analyzes data and enables device operation. Additionally, Duke Energy is able to apply a single set of rules to data management as opposed to creating several sets for individual or vendor specific data while providing true situational awareness based on the local geography, and condition of the overall grid. This is especially important from a security standpoint where development and application of a single schema to secure data from multiple devices greatly strengthens the overall security approach. This approach also supports a similar security approach for legacy equipment that does not support some of the newer security requirements. Local aggregation provides the capability to operate in a micro-grid situation or as dynamic switching becomes more prevalent, understanding what impact those switching changes will have on the network. Finally, by having local access to data from the various devices that will be utilized on the grid, the capability to operate in times of limited WAN communications or heavy data loads are greatly increased. The use of local aggregation and analytics also provides the capability to manage the WAN and data storage cost by utilizing exception based reporting in place of bringing all data back to the data center to analyze and report on.

Think of the communications node as an iPhone® for the modern grid. It is a device with the future communications capability for multiple networks, with capability to route the data between multiple devices and with enough storage and processing power to enable an extensible ecosystem of data applications which are anticipated to be built over a number of years. One of the largest challenges most vendors face in the digital grid space is finding the adequate infrastructure for their solution. Since the node architecture is based on an open hardware and software development environment, the node will play a crucial role in creating that secure infrastructure for vendors developing compatible applications. Through this integration and aggregation of applications, Duke Energy gains a better view of where our assets are, of the relational environment our various grid components have to each other and how they are working together to optimize energy for our customers.

## Communications

A key philosophy behind the communications solution is that no single technology is capable of meeting the needs of or providing the coverage necessary for Duke Energy's service territory. Therefore, the communications node is designed to have the options of utilizing wireless and wired connectivity for the three types of communications it supports:

- Wide Area Networking (WAN) – The WAN is the network connecting the communications nodes to the enterprise data center and back office.
- Local Area Networking (LAN) –The LAN is the network serving end points such as sensors, capacitor banks, homes, etc. - in the same general area as the communications node. Local connections to communications nodes are considered part of the LAN network (example: a serial connection to a capacitor bank)
- Node-to-Node Communications (N2N) – N2N is a peer-to-peer form of communications that can be utilized in lieu of, or in conjunction with a WAN connection to a communication node. The N2N feature allows communications nodes to interface with each other and utilize a single WAN connection in one of the communications nodes for connectivity to the data center. Additionally, the N2N capability can also be utilized for diagnostics and to support other envisioned utility support functions. As optimization becomes more prevalent the ability to communicate and understand what is happening at other nodes will become a requirement.

The communications node will be capable of supporting multiple wireless and wired communications technologies in order to address unique situational requirements or a very specific application. The table on the next page shows the representative forms of communications and the association to the types of communications:

| WAN | LAN | N2N |
|---|---|---|
| Ethernet/Serial/USB | Ethernet/Serial/USB | Ethernet/Serial/USB |
| 2G/ 3G/4G wireless | IEEE 802.11 (Wi-Fi) | IEEE 802.11 (Wi-Fi) |
| | LonWorks® Powerline Carrier (PLC) | Mid-voltage PLC |
| | 900 MHz ERT Receiver | |

The communications node will have access to both internal and external Ethernet, serial and USB interfaces that can be utilized to connect to devices or modems. This open hardware/software architecture along with the capability to utilize other manufacturers' modems as well as end devices (fiber optic equipment, satellite equipment, capacitor banks, reclosers, and sensors) enables flexibility and capability.

Wide Area Network (WAN)

Duke Energy's current plan is to utilize public wireless carriers to support the WAN components of a digital grid platform. Use of a public wireless carrier within the utility is not new. Meters at some of our largest customers, capacitor banks and other devices currently utilize public wireless carriers. Utilities in other countries are currently utilizing public wireless carriers for their entire metering infrastructure.

Why Duke Energy is incorporating use of public wireless carrier networks

- Cellular technologies are based on existing standards and have been used extensively and securely in the communications sector with more than 5 billion active connections.
- Duke Energy benefits from the economic and technical economies of scale that have been unlocked by the public wireless carrier ecosystem.
- Public wireless carriers use Internet-based protocols (where available) as the transport layer standard, allowing the use of IP based WAN connectivity from the data center to the nodes.
- Utilizing the 3G networks available today provides for backwards compatibility to the cellular 2G networks, providing access to a redundant network.
- The public wireless carrier industry will continue to invest billions in its hardware, software and facilities.
- The technological advances stemming from investments to serve the retail voice and data customers directly benefit the utility and its customers.
- Utilities will have a greater influence on technology and price as a customer of the larger carriers than if we are developing private communications equipment for ourselves only.
- Duke Energy has no desire to be in the communications business. We need to harness already- existing expertise and capabilities that the cellular networks provide in designing, building, and maintaining the communications.

As we started evaluating the various options for communications utilizing public carriers several things become apparent. First, embedding the WAN connectivity into end devices such as meters had several challenges, i.e. development time, cost, certification testing, power supplies and heat dissipation. Utilizing the 3G modules in a meter would presently be cost prohibitive. While utilizing 2G modules would be more price-competitive, employing those 2G networks with a high number of devices in a small area could create problems. These issues, combined with other challenges like the disparity in life cycle of assets and the product evolutions, moved us into a LAN/WAN communications node environment that allow us to take advantage of the new capabilities without changing everything.

Up until recently, there was little digital grid activity utilizing cellular networks. The incorporation of a holistic digital grid communication infrastructure significantly changes and increases this activity. Consequently, Duke Energy spent a significant amount of time with its cellular partner developing technical and functional specifications for the WAN. For example, unlike the "typical" cellular customer, a unique aspect with the utility digital grid infrastructure is that hundreds or thousands of devices may go off and come on at the same moment. If not managed properly, this activity could overload a cellular station and cause problems to other cellular customers. The cellular companies advances in allowing companies to establish private, not internet routable IP networks has also been instrumental in providing the capabilities for security that will be required as we move forward.

As a result of our approach, Duke Energy established a collaborative effort with one of the cellular carriers and, together, has developed innovative pricing and operations and maintenance (O&M) model that supports the requirements and reduces the overall costs of digital grid communications This effort has also enabled the cellular company to better understand the utilities operations and needs thus making the present and next evolutions more capable of supporting machine-to-machine (M2M) environments for the utilities in a more robust fashion.

Why Duke chose to use 3G technologies instead of 2G?

- Reduced latency.
- Increased throughput.
- Enhanced security capability.
- Fallback to 2G provides a measure of redundancy.
- Network access time faster.
- Capable of supporting the number of cellular devices with less impact.

Coverage by the public carriers continues to increase, mitigating the expense and complexity of providing a private network capable of supporting the digital grid. While all areas today are not covered by a single carrier, utilizing multiple carriers and the possibilities of micro-cells, satellite and repeater technologies will ensure that Duke Energy's service territory is covered. Duke Energy's core competencies and focus is on generating and delivering energy.

Utilizing the public carriers that have a nationwide footprint affords Duke Energy the ability to rapidly expand its digital grid infrastructure is its service territory expands.

Local Area Network (LAN)

The LAN connection provides connectivity to all of the end devices that can operate in a local environment utilizing point to multi-point communications such as meters, sensors, distribution automation equipment, in-home/business gateways, etc. Much like the WAN, the LAN connectivity in the node provides the capability to utilize both internal and optional external Ethernet, serial, and USB interfaces that can connect to 3rd party devices or modems. This capability along with the open hardware/software development environment will provide the capability to connect to and communicate to legacy devices as well as new devices as they become available. The node has the capability to support connectivity to devices or head-ends utilizing the DNP protocol as a master or slave allowing this to become a protocol converter if needed. Existing devices have been integrated into the node and connected to an internal Ethernet port. By doing this, we have been able to utilize, for example, the 900 MHz capability of an ERT-enabled gas meters with very little integration effort. The node also utilizes a wireless 802.11 option and a wired power line communication option utilizing LonWorks®. The use of the 802.11 Wi-Fi provides a radio and protocol that has been widely adopted and is manufactured by a large number of device manufactures. Wi-Fi should be considered as a joint use device in that its capability is utilized not only in the LAN environment but also in the N2N environment. The LAN will provide a connection to metering, sensors, capacitor banks, in-home devices or gateways, on the same Wi-Fi or PLC connection depending on the functions needed at a particular location.

## Node-to-Node (N2N)

The primary driver for N2N functionality was the need to supply communications that provides details for a geographical area based upon the electric grid design versus the communications network design. As envisioned today, the N2N network would leverage a Wi-Fi with mesh capability (802.11s) to reach more nodes within a fairly small geographic region thereby creating a Neighborhood Area Network (NAN). This capability also allows the use of the N2N network to gain access to another node's WAN connection as a means to fill in for spotty cellular coverage or redundancy of the WAN. When utilizing the N2N network as means for outage detection, nodes that are located at strategic points on the grid would poll other nodes, reporting only exceptions or upon communications failures. This polling would occur on the N2N network only and would not, therefore, incur any data usage on the cellular network.

Also under evaluation is a low frequency, lower bandwidth power line communication solution providing circuit level capabilities. This form of PLC has the capability to travel long dist ances on the mid-voltage network and pass through the low voltage transformer where it could then communicate with the various nodes. This level of connectivity would allow for phase detection of the transformers and enhances outage detection capability.

The N2N capability would allow the nodes to gather and analyze the data for all of the devices within its LAN and pass on the relevant data, alerts or required information to other nodes without having to traverse the WAN or head-end systems within the data center. Additionally, this capability also allows the use of the N2N network to gain access to another nodes' WAN connection as a method of compensating for spotty cellular coverage and provide redundancy for the WAN. The N2N network would be utilized as means for supporting outage detection so that nodes could be polled without the need to incur cellular usage charges.

Technology decisions
Why Duke Energy is utilizing LonWorks® PLC

Utilizing PLC as a method of communicating to utility devices has been done in many different forms for many years. With the combination of the communications node, utilizing a cellular WAN and the LonWorks® PLC, the vision of utilizing a communication method that leverages the existing electric infrastructure is now achievable.

LonWorks® PLC Drivers

- Standards-based.
- Multiple manufacturers of both chips and devices.
- Primarily designed as a controls mechanism.
- Utilizes the power company's existing wires for the communications media.
- Allows for accurate asset association.
- Provides added benefits by proactively aiding in determining low voltage cable and connections degradation or failures prior to an actual failure.
- Provides an alternative to wireless for communicating to end devices, in home, in building or on the low voltage network of a utility.

LonWorks® PLC had been largely utilized for deployment and connectivity to meters in Europe and was also the predominant method used in commercial buildings for control applications and automation. LonWorks® is a networking platform specifically created to address the needs of control applications and networking devices over media such as power lines, among others. Approximately 90 million devices have been installed with LonWorks® technology. Manufacturers in a variety of industries
including building, home, street lighting, transportation, utility, and industrial automation have adopted the platform as the basis for their product and service offerings. The LonWorks® protocol has been approved by several standards bodies and the chipsets and devices that utilize this capability are manufactured by multiple manufactures. Utilizing this solution in our trials and present deployments has also provided the capability to explore and validate some of the aforementioned drivers. Utilizing the PLC signal level, error rate and signal-to-noise information between the node and the meters allows for an accurate determination of the relationship of meter to transformer. Understanding which transformer is serving which meter will become more important as applications evolve to institute programs for optimization, cold load pick-up, balancing the PEV charging at a transformer level, etc. Utilizing the improved accuracy will enhance operations capability by more accurately identifying the relationship of the various grid devices. Also utilizing this same signal, we have been able to identify degradation in the low-voltage network allowing for a proactive approach to fixing potential problems prior to an actual outage. By monitoring the signal over time and alerting as the signal reaches various thresholds, instances of splices going bad, underground cable breakdown, or fraying due to trees on wires can be exposed. These items are only available because we are on the wire. The node will have the capability of utilizing both the A and C band communications utilizing LonWorks® PLC. This will allow a separation of data types from the utility (meters) and commercial devices (street lighting, in-building, etc.) providing another level of security and capability.

Why Duke Energy is utilizing 802.11Wi-Fi

- Since Wi-Fi is already the dominant home networking standard, easy adoption / leveraging for HAN use is more likely.
- Many mature 802.11 products that implement large outdoor networks exist today. These networks have been deployed successfully for years and broad expertise exists for deploying, maintaining and securing these networks.
- Supports all IP-based applications (both IPv4 and v6) including Smart Energy Profile 2.0
- Security protections: Link-, network-, and application-level security based on international standards which meet FIPS 140-2 certification. Rogue device and intrusion detection tools.
- 802.11s: amendment for mesh networking, defining how wireless devices can interconnect to create a WLAN mesh network (for N2N, etc).
- Longevity of the standard – The 802.11 standard was introduced in 1997.
- The number of endpoints, device types, manufacturers – adoption – proves scale.
- The chips cost effective.
- Decreased chance for interference with other unlicensed products since Wi-Fi is designed to co-exist.
- Dual operating frequency ranges are available.

The first IEEE 802.11 (Wi-Fi) standard was released in 1997. Since then, three major modulation changes (a, b and g) have been released along with several additional and relatively minor amendments. These revisions have collectively produced a single standard that allows for the implementation of several interoperable performance profiles and data rates that can range from 1 Mbps (802.11b) to 600 Mbps (802.11n). This flexibility has allowed the standard to be widely accepted and deployed making it the dominant home wireless standard today (roughly 100 million households worldwide leverage Wi-Fi in some capacity).

The demand has been met with a wide array of products from a broad swath of manufacturers. More than 1 billion end points have been deployed and chipset shipments now exceed 1 million units per day. All of this has served to provide multiple chipset and product choices to the consumer meaning that costs, due to scale and market demand, have consistently dropped.

## Communications node

The communications node that Duke Energy is deploying to support its vision of the 21st century grid is a combination of hardware and software that enables two way exchange of data between Duke Energy organizations, assets on the power delivery system and equipment at and within the premises providing the tools and information that the customer and Duke Energy will need to fulfill the vision. The intent is to have the communications node perform a variety of functions:

- Serve as a data aggregator for end points
- Perform remote analytics and appropriate control
- Provide short term storage for end point and local analytics data
- Provide integrated I/O options
- Provides embedded intelligence into the grid itself at key locations
- Serve as a router that forwards data between end devices, nodes and servers
- Serve as a gateway and perform protocol conversion as needed

The communications node has an operating system and open software framework. This operating system and open software framework will enable the communications node to manage multiple digital grid applications, interfaces and ports. More importantly, the open software framework will allow for new applications development and integration.

At a technical level, the communications node provides a physical and logical link between wide area networks, distribution assets and end points, as well as consumers' in-building networks and energy components (e.g. smart meters). It provides a single point of access for multiple organizations and systems to gather information and data from a variety of distribution and customer premise equipment.

Functional vision

The communications node provides several inherent advantages over today's more conventional technology deployments:

- Data from diverse endpoints can be aggregated and analyzed locally, allowing for less data traffic and providing a more holistic and robust characterization of the local environment.
- Control applications can leverage data and act in near real-time to both reduce overall traffic on the WAN, centralized server loads, and be more responsive in addressing grid events that directly impact the consumer.
- Monitors the state of the distribution transformer and low-voltage grid.
- Applications can be installed in the communications node, and/or software pushed to end points that are able to be remotely upgraded. This will enhance the ways the communications node collects and analyzes data.

Duke Energy expects the amount of data available about the grid itself to grow exponentially as new, intelligent end points are installed on the power delivery system. The digital grid will need to aggregate and analyze data locally in order to convert the bulk data into meaningful information that other systems and applications can use. The ability to aggregate data from different types of end points also reduces the need to support multiple, disparate communications networks to support line monitors, distribution automation, smart metering, etc. All these functions can benefit from integrated communications cost savings. Finally, the ability to modify what data aggregation and analysis occurs in a distributed fashion will allow the communications node to exploit new analytical capabilities as they become available along with the ability to modify the communications node's functionality to improve interaction with other enterprise and/or distributed applications that are implemented.

An end point is a physical entity that resides on either the power delivery system or at the customer premise and has the ability to communicate with the communications node utilizing at least one or more of the listed means of communications capabilities. The communications node is intended to support a growing number of end points that will be interfaced with the communications node throughout its effective lifetime. End points that Duke Energy envisions using with the communications node include, but are not limited to those in the table on the next page:

| End point devices that will communicate with the communications node | Connectivity via the communications node |
|---|---|
| • Electric / Gas / Water Meters<br>• Transformers<br>• Distribution line sensors<br>• Capacitor banks<br>• Reclosers<br>• Streetlights<br>• Distributed Generation Assets<br>• PEVs and PEV Charging Stations<br>• In-Premise Devices such as gateways, thermostats, load switches and displays | • Cellular<br>• LonWorks® PLC<br>• IEEE 802.11 2.4GHz Wi-Fi<br>• IEEE 802.11 5.0GHz Wi-Fi<br>• 900 MHz (ERT enabled receiver)<br>• Ethernet<br>• Serial<br>• USB |

Local Data Access (LDA)

There are many different end points that will be supported by the communications node. Moreover, these end points will produce data that require management both locally and centrally. Local data access (LDA) will be a key attribute of the communications node. LDA will enable third-party applications to access this data for local analysis and control when suitable without disrupting the flow of data to Duke Energy's back office operations. Examples of these applications include transformer overload alerts and voltage monitoring.

Applications enabled

There are a variety of applications that are envisioned to utilize the communications node. Due to the unique properties of the node, these applications can either be centrally managed, or the applications themselves can reside on the node. The following are some examples of applications that could be developed:

| Application | Description |
|---|---|
| Voltage Monitoring | Utilizes voltage sensing at the transformer and meter to generate exception reports which indicate voltage regulation |
| Transformer Overload Monitoring | Monitors loading on transformers and provides real-time alerts when transformer is overloaded |
| Remote Fault Detection | 3-phase line devices that measure current (amps) and identify the fault current and location of a |
| Outage and Restoration Notification | Remote and automated notification of power |
| Integrated Volt/Var Management - | Ability to remotely configure and control capacitor banks and regulators to achieve specific power factor and voltage objectives on the grid |
| Demand Response Event Management - | Remote control of customer equipment to manage peak capacity and grid operation issues |
| Streetlight Monitoring | Monitoring of streetlights to ensure they are operating appropriately |
| PEV Monitoring | Remotely identify in real time where PEV vehicles may be located and charging |

## Partner Ecosystem

Given Duke Energy's mission to reduce carbon emissions, enable energy efficiency programs and modernize its electric infrastructure to keep our product affordable, reliable and increasingly clean, we anticipate partnering with vendors and forming strategic alliances over time to develop those systems and solutions.

The digital grid has the capability to impact every aspect of a utility's business. Therefore, various initiatives within the company to support a uniform and integrated digital grid approach should be coordinated to encompass regulatory policy, generation, transmission and distribution, energy efficiency, technology research and development to optimize the benefits from these efforts.

Duke Energy is currently teamed with a number of partners, all of whom have industry expertise with a proven track record of delivery, and the ability to develop an innovative and integrated approach to digital grid solutions.

## Standards activities

Duke Energy is an active participant in the National Institute of Standards and Technology (NIST) standards development process and contributes thought leadership on national standards. Duke Energy actively works with several standards bodies and trade organizations to insure that we can obtain the proper alignment with the standards as they are adopted This alignment effort allows us to leverage economies of scale passed on by the vendors of systems and equipment, resulting from a much larger opportunity for our vendors. This alignment ultimately benefits customers by allowing competition
from a greater pool of vendors, systems and equipment in terms of features, functionality and cost , as well as reducing the risk of stranded assets as future enhancements are developed and deployed, as these should be compatible with standards based systems deployed today.

Besides NIST, Duke Energy participates in many of the digital grid standards development groups. Standards are still emerging and it is important for Duke Energy to continue to play a key role in standards bodies, to help shape standards that reflect its digital grid aspirations.

Some of Duke Energy's involvement includes:

- SGIP - Smart Grid Interoperability Panel.
- UCA - UCA International Users Group.
- IETF – Internet Engineering Task Force.
- IPSO – Internet Protocol Smart Object.
- OpenSG IUG- Open Smart Grid International Users Group.
- HomePlug.
- IEEE.
- EEI – Edison Electric Institute.

- EPRI – Electric Power Research Institute.
- UTC – United Telecom Council.
- GridWise Alliance.
- NERC - North American Reliability Council.
- NAESB – North American Energy Standards Board.

## Summary

Duke Energy has been instrumental in the development of the node and architecture depicted in this paper. We have multiple vendors building products that align with this architecture utilizing the capabilities described within this document. Cellular companies have recognized the potential and multiple carriers are stepping up to the plate to provide expertise and networks. In conjunction with our partners we have substantially driven cost down while increasing capability. Vendors are producing equipment that utilize these standards and capabilities and are introducing the innovations that will be required to make our vision a reality. This effort was not to develop something fundamentally new but more about utilizing existing knowledge and capabilities of other industries to obtain the needed capabilities.

Duke Energy has installed hundreds of thousands of communications nodes, meters, sensors and distribution automation equipment in aggregate, utilizing the very equipment and networks discussed. Today the communication nodes interface with electric and gas meters, line sensors, transformers and other end points. Duke Energy will continue to innovate and collaborate with its ecosystem of partners to identify, develop, and incorporate new applications and technologies that best leverage this platform for the digital grid.

# Appendix B

## Additional Company Background

Founded in 1996, Ambient Corporation has been focused on the collaborative development of smart grid technology and communication solutions since 2000.

We believe effective and efficient smart grid technology communications are at the heart of revolutionizing the grid and will transform it into an efficient energy service platform. The smart grid will address the current shortcomings of our aging grid and deliver significant benefits to utilities and energy consumers, including reduced costs, increased power quality and reliability, accommodation of renewable energy technologies, consumer empowerment over energy consumption and a universal platform for continued integration of new technologies.

Ambient is headquartered in Newton, Massachusetts with a satellite office in Europe. Our common stock trades on the NASDAQ Capital Market under the ticker symbol "AMBT".

### Industry recognized leader

Ambient's smart grid communications platform was the recipient of the top smart grid product at United Telecom Council's (UTC) Telecom 2011. The UTC Product Awards is an annual competition highlighting the very best in critical infrastructure industry technology.

Utilities benefit with from the Ambient Smart Grid communications platform as it provides:

### Support for a single network through flexible communications

Utilities need only invest in a single communications network. Our communications nodes support multiple communication technologies simultaneously allowing it to connect to any smart grid application or end device.

### Open platform for scalability and interoperability

Utilities can deploy multiple smart grid applications on a flexible platform that can evolve with and embrace new technologies, without the worry of being locked into proprietary technologies.

### Preservation of utility smart grid investments

The smart grid transformation is an evolutionary process. Ambient's communications platform protects utilities against stranding assets. As utilities gradually replace legacy smart grid assets, they can seamlessly integrate existing and new applications and technologies into our communications infrastructure, without the need for a wholesale or costly re-deployment of a new communications platform.

### Local application hosting and development framework
Ambient's smart grid communications nodes have excess processing and storage capacity, which allows the communication platform itself to host applications that run in our open application environment. Utilities can integrate smart grid applications directly into the communications node expanding its overall functionality, even after it has been deployed.

### Remote and distributed intelligence
Utilities can more efficiently manage a vast amount of distributed data. Our communications nodes are equipped with powerful processing and storage capabilities that allow for local management and control of smart grid data. The utility can control what data are sent back to operations, what can be stored locally and what can be discarded – all of which can significantly reduce the ongoing communications costs of transmitting such data to the back office.

### Secure communications
Utilities are afforded peace of mind. Our smart grid platform is secured through the use of both physical tamper detection features strong access controls, and secure protocols that encrypt data traffic.

### Reduced overall communications implementation and operating costs
We deliver our smart grid platform completely preconfigured to the needs of the utility, which allows for rapid and simplified deployment. Our integrated platform also eliminates the need for and cost associated with separate, application-specific devices, reducing upfront costs, and provides a single point of responsibility and maintenance on all smart grid applications, reducing operational and maintenance costs.

## Ambient Smart Grid® Communications Platform: Functionality and Benefits

### Complete turnkey delivery
Ambient® designs and builds the core network hardware, applications and management software - providing a complete communications solution. Our familiarity with multiple communications architectures, hardware, and software requirements, coupled with staged deployments supervised by experienced field engineers, provide us with the tools necessary for a successful rollout.

### Flexible and expandable network architecture
An Ambient Smart Grid communications platform is modular in nature, and allows a utility to deploy infrastructure on an as-needed basis. As the needs of the utility grow, the network can be expanded to meet new requirements. This flexibility minimizes

initial installation costs, shortens the time between investment and realization of revenues, and reduces operations and maintenance expenses.

## Outage detection and restoration confirmation

Our communications nodes are powered from low voltage lines, which eliminate the need for separate outage detection equipment throughout the grid at various consumption points since our technology detects power outages in the communications nodes themselves. The communications node can also be equipped with an optional battery, which can help a utility with outage notification and restoration, and allow for continued node operation in the event of a power outage. Remote access to information provided by the communication node substantially reduces the time to restore power to consumers and lowers restoration costs for utilities.

## Support of external applications

The Ambient Smart Grid is designed to incorporate external applications that leverage our distributed intelligence and communication technologies.

The Ambient Smart Grid platform transforms the distribution grid itself into a series of data points. Thus, utility operators are not limited to applications at the end of the distribution grid, such as metering applications. Grid operators can monitor and communicate with our nodes or grid equipment integrated at any point along the Ambient Smart Grid distribution network.