



**THE WIRELESS
FUTURE:
PARTNERING FOR
WHAT COMES NEXT**

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THE WIRELESS FUTURE: PARTNERING FOR WHAT COMES NEXT

1. INTRODUCTION

Cloud computing and the Internet of Things (IoT) have created opportunities not thought to be possible before. The idea of connecting devices and sensors over the cloud enables many new applications such as Industry 4.0, asset tracking, connected cars, telehealth and much more. Suddenly, many operational experts in vertical segments such as agriculture, the petroleum and oil industry, manufacturing, and more are becoming deeply involved in the Internet of Things. They are partnering with experts in IoT to provide complete solutions to their clients. The future is bright with more IoT applications, 5G network and Low-Power Wide Area Networks (LPWAN) being developed. And this is just the beginning.

Major firms around the world are investing in IoT. Cisco, GE, IBM, Google, Baidu and Siemens are among the leaders. SoftBank, the Japan-based telecom giant and owner of ARM (UK) and Sprint (USA), is investing heavily in IoT. Its newly acquired Encored USA will provide a platform service, "Enertalk", that offers analysis of real-time energy data with their IoT devices in roughly 100,000 households worldwide. Without question, the world is going IoT. Dell recently announced it would spend \$1 billion to form an IoT division to drive new business. IBM has created a Watson IoT platform to support IoT. The list goes on.

2. WHY INTERNET-OF-THINGS MATTERS

IoT enables enterprise companies to access real-time data in remote devices and sensors enabling increased productivity and better customer experiences. By way of illustration, Dell's IoT team found that by continuously monitoring the performance of machines on the production line, a factory can prevent production down time.

"Industry 4.0," published February 2016 under the auspices of the European Parliament's Committee on Industry and Research and Energy (ITRE) and authored by Centre for Strategy & Evaluation Services LLP, estimated that productivity improvements would increase revenue €90-150 billion (\$106-176 billion) over the next 5-10 years. Germany's GDP would increase €30 billion (\$35 billion) or 1 percent per year based on demand for new equipment and data applications. Industry 4.0 will be a game-changer for the EU manufacturing ecosystem. IoT is also changing healthcare, city planning, traffic control, agriculture, transportation and asset tracking, smart energy, enterprises and more. At the Microsoft IoT in Action event earlier this year, Microsoft asked their audience what they need to know about doing business in IoT. The consensus included things like how to make money, how to get started, and deployment of products after they are completed.

So how is IoT going to deliver on these promises? According to the State of the IoT Market: Our 2017 Report by Verizon (updated in Sept. 2017), IoT adoption is accelerating and expanding into all industries.

- IoT is playing a key role in almost every industry in helping to increase operational efficiency and new growth.
- Monitoring performance of machine and operation is not new. But now it has become enterprise-level, which is why most large firms are looking into IoT, fueling its growth.
- At the same time, low-power networks (LPWAN) related projects help organizations to reduce cost.

In short, LPWAN IoT solutions can deliver better system efficiency by monitoring operational performance. Achieving that requires implementing of LPWAN products that can seamlessly connect to the carrier network and choosing the right ecosystem platform.

Low-Power Wide Area Network (LPWAN) in the context of IoT

Many IoT applications are battery-powered such as wearable healthcare devices, smart agriculture and asset tracking, and thus require longer battery lives. Low-Power Wide Area Network (LPWAN) devices are used to support low-power IoT. In short, two categories of LPWAN are available; cellular and non-cellular. Many of these machine-to-machine (M2M) devices can run for 5 to 10 years without changing batteries. M2M applications usually are lower speed (in kilobits per second). The applications of LPWAN and M2M are broad. They include:

- Telehealth – patient monitoring and fitness
- Smart cities and buildings – traffic control, building energy management
- Smart agriculture
- Transportation
- Water safety and facility management
- Smart grid and energy management

Berg Insight, a market research firm, projected the global shipments of cellular IoT devices will grow to 530.1 million units in 2022 up from 155.6 million units in 2016, a 22.7 percent compound annual growth rate (CAGR). In the same period, annual shipments of LoRa and SigFox will be 50–100 million units each by 2022. The cellular IoT market represents broader opportunities for device makers, resellers, OEM and system integrators without having to build out LoRa networks.

With the growth potential of cellular IoT, all major telecom carriers are gearing up. The top three carriers, AT&T, T-Mobile and Verizon, are moving forward with cellular-based IoT networks. The Third Generation Partnership Project (3GPP), a global standardization body that defines standards and has representatives from tier 1 carriers, has released the 3GPP Release 13 that supports LTE-M and NB-IoT. Other versions are expected to follow.

Verizon is taking the lead with its LTE-M roll-out this year. Additionally, Verizon also provides an IoT platform called ThingSpace. Developers can create LTE-M devices with secured end-to-end connections. Currently, about 14,000 developers worldwide cover more than 175 countries.

3. SELECTING THE RIGHT ECOSYSTEM PLATFORM

Implementing IoT can be complex. Not only because it has many moving parts, it is also hard to predict the future. IoT solutions are complex, and many parts need to play together. As shown in Figure 1 on the next page, products (hardware and software) need to function well and with network connectivity attached to product databases and

application platforms which are dictated by the rules of analytics engines. Additionally, external information sources are connected to the analytics engine, with identity and security considerations throughout the system design. So what is the best way to choose a product and ecosystem platform?

SEE FIGURE 1 (pg. 6)

Here are some helpful hints on choosing a solution:

- What features do you need (speed, cost, security)? This will determine which wireless technology platform you want to use.
- What is the market potential of the platform? According to Berg Insight's research, the projection for cellular IoT is 5-10 times the size of the other offerings. This means the cellular IoT (LTE) market will offer more opportunities to device makers, integrators and resellers. Additionally, the bigger the market, the bigger the ecosystem and community, and the easier it is to get support.
- Which of the LTE technologies (4G LTE, LTE Cat1, LTE-M or NB-IoT) should you choose? If you are looking for low-cost, M2M connections that require less than 1 Mbps, then LTE-M and NB-IoT would be a good fit. The battery lives of both would be multiple years. Additionally, the overall cost of connection is coming down. Many M2M applications would fit this category.
- Is the overall ecosystem mature? After the product is designed and installed, is it easy to scale or expand? For example, how difficult is it to install a similar system at a different location, say, in a different country? How much time and how many resources will it take?

FIGURE 1: SMART IOT ARCHITECTURE



4. SHORTENING THE DEVELOPMENT CYCLE

Businesses are in a race to get to market. But often fast does not mean success, because a shortcut is taken – either intentionally or unknowingly. IoT Analytics, an IoT research firm, describes IoT product development as complex. They divide the development process into six phases. **SEE FIGURE 2**

- Phase 1:** Project definition and justification – the business case - Feasibility
- Phase 2:** Design approach: build or buy – Systems engineering
- Phase 3:** Selecting the right design and integration partner **SEE SECTION 5**
- Phase 4:** Proof and test of design concept (alpha test – internal) - Viability
- Phase 5:** Field test and pilot run (beta test with selected customers) - Desirability
- Phase 6:** Product launch (release to volume production) – Scale for business success

Once the business case has been decided, the next step is to figure out the design approach - whether to build or buy. Most developers would initially opt for building from the ground up, but in today's IoT ecosystem this is rarely the most efficient way. The sooner one can get to the proof of concept stage, the lower the risk.

Imagine working for months on development, only to find out that the device has low market acceptance. On the other hand, with modular

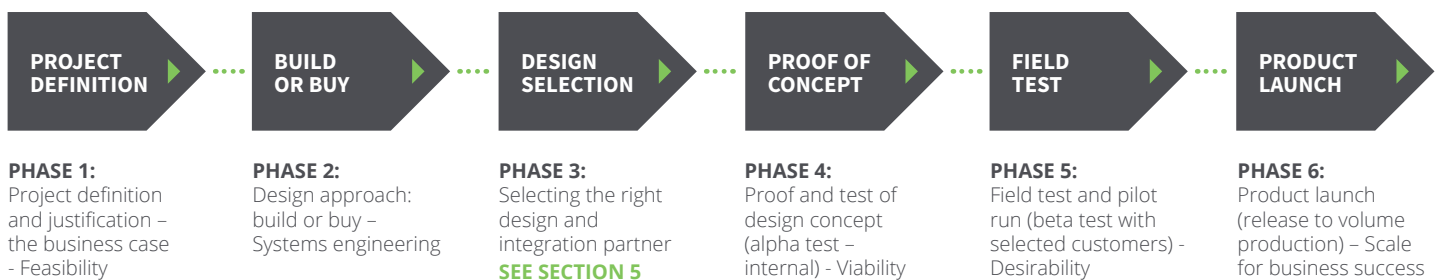
options, developers can modify the design quickly and test multiple markets at the same time. For example, the devices can be tested in healthcare, agriculture, manufacturing and oil and gas at the same time. Pick the one with the warmest reception to maximize the chance of success.

Additionally, it is always faster to get to the alpha and beta stages with a proven module, and it eliminates all the unknowns and risks. Using a proven wireless product will reduce design time, troubleshooting and the long process of certification such as FCC and carrier compliance. Once the device has achieved successful commercial deployment, it is much easier to do a redesign with customer feedback and at that point it may be a good time to reevaluate whether to design the wireless module in-house.

If you have chosen to build the wireless module at phase 2, it is important to obtain all the needed certifications before formally rolling out commercial products. The following section examines the network carrier certification process.

When applying for the carrier certification, make sure the steps below are observed. This may be time consuming, but important, as the network carriers want to ensure that the wireless device is reliable and works well with the network. Here is an overview of the certification process required by most carriers. It consists of four phases: register, submit, certify and prep for market.

FIGURE 2



CELLULAR CARRIER CERTIFICATION PROCESS

A. The registration process includes getting an account set up by completing the following steps:

- Submit company registration
- Sign a Non-Disclosure Agreement (NDA)
- Sign a Certification Agreement (CA)
- Provide Certificate of Insurance (COI)

B. Submit all required documentation:

- Device info
- FCC grant
- GCF grant
- Picture of product
- Supporting documents
- User guide
- Quick references
- Troubleshooting
- Lab logistics
- Selection of lab
- Date for lab submission

C. Get certified with the following testing process:

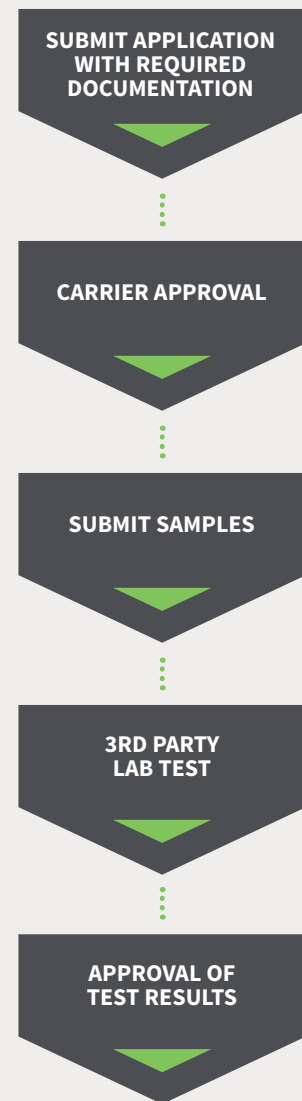
SEE FIGURE 3

- Submit documents to the carrier
- Submit sample to 3rd party lab
- Lab approves test results

D. Prep for market includes receiving of an Open Development Certification letter and the ability to run your device on the carrier’s network. Then you activate the device and upload your unique device identifiers (IMEIs) to the carrier’s database. If all goes well, the device will be successfully certified.

FIGURE 3:

Getting carrier certification can be expensive. Depending on how many modules are involved, it can cost over \$1 million.



5. PARTNER SELECTION CHECKLIST

Building from the ground up is often either too daunting or not economical, so a trusted partner is chosen to help developers shorten the product development time, minimize risk and get product to market fast. Developers of wireless products need to consider many factors including hardware, software, RF requirements, antenna, security, certification, compliance, test and production.

This complexity highlights the value of a partner with experience specializing in wireless design; someone with extensive experience in RF, antenna design, hardware/software security, and in working with the carriers and their certification processes. Using a partner with off-the-shelf wireless solutions that have passed all the certifications already simplifies the process considerably and cuts down development time.

Transitioning products from engineering to production is time consuming. First comes the pilot run and then the field tests. The next phase is the preproduction run and final product release. Potential problems can occur in each step, causing costly delays. One possible solution is to use the off-the-shelf wireless modules offered by Digi International. This will eliminate risks because these modules have been field-proven and millions of units have been shipped for many years.

A checklist for finding the right partner:

- ✔ Does the partner have a clear understanding of the IoT technology stack and their capabilities within the ecosystem? Will they make component decisions from quality suppliers for long-term availability?
- ✔ Does the partner have successful design experience in hardware, software, RF requirements, antenna and security within the IoT stack?

- ✔ Does the partner have experience working with certification and compliance including UL, FCC and carrier in-device that are critical to successful and on time launch of the product?
- ✔ Does the partner understand and offer solutions for your next growth steps whether they are deployment in other regions, transitioning to new technologies, or offering derivatives to meet new customer needs or new customer segments?
- ✔ Does the partner have experience with design-for-manufacturing (DFM) and can they help with transitioning products to production in small-volume pilot runs as well as high-volume production?
- ✔ Is the potential partner reliable, and do they enjoy a reputation for delivering quality products and services?

6. PARTNERING WITH DIGI TO UNCOVER NEW OPPORTUNITIES

Partnering with Digi will put you in an advantageous position as Digi has many years of experience in product design and support. Many of the modules are ready for implementation. The examples below show how users have benefited by using these solutions.

A. IoT insight and application case studies

While it is important to use products of high quality, the best way to assess quality is in the results the solutions deliver. Results in IoT come from reliability, security, flexibility, and durability delivering performance in application. A good way to assess the efficacy of a solution provider is to evaluate who has used the products and assess the delivered results. The following are three case studies to illustrate this point. There are many other cases available online (www.digi.com/news/customerstories)

Case 1: Digi XBee® module used in NASA's SORAEX-8 suborbital flight

National Aeronautics and Space Administration (NASA), as part of a program to determine potential applications of wireless technologies in space, launched the Flight Opportunities Program which used the Digi XBee module. SOAREX (Sub-Orbital Aerodynamic Re-entry Experiments) payloads (eighth of the series) were delivered by a suborbital rocket to roughly 250 miles above Earth to test a new "Exo-Brake" technology. The Exo-Brake is used to help the satellite to decelerate before re-entry to Earth. Digi XBee function was used to monitor the temperature, air pressure and performance, including 3-axis acceleration of the Exo-Brake.

FIGURE 4

Courtesy of NASA Wallops Flight Facility

<http://bit.ly/2CUUcAb>

**Case 2:** Chicago area commuter-rail agency turns to Digi to increase ridership with free internet access

FIGURE 5: Digi TransPort® 50-channel high-performance GPS receiver provides reliable Wi-Fi services

Thousands of passengers commute daily to and from Chicago. Some come from as far as South Bend, about 100 miles away, and they expect to have reliable Wi-Fi during their commute. The Northern Indiana Commuter Transportation District (NICTD) tried two times to initiate a Wi-Fi project without success. With Digi TransPort, a compact, mobile-access LTE router which supports 120 clients securely, NICTD can remotely monitor the performance of the system using the device health reports built on the Digi Remote Manager. Finally, the Digi TransPort 50-channel high-performance GPS receiver was used to provide reliable services. **"I've known Digi for a long time and have always found that their products are super-reliable, so we decided to try a pilot program on 10 of our 82 cars, and it has worked very well,"** commented Boris Matakovic, Chief Information Officer of the Chicago Area Commuter-Rail Agency.



Case 3: U.S. Water provides water treatment solutions to industrial clients across North America

FIGURE 6:

Waste water treatment facility

U.S. Water had a problem. They needed an M2M strategy to help them to efficiently monitor and aggregate data from field equipment, so they can compete with larger and more established companies. They went in search of the right company with the right solution. **“We looked at a number of solutions providers. Digi had the resources, products and experience U. S. Water required,”** said Henk. **“Most importantly, Digi provided the support and assistance on the development of the complete solution – not just a portion of it.”**

Digi provided strategic direction to U.S. Water with a complete connectivity solution by








leveraging the Verizon alliance. Digi’s end-to-end solution included consulting services, hardware products and Digi Remote Manager. The U.S. Water controllers located at customer sites were connected to the cellular routers, allowing access to data points from local controllers. Additionally, Digi XBee tank sensors were used to collect data from dispersed water tanks and sent to centralized cellular gateways. Now U.S. Water can connect 300 remote controllers and sensors into the complete system. This has helped U.S. Water to create supply chain efficiency and put them in total control.

The applications in space by NASA, Wi-Fi by Chicago Area Commuter-Rail Agency and data monitoring by U.S. Water demanded safety and reliability. These are just a few of the many projects Digi International has completed, successfully delivering results and earning the trust of customers.

B. Digi offers both experience and solutions. Getting new products to market fast will help foster leadership position. As described earlier, there are multiple steps to ensure quality products are designed and produced. It requires investments and time. Using a proven product will shorten the design cycle, as Digi has invested over the years in creating various wireless modules which have

been field tested, certified and secured. As shown in Figure 7, whatever your wireless design requires, chances are there is a good fit for you. Offerings from Digi include many versions of RF and cellular modules with support of Wi-Fi, Bluetooth, ZigBee, 4G, 802.15.4 and more. The broad range of products covers many industries including food service, healthcare, energy, industrial, retail, smart cities and transportation logistics.

FIGURE 7: DIGI XBEE3™ SMART MODULES

FAMILY	FREQUENCY/ BAND	PROTOCOL	DESCRIPTION	RF LINE OF SIGHT RANGE	FORM FACTOR	DEVELOPMENT KIT PART NUMBERS	RF Data Rate	CURRENT DRAW TX/RX	CERTIFIED REGIONS
Digi XBee3 ZigBee 3.0	2.4 GHz	ZigBee® Pro 	ZigBee mesh networking, low-cost, low-power	4000 ft (1200 m)	Micro 	XK3-Z8S-WZM	250 Kbps	135mA @ 19 dBm 40mA @ 8 dBm	US, Canada, and Europe
Digi XBee3 DigiMesh		DigiMesh® 	DigiMesh networking, low-cost, low-power		Surface Mount 	XK3-DMS-WZM			
Digi XBee3 802.15.4		Proprietary 802.15.4 	Low cost, low power point-to-multi-point device connectivity		Through-Hole 	XK3-AS-WZM			
Digi XBee3 Cellular Cat-1	LTE Bands 2,4,5,12 Verizon Band 13 (Coming Soon)	Verizon, AT&T, Canadian Carriers	Digi XBee3 Cellular Smart Modem, LTE-CAT 1	Cellular Network Coverage	Through-Hole 	XK3-C-A1-UT-U (AT&T)	10 Mbps Downlink / 5 Mbps Uplink	1Amp / 10uA (Low Power Mode) @3.3V	US and Canada
Digi XBee3 Cellular LTE-M	Verizon Bands: 4 and 13 AT&T Bands: 2, 4, and 12	AT&T, Verizon, Telus	Digi XBee3 Cellular Smart Modem, LTE-M			XK3-C-A2-UT-U (AT&T)	Up to 375 kbps Uplink and Downlink	550mA / 20uA (Power Save Mode) @3.3V	
Digi XBee3 Cellular NB-IoT	Bands 8 and 20	Vodafone, Deutsche TK, Orange, and others that support these bands	Digi XBee3 Cellular Smart Modem, NB-IOT			XK3-C-N1-UT-E	Up to 27.2 kbps Downlink, 62.5 kbps Uplink		Europe

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Furthermore, Digi can also help with custom design. With a strong and experienced design team, Digi can help customers develop, test, certify, produce and smoothly transfer production to its own factory located in Minnetonka, Minnesota. Once volume increases beyond 10,000 pieces, Digi can help customers to easily transition production to another high-volume contract manufacturer.

C. Uncover new opportunities together

If you want to grow your wireless business or integrate wireless solutions into your existing business, Digi International can help. Digi has many years of experience helping customers succeed in a wide variety of industries.

As a solution provider, Digi does not just sell you a product. You can count on Digi to provide you with a complete support system every step of the way. Digi can provide you and your clients with strategic direction and all the necessary components to help you deliver a seamless solution to put you in the driver's seat. When you encounter an opportunity that involves IoT or wireless, chances are Digi has done it already. We would like to invite you to talk to us and let us help with your proposal, as well as provide suggestions and support. Contact us today, and let's get started on your IoT future.

Contact a Digi expert and get started today

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