



# SiGNALS Ahead

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## 186GB in an LTE Network – Been there, done that

### Commercial LTE Network Performance Benchmark Report Preview

**T**his report preview contains an overview of a separately published 69-page two-part report, which we believe is by far the most scientific and exhaustive independent performance analysis ever conducted of an LTE network(s). To put things into perspective, we transferred nearly 186GB of data, or nearly twenty-five times more data usage than what a typical fixed broadband user consumes in an entire month – virtually all from vehicular or pedestrian mode and all using the two LTE networks. In this report preview we include a complete table of contents, list of figures and tables (92 figures and tables in total), and sample figures from the report. If you were ever considering a subscription to our research services, now is the time to act. Alternatively, you may purchase this report without purchasing a full subscription.

As part of this research project we obtained the XCAL LTE drive test tool and XCAP LTE post-processing tool from Accuver. To the best of our knowledge the XCAL/XCAP solution was the only solution that was available at the time of our testing which could interface with the Samsung and LG LTE devices, not to mention other vendor's HSPA+ or Mobile WiMAX chipsets, and this capability proved invaluable during this entire effort. With the use of this tool and our methodical approach to testing and analyzing

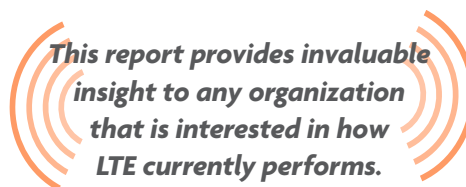
the network, we have arguably reached fairly conclusive and statistically valid opinions about how LTE performs today. Separately, we also tested a Huawei test modem, thus we are able

to shed some insight into how the Huawei chipset performs.

While we looked at some of the more basic performance KPIs,

such as downlink and

uplink data rates, the use of the Accuver solution allowed us to capture and analyze numerous underlying performance KPIs, including CINR, RSSI, resource block allocation, mod-



**This report provides invaluable insight to any organization that is interested in how LTE currently performs.**

ulation scheme (Antenna 1 and Antenna 2), MIMO type, and BLER. Further, during the post-processing phase we analyzed these KPIs by several different means, including throughput versus CINR, CINR versus RSSI, handover success rate, throughput during a handover, and CINR versus modulation scheme and MIMO type, to name a few. Many of the results are also shown as geo-coded plots using Google Earth.

Given the highly differentiated information that we provide, this report is critical reading for:

- Spectrum holders who have yet to deploy a broadband wireless network
- Mobile operators who are evaluating the merits of deploying LTE
- Organizations that want to understand how the critical building blocks of LTE (e.g., OFDMA and MIMO) actually behave in a real-world, commercial network
- LTE infrastructure, device and chipset suppliers who are looking for competitive intelligence
- Financial institutions who are making short-term or strategic investment decisions
- Government regulators who are responsible for spectrum or broadband service policies
- Anyone with a passion for wireless

The full report is divided into eight sections, including an introductory section. Section 2 of the report includes the key highlights and findings from drive testing the two networks. In this section we identify and discuss in detail eleven of the most significant conclusions and we offer our assessment on the current performance differences between the Ericsson and Huawei LTE solutions.

Section 3 contains our test methodology. In order to ensure statistically valid results, virtually all of our testing took place while in vehicular or pedestrian modes. Although this approach reduced the potential throughput that we would otherwise have experienced, it ensured that our results are statistically valid since it is virtually impossible to achieve meaningful results from a stationary position – even if a large number of locations are selected at random. Further, we had access to high bandwidth servers that were dedicated for our tests and we made sure to adjust our TCP window sizes – steps that are seldom done but which are critical to ensure the full potential of a high bandwidth technology. Finally, we publish all results that we collected to demonstrate that our conclusions are based on all available data points that we observed and analyzed.

The next two sections of the full report contain detailed results for specific test scenarios – Section 4 is dedicated to the Stockholm network and Section 5 is dedicated to the Oslo. These sections contain a wealth of information presented in numerous figures as well as our analysis of the underlying data. This report preview includes a few sample figures based on fictitious data points.

Section 6 puts the results into perspective and it includes the results of other tests in which we used the LTE networks for more practical applications. Section 7 provides some quick concluding remarks. Section 8 is an expanded appendix which includes additional results that didn't make their way into the main report.

This report preview contains six figures from the actual report. The first figure shows a screen shot of the XCAL LTE drive test tool in action during the data collection process. The next two figures show where we were conducting the tests and the speed we were driving or walking while conducting the tests. In the report we use a similar approach to plot many of the more interesting KPIs pertaining to network performance for a number of the test scenarios. For these figures, and in order to provide greater clarity, we focus on specific regions of the network that pertain to the test scenario being analyzed.

The fourth figure, based on hypothetical data, plots two important KPIs as a function of time. We use this format to look at many other KPIs in the report. The fifth figure, again based on hypothetical data, illustrates one method we use to look at the distribution of downlink PHY Layer throughput. Finally, the last figure, based on hypothetical data, shows a plot of downlink PHY Layer throughput versus CINR values. These figures are followed by some additional information about our *Signals Ahead* research product and then we provide the full report's Table of Contents and Index of Figures.

*This full report, which is available in high-resolution format, may be purchased separately for \$1,495 or it is included as part of a normal subscription to our research services. At least 25% of the purchase price can be applied as a credit toward the purchase of a full subscription to Signals Ahead (18 issues or roughly one year of research). Please review the ordering page for additional information about the various annual licenses that we offer. Note that purchasing an annual license to our research is by far a more economical approach and we do this since we know that once a company subscribes to our research, they will most likely remain loyal clients for years to come.*

In order to provide greater insight into the type of research that we provide, we have included brief summaries of recent reports that we have done as well as identified a list of likely topics that we will pursue in the coming year. Note that the research topics we pursue could change based on industry events and market trends, not to mention ideas that we develop through the course of doing normal research.

Potential topics for the coming year include:

- Voice over NGN (LTE, HSPA+, etc)
- Embedded modules/netbooks
- The challenges of delivering video in a mobile network
- HSPA/HSPA+/LTE chipset performance benchmark test results
- LTE Global Summit (Amsterdam)
- Economic considerations with various backhaul solutions
- Going Green – financial implications and challenges
- The impact of Type 3i receivers on UE performance (includes chipset benchmark tests of leading solutions)
- Whatever happened to IMS?
- 4G World
- LTE network performance benchmark results – retest of networks
- DC-HSPA network performance benchmark results
- Backhaul and NGN architecture considerations
- HSPA+ (MIMO) network performance benchmark results
- The impact of latency
- TD-SCDMA network performance benchmark results
- WiMAX chipset performance benchmark test results
- Technology and Market Outlook for 1X Advanced and EV-DO Advanced
- EV-DO Rev B network performance benchmark results

## IN CASE YOU MISSED IT

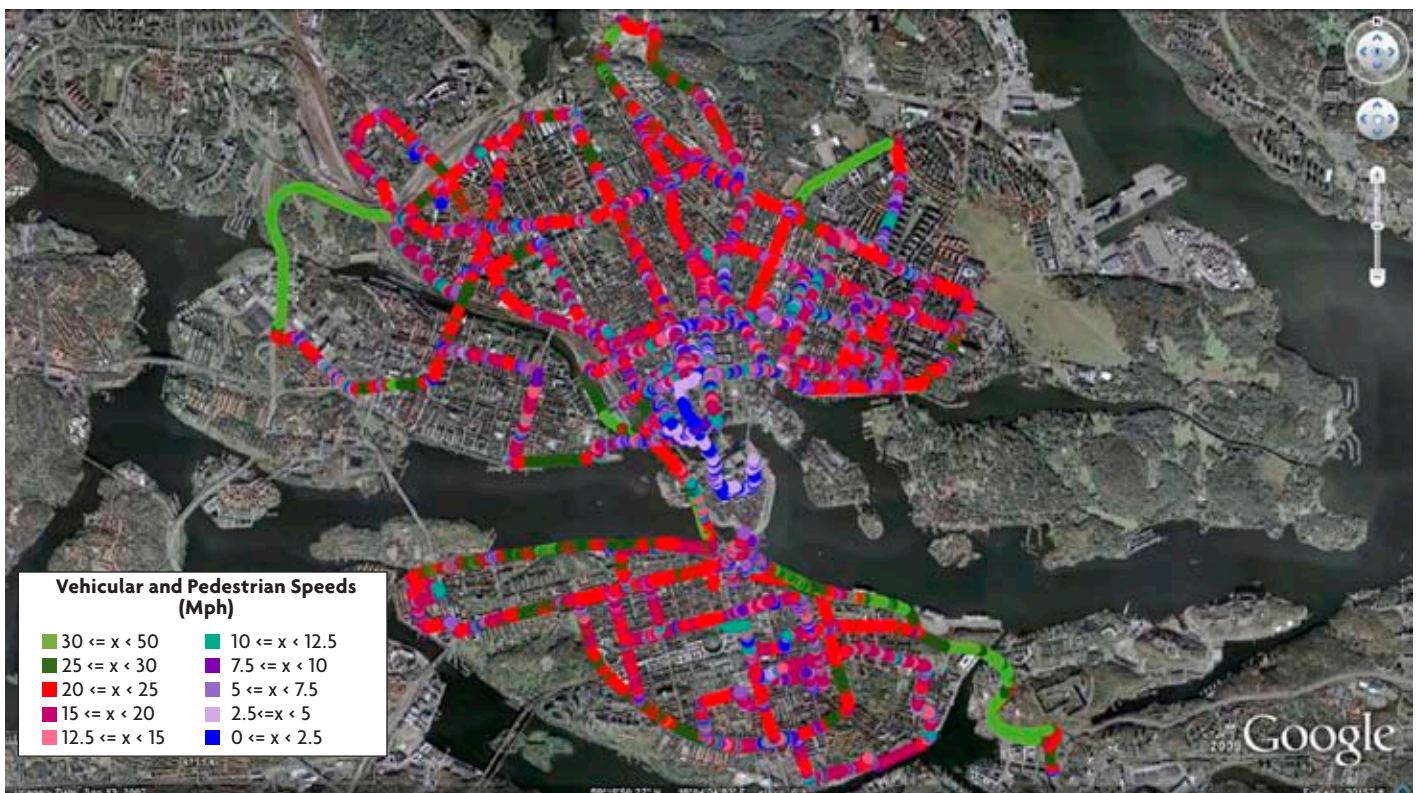
- **1/28/2010 “THE TROUBLE WITH TWITTERS”** We look at the impact of smartphone signaling on an operator’s 3G network. As part of our research into this report, we leveraged the Anite Nemo Handy drive test tool to capture the signaling traffic while using seemingly benign applications. In addition to identifying the worst offenders, we offer commentary on what the industry needs to do to address the growing problem.
- **1/04/10 “2010 – A LOOK AHEAD”** We provide our thoughts on the year ahead, including our list of important truisms and trends that we believe are and will continue to shape the wireless industry.
- **12/15/09 “SERVICE ASSURANCE - ENSURING NEXT-GENERATION NETWORKS”** We look at the Service Assurance industry which provides the services that are necessary to ensure that services offered by operators meet pre-defined service quality levels and customer experience targets. In particular, we look at the ecosystem of suppliers, from large NEMs to small startups, and we present many of the key trends that will emerge in the years to come.
- **11/19/09 “LTE IN THE AMERICAS”** We discuss the key themes and trends that emerged from the LTE Americas Summit that took place in Dallas, Texas and we compare those themes and trends with what emerged from the LTE event that took place during the summer in Europe.
- **11/04/09 “LET’S GO TO THE VIDEO”** We provide performance benchmark tests results from lab-based tests that were conducted on several leading smartphone platforms. In collaboration with Spirent Communications, we tested 7 handsets, including handsets from Nokia, Motorola, Samsung, LG and Sony Ericsson. KPIs include VMOS, average start time, A/V synch faults, video missing and video interruptions. Tests were conducted using 3G, Wi-Fi and playback from local memory.
- **10/01/09 “IT’S A MAD MAD MAD MAD [4G] WORLD”** We shed some light on why AT&T made its decision to deploy LTE over HSPA+ and why the strategies of AT&T and Telefonica should not be misinterpreted as the inevitable downfall of HSPA+. By looking strictly at the spectrum holdings of the operators, we can determine which potential mergers or partnerships make sense and which operators need spectrum to fulfill their network evolution strategy.
- **9/09/09 “WIRELESS IN WASHINGTON...AND THE SURROUNDING PORTLAND AREA”** In this 54-page special report we provide the first detailed assessment of the individual user experience in a Mobile WiMAX network. For this study we leveraged a Rohde and Schwarz network analyzer and other sophisticated data capture tools to analyze a wide assortment of KPIs (MIMO A/B/ availability, RSSI/CINR values, transmit power, modulation type, DL/UL throughput, etc). Our analyses are based on transferring 47GB of data and traveling nearly 420 miles around the Portland area over a 5-day period.

**Figure 1. Accuver XCAL LTE Drive Test Tool in Action**



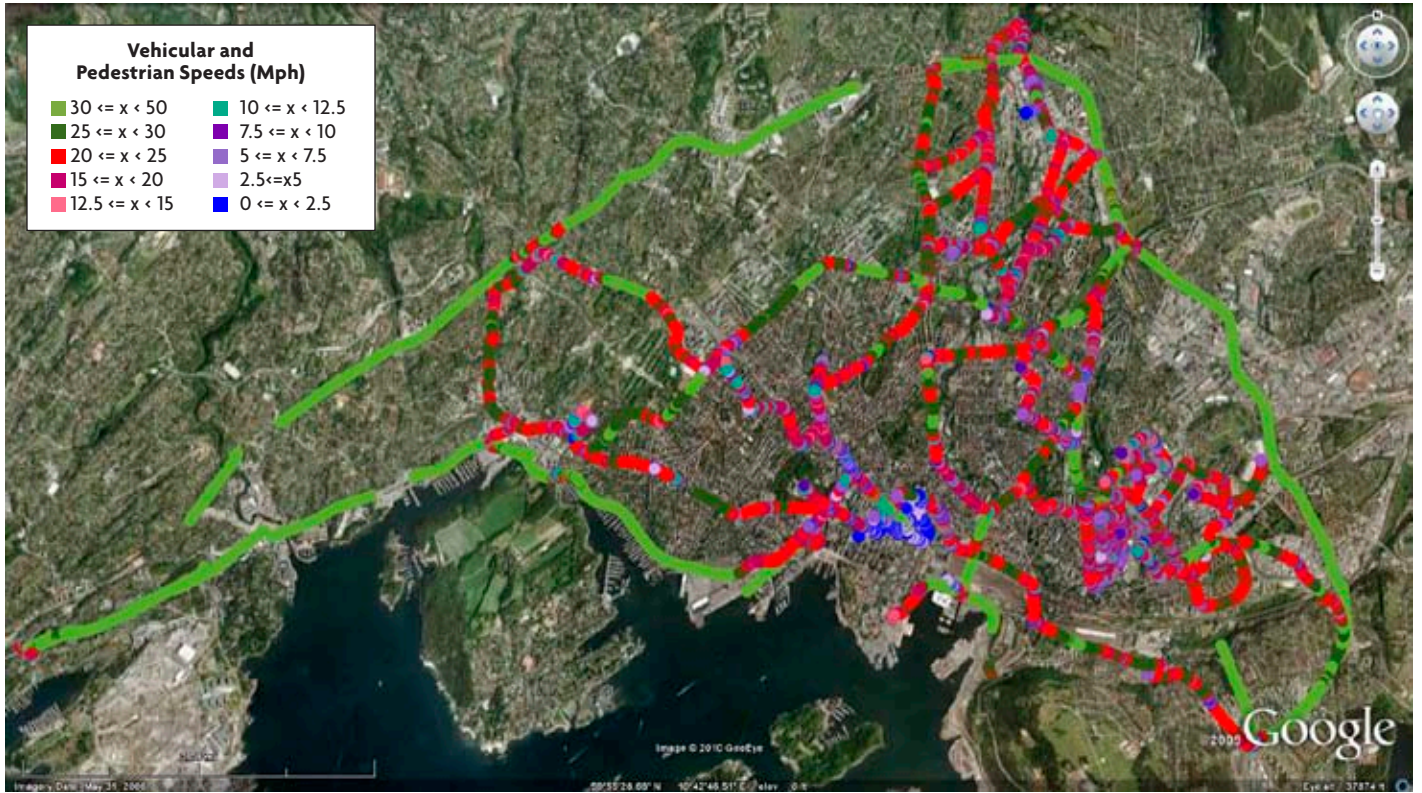
Source: Accuver and SRG

**Figure 2. "Oh the places we did go!" – Geo plot of all Test Routes with Speed (mph) - Stockholm**



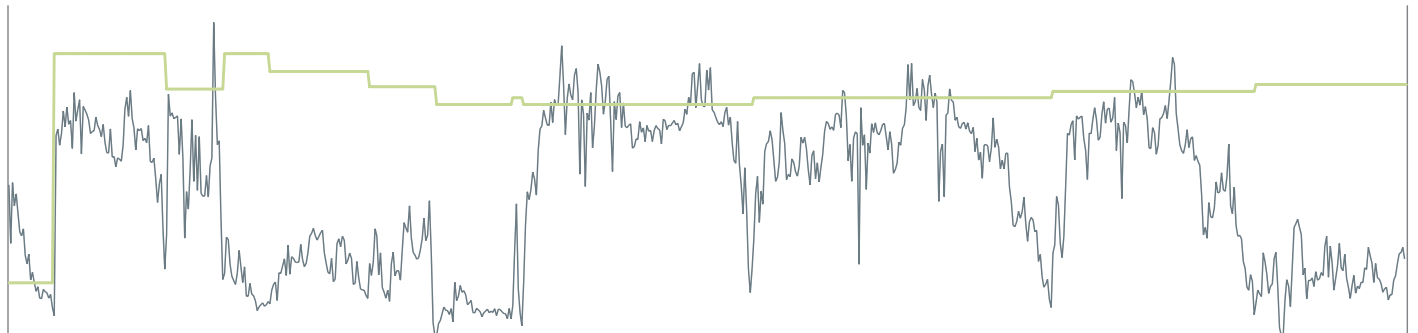
Source: Signals Research Group, LLC

**Figure 3. "Oh the places we did go!"**  
**Geo plot of all Test Routes with Speed (mph) - Oslo**



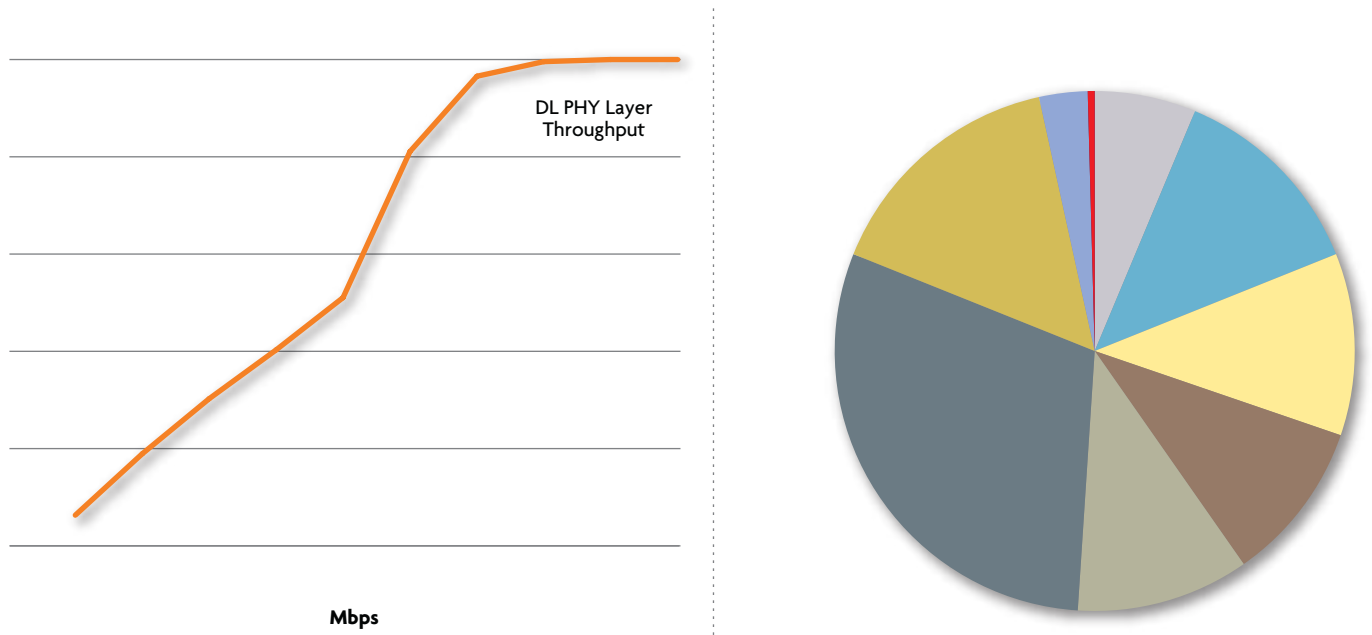
Source: Signals Research Group, LLC

**Figure 4. Test Scenario X – KPI versus KPI as a function of time**



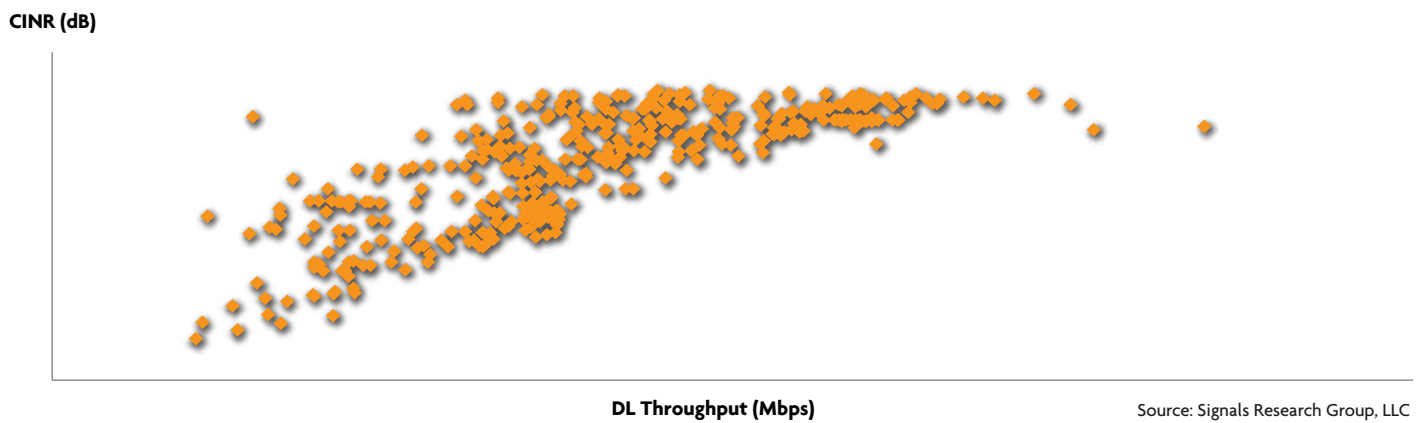
Source: Signals Research Group, LLC

**Figure 5. Test Scenario X – DL Throughput Results – CDF and Pie Chart Distribution**



Source: Signals Research Group, LLC

**Figure 6. Test Scenario X – DL PHY Layer Throughput versus CINR Values**



Source: Signals Research Group, LLC

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