

February 10, 2010

## SIGNALS Flash!

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## Greetings from the Land of IKEA

*A funny thing happened on the way to the Fira*

- ◆ This week we are conducting the first ever extensive independent drive test evaluation of a commercial LTE network, leveraging networks in Stockholm and Oslo.
- ◆ The full report, including a wealth of underlying performance KPIs and analysis will be available in March to all Signals Ahead subscribers – individual reports can also be purchased for non-clientele.
- ◆ In order to collect and analyze the rich set of device performance KPIs we are leveraging the XCAL (data collection) and XCAP (post-processing) products from Accuver, a leading supplier of network optimization and test and measurement equipment.
- ◆ Since we have only transferred 50GB in the last 1.5 days of testing while driving through roughly two-thirds of the network, we are not quite ready to share any insight into our overall opinion of the network – it is always fun to keep our readers in suspense.
- ◆ We do, however, provide the results for a brand new KPI that we have identified for LTE drive testing – the average download speed was 5.5 Gigabits per mile over the course of a 12 mile vehicular test around central Stockholm.
- ◆ Future upgrades, including the transition to a 2x20MHz carrier in Stockholm and a multi-mode dongle means we may want to come back for more.
- ◆ The network may or may not be the fastest network that we have ever tested (wait until March to find out) but by God it is the coldest!

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## LTE Drive Test in Progress

Most years when we head to Barcelona we head toward Frankfurt and then hang a right, so to speak. This year we left a week early and instead of hanging a right in Frankfurt we turned left and headed due north for the world's first LTE networks in Stockholm, Sweden and Oslo, Norway.

There is an old adage that if it is worth doing it is worth doing right. In keeping with that spirit we are both here in Stockholm for four days and later in Oslo for a couple of days where we are extensively testing the network before heading down south where we hope that the weather will be considerably more amenable to our Northern Californian lifestyle.

We have augmented our typical drive test tools with Columbia hiking boots, wool socks, mittens, a stocking cap, Sudafed, an all-wheel drive

Volvo XC90 with extra-warm seat heaters, and Carmex. Most importantly, we showed up armed with what we believe is the only drive test tool that is currently capable of interfacing with the Samsung USB dongle.

Thanks to Accuver, a leading supplier of network optimization and test and measurement equipment, we have been using its XCAL drive test tool to develop a deep understanding of how the LTE network in Stockholm [and later Oslo] performs. In addition to looking at basic information, such as downlink and uplink throughput, we are using the full capabilities of the tool to look at all of the underlying performance metrics, such as modulation scheme, DL/UL resource block assignments, MIMO availability, SINR, and RSSI, to name a few.

To the best of our knowledge, the XCAL/XCAP solutions are the only drive test solutions available today which interface with the Samsung dongle, therefore, our ability to use the tool should result in an even more differentiated report when it is all said and done. And if all goes according to plan we will also be testing another dongle/chipset combination, albeit a solution that is not yet commercially available.

To make things even more interesting we will be utilizing the mapping capabilities of the XCAP post-processing tool to show thermal plots of the most interesting KPIs that are mapped to the exact location where they occurred within Stockholm.

For comparison purposes, many of the independent “drive tests” that have already been done in this network or in other LTE/WiMAX/HSPA+ networks around the world use an external website/server that can be prone to unintended congestion or throughput limitations that cause the internet/server to be the bottleneck, and not the network itself. Further, a simple 10-20MB file transfer, or what we now refer to as a “ping test,” from a couple of locations in a large-scale network is by no means representative of how the network performs since the results of a few simple tests using a website with a network

measurement tool could easily understate or overstate the typical user experience in the network.

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*We have only transferred slightly more than 50GB in the drive test sessions over the course of 1.5 days.*

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In order to keep our Signals Ahead readers salivating until sometime in early March, we are going to refrain from providing any specific comments about the performance of the network itself. Further, we have only transferred slightly more than 50GB in the drive test sessions that we have conducted over the course of 1.5 days. Therefore, despite the massive amount of data that we have transferred from literally all across the network and all points in between, we do not believe we are yet in the position to pass judgement on the technology. Further, our pedestrian test today through Stockholm was inadvertently interrupted by the removal of ice from a 5<sup>th</sup> floor drainage pipe, and onto the narrow street below so if weather permitting we may repeat the test a few more times..

We would, however, like to introduce a brand new KPI that we believe will ultimately become the de facto means of judging the performance of an LTE network. Specifically, this KPI is based on taking the total amount of data transferred (or DL/UL by itself) during a drive test and then dividing by the number of miles driven during the test. In keeping with the spirit of LTE, the dimensions are Gigabits per mile (Gigabits per km is also acceptable in certain circles).

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*During one drive test the average downlink data transfer rate was 5.5 Gigabits per mile.*

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In our case, this KPI yielded a result of 5.5 Gigabits per mile (downlink throughput only). Readers are welcome to take a guess at 1) how many miles we drove during this particular test (this should be an easy one), 2) how much data we downloaded during this drive, and 3) the value of the more widely

accepted Mbps KPI. The reader with the most correct answers will win a multi-mode Apple iPad with built-in LTE and DC-HSPA functionality. *Subject to availability, certain restrictions apply.*

## Network Background

In addition to testing the network we also had or will have the chance to meet with various senior executives from the operator (TeliaSonera) and the infrastructure suppliers (Ericsson in Stockholm and Huawei in Oslo)

The network in Stockholm is comprised of roughly 300 cell sites (3 sector) using 2.6GHz spectrum while the network in Oslo is much smaller and comprised of 90 cell sites. At the moment the Stockholm network uses 2x10MHz radio channels but the channel bandwidth will soon be expanded to support a full 2x20MHz radio channel, or comparable to what exists in Oslo.

In terms of the size of the network, we currently estimate that the bulk of the Stockholm network is contained within a 10 square mile area with two smaller networks deployed north (Kista) and south (Farsta) of the city – reference the coverage map. Most of our testing is taking place in the Stockholm area although we did log some data in the Kista network. One of the interesting observations, and contained within the number of cell sites per square mile, is that it is quite evident that the operator designed its network to support massive amounts of capacity, after all the operator doesn't have the luxury of being able to deploy another LTE carrier since it is, or will soon be, fully utilizing its 2x20MHz of spectrum.

While the geographic region of the network is not large at the moment, the operator plans to expand the network later this year, including much greater coverage in the Stockholm area, as well as coverage to 25 cities and vacation areas throughout Sweden. Each site is provisioned with ample backhaul – fiber in the Stockholm area although microwave radio could be used when deploying the LTE network in more remote regions of the country. As the operator builds out its network, it is evaluating the use of its

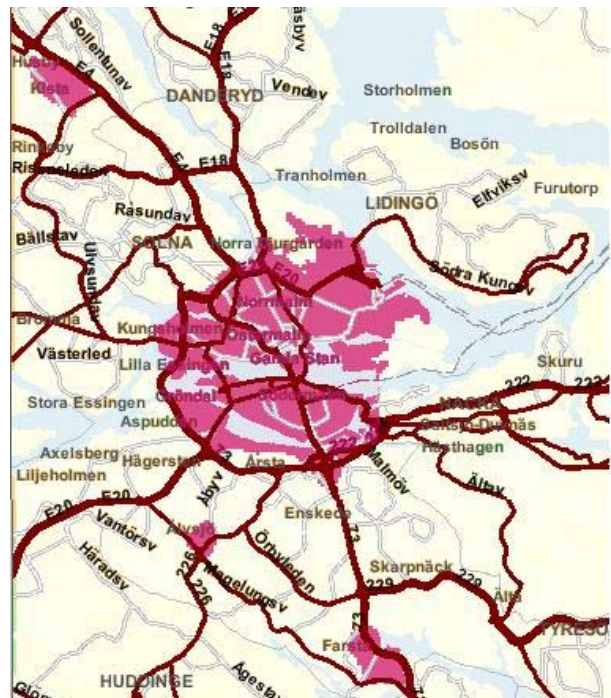
900MHz and 1800MHz spectrum while depending on the results of the upcoming 800MHz auction, TeliaSonera may have the opportunity to gain more attractive spectrum for covering wide geographic regions.

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*The pending switch to multi-mode dongles is the primary reason why the number of subscribers is in the hundreds, and not thousands.*

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Separate from its LTE network, TeliaSonera has a nationwide HSPA network (Cat 10, 14.4Mbps) and we are of the understanding that it is launching HSPA+ in a limited geographic region sometime this week.



We don't have a good grasp on the number of active subscribers on the network but we know that it is on the order of hundreds, and not thousands. In addition to a limited supply of Samsung LTE

dongles (Samsung LTE modem), there is a financial benefit associated with limiting the number of LTE dongles that are sold since the operator will swap these single-mode dongles for multi-mode dongles as soon as they become available – tentatively later this summer. TeliaSonera is currently in the RFQ process although it hasn't made any decisions on who its supplier will be. In the event that the incumbent wins the contract, one option that Samsung is considering is to offer a multi-mode LTE/HSPA chipset that uses its own HSPA modem. Samsung has struggled in the past with its 3G chipset strategy but perhaps it will find success this time around. It would, however, be surprising and an impactful in the wireless IC industry if it happened.

Once these multi-mode dongles are available the LTE-HSPA handover will still be a “drop and reconnect” handover until at least some time next year. For a data session, this kind of a handover is probably not a big deal based on normal usage patterns in a mobile environment, however ultimately a seamless or near seamless handover will be critical.

### **Final Thoughts**

Assuming our case of testing pneumonia doesn't get the better of us, we will be heading to Barcelona early Saturday morning for a “fun filled” week of wireless activities.

### **Biography**

In his current endeavor, Michael Thelander guides a team of industry experts who provide technical and network economics analysis for operators, vendors, financial institutions and trade associations in the wireless industry.

Additionally, Mr. Thelander is responsible for the consultancy's Signals Ahead and Signals Flash research products which have a broad following of subscribers across the entire wireless ecosystem.

Prior to founding Signals Research Group, LLC in 2004, Michael Thelander was an analyst with Deutsche Bank, where he covered the wireless telecommunications industry.

Prior to joining Deutsche Bank, Mr. Thelander was a consultant with KPMG (now known as BearingPoint) and a communications officer with the United States Army. Mr. Thelander has also published numerous articles for leading trade publications and engineering journals throughout his career. He is frequently quoted in leading publications, including the Wall Street Journal, The Economist, Fortune, Reuters, New York Times and BusinessWeek, as well as various trade publications.

Mr. Thelander holds a Masters of Science in Solid State Physics from North Carolina State University and a Masters of Business Administration from the University of Chicago, Graduate School of Business.

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