Nokia Siemens Networks Smart Labs

Understanding Smartphone Behavior in the Network

Nokia Siemens Networks

White Paper

1. Smart Lab Introduction

Contents

The massive takeup of smartphones that has occurred since 2007 has been a boon for the telecommunications industry. The services, applications, and connectivity that the industry provides is something that consumers talk, blog, and tweet about with passion.

However, this boom in smartphones has ended up posing a challenge to network operators. Because the first major use of high-speed data was laptops with dongles gulping down gigabytes of P2P applications and streamed video, operators worldwide focused on efficient delivery of data capacity as their top priority. But smartphones are different. The average smartphone consumes only 10% of the data traffic that a laptop does, but smartphones, largely driven by the applications that consumers love, can connect to the network in the background hundreds or even thousands of times daily, pushing signaling traffic higher than network planners ever imagined.

Today's data network focus is therefore widening to include not just data-hungry laptops, but connection-hungry smartphones as well. The task before us all as an industry is to understand how handsets, their batteries, networks, and applications work together, to determine the proper performance balance for each so that both end user experience and network efficiency can be optimized.

It is for this precise purpose that Nokia Siemens Networks has established multiple Smart Labs worldwide. The labs in Dallas, US, Espoo, Finland, and most recently opened in Seoul, Korea, help find the ideal configurations of mobile handsets, applications and networks to minimize negative network impact from smart devices, improve resource consumption as well as better handset and application performance, and to ultimately provide the best possible user experience.

Ultimately, it is only when all of the players in the value chain understand the effect that they have on all of the other players will we be able to develop the ideal win-win-win-win scenario among network operators, handset vendors, application developers, and consumers. Through its research, Nokia Siemens Networks Smart Labs are deepening and sharing this understanding of how we all work best together, so that getting to a fully smartphone-friendly ecosystem isn't just the result of trial and error, but is based on a industry-wide knowledge of the issues and their effects on all the players.

2. Background

2.1 Smartphone success

Until relatively recently, the mobile broadband industry was focusing on providing laptop and dongle users with enough data capacity. But the arrival of the iPhone, Android and also other smart devices has ushered in a brand new world of data usage: now mobile device users are able to use applications that are always connected to the network in order to stay in touch with friends via instant messaging, Facebook, MySpace, Skype, Twitter, and other universally popular applications.

A current trend for internet social networking websites such as MySpace and Facebook is to turn mobile. Facebook, for example, has more than 500 million active users and more than 200 million are currently accessing Facebook through their mobile devices. According to Facebook, people that access the site on their mobile devices are twice as active on Facebook as non-mobile users.

Some of the most popular smartphone applications are also some of the greatest generators of signaling traffic. Social networking applications, in which friends stay connected with each other for extended periods of time, inherently involve frequent back and forth messages or status updates. Instant messaging services, such as Yahoo IM and Skype, and other popular services, such as Facebook or various friend tracker applications, are just some of the examples – and if someone is “connected” it’s not uncommon for him or her to be logged into multiple social networking applications simultaneously.

Online networked gaming is also moving to mobile platforms. Most smartphones have a screen that is large enough and a processor that is powerful enough to run online games, the same games people are already playing in the internet. Mobile online gaming communities are getting bigger and bigger and they already lure millions of people on a daily basis. Zynga, for example, which provides networked games such as Farmville and Mafia Wars to Facebook, has attracted 21 million gamers so far, or a full 10% of the entire world internet

Smart Lab Test Result: Mobile Networked Gaming

We tested a popular online multiplayer poker game and measured the data and mobile network signaling traffic generated by playing the game for 30 minutes on both a laptop and a smartphone, in this case the iPhone version 4.1. We also measured baseline activity on the iPhone with weather and email applications running in the background, also for 30 minutes.

What we found was that both the smartphone and the laptop generated a reasonable amount of data traffic during game play. Assuming a fictional smartphone data rate plan of 10 GB for €60, the data generated for this half hour would cost less than one cent to the end user. The laptop uses twice as much data because game servers push more ads to the end user when they detect that a laptop is the end device.

The story is different when we look at the signaling traffic. The laptop generated 188 signaling messages during the half hour, while the smartphone generated more than 10 times that amount, at a staggering 1996 signals during the half hour. This is 66 signals per minute, or an average of one signal per second.

The implications of the test are clear. As interaction-heavy applications such as online gaming gain in popularity, operators with significant numbers of smartphone customers must prepare for further increases in their signaling traffic and dimension their networks accordingly.

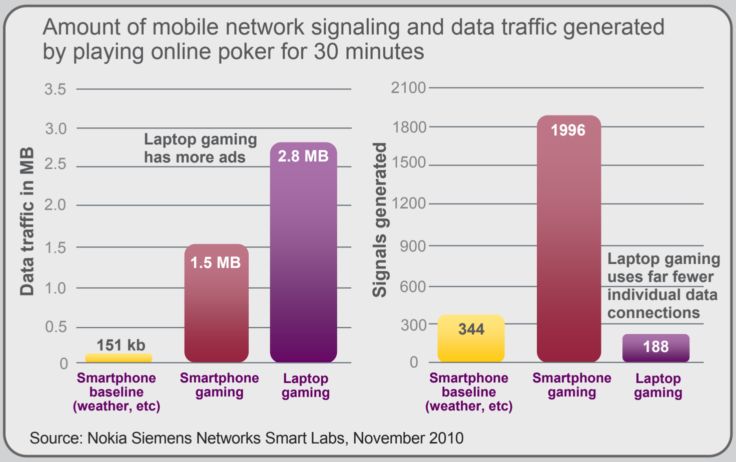


Figure 1: Smart Lab test results comparing data traffic and mobile network signaling generated by smartphones and laptops playing the same online game for half an hour

population. Even more startling, Zynga's servers deliver 1 Petabye of data per day, which is 25% higher than the current global mobile internet traffic total of 0.82 Petabytes per day. Most of this traffic is being delivered over fixed lines today, but it is a certainty that something this popular worldwide will move squarely into the mobile space once improved network speeds and latency provide a powerfully good gaming experience over mobile as well.

2.2 The smartphone challenge

At first, operators were pleased when they saw that smart devices were, on average, generating only about one-tenth the data traffic that laptops were. Even better, smartphone customers have been measured to generate a 20-60% increase of ARPU at operators in Western Europe, for example. The combination of higher returns and lower network use means that smartphone users are good mobile data customers, and operators have shown that they are willing to invest to attract and keep them. Globally, smartphones now account for 75% of handset subsidies.

But there is an additional result of smartphone popularity. Once smartphones started to be used heavily by many users in concentrated areas, customers in the U.S. and Europe started complaining that the quality of their voice and data services was no longer good. In some densely populated cities, the issues were particularly acute, and the end-user complaints particularly loud. Analysis of the network traffic showed that – surprise! – smartphones were the problem.

But smartphones don't generate anything like the amount of data that laptops do. So what was the problem? The answer lies in how smartphones and laptops behave differently in the network.

With an eye on the laptop user experience, since laptop users were initially presumed to be the most frequent users of high-speed mobile data, operators worldwide had initially optimised their wireless networks for browsing. One way that they did this was by keeping the data channel active as long as possible to give a smooth end-user experience. Making the initial connection to the network to send or receive data necessarily takes a bit of time, but if the data connection stays active, users do not have to endure repeated set-up delays each time their device reconnects. The only drawback to this approach is that prolonged time spent in the active data transmission mode consumes significant amounts of battery power. This isn't an issue for laptops, but for a smartphone, long times spent actively connected to the network meant that its battery can easily drain completely in a matter of hours.

When end users started complaining about poor battery life in early smartphones, handset manufacturers responded to their needs by introducing proprietary features to prolong battery life – but the same power-saving features ended up being a significant root cause of increased signaling load.

Signaling traffic consists of the small background messages exchanged between a handset and a network to set up or end a data connection. Laptops generate very little signaling traffic because they tend to connect to the network and stay connected. But smartphones, driven by popular applications such as social networking, email, online gaming, and news reports that require constant updates, are constantly making and breaking connections, all of which generates signaling traffic. And it's this signaling load that increased and started causing network problems when handset manufacturers began to take action to extend their battery life.

3. Fast Dormancy and its consequences

The proprietary software feature that smartphone manufacturers introduced to prolong battery life is called Fast Dormancy. In the 3GPP standard, it is the network which determines what level of activity, or state, the handset is in. With Fast Dormancy, handset manufacturers took advantage of a loophole in the standard to enable the handset to determine its own state. In the new smartphone behaviour that Fast Dormancy brings, the handset forces the network to release its data connection the moment it has downloaded a piece of data, then the handset disconnects from the network and returns to the Idle state. The benefit of Fast Dormancy is that smartphone battery life is improved once handsets are no longer held for long periods of time in the Active state. This benefit is immediately visible to end users, who understandably appreciate smartphone batteries that last longer. The drawback is that because the handset is now spending the shortest time possible in the Active state, if a smartphone wants to connect to the network again to send more data, it must initiate an entirely new connection from the Idle state. And this greatly increases signaling traffic, which wastes network resources and can ultimately mean that fewer smartphones are able to connect.

The chart to the right is an example from a European network. The chart shows the distribution of data traffic and signaling traffic among different devices. It shows that the vast majority of the signaling in the network is generated by smartphones, but that there are also big differences between smartphone types.

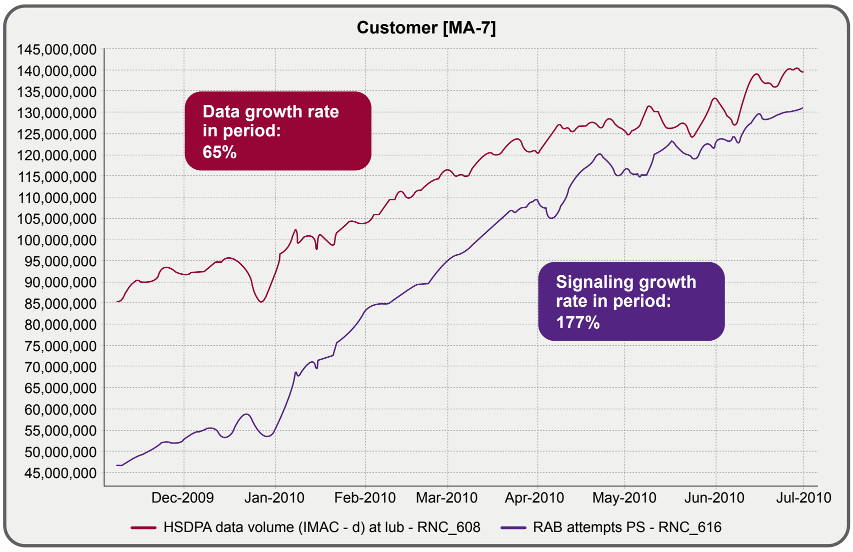


Figure 2: Data growth (orange line) and signaling growth (blue line) in a live network in Western Europe between December 2009 and July 2010. Cell_PCH is not active. During the period, the data volume grew 65% and the signaling volume grew 177%. The significantly higher signaling growth rate is due to the high number of handsets with Fast Dormancy active in the network.

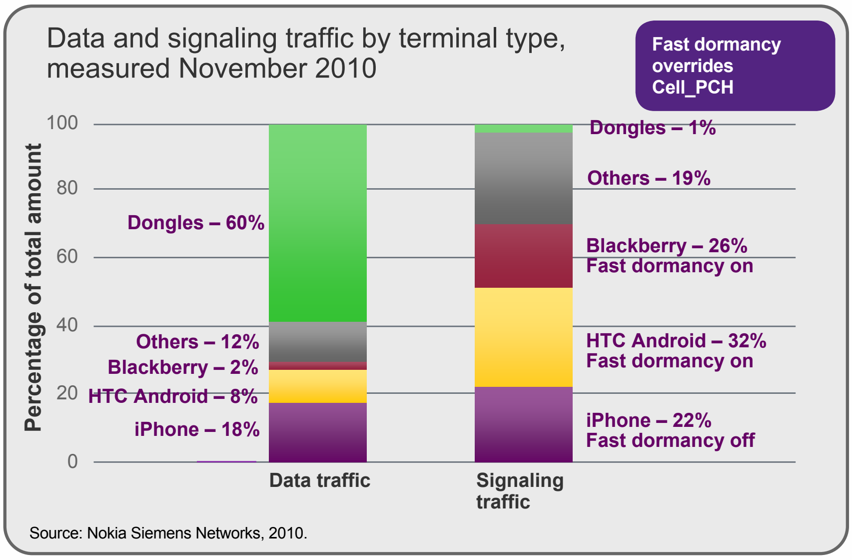


Figure 3: Data and signaling volumes measured in a live commercial network in Western Europe, November 2010. Note that while dongles consume 60% of the data traffic, they generate only 1% of the signaling traffic, since laptops tend to connect once to the network and stay connected. Smartphones, on the other hand, make up only 40% of the data traffic but generate 99% of the signaling traffic.

Smart Lab Test Result: The effects of Fast Dormancy

The Nokia Siemens Networks Smart Lab was asked by a major European operator to determine the effects of multitasking, or multiple simultaneously active applications, on signaling volumes. To do this, we compared signaling load per device in a multitasking scenario with five apps: browsing, a weather widget, email, Google maps, and Facebook. The Android device generated more than twice as much signaling as the other handsets, due to its own particular Fast Dormancy implementation.

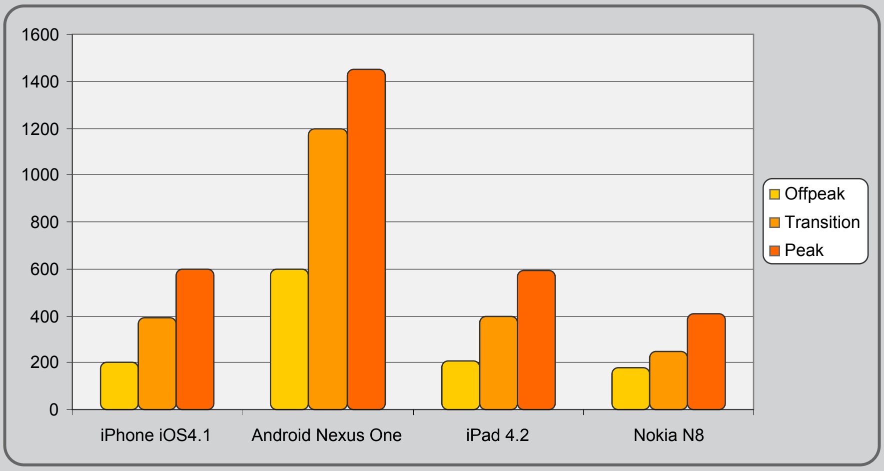
The Nokia Siemens Networks conclusion is that the larger signaling load caused by Android devices is not only due to multitasking (iPhone and Symbian devices support multitasking nowadays, too) but is due to the way fast dormancy has been implemented in Android devices.

Android devices are currently known to use a basic form of fast dormancy, which is not sensitive to whether the network is able to support Cell_PCH. Consequently, Android devices cause a higher signaling load than other devices on the network.

Apple's iPhone, on the other hand, began using a modified version of Fast Dormancy in their iOS4.1 software release in mid-2010 in which the handset is not forced back to Idle if the backlight is still on. This follows the logic that if the backlight is on, the user is actively looking at the phone and may request more data from the network in the next few seconds. Keeping the phone connected to the network in this case greatly reduces the signaling otherwise generated when handsets continually bounce from Idle to Active and back again to Idle. Apple's introduction of this Fast Dormancy backlight modification is one of the main reasons for its overall lower signaling load.

Nokia smartphones sold since June 2010 only activate Fast Dormancy when the network doesn't support Cell_PCH (see Section 4.1) or if network parameters are not optimized for device power consumption, so their phones also generate far fewer signals than Android models.

Signaling messages by terminal type



3.1 Nokia Siemens Networks and Cell_PCH

While handset manufacturers were dealing with the battery life challenges brought by smartphones, network operators were discovering that in their networks that had been optimized for laptops, smartphones were generating increasingly unmanageable signaling loads.

To solve this problem, Nokia Siemens Networks began recommending use of the paging channel, or Cell_PCH, in its networks. Part of the 3GPP standard but only widely used commercially by Nokia Siemens Networks, the use of Cell_PCH was originally designed to reduce data connection set-up time. When a handset is returned to the Idle state after making a data connection, the entire round trip from Idle to Active and back to Idle requires 30 signaling messages. But when a handset is maintained not in the Idle state, but in the Cell_PCH mode between active connections, it only requires 12 signaling messages for the round trip. The advantage? Much shorter connection times. Waiting for 30 signals to be sent means that establishing each new data connection can take up to two seconds. But waiting for 12 signals to be sent only requires half a second. The result is a clear gain in improved end-user experience through shorter wait periods when each new data connection is made. Nokia Siemens Networks began implementing Cell_PCH in commercial networks from the very beginning of the 3G era in order to deliver precisely this better user experience.

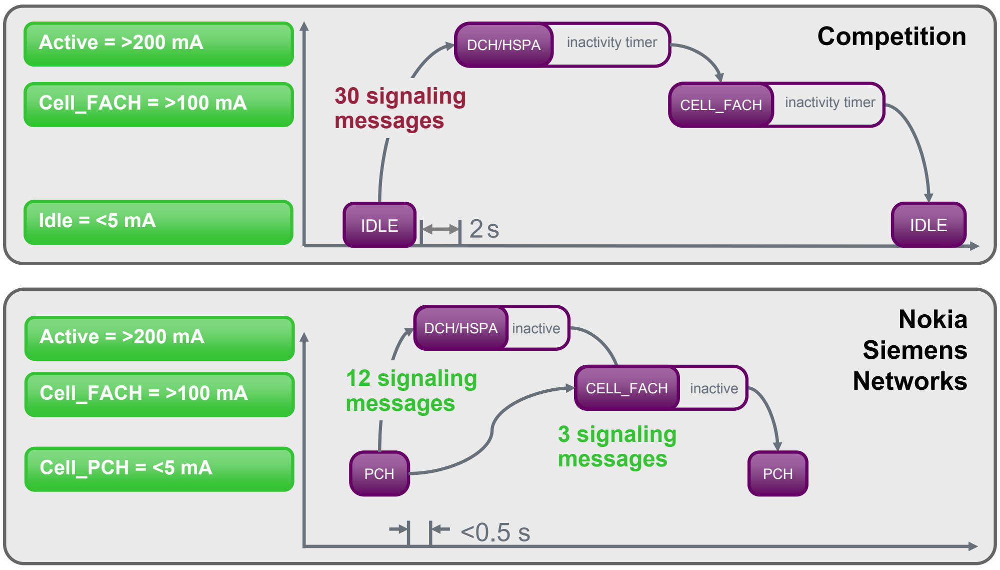


Figure 5: Nokia Siemens Networks generates fewer signals and requires less handset battery power than other network vendors.

A bonus in using Cell_PCH is that with shorter wait times for new connections, handsets can be kept in the Active state for much less time than in non-Cell_PCH networks. With a short wait time and few signals generated by each individual data connection, it is no longer necessary to hold the handset in Active for long periods just in case the user wants to request new data from the network – setting up a new data connection is no problem for either the user or the network. Because of this, Cell_PCH brings both shorter data connection setup times and longer battery life – nearly 50% longer in independent testing.

Now, with the advent of smartphones, Nokia Siemens Networks discovered that in Cell_PCH, we had also developed a method of reducing overall signaling traffic just as smartphones were increasing it. Independent tests in live networks have shown that Nokia Siemens Networks' implementations of Cell_PCH can reduce signaling from 30% to 50% and cut needed SGSN capacity nearly in half, which provides welcome relief to networks increasingly dominated by smartphones.

The problem was that this win-win-win solution for latency, battery life and signaling was incompatible with handset vendor-proprietary Fast Dormancy. Since Fast Dormancy software in the handset overrides the network and forces handsets back down to Idle between data connections, it also overrides Cell_PCH – handsets with Fast Dormancy always go to Idle, not Cell_PCH, and then need the full 30 signals and a long two seconds to reconnect to the network for the next data connection. This means that handsets with Fast Dormancy enabled – which includes all major smartphones in recent years – override Cell_PCH and create significantly more signaling traffic than network planners ever expected.

Operators with 100% Nokia Siemens Networks radio equipment who have enabled Cell_PCH and asked the major handset manufacturers to disable Fast Dormancy in their market, have been able to benefit from the increased battery life, decreased signaling, and shortened data connection wait times that Cell_PCH offers. But the reality is that most operators have multiple vendors for their network equipment, not just one.

3.2 Network Controlled Fast Dormancy

Up until now using Cell_PCH in multivendor networks has been a challenge, as no other network vendor employs this standard technique widely and successfully, despite all smartphones having built-in Cell_PCH capability.

A compromise was finally found when the 3GPP standards body developed a solution called Network Controlled Fast Dormancy, also known as Release 8 Fast Dormancy. With Network Controlled Fast Dormancy, smartphones can now act dynamically, exploiting Cell_PCH on Nokia Siemens Networks' smart networks or adjusting to Fast Dormancy on other vendors' traditional networks.

The result is that on the Cell_PCH-enabled part of the network, both battery life and signaling are optimized, and in the non-Cell_PCH part of the network, at least end users have the improved battery performance that proprietary Fast Dormancy brings – but still with the greatly increased signaling traffic that proprietary Fast Dormancy brings as well. The real benefit is that Network Controlled Fast Dormancy allows operators to fully benefit from Cell_PCH in the Nokia Siemens Networks portion of multivendor networks.

4. The smartphone industry addresses the issue

Unlike Cell_PCH, which builds on the paging channel that is already a feature of every commercial handset, Network Controlled Fast Dormancy requires support from both the network and the handset. This means that multiple players in the industry must work together in order to bring it fully to market.

4.1 Nokia

The very first industry player to bring a product to market that balanced the realities of Cell_PCH vs Fast Dormancy was Nokia. Beginning in the second quarter of 2010, Nokia began adding what they called Quick Release to all of their smartphones. With Quick Release, the handset senses the settings in the network and changes its behaviour to ensure that it is optimized no matter which equipment it is currently on. When in a Nokia Siemens Networks sector that has Cell_PCH enabled, the handset uses the Cell_PCH functionality and both operator and end user benefit from reduced signaling and increased battery life. When in other networks suppliers' sectors where Cell_PCH is not deployed, the handset changes its behavior and doesn't rely on the network to guide its battery-saving activities, but instead proactively shortens the length of time that it spends in the active state – in short, it mimics proprietary Fast Dormancy behaviour. This helps the phone measurably prolong its battery life on the non-Nokia Siemens Networks portion of the network as well, thus enabling multivendor operators to get the benefits of turning on Cell_PCH on one part of their network without sacrificing battery performance on the other. The result is improved battery life across the entire network and significant signaling reductions in the Nokia Siemens Networks portion.

4.2 Qualcomm

The next step beyond Nokia's Quick Release is the full implementation of standards-compliant Network Controlled Fast Dormancy. One of the early movers in this area has been Qualcomm, which has been developing the chipsets necessary for the handset to support the feature. In late 2010, Nokia Siemens Networks and Qualcomm together completed interoperability testing of Network Controlled Fast Dormancy on a standards-compliant handset and network pair. It was the industry's first public instance of collaboration supporting Network Controlled Fast Dormancy and demonstrated that it was possible to maximize smartphone battery life while simultaneously providing optimum performance for wireless network operators. Nokia Siemens Networks then brought the Network Controlled Fast Dormancy feature into our RU20 release of WCDMA, which launched in the second half of 2010 and is now running commercially in dozens of networks worldwide.

4.3 Apple

In November 2010, Apple launched the latest release of its iPhone software, iOS 4.2. With this software upgrade, the iPhone 4 became the first commercially available handset to use the standardized Network Controlled Fast Dormancy feature that Nokia Siemens Networks implemented in its radio networks at the end of September 2010.

Nokia Siemens Networks fully expects all smartphone manufacturers to include this feature in their handsets eventually, but the Apple version was the first one to be available publicly. And because Apple is able to roll out software quickly and efficiently to its existing handset base through their iTunes platform, the iPhone 4 models already out in the market will be enabled with Network Controlled Fast Dormancy quite quickly – the usual rate of updates for iPhones is for 70% of handsets in the market to be updated with new software releases within one month.

Together, Apple and Nokia made up 50% of global smartphone sales in Q3 of 2010. With Nokia's Quick Release (which is in effect a proprietary, handset-based version of Network Controlled Fast Dormancy) and Apple's Network Controlled Fast Dormancy support, half of all new smartphones entering the market from here forwards will be able to use Network Controlled Fast Dormancy from the start. It will not take long for a critical mass of Network Controlled Fast Dormancy handsets to fill the world's smartphone market, thus making it fully commercially viable for operators with networks provided by multiple vendors to enable Network Controlled Fast Dormancy in their networks and to begin seeing signaling reductions in their networks – as long as at least some of the network radio is provided by Nokia Siemens Networks.

Smart Lab Test Result: Apple's Fast Dormancy evolution

The Nokia Siemens Networks Smart Lab has evaluated the signaling performance of iPhones using three different flavours of Fast Dormancy: the "old", proprietary Fast Dormancy of iOS4.0, Fast Dormancy with the backlight modification of iOS4.1 in which Fast Dormancy is only activated if the backlight is off (see text box "The Effects of Fast Dormancy"), and iOS4.2, in which Network Controlled Fast Dormancy is active.

The result shows clearly that Apple's efforts to reduce the signaling messages created by its handsets have been successful. The use of Network Controlled Fast Dormancy in iOS4.2 on a Network Controlled Fast Dormancy-supporting network drops the amount of signaling generated by a baseline set of applications and activities by 55% from Apple's original proprietary Fast Dormancy.

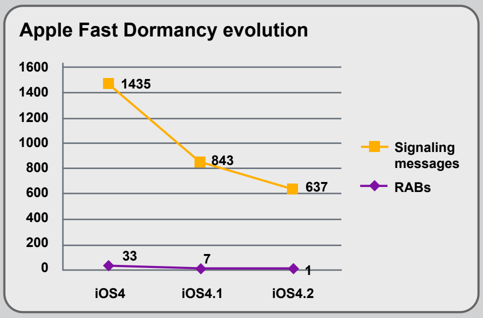


Figure 6: Signaling messages generated by different versions of iPhone software as measured in the Nokia Siemens Networks Smart Lab.

5. What's next in smartphone management – the Nokia Siemens Networks solution

Finding the right balance between battery life and network signaling is at the heart of the Nokia Siemens Networks smartphone-friendly network. With the Cell_PCH solution that we began to implement at the very start of the 3G era, Nokia Siemens Networks leads the telecommunications industry in its ability to provide support for smartphones that meets the needs of both operators (low signaling) and end users (longer battery lifetime).

But Cell_PCH is only one aspect of the Nokia Siemens Networks Smart Networks for Smartphones solution. For example, Nokia Siemens Networks also greatly increases its overall signaling capacity by using a pooled Radio Network Controller, or RNC. Other vendors divide their RNC capacity into subracks, and when one reaches full capacity, that reduces the signaling effectiveness of the entire network. But with one single pooled RNC, Nokia Siemens Networks is able to bring every bit of its available RNC capacity into play before encountering capacity issues. This enables us to support 4-10 times more smartphones at once in our networks than other vendors can.

Other features include Continuous Packet Connectivity and High-Speed Cell_FACH, which both extend handset battery life, the RNC 2600 with its quintupled signaling capacity, and direct Cell_PCH to Cell_DCH transitions for faster data connection setup times. Nokia Siemens Networks also recognizes that there are many markets in which the bulk of smartphone traffic is carried on GSM, not WCDMA, and provides key smartphone optimization solutions and services for GSM as well.

Overall, Nokia Siemens Networks' focus on reducing signaling translates directly into savings in network hardware, both in Radio Network Controller and Packet Core CAPEX, while the focus on improving battery lifetime brings tangible benefits to end users as well.

Looking into the future, Nokia Siemens Networks is also actively working to ensure optimized smartphone behaviour in LTE networks from their very earliest implementations.

6. Nokia Siemens Networks Smart Labs

To truly meet the expectations of people who demand always-on connectivity, the key components of the mobile Internet ecosystem – applications, devices, and networks – must work together smoothly. This can only be achieved when all ecosystem stakeholders work together toward the same goal. To do this, Nokia Siemens Networks established Smart Labs in early 2010 to ensure that applications, devices and networks are designed to interwork seamlessly from the beginning of production, launch or deployment.

The Smart Labs focus on the key factors that have the most impact on the smartphone experience, and drive alignment across those elements in cooperation with the industry's leading service providers, device manufacturers, application developers, and systems integrators. There are labs in Espoo, Finland, Dallas, Texas, and Seoul, Korea, in addition to other facilities dedicated specifically to the needs of single operators.

In the Nokia Siemens Networks Smart Labs, smartphone applications are run over different devices, operating systems and mobile browsers on the latest implementations of our GSM, HSPA, HSPA+ and LTE radio technologies. This is done in collaboration with leading application and device vendors, and with the participation of mobile operators to provide the connection to real life needs. The results of our Smart Labs activity are used by Nokia Siemens Networks Consulting, which helps operators improve their understanding of the particular requirements that commercial and emerging applications are placing on their network evolution and day-to-day operations. We also share test results directly with interested operators.

Nokia Siemens Networks is leading the industry in its discovery of new smartphone-oriented modes of operation, not only technically, but also with developments such as the Smart Labs. By testing new smartphone handset software versions and applications before release, Nokia Siemens Networks can get ahead of the curve and advise operators on how to prepare for new smartphone challenges before they arise. The Smart Lab test results highlighted throughout this paper provide an indication of the kinds of insights that we generate and share.

The Nokia Siemens Networks Smart Labs have been actively engaging operators, device manufacturers, and application developers, both publicly and under NDA. Examples of activities conducted with different partner groups include:

- Application and device tests in the Smart Lab according to partner need
- Investigation of application behaviors and effects on user experience, battery life, and network load
- Joint projects to optimize network and application behavior
- Testing different parameter settings to find the optimal settings for best user experience and network load
- Optimization of application behavior under a variety of network conditions
- Smart Lab test findings overview workshops

Even though the Nokia Siemens Smart Labs are a relatively new aspect of our creation of the most smartphone-friendly networks in the industry, they have already shown substantial benefits to those who have collaborated with us there.

For application developers and device vendors, these benefits include:

- The opportunity to test and develop applications over next-generation mobile networks
- A faster development cycle and better early optimization, including verification of performance and network impact before launch
- New possibilities for collaboration with major operators
- Identification of improved software development practices that provide network and end user optimization as well as good application performance

For network operators, collaboration with Nokia Siemens Networks in the Smart Labs brings:

- Access to test results and insights
- Deeper understanding of how to design, optimize and operate networks for mainstream internet applications
- Improved abiltity to optimize applications and services in different network conditions, including variation across fair usage policies, during network congestion, and with varying signal strengths

One of the key benefits of the Smart Labs is our "just over the horizon" focus, in which we look not only at the popular applications of today, but also at what's coming next. In this way, we and our partners stay informed and prepared, whatever the next killer app or device is.

Smart Lab Test Result: Signaling and Firewall TCP timeout settings

Several operators have reported to us that they have seen an increase in signaling traffic when the TCP connection timeout period has been reduced in their firewalls between the network and the open internet. They asked us to look into this.

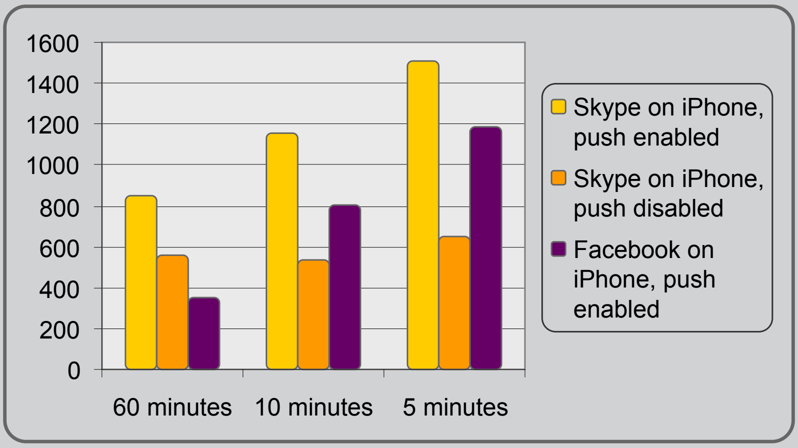
The results clearly show that signaling does increase when TCP connection timeout settings are shortened. On average, we found that a setting of five minutes generated 74% more signaling traffic overall than a setting of 60 minutes.

What is happening is that when the firewall timeout is set to a short duration, it's actually shorter than the duration of the keep-alive messages sent by some of the handset applications. So if, say, Skype sends a keep-alive message every 15 minutes, but the firewall times out and breaks the internet connection after only 10 minutes, the next keep-alive message will fail because the connection to the internet is gone. So Skype will keep sending more keep-alive messages until the firewall reestablishes the connection. Then, after another 10 minutes of inactivity, the firewall terminates the connection, and the cycle starts all over again. This greatly magnifies the network effort needed to support keep-alive messages.

We at Nokia Siemens Networks have found that in the real world, some operators have TCP timeout settings that are as short as two minutes. This helps reduce the needed database capacity of the firewall, saving some thousands of dollars, but pumps up the signal volume in the network, potentially causing much greater spends to deal with RNC capacity issues. This illustrates the importance of understanding smartphones and their effects not just in the radio network, but right across the enterprise, so that operators can balance, in this example, firewall optimization on the one hand with network optimization on the other.

Nokia Siemens Networks recommends a firewall TCP connection timeout setting of 35 minutes or more.

Amount of signaling in one hour



Firewall TCP connection timeout settings

7. Recommendations for the mobile industry

Nokia Siemens Networks recognizes that our findings in the Smart Labs are only valuable when they're shared with the rest of the industry. To this end, we conclude with recommendations for operators, application developers and device manufacturers about how each can work to best share the scarce resources of mobile networks in a fair way, so that all participants benefit – the end user most of all.

7.1 Application Developers and Device Manufacturers

Application developers and device manufacturers naturally focus on creating the best end-user experience possible. While this is the ultimate goal of all members of the mobile ecosystem, it's important for a balance to be found so that excellence in application design does not come at a cost of excess battery drainage or massive signaling increase.

Power management is probably the most critical issue here, since it affects end user delight so directly and, poorly managed, can have tremendous knock-on effects on the network. There is no simple, straightforward solution to the power consumption issue, so it must be considered on all fronts and addressed with many small actions.

Ways that application developers and device manufacturers can help to find this optimal balance among end user performance, battery lifetime, and signaling volumes include:

- Optimizing data transmission for size and minimizing the size of keep-alive messages in order to utilize Cell_FACH/RACH
- Optimizing usage of presence updates and status update messages
- Taking advantage of cacheing and reducing optionally downloadable data items such as images or attachments
- Avoiding protocols that require polling
- Closing data connections when no longer needed
- Opting for TCP over UDP since TCP requires fewer keep-alive messages – this is especially important for always-on applications such as push email
- Choosing periodic bursty data transfers rather than a constant “drop-by-drop” transfer
- Utilizing network access optimisation APIs (such as the notification API) in order to synchronize/group transactions with the network
- Using message buffering/ aggregation between different applications as much as possible
- Reducing network interaction when the application is not in active use

We encourage application developers who want to know more about how to optimize their applications for commercial networks to contact us.

7.2 Operators

Both in the Smart Labs and in the nearly 200 commercial Nokia Siemens WCDMA networks currently running globally, we have had the opportunity to observe and conclude what network settings best help smartphones and applications run smoothly and behave well. While networks are necessarily complex entities whose optimization is best handled on a one-on-one, consultative basis, we have found that taking these actions can bring an improvement in signaling efficiency and performance to just about any network:

- Activatíng Cell_PCH for the whole network
- Activating Network Controlled Fast Dormancy (also known as 3GPP Release 8 Fast Dormancy)
- Setting T1+T2 to be less than five seconds in order to reduce smartphone power consumption
- Optimizing other RNC parameters to suit the network-specific traffic profile (Nokia Siemens Networks can help)
- Utilizing Cell_FACH for the most efficient handling of very small “keep-alive” messages
- Ensuring that the inactivity timer in the firewall that faces the public internet is set to be at least 35 minutes to prevent the excessive signaling that comes from retries when the internet connection is prematurely terminated
- Upgrading to the most recent and powerful RNC hardware and software for maximum network signaling capacity without the cost or complications of adding new RNCs
- Upgrading to the Nokia Siemens Networks multicontroller RNC for software-definable capacity allocation per traffic profile to flexibly allocate signaling and control plane capacity as signaling grows in your network
- i-HSPA for hot areas where RNCs from any vendor are reaching capacity, to offload the signaling traffic in capacity crunch spots and eliminate the need for adding new RNCs

Please contact us if you would like to learn more about our Smart Lab findings or how we may be able to collaborate with you to improve smartphone performance on your network.

8. Conclusion

With the great popularity of smartphones comes great responsibility for the industry to support them well. Today, four times more people use mobile broadband on smartphones than on laptops, so the smartphone segment is actually the main user group of the advanced data products that we as an industry provide. It's important to get it right.

At Nokia Siemens Networks, we've designed our networks to deliver the best smartphone performance possible during the entire time that mobile high-speed data has been available. We build on our deep knowledge of how networks and smartphones best work together to reach out to the rest of the industry as a partner and collaborator, for it is only in working together on the issues posed by smartphones that we'll all be able to deliver the end results that our customers want.

If you would like to know more about how you or your company can work with us in our Smart Labs to address a particular smartphone issue or to increase your overall understanding of the ecosystem, please go to **www.nokiasiemensnetworks.com/smartlabs**. We look forward to hearing from you.

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