LoRa, The LPWA Choice For Cable Operator's Entry Into The Smart Home Market

A Technical Paper prepared for SCTE•ISBE by

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Introduction

According to IHS estimates, the Smart Home market is expected to grow at CAGR of 26% to reach 75.4 billion devices by 2025. LPWA IoT solutions are low cost, simple, and effective approach to solving automation and security in homes. This paper will describe how Low Power Wide Area Networking using LoRa gateways and endpoints can allow operators to support reliable connectivity for IoT solutions while minimizing capital and operational support costs. The paper will also outline unique use cases for LoRa and IoT that will provide innovative new revenue opportunities for cable operators. A survey of LPWA technologies in this paper will show that LoRa is the leading choice. Since Cable operators are already in the homes and have the relationship with the customers, they are in a unique position to offer automation and security solutions and win a large portion of the Smart Home market.

Content

Unless one has been living under a rock for the last five years, they have noticed an explosion growth of connected devices, often referred to as the Internet of Things, or IoT. According to a recent Forbes article, the analysis firm Gartner has predicted that the number of connected devices will grow from 8.4 billion in 2017 to 20 billion by the year 2020. These will include the familiar smart home devices such as thermostats, garage door openers, doorbells, lightbulbs and personal assistants. However, to reach the device numbers predicted by the analysts we are going to have to think beyond connecting the devices we use in our homes. In short, IoT is going to have to go outside and play and as it does they are going to have to deal with challenges in both networking and battery life that will present opportunities for service providers. Over the next few years we will see IoT bring "smarts" to our cars, air quality monitoring in cities, parking spaces, trash cans and cows.   Yes that's right, we are going to have an "Internet of Cows".

The Internet of Cows Problem

In 2013, Fujitsu Limited rolled out its GYUHO software as a service solution targeted to support the food and agricultural industry. One of the interesting use cases of the technology was to detect when cows were going into estrous.   As it turns out, cows start to move around more as they begin to enter their prime mating window and by attaching pedometers with wireless radios, ranchers can monitor their herd and receive alerts when a cow is about to go into estrous. In a test group of 40,000 cattle, the software allowed the ranchers to improve their fertilization rates from 1 in 2 to 2.5k attempts to 1 in 1.58 mating attempts. In addition to optimizing mating times to achieve better impregnation rates, they are also able to determine the sex of the calf with a 70% accuracy.   Improving both of these metrics allow the ranchers to achieve more profit while lowering their feed and other operational costs.

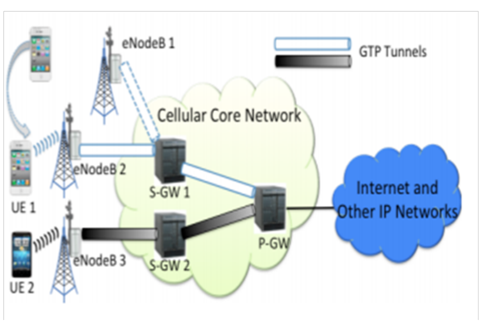
Our cow use case has both of the requirements that current radio technologies such as WiFi or 4G/5G are not able to support well. The first challenge is one of proximity to WiFi hotspots or cell towers.   Cows generally do not live in metropolitan areas where these facilities are often in such abundance as to be taken for granted. To support our Internet of Cows economically both from a capital and operating expense, we need to be able to reach multi-kilometer distances with low cost devices. The data throughput requirements are minimal since we do not anticipate our cows will be streaming Netflix, but we do expect them to be able to easily wander over a large area. The second challenge is one of battery life. It is just not feasible to expect our cows to drop in for a recharge every few hours, and the intent is to make the rancher's lives simpler and more profitable so changing out batteries on a regular basis is an expense and effort we want to avoid. The technology used to support our Internet of Cows would ideally be able to run for months or years before having to have batteries replaced or recharged.

It is not just our Internet of Cows that need support for low data rate, low power and long distance. There are multitudes of commercial IoT use cases that have similar requirements.

In summary, we are looking for a technology that can support relatively low data rates over a large distance and with low power demands to support long battery life.

One of these use cases that is getting a lot of press lately is the idea of "Smart Cities". Kansas City, Kansas has been working to create a 51 block Smart City in their city core as part of an initial roll out of advanced services citywide. Within this area citizens not only have access to free WiFi, but the city has also connected its safety infrastructure such as street lights and emergency vehicles to the network to provide better access to information, and to support the ability to more closely and efficiently manage this infrastructure. In addition, they have deployed trashcans that have sensors to analyze temperature, humidity and fill level. This allows the city maintenance staff to determine exactly where and when public trashcans need emptying and route their resources more efficiently. This has allowed them to greatly reduce the amount of staff and fuel previously used visiting every single trashcan in the city, regardless of whether it was in need of service. Now, while the trashcans are located well within the range of traditional WiFi, the trashcans do not have need of WiFi data rates, nor would it be ideal to burden replacing batteries during each trashcan visit as this would offset much of the operational savings. Solar could be one option, but not all trashcans are in direct sunlight so ideally, this solution would be supported by a radio infrastructure capable of supporting low power and therefore, extremely long battery life.

	Optimized for	Direction	Latency	Cost	Complexity	Spectrum
Cellular & WiFi	Voice and Data	Large Download, Small upload	Low	High (Setting up a network is very expensive).	High (Connection based)	Licensed
IoT	Cost, Battery life	Large Upload, small download	NA (Wide range of use-cases)	Low. Can build private network	Low (Connectionless)	Unlicensed



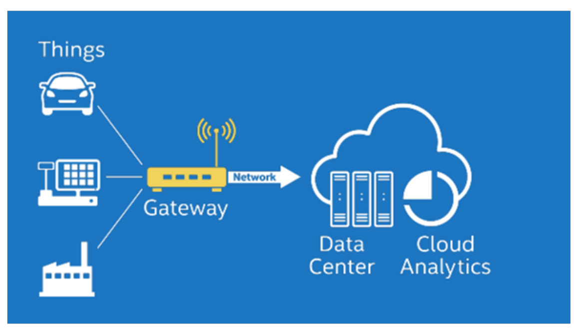


Figure 1 - IoT Demands a New Approach to Connectivity

As we can see from Figure 1, the primary requirements for commercial IoT deployments are focused around low cost and long battery life instead of optimizing for voice and data services as traditional wireless networks were designed to support. If we are going to optimize a network to support the needs of billions of small, chatty devices that need to be left out in the wild to live for years without human intervention, then new radio technologies must be considered.

There are several technology standards that are emerging to support IoT and they all have their strengths and shortcomings. In this paper, we will compare four of the most popular, specifically comparing them against LoRa. These are Long Term Evolution Category M1 (LTE-M), Narrow Band IoT (NB-IoT), WiFi, and of course, LoRa. SigFox was specifically not considered because this is a closed network run by a private company. Random Phase Multiple Access (RPMA), an Ingenu product and nWave's Weightless protocol primarily used in smart meters were also not considered, not because of any technical shortcomings but because they lack any significant adoption beyond the companies who started their development.

LTE-M was developed as part of the 3rd Generation Partnership Project (3GPP R13, 2016) standards work. It supports data rates from tens of kbps to 1Mbps. It has an advantage for existing wireless providers in that they could leverage their existing network. It has disadvantages in that it is not yet commercially available, although there are pilots. Additionally, the modules are expensive relative to other IoT options and when available it is expected that license fees will be charged per device, and that there will be fees for both data connectivity and usage.

NB-IoT is also a part of the 3GPP R13 2016 standards development. It was designed primarily for low data rates of less than tens of kilobytes per second and as with LTE-M should allow providers to leverage their existing infrastructure. But as with LTE-M, devices are still in the trial phase and it is expected that fees similar to existing wireless infrastructure will be incurred on the device.

802.11 WiFi is another technology heavily leveraged by the IoT industry, primarily because it is a well-understood, global standard known for its ubiquity and ease of use. It supports high bandwidth data rates but at the cost of high power demands that impact battery consumption. It is also a relatively low range technology with poor building penetration.

LoRa was established as a standard by the LoRa Alliance (https://lora-alliance.org/) in 2015. The standard utilizes unlicensed spectrum in the 915Mhz band in North America to support very low power transmission over distances greater than 10 kilometers in rural areas. It has advantages of a built-in security model, low battery usage, low cost and very long range with the ability to also penetrate buildings. Data rates are very low ranging from .3 to 50 kbps, but for many commercial use cases this rate is acceptable. Currently end devices are in the $20 range with targeted prices of $2-$5 as volumes increase and gateway costs of around $500-$700 with a gateway being capable of supporting more than 62 thousand devices depending on how often they are transmitting. In addition, the LoRa network is open with no connectivity or data fees, or licenses on a per device and or gateway basis making it ideal for high volume, low cost IoT deployments.

There are currently world wide deployments of LoRa gateways by both public and private consortiums. More than 83 network operators such as The Things Network (https://www.thethingsnetwork.org) and Senet (https://www.senetco.com) are in operation, and they are working aggressively to promote and expand deployments. Companies or even individuals can join groups like the Things Network simply by purchasing and connecting a LoRa gateway. There are also a multitude of commercial IoT devices available for purchase as well as open hardware and software development kits designed to seed innovation.

What is in it for the Cable Operator?

All of the top tier cable operators in North America have invested heavily in the deployments of public WiFi networks and they should continue to do so as these networks will be in high demand for IoT and end user usage that demands low latency and high bandwidth. The consideration of deploying LoRa technology will require consideration of new approaches to monetizing the network, as LoRa does not provide a mechanism for charging the end user or device for access or consumption as operators would traditionally have done. IoT will instead offer new business models whereby the suppliers of hardware, software and most importantly, services will profit from the technology investments. In our Internet of Cows example, the rancher was provided the entire solution as a service which included charges for the equipment and recurring charges for the monitoring services. The Kansas City trash can example was also delivered as a turnkey service to the City. There will inevitably be open consortiums like The Things Network, but these are intended to encourage innovation, not provide sustainable commercial solutions. There will also be new entrants like Senet who will attempt to build out new networks, but they either will largely be leveraging other providers' infrastructure or starting from ground zero, neither of which is an economic nor a time to market advantage. Cable Operators are uniquely positioned to begin offering turnkey IoT Solutions to markets and end customers. The existing HFC network infrastructure is currently servicing around 120 million households in the US, providing cable operators with the fundamental infrastructure necessary to begin deploying IoT infrastructure. Having not only last mile access infrastructure but also infrastructure that reaches into the house and business is a great advantage in deploying new services. Security services for homes and small business is a past example of where Cable Companies have been able to successfully develop a new service offering. As such, Cable operators are in a unique position to create new revenue streams supporting end-to-end IoT solutions, especially for emerging smart cities initiatives such as the Kansas City example. Not only does this have the potential to add new revenue to the bottom line but by offering this as a service to the franchise authority to create Smart Cities, they can further strengthen their partnership in the markets they are serving.

Conclusion

IoT deployments will continue to accelerate and offer an increasingly diverse set of new services to support the needs of consumers, businesses and municipalities. In order to support low cost, long range and long battery life, new transport technologies will need to be deployed in order to create a ubiquitous and always available network. Cable Operators are uniquely positioned to begin building these networks to support a variety of new services capabilities that will allow them to continue to serve their customers with the most advanced technologies and solutions.

Abbreviations

3GPP	3rd Generation Partnership Project
IoT	Internet of Things
Kbps	Kilobits per second
LPWA	Low Power Wide Area
LoRa	Long Range
LTE-M	Long Term Evolution Category M1
Mbps	Megabits per second
NB-IoT	Narrow Band IoT
RPMA	Random Phase Multiple Access
ISBE	International Society of Broadband Experts
SCTE	Society of Cable Telecommunications Engineers

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