A Glimpse Into the 5G Future: 48 Hours With Gigabit LTE

A look into future 5G use cases with Gigabit LTE on Telstra

Executive Summary

As 4G LTE (Long Term Evolution) continues to mature, the industry is looking toward new technologies like Gigabit LTE to help consumers transition to 5G. Gigabit LTE is a marketing name for 3GPP's (3rd Generation Partnership Project) LTE Advanced Pro technology, included in 3GPPP Release 13. This technology is part of the 4G LTE family of technologies and represents the next phase of 4G LTE's evolution. It is the coverage layer that most users will experience once 5G becomes a reality.

Currently, 15 cellular networks in 11 countries have Gigabit-Class LTE planned or trialed; another 47 networks in 37 countries are trialing or deploying supporting modem features. Additionally, there are 183 LTE-Advanced commercial deployments around the globe, serving as a base for LTE-Advanced Pro. In the US, all four major carriers now offer unlimited data plans in anticipation of Gigabit LTE, something that was thought impossible only a few years ago.

Technologies like 5G that are heavily dependent on the 3GPP 5G NR (New Radio) standard will require significant network upgrades and overhauls. Gigabit LTE will be crucial to 5G's rollout and its continued use as a coverage layer or fallback. The existing base of LTE-A and LTE-Advanced Pro being laid out today could serve the purpose that HSPA and CDMA serve today.

To understand how Gigabit LTE will change user experiences, Moor Insights & Strategy (MI&S) spent 48 hours using Gigabit LTE on Telstra's network in Australia, the first Gigabit LTE network in the world. The use cases cover a broad array of user experiences and workloads on the network and varied in time of day and frequency. This testing is designed to represent how users might experience Gigabit LTE daily.

Gigabit LTE Device & Network Technologies

The technologies that enabled MI&S's Gigabit LTE testing come from several companies that worked together on the first Gigabit LTE network. Each company contributed a different technology or expertise.

Qualcomm supplied the Snapdragon X16 modem, which enables wireless download speeds up to 1 Gbps. It achieves these speeds through three key technologies: Carrier Aggregation (which combines three to four different spectrum bands into one connection), 256 QAM (quadrature amplitude modulation), and 4x4 MIMO (multiple input, multiple output). Qualcomm's second-generation Snapdragon X20 LTE modem, announced at Mobile World Congress, is capable of download speeds up to 1.2 Gbps.

Telstra provided the cellular network, which includes end-to-end hardware and software. One Telstra's most critical contributions was enough bandwidth to the base stations to enable them to feed the Qualcomm modems. Telstra also provided its network engineering staff to help with any issues during testing. Telstra announced new data plans, which are double their previous offer prior to the launch of Gigabit LTE.

Ericsson provided the base stations that power the cells. The base stations supplied Qualcomm's modems with the wireless communications on Telstra's network. Ericsson's base stations broadcast the signals with CA, 256 QAM, and 4x4 MIMO to help make these speeds possible. The Ericsson base stations on the Telstra network communicated with mobile routers powered by the Snapdragon X16 modem.

Netgear supplied the mobile routers with the Snapdragon X16 modems inside. The Netgear Nighthawk M1 mobile router was designed and launched with Gigabit LTE in mind; it supports four antennas to make 4x4 MIMO possible. Its 5050 mAh battery and 802.11AC Wi-Fi help make the best use of Gigabit LTE. Netgear's Nighthawk M1 announcement coincided with Telstra's launch of its Gigabit LTE network.

Figure 1: Netgear Nighthawk M1

Photo: Moor Insights & Strategy

Gigabit LTE Use Cases

Gigabit LTE's use cases are representative of its status as a bridge between 4G and 5G and as a fundamental enabler of new technologies. Therefore, many 5G use cases can be applicable to Gigabit LTE. Gigabit LTE is still based on LTE, which means day-to-day connectivity can benefit simply from having a faster connection. Downloads and uploads happen more quickly and use less battery.

Simultaneous usage is an emerging Gigabit LTE capability. One example is gaming over LTE while simultaneously streaming a live video feed of oneself gaming remotely. Latency-sensitive gamers who want to game and stream anywhere can do so easily. This use case will expand, as millennials and younger embrace wireless as their primary connection and game streaming as part of their core entertainment options.

A commonly touted 5G use case is augmented reality (AR) and virtual reality (VR). Both can benefit from Gigabit LTE's higher downlink speeds, which enable higher bitrates and more consistent bandwidth. At CES, NextVR indicated it would be able to enable the next generation of high quality VR streaming experiences with 100 Mbps connections, which are already possible with Gigabit LTE. In AR, large assets need to be downloaded from the application; a Gigabit LTE connection would make downloading these 100MB+ assets much faster (and almost instant with 5G).

Live 360-degree video can benefit from Gigabit LTE today and from 5G in the future. Currently, 360-degree video is consumed on primarily smartphones and in the future will likely include a mix of VR headsets. Gigabit LTE will help enable 360-degree video creation and consumption and allow more immersive, better looking experiences. Live videos are popular on Facebook, and live 360-degree videos are gaining popularity on platforms like Periscope and YouTube, even with limited resolutions and bitrates. Gigabit LTE can help increase resolutions and bitrates for higher quality live streams.

Experiential Testing & Speeds

MI&S tested Gigabit LTE use cases to measure real world performance. Testing was done during different times of day, with the bulk during the peak hours of 9:00 to 21:00 in the Sydney, Australia CBD (Central Business District).

The hardware and software used to test Telstra's Gigabit LTE network included:

- 8i Holo App
- Alienware 13 OLED Gaming Notebook
- Facebook Live
- Google Pixel w/ Daydream View
- Insta360
- Lenovo Phab2 Pro w/ Tango
- Netgear Nighthawk M1
- Overwatch
- Periscope
- Samsung S7 Edge w/ Gear VR
- Snap Spectacles
- Snapchat
- Speedtest.net
- Telstra SIM Card w/ Telstra Data Plan
- YouTube

The testing methodology used the Telstra Gigabit LTE network around the Sydney CBD where Gigabit LTE currently exists. Most time was around Darling Harbor, Circular Quay, Sydney Opera House, Hyde Park, and the areas between. MI&S used the Netgear M1 hotspot and with multiple devices connected via Wi-Fi. For the maximum speed tests, MI&S used a wired USB connection via a laptop.

MI&S tested Periscope 360 live streaming, which worked, as did YouTube 360. Both streamed smoothly over Gigabit LTE, reflecting the technology's improved upload capabilities, not just download. We also uploaded a 360 video to Facebook; it took Facebook longer to process the video (5 minutes) than it did to upload (2 minutes). We also did regular Facebook live streams to test connection quality. One benefit of faster downloads was near instantaneous streaming of VR videos on the Samsung Gear VR and downloading holograms in AR on the Lenovo Phab2 Pro's Holo App by 8i.

During the two days spent testing Gigabit LTE on Telstra's network, MI&S used multiple Wi-Fi connected devices and a gaming laptop connected via USB. The fastest speeds were observed using the laptop over USB: average 364 Mbps download, 60 Mbps upload, and 21 ms latency. MI&S tested the network over 30 times at different times of day in different places using the Google Pixel over Wi-Fi while using other devices: average 146 Mbps download, 48 Mbps upload, and 20 ms latency.

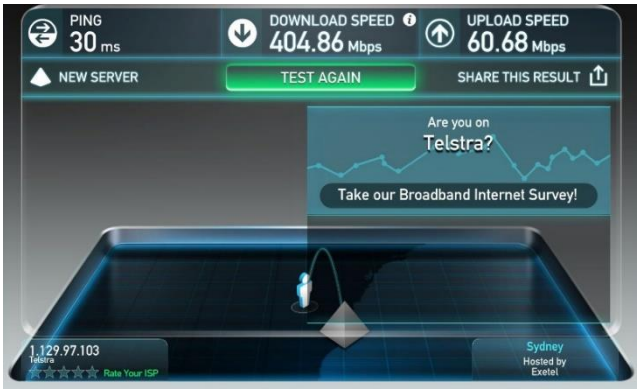
To test the connection's stability, latency, and ability to provide consistent uploads and downloads, MI&S used Overwatch live streaming over Facebook on the Alienware 13 OLED laptop. MI&S experienced in-game latencies under 70 ms, which are acceptable for gaming, especially in a crowded area like the Sydney Opera House.

Figure 2: Playing Overwatch While Streaming on Facebook

Screenshot: Moor Insights & Strategy

In rich media and entertainment testing, 4K video playback was nearly instantaneous; Snapchat Spectacles video upload was almost immediate. These tests used the Alienware 13 notebook and the Netgear Nighthawk M1 and tested on Speedtest.net. The fastest was 404 Mbps download and 60 Mbps upload with a ping of 30—almost eight times faster download than the average fixed broadband connection in the US.

Figure 3: Speedtest.net Result



Screenshot: Moor Insights & Strategy

In addition to single-user benefits, Gigabit LTE benefits everyone in each cell, because it allows better utilization of spectrum and increased throughput. As more devices support Gigabit LTE, the overall experience for everyone improves through more efficient spectrum use. Even users at the cell edge benefit from higher throughput Gigabit LTE near the center, because those users free up spectrum quickly.

Gigabit LTE's Role in 5G

A Glimpse of 5G
We are already seeing multiple operators like Telstra and Sprint launching with varying footprints. Gigabit LTE will be a gradual upgrade of existing LTE networks to provide capacity and speeds where they are needed. Many of the lessons learned with Gigabit LTE can be used to develop and deploy 5G networks as well. These include how to build and supply base stations with enough bandwidth to expand capacity to meet demand. Application developers will start to realize some 5G content ideas can take hold with Gigabit LTE then easily transition to 5G, like VR and AR or drones. We have already seen some of these benefits in current Gigabit LTE deployments like Sprint's in New Orleans, where MI&S experienced download speeds of up to 500 Mbps during a live NBA game filled with thousands of fans.

Coverage Layer for 5G
Many in the industry see 5G changing every facet of our lives. However, in the early days, many 5G networks will be deployed at very high frequencies, making coverage an even greater challenge than in the past. Some problems can be alleviated by using sub-6GHz spectrum, but even then, spectrum over 2GHz tends to be more difficult to permeate indoors and long distances. Techniques like Sprint's use of HPUE will be needed to improve the coverage of mid-band TDD-LTE networks.

Devices & Networks This Year
Devices and networks with Gigabit LTE are coming this year. Telstra and Sprint have already launched Gigabit LTE networks, and Netgear was first to launch a Gigabit LTE device. Sony announced the Xperia XZ Premium at MWC 2017 in Barcelona. Motorola has a Gigabit LTE device in the works, but we have yet to see when it will launch or what it will be called. We expect that with the introduction of Gigabit LTE, we will continue to see larger data plans and more consumers moving toward many of the new unlimited plans operators are introducing.

Call to Action
After 48 hours of living with Gigabit LTE, MI&S believes consumers and cellular operators will benefit from its improved throughput and responsiveness. Operators, OEMs, and consumers should consider devices with Gigabit LTE for the best user experience. These benefits may come at a premium right now, but the premiums may be worth it considering the expanded user experiences and improved performance and efficiency.

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