Today's Mobile Devices: Network Behaviors and Insights

Alcatel·Lucent

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Introduction

Mobile Devices Impacts on the Network

By Peter Bernstein, Senior Editor, TMCnet

Recently Next Generation Communications Community readers a received a copy of the Alcatel-Lucent Motive business unit's *The Mobile Device Report* on the impacts mobile devices are having on today's networks.

The report is now available for download along with a link to a recent webinar that Alcatel-Lucent conducted that delved into it. This ebook describes a few of the more interesting findings.

Just as a quick refresh, this is all based on information gathered from the Motive Wireless Network Guardian (WNG). It represents data, from over 54 million subscribers, that is aggregated from live 3G and LTE customer networks from around the world and represents total daily data usage of over 4 petabytes. The report provides an aggregated view of each device category's overall network impact, in terms of data usage, signaling activity and subscriber share.

It then provides granularity on each device's individual data usage and signaling activity, which is also defined as the device's network cost. It concludes with information and insights on the influence of LTE on mobile devices, and an analysis of the top smartphones' signaling activity.

This ebook, written by Patrick McCabe, Senior Product Marketing Manager at Alcatel-Lucent, presents report findings about the high level mobile device distribution and the percentage share of data usage and signaling activity by device category. Research showed the dominance of Android and iOS devices in regards to both data usage and signaling. And charts in fact highlight the still nascent impact of M2M on the network as well as mobile Wi-Fi.

Chapter 1 presents all of the devices of the study in terms of their collective network impact to the mobile network. Not surprisingly Android-based smartphones and iphones dominate the world market. For those in the signaling business, it is a nice illustration of how the explosion of data usage by devices that everyone likes to talk about is creating a signaling storm of significant proportions which is why next generation signaling is such a priority.

Chapter 2 goes on to describe which devices are more efficient users of radio spectrum:

> "Androids and iPhones are relatively efficient with scores of 7 and 5, respectively. These scores also indicate that the iPhone is a more radio-efficient device, using over 50% less signaling than Androids for the same amount of data usage.
>
> The inverse of this score, a device's radio efficiency, is measured by the relative amount of data delivered per unit of signaling. Radio inefficiency and efficiency scores are a quick way to

> understand what the network impact will be relative to signaling activity when rolling out specific mobile devices in new markets."

Chapter 3 compares the overall network impact that devices have on LTE networks by comparing it with their impact on 3G networks based on three dimensions: overall device popularity as measured by percentage share of total subscriber population, percentage share of total network data usage, and percentage share of total network signaling activity.

Chapter 4 details the top applications on smartphones that contribute the most to signaling activities with a look at both Android and iOS apps.

Chapter 5 provides specificity on the increase in signaling from Google Cloud Messaging as indicative of how even what might seem as innocuous capabilities can dramatically increase signaling traffic.

Realities are, the Motive's WNG's unique network-based view of data usage and signaling underscore, which devices and apps have what types of impacts on the network can be a valuable planning tool for mobile network operators. It should also be added that this is the type of information that, when shared with consumers, can help them manage how they use their smart devices more efficiently and effectively.

Once you've explored the chapters in this ebook, be sure to download the full report for a deeper dive into these subjects.

Chapter 1

Analyzing the Mobile Devices Connected to Today's Network

We know from our own experience and from anecdotal evidence that mobile devices are proliferating and that mobile data usage is growing rapidly. This tremendous change necessitates change to the underlying network, too. But in order to make the best choices in terms of infrastructure investment, mobile service providers must have accurate data showing what devices are being used and which consume the most data and signaling resources.

Alcatel-Lucent recently compiled the result of actual data collected by its Motive® Wireless Network Guardian. The data, from over 30 million subscribers, is aggregated from live 3G customer networks across most regions of the world, and represents total daily data usage of over 1 petabyte.

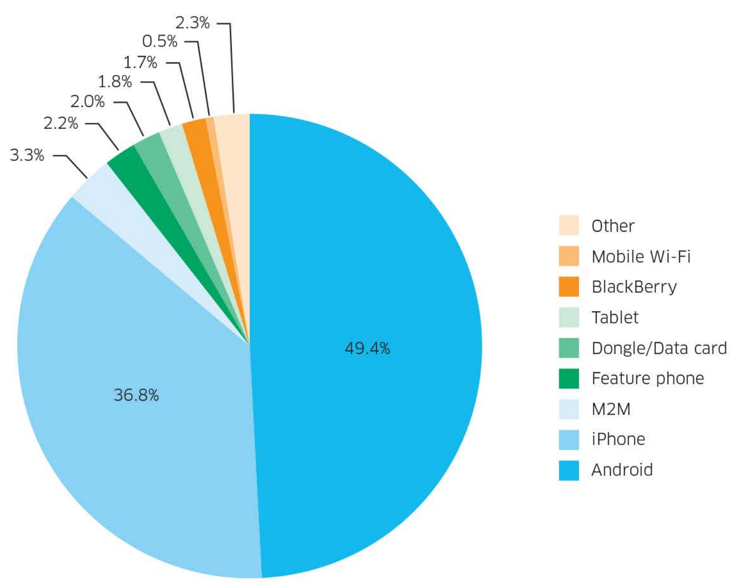

Figure 1. Mobile device distribution

Figure 1 shows that Android and iPhone devices make up more than 86% of the total connected devices in the global composite network that was analyzed – a testament to how pervasive smartphones have become. This is consistent with the findings from other industry reports. This may be a harbinger of things to come with respect to consumers' voracious appetite for more and more features, capabilities and personalized experiences.

To accurately measure the overall impact on the network, it is important to consider just how much data is being used and overall signaling activity. Data usage drives the service provider's bandwidth-related capital expenditures and the consumer's data usage fees.

Signaling activity measures the amount of network-to-device bi-directional exchanges needed to manage a radio connection to a mobile device. Signaling uses spectral, hardware, and processing resources in the service provider's network and is a significant cause of battery depletion on a mobile device.

Figure 2 shows the percentage share of both data usage and signaling activity for each device category in the network.

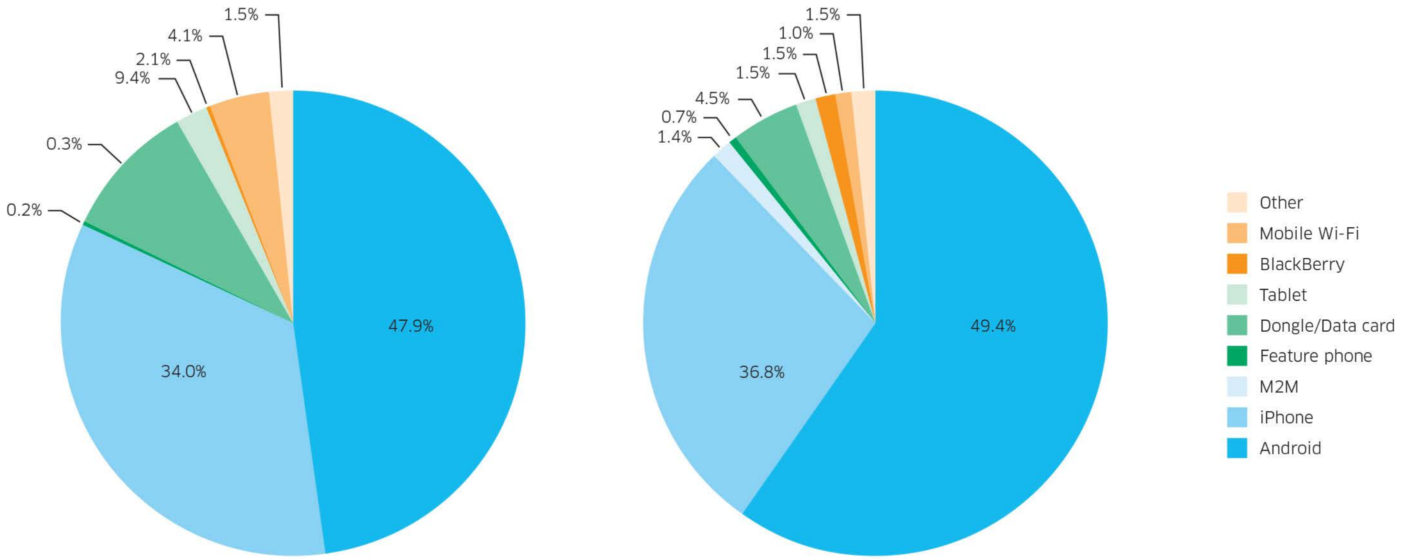

Figure 2. Percentage share of data usage (left) and signaling activity (right)

Androids consume almost 50% of the total network data usage and, combined with the iPhone category, they account for more than 80% of the total network data usage. When looking at signaling activity, Androids and iPhones also dominate with Androids representing an incredible 59.7% share of signaling activity. Combined with the iPhone category, they account for almost 90% of the total signaling activity.

It is also clear that Androids have a larger impact on the network than iPhones do as its share of signaling and data usage are 59.7% and 47.9%, respectively, when compared to 28% and 34%, respectively for iPhones. This difference represents a 31.7% higher share of signaling and a 13.9% higher share of data usage for the Android category over the iPhone category. This is due in large part to the fact that worldwide Androids are more popular than iPhones, but also because, individually and on average, Androids signal more than iPhones.

Despite only a 2% subscriber share, the Dongle/Datacard category shows a 9.4% share of data usage. This may be explained by understanding that these devices are typically attached to a PC or laptop which has a larger screen and is not as prone to mobility as are smartphones. As such, these devices may be consuming a proportionally larger amount of data usage than other categories by streaming video, downloading various videos, playing online video games, downloading/uploading high-res pictures, etc.

The Mobile Wi-Fi category shows a similar trend. With only 0.5% of the subscriber share, this category still manages to consume 4.1% share of data usage. This represents the largest data usage-to-subscriber share ratio across all device categories due to each Mobile Wi-Fi device having many mobile Wi-Fi devices aggregated behind it, collectively generating a large amount of data for a relatively small percentage of subscriber share.

The Machine to Machine (M2M) category represents non-personal devices that fall under commercial use for monitoring and control purposes. M2M devices signal much more actively when compared to their data usage. In this global composite network, M2M consumes 0.2% share of data usage while generating 1.4% share of signaling activity.

Although tiny in terms of overall popularity, the M2M category represents the largest ratio between signaling and data usage, which means these devices are signaling a lot more than they are sending data. Some M2M applications, such as a home smartmeter, frequently establish mobile connections generating multiple signaling messages to establish network connectivity, yet have small amounts of data to send each time.

The growth rate of mobile data is staggering and continues to increase at an incredible rate as mobile devices have evolved from being tools for personal communication into being high performing, multi-media platforms. Live-streaming high-definition (HD) video, surfing the web, engaging in social media, on-line gaming and secure banking are just a few of the types of applications used daily on an ever-growing number of connected devices worldwide.

Given that the total number of active wireless connected devices is expected to grow from 13 billion in 2013 to more than 40.9 billion in 2020, it's critical that mobile service providers, as well as mobile device manufacturers, understand their impact on the mobile network. Which devices consume the most signaling resources? Which use the most data? Answers to questions such as these are essential if service providers are to plan and grow their network efficiently, and for device manufacturers to enhance their designs.

In the next chapters, we'll take a closer look at the role device behavior plays in the network.

Chapter 2

Mobile Devices: They All Have Their Own Individual Personalities

Spend any time on social media and you will invariably eventually be exposed to some sort of personality test. What sandwich are you? What part of the country should you move to? Which *Star Wars* character are you? While those tests are fun, you probably could get through your day not knowing that your sandwich personality is peanut butter and jelly or that you should pack everything up and move to Saskatchewan dressed like Chewbacca.

At Alcatel-Lucent we recently conducted a personality test of sorts and, unlike those online multiple choice exercises, the personalities we determined actually do have impact on virtually everyone's day-to-day life. What's more, the subjects of our research may surprise you: connected mobile devices.

That's right...the smartphone in your pocket, the tablet in your hand, the laptop in your briefcase and the computer chip in your car...believe it or not, they all have their own unique personalities, especially when it comes to specific behavior on the mobile network. Understanding these personalities are important, as they may influence how you use your existing mobile device and may even impact the choice you make when purchasing your next one.

In Chapter 1, I talked about some of the findings from Alcatel-Lucent's Mobile Device Report that showed how the popularity of a device can impact the mobile network. Specifically, I discussed the overall impact that each major mobile device category has on the network in terms of percent share of data usage and signaling – both of which drive the capacity needs of operator networks. Although providing great insight into the mobile devices as an aggregated category, these results do not say anything about mobile devices individually. In this second chapter, I'll explore the individual network costs of different devices. These costs are important as they have a direct impact on the user's data usage and signaling activity which can influence their telecom bill as well as the battery life of the device.

Device network costs

So let's take a closer look at the cost impact of individual devices across a mobile network. Specifically, this can be measured across two critical dimensions:

Average daily data usage cost - represents the actual amount of data packets delivered downstream and upstream to/ and from the mobile device as identified by Motive WNG.

Average daily signaling activity cost - measures the network-to-device bidirectional exchanges that occur to set up a radio connection to a mobile device for data use.

Some key observations from our research in this area include (Figure 1):

- Android-based smartphones use about 56% more signaling than iPhones. However, Androids and iPhones use about the same amount of data.
- The dongle and datacard (commonly used when accessing the network from a laptop) and mobile Wi-Fi categories have the highest data usage and signaling activity by far. In fact, the amount of per-device signaling activity exhibited by the dongle and datacard category is well over two times and three times the amounts for Android and iPhone devices, respectively.
- Machine-to-Machine (M2M, BlackBerrys, and feature phones exhibit very little data usage with respect to their signaling activity. This is likely due to the fact that — unlike smartphones — these devices are not used as data-intensive multimedia platforms.

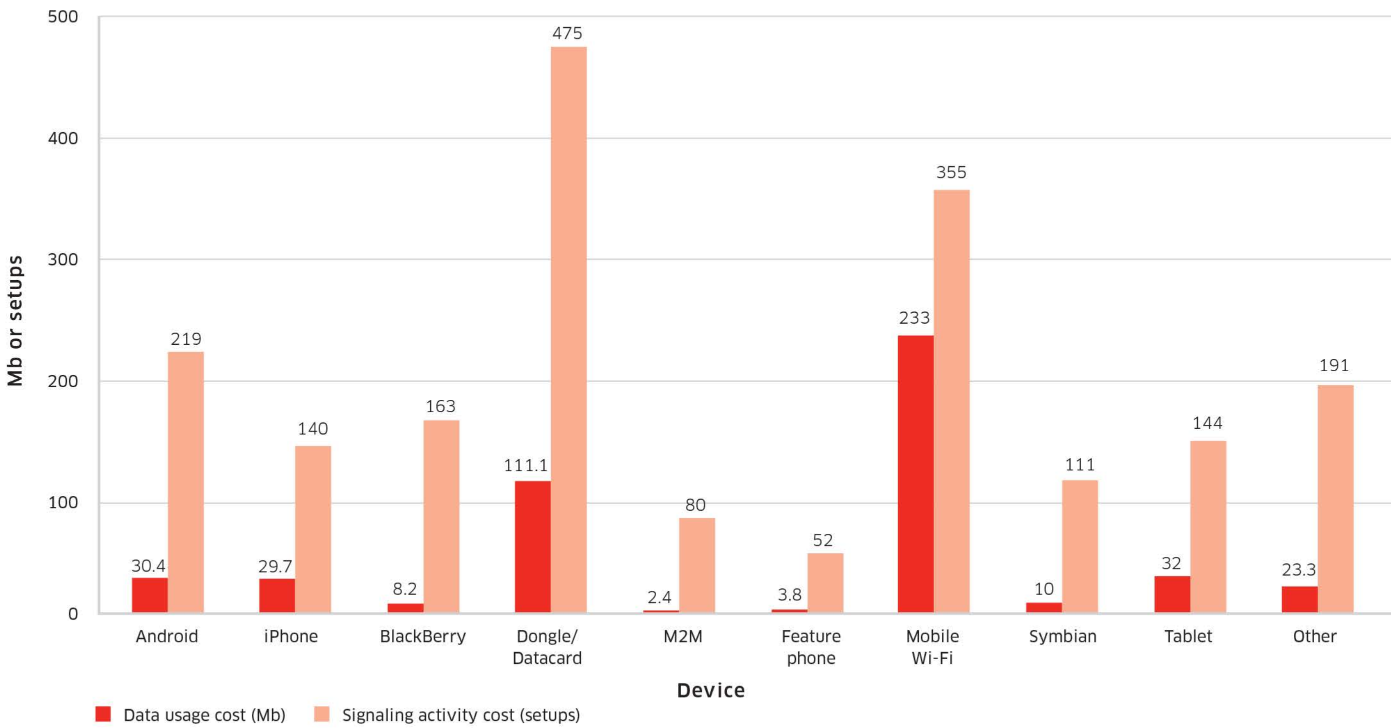

Figure 1. Device network costs

Network inefficiency scores

The network costs we just observed can be used to establish radio inefficiency scores for each device. This is calculated for each device category by taking the amount of daily signaling activity and dividing it by the amount of daily data usage. This score measures the amount of signaling per unit of data usage and demonstrates how “chatty” certain devices are on the network.

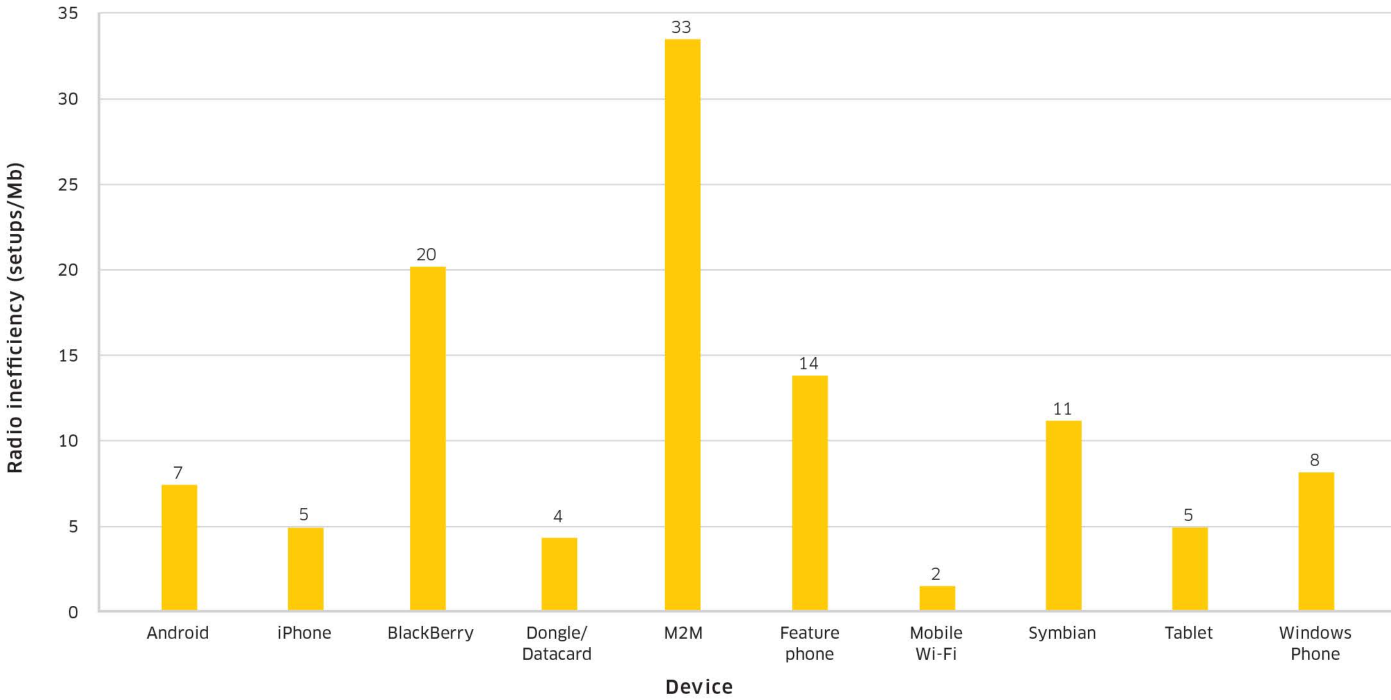

Figure 2. Device network inefficiency

Figure 2 shows these inefficiency scores across each device category and illustrates some key findings on how different devices handle efficiency.

The M2M category is by far the most radio inefficient or chatty device. This may be explained by the nature of certain M2M services. In some cases, these services establish connections while having relatively little data to transmit. For example, a home monitoring appliance may send an update many times per day to a centralized server, transmitting small bits of information on home temperature, natural gas use, etc.

BlackBerrys and feature phones are also relatively inefficient. This reflects the fact that these phones are not used as data intensive platforms like iPhones and Androids.

iPhones and Androids are relatively efficient devices. However, iPhones with a score of 5 are more radio-efficient than Androids with a score of 7. This is really due to the fact that iPhones use about 50% less signaling for the same amount of data.

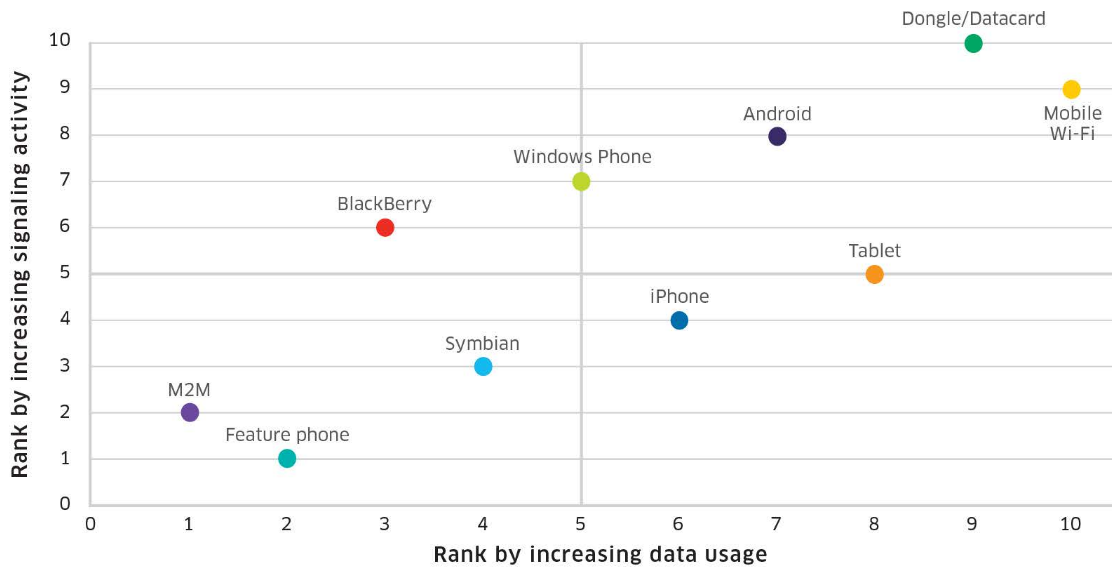

Figure 3. Network device scores – ranking and plot

Pulling everything together, we were able to rank and plot each device by category using the following observations:

- Mobile Wi-Fi and the dongle and datacard categories are most costly, followed by Android, tablets and Windows Phones.
- The iPhone category is ranked sixth, in the bottom half of network cost scores.
- M2M and feature phones exhibit the smallest cost.

The graph plots data usage and signaling activity cost scores. This view offers more visual understanding of a device's network cost across both dimensions of cost. This graph further demonstrates the enormous cost of the dongle and datacard and Mobile Wi-Fi categories.

Data usage cost for dongles and datacards is high because these devices are naturally data intensive due to larger screens that promote video use. In terms of having an extremely high signaling activity cost, this can be attributed to the "road warrior" effect of users (especially in North America) who regularly use their laptops on the go to do business. In addition, the applications used are very signaling-intensive -- like chatty mobile VPNs that typically send a constant "keep alive" signaling heartbeat, VoIP, and messaging applications like Google Talk, as well as lots of web surfing that generate significant signaling traffic.

Mobile Wi-Fi devices will naturally consume a large amount of data and generate a lot of signaling activity as each of these devices aggregate many Wi-Fi devices behind it.

Why is this information important?

A detailed understanding of the behavior of mobile devices can benefit users and service providers alike. Consumers can use device cost and efficiency information to adjust usage behavior, as well as decisions on device and applications to get the most from their personal investment.

Service providers can use insights like these to predict the impact of device growth while optimally planning network growth and the promotion of new devices. To fully harness the possibilities offered by the report and described in this ebook, service providers need to conduct their own studies using data derived from their own networks. Service providers can gain more powerful insights about their networks with the Motive Wireless Network Guardian.

Chapter 3

LTE Unleashes the Potential of Mobile Devices

Is LTE just another faster, more efficient mobile architecture or is it more than that? Does LTE fundamentally change the way mobile services are consumed?

In this chapter I will share results that indicate a massive increase in data usage and signaling activity for mobile devices operating on LTE networks. In fact, our results show that on average mobile devices use almost four times more data when on LTE networks compared with 3G.

The analysis from previous chapters were based on 3G networks. In this chapter these results are used as a baseline to compare with our analysis on LTE networks. The LTE analysis in this chapter uses actual data from more than 24 million subscribers, generating over 3 petabytes of mobile data daily on live LTE networks across North America, the Middle East and Asia. All results are aggregated and anonymized and are not representative of any specific network.

LTE to 3G device network impact comparison

Let's first consider the overall network impact that devices have on LTE networks by comparing it with their impact on 3G networks. Network impact is defined in three dimensions: overall device popularity as measured by percentage share of total subscriber population, percentage share of total network data usage, and percentage share of total network signaling activity.

One simple way to make this comparison is to calculate the ratio of percentage shares of LTE to 3G across each of these three dimensions. Any value above 1 represents an increase in network impact, while any value below 1 represents a decrease in network impact. Figure 1 plots these ratios for each dimension across each mobile device category we considered.

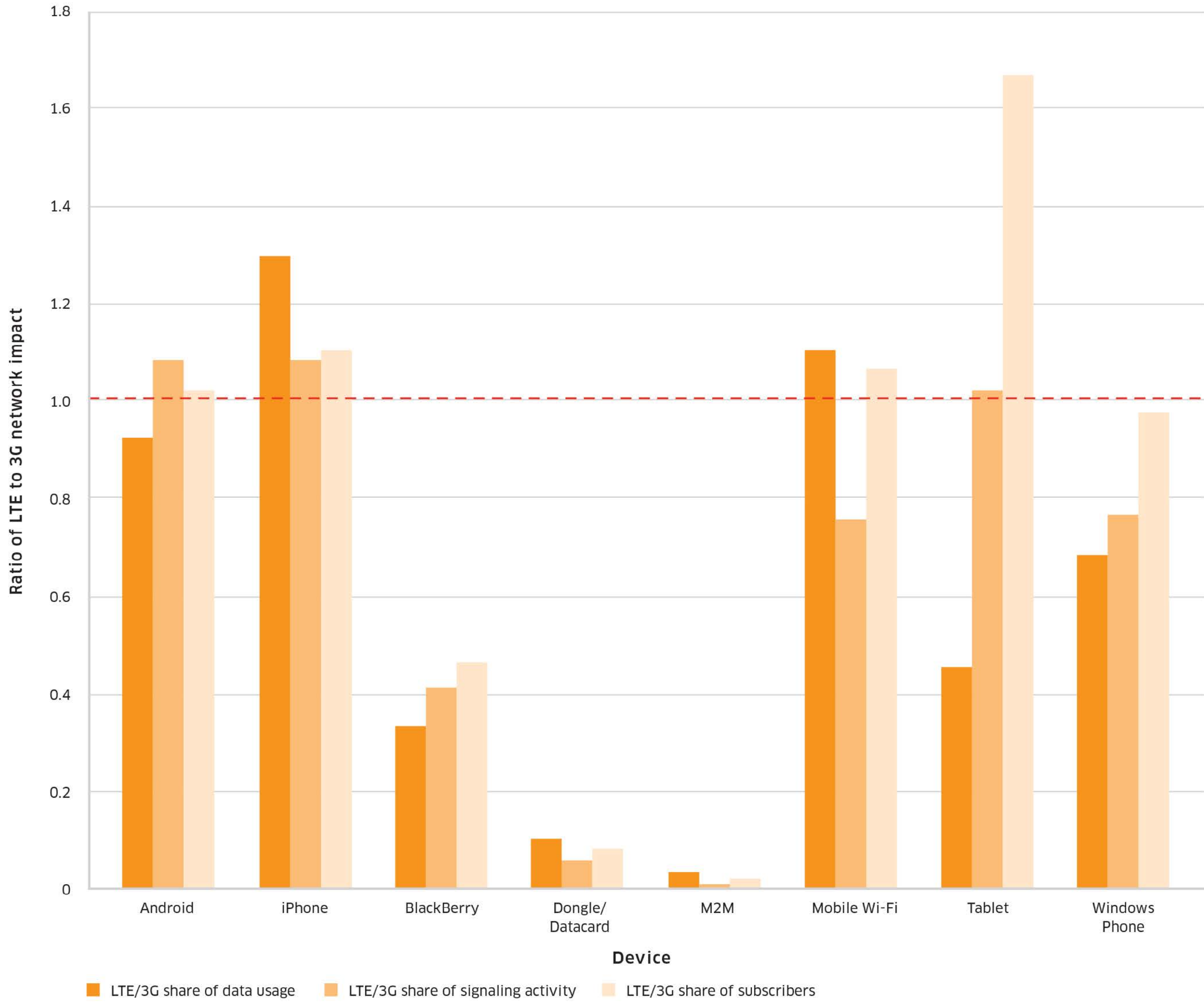

Figure 1. Network impact comparison – percentage share ratios of 3G to LTE

When looking at the Android and iPhone categories from Figure 1:

- Android's share of data usage decreased by almost 4% in LTE resulting in a ratio of 0.92 but its share of signaling activity increased by almost 5% resulting in a ratio of 1.07.
- iPhones gained a significant 11% share of data usage resulting in a ratio of 1.29 , and also gained over 2% share of signaling activity resulting in a ratio of 1.07.
- Androids and iPhones both are a little more popular in LTE as they gained 1% and 4% of subscriber share, resulting in ratios of 1.02 and 1.09, respectively.

When looking at the other device categories from Figure 1:

- Blackberrys, dongle/datacards, and machine-to-machine (M2M) device categories have all significantly decreased in network impact on LTE networks resulting in subscriber share values of 0.80%, 0.07%, and 0.15%, with ratios of 0.46, 0.08, and 0.02, respectively

- The dongle/datacard category saw its share of data usage decrease below 1% and its share of signaling drop below 0.5%. This decrease can be explained by the sizable drop in its share of subscribers. This drop probably results from a slower transition to LTE, and the fact that many of these devices are provided by users' employers who have a mandate to maximize the life of the device even when new technology is available.
- The reduced popularity of M2M devices in LTE is easy to explain, since it is about economics and coverage. M2M applications and services usually don't need a lot of bandwidth and performance, but they certainly need coverage. Economically, 3G networks are best suited for both cost and coverage for these types of services.

It is not surprising that there are no major shifts in network impact for the top smartphone brands as indicated in Figure 1, as we would expect these brands to continue to dominate in LTE. In addition, Blackberry and dongles/datacards have had limited LTE market penetration and there is no need for most M2M applications to leverage the performance benefits of LTE access.

LTE to 3G device network cost comparison

The analysis on network impact does not really tell the true story behind how LTE changes the way mobile devices are used. To really understand this we have to take a look at each device individually and the device's network cost is a perfect metric for this. The device's network cost measures the individual impact that a device has on the network in the absence of device popularity. This cost is measured across two dimensions, the average daily data usage and the average daily signaling activity.

Let's show these costs by comparing the costs in LTE networks with those in 3G networks. As we did in Figure 1, we will make this comparison by calculating the ratio of these costs in LTE networks to 3G networks across each of these two dimensions as shown in Figure 2. Any value above 1 represents a cost increase, while any value below 1 represents a cost decrease.

I found the results quite significant:

- We see a massive increase on the global composite LTE network for both data usage cost and signaling activity cost across almost all categories.
- An average Android-based device will use 3.5 times more data and generate 2.3 times more signaling activity.
- An average iPhone will use 4.5 times more data and generate 2.1 times more signaling.
- In general, all categories, except tablets, use more data, with increases ranging from 2.7 times to 5.8 times more on LTE networks.
- All categories except M2M use more signaling, with increases ranging from 1.3 times to 2.3 times more.

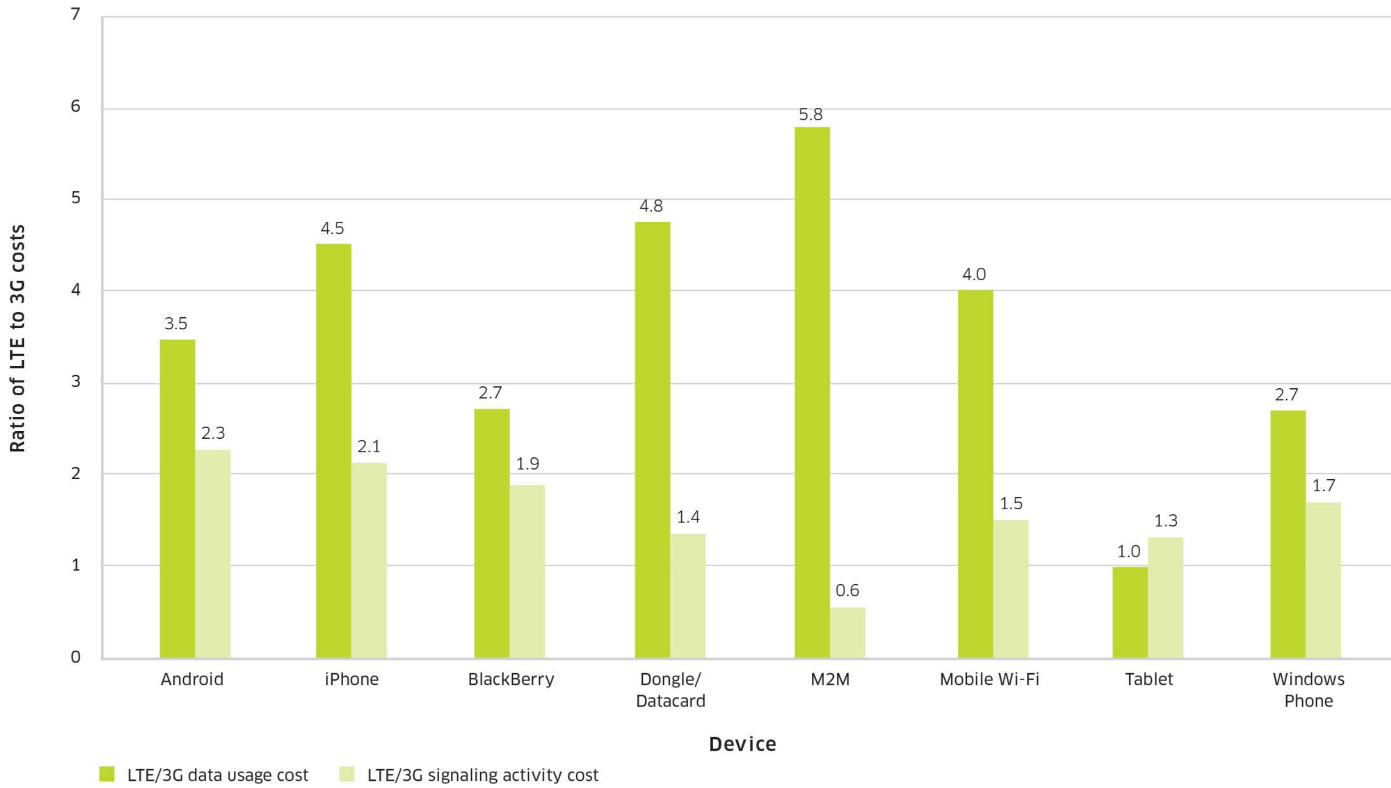

Figure 2. LTE to 3G device network cost comparison

Why this huge increase?

The primary driver for this massive increase in data usage and signaling activity on LTE networks is the significant performance capability of LTE. Because of this performance improvement, LTE networks can deliver real data-intensive experiences, such as video streaming, on mobile devices. This not only gives mobile users more confidence to use more data-intensive, real-time services but it also has opened the door for device manufacturers to finally design devices with the capabilities to reap the benefits of the new speeds, scale, and performance that LTE offers.

Chapter 4

Smartphone Signaling: A Look Under the Hood

In Chapter 2, we showed that on average Android-based smartphones signaled over 50% more than iPhones. This is important from the consumer's perspective as signaling activity is a big contributor to battery drain. It is also crucial for the service provider since signaling consumes valuable network resources.

In this chapter we will take a look "under the hood" and will show how application use and inherent design philosophies may be a contributing factor to their different signaling behaviors.

To get started let's look at the basics. Signaling is measured as the network-to-device bidirectional exchanges that occur to set up and manage a radio connection to a mobile device for data use. In this chapter, we specifically examine signaling that is a result of the behavior of applications. This can be due to application-to-device notifications, application level signaling, and other behavior that requires a change in the radio connection.

Top Android and iPhone signaling applications

To begin our investigation let's first take a look at the top 10 applications on these smartphones that contribute the most to signaling activity in terms of percentage share, as shown in Figure 1.

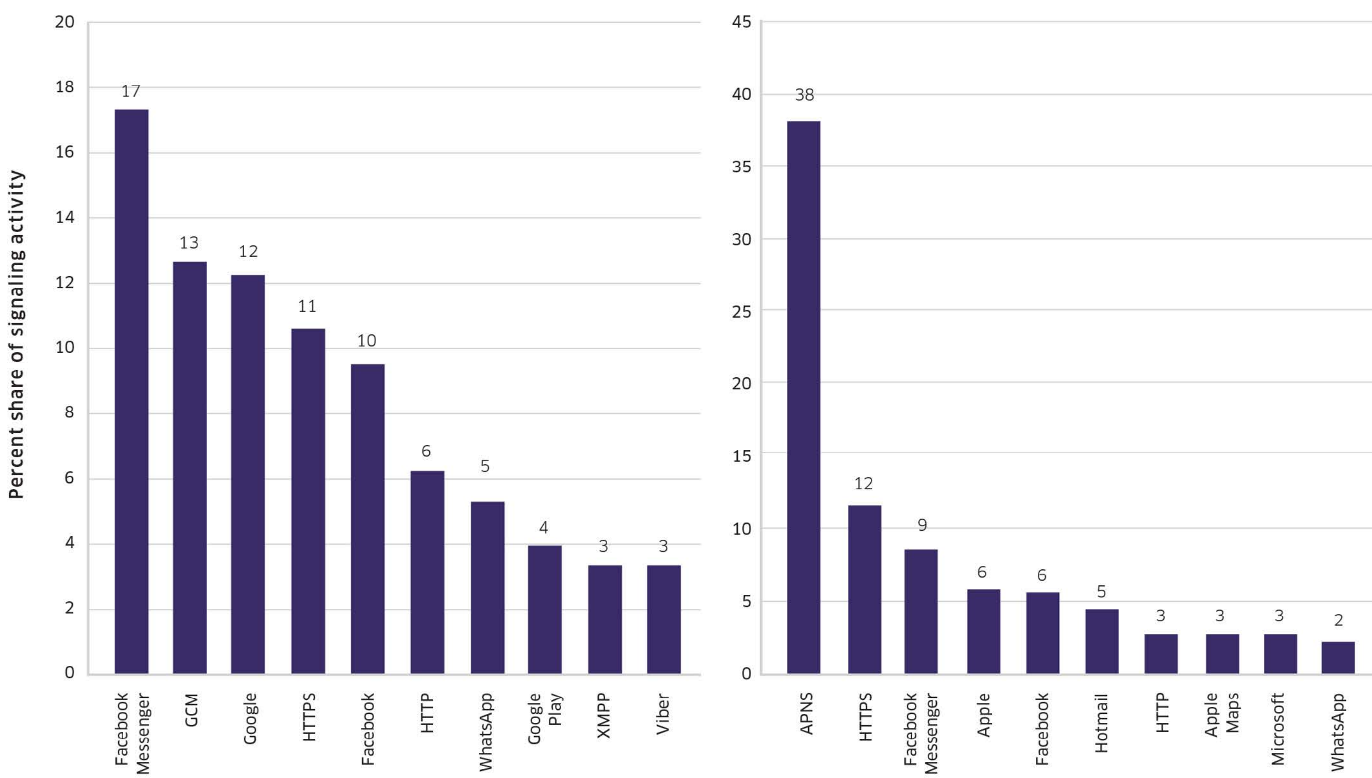

Figure 1. Top Android and iPhone apps for signaling share

In the Android category, Facebook Messenger has the highest share at 17%, following by Google Cloud Messaging (GCM) at 13%, Google at 12%, HTTPS at 11%, Facebook at 10%. Rounding out the top ten is HTTP, WhatsApp, Google Play, Extensible Messaging and Presence Protocol (XMPP), and Viber. XMPP is a protocol that is primarily used by Google Talk and Viber.

In the iPhone category, Apple Push Notification Service (APNS) has the highest share at 38%, followed by HTTPS at 12%, Facebook Messenger at 9%, Apple at 6%, and Facebook at 6%. Rounding out the top ten is Hotmail, HTTP, Apple Maps, Microsoft, and WhatsApp.

It's clear that the distribution of the share of signaling across the top 10 applications is very different. For iPhones, APNS dominates and accounts for a 38% share of daily signaling activity, while the share of signaling activity drops significantly across all other applications. For Androids, Facebook Messenger and GCM are at the top with 17% share and 13% share, respectively, while the share of signaling activity drops gradually for the other applications.

What this means is that on iPhones, a very significant portion of the signaling is due to the delivery of push notifications from APNS. On Androids, the effect of its own push notification service, GCM, is not near as large and the signaling impact is more evenly spread across a larger set of apps. In fact, GCM on Androids is the second top signaling application, accounting for less than half as much signaling share as APNS does on iPhones. Does this mean that Androids handle fewer push notifications than iPhones? To answer this, we need to examine how both push notification mechanisms are handled.

Notification services: APNS and GCM

The core design principle behind APNS is its centralized server, which coordinates the delivery of notifications to applications on a phone. As a result, there's no need for each application to develop and support its own notification mechanism. A large base of iPhone applications came to rely on this centralized mechanism.

After the Android entered the smartphone landscape, Google developed its own push notification infrastructure, called GCM, which also centralizes how notifications are managed. In addition to GCM, a number of third-party notification applications for Android-based smartphones emerged, such as Xtify and Urbanairship. In the usual spirit of openness and flexibility of the Android community, this has led to a fragmented base of developer preferences for how to handle push notification services.

The signaling impact of the APNS is quite large because it accounts for the signaling done on behalf of a large number of iPhone apps, whereas Google's GCM appears to be serving a smaller set of applications. From this we understand that APNS is used much more ubiquitously than GCM but how does this make Android-based smartphones more signaling heavy? To answer this question we need to dig a little deeper into the actual costs.

The per-application network cost of signaling

To further contrast Android and iPhone signaling behavior, Figure 2 shows the per-application signaling activity cost, measured by the average number of connection setups per day, for each the top signaling applications already identified in Figure 1.

For every application that is common across both devices, signaling activity is heavier on Androids than on iPhones. For example, WhatsApp has 33 connection setups a day on Androids, compared to 19 on iPhones. Because WhatsApp on iPhone uses APNS, much of the signaling required for notifications is being accounted for within APNS, thus lowering the overall signaling of the application. This is similar with Facebook Messenger, HTTPS, HTTP, Facebook and other common applications.

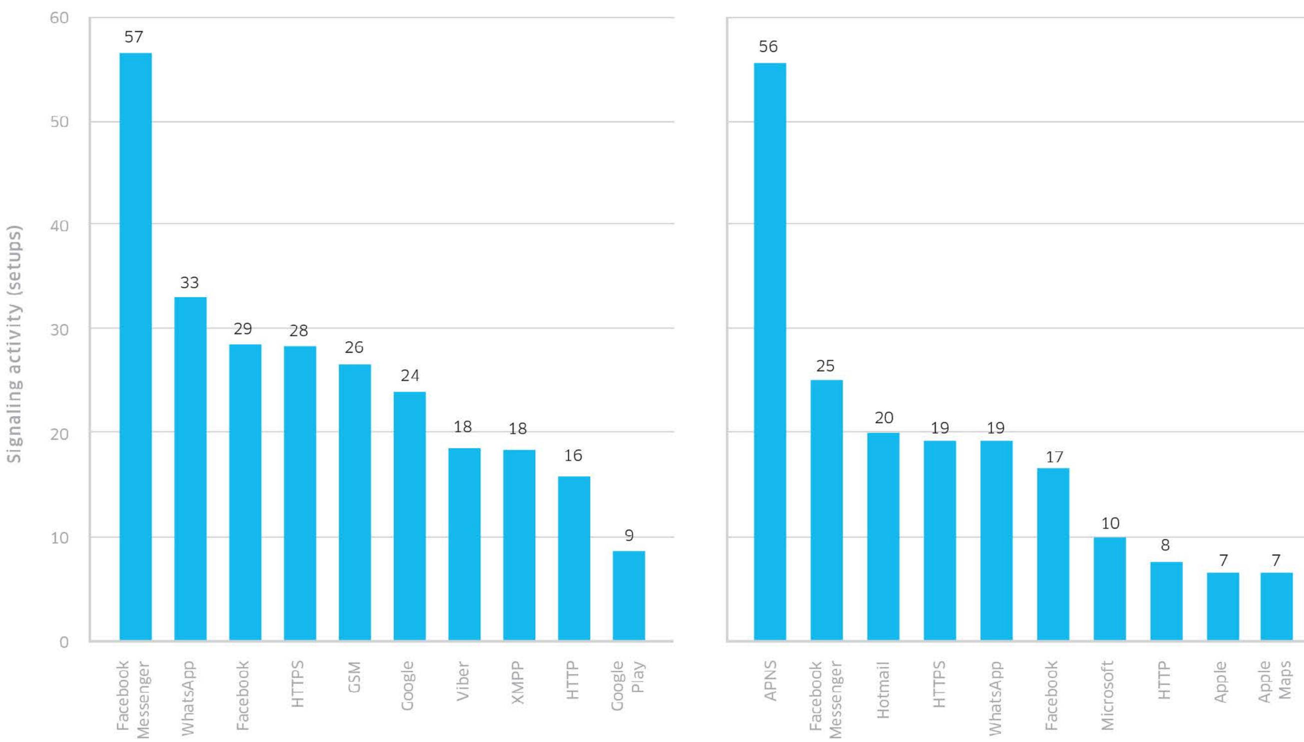

Figure 2. Daily average signaling activity cost for top Android and iPhone apps

The net result appears to be that the aggregation of notifications performed by APNS, coupled with well known architectural design limitations of APNS (which limit the number of connections that are available for handling notifications), steer iPhone application developers to become more network friendly and place a cap on the aggregate signaling load across the registered applications.

Conversely, when push notifications are distributed across different notification components, as appears to be the case with Android's approach, multiple applications are likely to compete for network resources and hit the network with more frequent connection setup requests.

It remains to be investigated whether or not the responsiveness of applications regarding notifications is compromised on iPhones in a way that affects the user's perceived quality of experience. However, from a network perspective, the centralization of push notifications under APNS along with certain design limitations seems to have a net effect of lowering the overall signaling activity on the iPhone while enabling radio efficiencies that would not be viable in a more distributed solution, such as the Android's GCM.

Chapter 5

Google's Power to Impact Network Signaling

How sensitive are mobile networks to shifts in behavior of mobile device applications? Can the change in the signaling behavior of a single smartphone application create disruption on the mobile network?

In this chapter we will show that the answer is a definitive "yes" to these questions, which makes it imperative that mobile operators understand their network right down to the individual applications.

An increase in signaling for Google Cloud Messaging

Google Cloud Messaging (GCM) is a push notification infrastructure and a background application on Android-based smartphones. GCM centralizes how notifications are managed between applications on Android-based smartphones and application servers on the Internet. Based on Alcatel-Lucent's analysis from a collection of anonymized live 3G and LTE networks, we observed a dramatic increase in signaling traffic on the GCM application from January 12 to February 19, 2015. Figure 1 shows a representative signature of this phenomenon.

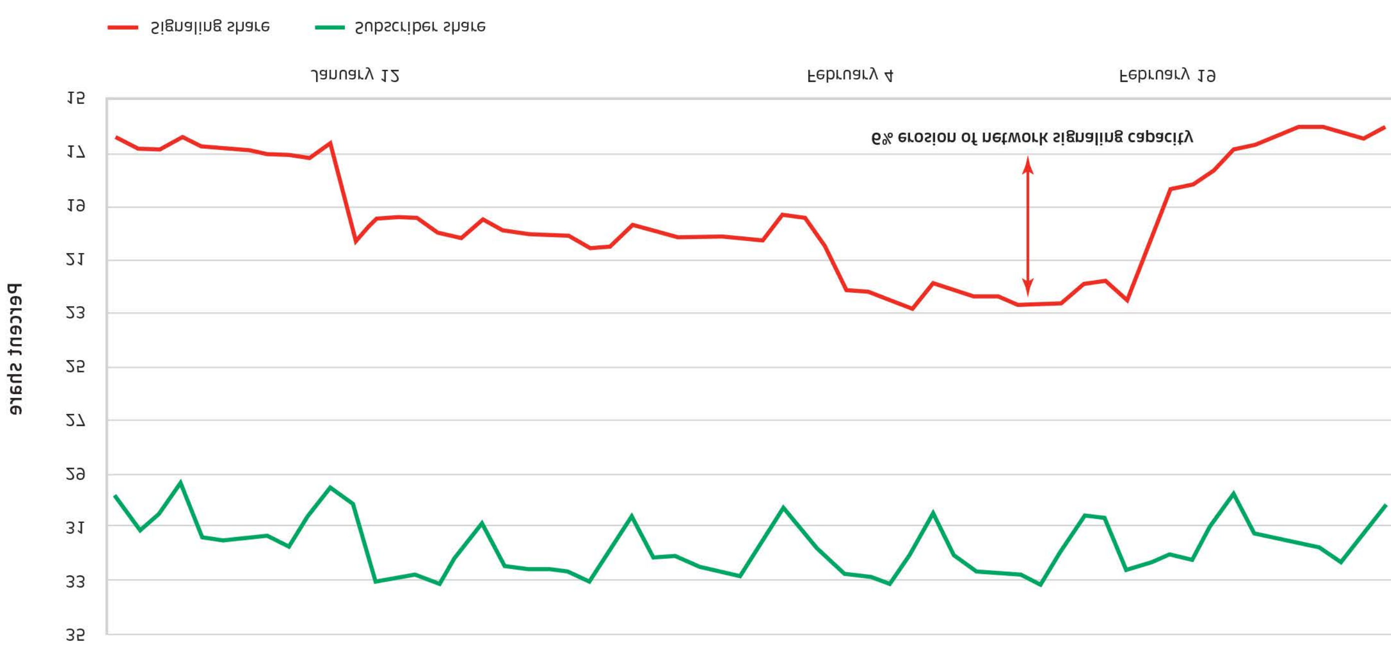

Figure 1. Percentage subscriber and signaling shares for Google Cloud Messaging

The bottom line on the chart reflects the percentage share of signaling activity for the GCM application over time from among all of the applications that generate signaling on Android-based smartphones. On January 12, 2015, GCM experienced a significant increase in signaling, as shown by its increase in signaling share from 17% to 20%. On February 4, 2015 GCM experienced another signaling increase, as its signaling share went from 21% to a peak of 23%. This increase in signaling resolved itself on February 19, 2015 when GCM's signaling share went back down to expected levels.

The top line on Figure 1 shows the percentage subscriber share of the GCM application over the same time frame. In other words this line represents the percentage of Android-based smartphones that are actively using the GCM application. Clearly, there is no increase in subscriber share during the time the signaling increase occurred. This indicates that the increase in signaling activity for GCM was not due to an increase in active subscribers. Although it is unknown what caused this increase in signaling, further forensic investigation showed significant network and subscriber impact during the period of this increase.

The network and subscriber impact

Although a rise in signaling share from 17% to 23% on a single application may appear rather innocuous at first, it does have a significant impact on mobile networks. During this period of signaling increase, an average erosion of 6% in overall signaling capacity was experienced across the networks that were analyzed. This is a costly loss that can place a large strain on radio resources, and it can even cause outages in locations that were already operating close to capacity — or where there was a dominant proportion of Android users.

This signaling increase also impacts subscribers, as during the same timeframe of the signaling increase, individual signaling activity on Android-based smartphones increased anywhere from 6% to 51%, with an average 32% increase across all networks. This is important because signaling activity is a significant contributor to battery drain, which is of primary concern for mobile subscribers.

The incident shown in this case study highlights the great vulnerability of carrier networks to sudden changes in the signaling behavior of popular applications. A similar incident, featured in a blog in Analytics Beat, occurred when Facebook released a chattier version of its popular application. Developers of widely used applications need to be aware of their responsibility to ensure that software updates do not adversely affect how their apps interact with networks.

For Additional Information

To learn more about the insights shared in this ebook and others, download the full Mobile Device Report.

To fully harness the possibilities offered by the report and described in this ebook, service providers need to conduct their own studies using data derived from their own networks. Service providers can gain more powerful insights about their networks with the Motive Wireless Network Guardian.

Also see the Alcatel-Lucent Network Intelligence solution page.

About the Author

Patrick McCabe, Senior Product Marketing Manager at Alcatel-Lucent, is responsible for promoting products and solutions for the Network Intelligence portfolio. Patrick has held a number of support, sales, and marketing roles during his 20 years in the telecommunications industry.

He was educated at St Francis Xavier University and Technical University of Nova Scotia (DalTech), and holds Bachelor and Masters degrees in Engineering.