Voler SYSTEMS

The Promise of 5G: Hype versus Reality

By Walter N. Maclay, President, Voler Systems

Copyright ©2020
www.volersystems.com

1021 S. Wolfe Rd, Suite 285, Sunnyvale, CA 94086
info@volersystems.com

Companies are always on the lookout for technologies that can help dramatically accelerate their business processes while minimizing costs and ensuring quality. Business innovators can capitalize on this by designing IoT products that cater to companies' demands for speed while helping them keep costs to a minimum.

Fifth generation wireless technology (5G) is a promising technology to build IoT solutions that allow for lightning-fast, extremely reliable and low-cost machine-to-machine communications.

But can 5G, which is still emerging, really fulfill all its promises? Are its "advertised" promises realistic or simple puffery?

The 5G Promise

Many believe that 5G will enable "Sci-Fi like" use cases that older generations of wireless technology cannot support. Even 4G pales in comparison with 5G in terms of speed, latency, and spectrum frequency, among other factors (see Figure 1).

4G		5G
Up to 150Mbps	**Speed**	100 Mbps - 10 Gbps
50 ms	**Latency**	1 ms
Below 6 GHz	**Spectrum frequency**	Up to 86 GHz
High power consumption	**Battery Life**	10-year battery life
High	**Data Volume**	1000x more network connections
4G cell towers serve fewer connections	**Advantages/Disadvantages**	Higher bandwidth, highly directional, resulting in up to 100x number of connected devices
Cells are not directional, limiting the number of connections		Supports huge capacity for fast data
Connections frequently drop when moving		Less cluttered with existing cellular data
Less secure for comparable services and functionality than 5G		More security than 4G

Figure 1: 4G and 5G Comparison, as advertised. (Image source: Voler Systems)

Copyright ©2020
www.volersystems.com

1021 S. Wolfe Rd, Suite 285, Sunnyvale, CA 94086
info@volersystems.com

5G has various business use cases including private networks for Smart Transportation and hyper-connected healthcare. Smart Transportation will enable new services by leveraging fast and reliable wireless communications between smart vehicles and sensors embedded in roads and railways. It will allow for increased visibility and control over smart transportation systems.

In healthcare, 5G technology is expected to improve patient outcomes and well-being by predicting potential individual health problems and organizing early medical interventions. It can help enable sustainable health services through applications such as remote robotic surgery. This is why forward-thinking healthcare organizations like Rush Hospital in Chicago are planning to move to 5G connectivity.

The reality, however, is more complex

Various factors influence or hinder businesses from fully realizing 5G's potential, First let's discuss some important basics about 5G:

Frequency Bands

5G performance relies on the available frequency band (see Figure 2). The peak data speed, for example, is only up to 100 Mbps within the low-band spectrum (below 1 GHz), as high as 400 Mbps within the mid-band spectrum (1 GHz to 6 GHz), and up to 10 Gbps within the high-band spectrum (6 GHz to 86 GHz). High-band spectrum or millimeter wave (mmWave), however, has limited availability.

Moreover, mmWave signals don't transmit more than about 100 meters and cannot penetrate walls or even windows. Due to the required density of base stations it will only be available in dense urban areas, but the signal is blocked by buildings. IoT usually does not need the high speed of mmWave, however.

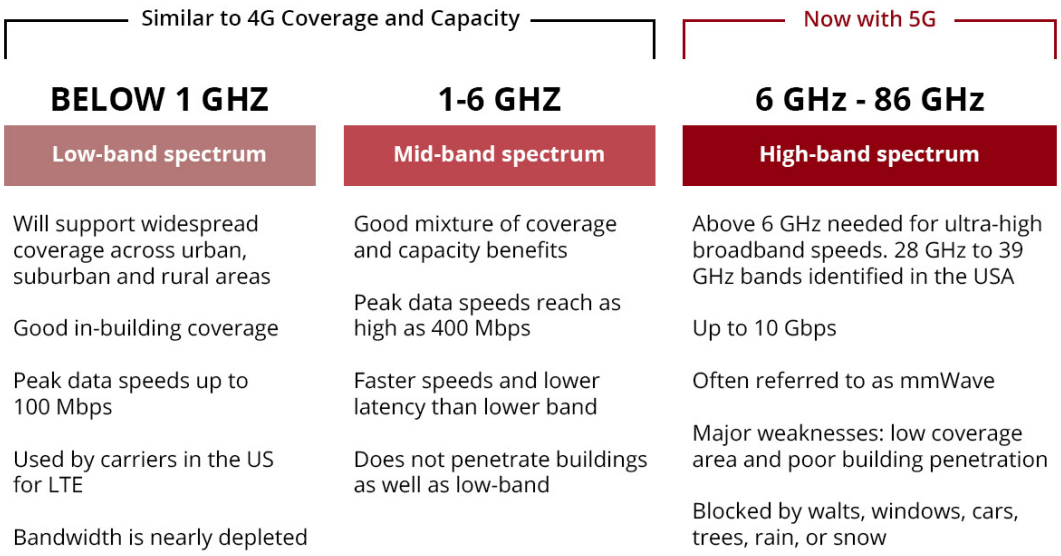

Figure 2: 5G Spectrum within Three Key Frequency Bands (Image source: Voler Systems)

Copyright ©2020
www.volersystems.com

1021 S. Wolfe Rd, Suite 285, Sunnyvale, CA 94086
info@volersystems.com

5G Service Classes

The three 5G service classes are enhanced mobile broadband (eMBB), ultra-reliable and low-latency communications (URLLC), and massive machine-type communications (mMTC). Each has its characteristics, applications, and limitations.

- **eMBB** allows for very high data rates, up to 10 Gb/sec (20 times 4G), very high traffic capacity (1 million devices/km^2), and very low air latency (down to 4 ms). Its use cases include virtual reality (VR) and augmented reality (AR). This is the service class for smart devices such as smartphones, tablets, and UHD TV (4K and 8K) broadcast.

  eMBB's performance, however, depends on the frequency band available. If the available frequency band is below 1 GHz, for example, the experience will be much like 4G (up to a 100 Mb/sec data rate down and 50 Mb/sec up). Latency of 4 ms is one direction, and only to the nearest cell tower. Long distance transmission is much slower.

- **URLLC** is designed for on-premise scenarios like intelligent transport systems (infrastructure backhaul), discrete automation (motion control), process automation (remote control), and electricity distribution (high voltage). It promises very low latency (down to 1 ms) and ultra-high availability and reliability (99.9999%), which is much better than 4G.

  But even if 5G promises to radically improve URLLC performance, many things remain unlikely such as remote surgery and high-speed remote-connected video games and augmented reality at home. The "six nines" reliability it promises is questionable for any wireless connection.

- **mMTC** will support massive IoT deployment and allow for very low device cost and very low energy consumption, which is an attractive proposition for smart buildings, logistics, tracking, fleet management, wearable devices, and smart meters.

  The mMTC standard is still being written, so for now IoT is supported by 4G standards: NB-IoT and LTE-M.

5G does not currently provide all that it promises

The current state of mMTC is far from the hype. Currently, 5G does not provide all that it promises. Standards for mMTC are still being worked on and existing 5G technologies are not optimized for packet size and short sessions. Control signaling is also inefficient in that it requires 100 bytes of signaling to send 10 bytes of data. Existing channel coding schemes are also inefficient for small data packets. The anticipated 10-year battery life is possible only with very infrequent messages and very low data rates.

Copyright ©2020
www.volersystems.com

1021 S. Wolfe Rd, Suite 285, Sunnyvale, CA 94086
info@volersystems.com

5G Availability

5G availability is also a determining factor. Figure 3 depicts what cities and carriers are offering 5G as of May 2020. It shows that the user's location and the carrier he uses will make a big difference due to the following reasons:

- Only four US wireless carriers are deploying 5G: AT&T, Verizon, T-Mobile, and Sprint
- To use 5G, a 5G phone or device is required
- There is little coverage in rural areas
- High-speed mmWave coverage is unlikely to ever be offered in suburban or rural areas, as it would require a cell tower every 300 meters
- Some carriers have limited speed

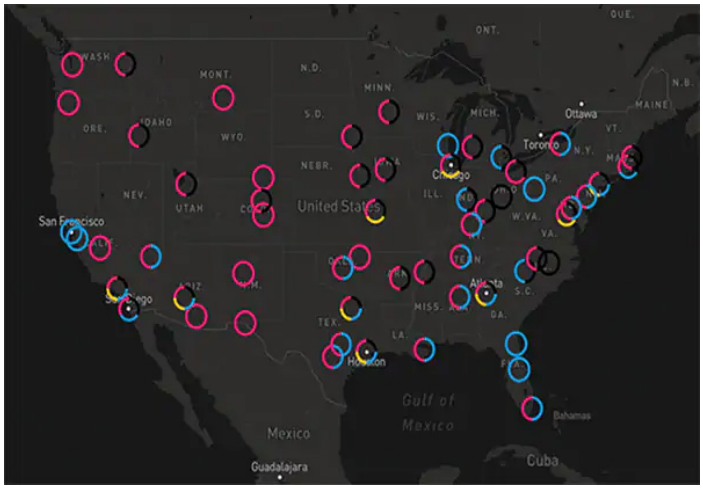

Figure 3: 5G Availability Map
Red: T-Mobile, Black: Verizon, Blue: AT&T, Yellow: Sprint (Image source: Digital Trends)

What about existing IoT services?

NB-IoT and LTE-M (also called Cat M or Emtc) will coexist with 5G. NB-IoT and LTE-M coverage in the US is good. In May 2019, Verizon *announced* that 92% of the US population is covered by their NB-IoT network.

Non-cellular services (ZigBee, LoRa, Ingenu, Sigfox, and Weightless), on the other hand, are not included in 5G but will still work using an unlicensed spectrum. But they are not available in many places.

What does this mean for the future of IoT?

There is little change for now.

But the 4G technology, NB-IoT and LTE-M, has only been deployed sufficiently since 2019. It allows battery operated devices to communicate directly to the Internet without going through a cell phone or Wi-Fi hotspot. The time for this technology is now.

Note, however, that each wireless standard has its advantages and disadvantages (see Table 1). To know the right standard for designing in IoT devices — and avoiding costly mistakes and other IoT design risks — consult with IoT design experts or hire competent IoT engineers.

Copyright ©2020
www.volersystems.com

1021 S. Wolfe Rd, Suite 285, Sunnyvale, CA 94086
info@volersystems.com

	LTE-M	NB-IOT	Sigfox	LoRa	BTLE Mesh	Zigbee
Range	1 km to 50 km	1 km to 50 km	10 km to 50 km	2 km to 50 km	10 m	50 m
Data rate	1 Mbit/s	20-150 Kbit/s	300 bits/s	200-50 Kbit/s	20 Kbit/s	40 Kbit/s
Supports Audio	Yes	Yes	No	No	No	Yes
Network	Public	Public	Public	Public or Private	Private	Private
Available	Good coverage	Good coverage	30% of US population	Yes Limited public	Limited	Mature

Table 1: Comparison of Existing IoT Wireless Standards. (Image source: Voler Systems)

Conclusion

IoT-powered, 5G-enabled industries are becoming a reality. But since 5G is still in its infancy, it does not yet provide all that it promises. Nevertheless, 5G is a promising new technology that will surely benefit businesses.

Business innovators can help make 5G promises a reality by designing IoT devices that are 5G or 4G ready, secure, and reliable. This, however, is not a simple undertaking and requires expert help.

Voler offers businesses expert guidance on designing and developing next-generation IoT and wearable devices. Voler helps select the right technology for IoT devices and determines the right combination of electronics for guaranteed security and reliability. Schedule a discussion with Voler to *learn more*.

Copyright ©2020
www.volersystems.com

1021 S. Wolfe Rd, Suite 285, Sunnyvale, CA 94086
info@volersystems.com