CELLULAR IOT LPWAN TECHNOLOGY MEETS TODAY'S FIELD NETWORK CHALLENGES

Open, standards-based cellular solution optimizes AMR/AMI applications while reducing risk, lowering costs and sustaining assets

Honeywell

TABLE OF CONTENTS

ABSTRACT

A crucial challenge for today's utility companies is working toward grid modernization, and in the process, having to transform their business. A top area of focus is often around how to automate meter reading infrastructure and communicate with devices in large utility distribution networks.

Growing electricity demand and advancements in industrial Internet of Things (IoT) networks, which attempt to manage the power system network with various levels of automation, have directed attention to the role of converting utility operations to be smarter and more efficient.

Utility metering requires cost-effective, reliable and robust two-way communications for advanced metering infrastructure (AMI). There are emerging communication technologies that have the potential to change the communications landscape.

When assessing the challenges utilities face with their field networks, it is helpful to look at the overall context and consider some of the factors driving new approaches to establishing, operating and maintaining metering assets.

Adoption of early AMR systems took place more than 20 years ago, and the assets nearing end of life are primarily battery-powered devices used for metering water and gas consumption. The batteries for this original equipment are now losing power on a regular basis—putting critical operations at risk.

One of the game changers in the utility AMI/AMR market is the emergence of low-power, wide area network (LPWAN) technology. The move toward wireless communications allows utilities to identify operating issues in real-time. Their goal is to measure, monitor and automate from edge to cloud, enabling operations to run more efficiently, reliably and cost-effectively, and utilizing actionable data to better serve customers.

INTRODUCTION

In a highly competitive and cost-conscious world, utilities must find ways to speed up the deployment of new communication-enabled, intelligent sensors and controls for the smart electric grid. These technologies allow consumers to use energy at the optimum time and help utilities manage and plan for peak demand.

However, the utilities industry is risk-adverse, and any new technology takes time to gain a foothold in the market. As a result, utilities tend to stick to "tried and tested" solutions.

Monolithic and proprietary field networks for AMI assets are typically deployed in a canopy, total coverage fashion. Failures in this network infrastructure are very costly to address since they must be dealt with one at a time and require truck rolls and the assignment of field personnel.

For a gas utility, one impetus for a new field network approach might be stricter, regionally driven safety initiatives. Conversely, for an electric utility, it might be the ongoing challenge of integrating renewables and accommodating two-way energy flow. And, of course, there are ever-present responsibilities that all utilities have for maintaining the security of critical infrastructure.

Utilities of all sizes are concerned that they won't be able to execute on future plans for their core business due to the field network decisions they make today. The bottom line is they are no longer willing to be slowed down by insufficient network capabilities and do not want their innovation programs inhibited by limitations of the network.

DEMANDS ON NETWORK PERFORMANCE

During recent decades, utilities have encountered difficult hurdles in meeting the emerging demands of smart grid applications. The objectives of both users and suppliers include energy reliability and efficiency, a sustainable energy supply, transmission and consumption that are understood, and a balance between energy demand and supply—all supported by an optimized infrastructure. At the same time, the need to digitize operations and the business goes together with attaining these objectives.

THE SPECIFIC OPERATING CHALLENGES FOR UTILITIES

Proprietary Network Options

Proprietary network options have been the norm for utilities over the last 20 years or so. Typically, these options involve networks that are tightly linked to applications and cannot be separated. They are purpose-built to address a particular utility problem or need. In many cases, the deployed solution was the only one that could meet the application requirement, but the end result for the utility was an unsustainable proliferation of networks, single vendor lock-in for the application, and severely limited or no multi-application interoperability. Although the WiSUN alliance was formed to address interoperability, it failed to deliver on that key promise. Even if a best-in-class application is identified, it is very unlikely that it will actually work in an end-to-end proprietary system. A vendor can claim to have a so-called "open" ecosystem; however, it may be prohibitively expensive for another vendor to invest to achieve even rudimentary compatibility within the ecosystem.

Clearly, the aforementioned scenario becomes a barrier to innovation, which is simply unacceptable to many utilities in this day and age.

End-of-Life Metering Assets
North American utilities are dealing with the reality that their first generation AMR or early adopter AMI deployments are heading towards end of life, and they need to start making decisions on the direction for refresh or technology migration. Some early AMR/AMI hardware and software assets are becoming increasingly obsolete, making them difficult to support and maintain.

Economics of AMR/AMI Deployment
With a legacy AMR/AMI solution, there was really no way for utilities to achieve the economics they were attempting to deliver. Rather, they had to rebuild a full canopy deployment for every implementation. In addition, utilities found they needed to establish a new network infrastructure for each application, and that each network type could only support a narrow range of use cases.

Demands on Technology Staffing
Utilities must be mindful of the demands for deploying and maintaining complex field networks. Even if they are comfortable with this task and have done it before, they may be unsure of how much responsibility they can continue to take on. Network deployment efforts can require considerable in-house resources and compete with core business objectives.

With proprietary network solutions, it is necessary to hire specially trained personnel. This approach is often fraught with risk. Information technology (IT) costs associated with operating and maintaining a proprietary network can greatly affect business results. Utilities must attract and retain the skilled workers needed to keep the network running in the most efficient, secure and reliable manner possible—a costly and difficult endeavor.

Crucial Security Requirements
With the critical nature of utilities for national security, fixed networks can be vulnerable due to lack of hardware-based and multi-layered security implementation. The technology staffing concerns mentioned here are magnified due to the difficulty of acquiring and maintaining security architects and professionals. With rising cybersecurity threats focused on utility operations, the decision to outsource network-as-a-service activities is more important than ever. Utilities need to partner with a technology provider that understands the implications of industrial security in general, and how these issues impact utility network security. Operating a critical network infrastructure in an ever-changing security landscape is no easy task.

Ongoing Cellular Developments
In many ways, utilities are now at a fork in the road. On one hand, they are looking at technologies that provide higher bandwidth, modules are more costly, require more power and could provide lower latency. On the other hand, they need to support use cases where bandwidth requirements are limited, devices have to be low cost and requires very little power consumption, and applications are relatively latency tolerant.

Regardless of the chosen direction, bandwidth, latency, and performance, demands keep growing. Utilities must also consider the promise of 5G ultra-low-latency, drone control, autonomous vehicles, etc. which will keep pushing bandwidth requirements.

Users of 5G have greater flexibility in the deployment of cellular infrastructure, which, in turn, provides new options for implementing the technology in smart metering use cases. Solutions employing 5G offer higher bandwidth and lower latency in edge computing.

For industrial applications, they support the key objectives of improved network performance and resilience. The latest versions of this technology are specifically designed to sustain industry standards from 4G to 5G. This is an important feature for utilities, who place great emphasis on the longevity of network assets. Indeed, the decision by standards bodies to continue support under 5G is extremely valuable to utility operators. They need to know that the same device will be supported as the network itself evolves.

Evolution of Industry Standards

A little over five years ago, the cellular standards organization 3GPP and other industry concerns recognized there was a different category of requirements for the industrial IoT, particularly for utilities and smart cities. Fundamentally, these applications are resource-constrained and characterized by widely-dispersed field assets incorporating sensor and control functionalities. To make the situation even more complicated, industrial IoT assets often require battery-powered communications, which must last for many years. The standards bodies responded appropriately by creating a new branch of standards, whereby 3GPP headed down a path that stayed within the family of LTE standards, but, in fact, effectively addressed the emerging communication needs of the IoT device class. Now, for the first time, there are massive scale, lowpower, wide area use cases, which are feasible for deployment on cellular networks in edge computing.

ADOPTION OF CELLULAR IOT SOLUTIONS

By combining managed connectivity, which can be offered as a service on LTE networks, with smart energy software, hardware and services, technology suppliers can provide utility companies with a highly scalable, fully managed, open computing and communications platform to help them manage operations efficiently and safely deliver new services to their customers.

Low power, wide area networks (LPWAN) have gained significant notoriety in industrial IoT circles over the last few years. This technology, created to describe a portion of the IoT and machine-to-machine (M2M) market, is used to connect sensors and controllers to the internet without the need for traditional WiFi, cellular or other fixed network solutions.

By 2025, LPWAN and cellular technologies will account for one in five communicating meters, according to the research firm Omdia.

LPWAN technology is used when other wireless networks aren't a good fit or lack appropriate long-range performance. Traditional cellular M2M networks are costly, consume a lot of power and are expensive as far as hardware and services are concerned. LPWAN technology is perfectly suited for connecting devices that need to send small amounts of data over a long range, while maintaining long battery life.

An important improvement provided by LPWAN for field networks is coverage—in other words, the geographic reach of the wireless service. Significant performance gains came from coverage enhancement modes integrated into the LPWAN standards, which include features such as transmission repetition and better error correction.

New LPWAN standards have also led to less expensive devices, including modems designed to utilize smaller transmit and receive bandwidth, support much lower peak data rates and operate in half duplex mode. This, in turn, resulted in simpler antenna designs that drove down costs. Devices on LPWANs operate in a lower power class, which further decreases cost. Battery life is another crucial area optimized by the technology. Field deployed devices can last for much longer than had previously been possible with any cellular solution (and with a less costly battery)—in some cases up to 20 years.

Although cellular technology has had a reputation for high cost and unwieldy data plans, the LPWAN approach has an entirely different structure for device and service costs, which makes it viable as a massive scale deployment option. When considering real operational costs, hidden costs and potential risk, the total cost of ownership (TCO) advantages are in favor of a LPWAN IoT cellular solution. These qualifications are unique in the market and help Honeywell meet the most demanding application requirements.

Honeywell is in the business of supplying industrial IoT connected devices to many different mission-critical industries worldwide. Its solutions combine proven know-how in this area with extensive knowledge of power and utility operations, unsurpassed industrial security expertise, deep global relationships with leading cellular carriers, and a long record of technology evolution.

Honeywell's solution is based on secure, open standards-based cellular technology as a preferable alternative to traditional proprietary approaches to building utility metering infrastructure. It responds to requirements in the utility market for a low-cost, resilient and geographically-dispersed network capability for smart metering assets. Honeywell provides utility operators with a cost-effective alternative to customized solutions for automated/automatic meter reading.

ADVANTAGES FOR UTILITY OPERATORS

A growing number of utilities are realizing the value of an established global standard as the foundation for their field network infrastructure. This approach pays dividends in terms of the diversity of suppliers, the availability of devices and the expertise to support accurate and reliable operation and reduce cost of ownership over time.

The development of cellular low-power wide area network technology has resulted in a sea change in current AMI/AMR strategies. Cellular companies have introduced true LPWAN capabilities with the performance and reliability characteristics and price point that align with the use cases commonly found in the utility market. For the first time, utilities have the option to use a public cellular provider to deliver a better performing network without the constraints imposed by a proprietary solution.

Experience has shown that new cellular IoT LPWAN solutions have numerous advantages for utility operators. They enable long battery life in remote devices, assure deep signal penetration and assist in actively monitoring service delivery points that are not easily attainable with other existing communication technologies.

LTE (4G) standards developed by 3GPP have finally allowed all the network operators across the globe to achieve a uniform wireless telecommunication network. LTE technologies are being deployed across every continent. Most developed regions of the world have either LTE-M or NB-IoT or both. There is an exceptional testing and interoperability regime for network devices as part of the implementation process. The result has been truly massive ecosystems with a staggering number of devices and applications supported under LTE. This impressive growth contrasts with the exceptionally small ecosystems typically associated with proprietary utility field networks.

Moreover, the cellular IoT LPWAN licensed spectrum is carefully managed, greatly reducing the probability of interference. And, of course, within the license, users can transmit at much higher power.

The robust security features inherent with LTE implementations, and the rigorous security operations that cellular carriers must maintain, leads to LTE being some of the most secure over-the-air networks in existence. This is obviously an attractive feature for utilities.

Public cellular capabilities are recognized for allowing targeted deployments, whereby utilities can deploy an edge device exactly where and when it's needed. By choosing a public wireless cellular solution as soon as end of life is reached with an existing system, utilities can immediately achieve improved performance. With cellular, users can deploy wherever they like, because—for the most part—there is ubiquitous coverage. LTE delivers superior network performance, including the necessary bandwidth and reduced latency for today's applications.

LPWAN technology was specifically designed to be sustained as a standard through 4G to 5G evolution. Even older technologies had approximately 20-year lives, so it is reasonable to anticipate a longer life between 4G and 5G, as well as ongoing operational cost reductions for devices, modems, and the network itself.

The implementation of standards-based cellular IoT technology also eliminates the need for specialized skill sets to keep proprietary field networks in top working order and helps to minimize related risk.

Lastly, there are features of the cellular IoT LPWAN that are intended to optimize flexibility and bandwidth, and its relatively low latency readily supports emerging advanced use cases. This enables users to target existing applications as well as new application areas such as distributed analytics.

No one size fits all in modern smart grid applications, so utilities deploying advanced edge-to-cloud solutions need options and combinations of features that can match their specific operating requirements.

CONCLUSION

With the rise of promising cellular IoT LPWAN technologies, new smart metering solutions are proving to be a compelling alternative to other connectivity options for both IoT networks and smart city applications. They have been shown to optimize automated meter reading infrastructure and communication with devices in large utility distribution networks.

In this whitepaper, it has been shown that cellular IoT LPWAN solutions deliver promising new options for improving the performance, cost, and reliability of next generation field networks. These solutions will drive digitalization by delivering M2M communications on a massive scale. Connected, intelligent, software-defined products enable new opportunities for both utilities and their customers by boosting connectivity. For utilities, the key to success going forward is to work with a technology partner who understands the needs of their industry and offers technologies, resources and services that are truly sustainable in the long run.

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