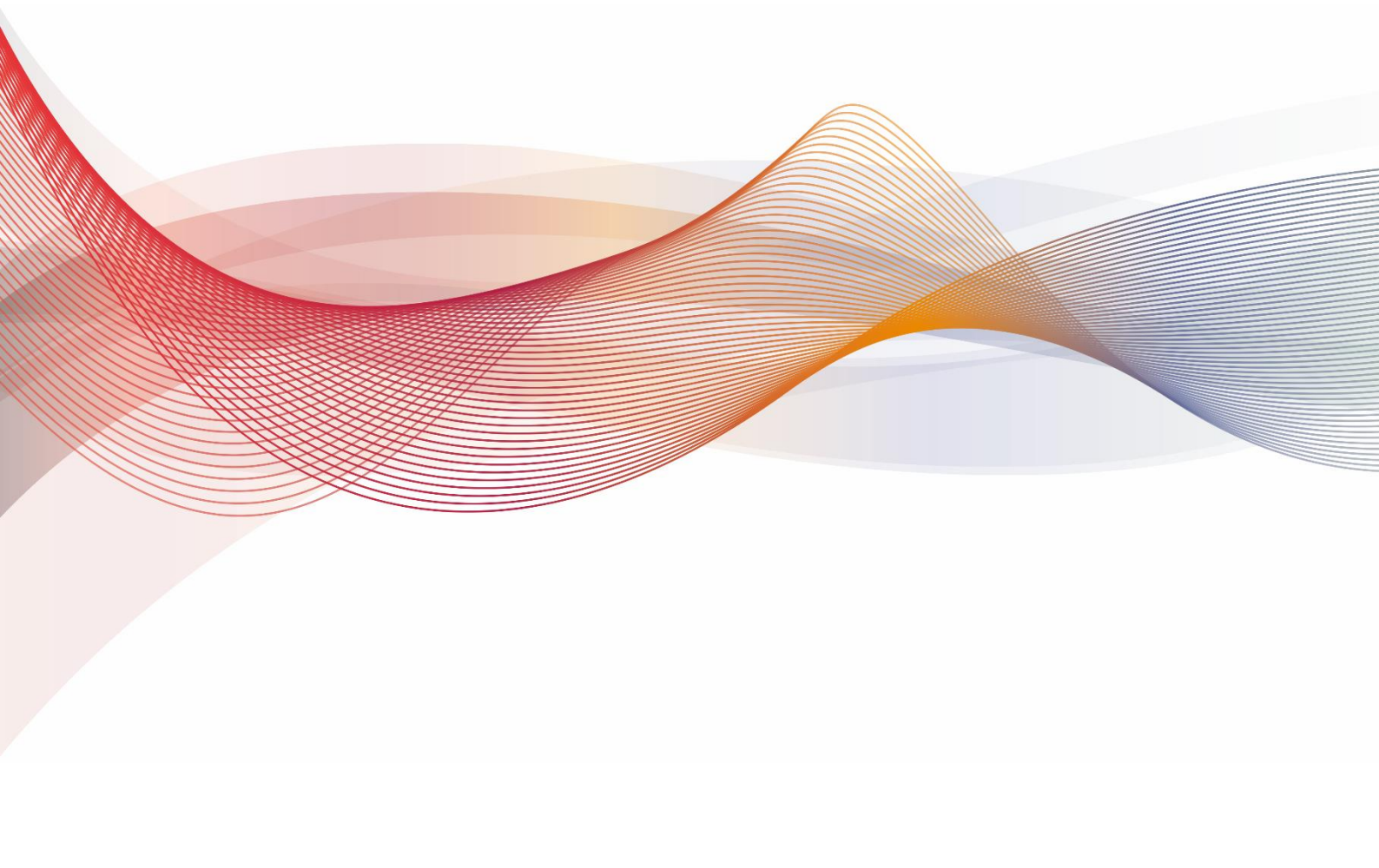
GSMA

SPECTRUM 4 ALL
DRIVING GROWTH THROUGH MOBILE

GSMA - Mobile Spectrum

Data demand explained

June 2015



Executive Overview

Mobile broadband services are undergoing a period of dramatic growth causing a tremendous increase in data traffic. This rising tide of traffic is being driven by the growing number of mobile subscribers, particularly smartphone users, who are connecting to faster networks and consuming bandwidth-hungry video content.

Such is the rate at which mobile subscribers are consuming more data that new technologies alone cannot keep up. Mobile operators are continuously making their networks more efficient by investing in new generations of mobile technology (e.g. 4G) and rolling out ever increasing numbers of cellular base stations as well as public Wi-Fi. However, these network upgrades will not be sufficient to meet growing demand - mobile services also need access to more spectrum.

The more spectrum operators have, the more traffic they can carry. Even with the use of new wireless technologies and Wi-Fi, the GSMA has calculated, based on traffic growth estimates, 600-800MHz of additional spectrum will need to be made available for mobile broadband use by 2020 in order to meet growing consumer demand. The availability of this additional harmonised spectrum will be critical for the future vitality of mobile services and the broader digital economy.

The rapid rise in traffic is putting mobile networks under strain, especially during peak periods. To be able to keep up with demand in the medium-to-long term, and to offer commercially viable services, operators need to use globally, or at least regionally, harmonised spectrum so that equipment makers can gain economies of scale for rapidly rolling out new equipment to allow mobile devices to operate in many different countries.

Although policy makers might be tempted to see the spectrum crunch as a long-term problem that can be tackled at a later date, it actually needs to be addressed now. The identification of harmonised spectrum requires considerable international coordination and that takes time.

It can take up to 10 years for new internationally harmonised spectrum for mobile to be agreed, licensed and used to deliver services. It is therefore vital that governments and regulators act now in order to meet the expected mobile data demands in 2020 and beyond. At the ITU's World Radiocommunication Conference in November 2015 (WRC-15), policy makers need to ensure that sufficient additional spectrum is identified for mobile broadband services for the next decade.

Now is the time to act

> *"The rise of mobile broadband is a game changer for global development. But delivering affordable ubiquitous services depends on access to sufficient harmonised spectrum in the right frequency bands."*
> **Suvi Linden, UN Broadband Commissioner and former Minister of Communications for Finland**

Multimedia unleashed by mobile broadband

> *"Today, it's all about mobile, mobile, mobile. And to me that means spectrum, spectrum, spectrum. To keep pace with a transforming mobile sector, expanding ecosystem, and soaring consumer demand for data, we need to release more airwaves for new broadband data use – and use the airwaves we have more efficiently. Spectrum, after all, is the lifeblood of mobile broadband."*
> **Commissioner Jessica Rosenworcel, FCC.**

Behind the scenes, advances in mobile network technology are enabling consumers to access multimedia applications that would have been impossible on the first and second generation mobile networks. The deployment of mobile broadband services has unleashed a multitude of multimedia services and a corresponding explosion in data traffic.

Last year's mobile data traffic alone was nearly 30 times the size of the entire global Internet in 2000.

Vodafone[1] reported that data traffic on its global networks jumped 80% in the year ending Q2 2014, with growth driven by 4G in Europe and 3G in India. China Mobile, China's largest mobile operator, reported its mobile data traffic grew by 158% annually to reach 490.3 billion megabytes in Q1 2015.

In more advanced mobile markets, 4G services are driving a surge in data usage: 4G users typically consume twice as much data per month as other users, according to GSMA Intelligence[2]. More importantly, the growth rate of mobile data traffic is noticeably different after introduction of 4G (see fig 1).

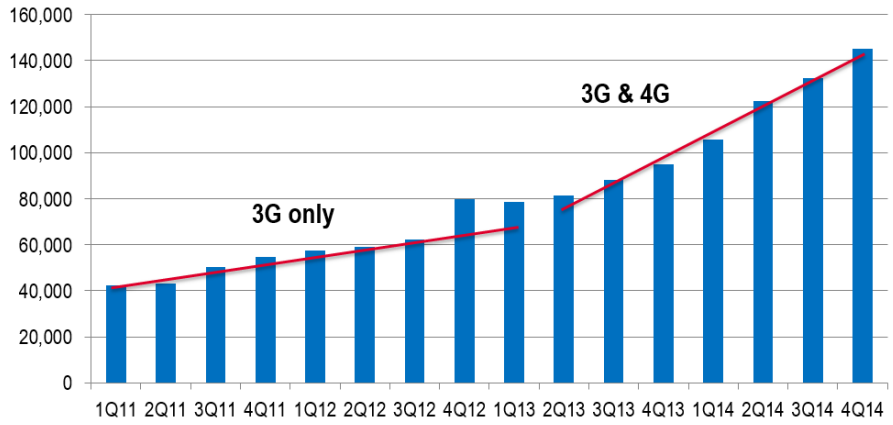


Figure 1: Quarterly mobile data growth in Italy which includes the introduction of 4G (in terabytes)

For a glimpse of the future, we can look at South Korea. With 100% 4G population coverage and LTE accounting for more than half the mobile connections, the country is the world's most advanced 4G market. The average monthly data consumption of its 4G users reached 3 gigabytes at end of 2014 – compared with 819 megabytes which was the global average for smartphone users.

GSMA Intelligence notes that users in South Korea have also begun to shun Wi-Fi networks - continuing to use 4G even when Wi-Fi is available - to maintain the consistency of their experience, especially when the 4G network provides a faster download/upload speed than a Wi-Fi service.

4G users are data-hungry and operators in the U.S. are seeing similar trends. Verizon Wireless announced that retail customers connected to its 4G network were responsible for 84% of its total data traffic in Q4 2014.

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[1] Vodafone financial update November 2014
[2] https://gsmaintelligence.com/analysis/2014/1/4g-driving-dta-usage-but-not-all-markets-reaping-the-rewards/412/

Conversion of mobile traffic growth to additional spectrum requirements

A mobile operator's radio spectrum requirements depend on the total amount of traffic it needs to carry in the most densely populated locations during the busiest periods.

Operators design their networks to support the traffic generated by users taking into consideration the time-of-day usage variations, cell size for geographic coverage, user density, and performance parameters, such as access failures, call drops, and acceptable error rate. Additionally, the radio networks are designed to carry the traffic cost-effectively.

Different radio technologies have different spectral efficiency in terms of the amount of traffic they can carry per second over a unit of spectrum bandwidth. The mix of technologies (e.g. GSM, HSPA, LTE) in use will determine how much spectrum a mobile operator will need to meet the demand for traffic in the busiest periods in a specific location. All these elements are taken into consideration to estimate the amount of spectrum required to meet the growth in mobile traffic.

Data traffic will continue to soar

Although mobile data traffic has grown dramatically in the past five years, there are plenty of reasons to believe there is far more growth still to come. In the next ten years, billions more people and machines will use mobile networks to access online services and connect with each other. At the same time, smartphones will become increasingly ubiquitous and each new smartphone user will send and receive far more data than they did with their previous handset.

Moreover, usage of video-on-demand services will continue to rise and the resolution of these videos will continue to improve. Every day people watch hundreds of millions of hours on YouTube and generate billions of views - half of all YouTube views are on mobile devices. Facebook is a relative newcomer to the world of video delivery but now serves four billion videos per day - 75% of which are consumed on mobile devices.

By 2020, people will expect to be able to watch videos in HD whenever and wherever they want regardless of how the content is being streamed to their device.

A tidal wave of traffic

The growing popularity of high definition video and other rich multimedia content is going to fuel a further surge in mobile data traffic. While market forecasts vary, there is a consensus that the traffic on mobile networks is going to grow dramatically for the rest of this decade.

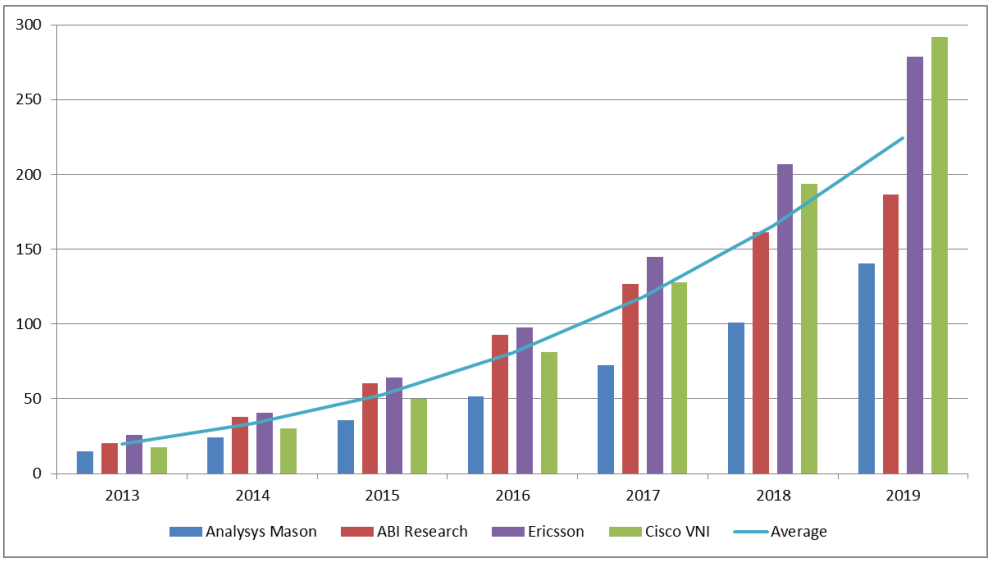


Figure 2: Annual global mobile data traffic (in Exabytes)

By 2020, there will be 2.8 billion 4G-LTE connections worldwide, up from 500 million at the end of 2014[3]. As 4G users generate far more data than 3G users that implies a massive increase in traffic over the next six years. Cisco VNI[4] forecast for South Korea states mobile traffic will reach 13GB per month per unique subscriber by 2019.

[3] GSMA Intelligence

[4] http://www.cisco.com/assets/sol/sp/vni/forecast_highlights_mobile/index.html#~Country

Mounting pressure on mobile networks

Mobile networks are like roads – they have limited space. If too much traffic arrives at once, they become congested and the traffic slows to a crawl or even grinds to a halt. Like roads, mobile networks have bottlenecks. And mobile networks also have rush hours – traffic tends to peak at certain times of the day. For example, the base stations near a railway station are most likely to get congested between 5pm and 7pm on a weekday. Similarly, the mobile networks in business centres (central business districts) could be inundated with traffic during the lunch hour when local office workers spill onto the streets.

If network congestion is allowed to rise unchecked, it could eventually stop the positive impact of mobile broadband services on the economy and on society. It is critically important to increase network capacity to prevent these bottlenecks.

How to increase network capacity

A mobile capacity crunch is inevitable, but mobile operators essentially have four inter-related ways to address the soaring demand for data-hungry services. These are:

1. Network densification – deploying more base stations.
2. Offloading traffic – steering more traffic towards Wi-Fi and fixed networks and away from mobile base stations.
3. Improving spectral efficiency – using new technologies to squeeze more traffic into a specific slice of spectrum.
4. Acquiring more mobile spectrum – if governments make more spectrum available for mobile broadband services then operators can use it to add capacity to their networks.

1. Network densification

Mobile operators can increase the number of base stations in those parts of the network that are becoming congested at peak times. In practice, this could mean deploying new base stations or it could mean harnessing small cell technologies – attaching light weight transmitters to lampposts, buildings and other locations to take the pressure off the existing base stations. All of this does come at a cost in both time and money. Deploying new sites involves more capital expenditure, more backhaul (fixed infrastructure) and time consuming processes to get planning for new locations in capacity limited areas. This leads to less optimal investment into mobile network which will ultimately impact the price paid by end consumers.

2. Offloading traffic

Another way to reduce the pressure on existing base stations is to encourage people to connect to Wi-Fi hotspots and offloading the data to the fixed network. In some countries, mobile operators now provide their customers with access to Wi-Fi connections in coffee shops, restaurants, hotels and transport terminals. While these Wi-Fi hotspots can provide high-speed connectivity, their performance is highly dependent on the quality of the backhaul connecting the Wi-Fi router to the operator's network and the number of people using Wi-Fi in the vicinity. Furthermore, these networks do not provide secure communications.

Although Wi-Fi, which uses unlicensed spectrum, can appear to be a low-cost solution to the capacity crunch, it isn't a panacea. Like a free beach or motorway, unlicensed spectrum tends to attract lots of users and can get very crowded as well. Indeed, in city centres, Wi-Fi hotspots can be very congested and can interfere with each other.

3. Improving spectral efficiency

The spectral efficiency of mobile services increases with each new release of network technology. The mobile industry estimates that 3G technology is eight times more spectrally efficient than 2G technology, while LTE/LTE-Advanced is 20 times more spectrally efficient than 2G. Of course, fully realising these gains depends on the widespread deployment of new network technologies and uptake of compatible devices by end-users.

In some cases, a mobile operator will require new spectrum to deploy LTE. In other cases, where their licenses and market circumstances permit, mobile operators can deploy LTE in frequencies that had originally been used for 2G. However, not all spectrum can be 'refarmed' in this way: Operators may have to continue to support some 2G connections, such as those used by smart energy grids and other machine-to-machine applications with long lifespans.

4. Licensing more mobile spectrum

The more spectrum that governments allow mobile operators to have, the more traffic they can carry. Based on traffic growth estimates, even with the help of the measures listed above, the GSMA has calculated that 600-800MHz of additional spectrum will need to be made available for mobile broadband use by 2020 – this is consistent with other industry estimates. The amount of spectrum needed for each national market will vary depending on their data demand forecasts, population distribution and other national circumstances.

What spectrum should be made available for mobile?

Before a band can be licensed to a mobile operator by a national regulator, it must first be identified for mobile broadband on an international basis through the ITU – the UN's telecom body. This ensures the band is harmonised for mobile use around the world which drives down the prices of mobile devices through economies of scale, enables roaming and minimises international interference. The process of agreeing new international mobile bands takes place at the ITU's World Radiocommunication Conference (WRC) which takes place every three to four years.

The next WRC will take place in November 2015 (WRC-15) where governments have been tasked with agreeing new mobile broadband spectrum identifications. It can take up to 10 years for new internationally harmonised mobile spectrum to be made available for mobile operators, licensed and used to deliver services. For example, 3G and 4G spectrum was first identified at the WRCs in 1992 and 2000 respectively which is almost a decade before the services launched. Therefore, governments will need to consider their potential mobile requirements in 2025 when making decisions this November.

Clearly governments don't license the spectrum made available at a WRC straight away. International agreements and spectrum planning mean several services may operate in the same frequency band without causing harmful interference to each other. These agreements grant governments the flexibility to continue to support existing services in new mobile bands for as long as necessary before introducing mobile services into parts, or all, of the band. This allows governments to increase the amount of mobile spectrum in line with national demand from consumers.
The GSMA is supporting four new mobile bands at WRC-15. These have been chosen because they can be widely harmonised around the world, and existing services can be viably supported elsewhere in the band or in alternative spectrum. These bands comprise a mixture of coverage (i.e. lower frequency) and capacity (i.e. higher bandwidth) bands to ensure that networks can provide cost-effective services in rural and metropolitan areas as well as deep inside buildings.

- Sub-700MHz UHF (470-694/8MHz)
- L-band (1350-1400MHz & 1427-1518MHz)
- 2.7-2.9GHz
- C-band (3.4-3.8GHz & 3.8-4.2GHz)

Detailed research into the bands, including sharing studies, which explore how mobile services can viably share the band with existing users, as well as economic studies, which highlight the business case for more efficient usage of spectrum resource, can be found at http://www.gsma.com/spectrum/resources/.

Now is the time to act

Over the coming years mobile services could transform society more than at any other time in history. Faster and more ubiquitous mobile services are set to drive a more connected world where billions of wirelessly-enabled devices will power new smart cities, industries and whole countries. Mobile broadband services will allow everybody to access any digital service everywhere. But the quality, capacity and reach of mobile services will always be determined by spectrum availability. Governments will be able to safeguard their mobile future by supporting vital new mobile spectrum bands at the World Radiocommunication Conference in November 2015.



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