

Cisco Visual Networking Index: Global Mobile Data Traffic Forecast Update, 2014–2019



February 3, 2015

The Cisco[®] Visual Networking Index (VNI) Global Mobile Data Traffic Forecast Update is part of the comprehensive Cisco VNI Forecast, an ongoing initiative to track and forecast the impact of visual networking applications on global networks. This paper presents some of Cisco's major global mobile data traffic projections and growth trends.

Executive Summary

The Mobile Network in 2014

Global mobile data traffic grew 69 percent in 2014. Global mobile data traffic reached 2.5 exabytes per month at the end of 2014, up from 1.5 exabytes per month at the end of 2013.

Last year's mobile data traffic was nearly 30 times the size of the entire global Internet in 2000. One exabyte of traffic traversed the global Internet in 2000, and in 2014 mobile networks carried nearly 30 exabytes of traffic.

Mobile video traffic exceeded 50 percent of total mobile data traffic for the first time in 2012. Mobile video traffic exceeded 50 percent of total mobile data traffic by the end of 2012 and grew to 55 percent by the end of 2014.

Almost half a billion (497 million) mobile devices and connections were added in 2014. Global mobile devices and connections in 2014 grew to 7.4 billion, up from 6.9 billion in 2013. Smartphones accounted for 88 percent of that growth, with 439 million net additions in 2014.

Globally, smart devices represented 26 percent of the total mobile devices and connections in 2014; they accounted for 88 percent of the mobile data traffic. (For the purposes of this study, smart devices refers to mobile connections that have advanced multi-media/computing capabilities with a minimum of 3G connectivity.) **In 2014, on an average, a smart device generated 22 times more traffic than a non-smart device.**

Mobile network (cellular) connection speeds grew 20 percent in 2014. Globally, the average mobile network downstream speed in 2014 was 1,683 kilobits per second (kbps), up from 1,387 kbps in 2013.

In 2014, a fourth-generation (4G) connection generated 10 times more traffic on average than a non-4G connection. Although 4G connections represent only 6 percent of mobile connections today, they already account for 40 percent of mobile data traffic.

The top 1 percent of mobile data subscribers generated 18 percent of mobile data traffic, down from 52 percent at the beginning of 2010. According to a mobile data usage study conducted by Cisco, the top 20 percent of mobile users generated 85 percent of mobile data traffic, and the top 1 percent generated 18 percent.

Average smartphone usage grew 45 percent in 2014. The average amount of traffic per smartphone in 2014 was 819 MB per month, up from 563 MB per month in 2013.

Smartphones represented only 29 percent of total global handsets in use in 2014, but represented 69 percent of total global handset traffic. In 2014, the typical smartphone generated 37 times more mobile data traffic (819 MB per month) than the typical basic-feature cell phone (which generated only 22 MB per month of mobile data traffic).

Globally, there were nearly 109 million wearable devices (a sub-segment of the machine-to-machine [M2M] category) in 2014 generating 15 petabytes of monthly traffic.

Globally, 46 percent of total mobile data traffic was offloaded onto the fixed network through Wi-Fi or femtocell in 2014. In 2014, 2.2 exabytes of mobile data traffic were offloaded onto the fixed network each month. Without offload, mobile data traffic would have grown 84 percent rather than 69 percent in 2014.

Per-user iOS mobile devices (smartphones and tablets) data usage marginally surpassed that of Android mobile devices data usage. By the end of 2014, average iOS consumption exceeded average Android consumption in North America and Western Europe.

In 2014, 27 percent of mobile devices were potentially IPv6-capable. This estimate is based on network connection speed and OS capability.

In 2014, the number of mobile-connected tablets increased 1.6-fold to 74 million, and each tablet generated 2.5 times more traffic than the average smartphone. In 2014, mobile data traffic per tablet was 2,076 MB per month, compared to 819 MB per month per smartphone.

There were 189 million laptops on the mobile network in 2014, and each laptop generated 3.2 times more traffic than the average smartphone. Mobile data traffic per laptop was 2.6 GB per month in 2014.

Average nonsmartphone usage doubled to 22 MB per month in 2014, compared to 11 MB per month in 2013. Basic handsets still make up the vast majority of handsets on the network (68 percent).

The Mobile Network Through 2019

Mobile data traffic will reach the following milestones within the next 5 years:

- Monthly global mobile data traffic will surpass 24.3 exabytes by 2019.
- The number of mobile-connected devices exceeded the world's population in 2014.
- The average global mobile connection speed will surpass 2 Mbps by 2016.
- Because of increased usage on smartphones, smartphones will reach three-quarters of mobile data traffic by 2019.
- Monthly mobile tablet traffic will surpass 2.0 exabytes per month by 2018.
- Tablets will exceed 10 percent of global mobile data traffic by 2016.
- 4G traffic will be more than half of the total mobile traffic by 2017.
- More traffic will be offloaded from cellular networks (on to Wi-Fi) than remains on cellular networks by 2016.

Global mobile data traffic will increase nearly tenfold between 2014 and 2019. Mobile data traffic will grow at a compound annual growth rate (CAGR) of 57 percent from 2014 to 2019, reaching 24.3 exabytes per month by 2019.

By the end of 2014, the number of mobile-connected devices will exceed the number of people on earth, and by 2019 there will be nearly 1.5 mobile devices per capita. There will be 11.5 billion mobile-connected devices by 2019, including M2M modules—exceeding the world's projected population at that time (7.6 billion).

Mobile network connection speeds will increase more than twofold by 2019. The average mobile network connection speed (1.7 Mbps in 2014) will reach nearly 4.0 megabits per second (Mbps) by 2019. By 2016, average mobile network connection speed will surpass 2.0 Mbps.

By 2019, 4G will be 26 percent of connections, but 68 percent of total traffic. By 2019, a 4G connection will generate 10 times more traffic on average than a non-4G connection.

By 2019, more than half of all devices connected to the mobile network will be “smart” devices. Globally, 54 percent of mobile devices will be smart devices by 2019, up from 26 percent in 2014. The vast majority of mobile data traffic (97 percent) will originate from these smart devices by 2019, up from 88 percent in 2014.

By 2019, 54 percent of all global mobile devices could potentially be capable of connecting to an IPv6 mobile network. More than 6.2 billion devices will be IPv6-capable by 2019.

Nearly three-fourths of the world's mobile data traffic will be video by 2019. Mobile video will increase 13-fold between 2014 and 2019, accounting for 72 percent of total mobile data traffic by the end of the forecast period.

By 2019, mobile-connected tablets will generate nearly double the traffic generated by the entire global mobile network in 2014. The amount of mobile data traffic generated by tablets by 2019 (3.2 exabytes per month) will be 1.3 times higher than the total amount of global mobile data traffic in 2014 (2.5 exabytes per month).

The average smartphone will generate 4.0 GB of traffic per month by 2019, a fivefold increase over the 2014 average of 819 MB per month. By 2019, aggregate smartphone traffic will be 10.5 times greater than it is today, with a CAGR of 60 percent.

By 2016, more than half of all traffic from mobile-connected devices (almost 14 exabytes) will be offloaded to the fixed network by means of Wi-Fi devices and femtocells each month. Without Wi-Fi and femtocell offload, total mobile data traffic would grow at a CAGR of 62 percent between 2014 and 2019, instead of the projected CAGR of 57 percent.

The Middle East and Africa will have the strongest mobile data traffic growth of any region with a 72-percent CAGR. This region will be followed by Central and Eastern Europe at 71 percent and Latin America at 59 percent.

Appendix A summarizes the details and methodology of the VNI Mobile Forecast.

2014 Year in Review

Global mobile data traffic grew 69 percent in 2014, a growth rate comparable to that in 2012, but lower than that in 2013, which was a “rebound” year after the 2012 slowdown. Growth rates varied widely by region, see Table 1. All of the emerging market regions experienced a strong growth of mobile data traffic in 2014. (Middle East and Africa grew 107 percent, Latin America grew 87 percent, and Central and Eastern Europe grew 91 percent.) Mobile data traffic grew 69 percent in Asia Pacific, 63 percent in North America, and 45 percent in Western Europe.

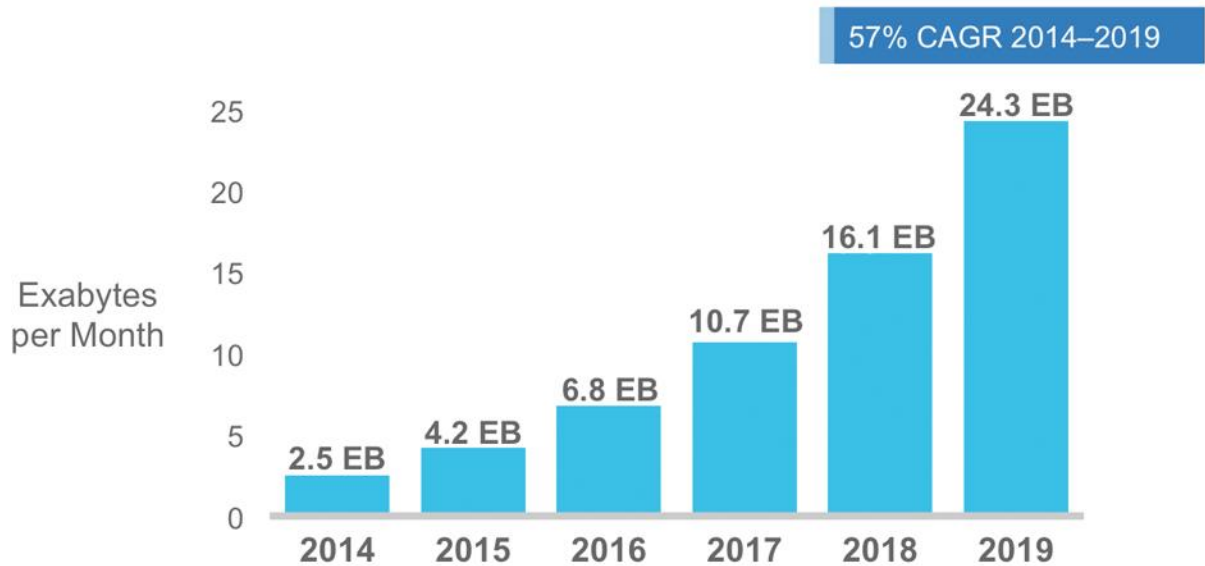
Table 1. Examples of Mobile Data Traffic Growth in 2014

Region	Mobile Traffic Growth Examples
United States	As reported by CTIA, mobile data traffic grew 120% in 2013.
China	Mobile data traffic of China's top three mobile operators grew 83% from mid-2013 to mid-2014.
Japan	Mobile data traffic grew 43% from Q3CY13 to Q3CY14, according to Japan's Ministry of Internal Affairs and Communications.
India	Bharti Airtel reported mobile data traffic growth of 95% between 3Q 2013 and 3Q 2014. Reliance Communications reported mobile data traffic growth of 75% between 3Q 2013 and 3Q 2014.
Australia	As reported by Australian regulator ACMA, mobile data traffic grew 52% from mid-2013 to mid-2014.
Italy	As reported by Italian regulator AGCOM, mobile traffic in Italy in 3Q14 was up 45% year-over-year.
France	As reported by French regulator ARCEP, mobile traffic in France was up 107% from 3Q 2013 to 3Q 2014.
Germany	As reported by German regulator BNA, mobile traffic in Germany grew 71% in 2013.
Sweden	As reported by Swedish regulator PTS, mobile traffic in Sweden grew 32 percent from mid-2013 to mid-2014.
Korea	As reported by Korean regulator KCC, mobile data traffic increased approximately 36% between 1H13 and 1H14.
Other	Vodafone's year-over-year global mobile traffic growth was 80% from 3Q13 to 3Q14. Vodafone's European traffic grew 65% 3Q13 to 3Q14.

Global Mobile Data Traffic, 2014 to 2019

Overall mobile data traffic is expected to grow to 24.3 exabytes per month by 2019, nearly a tenfold increase over 2014. Mobile data traffic will grow at a CAGR of 57 percent from 2014 to 2019 (Figure 1).

Figure 1. Cisco Forecasts 24.3 Exabytes per Month of Mobile Data Traffic by 2019



Source: Cisco VNI Mobile, 2015

The Asia Pacific and North America regions will account for a little over half of global mobile traffic by 2019, as shown in Figure 2. Middle East and Africa will experience the highest CAGR of 72 percent, increasing 15-fold over the forecast period. Central and Eastern Europe will have the second highest CAGR of 71 percent, increasing 14-fold over the forecast period. Latin America and Asia Pacific will have CAGRs of 59 percent and 58 percent, respectively.

Figure 2. Global Mobile Data Traffic Forecast by Region



Figures in parentheses refer to regional share in 2019.

Source: Cisco VNI Mobile, 2015

Top Global Mobile Networking Trends

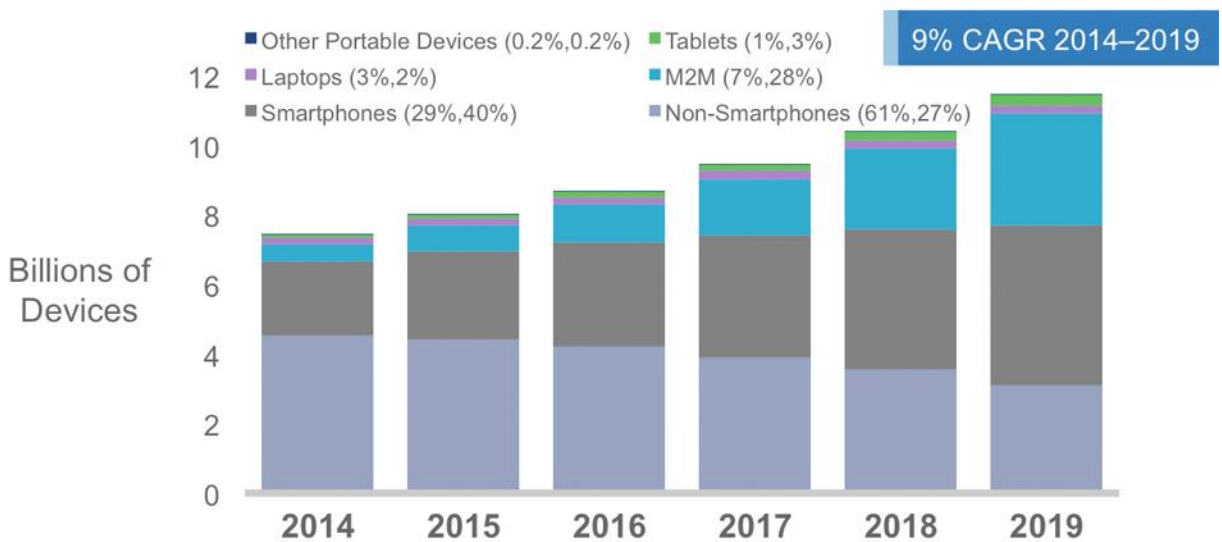
The sections that follow identify ten major trends contributing to the growth of mobile data traffic.

1. [Continuing Shift to Smarter Mobile Devices](#)
2. [Defining Cellular Network Advances \(2G, 3G, and 4G\)](#)
3. [Measuring Mobile IoE Adoption—M2M and Emerging Wearables](#)
4. [Analyzing Mobile Applications—Video Usage Increases](#)
5. [Profiling Bandwidth Consumption Patterns](#)
6. [Assessing Mobile Traffic/Offload by Access Type](#)
7. [Identifying a Potential Mobile App “Wildcard”—VoWi-Fi](#)
8. [Comparing Mobile Network Speed Improvements](#)
9. [Reviewing Tiered Pricing—Unlimited Data Makes Comeback](#)
10. [Tracking IPv6—Significant Global Mobile Adoption](#)

Trend 1: Continuing Shift to Smarter Mobile Devices

The increasing number of wireless devices that are accessing mobile networks worldwide is one of the primary contributors to global mobile traffic growth. Each year several new devices in different form factors and increased capabilities and intelligence are introduced in the market. Nearly half a billion (497 million) mobile devices and connections were added in 2014. In 2014, global mobile devices and connections grew to 7.4 billion, up from 6.9 billion in 2013. Globally, mobile devices and connections will grow to 11.5 billion by 2019 at a CAGR of 9 percent (Figure 3). By 2019, there will be 8.2 billion handheld or personal mobile-ready devices and 3.2 billion M2M connections (e.g., GPS systems in cars, asset tracking systems in shipping and manufacturing sectors, or medical applications making patient records and health status more readily available, et al.). Regionally, North America and Western Europe are going to have the fastest growth in mobile devices and connections with 22 percent and 14 percent CAGR from 2014 to 2019, respectively.

Figure 3. Global Mobile Devices and Connections Growth

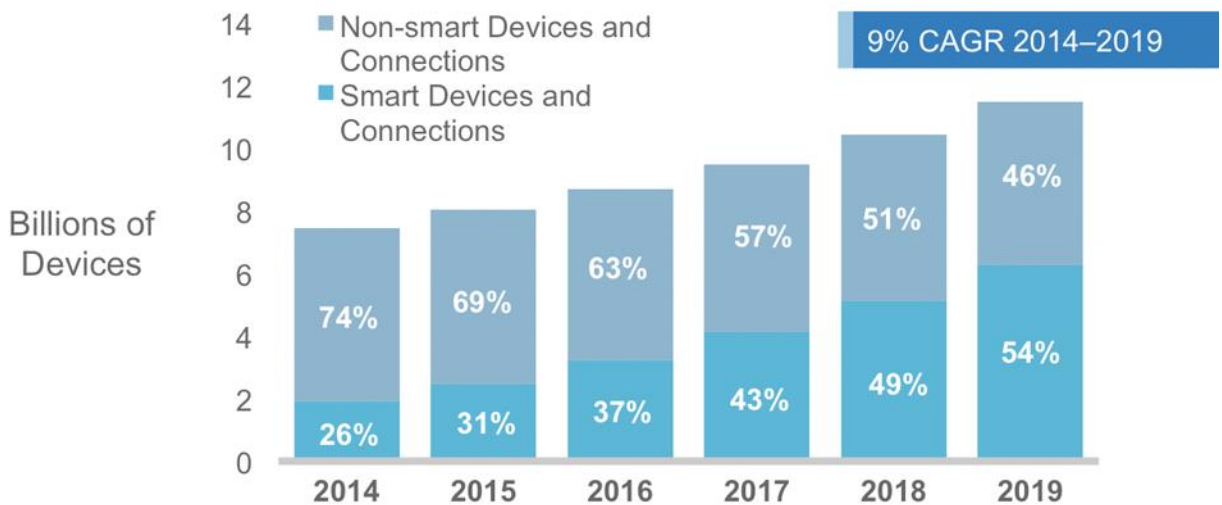


Figures in parentheses refer to 2014, 2019 device share.
Source: Cisco VNI Mobile, 2015

We see a rapid decline in the share of nonsmartphones from more than 61 percent in 2014 (4.5 billion) to less than 27 percent by 2019 (3.1 billion). The most noticeable growth is going to occur in M2M connections, followed by tablets. The M2M category is going to grow at 45-percent CAGR from 2014 to 2019, and tablets are going to grow at 32-percent CAGR during the same period.

Although there is an overall growth in the number of mobile devices and connections, there is also a visible shift in the device mix. This year we see a slight slowdown in the growth of tablets as a new device category, phablets (included in our smartphone category), were introduced. Tablet growth was also affected by the availability of lightweight laptops, which are quite similar to tablets in form factor but have more enhanced capabilities. Throughout the forecast period, we see that the device mix is getting smarter with an increasing number of devices with higher computing resources, and network connection capabilities that create a growing demand for more capable and intelligent networks. We define smart devices and connections as those having advanced computing and multimedia capabilities with a minimum of 3G connectivity. As mentioned previously, 497 million mobile devices and connections were added in 2014, and smartphones accounted for 88 percent of that growth at 439 million net adds. The share of smart devices and connections as a percentage of the total will increase from 26 percent in 2014 to more than half, at 54 percent, by 2019, growing 3.3-fold during the forecast period (Figure 4).

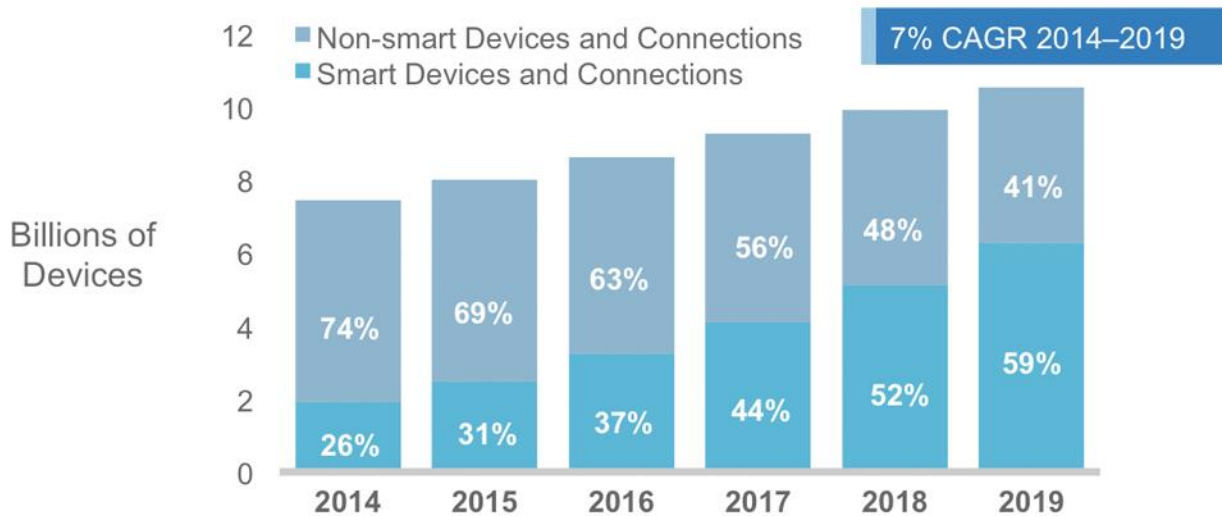
Figure 4. Global Growth of Smart Mobile Devices and Connections



Percentages refer to device and connections share.
Source: Cisco VNI Mobile, 2015

This year we are also including Low Power Wide Area (LPWA) connections in our analysis. This wireless network connectivity is meant specifically for M2M modules that require low bandwidth and wide geographic coverage. Because these modules have very low bandwidth requirements and tolerate high latencies, we do not include them in the smart devices and connections category. For some regions, such as North America where the growth of LPWA is expected to be high, their inclusion in the mix would skew the smart devices and connections percentage, so for regional comparison we have taken them out of the mix. Figure 5 provides a comparable global smart-to-nonsmart devices and connections split, excluding LPWA.

Figure 5. Global Growth of Smart Mobile Devices and Connections (Exc. LPWA)



Percentages refer to device and connections share.
Source: Cisco VNI Mobile, 2015

When we exclude LPWA M2M connections from the mix, the global percentage share of smart devices and connections is higher, at 59 percent by 2019.

Although it is a global phenomenon, some regions are ahead in this device mix conversion. By the end of 2019 North America will have nearly 90 percent of its installed base converted to smart devices and connections, followed by Western Europe with 78 percent smart devices and connections (Table 2).

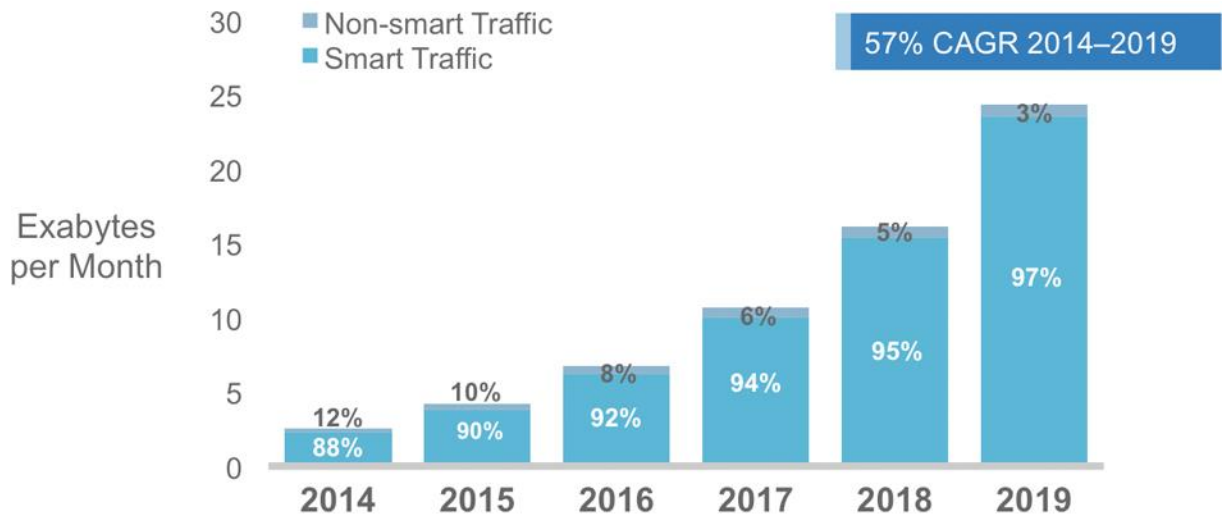
Table 2. Regional Share of Smart Devices and Connections (Percent of the Regional Total)

Region	2014	2019
North America	72%	89%
Western Europe	48%	78%
Central and Eastern Europe	18%	62%
Latin America	20%	61%
Asia Pacific	24%	56%
Middle East and Africa	11%	41%

Source: Cisco VNI Mobile, 2015

Figure 6 shows the impact of the growth of mobile smart devices and connections on global traffic. Globally, smart traffic is going to grow from 88 percent of the total global mobile traffic to 97 percent by 2019. This percentage is significantly higher than the ratio of smart devices and connections (54% by 2019), because on average a smart device generates much higher traffic than a nonsmart device.

Figure 6. Effect of Smart Mobile Devices and Connections Growth on Traffic



Percentages refer to traffic share.
Source: Cisco VNI Mobile, 2015

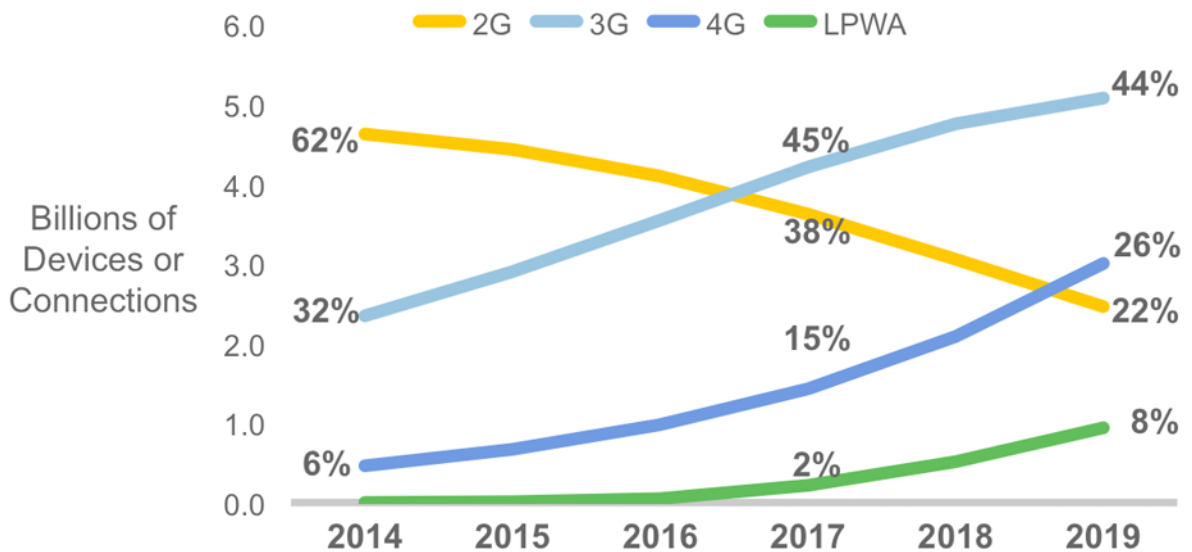
Trend 2: Defining Cellular Network Advances (2G, 3G, and 4G)

Mobile devices and connections are not only getting smarter in their computing capabilities but are also evolving from lower-generation network connectivity (2G) to higher-generation network connectivity (3G, 3.5G, and 4G or LTE). When device capabilities are combined with faster, higher bandwidth and more intelligent networks, it leads to wide adoption of advanced multimedia applications that contribute to increased mobile and Wi-Fi traffic.

The explosion of mobile applications and phenomenal adoption of mobile connectivity by end users on the one hand and the need for optimized bandwidth management and network monetization on the other hand is fueling the growth of global 4G deployments and adoption. Service providers around the world are busy rolling out 4G networks to help them meet the growing end-user demand for more bandwidth, higher security, and faster connectivity on the move (Appendix B).

Globally, the relative share of 3G- and 3.5G-capable devices and connections will surpass 2G-capable devices and connections by 2017 (45 percent and 38 percent relative share). The other significant cross-over will occur in 2019, when 4G will also surpass 2G connection share. By 2019, 26 percent of all global devices and connections will be 4G-capable (Figure 7). The global mobile 4G connections will grow from 459 million in 2014 to 3 billion by 2019 at a CAGR of 46 percent.

Figure 7. Global Mobile Devices and Connections by 2G, 3G, and 4G



Percentages refer to device and connections share.

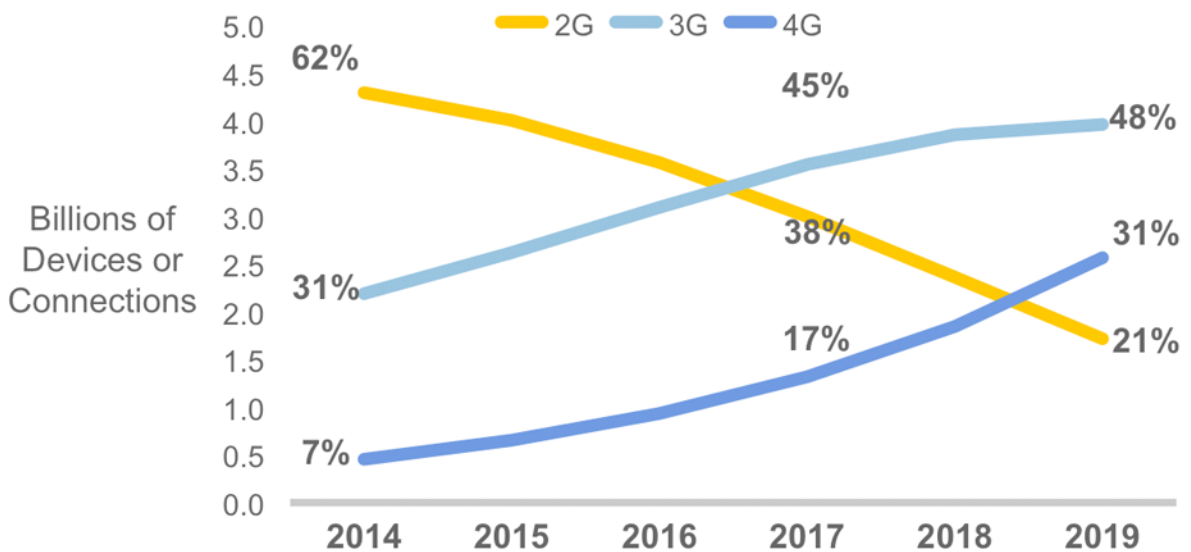
Source: Cisco VNI Mobile, 2015

This year, we are also including Low Power Wide Area (LPWA) connections in our analysis. This type of ultra-narrowband wireless network connectivity is meant specifically for M2M modules that require low bandwidth and wide geographic coverage. It provides high coverage with low power consumption, module, and connectivity costs, thereby creating new M2M use cases for mobile network operators (MNOs) that could not have been addressed by cellular networks alone. Examples include utility meters in residential basements, gas or water meters that do not have power connection, street lights, and pet or personal asset trackers. The share of LPWA connections (all M2M) will grow from less than a tenth of a percent in 2014 to 8 percent by 2019, from less than 1 million in 2014 to 933 million by 2019.

The network evolution toward more advanced networks is happening both across the end-user device segment and within the M2M connections category, as shown in Figures 8 and 9.

When the M2M category is excluded, the 4G growth becomes more apparent, with 31-percent device share by 2019.

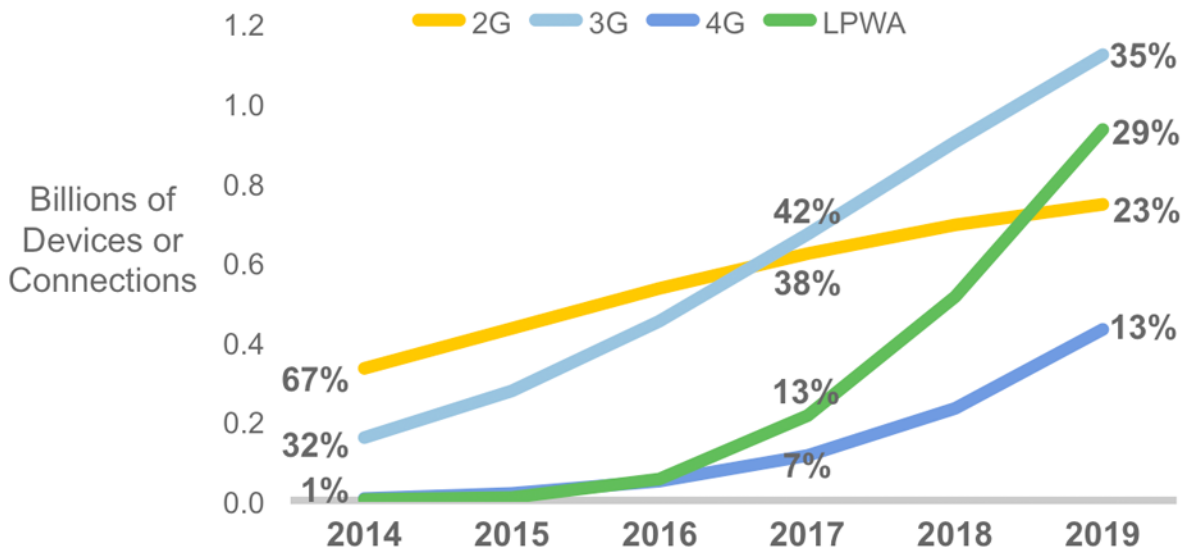
Figure 8. Global Mobile Devices (Excluding M2M) by 2G, 3G, and 4G



Percentages refer to device share.
Source: Cisco VNI Mobile, 2015

M2M capabilities, similar to end-user mobile devices, are migrating toward more advanced networks (Figure 9). On one hand, we see 4G connections share growing to 13 percent by 2019, up from 1 percent in 2014, and we also see a big growth in LPWA from 0.2 percent in 2014 to 29 percent by 2019. Even though LPWA might not be bandwidth-heavy and can tolerate high latency, it is an overlay strategy for MNOs to expand their M2M reach.

Figure 9. Global Mobile M2M Connections by 2G, 3G, and 4G



Percentages refer to M2M connections share.
Source: Cisco VNI Mobile, 2015

The transition from 2G to 3G or 4G deployment is a global phenomenon. In fact, by 2019, North America will have 42 percent of its mobile devices and connections with 4G capability, surpassing 3G-capable devices and connections. Western Europe (38 percent) will have the second highest ratio of 4G connections by 2019 (Appendix B). At the country level, Australia will have 48 percent of its total connections on 4G by 2019, with Japan having 47 percent of all its connections on 4G by 2019. China, followed by the United States, is going to lead the world in terms of its share of the total global 4G connections with 21 percent and 16 percent, respectively, of total global 4G connections by 2019.

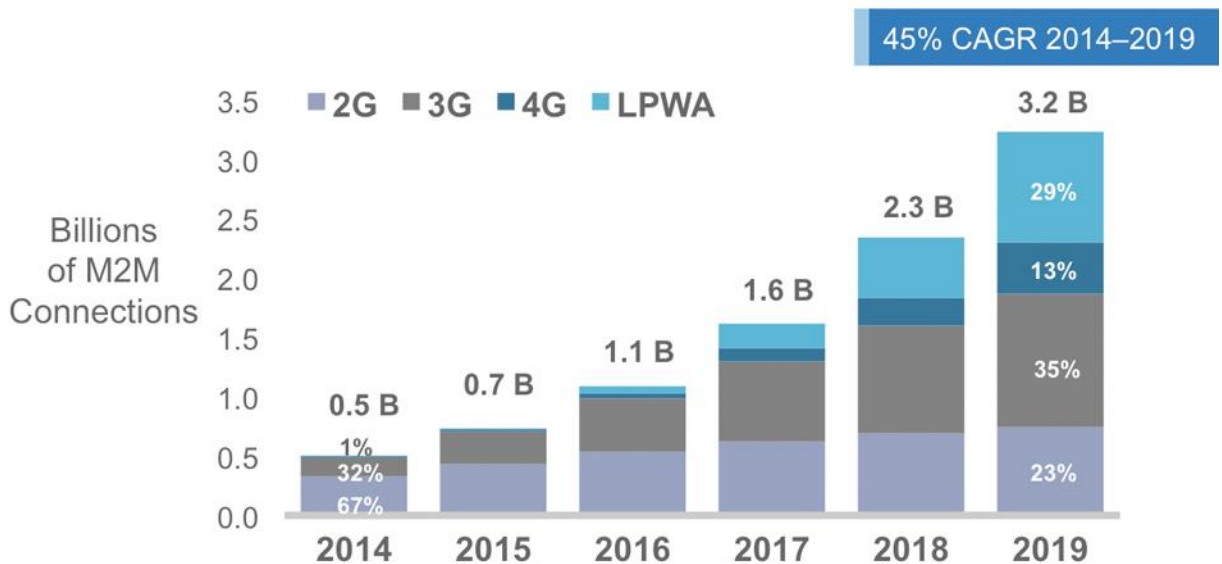
While the growth in 4G, with its higher bandwidth, lower latency, and increased security, will help regions bridge the gap between their mobile and fixed network performance, deployment of LPWA networks will help enhance the reach of mobile providers in the M2M segment. This situation will lead to even higher adoption of mobile technologies by end users, making access to any content on any device from anywhere and the Internet of Everything (IoE) more of a reality.

Trend 3: Measuring Mobile IoE Adoption—M2M and Emerging Wearables

The phenomenal growth in smarter end-user devices and M2M connections is a clear indicator of the growth of IoE, which is bringing together people, processes, data, and things to make networked connections more relevant and valuable. In this section, we will focus on the continued growth of M2M connections and the emerging trend of wearable devices. Both M2M and wearable devices are making computing and connectivity very pervasive in our day-to-day lives.

M2M connections—such as home and office security and automation, smart metering and utilities, maintenance, building automation, automotive, healthcare and consumer electronics, and more—are being used across a broad spectrum of industries, as well as in the consumer segment. As real-time information monitoring helps companies deploy new video-based security systems, while also helping hospitals and healthcare professionals remotely monitor the progress of their patients, bandwidth-intensive M2M connections are becoming more prevalent. Globally, M2M connections will grow from 495 million in 2014 to more than 3 billion by 2019, a 45-percent CAGR—a sevenfold growth. As discussed in the previous trend, M2M capabilities similar to end-user mobile devices are experiencing an evolution from 2G to 3G and 4G technologies (Figure 10).

Figure 10. Global Machine-to-Machine Growth and Migration from 2G to 3G and 4G



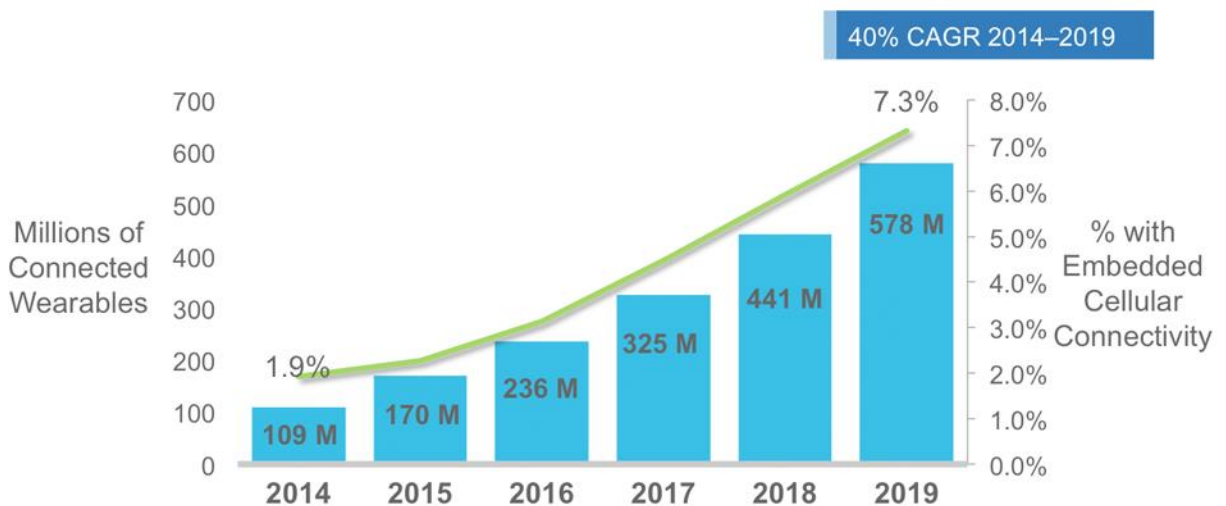
In 2014, 4G accounts for 1% and LPWA accounts for 0.2% of global mobile M2M connections.

Source: Cisco VNI Mobile, 2015

An important factor contributing to the growing adoption of IoE is the emergence of wearable devices, a category with high growth potential. Wearable devices, as the name suggests, are devices that can be worn on a person and have the capability to connect and communicate to the network either directly through embedded cellular connectivity or through another device (primarily a smartphone) using Wi-Fi, Bluetooth, or another technology. These devices come in various shapes and forms, ranging from smart watches, smart glasses, heads-up displays (HUDs), health and fitness trackers, health monitors, wearable scanners and navigation devices, smart clothing, et al. The growth in these devices has been fueled by enhancements in technology that have supported compression of computing and other electronics (making the devices light enough to be worn). These advances are being combined with fashion to match personal styles, especially in the consumer electronics segment, along with network improvements and the growth of applications, such as location-based services and augmented reality. Although there have been vast technological improvements to make wearables possible as a significant device category, wide-scale availability of embedded cellular connectivity still has some barriers to overcome for some applications—such as technology limitations, regulatory constraints, and health concerns.

By 2019, we estimate that there will be 578 million wearable devices globally, growing fivefold from 109 million in 2014 at a CAGR of 40 percent (Figure 11). As mentioned earlier, there will be limited embedded cellular connectivity in wearables through the forecast period. Only 7 percent will have embedded cellular connectivity by 2019, up from 2 percent in 2014. Currently, we do not include wearables as a separate device and connections category because it is at a nascent stage, so there is a noted overlap with the M2M category. We will continue to monitor this segment, and as the category grows and becomes more significant, we may break it out in future forecast iterations.

Figure 11. Global Connected Wearable Devices

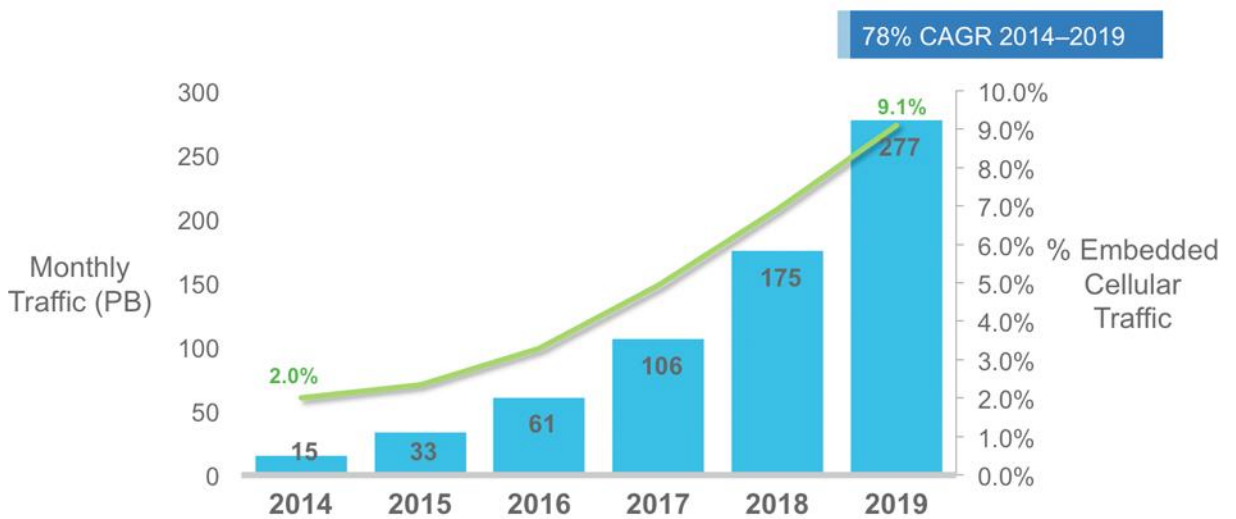


Source: Cisco VNI Mobile, 2015

Regionally, North America will have the largest regional share of wearables, with 33-percent share by 2019 (Appendix B). Other regions with significant share include Asia Pacific with 34 percent share in 2014, declining slightly to 32 percent by 2019.

The wearables category will have a tangible impact on mobile traffic, because even without embedded cellular connectivity they can connect to mobile networks through smartphones. Globally, traffic from wearables will account for 1.4 percent of smartphone traffic by 2019 (Figure 12). Globally, traffic from wearable devices will grow 18-fold from 2014 to 277 petabytes per month by 2019 (CAGR 78 percent). Globally, traffic from wearable devices will account for 1.1 percent of total mobile data traffic by 2019, compared to 0.6 percent at the end of 2014.

Figure 12. Global Wearable Devices Traffic Impact

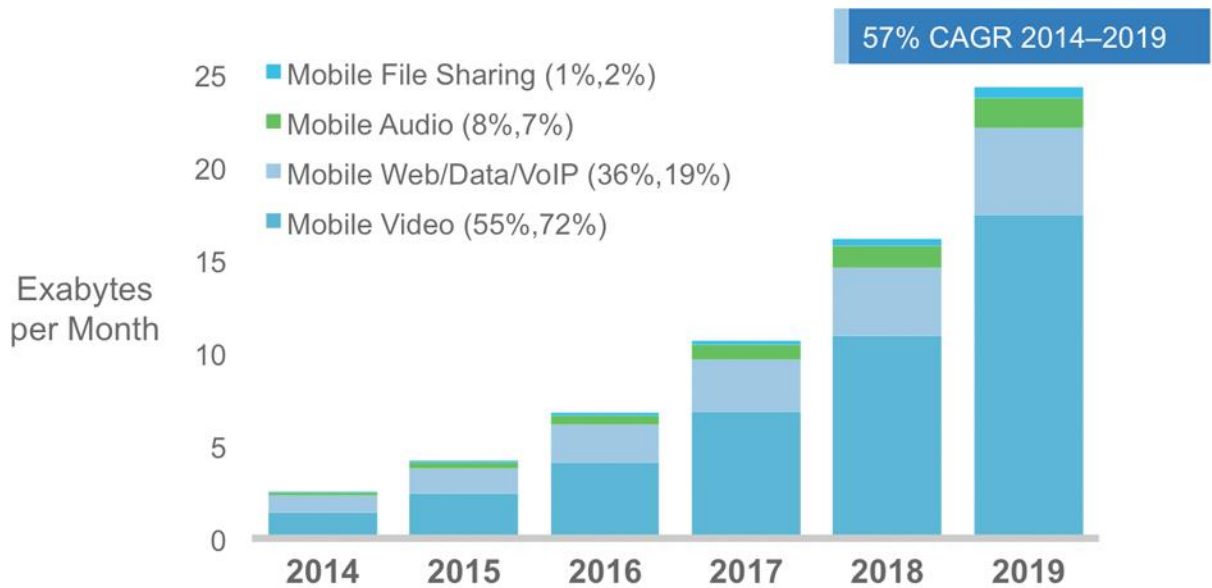


Source: Cisco VNI Mobile, 2015

Trend 4: Analyzing Mobile Applications—Video Usage Increases

Because mobile video content has much higher bit rates than other mobile content types, mobile video will generate much of the mobile traffic growth through 2019. Mobile video will grow at a CAGR of 66 percent between 2014 and 2019, the highest growth rate of any mobile application category that we forecast other than M2M traffic. Of the 24.3 exabytes per month crossing the mobile network by 2019, 17.4 exabytes will be due to video (Figure 13). Mobile video represented more than half of global mobile data traffic beginning in 2012, indicating that it is having an immediate impact on traffic today, not just in the future.

Figure 13. Mobile Video Will Generate More Than 69 Percent of Mobile Data Traffic by 2019

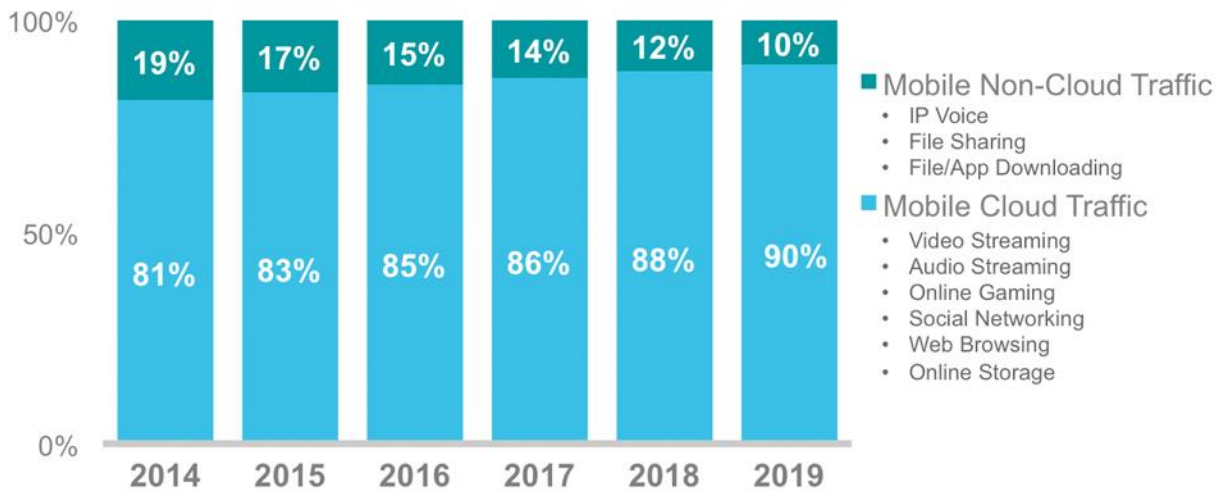


Figures in parentheses refer to 2014, 2019 traffic share.

Source: Cisco VNI Mobile, 2015

Because many Internet video applications can be categorized as cloud applications, mobile cloud traffic follows a curve similar to video. Mobile devices have memory and speed limitations that might prevent them from acting as media consumption devices, were it not for cloud applications and services. Cloud applications and services such as Netflix, YouTube, Pandora, and Spotify allow mobile users to overcome the memory capacity and processing power limitations of mobile devices. Globally, cloud applications will account for 90 percent of total mobile data traffic by 2019, compared to 81 percent at the end of 2014 (Figure 14). Mobile cloud traffic will grow 11-fold from 2014 to 2019, a CAGR of 60 percent.

Figure 14. Cloud Applications Will Account for 90 Percent of Mobile Data Traffic by 2019



Source: Cisco VNI Mobile, 2015

Trend 5: Profiling Bandwidth Consumption

The proliferation of high-end handsets, tablets, and laptops on mobile networks is a major traffic generator, because these devices offer the consumer content and applications not supported by previous generations of mobile devices. As shown in Figure 15, a single smartphone can generate as much traffic as 37 basic-feature phones; a tablet as much traffic as 94 basic-feature phones; and a single laptop can generate as much traffic as 119 basic-feature phones.

Figure 15. High-End Devices Significantly Multiply Traffic



* Monthly basic mobile phone data traffic.

Source: Cisco VNI Mobile, 2015

Average traffic per device is expected to increase rapidly during the forecast period, as shown in Table 3.

Table 3. Summary of Per-Device Usage Growth, MB per Month

Device Type	2014	2019
Nonsmartphone	22 MB/month	105 MB/month
M2M Module	70 MB/month	366 MB/month
Wearable Device	141 MB/month	479 MB/month
Smartphone	819 MB/month	3,981 MB/month
4G Smartphone	2,000 MB/month	5,458 MB/month
Tablet	2,076 MB/month	10,767 MB/month
4G Tablet	2,913 MB/month	12,314 MB/month
Laptop	2,641 MB/month	5,589 MB/month

Source: Cisco VNI Mobile, 2015

The growth in usage per device outpaces the growth in the number of devices. As shown in Table 4, the growth rate of mobile data traffic from new devices is two to five times greater than the growth rate of users.

Table 4. Comparison of Global Device Unit Growth and Global Mobile Data Traffic Growth

Device Type	Growth in Devices, 2014–2019 CAGR	Growth in Mobile Data Traffic, 2014–2019 CAGR
Smartphone	16.7%	60.1%
Tablet	32.0%	83.4%
Laptop	5.3%	22.3%
M2M Module	45.5%	102.7%

Source: Cisco VNI Mobile, 2015

A few of the main promoters of growth in average usage are described in the following list:

- As mobile network connection speeds increase, the average bit rate of content accessed through the mobile network will increase. High-definition video will be more prevalent, and the proportion of streamed content, as compared to side-loaded content, is also expected to increase with average mobile network connection speed.
- The shift toward on-demand video will affect mobile networks as much as it will affect fixed networks. Traffic can increase dramatically, even while the total amount of time spent watching video remains relatively constant.
- As mobile network capacity improves and the number of multiple-device users grows, operators are more likely to offer mobile broadband packages comparable in price and speed to those of fixed broadband. This situation is encouraging mobile broadband substitution for fixed broadband, where the usage profile is substantially higher than average.
- Mobile devices increase an individual's contact time with the network, and it is likely that this increased contact time will lead to an increase in overall minutes of use per user. However, not all of the increase in mobile data traffic can be attributed to traffic migration to the mobile network from the fixed network. Many uniquely mobile applications continue to emerge, such as location-based services, mobile-only games, and mobile commerce applications.

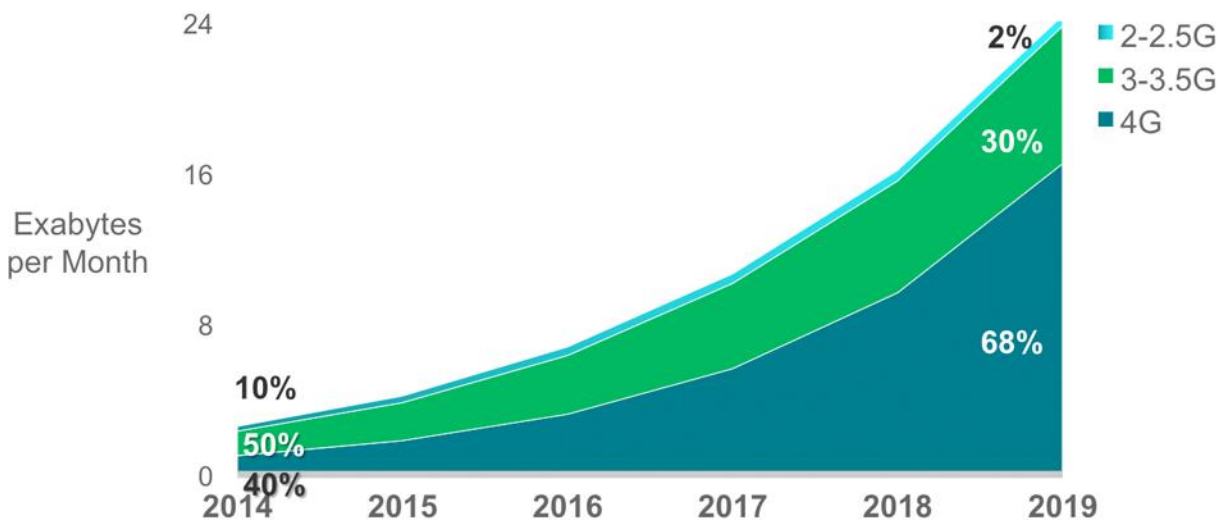
Trend 6: Assessing Mobile Traffic/Offload by Access Type

Impact of 4G

While 3G and 3.5G account for the majority (60 percent) of mobile data traffic today, 4G will grow to represent more than two-thirds of all mobile data traffic by 2019, despite a connection share of only 26 percent (Figure 16).

Currently, a 4G connection generates nearly 10 times more traffic than a non-4G connection. There are two reasons. The first is that many 4G connections today are for high-end devices, which have a higher average usage. The second is that higher speeds encourage the adoption and usage of high-bandwidth applications, such that a smartphone on a 4G network is likely to generate significantly more traffic than the same model smartphone on a 3G or 3.5G network. As smartphones come to represent a larger share of 4G connections, the gap between the average traffic of 4G devices and non-4G devices will narrow, but by 2019 a 4G connection will still generate 5 times more traffic than a non-4G connection.

Figure 16. By 2019, 68 Percent of Total Mobile Data Traffic Will Be 4G



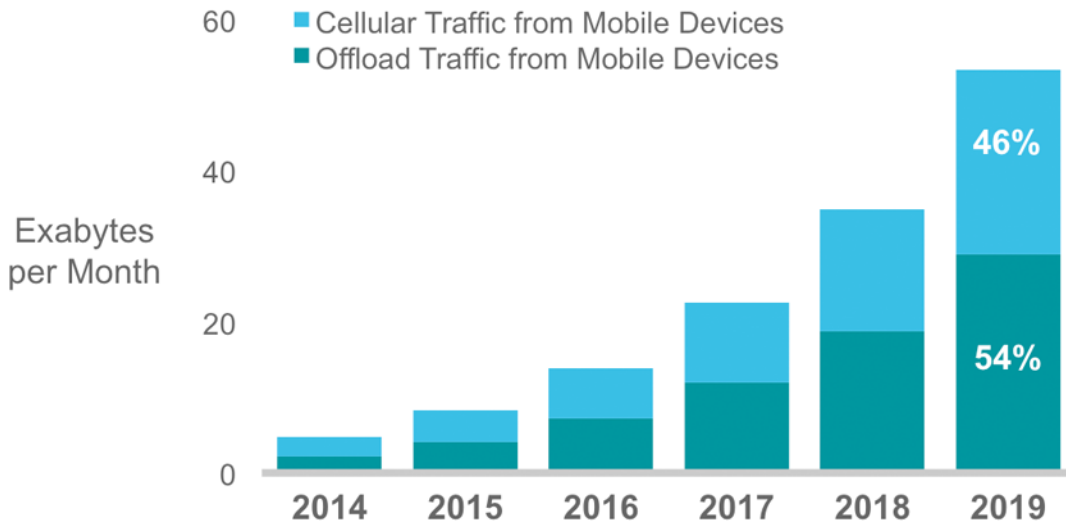
Source: Cisco VNI Mobile, 2015

Offload

Much mobile data activity takes place within users' homes. For users with fixed broadband and Wi-Fi access points at home, or for users served by operator-owned femtocells and picocells, a sizable proportion of traffic generated by mobile and portable devices is offloaded from the mobile network onto the fixed network. For the purposes of this study, offload pertains to traffic from dual-mode devices (i.e., supports cellular and Wi-Fi connectivity; excluding laptops) over Wi-Fi and small-cell networks. Offloading occurs at the user/device level when one switches from a cellular connection to Wi-Fi/small-cell access. Our mobile offload projections include traffic from both public hotspots as well as residential Wi-Fi networks.

As a percentage of total mobile data traffic from all mobile-connected devices, mobile offload increases from 45 percent (1.2 exabytes/month) in 2014 to 54 percent (28.9 exabytes/month) by 2019 (Figure 17). Without offload, Global mobile data traffic would grow at a CAGR of 62 percent instead of 57 percent. Offload volume is determined by smartphone penetration, dual-mode share of handsets, percentage of home-based mobile Internet use, and percentage of dual-mode smartphone owners with Wi-Fi fixed Internet access at home.

Figure 17. By 2019, 54 Percent of Total Mobile Data Traffic Will Be Offloaded

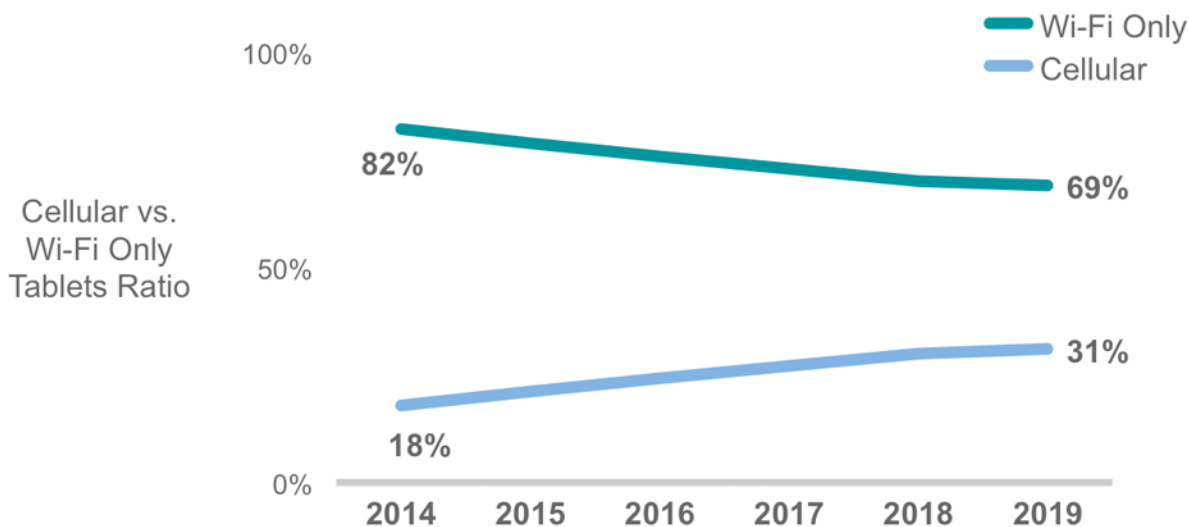


Offload pertains to traffic from dual mode devices (excluding laptops) over Wi-Fi/small cell networks.
Source: Cisco VNI Mobile, 2015

The amount of traffic offloaded from smartphones will be 54 percent by 2019, and the amount of traffic offloaded from tablets will be 70 percent.

A supporting trend is the growth of cellular connectivity for devices such as tablets, which in their earlier generation were limited to Wi-Fi connectivity only. With increased desire for mobility and mobile carriers that offer data plans catering to multidevice owners, we find that cellular connectivity is on a rise, albeit cautiously, as the end users are “testing the waters.” As a point in case, we estimate that by 2019, 31 percent of all tablets will have a cellular connection, up from 18 percent in 2014 (Figure 18).

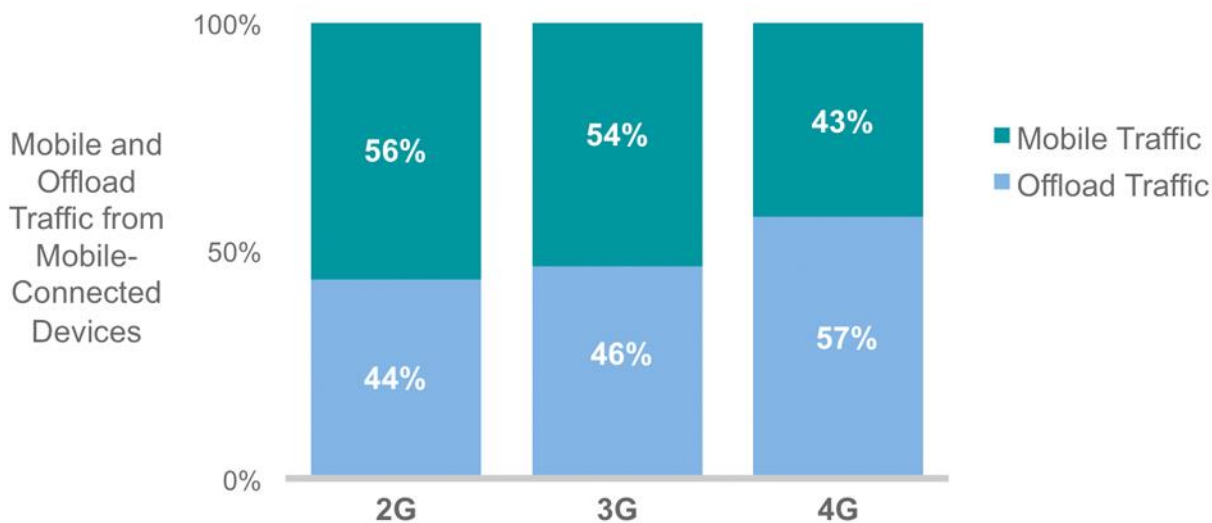
Figure 18. By 2019, 31 Percent of Global Tablets Will Be Cellular Connected



Source: Cisco VNI Mobile, 2015

Some have speculated that Wi-Fi offload will be less relevant after 4G networks are in place because of the faster speeds and more abundant bandwidth. However, 4G networks will attract high-usage devices such as advanced smartphones and tablets, and it appears that 4G plans will be subject to data caps similar to 3G plans. For these reasons, Wi-Fi offload is higher on 4G networks than on lower-speed networks, now and in the future according to our projections. The amount of traffic offloaded from 4G was 44 percent at the end of 2014, and it will be 57 percent by 2019 (Figure 19). The amount of traffic offloaded from 3G will be 49 percent by 2019, and the amount of traffic offloaded from 2G will be 46 percent.

Figure 19. Mobile Data Traffic and Offload Traffic, 2019



Source: Cisco VNI Mobile, 2015

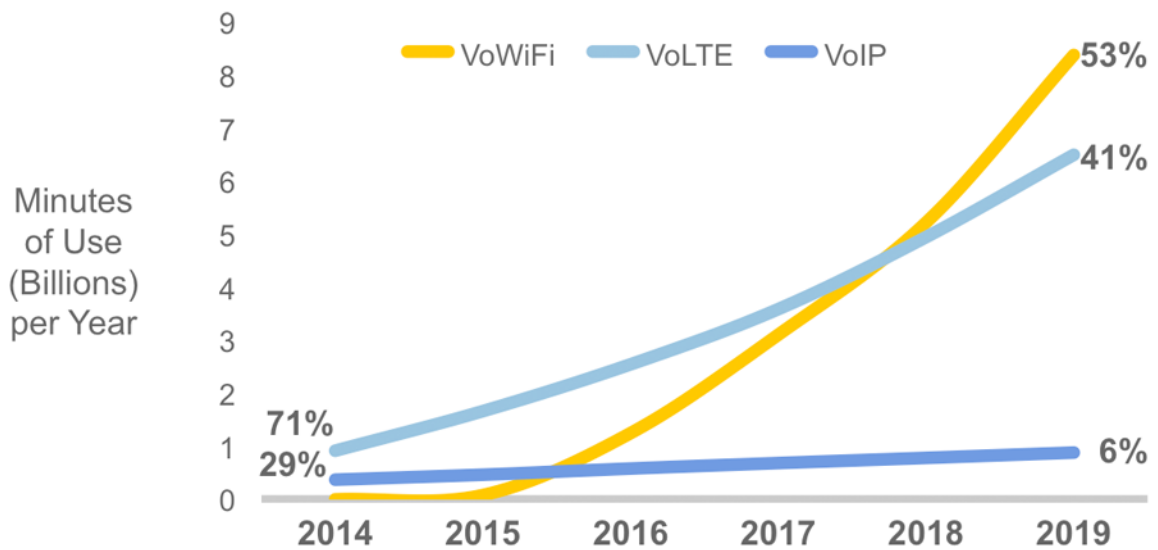
Trend 7: Identifying a Potential Mobile App “Wildcard”—VoWi-Fi

Several global mobile carriers have recently launched or announced a launch of voice-over-Wi-Fi (VoWi-Fi) service. Voice over Wi-Fi is not a new concept, but the earlier solutions had several limitations that affected the adoption and ultimately the end-user experience. Since then several enhancements in VoWi-Fi that now make it a carrier-grade user-experience have been made. This service can now be offered independent of the hardware capabilities of the device as long as the device has Wi-Fi enabled on it, even non-SIM devices such as Wi-Fi-only tablets can have this service turned on.

VoWi-Fi not only can extend the reach of MNOs by enabling them to deliver a cost-effective, scalable, and quality solution for delivering in building coverage, where cellular coverage might be sketchy, but also can help them battle the erosion of revenue from over-the-top providers’ (OTTPs’) VoIP offers.

Figure 20 shows that VoWi-Fi is going to surpass voice over LTE (VoLTE) by 2018 in terms of minutes of use. By 2019, VoWi-Fi will have 53 percent of mobile IP voice, up from less than a tenth of a percent in 2014.

Figure 20. Mobile Voice Minutes of Use—VoWi-Fi, VoLTE, and VoIP

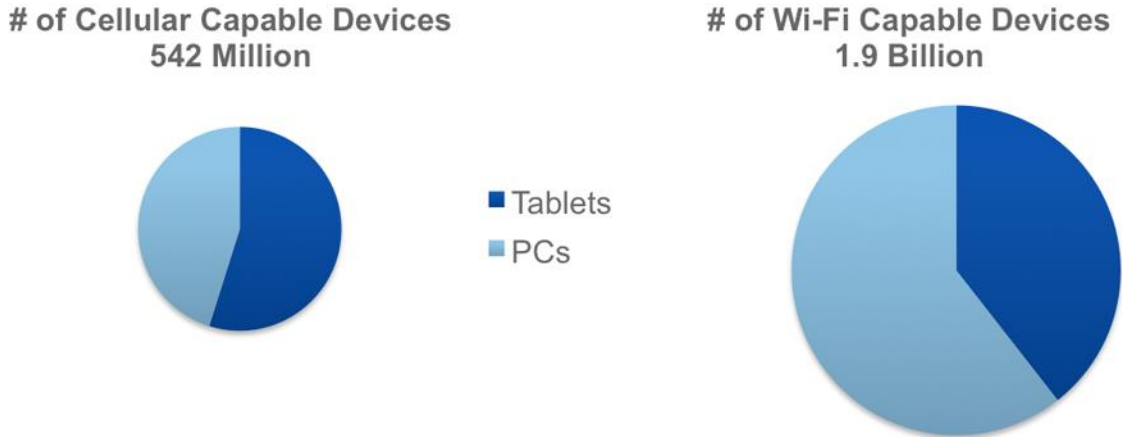


Note: VoLTE and VoIP are mobile-specific, VoWi-Fi could be from any Wi-Fi connection. Circuit-switched mobile voice is excluded from the mix. It would grow at 5 percent CAGR.

Source: ACG, Ovum, Cisco VNI Mobile, 2015

Because VoWi-Fi is a native application, it has its advantages over VoIP in terms of faster and higher-quality performance besides providing keypad and contact-list integration. VoWi-Fi can also be delivered over non-SIM devices, but the coverage and usage would be much larger relative to VoLTE. Figure 21 shows how the number of tablets and PCs connected on Wi-Fi will far exceed those with cellular connectivity.

Figure 21. By 2019, Wi-Fi Will Connect Nearly 3.5-Fold Cellular Connected Tablets and PCs



Source: Cisco VNI Mobile, 2015

Wi-Fi access has had widespread acceptance by MNOs globally, and it has evolved as a complementary network for traffic offload purposes—offloading from expensive cellular networks on to lower-cost-per-bit Wi-Fi networks. If we draw a parallel from data to voice, we can foresee a similar evolution where VoWi-Fi can evolve as a supplement to cellular voice, extending the coverage of cellular networks through Wi-Fi for voice within the buildings and other areas that have a wider and more optimum access to Wi-Fi hotspots.

Trend 8: Comparing Mobile Network Speed Improvements

Globally, the average mobile network connection speed in 2014 was 1,683 kbps. The average speed will grow at a CAGR of 19 percent, and will reach nearly 4.0 Mbps by 2019. Smartphone speeds, generally 3G and higher, will be nearly three times higher than the overall average by 2019. Smartphone speeds will nearly double by 2019, reaching 10 Mbps.

There is anecdotal evidence to support the idea that usage increases when speed increases, although there is often a delay between the increase in speed and the increased usage, which can range from a few months to several years. The Cisco VNI Mobile Forecast relates application bit rates to the average speeds in each country. Many of the trends in the resulting traffic forecast can be seen in the speed forecast, such as the high growth rates for developing countries and regions relative to more developed areas (Table 5).

Table 5. Global and Regional Projected Average Mobile Network Connection Speeds (in kbps)

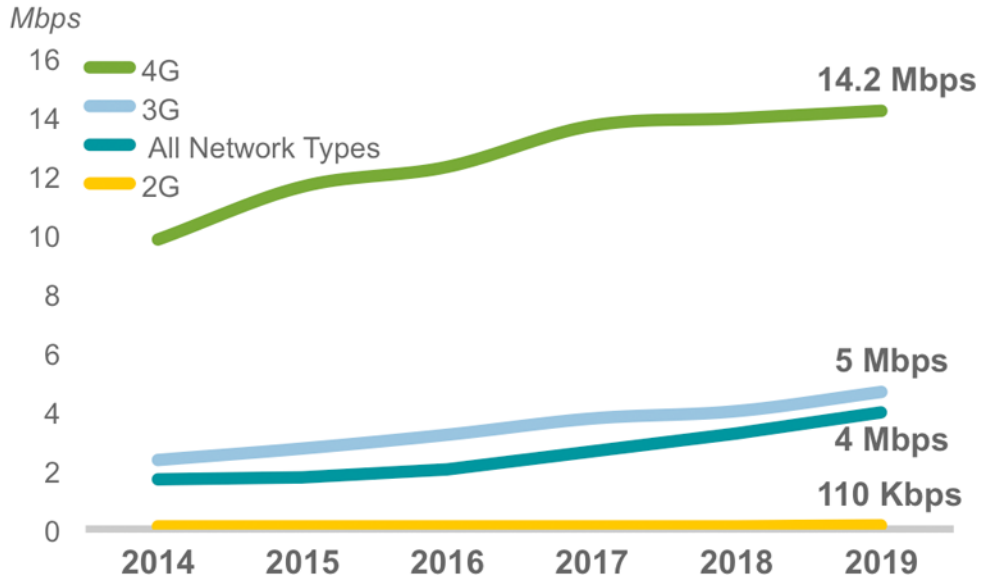
	2014	2014	2015	2016	2017	2019	CAGR 2014–2019
Global							
Global speed: All handsets	1,683	1,747	2,017	2,629	3,248	3,963	9%
Global speed: Smartphones	6,097	6,899	7,686	8,468	8,829	10,403	11%
Global speed: Tablets	8,697	10,203	10,907	12,119	12,403	13,054	8%
By Region							
Middle East & Africa	582	700	742	1,095	1,577	2,097	29%
Central & Eastern Europe	1,620	1,939	2,353	2,762	3,167	3,671	18%
Latin America	1,378	1,556	1,781	2,077	2,463	2,949	16%
Western Europe	2,037	2,452	2,916	3,408	3,910	4,687	18%
Asia-Pacific	2,026	2,233	2,443	2,730	3,047	3,509	12%
North America	2,816	3,052	3,542	4,299	5,196	6,399	18%

Current and historical speeds are based on data from Ookla's Speedtest. Forward projections for mobile data speeds are based on third-party forecasts for the relative proportions of 2G, 3G, 3.5G, and 4G among mobile connections through 2019.

Source: Cisco VNI Mobile, 2015

The speed at which data can travel to and from a mobile device can be affected in two places: the infrastructure speed capability outside the device, and the connectivity speed from the network capability inside the device (Figure 22). These speeds are actual and modeled end-user speeds and not theoretical speeds that the devices, connection, or technology is capable of providing. Several variables affect the performance of a mobile connection: Rollout of 2G/3G/4G in various countries and regions, technology used by the cell towers, spectrum availability, terrain, signal strength, and number of devices sharing a cell tower. The type of application being used by the end user is also an important factor. Download speed, upload speed, and latency characteristics vary widely depending on the type of application, be it video, radio, or instant messaging.

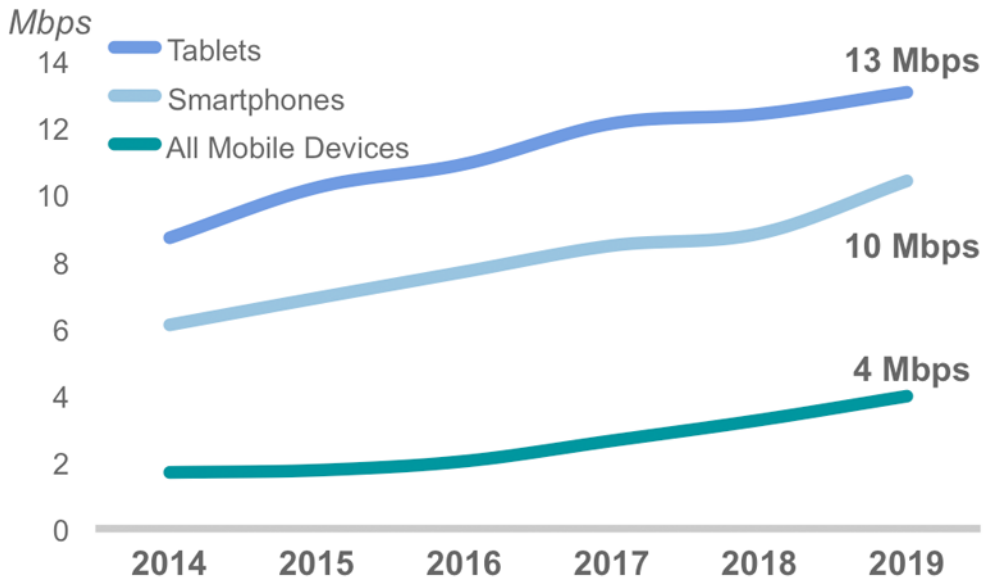
Figure 22. Mobile Speeds by Technology: 2G vs. 3G vs. 4G



Source: Cisco VNI Mobile, 2015

By 2019, 4G speeds will be four times higher than that of an average mobile connection. In comparison, 3G speeds will be 1.2-fold as fast as the average mobile connection by 2019 (Figure 23).

Figure 23. Mobile Speeds by Device



Source: Cisco VNI Mobile, 2015

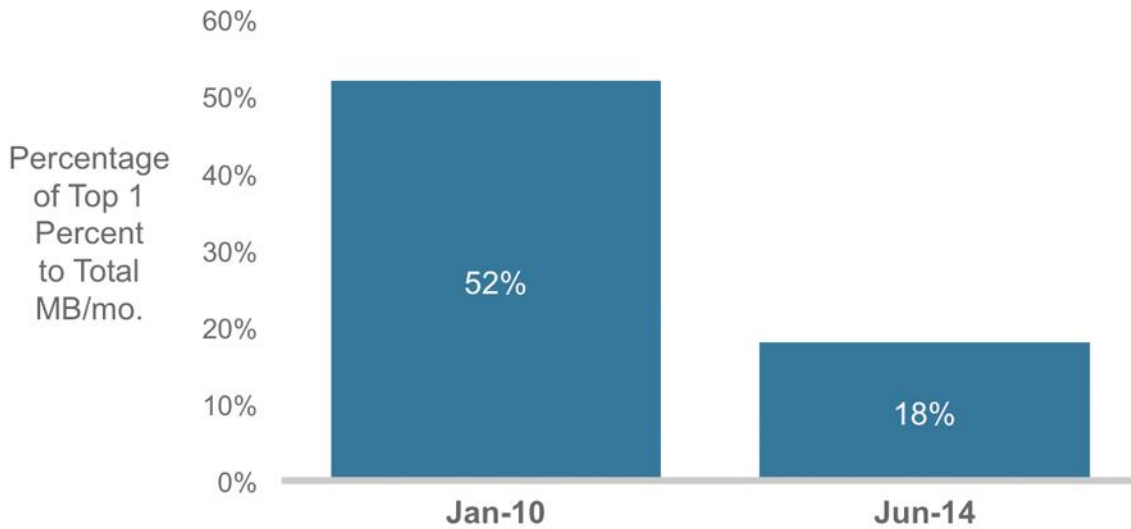
Trend 9: Reviewing Tiered Pricing—Unlimited Data Makes Comeback

An increasing number of service providers worldwide are moving from unlimited data plans to tiered mobile data packages. However, a few Tier 2 and other operators in the past year have reintroduced unlimited plans to gain customers and reduce turnover. To make an initial estimate of the impact of tiered pricing on traffic growth, we repeated a case study based on the data of two Tier 1 and Tier 2 global service providers from mature mobile markets. The study tracks data usage from the timeframe of the introduction of tiered pricing 4 years ago. The study until the latest update comprised only Tier 1 operators, and the latest findings include Tier 2 operators. The findings in this study are based on Cisco's analysis of data provided by a third-party data analysis firm. This firm maintains a panel of volunteer participants who have given the company access to their mobile service bills, including KB of data usage. The data in this study reflects usage associated with more than 51,533 devices and spans 12 months (October 2013 through June 2014) and also refers to the study from the previous update for longer-term trends. The overall study spans 3 years. Cisco's analysis of the data consists of categorizing the pricing plans, operating systems, devices, and users; incorporating additional third-party information on device characteristics; and performing exploratory and statistical data analysis. Although the results of the study represent actual data from a few Tier 1 and Tier 2 mobile data operators, from mature markets, global forecasts that include emerging markets and Tier 2 providers may lead to lower estimates.

Unlimited plans have made a resurgence from October 2013 to June 2014 with the increased number of unlimited plan offerings by Tier 2 operators. In October 2013, 63 percent of the data plans were tiered and 37 percent of the data plans were unlimited. By June 2014, 55 percent of the plans were tiered and 45 percent of the plans were unlimited. The gigabyte consumption of both tiered and unlimited plans increased. An average tiered plan consumption grew from 0.98 GB in October 2013 to 1.1 GB in June 2014. Unlimited plans consumption grew at a faster rate, from 1.9 GB in October 2013 to 2.6 GB in June 2014. Tiered pricing plans are often designed to constrain the heaviest mobile data users, especially the top 1 percent of mobile data consumers. An examination of heavy mobile data users reveals that the top 1 percent of mobile users is actually the top 3 percent, because the top 1 percent of users varies each month. For example, for a mobile data subscriber base of 1000 users; the top 1 percent is 10 users. However, the same set of 10 users does not appear in the top 1 percent category in each month; rather, a larger set of 30 subscribers rotates through the top 1 percent. This top 3 percent are the users who have the potential of being in the top 1 percent bracket in any given month, and they substitute for each other in subsequent months. The trend is due to the nature of consumption of mobile data applications.

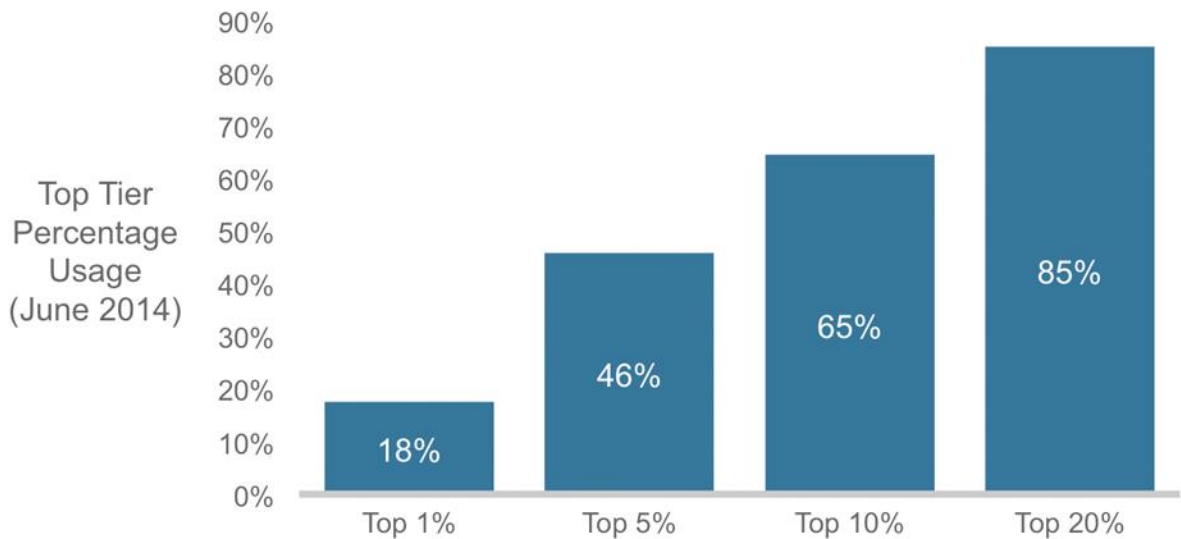
The usage per month of the average top 1 percent of mobile data users has been steadily decreasing compared to overall usage. At the beginning of the 3-year study, 52 percent of the traffic was generated by the top 1 percent. With the inclusion of Tier 2 operators in the study, the top 1 percent generated 18 percent of the overall traffic per month by June 2014 (Figure 24). The top 20 percent of mobile users generate nearly 85 percent of mobile data traffic (Figure 25).

Figure 24. Top 1 Percent Generates 52 Percent of Monthly Data Traffic in January 2010 Compared to 18 Percent in June 2014



Source: Cisco VNI Mobile, 2015

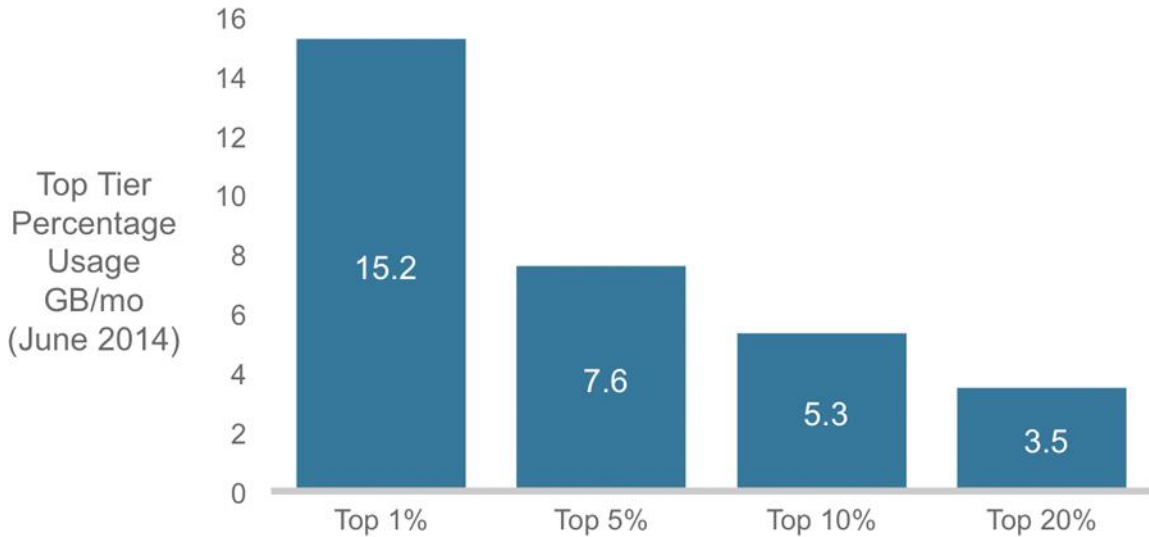
Figure 25. Top 20 Percent Consumes Nearly 85 Percent of Mobile Data Traffic



Source: Cisco VNI Mobile, 2015

With the introduction of new, larger screen smartphones and tablets with all mobile-data-plan types, there is a continuing increase in usage in terms of gigabytes per month per user in all the top tiers (Figure 26).

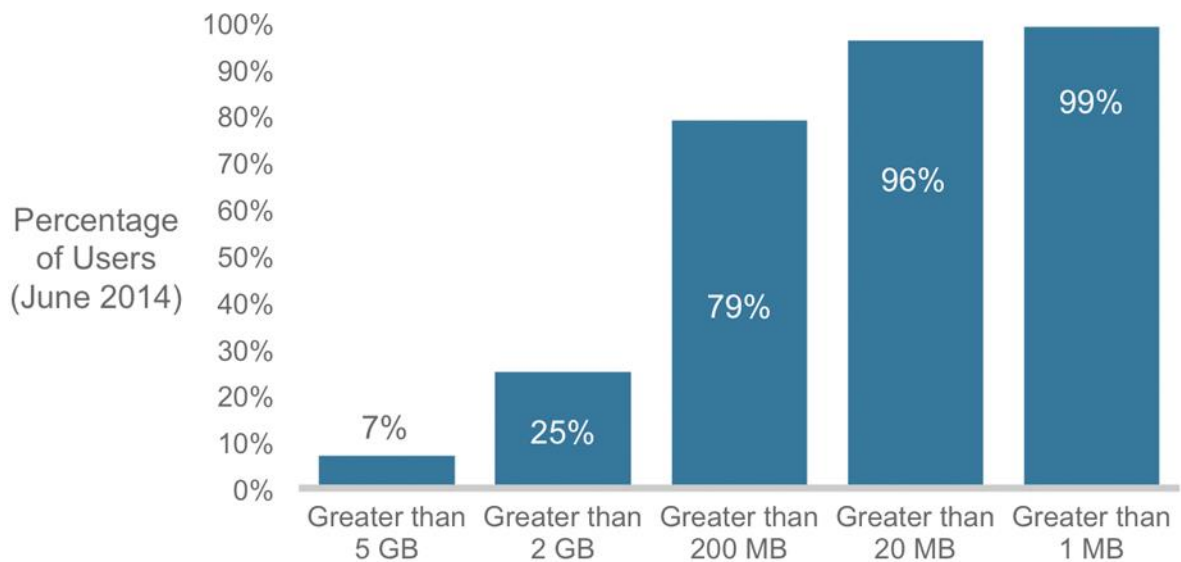
Figure 26. Top 20 Percent of Average Users Consumes 3.5 Gigabytes per Month



Study limited to few Tier 1 and Tier 2 operators.
Source: Cisco VNI Mobile, 2015

The proportion of mobile users generating more than 2 gigabytes per month was 25 percent of users at the end of 2014 (Figure 27).

Figure 27. Twenty-Five Percent of Users Consume More Than 2 GB per Month



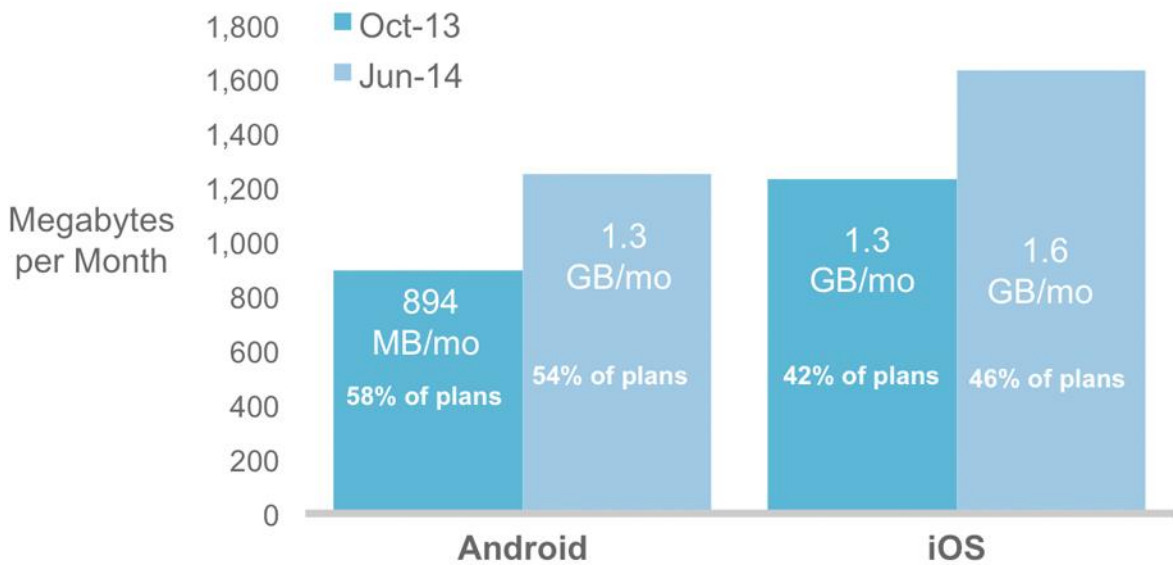
Study limited to few Tier 1 and Tier 2 operators.
Source: Cisco VNI Mobile, 2015

More detail on the tiered pricing case study is available in Appendix C.

iOS Marginally Surpasses Android in Data Usage

At the beginning of the 4-year tiered pricing case study, Android data consumption was equal to, if not higher, than that of other smartphone platforms. However, Apple-based devices have now caught up, and their data consumption is marginally higher than that of Android devices in terms of megabytes per month per connection usage (Figure 28).

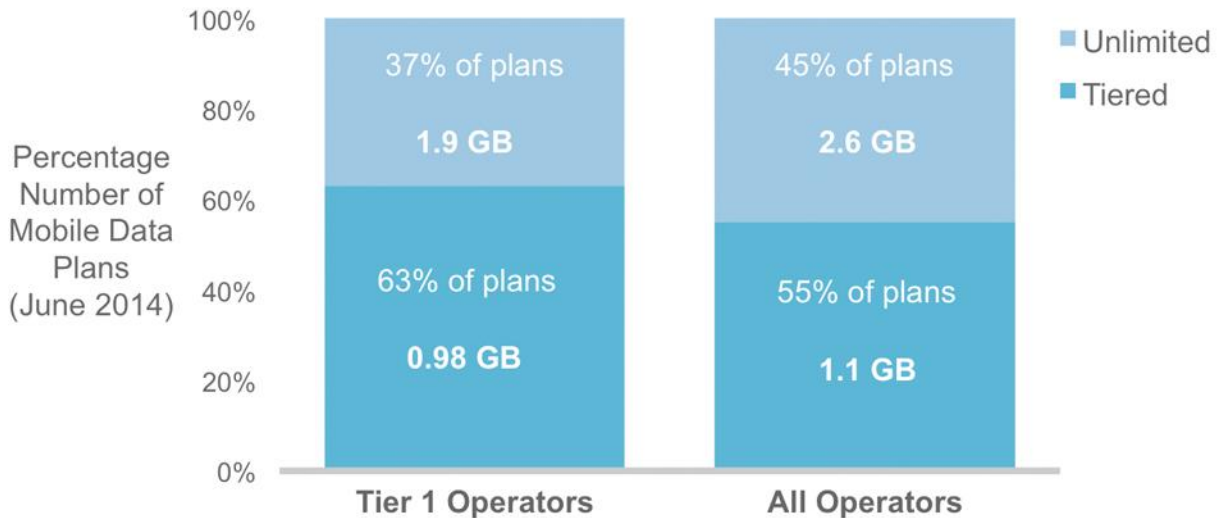
Figure 28. Megabytes per Month by Operating System



Source: Cisco VNI Mobile, 2015

Tiered plans outnumber unlimited plans; unlimited plans continue to lead in data consumption. With the sample Tier 2 carriers included in the study in the past year, unlimited plans are making a comeback both in number as well as usage figures (Figure 29).

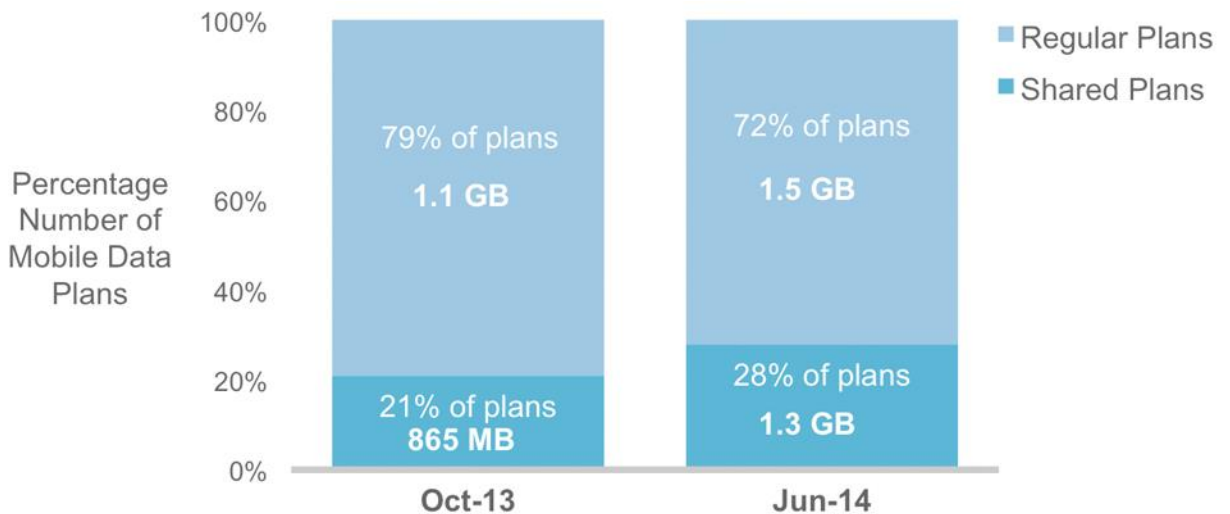
Figure 29. Tiered vs. Unlimited Plans



Study limited to few Tier 1 and Tier 2 operators.
Source: Cisco VNI Mobile, 2015

While the number of shared plans is increasing; no clear effect or significant difference on usage compared to regular plans was evident during the short time frame of the study (Figure 30).

Figure 30. Shared vs. Regular Data Plans



Study limited to few Tier 1 and Tier 2 operators.
Source: Cisco VNI Mobile, 2015

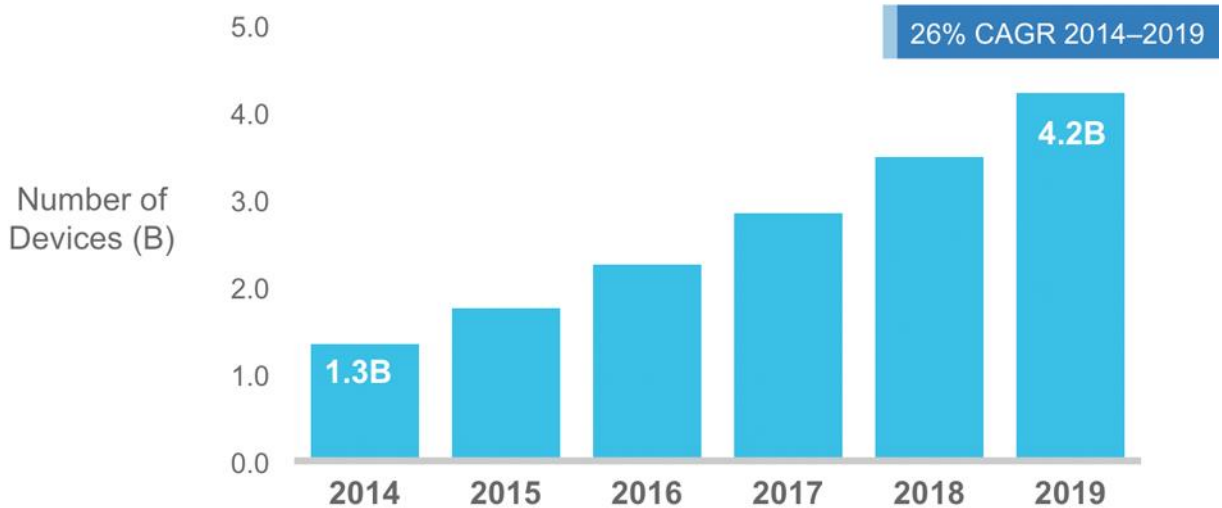
More detail on consumption by operating system is available in Appendix C.

Trend 10: Tracking IPv6—Significant Global Mobile Adoption

The transition to IPv6, which helps connect and manage the proliferation of newer-generation devices that are contributing to mobile network usage and data traffic growth, is well underway. Continuing the Cisco VNI focus on IPv6, the Cisco VNI 2014–2019 Mobile Data Traffic Forecast provides an update on IPv6-capable mobile devices and connections and the potential for IPv6 mobile data traffic.

Focusing on the high-growth mobile-device segments of smartphones and tablets, the forecast projects that globally 87 percent of smartphones and tablets (4.2 billion) will be IPv6-capable by 2019 (up from 61 percent, or 1.3 billion smartphones and tablets in 2014) (Figure 31). This estimation is based on OS support of IPv6 (primarily Android and iOS) and the accelerated move to higher-speed mobile networks (3.5G or higher) capable of enabling IPv6. (This forecast is intended as a projection of the number of IPv6-capable mobile devices, not mobile devices with an IPv6 connection actively configured by the ISP.)

Figure 31. Global IPv6-Capable Smartphones and Tablets

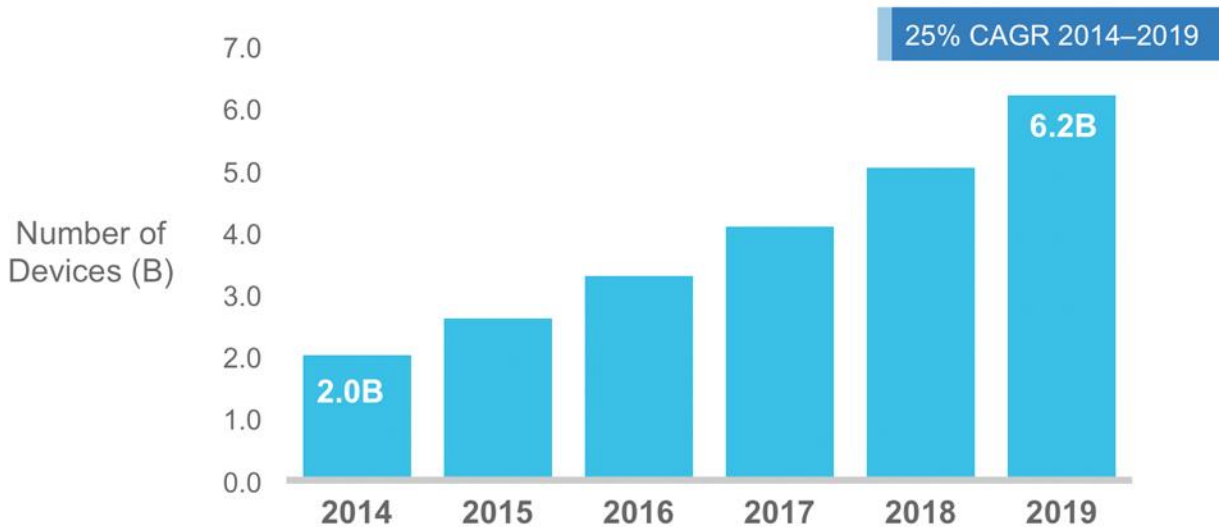


Source: Cisco VNI Mobile, 2015

For all mobile devices and connections, the forecasts project that, globally, 59 percent (6.2 billion) will be IPv6-capable by 2019, up from 27 percent (2.0 billion) in 2014. (Figure 32). M2M emerges as a key segment of growth for IPv6-capable devices, reaching 1.2 billion by 2019, an 18-fold increase during the forecast period. With its capability to vastly scale IP addresses and manage complex networks, IPv6 is critical in supporting the IoT of today and in the future. (Refer to Table 15 in Appendix D for more device detail.)

Regionally, Asia Pacific will lead throughout the forecast period with the highest number of IPv6-capable devices and connections, reaching 2.9 billion by 2019. Middle East and Africa and Central and Eastern Europe will have the highest growth rates during the forecast period, both at 30-percent CAGR. (Refer to Table 16 in Appendix D for more regional detail.)

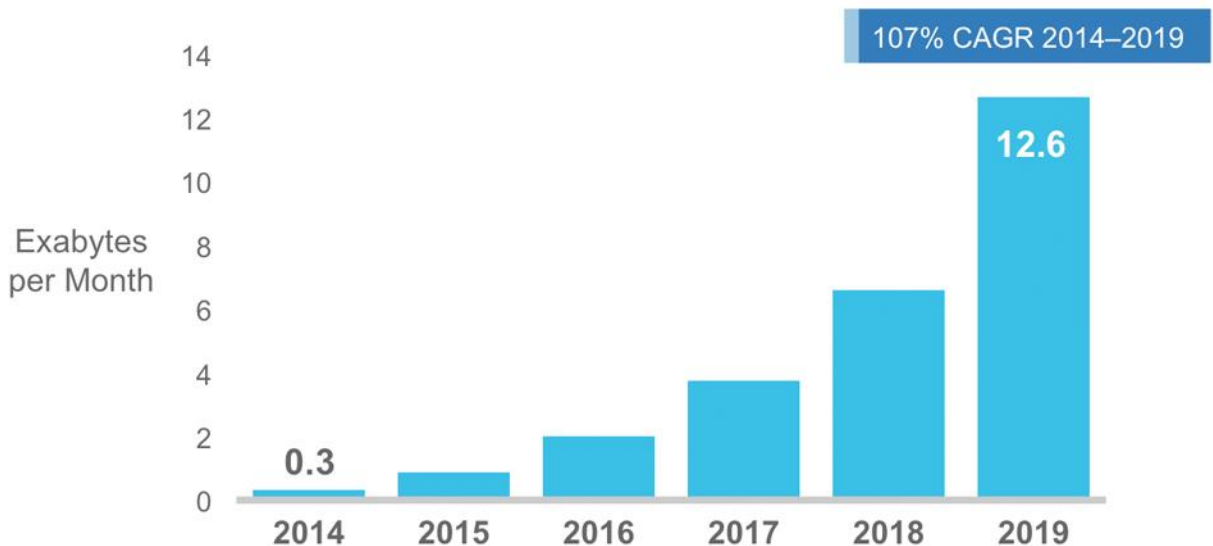
Figure 32. Global IPv6-Capable Mobile Devices



Source: Cisco VNI Mobile, 2015

Considering the significant potential for mobile device IPv6 connectivity, the Cisco VNI Mobile Forecast provides an estimation for IPv6 network traffic based on a graduated percentage of IPv6-capable devices becoming actively connected to an IPv6 network. Looking to 2019, if approximately 60 percent of IPv6-capable devices are connected to an IPv6 network, the forecast estimates that, globally, IPv6 traffic will amount to 12.6 exabytes per month or 52 percent of total mobile data traffic, a 38-fold growth from 2014 to 2019 (Figure 33).

Figure 33. Projected IPv6 Mobile Data Traffic Forecast 2014–2019



Source: Cisco VNI Mobile, 2015

For additional views on the latest IPv6 deployment trends, visit the [Cisco 6Lab site](#). The Cisco 6Lab analysis includes current statistics by country on IPv6 prefix deployment, IPv6 web content availability, and estimations of IPv6 users. With the convergence of IPv6 device capability, content availability, and network deployment, the discussion of IPv6 may shift from “what if” to “how soon will” service providers and end users realize the potential IPv6 has to offer.

Conclusion

Mobile data services are well on their way to becoming necessities for many network users. Mobile voice service is already considered a necessity by most, and mobile voice, data, and video services are fast becoming an essential part of consumers' lives. Used extensively by consumer as well as enterprise segments, with impressive uptakes in both developed and emerging markets, mobility has proved to be transformational. Mobile subscribers are growing rapidly, and bandwidth demand due to data and video is increasing. Mobile M2M connections continue to increase. The next 5 years are projected to provide unabated mobile video adoption. Backhaul capacity must increase so mobile broadband, data access, and video services can effectively support consumer usage trends and keep mobile infrastructure costs in check.

Deploying next-generation mobile networks requires greater service portability and interoperability. With the proliferation of mobile and portable devices, there is an imminent need for networks to allow all these devices to be connected transparently, with the network providing high-performance computing and delivering enhanced real-time video and multimedia. This openness will broaden the range of applications and services that can be shared, creating a highly enhanced mobile broadband experience. The expansion of wireless presence will increase the number of consumers who access and rely on mobile networks, creating a need for greater economies of scale and lower cost per bit.

As many business models emerge with new forms of advertising, media and content partnerships, and mobile services including M2M, live gaming, and augmented reality, a mutually beneficial situation needs to be developed for service providers and over-the-top providers. New partnerships, ecosystems, and strategic consolidations are expected as mobile operators, content providers, application developers, and others seek to monetize the video traffic that traverses mobile networks. Operators must solve the challenge of effectively monetizing video traffic while increasing infrastructure capital expenditures. They must become more agile and able to change course quickly and provide innovative services to engage the Web 3.0 consumer. While the net neutrality regulatory process and business models of operators evolve, there is an unmet demand from consumers for the highest quality and speeds. As wireless technologies aim to provide experiences formerly available only through wired networks, the next few years will be critical for operators and service providers to plan future network deployments that will create an adaptable environment in which the multitude of mobile-enabled devices and applications of the future can be deployed.

For More Information

Inquiries can be directed to traffic-inquiries@cisco.com.

Appendix A: The Cisco VNI Global Mobile Data Traffic Forecast

Table 6 shows detailed data from the Cisco VNI Global Mobile Data Traffic Forecast. This forecast includes only cellular traffic and excludes traffic offloaded onto Wi-Fi and small cell from dual-mode devices. The “Other Portable Devices” category includes readers, portable gaming consoles, and other portable devices with embedded cellular connectivity. Wearables are included in the “M2M” category.

Table 6. Global Mobile Data Traffic, 2014–2019

	2014	2015	2016	2017	2018	2019	CAGR 2014–2019
By Application Category (TB per Month)							
Web/Data/VoIP	918,204	1,379,822	2,003,961	2,791,530	3,665,435	4,684,122	39%
Video	1,377,497	2,399,765	4,104,719	6,840,211	10,950,770	17,454,028	66%
Audio Streaming	193,756	323,915	521,071	801,106	1,157,536	1,623,894	53%
File Sharing	35,574	74,694	141,316	245,650	391,052	593,533	76%
By Device Type (TB per Month)							
Nonsmartphones	100,460	138,300	184,087	236,794	282,654	326,727	27%
Smartphones	1,735,263	2,959,242	4,867,986	7,799,668	11,967,545	18,235,073	60%
Laptops	498,285	645,297	829,244	1,010,113	1,182,919	1,365,884	22%
Tablets	154,081	353,244	711,644	1,268,857	2,042,920	3,200,215	83%
M2M	35,657	80,287	175,821	360,121	685,249	1,223,708	103%
Other Portable Devices	1,284	1,827	2,285	2,945	3,505	3,971	25%
By Region (TB per Month)							
North America	562,549	848,841	1,287,056	1,897,360	2,703,861	3,823,340	47%
Western Europe	341,399	503,858	759,547	1,136,508	1,653,008	2,414,260	48%
Asia Pacific	977,352	1,622,007	2,615,992	4,114,085	6,244,853	9,502,851	58%
Latin America	200,900	353,909	580,701	914,924	1,380,221	2,034,931	59%
Central and Eastern Europe	242,253	464,299	831,932	1,408,927	2,230,698	3,495,963	71%
Middle East and Africa	199,484	382,708	690,014	1,193,765	1,927,411	3,043,151	72%
Total (TB per Month)							
Total Mobile Data Traffic	2,523,938	4,175,622	6,765,242	10,665,569	16,140,053	24,314,495	57%

Source: Cisco, 2015

The Cisco VNI Global Mobile Data Traffic Forecast relies in part upon data published by Ovum, Machina, Strategy Analytics, Infonetics, Gartner, IDC, Dell’Oro, Synergy, ACG Research, Nielsen, comScore, Verto Analytics, the International Telecommunications Union (ITU), CTIA, and telecommunications regulators in each of the countries covered by VNI.

The Cisco VNI methodology begins with the number and growth of connections and devices, applies adoption rates for applications, and then multiplies the application user base by Cisco's estimated minutes of use and KB per minute for that application. The methodology has evolved to link assumptions more closely with fundamental factors, to use data sources unique to Cisco, and to provide a high degree of application, segment, geographic, and device specificity.

- **Inclusion of fundamental factors.** As with the fixed IP traffic forecast, each Cisco VNI Global Mobile Data Traffic Forecast update increases the linkages between the main assumptions and fundamental factors such as available connection speed, pricing of connections and devices, computational processing power, screen size and resolution, and even device battery life. This update focuses on the relationship of mobile connection speeds and the KB-per-minute assumptions in the forecast model. Proprietary data from the [Cisco Data Meter application](#) was used as a baseline for current-year smartphone connection speeds for each country.
- **Device-centric approach.** As the number and variety of devices on the mobile network continue to increase, it becomes essential to model traffic at the device level rather than the connection level. This Cisco VNI Global Mobile Data Traffic Forecast update details traffic to smartphones; nonsmartphones; laptops, tablets, and netbooks; e-readers; digital still cameras; digital video cameras; digital photo frames; in-car entertainment systems; and handheld gaming consoles.
- **Estimation of the impact of traffic offload.** The Cisco VNI Global Mobile Data Traffic Forecast model now quantifies the effect of dual-mode devices and femtocells on handset traffic. Data from Cisco's IBSG Connected Life Market Watch and the USC Institute for Communication Technology Management's annual mobile survey was used to model offload effects.

Appendix B: Global 4G Networks and Connections

Tables 7 and 8 show the growth of regional 4G connections and wearable devices, respectively.

Table 7. Regional 4G Connections Growth

	2014		2019	
	Number of 4G Connections (K)	% of Total Connections	Number of 4G Connections (K)	% of Total Connections
Asia Pacific	203,430	5.4%	1,392,853	25.6%
Central and Eastern Europe	8,369	1.2%	221,724	21.6%
Latin America	8,948	1.2%	211,886	21.3%
Middle East and Africa	7,221	0.6%	232,006	13.8%
North America	169,133	39.1%	490,270	42.4%
Western Europe	61,548	10.1%	450,806	38.2%
Global	458,649	6.2%	2,999,545	26.1%

Source: Cisco, 2015

Table 8. Regional Wearable Devices Growth

	2014		2019	
	Number of Wearable Devices (K)	% of Global	Number of Wearable Devices (K)	% of Global
Asia Pacific	37,161	34.2%	184,045	31.8%
Central and Eastern Europe	8,852	8.1%	50,655	8.8%
Latin America	6,012	5.5%	27,854	4.8%
Middle East and Africa	4,852	4.5%	20,940	3.6%
North America	32,323	29.7%	188,150	32.5%
Western Europe	19,484	17.9%	106,665	18.4%
Global	108,684	100.0%	578,310	100.0%

Source: Cisco, 2015

Appendix C: A Case Study on the Initial Impact of Tiered Pricing on Mobile Data Usage

The Changing Role of the Top 1 Percent of Mobile Data Subscribers

Four years ago, the top 1 percent of mobile data subscribers was responsible for a disproportionate amount of mobile data traffic. However, according to the data from this study, this disproportion is becoming less pronounced with time. The amount of traffic due to the top 1 percent of subscribers declined from 52 percent in January 2010 to 18 percent in June 2014. In the recent iteration of the study from October 2013 to June 2014 the amount of traffic due to the top 1 percent of the subscribers, however, increased from 14 percent to 18 percent (Table 9). This increase is due to the inclusion of Tier 2 carriers in the study that offer a relatively higher number of unlimited plans. Looking at the top 1% traffic for just Tier 1 carriers in the study, usage compared to overall monthly traffic ranges from 12% to 15%, showing an overall slight resurgence in the top 1% traffic. This resurgence is attributed to the growth of smartphone usage because more and more users are switching from 2G to 3G to 4G. Tablets, PC data cards, and netbooks have a smaller representation in the study compared to smartphones (Tables 9 and 10).

Table 9. Percentage of Traffic by User Tier, Months October 2013–June 2014

Data Users	Oct-13	Nov-13	Dec-13	Jan-14	Feb-14	Mar-14	Apr-14	May-14	Jun-14
% traffic due to Top 1%	14%	14%	14%	15%	16%	18%	16%	16%	18%
% traffic due to Top 10%	48%	50%	50%	54%	60%	64%	59%	61%	65%

Source: Cisco VNI, 2015

Table 10. Average Traffic by User Tier in MB per Month

Average MB per Month	Oct-13	Nov-13	Dec-13	Jan-14	Feb-14	Mar-14	Apr-14	May-14	Jun-14
Top 1%	14,896	15,242	16,126	14,294	13,842	13,026	14,864	14,247	15,236
Top 5%	6,877	7,145	7,458	7,099	6,931	6,472	7,561	7,335	7,588
Top 10%	4,919	5,067	5,304	5,032	4,870	4,515	5,363	5,202	5,322
Top 20%	3,476	3,517	3,719	3,429	3,262	2,961	3,602	3,473	3,497

Source: Cisco VNI, 2015

Tiered pricing plans have lower megabyte-per-month consumption compared to unlimited plans. However, the overall measures displayed healthy growth with few signs of growth slowing, and the move to tiered pricing does not appear to have an immediate effect on overall mobile data traffic.

The percentage of mobile data users generating more than 2 GB per month was nearly 25 percent by June 2014, and the percentage of users generating more than 200 MB per month reached 75 percent (Table 11).

Table 11. One Percent of Mobile Data Users Consume 5 GB per Month

%	Oct-13	Nov-13	Dec-13	Jan-14	Feb-14	Mar-14	Apr-14	May-14	Jun-14
Greater than 5 GB	3%	4%	4%	4%	5%	5%	6%	6%	7%
Greater than 2 GB	20%	19%	23%	19%	20%	18%	22%	22%	24%
Greater than 200 MB	73%	73%	73%	72%	71%	69%	74%	74%	75%
Greater than 20 MB	91%	91%	91%	91%	90%	89%	91%	91%	92%

Source: Cisco VNI, 2015

The rapid increase in data usage presents a challenge to service providers who have implemented tiers defined solely in terms of usage limits. Mobile data caps that fall too far behind usage volumes may create opportunities for competitors in the market. Therefore, many service providers are creating more nuanced tiers, shared data plans, and data add-ons, such as a separate charge for tethering and hotspot functions. A new development in select markets is the offering of unlimited plans by Tier 2 carriers. Such offerings tend to require less vigilance on the part of subscribers than data caps, yet still monetize scenarios that tend to have high data usage. Shared data family plans are being introduced, and their effects on overall mobile data traffic are yet to be determined.

Mobile Data Traffic Volume by Operating System

Although the effect of the tiered plan is clear, the average consumption per connection continues to increase for both tiered and unlimited plans. Both Android- and Apple-based devices are prominent bandwidth promoters in tiered as well as unlimited plans. Apple-based iOS mobile devices led in average megabyte-per-month usage with unlimited and tiered plans compared to Android-based mobile devices (Tables 12 and 13).

Table 12. MB per Month Usage per Mobile Operating System in Unlimited Plans

Operating System	Oct-13	Nov-13	Dec-13	Jan-14	Feb-14	Mar-14	Apr-14	May-14	Jun-14
iOS	1,483	1,546	1,563	1,626	1,708	1,643	1,931	1,932	2,153
Android	1,414	1,537	1,648	1,564	1,544	1,490	1,764	1,751	1,930
Windows	1,483	1,546	1,563	1,626	1,708	1,643	1,931	1,932	2,153

Source: Cisco VNI, 2015

Table 13. MB per Month Usage per Mobile Operating System in Tiered Pricing Plans

Operating System	Oct-13	Nov-13	Dec-13	Jan-14	Feb-14	Mar-14	Apr-14	May-14	Jun-14
iOS	1,074	1,061	1,151	1,041	1,046	966	1,174	1,175	1,290
Android	938	935	1,009	884	846	816	922	874	987
Windows	841	775	772	744	673	633	912	855	762

Source: Cisco VNI, 2015

Shared data plans have been introduced in mature markets, and the initial findings show lower traffic usage in shared plans; but both shared as well as regular plans continue to grow in terms of usage per month (Table 14).

Table 14. Shared vs. Regular Plans

Shared vs. Regular Plan (MB/month)	Oct-13	Nov-13	Dec-13	Jan-14	Feb-14	Mar-14	Apr-14	May-14	Jun-14
Regular Plan	1,276	1,312	1,413	1,324	1,332	1,276	1,498	1,501	1,641
Shared Plan	923	962	979	995	1,058	1,060	1,261	1,263	1,389

Source: Cisco VNI, 2015

Appendix D: IPv6-Capable Devices, 2014–2019

Table 15 provides the segmentation of IPv6-capable devices by device type, and Table 16 provides regional IPv6-capable forecast detail.

Table 15. IPv6-Capable Devices by Device Type, 2014–2019

Devices (K)	2014	2015	2016	2017	2018	2019	CAGR 2014–2019
Global	2,011,486	2,614,224	3,301,088	4,086,574	5,044,931	6,208,921	25%
Laptops	162,993	180,091	199,843	215,855	227,811	236,472	8%
M2M	62,640	121,469	243,196	450,996	754,519	1,155,014	79%
Nonsmartphones	435,720	551,899	589,772	563,033	558,834	579,722	6%
Other Portables	14,212	11,853	11,274	12,378	14,717	17,262	4%
Smartphones	1,270,457	1,650,435	2,115,471	2,656,844	3,256,192	3,934,847	25%
Tablets	65,464	98,476	141,531	187,469	232,857	285,603	34%

Source: Cisco, 2015

Table 16. IPv6-Capable Devices by Region, 2014–2019

Devices (K)	2014	2015	2016	2017	2018	2019	CAGR 2014–2019
Global	2,011,486	2,614,224	3,301,088	4,086,574	5,044,931	6,208,921	25%
Asia Pacific	902,595	1,188,908	1,501,166	1,863,822	2,316,171	2,887,641	26%
Latin America	200,645	265,430	336,269	413,393	506,861	616,992	25%
North America	244,948	292,870	362,471	441,493	527,250	620,753	20%
Western Europe	293,536	351,011	423,140	506,104	600,566	707,642	19%
Central and Eastern Europe	156,203	215,090	282,827	363,729	460,659	578,693	30%
Middle East and Africa	213,559	300,915	395,215	498,033	633,425	797,199	30%

Source: Cisco, 2015



Americas Headquarters
Cisco Systems, Inc.
San Jose, CA

Asia Pacific Headquarters
Cisco Systems (USA) Pte. Ltd.
Singapore

Europe Headquarters
Cisco Systems International BV Amsterdam,
The Netherlands

Cisco has more than 200 offices worldwide. Addresses, phone numbers, and fax numbers are listed on the Cisco Website at www.cisco.com/go/offices.

Cisco and the Cisco logo are trademarks or registered trademarks of Cisco and/or its affiliates in the U.S. and other countries. To view a list of Cisco trademarks, go to this URL: www.cisco.com/go/trademarks. Third party trademarks mentioned are the property of their respective owners. The use of the word partner does not imply a partnership relationship between Cisco and any other company. (1110R)