SOLVING LTE NETWORK PROBLEMS WITH PCTEL SCANNING RECEIVERS

Introduction

4G LTE is all about data. In a world of limited spectrum resources, LTE can deliver higher data throughput rates and reduce the cost of delivering a megabyte (MB) of data.[1] However, outside sources of interference, as well as the design and configuration of the LTE network, may reduce LTE's spectral efficiency, resulting in lower data throughput rates for users and higher costs for network operators.

Data collected during network drive and walk testing is used by engineers to find and eliminate interference and other problems that impact LTE network performance. There are two main types of devices used during wireless network field testing: scanning receivers and test mobiles. Test mobiles are modified customer devices, and they provide a wealth of information on the user experience, such as dropped calls and uplink and downlink data throughput rates. However, test mobiles are not specifically designed for high-performance RF measurements. When it comes to detecting and diagnosing RF problems such as external interference and pilot or cell ID pollution, engineers need accurate, detailed information on RF signals—information that can be provided by high performance scanning receivers.

PCTEL scanning receivers are designed, calibrated, and tested to provide detailed RF data with high measurement accuracy. This data can be used to improve LTE network performance at all stages of the network lifecycle, from baseline testing to optimization. This paper will focus on two specific applications where scanning receivers provide benefits that go beyond what can be achieved with test mobiles alone: (1) identifying outside sources of interference on a live LTE network, and (2) testing Distributed Antennas Systems (DAS) and other small-cell networks.

Measurement Accuracy

LTE Reference Signal Received Power (RSRP)

PCTEL Scanning Receiver: ±1 dB

UE: ±6 dB[2]

[1] Huawei, "LTE is now," *Huawei Communicate* 54 (February 2010), 12.

[2] 3GPP, 3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access (E-UTRA); Requirements for support of radio resource management(Release 10) (3GPP, March 2013), TS 36.133 V10.10.0, 117-120.

APPLICATION NOTE

Outside Interference

PCTEL scanning receivers have a variety of features that make them more effective at detecting and identifying outside interference than test mobile devices. These features include full-bandwidth scanning, as well as a range of specialized power measurements. PCTEL's advanced interference detection features have been used to solve problems in the field, including identifying a source of interference on a TD-LTE network in China.

SeeGull® MX

Outside interference can occur anywhere in the LTE channel, which may be as wide as 20 MHz, however test mobiles may offer power measurements on only the center 1.08 MHz In this case, the test mobile can easily miss degradations in signal quality that occur elsewhere in the channel. When signal quality anywhere in the LTE channel is reduced due to outside interference, LTE network efficiency, capacity, and throughput rates may suffer. SeeGull® scanning receivers solve this problem by decoding cell IDs and measuring power throughout the entire LTE channel.

SeeGull® EXflex™

Accurate, specialized power measurements are crucial for detecting and identifying sources of outside interference. SeeGull's **spectrum analysis** feature allows test engineers to examine the entire bandwidth. However, some RF signals occur intermittently, making it more difficult to detect and identify interference with traditional spectrum analysis. PCTEL's **Enhanced Power Scan (EPS™)** provides power measurements that can be customized in time and frequency, allowing engineers to focus on specific RF signals. SeeGull's **LTE Power Analysis** makes it even easier for engineers to identify interference problems on a TD-LTE network. LTE Power Analysis provides easy-to-use power measurements of specific parts of the LTE signal, including frames, slots, and Resource Blocks (RBs). Together, spectrum analysis, EPS, and LTE Power Analysis make it easy for engineers to identify, detect, and even locate sources of outside interference.

PCTEL solved an outside interference problem for a major wireless infrastructure provider managing a TD-LTE network for a major Chinese operator. Over the course of a month, the infrastructure provider observed reduced data throughput rates in a particular area. First test mobiles, and then a competitor's scanning receiver, were unable to identify the source

APPLICATION NOTE

of the problem. As a result, the infrastructure provider thought there might be a problem with their base station equipment. However, in reality, the problem was outside interference, as PCTEL scanning receivers were able to demonstrate.

After the infrastructure provider had used the competitor scanner for a week without detecting interference, PCTEL arrived on the site with a SeeGull MX scanning receiver. Within three hours, the SeeGull MX not only confirmed that the problem was caused by outside interference, but also located and identified the source of the interference. Engineers first used LTE Power Analysis of individual LTE slots as well as EPS, which revealed that outside interference was causing the problem. Once the interference was identified, engineers used the SeeGull MX in conjunction with a directional antenna to locate the source, which turned out to be a government internal wireless communication system which was not registered with the China Radio Regulation Commission.

With the source of the problem identified, the infrastructure provider was able to assure the operator of the quality of their network equipment. Meanwhile, the operator had the information they needed to discuss the interference problem with the government. The SeeGull MX scanning receiver thus provided a quick resolution to a problem that could not be identified or solved with test mobile devices or with a competitive scanning receiver.

DAS and Small-Cell Networks

Distributed Antenna Systems and small-cell networks are designed to provide increased network capacity and throughput inside of buildings and in densely-populated areas. In most cases, these networks are built in locations that are already served by a macro network. The macro network generally operates at much higher power levels than the small-cell network. These high-power signals may overwhelm the small-cell network, making it impossible for mobile devices, including test mobiles, to decode signals from the small-cell network. In this situation, not only would users see little or no benefit from the small-cell network, but also test mobiles would be unable to provide data for acceptance testing.

This was exactly the problem PCTEL solved for a leading DAS provider at a major North American sports venue. In this case, a DAS provider was building and optimizing a DAS for a single major North American wireless network operator. PCTEL provided testing using both the SeeGull MX scanning receiver and test mobile devices. The test mobile data alone did not provide the information on all relevant DAS signals needed to make adjustments to the network. However, with data from the SeeGull MX, the DAS provider was able to fine-tune the network to meet performance requirements and complete the installation.

APPLICATION NOTE

The SeeGull MX was able to decode DAS network signals due to its **high dynamic range**. High dynamic range means that SeeGull can decode low-power signals even in the presence of high-power signals. The SeeGull MX is also able to decode and measure a large number of LTE cell IDs at once. As a result, the SeeGull MX provided a full range of accurate data for the DAS as well as the macro network.

The DAS provider used this information to perform baseline and optimization testing. These test results were used to adjust DAS antennas and configure the network to improve capacity and throughput. Using PCTEL scanner data, the DAS vendor was able to complete the project to the customer's satisfaction. As a result, the DAS provider will be using PCTEL again to test the DAS for another wireless provider at the same venue.

Decoding low-level signals is crucial for installation and validation of DAS networks. PCTEL scanning receivers have provided data DAS vendors need to complete their projects and meet network performance goals in multiple sporting venues in North America. They can play a similar role for DAS and other small cell networks around the world.

Conclusion

SeeGull scanning receivers provide clear benefits as a component in LTE drive and walk test systems. In particular, SeeGull scanning receivers can be used to identify sources of outside interference that test mobiles may miss once a network has been turned on. SeeGull scanning receivers are also able to decode DAS and small-cell network signals when test mobiles are not.

Beyond these applications, SeeGull scanning receivers are engineering tools that provide a clearer and more complete picture of the RF environment than test mobiles alone. Since LTE network throughput, capacity, and efficiency are directly impacted by the quality of the RF signal, SeeGull scanning receivers can help operators and service providers alike improve network performance throughout the network lifecycle, from the network design phase to ongoing optimization efforts.

APPLICATION NOTE