Internet of Things Handbook

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How best to address connectivity for IoT issues

TechTarget

In this handbook:

Connectivity for IoT is rarely a one-size-fits-all choice

What an impending marriage of IoT and 5G means for the future

Do cellular IoT communications fit your IoT strategy's needs?

Is LoRa technology the wireless standard IoT has been waiting for?

Connectivity for IoT is rarely a one-size-fits-all choice

SHARON SHEA, SITE EDITOR

By 2025, billions of devices will be internet-connected, offering organizations a bevy of insights to optimize operations, cut costs and improve decision-making.

But it's not magic. You can't just add a sensor to a machine and create a new revenue model. You need the *proper* sensors to collect the *proper* data, and the *proper* analytics to garner insights. The right connectivity is key to this process.

When it comes to connectivity for IoT, one size doesn't fit all. While there are wired options and satellites, most IoT systems will use short- or long-range wireless, depending on the use case. But the decisions don't stop there.

An array of options exists for short-range connectivity for IoT, from Bluetooth to near-field communications to Wi-Fi and more. For long-range, there are even more choices to make, including licensed (such as LTE Cat

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M1, Narrowband IoT or 5G) or unlicensed (LoRaWAN, Sigfox or Random Phase Multiple Access).

Each IoT connectivity option has its own benefits and tradeoffs around data transmission (e.g., amount of data and frequency), latency, power consumption, cost and security, to name a few. High-volume, fast data transfers generally use more power. Looking for low power consumption? The tradeoffs are generally shorter range and less bandwidth.

Does your organization collect water meter readings across a city? Maybe LoRa is a good option to send small amounts of data at regular intervals. In an industrial setting that needs to connect billions of small, non-real-time sensors or requires ultra-reliable, low-latency connectivity? 5G may be best. For agriculture businesses that want to capitalize on IoT, cellular isn't an option -- low-power, long-range WAN may be the best bet.

Before you perform predictive maintenance, build digital twins or enable machine learning, choose the proper connectivity for IoT to get your data where it's going efficiently, cost-effectively and safely.

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GEORGE LAWTON, CONTRIBUTOR

5G is an emerging set of cellular technologies, specifications and proposed standards that promise to dramatically improve the speed and responsiveness of wireless networks. One area that will greatly benefit is the internet of things. Touted benefits of 5G for IoT include faster connectivity, lower latency, reduced power consumption, increased reliability and better security models. Other promises of 5G include improving support for new architectures like IoT edge computing and public mesh networks.

Enterprises are looking for ubiquitous connectivity and near-real-time remote diagnostics and management capabilities for mission-critical IoT -- and 5G is here to answer that call.

"5G's low latency, faster transmissions and secure communication will speed up IoT adoption for enterprises," said Nitesh Arora, head of marketing at Cloudleaf Inc., an intelligent-sensor platform.

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Kurt Steinhauer, president of Smart Edge, an edge-computing platform, predicted that all facets of industry will be impacted by 5G, especially manufacturing, transportation, healthcare and retail.

Developers will be able to access different kinds of network capabilities provided through a unified IoT and 5G network, said Colin Alexander, director of wireless infrastructure at Arm Limited. Use cases like enhanced mobile broadband will target more efficient broadband access to connected homes and mobile devices, whereas massive machine connectivity use cases will support the connectivity of billions of small, non-real-time IoT sensors for a range of connected applications. Another class of uses will cover ultra-reliable low-latency connectivity and target high-value, industrial IoT and vehicle-to-X connectivity that requires a mix of low latency and high reliability.

DON'T GET DISTRACTED BY IOT AND 5G'S PROMISES

In the long run, 5G infrastructure could unify competing wireless standards, said Bruce Collins, director of product management at Cambium Networks Ltd., a wireless infrastructure provider. "It is also adding some confusion in the market today as there are existing private

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and public solutions being deployed now while 5G is a couple years away from adoption and initial deployments," he added.

5G represents a further splintering or fragmenting of the IoT wireless space. Many existing low-power wide-area technologies -- such as LoRa, Cat M1 and Narrowband IoT -- are being deployed today. "5G, which will only be ratified in 2019, with IoT at a lower priority, can serve as a distraction for operators looking to solve problems today," Collins said.

The key thing for operators to keep in mind as the options proliferate is that the use case is more important than the network technology. Enterprises should focus on identifying a manageable, scalable, secure network that uses the right technique for the right system. "We recommend that enterprises looking to deploy IoT networks start with the application first and then work backwards to the selection of a wireless technology," Collins said.

NEW ARCHITECTURES FOR IOT AND 5G

One practical way for IoT developers and enterprise architects to approach 5G adoption is to think about creating different IoT architecture

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layers relating to sensing, transportation and applications, said Cloudleaf's Arora. 5G technologies will provide a variety of options at the transport layer. The use of software-defined networking tools could help future-proof code built for the sensor and application layers.

One area that will greatly benefit [from 5G] is the internet of things.

Existing mesh networks rely on disparate networks to connect to the internet via proprietary gateways to reduce cost and power requirements, but this also adds complexity. If 5G lives up to its promise, enterprise architects might consider replacing these mesh networks with less complex connections direct to cell phone towers, or by using microcell towers installed indoors. "This should increase bandwidth and resilience," said Saar Yoskovitz, CEO of Augury, an industrial equipment monitoring provider.

Danny Tseng, staff manager of technical marketing at Qualcomm Inc., said multi-hop mesh network capabilities are planned for future 5G specifications that will extend IoT and 5G networks beyond the limits of public infrastructure. This could allow a device that is out of the traditional

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coverage of a 5G network -- for example, in a basement -- to connect to the network using other 5G devices as a relay.

5G new radio industrial IoT (IIoT) has been proposed as a new standard for industrial apps that could start to roll out in 2021, Tseng said. This could help 5G become the default choice for industrial networking. "The biggest challenge is also having the entire IIoT industry working together to make this happen, but it is making good progress in 3GPP, the standards body responsible for designing the technologies that drive global cellular standards," Tseng said.

'CLOUDIFYING' THE NETWORK TO EMBRACE 5G FOR IOT

Current mobile technologies are optimized for downloads. But in most IoT applications, data is generated at the edge of the network and uploaded to the network. Said Ouissal, CEO of Zededa, a distributed cloud infrastructure provider for IoT, said he believes 5G network providers will need to invest more resources to create wide-area mesh networks that allow data to flow between devices for safety and situational awareness applications. The opportunity is to design data traffic routing that is more efficient for edge-to-edge communications.

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Today the communication from point A to point B still goes up to the service provider core network and then back down, even if point A and point B are 10 feet apart. "This doesn't work for IoT and strikes at the heart of the new networks' use cases to come," Ouissal said. Data infrastructure providers will need to create networking infrastructure that works more like the cloud than traditional telco networks. If they are successful, this would reduce the burden for IoT developers to think about scaling and provisioning across public networks in the same way that traditional cloud infrastructure reduces concerns about compute and storage infrastructure.

Alex Kubicek, CEO of Understory Inc., a weather data service, said his company is exploring practices like building in caching and edge computing to fall back to if 5G is not available. "Since these solutions are pretty easy to implement, there isn't much cause for concern," he said.

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SALLY JOHNSON

With IoT spending forecast by IDC to hit $1.2 trillion in 2022, a staggering amount of "things" will require connectivity.

There are myriad IoT applications and numerous options when it comes to connecting them, but there's no one-size-fits-all technology -- so how do you choose which type of connectivity is right for your enterprise?

This is an important decision to make now that the IoT market has reached a turning point. "Projects are moving from proof of concept into commercial deployments," said Carrie MacGillivray, group vice president and global IoT practice lead at IDC. "Organizations are searching for the best ways to extend their investment as they scale their projects, driving spending for the hardware, software, services and connectivity required to enable IoT solutions."

Cellular is a decades-old option, but is cellular IoT connectivity your organization's best bet?

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PROS AND CONS OF CELLULAR IOT CONNECTIVITY

"The pros of cellular are obviously its footprint for transportation and vertical markets with geographic challenges like the electric grid," said Christian Renaud, research vice president for IoT at 451 Research. "And with LTE, and eventually 5G, we're going to gain speed and lower latency, which will enable new applications."

Many IoT applications are part of a control loop, with strict latency requirements (less than 50 or even less than 10 milliseconds), which Renaud called a challenge for 2G and 3G networks, adding that "4G got closer, and 5G nails it by deploying many more cells and using frequency better."

The downsides of cellular IoT connectivity? Cost and susceptibility to interference. "Say I have a device that sends a level reading of a fuel tank once a day so you know whether to dispatch a truck there or not; I'm not going to want to pay $30, $50, $100 per month for that connection," Renaud said. "And susceptibility to interference is also a key concern for mission-critical applications like grid control and precision manufacturing."

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Today, cellular use is widespread in transportation and retail, which isn't overly surprising. But it's used less frequently in manufacturing and energy, which, according to Renaud, is a bit of a surprise. "Energy, oil and gas operations are often outside of cellular range -- in Siberia, the Arctic Circle or the Gulf of Mexico -- so there's no coverage, and the electric grid can sometimes be in the same boat with its transmission lines, going for hundreds or thousands of miles through rural areas with limited coverage," he said.

CHOOSING A CELLULAR CONNECTIVITY PROVIDER FOR IOT APPLICATIONS

It's a good idea to consider shaping your carrier plan and selection to your specific workload or application, Renaud said. "If you're, say, a Redbox kiosk with a handful of authorization requests or credit card charges per hour, you can estimate how many connections you'll have, the data volume and shop around for the best price."

Then again, Renaud advised, if your operation involves video surveillance cameras, then you might want to prioritize plans and carriers with as close to unlimited data as you can get or consider doing local video analytics on the camera itself and uploading metadata for a fraction of the cost.

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At this stage, he added, multiple cellular routing vendors have platforms that are multi-SIM or multicarrier, so companies can negotiate contracts with multiple network operators and arbitrage between different plans based on how close they are getting to data limits and if they are seeing performance issues on a particular carrier.

So what if you run a big agricultural production or ranch in a remote location and want to tap into the internet of thing? Is cellular IoT connectivity a viable option? "If it's a big agricultural site, then the chances are that cellular density isn't there, but that they'll have a good quantity of soil sensors or grazing land sensors," Renaud said. "In quantities that high, it wouldn't be cost-effective to pay a cellular subscription using current pricing models. This is where low-power wide-area networking has an edge."

For infrequent low-traffic applications like agriculture, a single tower that covers hundreds of miles of agricultural land has an advantage, Renaud elaborated. "Also, sensors have finite battery lives that are impacted by the power of broadcasting, the frequency of connections, etc. Batteries that can last years between replacements requiring a truck roll are more cost-effective than traditional cellular batteries that require replacement within days or weeks at normal transmission rates."

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STEVE ZURIER

There's a chance that a low-power wide-area network technology such as LoRa may catch fire worldwide, but one industry expert warns that LoRa has only a small window of opportunity.

Gartner analyst Mark Hung said LoRa's time is short because by the first quarter of 2017 carriers will have access to 3GPP technologies such as LTE Cat-M and NB-IoT.

"If time to market is a consideration, then proprietary LPWAN technologies such as LoRa and Sigfox can be considered," he said. "But the likelihood is that organizations will wait for 3GPP technologies as they gear up next year. However, it is possible that LoRa technology will survive as a niche player for utilities, agriculture and smart cities."

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LORA TECHNOLOGY FINDS ALLIES

Semtech Corporation, developer of LoRa technology, has been wasting little time forging relationships. In October 2016, it announced an agreement with Comcast for the cable company to deploy a trial network based on Semtech's LoRa technology during the fourth quarter of 2016 in Philadelphia and San Francisco. The pilot will focus on metering, asset tracking and other smart city applications. If successful, the network could expand to some 30 cities over the next two years.

Semtech also has been working with network provider Senet to develop a public network service based on LoRa technology. Will Yapp, vice president of business development at Senet, said LoRa appealed to them because it is unidirectional, bidirectional and can handle organizations' mobility needs. "It was the only LPWAN technology that met all those three criteria," he said.

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LoRa also offers long battery life of at least 10 years, in some cases up to 20. In terms of distances, LoRa works well in dense urban environments and across multiple buildings, and LoRa sensors can connect to networks up to 15 to 30 miles away in rural areas, making it perfect for agricultural applications.

The LoRa Alliance, which launched in March 2015, now boasts more than 300 companies dedicated to developing LoRa technology for IoT, machine-to-machine, smart city and other industrial applications.

The likelihood is that organizations will wait for 3GPP technologies as they gear up next year. However, it is possible that LoRa technology will survive as a niche player for utilities, agriculture and smart cities.

Mark Hung
Research VP, Gartner

"We like the extensive ecosystem of device manufacturers, chipset providers and systems integrators that LoRa developed," Yapp added. "LoRa has a lot of Fortune 500 players involved such as GE, Bosch and Schneider Electric."

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LORA BUILDS A STRONG BUSINESS CASE

Senet's Yapp said that LoRa technology completely changes the business model in the utility industry. In the past, a tank monitor cost $250 and the network cost $10 per month. With LoRa and Senet, the monitors cost $40 and network charges are as low as $2 per month.

Thomas Butler, vice president of marketing at Mueller Systems, a device maker that has implemented LoRa chips into its Mi.Net products, added he's hopeful the new LoRa devices will be effective for water meter applications at municipalities. Butler said Mueller Systems has deployed LoRa devices in various municipalities around the country -- but, as it had only been deployed for three to six months, he didn't have specific benchmarks.

However, LoRa meters boast significant benefits. For starters, LoRa's battery life is a major selling point for cash-strapped municipalities looking to get the most bang for their buck. Even more importantly, with LoRa technology municipalities can now monitor water levels 24/7; they can take readings every hour on the hour, a capability that will let them identify any leaks early as well as track any unusual spikes in usage.

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"This is a huge deal," Butler said. "In the past, municipalities would have to send people out in the field to take water meter readings. Typically, they would only take a reading once a month, sometimes even only once a quarter."

Butler added that the ability to take more frequent readings promises to help municipalities better manage their water, whether their goal is more effective conservation or simply to offer better customer service to residents when they experience spikes in water usage or leaks.

"Now, if there's a leak, the system can catch it and immediately notify the customer as well as get a repair person out to the home," he said.

LORA TECHNOLOGY: BIG LEAPS AND BABY STEPS

Keep in mind that LPWAN technologies are still very new. Butler pointed out that most of the municipalities Mueller Systems works with run LoRa over a 900 MHz ISM network, but that may change in the months ahead. He added that products from Mueller Systems will soon support both the Senet and Comcast LPWAN networks.

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"The real advantage to customers is that, if they go over a network like Senet's, they will be able to use other LoRa devices, such as pressure sensors from Trimble, and run them over the LPWAN network," he explained.

But Hung said the reality is that organizations are just rolling out these technologies, and they are so new that people simply don't have enough information as to how effective they really are.

However, LoRa has shown some great promise; it has made inroads in the U.S. as well as in France where carrier Orange SA has deployed it.

Yet Hung said the activity tends to be around the chipmaker Semtech as well as systems integration and network partners such as Senet and Comcast. While it appears that more chipmakers will get involved, this hasn't happened yet.

"LoRa is being sold really hard and it does have merit," Hung said, "But I think once the 3GPP technologies gather steam, LoRa will become more of a niche player."

Still, even if it's for municipalities, agriculture and other smart grid applications, LoRa technology might wind up building a substantial

market. One thing's for sure: Over the next 12 to 18 months, all these competing wireless IoT networking technologies will emerge, and we'll have a better sense of which ones the market accepts.

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