

ERICSSON MOBILITY REPORT

ON THE PULSE OF THE NETWORKED SOCIETY



CONTENTS

Mobile subscriptions update	4
Subscriptions outlook	6
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Mobile traffic update	9
Traffic development	10
<hr/>	
Coverage	12
Speed	14
<hr/>	
Video needs mobile	16
The impact of free game apps	18
<hr/>	
Traffic mix for applications and devices	20
Tethering	21
Uplink versus downlink traffic volumes	24
<hr/>	
Key figures	26
Methodology and glossary	27

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ERICSSON MOBILITY REPORT

November 2012

Traffic in mobile networks continues to grow at an impressive rate worldwide. While voice remains a cornerstone of most operators' service offerings, it is data growth, driven by the uptake of smart devices and apps, which is having the most significant impact on networks globally.

In this release, the regular features which track subscriptions and traffic have been updated to reflect our latest measurements and to include annual forecast numbers to 2018. The updated forecasts are in line with previous ones, showing continued uptake of both mobile subscriptions and mobile traffic.

The growing availability of mobile broadband has raised user expectations of mobile network quality. Mobility is integral to our everyday lives. Providing coverage, sufficient quality and speed to run apps anywhere and anytime is key.

The traffic mix of applications differs between device types, but one common finding is that video is the biggest contributor to mobile traffic volumes. Looking below the surface of our traffic measurements, we provide a thorough analysis of tethering and the asymmetry of uplink and downlink volumes in applications.

Finally, for an overview, check out the key figures section at the end. We hope you find this report engaging and valuable.



ABOUT THIS REPORT

Ericsson has performed in-depth data traffic measurements since the early days of mobile broadband from a large base of live networks covering all regions of the world.

The aim of this report is to share analysis based on these measurements, internal forecasts and other relevant studies to provide insights into the current traffic and market trends.

Publisher: Douglas Gilstrap,
Senior Vice President and
Head of Strategy, Ericsson

SUBSCRIPTIONS

6

9.3 billion mobile subscriptions by the end of 2018.

SPEED

14

Global median smartphone downlink speed is over 1.3 Mbps.

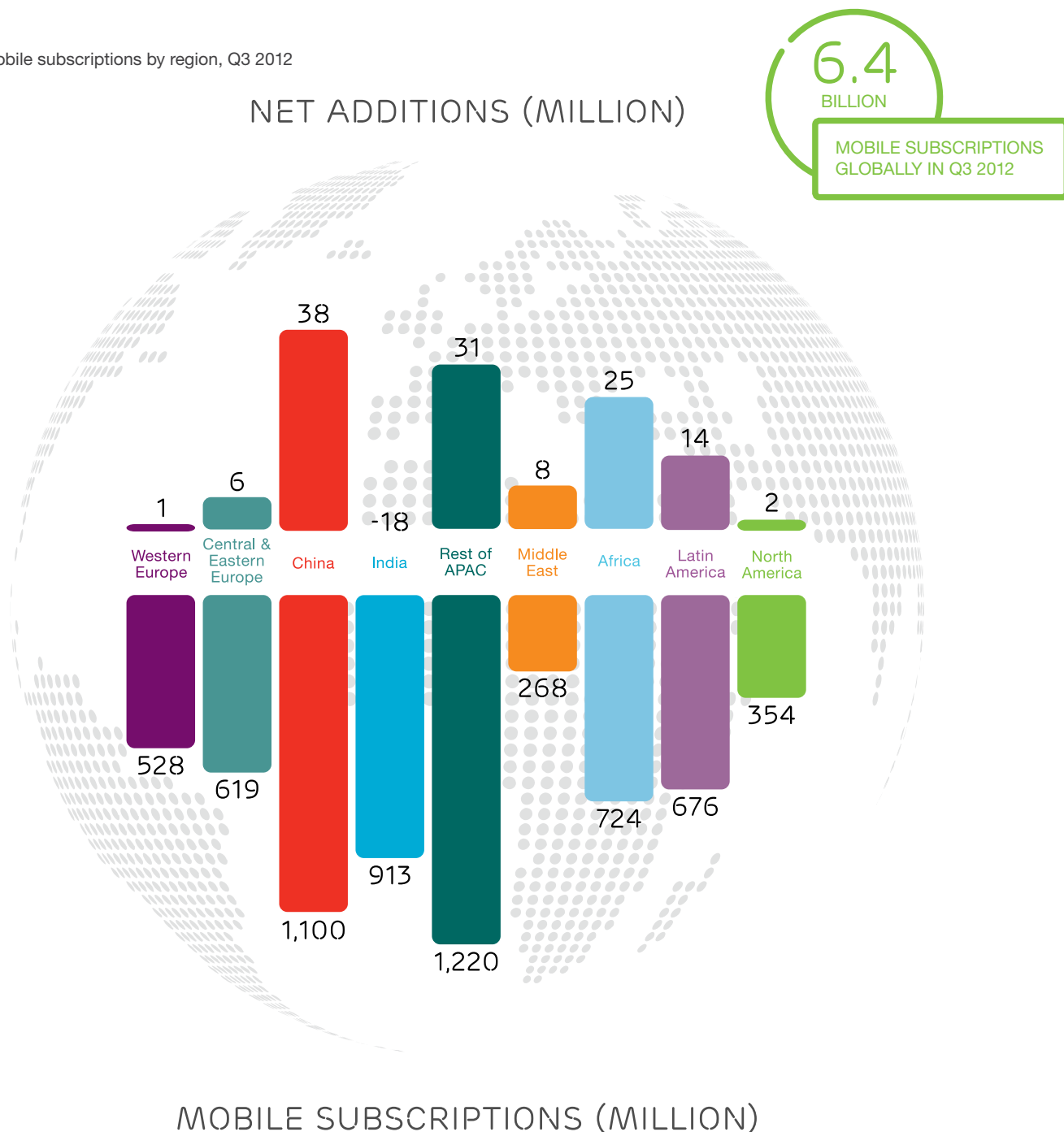
TETHERING

21

Tethering users consume up to 20 times more data traffic than others.

MOBILE SUBSCRIPTIONS UPDATE

Figure 1: Mobile subscriptions by region, Q3 2012



Source: Ericsson (November 2012)

Figure 1

Mobile subscription figures are estimates as of Q3 2012. Mobile net additions are estimates during Q3 2012. APAC = Asia Pacific. The estimate of mobile net additions has been made based on historic information from external sources and regulatory and operator

reports, combined with Ericsson analysis. Historical data may be revised when operators report updated figures. The decline in mobile subscriptions for India is due to removal of inactive subscriptions.

- > Global mobile penetration reached 91 percent in Q3 2012 and mobile subscriptions now total around 6.4 billion. However, the actual number of subscribers is around 4.3 billion, since many have several subscriptions.
- > China alone accounted for around 35 percent of net additions, adding around 38 million subscriptions.
- > Brazil (+9 million), Indonesia (+7 million), and the Philippines (+5 million) follow in terms of net additions.
- > The number of mobile subscriptions in India declined by around 18 million in the quarter. The reason is an increased focus on active subscriptions, with the decline coming from the removal of inactive subscriptions.
- > Mobile subscriptions have grown by around 9 percent year-on-year and 2 percent quarter-on-quarter.
- > Mobile broadband subscriptions¹ have grown by around 55 percent year-on-year and have reached above 1.4 billion.
- > There is continued strong momentum for smartphone uptake in all regions. Approximately 40 percent of all mobile phones sold in Q3 2012 were smartphones, compared to around 30 percent for the full year in 2011. Only around 15 percent of the worldwide installed base of mobile phone subscriptions uses smartphones, which means that there is considerable room for further uptake.
- > LTE is now growing strongly, with 13 million new subscriptions added in Q3 2012. GSM/EDGE added around 20 million and WCDMA/HSPA around 65 million.

Figure 2: Penetration percentage Q3 2012



Source: Ericsson (November 2012)

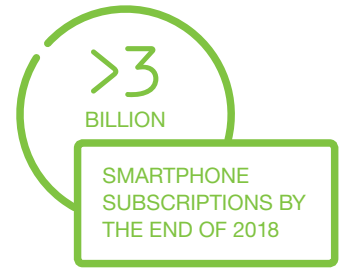
¹ Mobile broadband is defined as CDMA2000 EV-DO, HSPA, LTE, Mobile WiMAX and TD-SCDMA.

SUBSCRIPTIONS VS SUBSCRIBERS

There is a large difference between the number of subscriptions and subscribers. This is due to the fact that many subscribers have several subscriptions. Reasons for this could include users lowering their traffic cost by using optimized subscriptions for different types of calls, maximizing coverage and having different subscriptions for mobile PCs/tablets and for mobile phones. In addition, it takes time

before inactive subscriptions are removed from operator databases. Consequently, subscription penetration can easily reach above 100 percent, which is the case in many countries today. It should however be noted that in some developing regions it is common for several people to share one subscription, having for example a family phone.

SUBSCRIPTIONS OUTLOOK



By the end of 2012, total mobile subscriptions will be around 6.6 billion. By the end of 2018, they are expected to reach 9.3 billion. These figures do not include M2M subscriptions, which will also add to the number of subscriptions. Global mobile broadband subscriptions will be around 1.5 billion in 2012, and are predicted to reach 6.5 billion in 2018. The majority of devices are, and will continue to be, mobile phones. Mobile broadband will gain a larger share of total broadband subscriptions in many markets, complementing xDSL in certain segments and replacing it in others. Mobile broadband also includes some feature phones.

Mobile devices

Ericsson expects the subscription types associated with large data volumes (such as those for mobile PCs and smartphones) to exceed 4 billion by 2018. This is shown in figure 4.

Mobile subscriptions are increasing for PCs, mobile routers and tablets that use large screen sizes. They are expected to grow from 250 million in 2012 to around 850 million in 2018, exceeding the number of fixed broadband subscriptions.

Total smartphone subscriptions will reach 1.1 billion by the end of 2012 and are expected to grow to 3.3 billion in 2018. Today the majority of mobile subscriptions are for basic phones.

Even though smartphone penetration will increase significantly, we expect subscriptions for basic phones and inactive subscriptions to stay at around 5 billion in the coming years. The reason for this is that a large part of subscriber growth will come from the lower-end phone segment.

Regional differences will be large. In 2018 almost all handsets in Western Europe (WE) and North America (NA) will be smartphones, compared with only around one third of handsets for Middle East and Africa (MEA) and Asia Pacific (APAC).

Figure 3: Fixed and mobile subscriptions 2009-2018

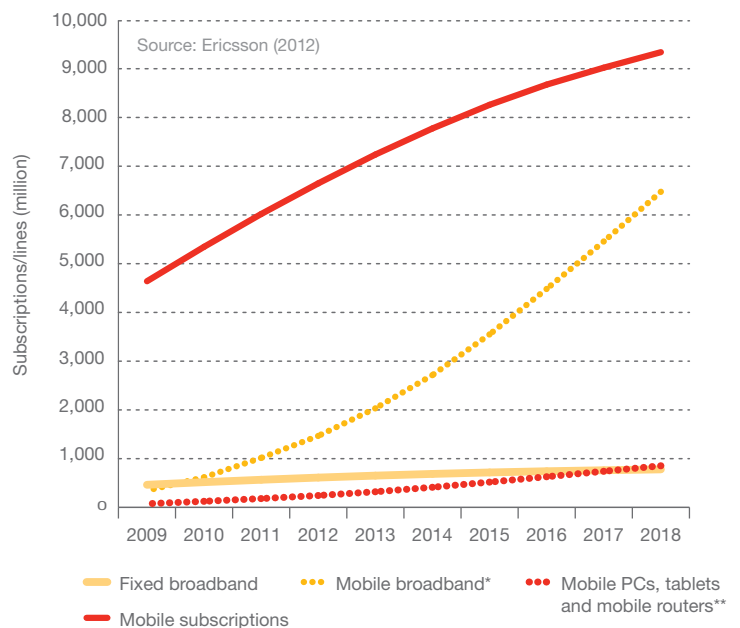
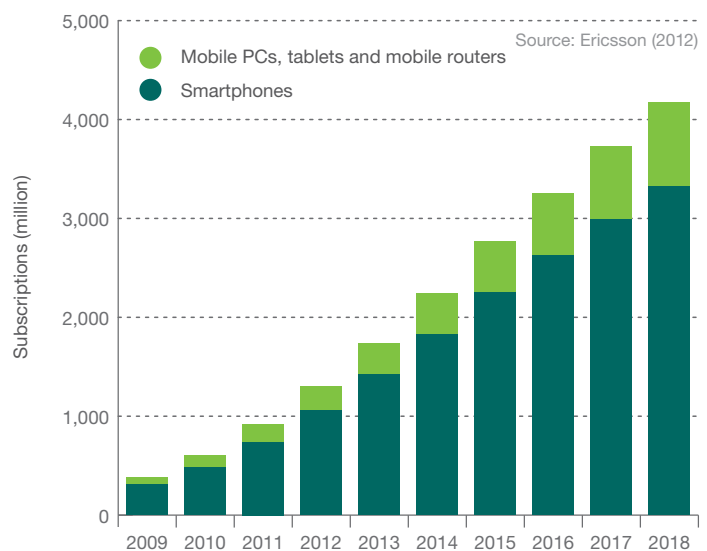
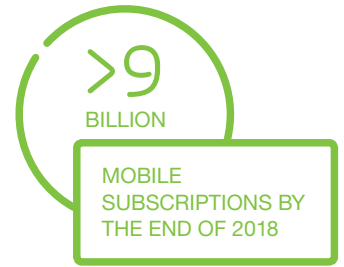


Figure 4: Smartphone, PC, mobile routers and tablet subscriptions with cellular connection 2009-2018



*Mobile broadband: CDMA2000 EV-DO, HSPA, LTE, Mobile WiMAX and TD-SCDMA. It includes mobile PCs, tablets, mobile routers and mobile phones including both smartphones and feature phones.

**Mobile PC: laptop or desktop PC devices with built-in cellular modem or external USB dongle. Mobile router: A device with a cellular network connection to the internet, and Wi-Fi or ethernet connection to one or several clients (such as PCs and tablets).



Mobile technology

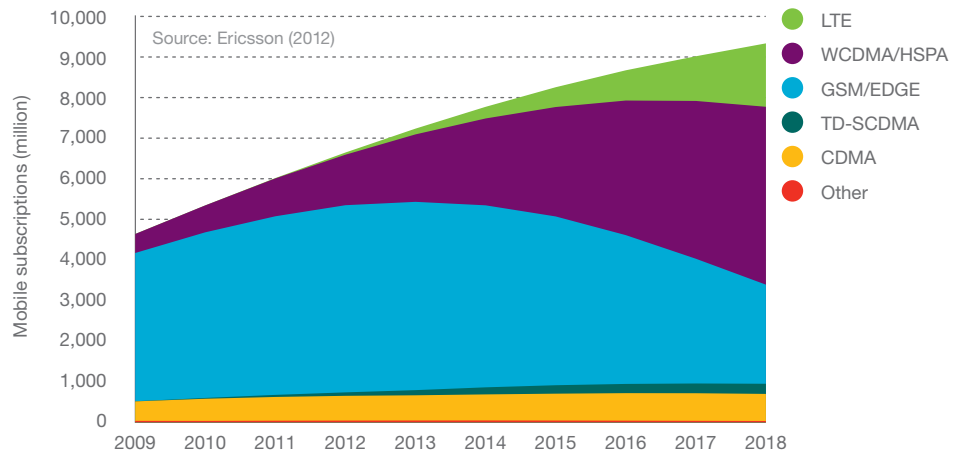
Figure 5 illustrates reported mobile subscriptions by technology. In this graph, subscriptions are defined by the most advanced technology that the mobile phone and network are capable of.

LTE is currently being deployed and built-out in all regions and will reach around 1.6 billion subscriptions in 2018. These subscriptions will represent the high-end share of the total subscriber base by 2018. Rapid migration to more advanced technologies in developed countries means global GSM/EDGE subscription numbers will decline after 2012-2013. On a global scale GSM/EDGE will continue to lead in terms of subscription numbers until the latter years of the forecast period. This is because new, less affluent users entering networks in growing markets will be likely to use the cheapest mobile phones and subscriptions available. In addition, it takes time for the installed base of phones to be upgraded.

Regional growth

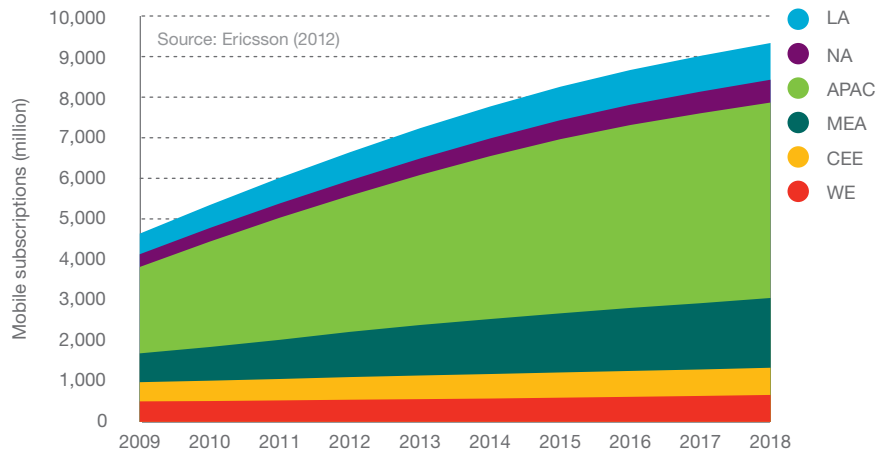
Figure 6 illustrates mobile subscriptions in each region up until the end of 2018 and is characterized by continued growth in all regions. In APAC this growth is primarily driven by new subscribers. On the other hand, overall North American subscription growth is based on multiple subscriptions per individual – for example, adding a tablet.

Figure 5: Mobile subscriptions by technology, 2009-2018



Subscriptions are defined by the most advanced technology that the mobile phone and network are capable of.

Figure 6: Mobile subscriptions by region, 2009-2018



The number of fixed broadband users is at least three times the number of fixed broadband connections, due to multiple usage in households, enterprises and public access spots. This is the opposite of the mobile phone situation, where subscription numbers exceed user numbers. In the latter years of the forecasting period, it is likely

that the usage trend for mobile PCs will be similar to fixed broadband usage today, with several users per subscription. This is especially the case in developing markets where mobile access will be the main source of internet connection.

Regional technology maturity

Different maturity levels between regions are reflected in their radio technology mix. Less mature regions are dominated by 2G technologies, like GSM/EDGE, while more mature regions like Western Europe are dominated by HSPA. LTE is growing very strongly, particularly in North America.

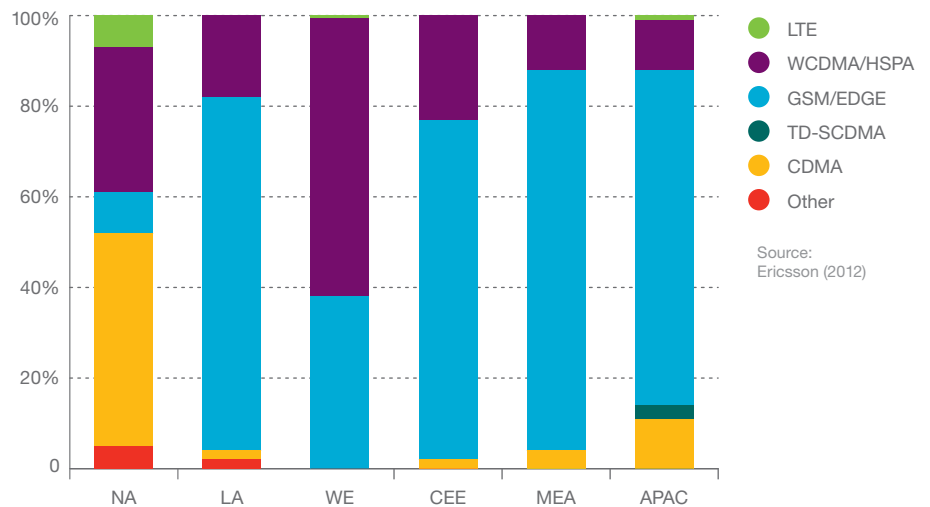
North America is characterized by early growth in LTE, which will make LTE the dominant technology in 2018. GSM/EDGE-only subscriptions will virtually be no longer present. The fast growth in LTE subscriptions is driven by strong competition and consumer demand, following CDMA operators' early decisions to migrate to LTE.

Latin America (LA) has a large GSM/EDGE subscriber base. The strong growth in subscriptions in this region will be driven by economic development and consumer demand. In 2018, WCDMA/HSPA will be the dominant technology, however GSM/EDGE-only subscriptions will still have a significant presence.

As a mature market, Western Europe will show little subscriptions growth in the years to come. What growth there is will come from an increasing number of connected devices. HSPA is the dominant technology in 2012. By 2018, LTE is expected to have penetrated around 30 percent of the subscriptions base in Western Europe.

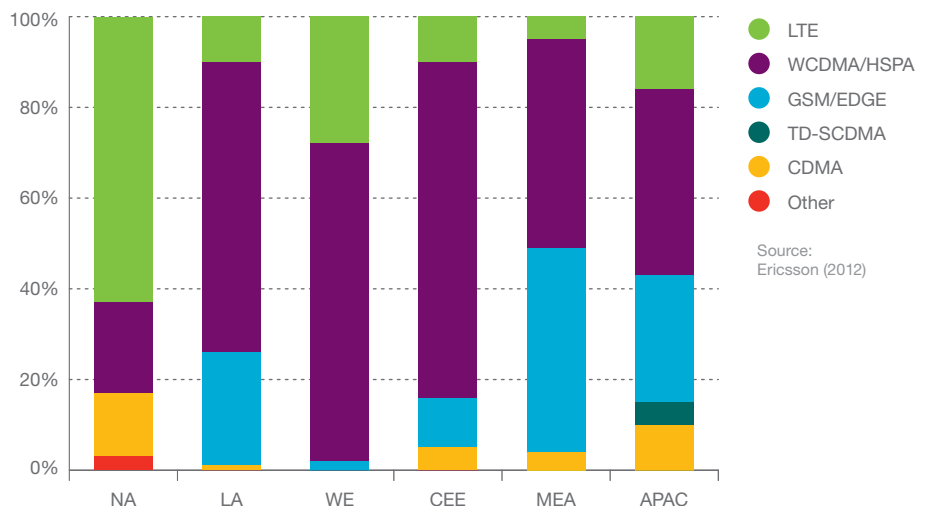
The Asia Pacific market continues to see a massive increase in subscriptions. Markets like Japan and Korea will take up LTE subscriptions very early compared to late uptake in less developed countries. China will add substantial LTE subscriptions in the latter years.

Figure 7: Mobile subscriptions by technology and region 2012



Subscriptions are defined by the most advanced technology that the mobile phone and network are capable of.

Figure 8: Mobile subscriptions by technology and region 2018



Central and Eastern Europe (CEE) shows a strong increase in HSPA subscriptions. LTE will initially grow in the most developed parts of the region, and will be present in most countries by 2018.

The Middle East and Africa is dominated by GSM/EDGE in 2012. By 2018 it will be the region with the largest share of GSM/EDGE, driven by a demand for low cost telephones. However, the region is diverse, so there will be large differences between highly developed areas and less developed areas.

MOBILE TRAFFIC UPDATE

2X
MOBILE DATA TRAFFIC DOUBLED BETWEEN Q3 2011 AND Q3 2012

Global traffic in mobile networks

Figure 9 shows the total monthly traffic split for voice and data. It depicts a stable trend of data traffic growth with some seasonal variations. Mobile data subscriptions will grow strongly, and drive the growth in data traffic along with a continuous increase in the average data volumes per subscription.

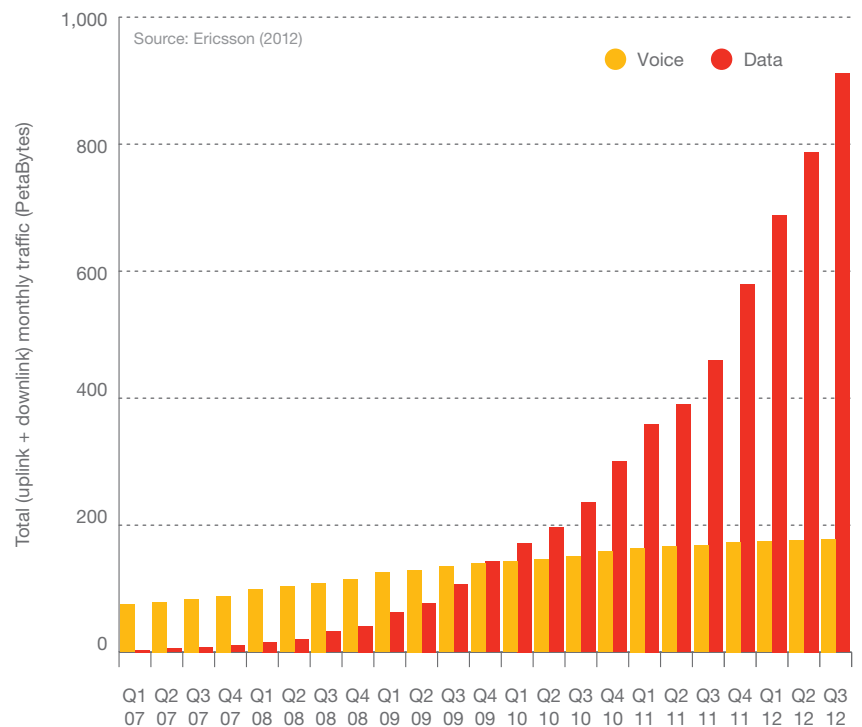
Mobile voice traffic continues to grow at a steady rate, mainly driven by new subscriptions in Asia Pacific and Middle East & Africa. Highlights include:

- > Data traffic doubled between Q3 2011 and Q3 2012
- > Quarterly growth between Q2 2012 and Q3 2012 was 16 percent

It should be noted that there are big differences in traffic levels between markets, regions and operators.

These measurements have been performed by Ericsson over several years using a large base of commercial networks that together cover all regions of the world. They form a representative base for calculating world total traffic in mobile networks².

Figure 9: Global total traffic in mobile networks, 2007-2012



²Traffic does not include DVB-H, Wi-Fi, or Mobile WiMax.

TRAFFIC DEVELOPMENT

12X
MOBILE DATA TRAFFIC WILL GROW ~12 TIMES BETWEEN 2012 AND 2018

Traffic outlook

In 2012, overall mobile data traffic is expected to continue the trend of doubling each year. Today, mobile PCs dominate traffic in most regions, except in North America. However, smartphone traffic is growing faster due to the high growth in subscriptions. In the latter years of the forecast period, data traffic will be split fairly equally between mobile phones on one hand and mobile PCs, tablets and mobile routers on the other.

Mobile data traffic will grow considerably faster than fixed data traffic over the forecast period. However, in absolute volume, fixed data traffic will remain dominant over the same period.

Accessing the internet from mobile devices will drive mobile traffic development. Mobile data traffic is expected to grow with a CAGR of around 50 percent (2012-2018), driven mainly by video. This entails growth of around 12 times by the end of 2018.

Traffic per subscriber is partly affected by the screen size of the user's individual device. Resolution is also a factor, with recent smartphones closing in on PC-level quality. On average, a mobile PC generates approximately seven times more traffic than a smartphone. By the end of 2012, an average mobile PC generated approximately 3 GB per month, versus 450 MB per month produced by the average smartphone. By the end of 2018, it is estimated that a mobile PC will generate over 10 GB per month, and a smartphone around 2 GB. Note that there are large differences between user patterns on different networks, markets and user types.

MOBILE DATA TRAFFIC

Mobile data traffic is a share of total traffic. It represents four percent in 2012 and nine percent in 2018.

Figure 10: Global mobile traffic: voice and data 2010-2018

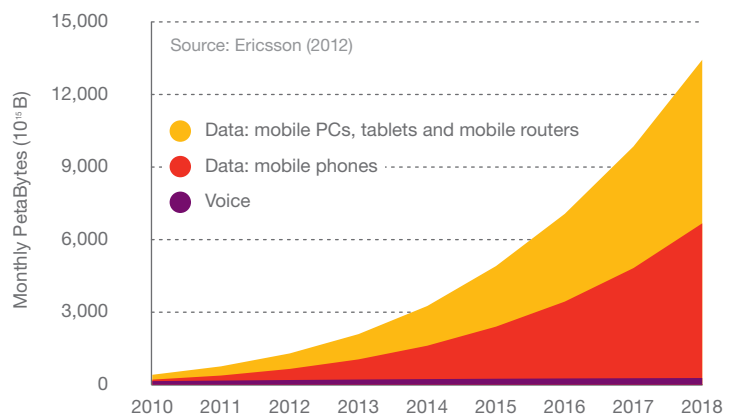


Figure 11: Global fixed traffic 2010-2018

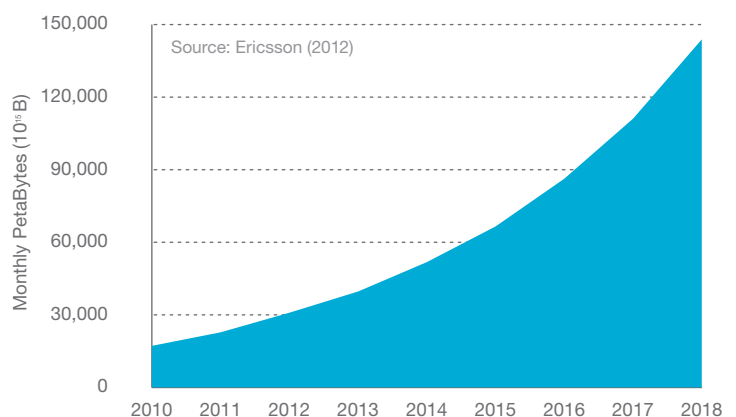
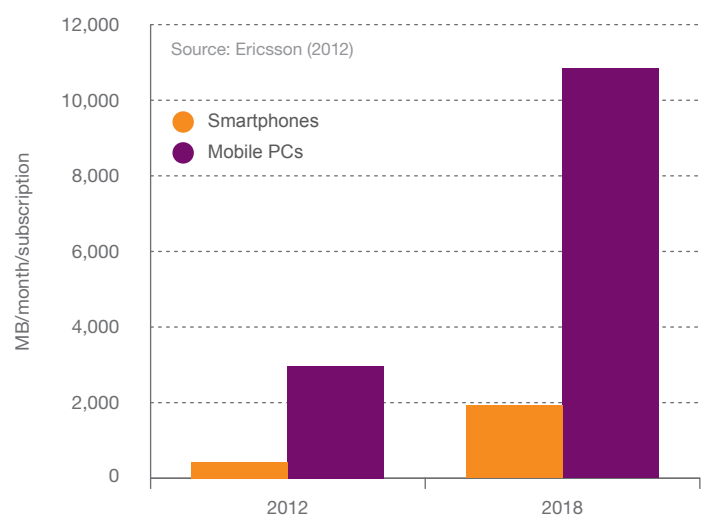


Figure 12: Smartphone and mobile PC traffic per month and subscription 2012 and 2018



14X

MOBILE DATA TRAFFIC FOR SMARTPHONES WILL GROW ~14 TIMES BETWEEN 2012 AND 2018

Regional mobile traffic variations

By looking at each region in figure 13 and comparing the traffic generated from different device types, we can see the diverse maturity levels between regions.

As illustrated in figure 14, Asia Pacific had the largest share of the total traffic in 2012. North America and Western Europe have a significantly larger share of total traffic volume than their subscription numbers alone would imply. This is due to the high penetration of 3G/4G networks, as well as that of PCs, smartphones and tablets.

Data traffic has doubled in 2012 and will continue to grow at a high rate, whereas voice traffic will maintain moderate single digit growth per annum. In other words, by 2018, voice traffic volumes in all regions will be very small compared to data traffic.

As seen in figures 14 and 15, Asia Pacific is expected to increase its share of the global volume from around one third today to almost 40 percent in 2018.

TRAFFIC MANAGEMENT IMPACT
 Note that a large part of data traffic is generated by a limited number of users in each device category. These users may considerably change their usage if operators implement data volume caps or other traffic management schemes. Measures like this could significantly impact the traffic forecast.

Figure 13: Mobile traffic by region and type, 2012

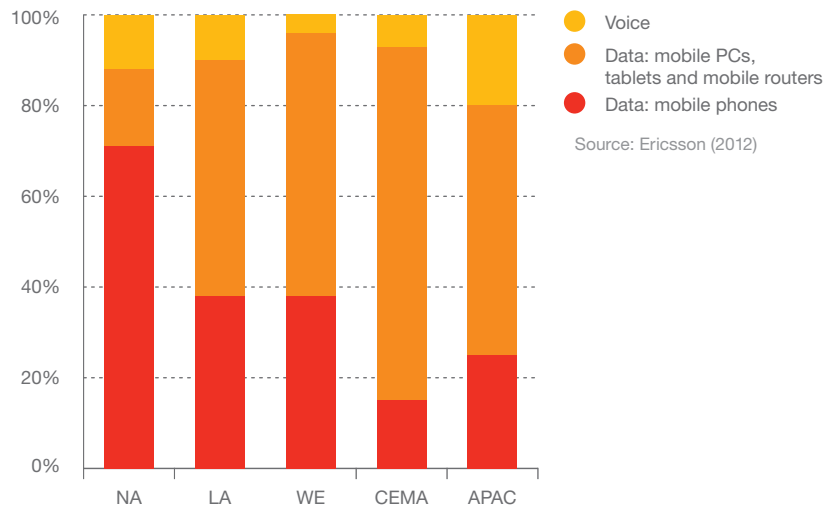


Figure 14: Mobile traffic share by region, 2012

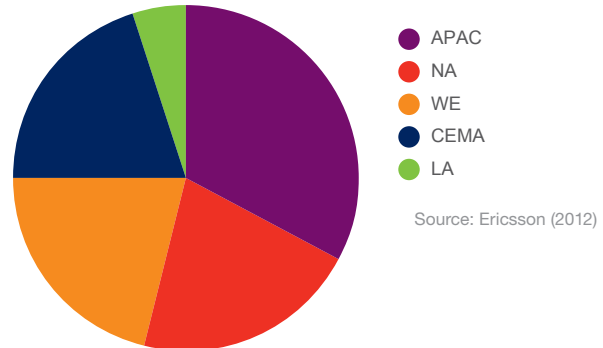
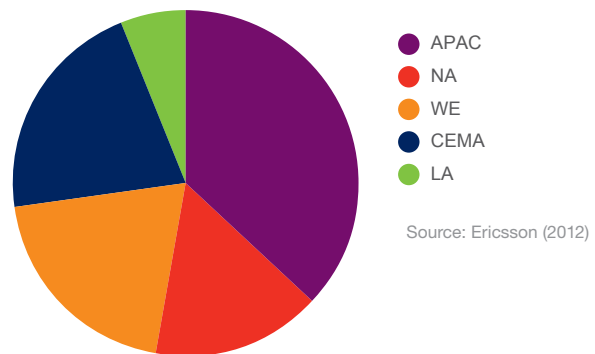


Figure 15: Mobile traffic share by region, 2018



Traffic refers to aggregated traffic in mobile access networks. DVB-H and Mobile WiMax or Wi-Fi traffic have not been included. M2M traffic is not included.



BY 2017, APAC WILL ACCOUNT FOR TWO THIRDS OF ALL LTE POPULATION COVERAGE

COVERAGE

Coverage of the world's mobile networks is constantly increasing as more base stations are deployed. GSM/EDGE technology has by far the widest reach and today covers more than 85 percent of the world's population. Geographically, only sparsely populated areas remain to be covered by GSM/EDGE.

WCDMA/HSPA covered more than 45 percent of the world's population in 2011 and now covers more than 50 percent. Further build-out of WCDMA/HSPA population coverage will be driven by a number of factors including increased user demand for internet access, the increasing affordability of smartphones and regulatory requirements to connect the unconnected. By 2017, an estimated 85 percent of the world's population will have the opportunity to access the internet using WCDMA/HSPA networks³.

APAC population coverage

APAC represents a large share of the global population. It is therefore interesting to study this region's current and forecasted build-out.

GSM's population coverage in APAC last year and its subsequent forecast for 2017 closely mirror the overall global situation.

The WCDMA/HSPA population coverage is higher in APAC than the global average. It is estimated that by 2017, 90 percent of the population will be covered by WCDMA/HSPA networks.

Japan, Korea and Australia are early adopters of LTE in APAC. It is forecasted that LTE population coverage in APAC will increase to 60 percent by 2017, surpassing the global average of 50 percent in the same year. By 2017 APAC will account for around two thirds of the world's LTE population coverage.

Figure 16: Population coverage, 2011 and 2017

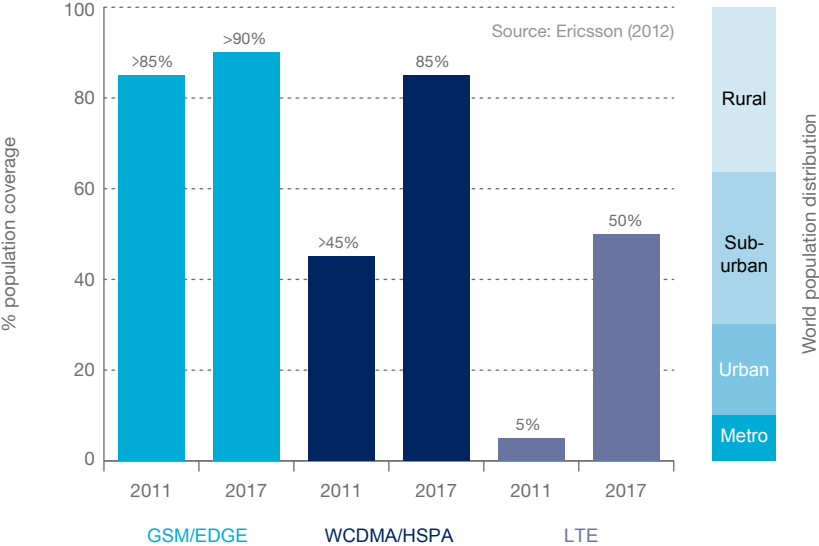
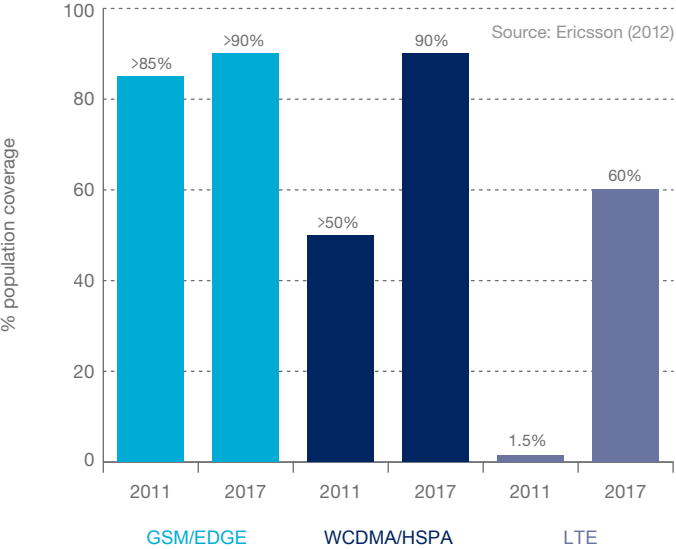


Figure 17: APAC population coverage, 2011 and 2017



³The figures refer to population coverage of each technology. The ability to utilize the technology is subject to other factors, such as access to devices and subscriptions.

WCDMA/HSPA networks

The WCDMA/HSPA networks that currently provide coverage to more than half of the world's population support various speeds. All WCDMA networks deployed worldwide have been upgraded with HSPA. Around 75 percent of HSPA networks have been upgraded to a peak downlink speed of 7.2 Mbps or above and approximately 50 percent have been upgraded to 21 Mbps or higher.

Around 20 percent of HSPA networks now have speeds of up to 42 Mbps in whole or parts of the network following a wave of upgrades. We are already seeing evolutionary steps towards speeds of over 100 Mbps.

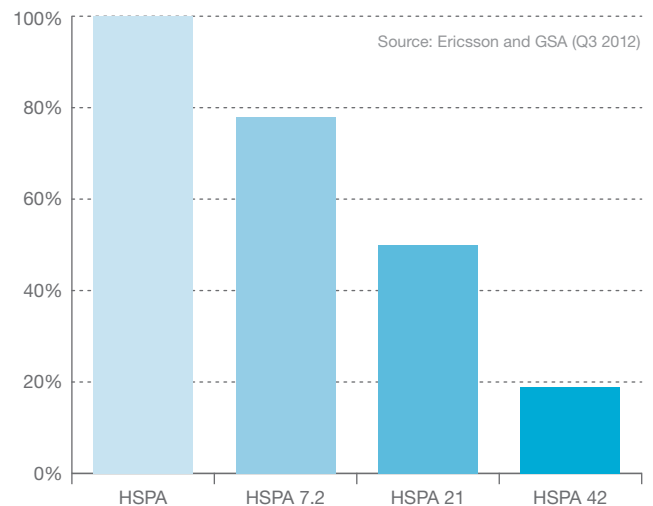
LTE network rollout

Despite being in the early days of rollout, LTE networks can already provide downlink peak rates of around 100 Mbps, with current standardization allowing for even higher speeds. Today, peak speeds experienced by users are often limited by device capabilities. The evolution of LTE, also referred to as LTE-Advanced, enables peak data rates exceeding 1 Gbps.

LTE is being deployed in a variety of new and existing spectrum bands and supports both Frequency-Division Duplex (FDD) and Time-Division Duplex (TDD). It also supports flexible carrier bandwidths from 1.4 MHz up to 20 MHz.

There are around 100 LTE networks in commercial operation today. LTE is the fastest developing system in the history of mobile communication. By mid-2012, LTE was estimated to cover 455 million people globally and by 2017 it is expected to cover around 50 percent of the world's population.

Figure 18: Percentage of WCDMA networks upgraded to HSPA and to 7.2, 21 and 42 Mbps



SPEED

Growing expectations

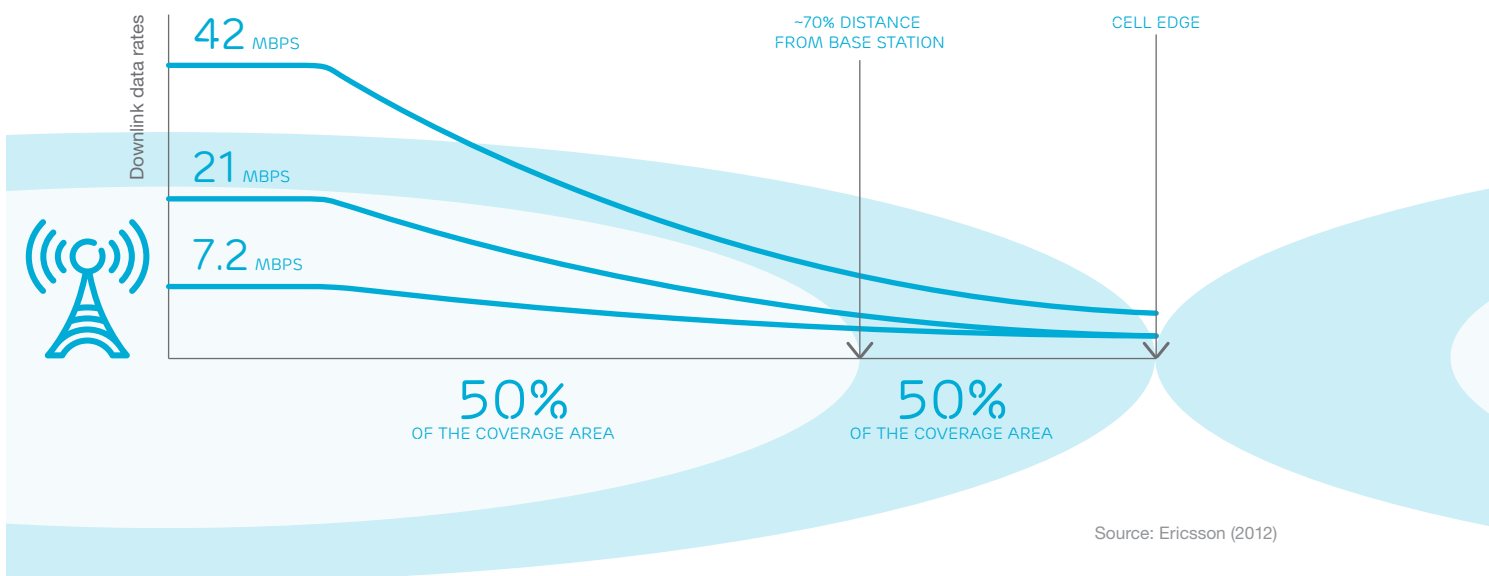
The growing availability of mobile broadband has raised customer expectations of mobile network quality. These expectations are further fueled by smart mobile devices that have enabled new user behavior. The mobile internet experience is becoming more pervasive and instrumental to the lives of private and business users alike.

Users across the world tend to have fairly common expectations of their mobile broadband experience. Providing ubiquitous coverage is an important factor in achieving positive user experience for both casual

and frequent users. Together, coverage and speed form the most important network quality satisfaction determinants for users. There are numerous additional factors that have an impact on how users experience network quality. These include capacity, latency and battery life, to mention just a few.

Speed is not determined solely by the network – other factors must be taken into consideration, including device capabilities and user behavior.

The diagram below shows how the distance between the base station and the cell edge also affects speed.



The diagram above illustrates how downlink speeds decline as radio signal strength is transmitted over a cell. The Y axis (data rate) shows downlink speeds and the X axis shows distance relative to the cell edge. Each of the three curves plot speeds for evolutionary steps of HSPA. It should be kept in mind that approximately 70 percent of the distance to the cell edge corresponds to 50 percent of the coverage area. 'Cell edge' refers to where there is typically a handover to an adjacent cell.

SPEEDTEST.NET APP

Speedtest.net is a useful source of data to understand the smartphone user experience. Network users can download the free app and run it to get an indication of the performance they are experiencing at a particular time and place. Speedtest.net collects

data from all tests run using the app, including downlink, uplink, latency, location, time, network and device model. The result is a growing database which has accumulated more than 250 million records to date.

Speed limitations

The speed that a user experiences is not only limited by the network – the device being used also has an impact. For example, if a user connects to a network capable of 42 Mbps with a handset that is limited to 7.2 Mbps, then a speed of no more than 7.2 Mbps can be achieved.

A recent drive test performed in a major northern European city showed median downlink speeds of 11 Mbps. This test was performed on a dual carrier network capable of 42 Mbps using a state-of-the-art dongle capable of handling 42 Mbps. The results indicate that an HSPA network can deliver higher speeds when not limited by device capabilities.

Downlink speed trend

Using data from Speedtest.net, figure 19 plots the median global downlink speed for smartphones from the first half of 2010 until the first half of 2012. Over this time, the speed has increased approximately 70 percent to 1.3 Mbps. These figures are based on a sample of more than 170 million smartphones globally.

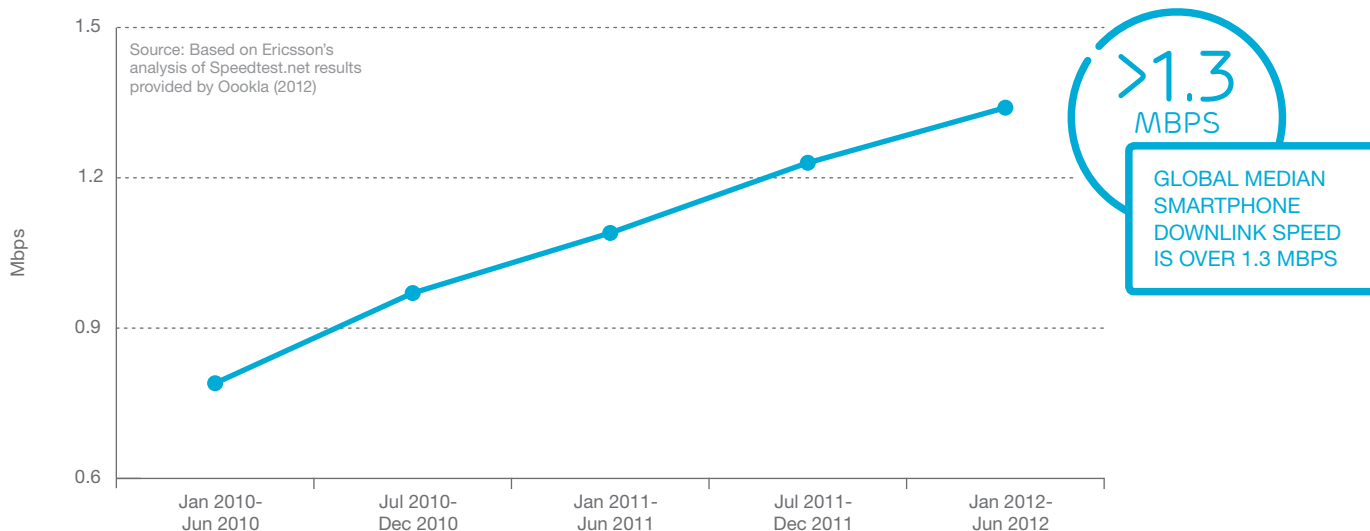
The measurements are taken from both iOS and Android terminals, on a variety of cellular technologies including GSM/EDGE, WCDMA/HSPA, LTE and CDMA.

The increase in speed during this timeframe is largely attributable to three factors:

- > Improved coverage of WCDMA/HSPA – hence an increasing proportion of measurements on 3G networks
- > Network upgrades, both 2G and 3G, enabling higher speeds
- > Handset and terminal developments and the increased penetration of devices capable of higher speeds

It is important to point out that there are already networks that provide a median speed of more than three times the global median. This indicates what the near future holds in terms of speed increases in mobile networks. Service providers are now faced with the challenge of providing users with sufficient quality and coverage to run their chosen apps anywhere and anytime.

Figure 19: Global median downlink speeds for smartphones



HETEROGENEOUS NETWORKS

Improvements to coverage and speed in metro and urban areas are key to meeting the demand for improved user experience. One way of meeting this demand is the deployment of heterogeneous networks. This involves improving and densifying

the macro layer, as well as adding small cells. Ericsson has projected that by 2017 each urban or metro macro sector will be complemented by an average of 3 small cells.

VIDEO NEEDS MOBILE

Social networking while watching video and TV

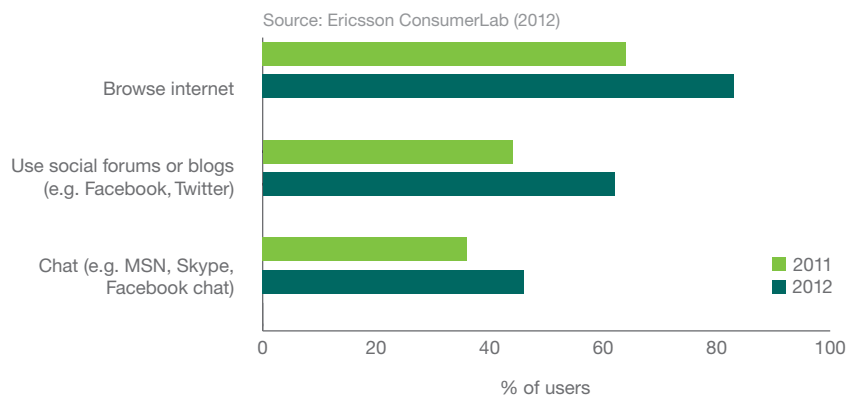
The smartphone is always within arm's reach, allowing us instant access to information, entertainment and social interaction. In fact, using social media on mobile devices has become an activity which consumers continuously engage in throughout the whole day. Furthermore, it has begun to influence and merge with other behaviors, such as watching TV and other video content. Consumers don't simply stop using Facebook or Twitter just because they have sat down in front of the TV. The two activities are instead done in parallel or even merged into a new kind of behavior.

Mobile devices, such as the smartphone, are becoming a natural part of the video experience

The Ericsson ConsumerLab TV and Video Report 2012 shows that more than 80 percent of respondents browse the internet while watching video and TV. More than 60 percent use social forums or blogs while watching video and TV on a weekly basis. Out of those who use social forums and chats while watching, 42 percent are, on a weekly basis, actually discussing the things they are currently watching.

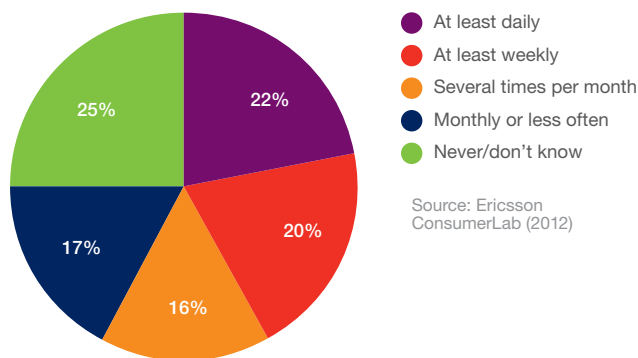
Watching different kinds of video content has always been a social activity. What we are seeing now is an increased use of social media while watching TV, especially when there is nobody else to talk to in the same room.

Figure 20: Which of the following activities do you do at the same time as you are watching TV/video content at least once per week?



Base: China, Germany, Spain, Sweden, Taiwan, UK, US

Figure 21: How often do you use social forums, chats (voice or text), etc. to discuss TV or video content at the same time as watching it?



Base: China, Germany, Spain, Sweden, Taiwan, UK, US (those who use social forums, blogs or chats while watching TV on a monthly basis)

Social behaviors enhance the overall TV and video experience, making it worth more. Over 30 percent of respondents say they are more likely to pay for content that they watch in a social context.

Multitasking video behavior

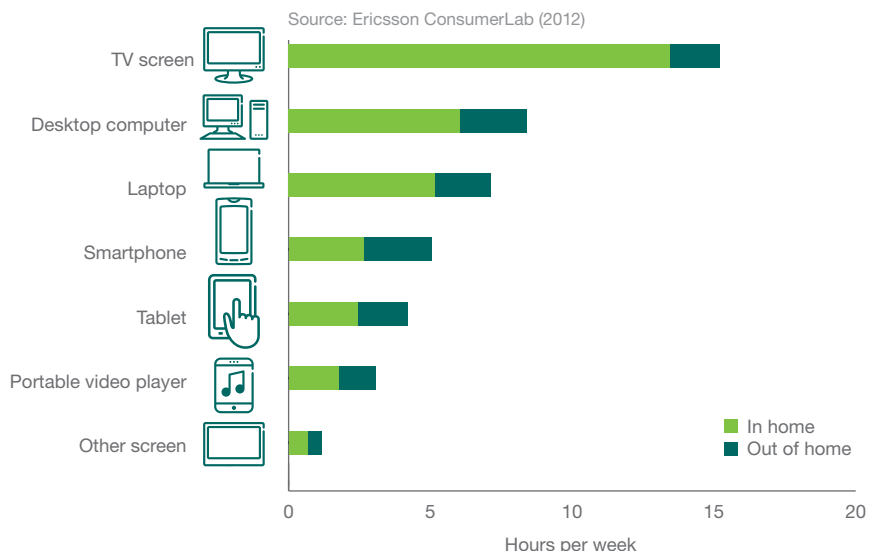
This kind of multitasking behavior is increasing because of the availability of different easy-to-use mobile devices such as smartphones, laptops and tablets. Almost 60 percent of people who use social forums or chats while watching video and TV say they do so using a laptop, while 54 percent say they use a smartphone.

Mobile devices increasingly important to the video experience

Mobile devices, such as the smartphone, are becoming a natural part of the the video and TV experience. Many consumers state that their different mobile devices have actually begun replacing their secondary TV screens around the home. Consumers are already using their laptops, smartphones and tablets to watch content in kitchens and bedrooms, despite not having thrown out secondary TVs from these rooms. The main reason for this is that these devices are already connected and can easily access the things people want to watch. While the main TV is still the preferred screen for TV and video consumption, mobile devices are being used more and more, partly due to the fact that they have time shift functionality and can connect to the internet.

TV and video is therefore no longer something that is consumed strictly on the TV screen inside the home. It is becoming device-independent and more interactive. Consumers are using several different devices for watching and expanding the video and TV experience.

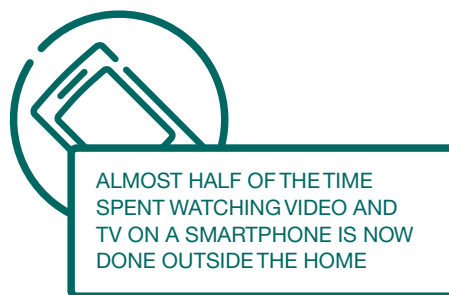
Figure 22: How many hours per week do you actively watch TV or other video content on the following screens, both at home and away from home?



Base: All 12 markets – have and use the device specified

Anytime, any place, any content

The amount of time spent using mobile devices is increasing. The majority of the video and TV consumption on these mobile devices is still conducted in the home. The smartphone is an exception as almost 50 percent of the time spent watching TV and video is done outside the home, where mobile broadband connections are facilitating the increase. Almost 40 percent of those who have a laptop, smartphone or tablet watch TV or video outside the home on a weekly basis. TV and video are finally becoming anytime, any place and any content experiences.



THE CONSUMERLAB TV & VIDEO REPORT 2012

ConsumerLab's research is based on qualitative and quantitative studies. It consists of qualitative in-home interviews in the US and in Sweden, combined with 12,000 online interviews (1,000 per country) in the US, UK, China, Spain, Sweden, Brazil, Taiwan, South Korea, Germany, Mexico, Chile and Italy. The results showing trends across several years are all based on

markets that have been studied from the first year of the research (China, Germany, Spain, Sweden, Taiwan, UK and US). All respondents were between 16-59 years old and watch some type of TV or video at least weekly and have a broadband connection at home. The research represents more than 460 million consumers.

THE IMPACT OF FREE GAME APPS

The growth of smartphones has been tremendous, fuelled by users' growing appetite for internet access and for using apps. This has created an app industry with an increasing number of developers and users. This industry is centred around two models – either the user purchases the premium version upfront or they choose the free version and receive advertisements. In some free apps the user is even required to click the link in the advertisement to continue using it. Versions that mix the two also exist. These are known as freemium.

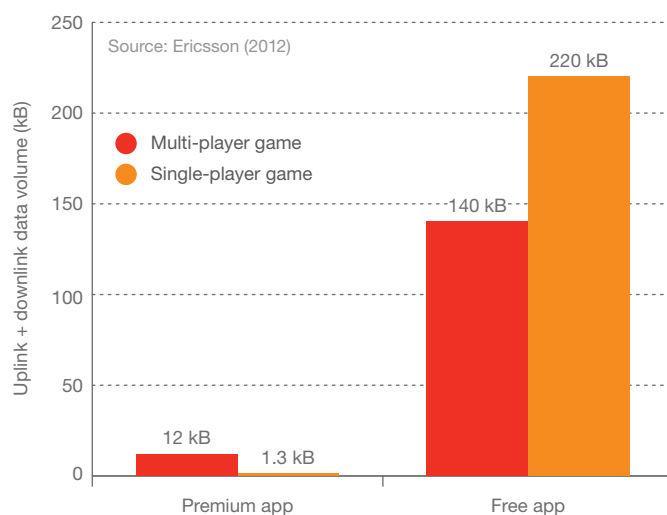
The advertisements in the free version of an app lead to higher data volumes and an increased number of requests to access the network

Free vs premium

Ericsson has measured the impact from the free version compared to the premium version of the same app. The study looked at different factors of the operator and the user, comparing data usage, network access and smartphone battery consumption. The study has not examined the added traffic from clicking on the link in the advertisement.

For the analysis two highly popular game apps for Android were measured – a single-player game and a multi-player game. The single-player app is characterized by short sessions with new levels being added constantly. The game, both in the free and premium versions, is stored and executed locally on the smartphone, with limited need to exchange game information over the network. In the free version advertisements are delivered for every new level played.

Figure 23: Comparison of data volume usage for a game session



Data volume measurement based on a typical game session lasting between 10 and 15 minutes for each game. Only data traffic from the game is measured, clicks on advertisements are not included.

The multi-player app is a game played over the network and over a longer period of time. After every turn it waits for each player to make a move. The game communicates over the network in both the free and premium versions, making updates after each move. In the free version advertisements are delivered for each new game and after each move.

Impact on users and networks

Advertising in apps leads to higher data volumes. Figure 23 shows that for a typical game session both of the free versions increase the data volumes due to advertisements. The data volumes are relatively limited and manageable for the operator. However, for the user, this background traffic could lead to extra charges, which could even exceed the cost of the premium version of the app. Examples of such situations include roaming or hitting extra tariffs when exceeding data plan quotas.



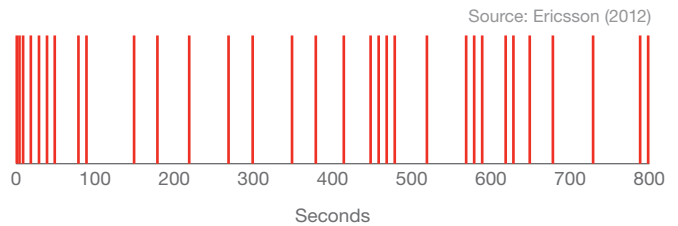
FREE VERSIONS OF SINGLE-PLAYER GAMES GENERALLY CAUSE INCREASED BATTERY CONSUMPTION

The different characteristics of the games create different needs when requesting network access, such as requests for a data channel. This has been measured over a period of time and the result for the free version can be seen in figure 24. The premium app had only one network access request, at the beginning of the time period. The free single-player game shows an increase of 30 times in the number of requests to access the network compared with the premium version. This increase will have an effect on the network load, with a potential need for additional network capacity. This is especially true when taking into consideration the popularity of apps, both in terms of user numbers and frequency of usage. The multiplayer game creates only a minor increase of network access requests in both the free and premium versions. This is because the advertisement is reusing the network access needed to exchange game information.

The battery consumption of the smartphone is directly and negatively impacted by increased network access requests. The advertisements in the free single-player game increased battery consumption by 25 percent compared with the premium version. This is based on the game session measured. The measurement for the multi-player game shows no significant increase in battery consumption. The app, free or premium version, needs to update game information and therefore will still need to request a connection.

The characteristics of the two game apps measured are not unique and other apps are likely to create a similar impact.

Figure 24: Network access requests over time for free version of single-player game (with ads)



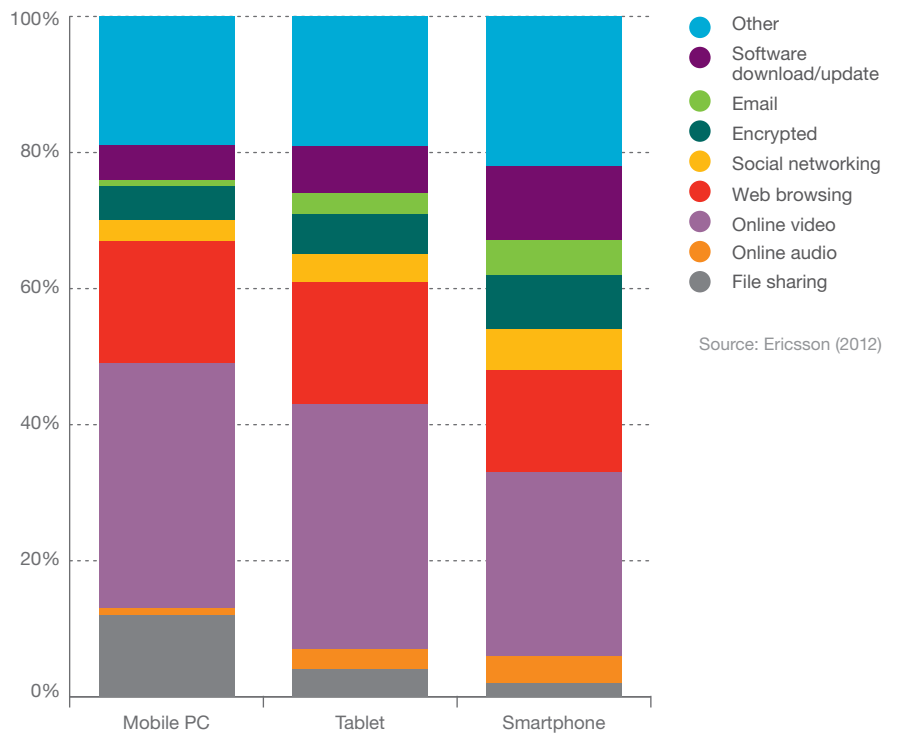
TRAFFIC MIX FOR APPLICATIONS AND DEVICES



Figure 25 shows how the most widely-used online applications contribute to overall mobile data traffic volumes, and how these contributions vary by the type of connected device. This is based on average values from the measured networks. Actual values in individual networks can differ a lot. Regardless of device type, online video is the biggest contributor to traffic volumes (25-40 percent), followed by web browsing (15-20 percent). Traffic drawn from mobile PCs is notable for having significantly higher file sharing activity than other devices. Online audio, email, software downloads and social networking are also important contributors to data traffic on tablets and smartphone devices. The file sharing part under smartphones comes from tethering traffic.

The measurements in this section were made in a selected number of commercial HSPA and LTE networks in Asia, Europe and the Americas.

Figure 25: Application mobile data traffic volumes by device type



Source: Ericsson (2012)

The data used for this graph does not take into account Wi-Fi traffic. Smartphones include Android and iPhone only. "Other" includes applications that were not possible to identify or that don't qualify as one of the listed applications.



TETHERING

Tethering enables users to share their mobile internet connection with other devices, such as mobile PCs, tablets or smartphones. Devices can be tethered over Wi-Fi, Bluetooth or by physical connection such as a USB cable. This is illustrated in the diagram to the right.



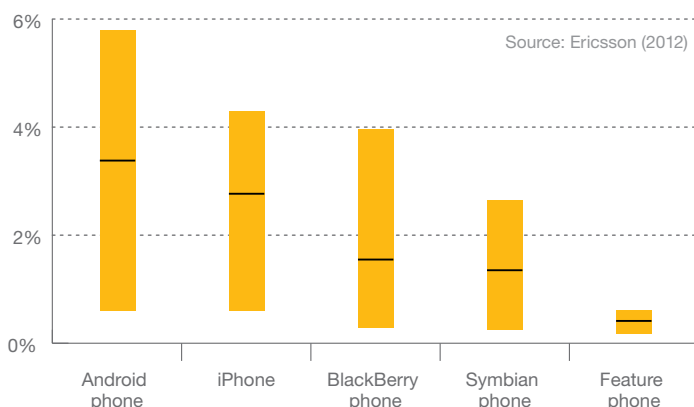
This section investigates the utilization of tethering on mobile phones and its impact on mobile data traffic.

Android and iPhone tether the most

Figure 26 shows the penetration of tethering from mobile phones with different operating systems. Tethering can easily be set up on the majority of Android and iPhone devices currently available on the market. This is one reason why these devices are the ones most commonly used for tethering. There is a large variation between networks created by different operator policies towards tethering. On the average network, around 3.5 percent of Android smartphones are used to tether other devices and enable internet access. The tethering penetration is around six percent in the network with the highest amount of Android tethering users.

One trend is that operators increasingly charge consumers for tethering devices. However, some regulator and consumer interest groups have opposed introducing tethering fees to data plans.

Figure 26: Tethering penetration per phone Operating System



Mobile data tethering traffic was identified correlating the IMEI TAC (terminal identifier) of the terminal accessing the HSPA network and the user agent HTTP header field containing information about the end user terminal and application. Identifying tethering with the same terminal model is thus not possible. Measurements were performed during one week. The percentage of tethering users would be higher if measured over a month. Only subscriptions with data traffic are considered, voice-only subscriptions are excluded.

Traffic variation figures

The results show that there is a big difference between the individual networks measured in this chapter. The graphs therefore reflect this broad spread of data in different measured networks.

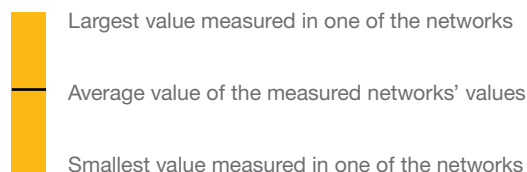


Figure 27 shows the tethering penetration of different smartphones from the same vendor with the same OS. There can be large differences between models depending on tethering capabilities. Generally, tethering is more popular on models with a built-in Wi-Fi hotspot feature.

Tethering combinations

Figure 28 compares tethering combinations on different mobile phones. The most common tethering combination is to share the 3G connection of an iPhone or an Android smartphone with a mobile PC. Typically, more than 1.5 percent of iPhone and Android smartphone users in a network share their 3G connection with a mobile PC.

Figure 27: Penetration of tethering for different smartphone models from the same vendor and with the same OS

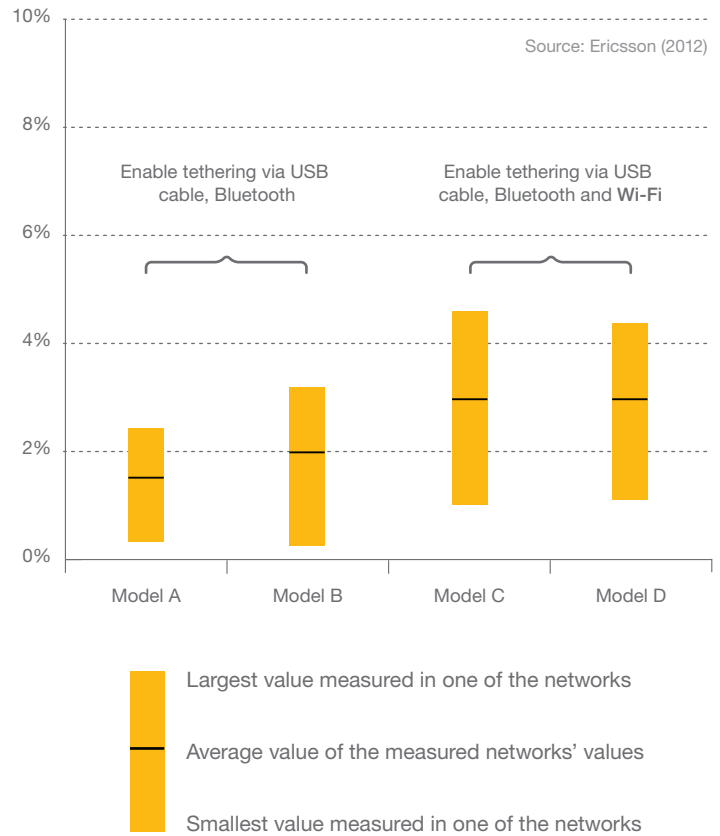
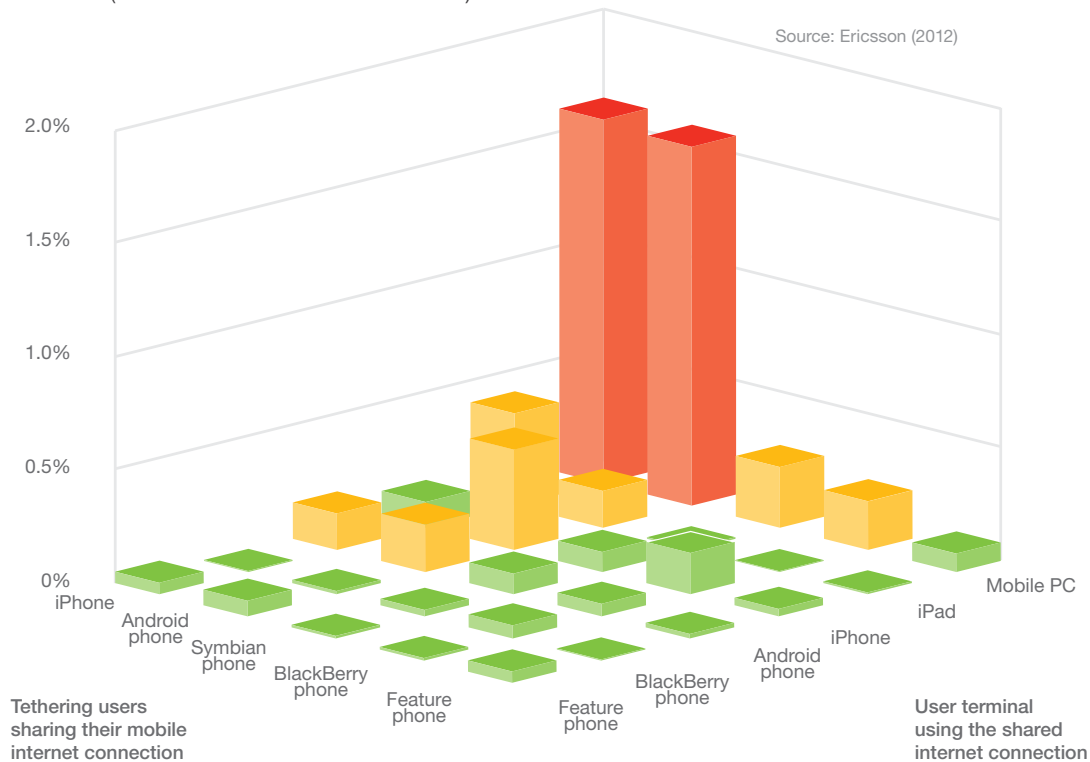


Figure 28: Different tethering combinations (medians from all measured networks)



Tethering for Android tablets and Windows phones is excluded from the analysis. This is because the results are statistically unreliable due to the small number of devices seen in most measurements. Mobile routers have not been included since they are meant to tether.

Tethering iPhones and Android smartphones to other Android or iOS devices is less frequent but still notable. For example, around 0.5 percent of iPhones tether with iPads, and around 0.6 percent of Android phones tether with iPhones. Symbian and BlackBerry smartphones follow the same pattern but on lower levels. All other combinations are very rare. The supply of iPhone and Android smartphones in most markets exceeds that of other models. This impacts the tethering numbers. Note that a device can tether with several different devices simultaneously.

Tethering users have higher usage

Figure 29 allows us to compare the traffic from tethering users with those that do not tether. It includes all traffic and shows that the average traffic per subscription from tethering users can be up to 20 times higher than for those that do not tether. The variation for iPhones is less than for other models because it does not include low end models as is the case for other smartphone Operating Systems.

Figure 30 only includes traffic from tethering users. The traffic that comes from tethering is compared with the total traffic that tethered users generate. On average, more than half of the total traffic volume from tethering users comes from tethering, except for iPhones.

Tethering users normally have higher average traffic usage even when not including the tethered traffic.

The measurements in this section were made in a selected number of commercial WCDMA/HSPA networks in Asia, Europe and the Americas.

Figure 29: Traffic from tethering users compared to traffic from non tethering users

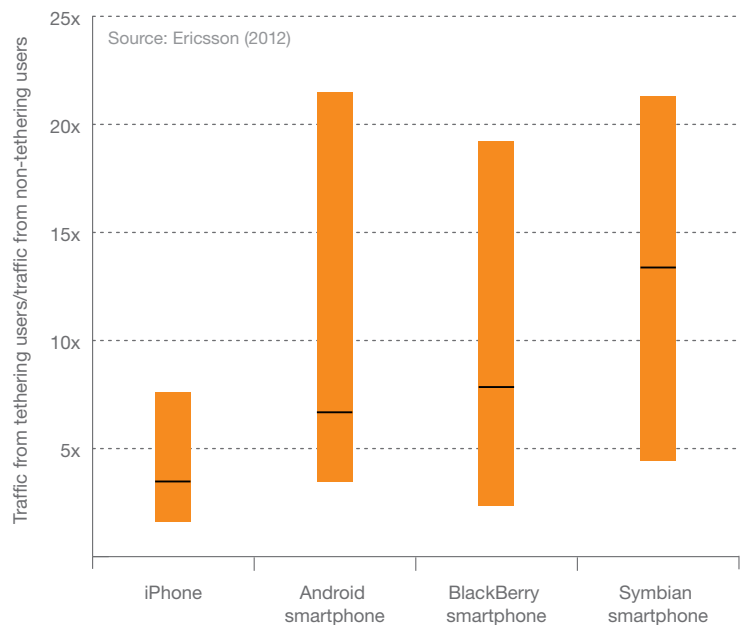
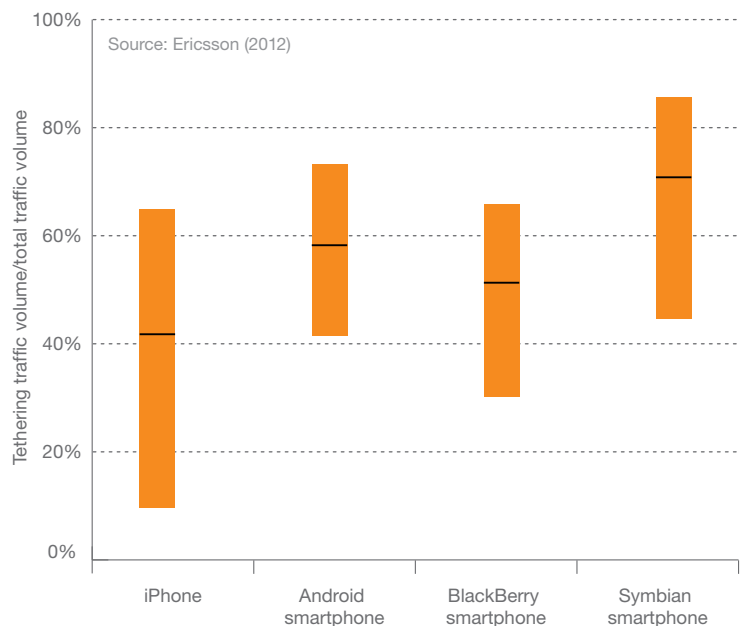


Figure 30: Tethering traffic volume ratio – tethering users



20X
 TRAFFIC FROM TETHERING USERS CAN BE UP TO 20 TIMES HIGHER THAN TRAFFIC FROM NON-TETHERING USERS

Traffic variation figures

The results show that there is a big difference between the individual networks measured in this chapter. The graphs therefore reflect this broad spread of data in different measured networks.

- Largest average value measured in one of the networks
- Average value of the measured networks' average values
- Smallest average value measured in one of the networks

UPLINK VERSUS DOWNLINK TRAFFIC VOLUMES

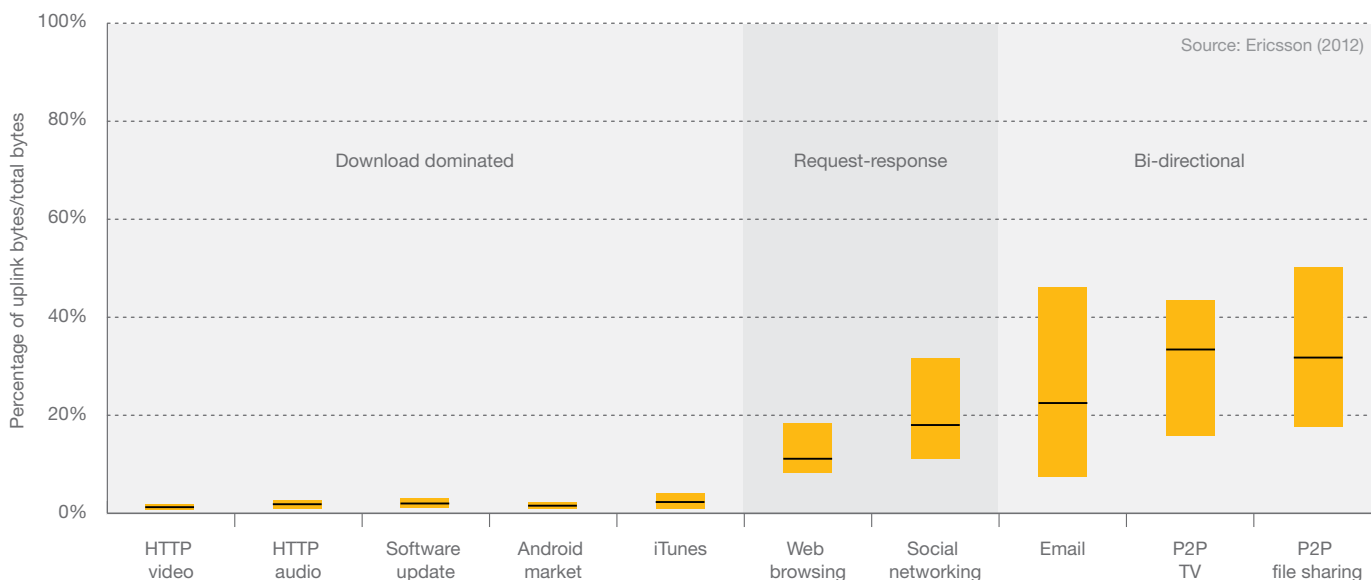
The ratio of uplink and downlink traffic volumes varies a lot between applications. It is an important factor that needs to be considered when designing and dimensioning mobile data networks. Figure 31 shows the ratio of uplink versus total data traffic volume for different applications. Measurements have been performed at the edge of the packet core network; results for the radio interface will differ slightly (higher uplink traffic ratios) due to additional protocol data headers.

Uplink traffic ratios for P2P file sharing, P2P TV and email vary largely between different networks. Two of the main reasons for this are uplink radio capabilities and peer selection algorithms in P2P systems.

When selecting peers from which to download any given content, those with higher uplink capacity are usually preferred in most P2P systems. Therefore networks with better uplink capabilities usually have higher uplink volume ratios for P2P traffic. This is reflected by the fact that the highest uplink ratio for P2P file sharing traffic has been measured in an LTE network. Audio and video encoding bitrates are also adapted dynamically according to available uplink and downlink capacities in many VoIP and video conferencing applications.

Depending on the popularity of different applications and terminals, the overall ratio of uplink traffic volume can vary a lot between networks.

Figure 31: Ratio of uplink traffic volume for different applications



Example of how to read this graph: the highest ratio of uplink traffic volume for P2P file sharing in one network was around 50 percent.

Download dominated applications: software download, software update, HTTP video, HTTP audio, web TV, etc. These applications are download only. (iTunes includes App Store)

Request-response applications: social networking, web browsing, etc. These have a typical request-response communication pattern where requests (in the uplink direction) are typically much smaller than responses (in the downlink direction).

Bi-directional applications: email, instant messaging, VoIP, video conferencing and various P2P applications. On average these

applications generate similar amounts of uplink and downlink traffic volumes. Emails and instant messages are both sent and received, shared files are both uploaded and downloaded, etc.

Many applications have popular P2P equivalents motivated by savings on infrastructure cost. For example, Skype for VoIP, PPStream or PPLive for online TV, Spotify for online audio, BitTorrent for file sharing. In P2P systems, content is not provided by dedicated servers but by other regular users (peers) in the system.

However, it can be as low as 10 percent in networks where there is a lot of HTTP video usage and can reach up to 25 percent in mobile PC-dominated networks with a lot of P2P file sharing or P2P TV usage.

In most measured networks, there have been no major changes in uplink/downlink traffic ratios for the past two years. However there are a few exceptions, the ratio of uplink traffic volume has slightly decreased in a few mobile PC-dominated networks with high P2P application usage (mainly in Asia). This is a result of increasing smartphone traffic volume shares and hence decreasing P2P traffic share from mobile PCs. On the other hand, the proliferation of online storage services (such as Google Drive and iCloud) and increasing popularity of mobile photo and video uploads to social networking sites will increase the uplink traffic volumes in the future.

The measurements in this section were made in a selected number of commercial WCDMA/HSPA and LTE networks in Asia, Europe and the Americas.

SOCIAL NETWORKING

It is interesting to note the high uplink traffic ratio for social networking. This is because it is not only focused on viewing existing content – users also actively contribute to creating content. Examples include uploading posts, pictures and videos.

Uplink traffic ratios for P2P file sharing, P2P TV and email vary a lot between different networks



Traffic variation figures

The results show that there is a big difference between the individual networks measured in this chapter. The graphs therefore reflect this broad spread of data in different measured networks.

Largest average value measured in one of the networks

Average value of the measured networks' average values

Smallest average value measured in one of the networks

KEY FIGURES

Mobile subscription essentials	2011	2012	2018 forecast	CAGR 2012-2018	Unit
Worldwide mobile subscriptions	6,000	6,600	9,300	6%	millions
– Smartphone subscriptions	750	1,100	3,300	20%	millions
– Mobile PC, tablet and mobile router subscriptions	200	250	850	25%	millions
– Mobile broadband subscriptions	1,000	1,500	6,500	30%	millions
– Mobile subscriptions, GSM/EDGE	4,400	4,600	2,400	-10%	millions
– Mobile subscriptions, WCDMA/HSPA	900	1,200	4,400	25%	millions
– Mobile subscriptions, LTE	9	55	1,600	75%	millions

Mobile traffic essentials	2011	2012	2018 forecast	CAGR 2012-2018	Unit
– Monthly data traffic per smartphone	300	450	1,900	30%	MB/month
– Monthly data traffic per PC	2,300	3,000	11,000	25%	MB/month
– Monthly data traffic per tablet	450	600	2,700	30%	MB/month
Total monthly mobile data traffic	600	1,100	13,000	50%	PetaByte/month

Traffic growth	Multiplier 2012-2018	CAGR 2012-2018
All mobile data	12	50%
– Smartphones	14	55%
– PC	7	40%
– Tablets	40	85%

METHODOLOGY

Forecast methodology

Ericsson performs forecasts on a regular basis to support internal decisions and planning as well as market communication. The subscription and traffic forecast baseline in this report is based on historical data from various sources, validated with Ericsson internal data, including extensive measurements in customer networks. Future development is estimated based on macroeconomic trends, user trends (researched by Ericsson ConsumerLab), market maturity, technology development expectations and documents such as industry analyst reports, on a national or regional level, together with internal assumptions and analysis. Updates to the subscription and traffic forecasts are announced on an annual basis.

Traffic measurements

New devices and applications affect mobile networks. Having deep and up-to-date knowledge of the traffic characteristics of different devices and applications is important when designing, testing and managing mobile networks. Ericsson regularly performs traffic measurements in over 100 live networks in all major regions of the world. Detailed measurements are made in a selected number of commercial WCDMA/HSPA and LTE networks with the purpose of discovering different traffic patterns. All subscriber data is made anonymous before it reaches Ericsson's analysts.

GLOSSARY

2G: 2nd generation mobile networks

3G: 3rd generation mobile networks

APAC: Asia Pacific

CAGR: Compound Annual Growth Rate

CDMA: Code Division Multiple Access

CEE: Central and Eastern Europe

CEMA: Central and Eastern Europe, Middle East and Africa

DSL: Digital Subscriber Line

EDGE: Enhanced Data Rates for Global Evolution

FDD: Frequency-Division Duplex

GB: GigaByte

GSM: Global System for Mobile Communications

HSPA: High Speed Packet Access

HTTP: Hypertext Transfer Protocol

IMEI-TAC: International Mobile Equipment Identity – Type Approval Code

LA: Latin America

LTE: Long-Term Evolution

M2M: Machine-to-Machine

MB: MegaByte

MBB: Mobile Broadband. Defined as CDMA2000 EV-DO, HSPA, LTE, Mobile WiMAX and TD-SCDMA

Mbps: Megabits per second

MEA: Middle East and Africa

Mobile PC: Defined as laptop or desktop PC devices with built-in cellular modem or external USB dongle

Mobile router: A device with a cellular network connection to the internet and Wi-Fi or ethernet connection to one or several clients (such as PCs or tablets)

NA: North America

OS: Operating System

P2P: Peer-to-Peer

PetaByte: 10¹⁵ Bytes

TDD: Time-Division Duplex

TD-SCDMA: Time Division-Synchronous Code Division Multiple Access

VoIP: Voice over IP (Internet Protocol)

WCDMA: Wideband Code Division Multiple Access

WE: Western Europe

xDSL: Various technologies for DSL

Ericsson is the world's leading provider of communications technology and services. We are enabling the Networked Society with efficient real-time solutions that allow us all to study, work and live our lives more freely, in sustainable societies around the world.

Our offering comprises services, software and infrastructure within Information and Communications Technology for telecom operators and other industries. Today more than 40 percent of the world's mobile traffic goes through Ericsson networks and we support customers' networks servicing more than 2.5 billion subscribers.

We operate in 180 countries and employ more than 100,000 people. Founded in 1876, Ericsson is headquartered in Stockholm, Sweden. In 2011 the company's net sales were SEK 226.9 billion (USD 35.0 billion). Ericsson is listed on NASDAQ OMX, Stockholm and NASDAQ, New York stock exchanges.

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