

# Standards update

## IoT Standards

### The End Game

By Cees Links, General Manager, Wireless Connectivity Business Unit, Qorvo

**Cees Links of Qorvo debates which IoT standards to use and how to choose.**

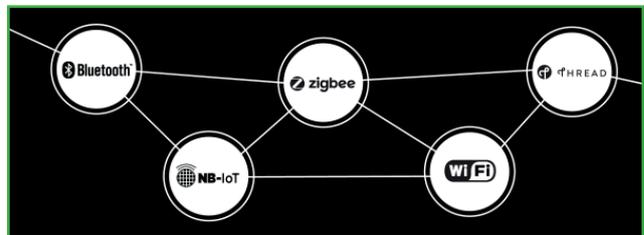


**Cees Links, General Manager, Wireless Connectivity Business Unit, Qorvo**

Cees Links (pronounced "Case") was the founder and CEO of GreenPeak Technologies, acquired by Qorvo in 2016. He is a pioneer of the wireless data industry, bringing the world of mobile computing and continuous networking together. In 2017, he was honoured as a Wi-Fi pioneer with the Golden Mousetrap Lifetime Achievement Award by Design News.

Quite regularly I get the question: with all these standards around, what should I choose? Zigbee, Thread, Bluetooth Mesh or Wi-Fi? Or maybe LoRa? Or is it better to wait for 5G and NB-IoT?

Of course, these questions create confusion and slow down the adoption of the Internet of Things (IoT). Part of this confusion is because it's isn't always clear which standards are suitable, as shown in Figure 1. In addition, marketers make unsubstantiated claims about new standard capabilities such



**Figure 1: An array of standards**

as latency ("in the milliseconds!"), as if that is really important. Not so. Most applications can deal with a latency of seconds; even live TV delayed a few seconds is still live TV.

So, how does one answer the question, "What standard should be used?" Usually, I answer this question with, "How can you make money?" Typically, the determining factor isn't the radio standard. With regard to radio, most apply "good enough is good enough" and making money is determined by the value created by the application that runs over wireless. Wireless is just wireless, like a wire is just a wire.

And keep in mind: whatever wireless standard is leading the pack today, in 5-10 years things will have changed anyway, so upgrading your network will be important. But waiting for "the

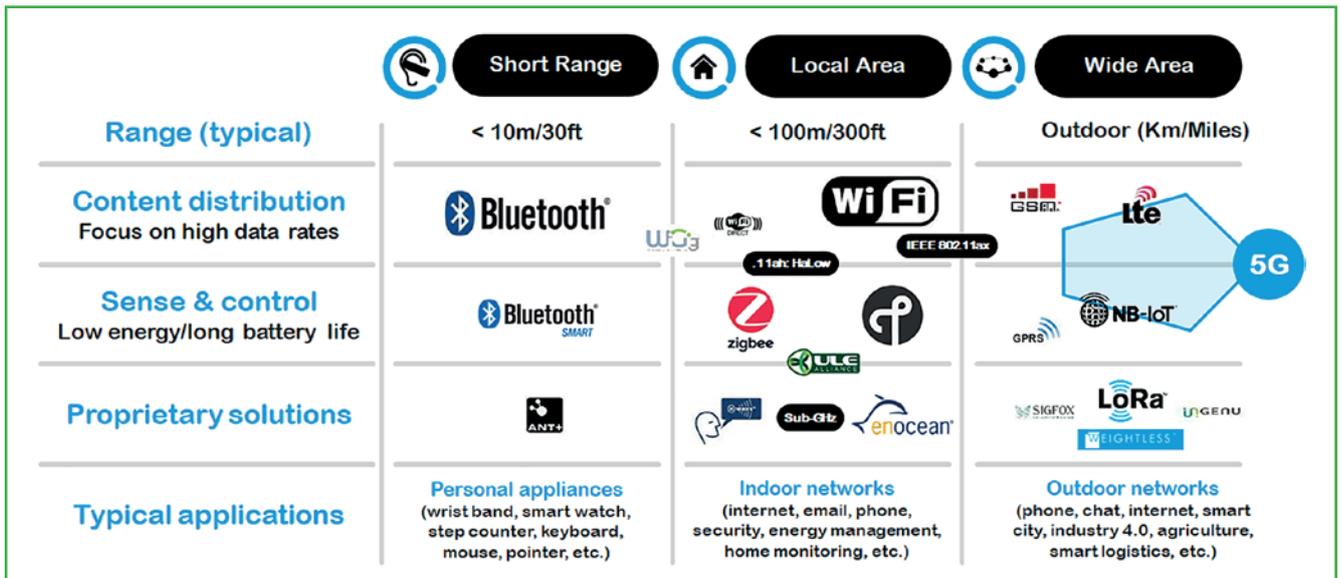


Figure 2

final and ultimate” wireless networking technology will take a long time.

Nevertheless, can we peer into the future and develop a sense of where things are going? I believe we can but, first, let’s create some perspective.

### Relationship between technology and psychology

Our smartphones have three radios (4G, Wi-Fi and Bluetooth). Why three, and not two (like a tablet) or one or four? There is a reason and it is linked to technology, as well as the psychology of how we experience our living space. Let me explain.

First, technology. Three factors largely determine the performance of a radio:

- Range (how far away you are from a base station — cell tower, router, hotspot etc.).
- Data rate (from a simple voice call to watching video).
- Battery life (the longer the better!).

The fourth factor is usually cost, with the simple mantra: “more is more expensive.” In other words, more range is usually more expensive; the same thing applies to higher data rates and longer battery life. Technically, however, everything is possible and you could have only one radio; it isn’t necessarily cost-effective, but you can.

Here’s an extreme example: imagine listening to a piece of music on your cell phone with a cordless (Bluetooth) headset,

where the headset connects directly to the phone and isn’t connected to the cellular network. However, technically it would be possible to connect both the phone and the headset to the cellular network and have the music running over the cellular network from your phone to your headset.

Here is another example. When you print a document at home from your computer to your Wi-Fi printer, do you think this document goes directly through the air from your computer to the printer? Technically, this is possible (e.g. with a Bluetooth or Wi-Fi Direct connection), but it’s also possible that it goes via Wi-Fi to your home router, and from your home router via Wi-Fi to your printer. It’s also possible that the print command goes to the cloud, and the document is printed directly from your cloud server over the cable (or fibre) network to your home router, and then is transferred wirelessly to the printer. There are many ways this can be organised over wired and wireless networks and, frankly, we’ve lost track and the details have become irrelevant. As long as it works, everyone is fine.

Secondly, how do we experience space? This has less to do with technology and more with psychology. On the smallest level, we first experience a personal space. Did you ever have a conversation with someone who came too close to your face, and you started to feel uncomfortable? If so, you understand what I mean by “personal space”. It’s the flexible bubble around you, wherever you are, and its size varies; if you’re squeezed into a busy metro, this space is much smaller than, for example, when you’re in a restaurant or in an office.

We also experience a spatial situation in which we can reach

with our voice or, to a certain extent, with our vision. This could be at home or the office. It is private territory, compared to the world outside. We sometimes distinguish this space by calling it indoor versus outdoor, or private versus public. And last but not least, there is the outdoor, public space — owned and regulated by the government.

If you translate these three spaces back to the three radios in our phone, there is some continuity: a Bluetooth radio for our personal space (our bubble), Wi-Fi for our private space and 3G/4G and soon 5G for access in the public space. Coincidence? Probably not. Whoever was involved in the “war of standards” knows that there was no higher committee deciding how to nicely split up different radios and standards over these three spaces. It just fell into place.

In the past 20-30 years, every standard has battled for maximum usage space — and some of these battles are still going on today. 5G, the next public space standard, is claiming that it works well indoors and may make Wi-Fi redundant. Bluetooth initially made serious claims for the Wi-Fi indoor market (never successful), while Wi-Fi has been eyeing the Bluetooth market with Wi-Fi Direct. Interestingly, although Wi-Fi Direct isn’t dominantly successful, it isn’t dead either — for drones, Wi-Fi Direct has found an interesting niche.

## Extending the concept to IoT standards

So, at least for now, we have learned to be comfortable with the three-radio concept in our phone and how they seamlessly connect to how we experience “space”. But how do we deal with the plethora of low-power IoT standards? The first goal is to understand the marketplace of low-power standards.

The real focus of these low-power standards is on long battery life — not data rates — without compromising range.

Usually, low-power standards are used to connect devices (e.g. sensors) to the internet (IoT) for the purpose of sharing sensor data, and the data rate required for this is orders of magnitude lower than for “normal” internet usage or watching videos. So, essentially low-power standards exchange data rate for battery life.

Interestingly, these low-power standards start to rally around the same three ranges mentioned earlier:

- **For our personal space:** Low-power Bluetooth (sometimes called BLE, for Bluetooth Low Energy).
- **For our private space (such as home, office or hotspot):** Zigbee (IEEE 802.15.4), which is essentially a low-power Wi-Fi standard.
- **For the public space:** NB-IoT/Cat-X as part of 4G/5G.

So, there is a possible answer to where all these standards could be going and simplifying the discussions that are going on in the industry (see Figure 3 below).

This low-power/sense & control alignment makes all the sense in the world because it lines up with how we experience space, as well as the three radios in our smartphone.

## What does this mean for the future?

However, nothing is certain, and looking into the future is a dicey job. Technologies continue to try venturing into “other spaces”, and there are several initiatives going on in the market. These can vary from ways to maximize the reuse of existing technology, or trying to answer simple questions (such as, can NB-IoT/Cat-X also be used for indoor networks?). Similarly, there is an effort to expand Bluetooth Low Energy into the networking space and add meshing capabilities to displace Zigbee — in the same way that Bluetooth tried to

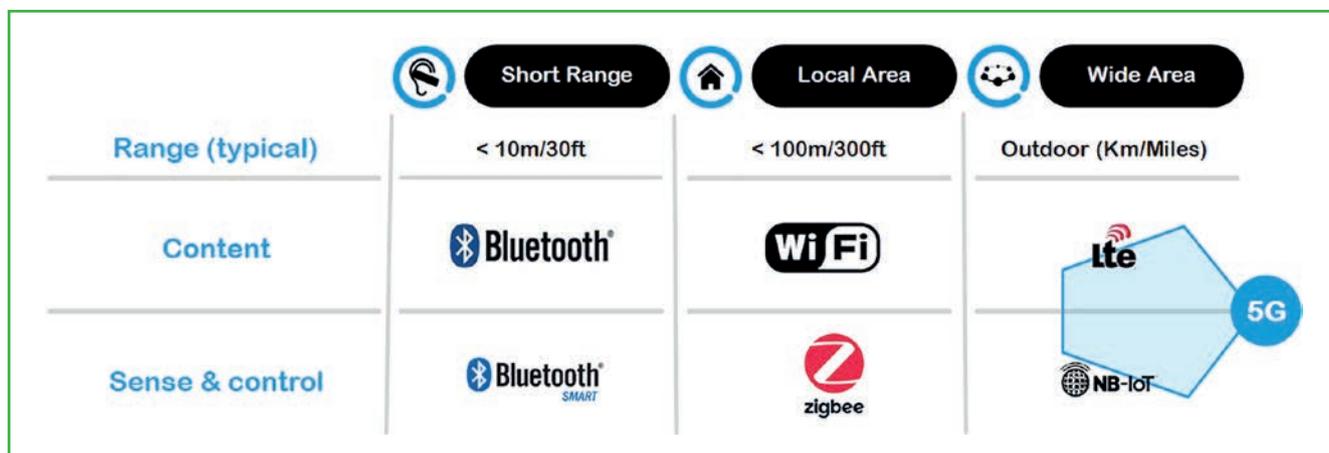


Figure 3

**“ There may be a fourth domain, between the local area (indoor) and the wide area (public). ”**

displace Wi-Fi around 20 years ago. These efforts may not be successful but, nevertheless, big companies are spending serious dollars on them.

One interesting note is that there may be a fourth domain, between the local area (indoor) and the wide area (public). There are large outdoor spaces that are still semi-private such as campuses, harbours, airports and exhibition centres. So, the question may be: Do we need another standard that is focused on this domain “in between”? The future will tell. Maybe the existing standards are flexible (and cost-effective) enough to serve this space well, or an emerging standard will be better qualified. In this respect, it’s interesting to see that LoRa, as a pseudo standard for outdoor, is very visible in this zone between private and public, in harbours and airports.

### Open vs. proprietary standards

This leads me to mention the role between open standards and proprietary standards. History has shown so far that open communication standards are more successful than closed standards. Wi-Fi has pushed HomeRF out of the market; similarly, BLE pushed out ANT+.

But other standards are still battling, such as Zigbee, Thread and Z-Wave (Silicon Labs). However, Zigbee and Thread are both based upon the open IEEE 802.15.4 standard (just as Wi-Fi is based on IEEE 802.11), while ZWave is proprietary and closed. It’ll be interesting to see which will come out on top, but most probably it will be a converged Zigbee/Thread; they already use the same application layer software (Dotdot) and their only difference is network layer software.

### High data rate vs. low power

For standards venturing into other areas, it’s also interesting to mention that the boundary between Wi-Fi (high data rate) and Zigbee (low power) is not very hard either. From an application space perspective, there are applications which require higher

data rates and, at the same time, need to run on batteries, thus requiring low power.

For some time now, significant efforts are ongoing to make Wi-Fi truly low power. The IEEE 802.11ah effort is one example, although it doesn’t seem to go anywhere because it’s operating in sub-GHz bands, lacking uniformity; different radio technologies are required in different areas in the world. However, true low-power implementations of Wi-Fi 4 (.11n) and Wi-Fi 5 (.11ac) might be interesting alternatives for Zigbee, if they reach low enough power — in other words, long enough battery life.

### Conclusion

This is all to be seen, and interesting to follow for everyone who is in the radio development space. However, it doesn’t change the situation mentioned earlier: ultimately the usefulness of the application creates the value for the end user, not the wireless wire.

Time will only tell which standards will be the most successful, but waiting for them will probably not be useful if you know how to make money now,



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