SCTE·ISBE CABLE-TEC EXPO 2019 NEW ORLEANS, LA SEPT. 30-OCT. 3

2019 Fall Technical Forum SCTE·ISBE • NCTA • CABLELABS

Leveraging Cellular LPWA for Massive IoT

A Technical Paper prepared for SCTE•ISBE by Joe Walsh

Joe Walsh
Managing Director
inCode Consulting, a Division of Ericsson
6000 Legacy Drive, Plano, Texas
+1 703.835.4386
jwalsh@incodeconsulting.com

Table of Contents

List of Figures

Introduction

Massive IoT has been gaining traction over the last several years driven largely by unlicensed spectrum technologies such as LoRa and SigFox driving down deployment and operation costs while increasing functionality through longer battery life. Cellular operators are taking notice, however, and are deploying several LPWA IoT options themselves incluging Cat-M and NB-IoT. These technologies are offering additional scalabity with national coverage, reliability with licensed spectrum control, and in some cases security. Additionally, because many corporate customers are already comfortable with the 3GPP models of cellular connectivity, there will be a natural sales channel advantage for MNOs for many use cases.

This paper discusses what is happening in the cellular IoT world compared to advances in unlicensed. It also explores ways operators are trying to expand their role in the value chain for IoT to capture additional revenue beyond connectivity.

Leveraging Cellular for Massive IoT

Let's agree that IoT is going to be big. Pick a number and put billions behind it and that is how many connected devices will be on the market by 2025. Operators see this number and think that the money will soon start to roll in faster than they can count. However as everyone is discovering (what has been common knowledge for ten years), the money is not in the connectivity; it is in all of the other areas of the ecosystem and unless operators act smartly, it will be hard for them to capitalize on the IoT wave.

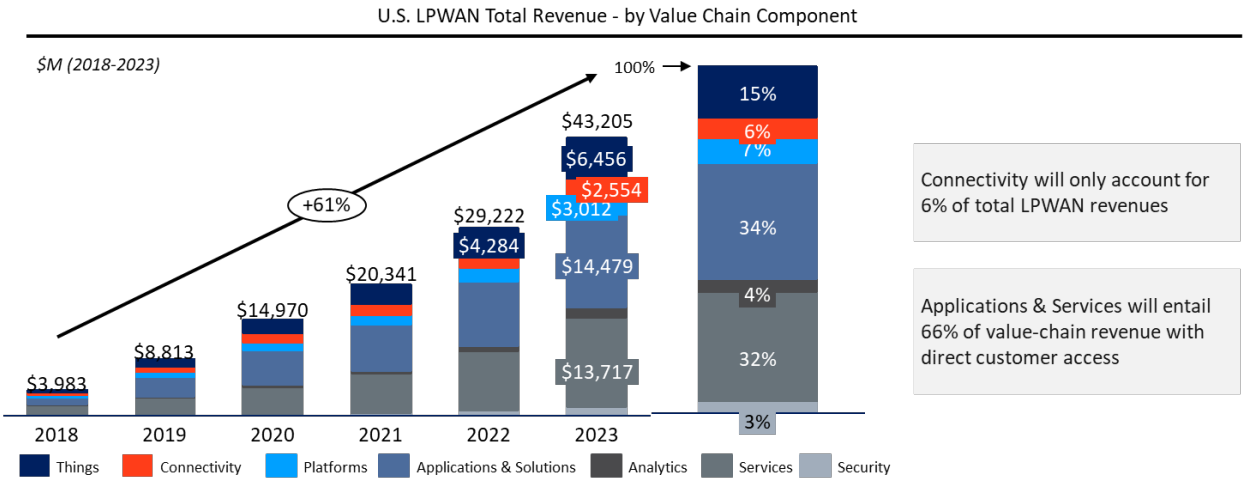

Figure 1- US LPWAN Total Revenue By Value Chain Component

1. Why Will Massive IoT Take Off Now?

We have all seen the projections of the coming wave of connected devices that were supposed to hit the following year for the last five years. While trying not to be "Lucy pulling the ball away from Charlie Brown" at the last second, this time it IS different. Technology is driving digital transformation which in turn is pushing technology deployment. A few of the key technology trends are:

1.1. New Network Options

In the past, a connected device had all the bandwidth and power requirements of a smartphone. Carriers could not (or would not) and the standards did not exist to easily differentiate a smart meter needing hundreds of bytes per day from a smartphone that needed hundreds of megabytes per day. Thus, the cost of the device module and network connectivity were high.

New networks, both unlicensed LoRa, and licensed NB-IoT and Cat-M are driving down the cost of deploying IoT solutions. Module prices are sub-$5 for both solutions and continuing their march downward. These networks are designed specifically to handle large density of connected devices powered by batteries and utilizing KB-level data packages.

The lower cost and power profile are driving a new class of IoT solutions with almost disposable devices that capture a wide array of data points. Carriers have followed suit to provide flexible pricing options. Industries such as consumer package goods (CPG) are starting to leverage these trends to install sensors within retail packaging, allowing them to track performance, offer real-time customer personalization, and predict supply-chain issues.

For example, T-Mobile recently launched its NB-IoT network with pricing as low as $6 per year for up to 12MB of data traffic. At this price point, new business models such as a CPG company putting sensors in pop-up displays they send to retail outlets to track performance. I expect carriers to introduce bundling options to ensure stickiness with their core activities (i.e., For $5, all connected home devices included in monthly cell phone contract.

1.2. Network Capability Enhancements

On the opposite side of the spectrum (pun somewhat intended), new network technologies driven by Private Networking and Edge Computing will increase the capabilities of networks, in turn driving up the number of connections.

The ability to stand up private networks will be instrumental for both unlicensed and licensed technologies. Farms in rural areas with limited licensed (cellular) connectivity have adopted LoRa to ensure coverage at a reasonable cost. Coke utilized inexpensive, but reliable LoRa gateways in their distribution warehouses to capture data from delivery vehicles as they entered the facility to reload.

Edge computing is typically associated with lower latency applications such as edge augmented reality. However the lower latency provided by edge computing can mean that components traditionally required on the device can be hosted in the cloud. This combined with Non-IP Data Delivery (NIDD) can extend battery life and reduce network traffic. Additionally, edge compute and storage capabilities can also be leveraged to make IoT connections more reliable if local connectivity rules data collection and device control in the event of a cloud failure.

1.3. New Technologies To Feed The Data Beast

As companies digitally transform themselves, they are beginning to realize the benefits of all the data captured to help improve operations, customer experience, employee satisfaction, and profitability. Advancements in machine learning (ML) and artificial intelligence (AI) are enabling these companies to leverage captured data to derive actionable insights. For example, video and audio-as-a-sensor are rapidly being adopted for equipment condition monitoring across a range of industries.

One laser-cutting equipment manufacturer wanted to reduce downtime for equipment caused by routine lubrication. The current process was to take the machine offline after a certain amount of usage – no matter if the machine needed lubrication or not.

To eliminate these inefficient calendar-based downtimes, the company installed microphones near machines and leveraged predictive analytics to detect noise patterns that indicated abnormal conditions needing lubrication. This eliminated unnecessary downtime from routine maintenance while still ensuring the machine was performing effectively.

2. Use Cases Will Drive the Market

Customers, however, are looking for end-to-end solutions and not any one of these specific technical capabilities. The development of these use cases, and selection of network technology, will depend on the unique characteristics of the use case such as battery life, mobility, data throughput needs, security, and geographic coverage. To develop an end-to-end solution, operators need to bring together various ecosystem components including:

Use Case	Best served by	Rationale	Industry momentum
Farm operations	Unlicensed	• Farmers prefer own infrastructure which must be easy to set up • Poor cellular coverage in rural locations • Low power, low cost of operation	• Early mover advantage for LoRa • Dominant in precision agri. & irrigation vinduino WaterBit CHIPSAFER
Asset tracking	Unlicensed or Licensed	• Licensed spectrum ideal for assets traversing multiple geographies • Unlicensed ideal for tracking assets in warehouses and indoor locations	• Licensed and unlicensed spectrum solutions target specific verticals/niches senet ineo·sense OSSIA T··Mobile·
Public safety	Licensed	• Five-nines reliability and ultra-low latency for mission critical applications • Telco-grade security and standards • Real-time analytics	• 3GPP standardizations propelling trials and deployments SAMSUNG + kt

Figure 2 - Illustrative use case driven technology selection

2.1. Connectivity

Operators must decide which use cases they will support given the network technologies they have deployed. While unlicensed technologies such as LoRa have had an early start, all major US operators have or are deploying NB-IoT and Cat-M shifting the scale-effect of the ecosystem towards licensed networks.

Current deployment models of LPWA leveraging lower band spectrum means that Tier 1 operators can have a large advantage for deployment of many use cases. This is especially true for NB-IoT that will leverage lower bit rates which provide better link budgets.

However unlicensed technologies will remain a strong alternative, assuming they can corral ecosystem partners to spur end-to-end solution development. It will mean that many of the use cases may require customers to deploy and manage the LoRa gateway themselves which can be an advantage if you have the support infrastructure to do so.

It should be pointed out that the licensed vs unlicensed divide is strongest in the US with many international operators choosing to deploy both licensed and unlicensed IoT networks.

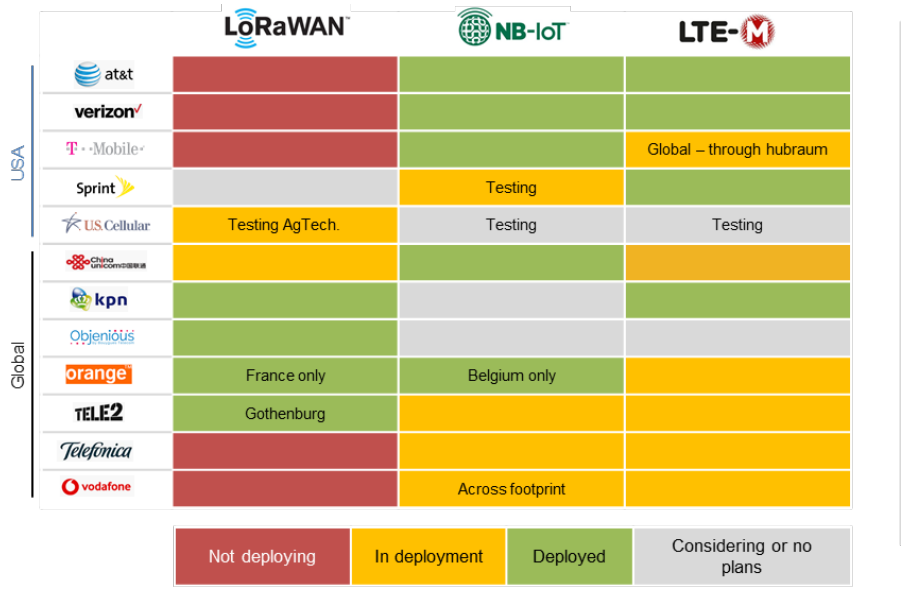

Figure 3 - Licesned vs unlicensed technology deployment by carrier US vs. ROW

Irrespective of type of network deployed, operators must make it easy for solution developers to develop, buy, sell, and maintain solutions. For example, Verizon specifically invested in ThingSpace, a web-based platform to make it easy for solution developers to create products and bring them to market.

2.2. Devices

A core component of any IoT network are the "Things" or devices that are connected to the network. Every "Thing" is generally comprised of a connectivity module, some sort of sensor, and some sort of processing capability. Operators generally are not good at producing "things" and likely should not try to extend themselves in this direction.

However, operators such as AT&T have long provided contracts for certified modules to simplify development of new IoT devices. T-Mobile offers NB-IoT modules on their website at negotiated bulk rates driving the cost down to $5/module, as well as a a developer kit powered by Twilio to simplify creation of solutions.

Both the licensed and unlicensed will have challenges in global ecosystem support. Even for North America, modules that support both NB-IoT and LTE-M are more expensive so use cases will need to select one or the other to support and deploy.

2.3. Analytics

Being able to capture data is only the first part of an IoT solution's function. To be truly valuable, these solutions must be able to deliver actionable insights.

Web-scale players have been strong in this space, but many startups have developed niche's as well. Pre-negotiated and integrated analytics capabilities can help developers take advantage of these while improving the network efficiency of their solutions.

2.4. Security

As we start to develop millions of new end-points, the security risk of the IoT network becomes significant. Operators can provide built-in security functionality into their developer kits and networks to ensure end-to-end security. Developer programs are also starting to educate their communities about designing security in from concept inception.

Cellular operators have always relied on the inherent security afforded by the SIM chip although this comes at the expense of power consumption. Two different approaches are emerging here with some ecosystem players such as Able Devices embracing the SIM to provide a common platform to run small java programs. One such use case for this is to leverage the SIM to auto provision subscriber identity to the device when deployed. This can also assit in OTA updates of firmware and security features.

A second approach is to leverage non-IP data delivery which has the dual function of reducing the payload on the network as well as increasing security by removing the IP addressability of end devices. In some situations, this may be able to move much of the processing to the cloud and thereby potentially simplifying end-device security.

Regardless, operators must provide security tools for developers and encourage them to adopt security from the early product concepts through operations.

2.5. Sales Channel

We don't often think about the sales channel as an ecosystem component, however it is important in the IoT market. Operators' sales channels have traditionally focused on selling connectivity and not end-to-end solutions. This limits their access to customers looking to buy vertical solutions.

Operators such as AT&T have been augmenting their sales channels to support selling of partner solutions but still have much room to capture their share of the IoT pie. They should look to have IoT solution overlay their traditional sales and support teams.

3. What is an Operator To Do?

To fully realize larger portions of the IoT revenue pie, operators will need to develop partnering as a core competency. For operators focusing on connectivity, partnering with some of the cloud platform players will be key to achieving sales volume. Operators pursuing this route correctly realize that the webscale players (Microsoft, Amazon, Google) are already entrenched in the enterprise application development space and have robust application development platforms, data analyctics, and IoT Service enablement. However these players lack the connectivity and in many cases device and data management functionality.

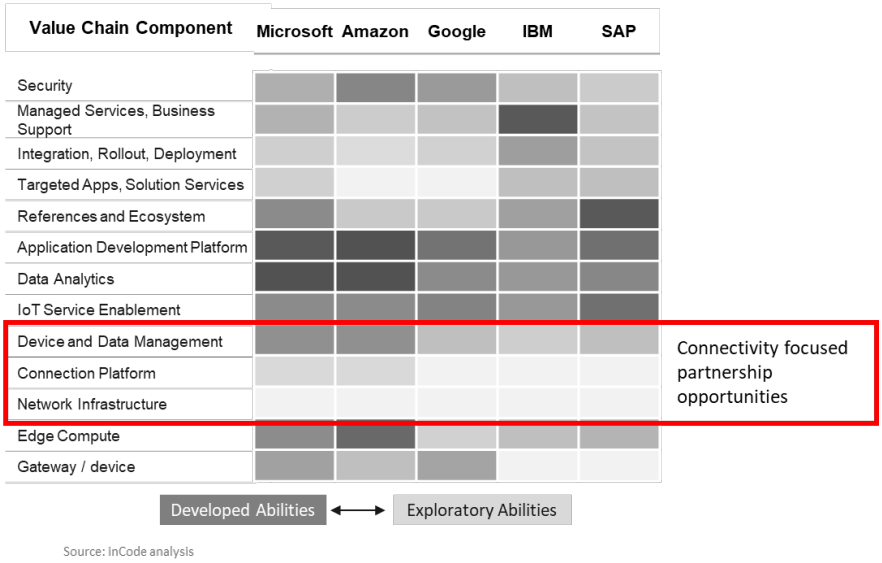

Figure 4 - Webscale player capability assessment by value chain component

Cellular operators, however are looking at a three layer maturity model to capture more of the value chain outside of connectivity.

3.1. Layer 1: The developer program

Most operators have developer programs that offer documentation, APIs, and some sort of support community. Established operators provide easy onboarding of new developers and a well-documented process to bring new solutions to market. This is really the cost of entry for operators to support an IoT network.

3.2. Layer 2: The Innovation Center

Most major Tier-1 operators have innovation centers geared towards IoT solutions. AT&T's Foundry, launched in 2011, led the way with one focus area being IoT solutions. Sprint recently launched the IoT Factory to bring customers, developers, SI's and their partner network to develop ready-to-sell vertical solutions.

3.3. Layer 3: Co-creation

Operators are in a relatively unique position to bring customers together with ecosystem players to co-create IoT solutions. Using design thinking to embed the voice of the customer into the rapid design / prototype / test processes, co-creation ensures that the product exiting the development process meets customer needs. Successful operators generally adopt a flexible intellectual property (IPR) policy that I describe as "what's mine is mine; what's yours is yours; what's ours is ours".

Conclusion

Operators must focus on end-to-end solutions to capture larger portions of the IoT market opportunity. They must identify the use cases that make sense based on their network technology, geographic reach, customer base, and sales channels. This analysis will drive the decision to offer licensed or unlicensed connectivity. For cable operators without licensed spectrum, there are a number of opportunities that can be explored including procuring licensed spectrum, wholesaling connectivity from an MNO, or leveraging CBRS. These decisions themselves will be driven by use cases (i.e., broad rural IoT likely not a good option for CBRS)

Once use cases have been identified, operators must then identify gaps that can be filled by ecosystem players and proactively fill with qualified partners. These partnerships need to be mutually beneficial, scoped to the scale of the partners, and have clear short-term and long-term goals for each party.

Lastly, operators wanting to capture significant portions of the value chain outside of connectivity must leverage their central role to facilitate co-creation of new IoT end-to-end solutions and build out the sales and support channels to solve their customer's challenges.

Abbreviations

AP	access point
CPG	consumer package good(s)
IoT	Internet of things
LPWAN	low power wide area network
MNO	mobile network operator
OTA	over the air
SIM	subscriber identiy module
HFC	hybrid fiber-coax
HD	high definition
Hz	hertz
ISBE	International Society of Broadband Experts
SCTE	Society of Cable Telecommunications Engineers