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DISCUSSION ON THE

Top 5 Factors for Choosing the Right Connectivity Technologies

CHOOSING CONNECTIVITY Q&A

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Today, more than a dozen of standard wide-area network technologies are available for deploying connected products and assets on a global scale. To help organizations navigate this complex connectivity landscape, we've invited two IoT experts – Leif-Olof Wallin (industry analyst) and Gus Vos (Chief Scientist at Semtech) – to talk about the top technology selection criteria in a webinar held on May 14, 2024.

The webinar featured an engaging Q&A session, where both IoT experts explored the nuances of technology selection and shared their perspectives on the evolution of 5G technologies over the coming decades. Believing that this conversation will be beneficial for technical decision-makers, we have compiled all the questions and answers in this document.

Why will LTE-M and NB-IoT have a longer lifespan compared to LTE?

LW (Leif-Olof Wallin): The short answer is that only these two technologies from LTE have been carried over into 5G unchanged. Therefore, an LTE-M module deployed today on an LTE network should seamlessly transition to a 5G network and continue to function.

GV (Gus Vos): That's a good question. The answer isn't straightforward, as there are various factors at play. Initially, we set out timelines for the potential shutdowns of these technologies, which naturally come with some uncertainties.

Operators recognize this need and, after working with customers, now face a decision: which technology should they maintain for the long haul, potentially up to 2045 or beyond? When it comes to choosing between LTE, LTE-M, or NB-IoT, the technical aspects become crucial.

Maintaining LTE-M and NB-IoT networks is less burdensome. These technologies have lower capacity requirements and specifications, meaning they can operate within a 5G NR network more efficiently and with less overhead compared to an LTE network. Essentially, the reduced operational burden makes LTE-M and NB-IoT more appealing for operators to sustain, meeting market demand more effectively.

What technology would provide the best coverage, 5G RedCap, 5G eRedCap, or LTE-M?

LW: When comparing narrowband IoT and LTE-M, these technologies are designed for better reach. The coverage area of a single cell using these technologies is significantly larger than that of a conventional LTE module. Therefore, I'd say these technologies offer greater coverage from a single cell. Would you like to add any details?

GV: No, I agree with that perspective. LTE-M and NB-IoT have complex mechanisms that allow for deep coverage. However, the extent of this coverage depends on the operator's configuration. Deeper coverage can reduce battery life and spectral efficiency, so operators might not always use the maximum potential. 5G RedCap and 5G eRedCap have also seen efforts to enhance coverage, but to my knowledge, these techniques have not been widely deployed. Even if they were, they wouldn't match the coverage enhancements provided by LTE-M and NB-IoT.

In short, LTE-M and NB-IoT offer superior coverage, while 5G RedCap and eRedCap provide less, depending on operator deployment.

If you start deploying NB-IoT or LTE-M in an LTE network today, can you move to a 5G network without changing the IoT devices?

GV: The short answer is yes, you can move to a 5G network without changing your IoT devices, but it depends on what you mean by "5G network."

NB-IoT and LTE-M can be deployed in-band as per Release 13 using dynamic spectrum sharing or a portion of the spectrum without any modifications. This means they can coexist with 5G NR technologies seamlessly. However, the transition depends on whether the network in question utilizes a 5G core (5GCN) or a 4G core (EPC).

Currently, most NB-IoT and LTE-M devices are designed to work with the 4G core. If the network operator has deployed 5G with a 5G core instead of the 4G core, the existing NB-IoT and LTE-M devices would not function properly since they only support the 4G core (EPC).

In Release 16, a standardization mechanism was introduced to support the 5G core for NB-IoT and LTE-M. However, the devices currently deployed or even those being released now do not support this feature. In the future, there is potential to add this feature as a software update to NB-IoT and LTE-M devices, which would then enable them to work with a 5G core. So, while the transition is technically feasible, it hinges on the network core being used and the current capabilities of the IoT devices.

Why wouldn't we use NB-IoT for asset tracking in special cases where you could send messages every 2 hours, and more frequent messages like every 15 minutes in rare event situations?

We do not recommend NB-IoT for asset tracking because it doesn't really support devices that move and switch between cells. If the application is mostly stationary and the connection time (amount of data) is short, NB-IoT may work.

Why don't you recommend using 5G RedCap for asset tracking?

5G RedCap is still a very nascent technology; it's still expensive and more power hungry than LTE-M. At this point in time, there are only 4 operators supporting 5G RedCap globally and 3 of them are in China. As more operators support 5G RedCap and chipset costs come down, it'll be an alternative, especially where external power is available.

Can you name a year when you expect the 4G network will shut down in Europe or in the US?

LW: For Europe, it's likely beyond 2035. The only place where it might happen earlier is North America, due to greater pressure to release spectrum. We're also witnessing significant 5G infrastructure development by all major operators in the US. So, perhaps the US could see a 4G shutdown a bit earlier, but I would still estimate it around 2035. What do you think, Gus?

GV: We're giving as much guidance as we can, but these timelines often change. For instance, the 2G and 3G shutdowns in North America experienced multiple delays, especially the 2G shutdown. Even if an operator announced a shutdown date today, it's not a certainty due to potential delays.

What are the regulatory/privacy considerations for a global deployment?

LW: There are a lot of regulatory issues and privacy laws that vary almost from country to country. It can also be a bit different if the service is consumer-facing or business-facing. Most of the considerations fall into the following areas:

- Does the country's regulator allow permanent roaming or not? Brazil and Turkey are two major countries that don't allow permanent roaming, but there are others.
- Mandatory local (in-country) break out of traffic.
- Mandate that data can't leave the country (must be stored in country)

Are you going to address LoRaWAN and LEO satellite NTN, and what does the combination of 5G and satellite look like?

GV: I think the most interesting part is that various technologies can integrate with NTN. For example, LoRaWAN can couple with LEO satellite NTN. This is one aspect to consider. Regarding LoRaWAN, there is also an option involving a LoRaWAN satellite that uses Frequency Hopping Spread Spectrum (FHSS). This technology is indeed possible and should be mentioned.

As for LEO satellites, today companies like Starlink are deploying thousands of LEO satellites to achieve mobile broadband coverage. These satellites will be suitable for IoT use cases, providing better speed, latency, and battery performance. However, they are not fully operational yet. Initially, geosynchronous satellites will likely be more widely available as they cover massive areas with fewer satellites.

LEO satellites face technical complexities, such as dealing with Doppler effects due to their fast movement, and they require GNSS support to adjust for these effects. These complexities mean that widespread deployment of LEO satellites will come a bit later.

Now, on the topic of combining 5G and satellites, there is a version of 5G NR that can be adapted to support satellite communication. Commercialization of this technology is on the horizon, but it will take some time. Using LEO satellites in conjunction with 5G NR makes sense due to the high speed requirements, whereas geosynchronous satellites might not be as suitable.

In the future, we might see 5G devices switching between terrestrial NR and satellite connections. However, it's important to note that integrating 5G with satellites is complex. Currently, it's simpler and more practical for smartphones, including 5G smartphones, to use NB-NTN for essential services like emergency texting, which requires low data and isn't highly sensitive to latency. The cost of satellite usage remains high, so it's not feasible to use satellites for data-intensive activities like social media browsing. In summary, while the integration of LoRaWAN with LEO satellites and the combination of 5G with satellite technology hold great promise, there are technical and cost-related challenges that need to be addressed before these solutions become mainstream.

Is it safe to assume that any cellular station with LTE supports Cat-1 / Cat-1 bis?

Correct. Cat-1 is part of the very first LTE standard: 3GPP Release 8 in 2008. It's mandatory to support it in all LTE networks. A Cat-1 bis modem would look like a Cat-1 modem to the network.

Are MNOs without Cat-1 bis certification a real problem today? (being able to use Cat-1 with these operators)

Yes, it can be a problem but only with MNOs that require device certification (e.g. North American carriers). We recommend you contact your cellular module vendor directly to discuss your specific deployment plans.

Regarding smart meters, does the evolution to AMI 2.0 expect more bandwidth? Does this new bandwidth requirement conflict with deeper coverage requirement that forces the use of NB-IoT or Cat-M?

AMI 2.0 is really about more real time and edge computing so bandwidth requirements will be somewhat higher, but the gating factor will be latency. It'll be hard to do AMI 2.0 unless you have at least LTE-M, preferably Cat-1.

Is there API interface standardization across vendors for different IoT OEM vendors?

3GPP has standardized some AT commands in TS 27.007 *https://www.3gpp.org/ftp/Specs/archive/27_series/27.007/27007-i60.zip*, but unfortunately it's not a complete set, so module vendors also have a set of proprietary AT commands.

What are the challenges we expect to see for 5G RedCap devices for testing and certification, has 3GPP redefined the criteria for these devices?

5G RedCap was introduced in 3GPP Release 17 in 2022 and eRedCap in Release 18. eRedCap doesn't really replace RedCap, but should be seen more as a technology that fits in between LTE-M and RedCap. RedCap requires a 5G SA network and a 5G core. Most operators with a 5G network won't be able to support it until late 2025/early 2026. eRedCap probably won't be deployed until 2027.

Learn More

We hope you enjoy reading this discussion. The best way to learn more is to watch the webinar replay, please visit the webinar landing page here: *https://info.sierrawireless.com/webinars-top-5-factors-for-choosing-the-right-connectivity-technologies*