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Myth Buster 4th Edition: 5G will never work over satellite

By Richard Swardh, Senior Vice President, MNO for Comtech EF Data

Over the last year I have often heard concerns from satellite operators and service providers that 5G will not work with satellite. Comments like, "satellite will never be able to provide the bandwidth required by 5G" or "satellite round trip delay of GEO, MEO or even LEO will make 5G impossible." Before I address these statements specifically, let's take a step back and try to frame what 5G is actually trying to achieve.

Every 10 years or so, a new mobile standard is introduced. In the early 1990s, 2G was introduced as the successor to analog systems. The early 2000s saw the dawn of the first 3G networks, and 10 years later, 4G/LTE was introduced. To generalize a bit, each standard came with distinct characteristics that evolved over time as new use cases developed. 2G GSM was a digital standard originally designed to increase the efficiency over analogue systems through the use of TDMA – more calls could fit in a given slice of spectrum. Originally, data services in 2G were very low bandwidth and circuit switched. But, as the success of SMS surprised most in the industry, a packet-based option was eventually added called GPRS in the first iteration and EDGE in the second. As 2G was being rolled out, a 3G specification based on CDMA was already being drafted. The goal of 3G was to support circuit switched voice and packet-based data services simultaneously with even higher spectral efficiency and capacity. 2Mbps was the stated goal in the beginning. As new use cases developed, the 3G standard evolved as well to now support up to 48Mbps to a handset. With the advent of feature phones and eventually smartphones, it became clearer that applications and services were demanding even higher data rates. Hence a new 4G standard was developed, and LTE was introduced in 2010, with the vision of one day being able to provide 1Gbps of throughput to a single user. This could be achieved

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through yet another radio interface standard, this time based on OFDM, higher order modulation and bonding of spectrum in several different frequency bands into one large bit pipe of data. As the massive growth of Internet services, smartphone penetration and the emergence of Internet of Things continued, and yet again surpassed all previous forecasts, it became clear that the existing network architecture and frequency allocations would not be enough to support new and emerging use cases. As such, there was yet again the need for a new standard, 5G.

What is different?

What is different with the new 5G standardization from previous generations is that it takes a much more holistic view on the overall ecosystem needing connectivity. In the past, the role of a new mobile standard was primarily focused around achieving a higher degree of spectral efficiency to allow for better utilization of the most valuable asset a mobile operator has, namely its spectrum rights. 5G on the other hand, according to a definition used by many industry insiders, *brings together all previous mobile standards, wired networks, IP services and Internet of Things under a common framework.* As such, the goal of 5G is not only about a new radio interface standard, but to enable end to end ecosystems that can cost-efficiently scale while supporting new services and business models. This is by no means an easy task, and hence a new level of cooperation between standardization bodies like never seen before is needed. The traditional telecom and ICT focused associations like 3GPP, ITU, ETSI, IEEE, GSMA are all coming together with various vertical and industry associations to define, test and trial a variety of use cases to drive the 5G ecosystem forward and ensure quick and efficient time to market.

As discussed earlier, the goal of 5G is to support the widest array of use cases possible. As with previous generations, it is really difficult to predict what will ultimately be the "killer application." Prior to the introduction of smartphones, and perhaps the iPhone in particular, it was somewhat unclear how users would take advantage of the high data rates that LTE brought to market, and the same is now true for what 5G brings. As such, a variety of use cases are being modelled. To illustrate this, here are a few examples of trials and demonstrations currently ongoing to help define the standard which is set to be ratified in 2020:

End-to-end latency

One of the stated goals of 5G is to significantly reduce the end-to-end latency. With lower latency, new use cases can open up, like being able to operate machinery or to perform remote surgery from a distance. Virtual reality headsets coupled with gloves, robotic arms or joysticks providing haptic feedback will make it all come together. Being able to couple tactile sensations with sights and sounds will open up many new use cases both in the professional workspace, as well in the entertainment and leisure industries.

Connectivity to cars is something that is being talked about to a great extent in the satellite industry and holds a lot of promise thanks to satellite's excellent reach. What is also important for a safer and more secure future, and also part of something called Intelligent Transport Systems, is the ability to communicate car to car, car to roadway infrastructure or even car to pedestrians. Communication to and from and between vehicles, is seen as a priority by car manufacturers, as well

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as by many governments and regulators as it can help alleviate congestion, pollution and reduce accidents. While some use cases will require just the same low latency and high security as in the remote surgery example above, some use cases such as watching a movie and streaming music on the go will not be subject to the same latency requirements.

Fixed wireless broadband services

Another goal, and likely one of the first commercial deployments of 5G, will be to enable fixed wireless broadband services. As these services require a lot of spectrum, the satellite industry needs to be on the lookout at the next World Radiocommunication Conference in 2019, as mobile operators will want to gobble up more spectrum. There are several pre-standard based trials going on around the world of 5G New Radio (NR is the very creative name the standardization body settled on) predominately in various millimetre bands between 28 and 80GHz. Previously, these bands in a telecom context were mostly used for point-to-point microwave deployments, as they propagate poorly especially in widebeam scenarios. However, new antenna technologies using massive MIMO and intelligent beam forming coupled with advanced signal processing will one day enable tens of Gbps to be delivered several kilometres to hundreds of users simultaneously. One could say this use case is perhaps following closest in the footsteps of what 3G and LTE already started with enabling the mobile broadband revolution. In fact, many of the innovations in LTE-Advanced are also part of the 5G NR standard for forward compatibility. As such, it was recently agreed in the 3GPP that a pre-release of the 5G standard will be released in 2019, using LTE radio and core network as an anchor for mobility management while adding a new 5G carrier.

On the other side of the bandwidth throughput spectrum, we find many use cases for M2M communication or Internet of Things. Anything that benefits from being connected will be connected, is the goal. However, it will be through a large variety of different connectivity options based on existing and new wireless standards, and the focus will largely be on how to cost efficiently manage and orchestrate services needed by basically an infinite number of connected "things." Key to IoT's success will be battery life of up to 10 years, ultra low-cost chipsets and cost effectively being able to support a massive amount of devices within a small area. Many of the use cases in this space are not sensitive to latency.

As you may notice, some of the use cases sound quite familiar and 5G should initially not be seen as an entirely stand-alone network technology, but as part of an evolution of existing standards. In a mobile context, it will build upon and enhance some of the building blocks already defined in LTE. Examples of two such technologies that MNOs have already started small scale implementations in mobile networks are Software Defined Networking (SDN) and Network Function Virtualization (NFV). These technologies will be at the core of 5G. Being able to de-couple user plane from control plane and have programmable networks will allow service providers to scale based on the needs of each application at a price point the market can support. Network functions that in the past could only be created through the use of dedicated and many times proprietary hardware can now be realized in software, and moved to commercial off-the-shelf compute and storage platforms either in private or public cloud infrastructure. Network slicing is a new term used to describe how multiple logical networks can be created on top of a common shared physical infrastructure and allow for greater flexibility as resources are elastic and on-demand. Not a subject for this paper, but many of the functions in satellite hub infrastructure are actually ideally suited to adopt SDN/NFV, cloud and open APIs to allow for even greater flexibility and deeper integration in to telecommunications networks.

So where does all this leave satellite in the world of 5G and mobile backhaul? Well, obviously there will be use cases requiring very low latency to enable a tactile Internet with haptic feedback that can never be supported with GEO, MEO or LEO satellite constellations. However, many use cases will simply become an evolution of existing use cases already supported today in 2G, 3G and LTE networks. What 5G will bring are additional opportunities for satellite as the cost of delivering services over 5G will continue to drop compared to using previous generations; improvements in spectral efficiency and smarter utilization of network resources will lower the cost per bit delivered making services attainable for even more users and "things." And, just like I discussed in my "Myth Busters 2nd Edition: LTE is only for High-Speed Services," the cost per bit delivered is always a key metric to follow. At any given data rate, 1Kbps, 1Mbps or 1Gbps, what matters most to an operator is the cost of delivering that bit. So, don't be surprised if use cases will emerge in 5G, just like they already have for LTE, for narrowband services using satellite. A new wireless standard is not just about achieving higher speeds, but about finding a more cost-efficient way of delivering services. Satellite will always have a role to play with its unique capabilities not available in any other technology. So, fret not – satellite will support many 5G use cases and be an important part in fulfilling its vision. Just don't expect it to happen right away. ■

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