A Look at Cellular Device Test Trends: An Interview with LitePoint

This interview was the basis of a June 11, 2015, Elecfans article.

1. What is your view on the overall situation of the 4G LTE market? What are some of the current trends?

The 4G mobile communication market is experiencing an interesting combination of the first-wave deployments maturing and moving to LTE-Advanced, while at the same time a continued pace of rapid growth, particularly driven by China. In China, the mainstream deployment of LTE networks started in 2014, with an estimated 100 million subscribers by the end of the year. In 2015, some estimates predict that there could be upwards of 500 million LTE subscribers in China by the end of 2015 – 500% growth year on year! Combined with the growth in China subscribers, we have seen that Chinese mobile device manufacturers have flourished with this opportunity. By unit shipments, there are now 6 China-based handset manufacturers in the top 10. With 4G infrastructure investment continuing around the globe, clearly 4G is now becoming mainstream, but LTE is far finished delivering on its capabilities. We will continue to see evolutions in the 4G networks to improve both the user & data capacity as well as a variety of services offered to the consumer.

2. What is LitePoint's focus in the LTE wireless testing market?What makes LitePoint products unique?

LitePoint seeks to enable our customers' high volume product ramps with the latest technology, resulting in positive customer experiences. Because mobile product cycles are short, our customers need to ship the maximum amount of volume while the products are in high demand. Time to market is key – with short product cycles, there is little time to refine manufacturing issues and the design must be solid before pilot production. If our customers are slow to market or they do not deliver products with a quality user experience, their brand can be damage. The technologies involved are complex and are growing more complex – LitePoint helps to "tame" new technologies. One of our core contributions is a close working relationship with the chipset companies. By being early on the chipset development, this enables us to deliver solutions to our customers that are optimized for our test products, which leads to the fastest production throughput with the best time-to-market and product quality.

3. What are the differences between LTE handset testing and base station testing?

Terminal testing and base station testing are fundamentally different. The biggest difference between base station and terminal testing is on the economics side. Because base stations are significantly lower volume and much higher cost to deploy than mobile devices, a significant amount of time and effort can be applied to base station testing. On mobile devices, there is always a cost and quality trade-off from a test point of view. The challenge is always how to ensure shipments to customers at the highest quality, while keeping the cost of calibrating and screening these units economical. Related to base station testing, LitePoint has invested in small cell base station (femtocell / picocell) testing. Small cell base stations share some commonality with handsets in that they are much lower cost, and the economics of test become quite important. To that end, LitePoint is delivering solutions today that make the manufacturing calibration and test of small cell base stations fit the required economics through efficient multi-device parallel testing.

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4. LTE-Advanced is next-generation enhancement to LTE, which aims to meet the higher demand and more applications in the wireless communications market over the next few years. What are the main features and test challenges of LTE-A?

As I mentioned, LTE has not yet finished delivering all of the performance of which it is capable – this leads us to LTE-Advanced. While this term can be quite broad, common features of an LTE-Advanced network are new RF channel management techniques, such as Carrier Aggregation (CA) and Multiple Input Multiple Output (MIMO) transmission strategies. CA effectively is combining multiple different channels of LTE spectrum in a single mobile device to achieve higher data rates. Globally, there are several networks have rolled out CA, typically involving two different but simultaneous component carriers. Some leading-edge networks are now starting to roll-out CA that involves up to three component carriers which further increases the maximum data rate. The challenge with CA is that the global LTE RF spectrum is very fragmented, and it is difficult to find available channels that are close together. This leads to the deployment of what is called "Inter-Band" Carrier Aggregation, where the channels that are combined are from completely different LTE bands. Depending on the spectrum allocation for the company managing the LTE network, this could involve channels that are over 1 GHz in spacing, which places a huge demand on the RF front-end of the mobile device. To simplify the mobile device architecture, multiple radios are commonly deployed to address this. While architecturally simple, this results in more to calibrate and test, potentially increasing test times for the manufacturers of these devices. As LTE-Advanced is an evolution of LTE, LitePoint's IQxstream Mobile Test System has been commonly deployed for the manufacture of 4G mobile devices and is ready for LTE-Advanced device calibration and verification. The tester is upgradeable as new features of LTE-Advanced continue to be deployed.

5. Are there any special test needs for addressing the different versions of LTE (TD-LTE, FDD-LTE)? Is LitePoint test equipment compatible with both?

While the core technology is the same, there are some differences in testing TD-LTE (half-duplex transmission) vs. FDD-LTE (full-duplex transmission). In particular, TD-LTE has some additional test requirements to verify the timing performance, such as the Transmit.

Time Mask test. Most other tests are common between the technologies. Because these two LTE versions have evolved out of 3G technologies, there are examples to draw from. For example W-CDMA uses an FDD transmission scheme (like FDD-LTE), and TD-SCDMA uses a TDD transmission scheme (like TD-LTE). By leveraging the experience with these legacy 3G technologies, there are no compatibility issues related to TDD/FDD with modern test equipment when addressing the different LTE versions.

6. What are the must-have features of 4G era test equipment? What are some emerging challenges driven by the technology?

There are several important "must have" features and specifications for 4G era test equipment. Some of these are fairly easy to identify (new frequency bands, modulation schemes, and channel bandwidths), but what might be a little less obvious is regarding the tester sequence architecture and resource settling time. Because LTE introduces more frequency bands and more modulation configurations, with traditional test techniques, the test time would increase, leading to higher test cost. To counteract longer test times, the chipset suppliers have implemented "test sequences," which are like pre-programmed test programs inside the chip. Rather than the user directly telling the device which channel and power to transmit on, the chipset runs through its pre-programmed set of conditions. This minimizes the back-and-forth communication between the user and the device, which is one of the bottlenecks in test time. As the chipset companies have refined techniques with sequences, and further reduce the test time, one significant challenge is supporting longer and longer sequences with very small step sizes (as low as 1 millisecond per step). This stresses not only the flexibility of the tester sequence architecture, but it also stresses the settling time of the signal generators and analyzers of the test equipment – both the tester and device need to be ready for measurements in less than 100 microseconds (1/10 of a millisecond). Some of the common test equipment for 3G devices cannot support the demands of today's latest 4G sequence techniques.

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7. What is LitePoint's view on 5G cellular technology and the challenges it will create? As part of future development of 5G, millimeter wave technology is being discussed. How does LitePoint plan to solve this challenge?

One of the main challenges with understanding 5G today is how broad the definition is evolving to be. Unlike the previous transitions from 2G to 3G to 4G, 5G is not so much as a "new wireless technology" as it is a new data access technology. While there are technologies being proposed as a part of 5G that typically are not found in mobile devices, such as millimeter wave radio frequencies, these technologies have been used with deployments in wireless backhaul and some early wireless video applications. The main challenge of 5G will be interoperability of existing technologies. With a common "always-on" connection to a traditional cellular network (such as LTE), devices under a "5G network" will need to be smarter to seek out the best option for data access. This could be through the existing cellular network, a nearby Wi-Fi hotspot, a commercial / enterprise "small cell" (femtocell), the proposed unlicensed-band LTE (LAA), or an entirely new mobile device technology (such as millimeter wave). Test solutions for each of these technologies have individually been in production many years, even millimeter wave. The challenge is really in testing the interoperability and seamless handover of these systems in the dense environment of a Smartphone, and do not cause inter-system noise, effectively inducing de-sensitization of the devices which reduces performance. The focus 5G test challenges will be on "user experience" testing.

8. How does LitePoint see 5G test technology development, market trends and timing?

If we look at 5G as an access technology, rather than a specific wireless technology, the first deployments of 5G are already here today. Recently, Smartphones have begun adding the ability to hand-over voice and data sessions from the core cellular network to an available Wi-Fi hotspot. Additionally, there are medium-term discussions about LTE being deployed in the unlicensed 5 GHz spectrum, which creates another data access interoperability path for a mobile device. Just as the first LTE cellular deployments started with small steps from 3G, the expansion from 4G to 5G has already started. Additional "5G wireless technologies" will continue to evolve over the next 5 to 10 years as they mature and become more cost-effective. The goal is to ensure that these emerging technologies become economical and provide the end-user with a quality experience.

