Cisco Global Cloud Index Supplement: Cloud Readiness Regional Details

What You Will Learn

The Cisco® Global Cloud Index is an ongoing effort to forecast the growth of global data center and cloud-based IP traffic. The study also includes a "Cloud Readiness" analysis that investigates the ability of each global region (Asia Pacific, Central and Eastern Europe, Latin America, Middle East and Africa, North America, and Western Europe) to support a sample set of basic, intermediate, and advanced business and consumer cloud applications. Each region's cloud readiness is assessed with relation to the sample services based on download and upload fixed and mobile network speeds as well as associated network latencies. This supplement provides additional country-level data that contributes to the infrastructural and end-user preparedness for cloud computing adoption within each respective region. These collective results represent the basis for each region's network performance averages (speeds and latencies). Please refer to the Cisco Global Cloud Index: Forecast and Methodology, 2015–2020 for complete research findings and projections.

Country-Level Details of Regional Cloud Readiness

The Cloud Readiness portion of the Cisco Global Cloud Index includes more than 300 million records from Ookla[1], along with inputs from the Data Meter application, Ovum/Informa, Point Topic, Synergy research, NetCraft, the International Telecommunication Union (ITU), World Bank, International Labor Organization, and the United Nations (UN). The network performance data gathered represents over 200 countries around the world, covering a span of 2 years. The regional averages presented in the Cisco Global Cloud Index: Forecast and Methodology, 2015–2020 are based on the detailed analysis of these speed tests.

To understand cloud readiness further, we look at numerous factors that influence end-user behaviors and Internet access. There are many intrinsic and extrinsic factors that influence the adoption of cloud computing, and make some countries and regions more cloud-ready than others. In this paper, we examine a few, namely demographic and economic factors such as the role of the members of Generation (Gen) Y, percentage of gross domestic product (GDP) per capita spend on fixed Internet, electricity production, and kilowatt-hours (kWh) per capita. Percentage of households with a computer, mobile subscriptions per household, percentage of fiber subscribers to all fixed broadband subscribers, percentage of fourth-generation (4G) subscriptions compared to all mobile subscriptions, the percentage of secure Internet servers to all web-facing servers, and fixed and mobile broadband speeds are then examined as key factors of network readiness for cloud computing.

Demographic Cloud Adoption Factor: Gen Y

By 2020, 62% of organizations in a recent survey say they will be running 100% of their information technology in the cloud. But younger startup companies are already close to that point.[2] Technology, and specifically the cloud, will play an important role in satisfying the highly connected members of Generation Y (born: 1977–1994) who don't want to be constrained by a limited suite of corporate and consumer applications and gadgets. It comes as no surprise that 60 percent of employees will be provisioned from the cloud by 2020, up from just 15 percent today.[3] By 2020, 50 percent of the workforce will be Generation Y and Z (born: 1995–2012) members—and they have grown up in a highly connected, collaborative, and mobile environment. Figure 1 shows details about the percentage of Gen Y members within the global population in 2015.[4]

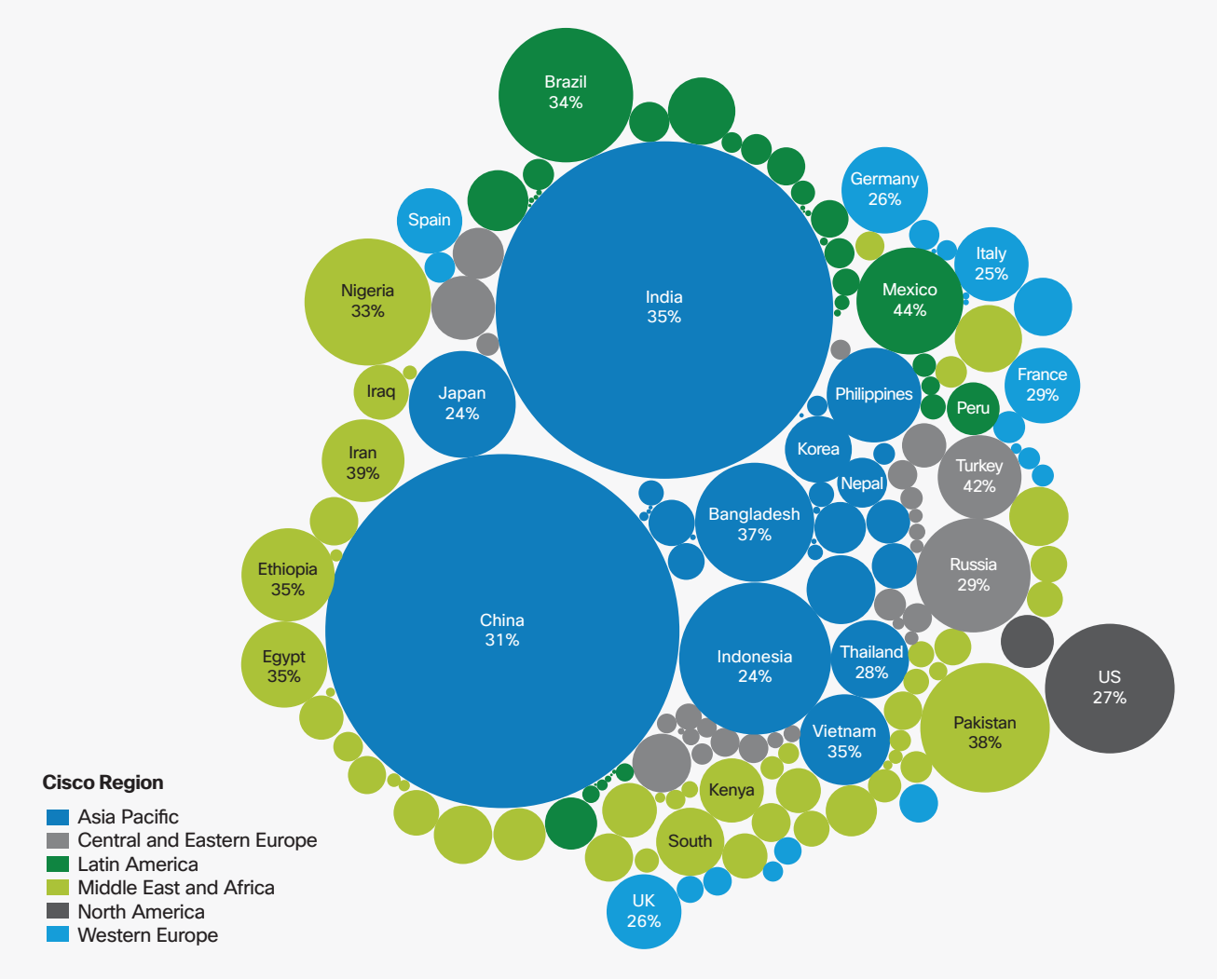
[1] Measured by Speedtest.net, small binary files are downloaded and uploaded between the web server and the client to estimate the connection speed in kbps.

[2] https://www.bettercloud.com/monitor/cloud-office-systems-adoption/

[3] www.channelnomics.com/channelnomics-us/news/2424142/saas-adoption-boosts-enterprise-software-fortunes

[4] www.lifehealthpro.com/2015/01/07/in-5-years-millennials-will-make-up-50-of-the-work

Figure 1. Percentage of Gen Y to Total Population by Country; Bubble Size Denotes Population

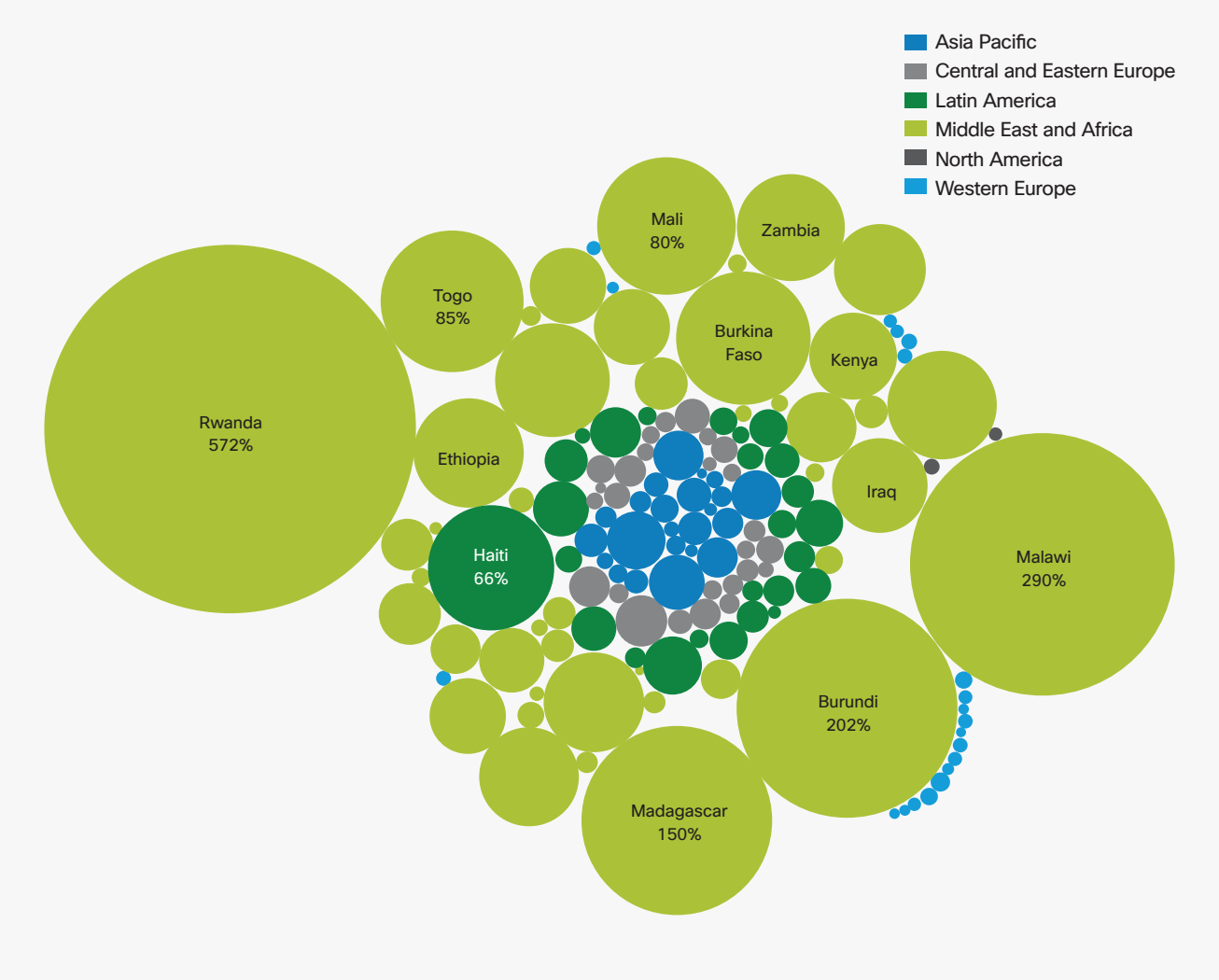


Source: Cisco Global Cloud Index 2016, International Labor Organization, United Nations

Economic Cloud Adoption Factor: Percentage of GDP per Capita Spend on Fixed Internet

Affordability of fixed broadband is an important accelerator for cloud adoption and country digitization. Fixed broadband spend is the price of the monthly subscription to an entry-level fixed broadband plan. For comparability reasons, the fixed broadband spend is based on a monthly usage of a minimum of 1 Gigabyte (GB). For plans that limit the monthly amount of data transferred by including caps below 1 GB, the cost for additional bytes is added to the sub-basket. Figure 2 represents fixed Internet spend and GDP per capita from the latest world development indicators from 2013 by the World Bank. In emerging markets, countries are devising ways to bridge the gap by either improving fixed infrastructure and offerings or leapfrogging fixed networks by deploying ubiquitous mobile technologies that offer Internet and as a result cloud services.

Figure 2. Percentage of GDP per Capita Spend on Fixed Internet; Bubble Size Represents Percentage of Each Country's GDP Spend on Fixed Internet



Source: Cisco Global Cloud Index 2016, World Bank World Development Indicators, International Monetary Fund

Economic Cloud Adoption Factor: Electricity Production, kWh per Capita

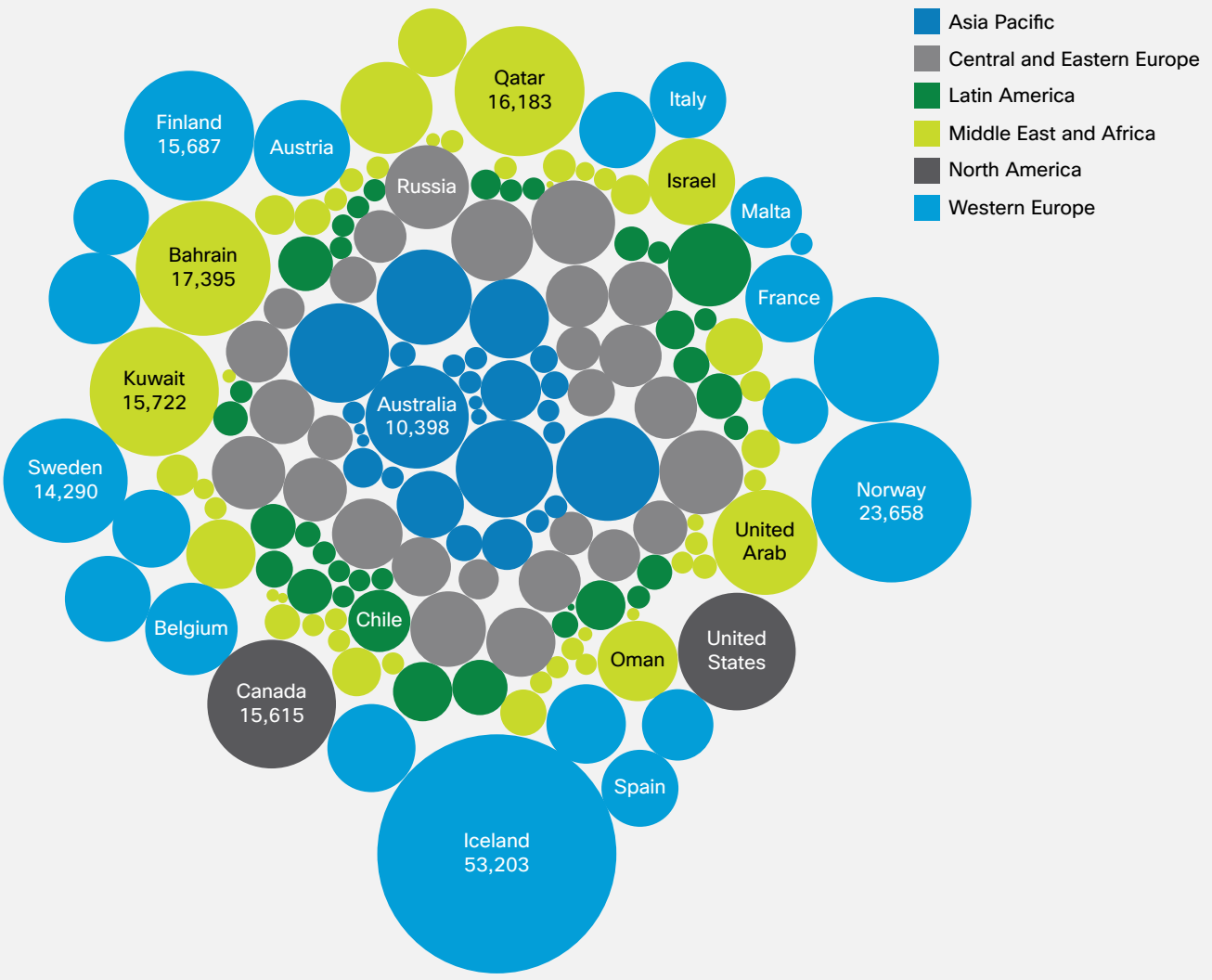
Data centers are the backbone of the modern economy and cloud adoption. However, the explosion of digital content, big data, e-commerce, and Internet traffic is also making data centers one of the fastest-growing consumers of electricity.

Total data center electricity usage in the U.S., which includes powering servers, storage, networking and the infrastructure to support it, was at 70 billion kWh (kilowatt hours) in 2014. Based on current trends, data centers are expected to consume approximately 73 billion kWh in 2020, becoming nearly flat over the next four years. Increase in server efficiency is resulting in reduced server growth rate, better utilization due to virtualization, and a shift to cloud computing.

This includes concentration of workloads in "hyperscale" data centers, defined as 400,000 square feet in size and above. Energy use by data centers may also decline if more work is shifted to hyperscale centers.[5] Figure 3 is based on the latest available data from the World Bank.

[5] http://www.computerworld.com/article/3089073/data-center/cloud-computing-slows-energy-demand-us-says.html

Figure 3. Electric Power Consumption (kWh per Capita); Bubble Size Denotes kWh per Capita

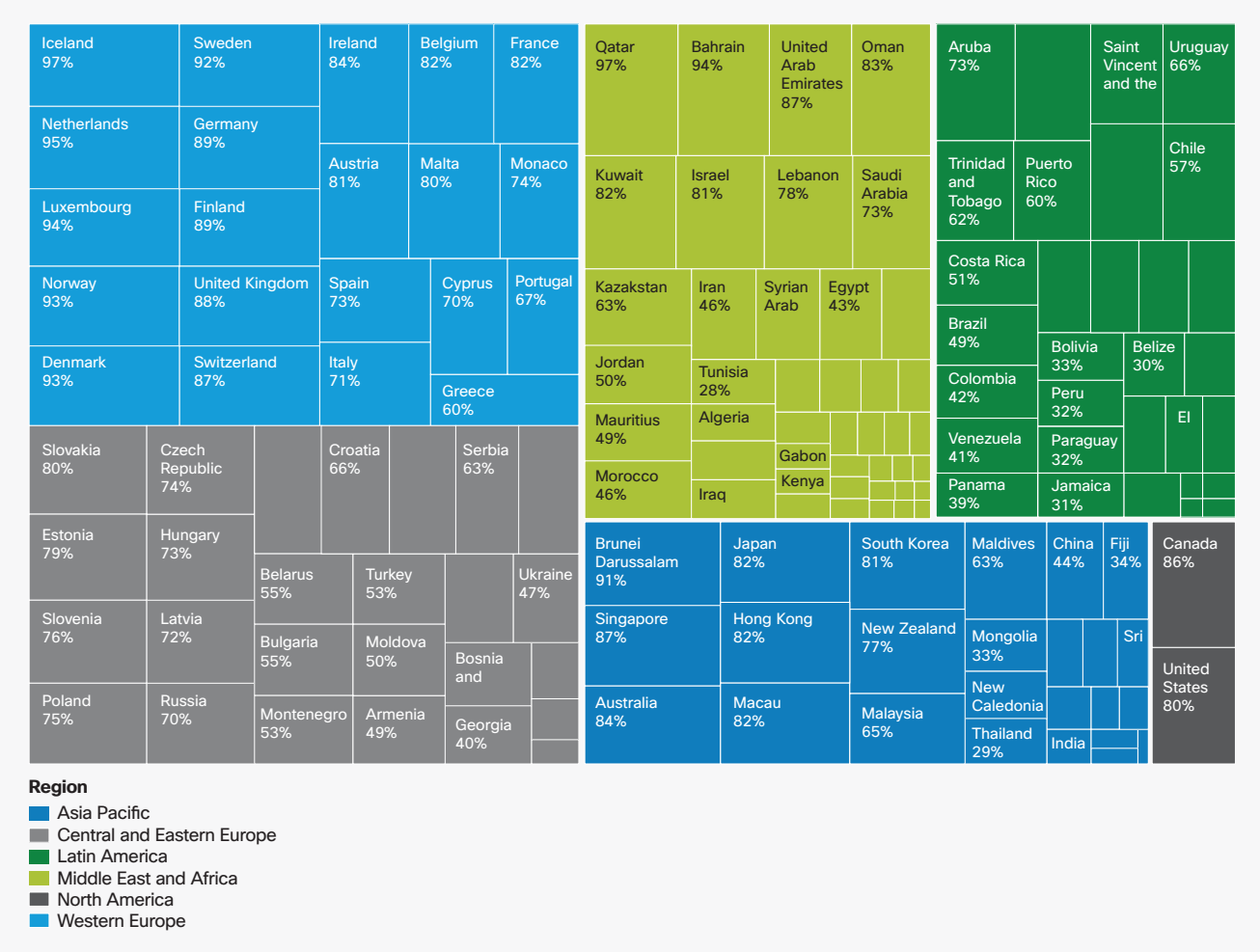


Source: World Bank World Development Indicators

Network Cloud Adoption Factor: Percentage of Households with a Computer

Personal Computer (PC) usage in households has led to the wide adoption of the Internet, and is an important accelerator in the adoption of cloud services. While social networking, file sharing, and web browsing applications have paved the way, video streaming with the DVR, cloud storage, home automation, and controls among others will lead the next wave of the adoption of cloud services. Figure 4 shows the relative percentage of households with a PC based on the most recent World Bank Indicators report.

Figure 4. Percentage of Households with a PC; Size of the rectangle also depicts the value as a percentage of the total country households

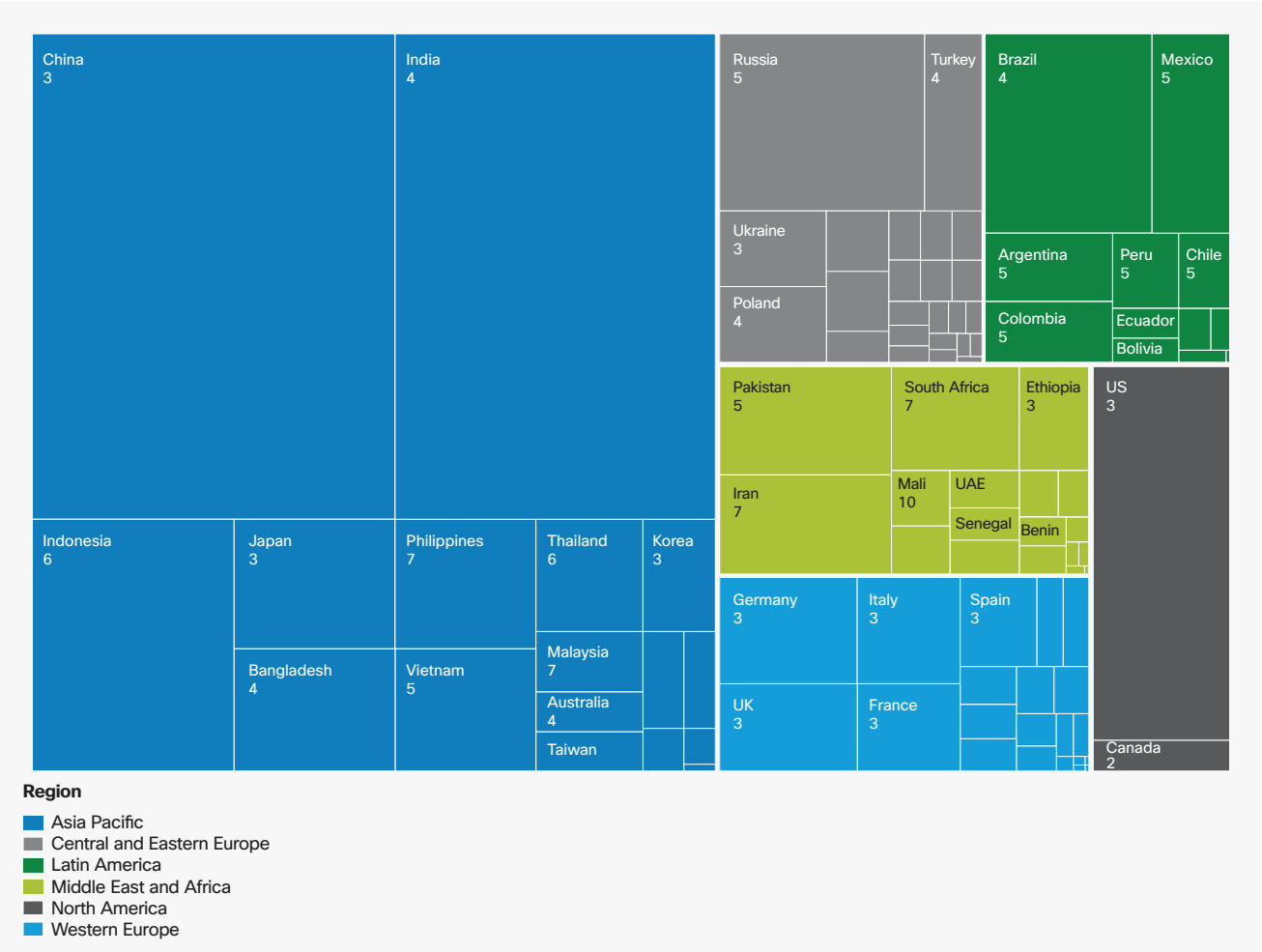


Source: World Bank World Development Indicators, 2015

Network Cloud Adoption Factor: Mobile Subscriptions per Household

Although mobile phone usage is nearly ubiquitous in most regions, smartphone and tablet use in emerging countries and regions with widespread rural populations and vast terrains is the next level of mobility that will advance cloud services adoption. Figure 5 depicts the overall mobile subscriptions per household in 2016. Size of the rectangles depict the total number of mobile subscriptions in each country.

Figure 5. Mobile Subscriptions per Household. Size of the heatmap rectangle indicates the number of mobile subscribers per country

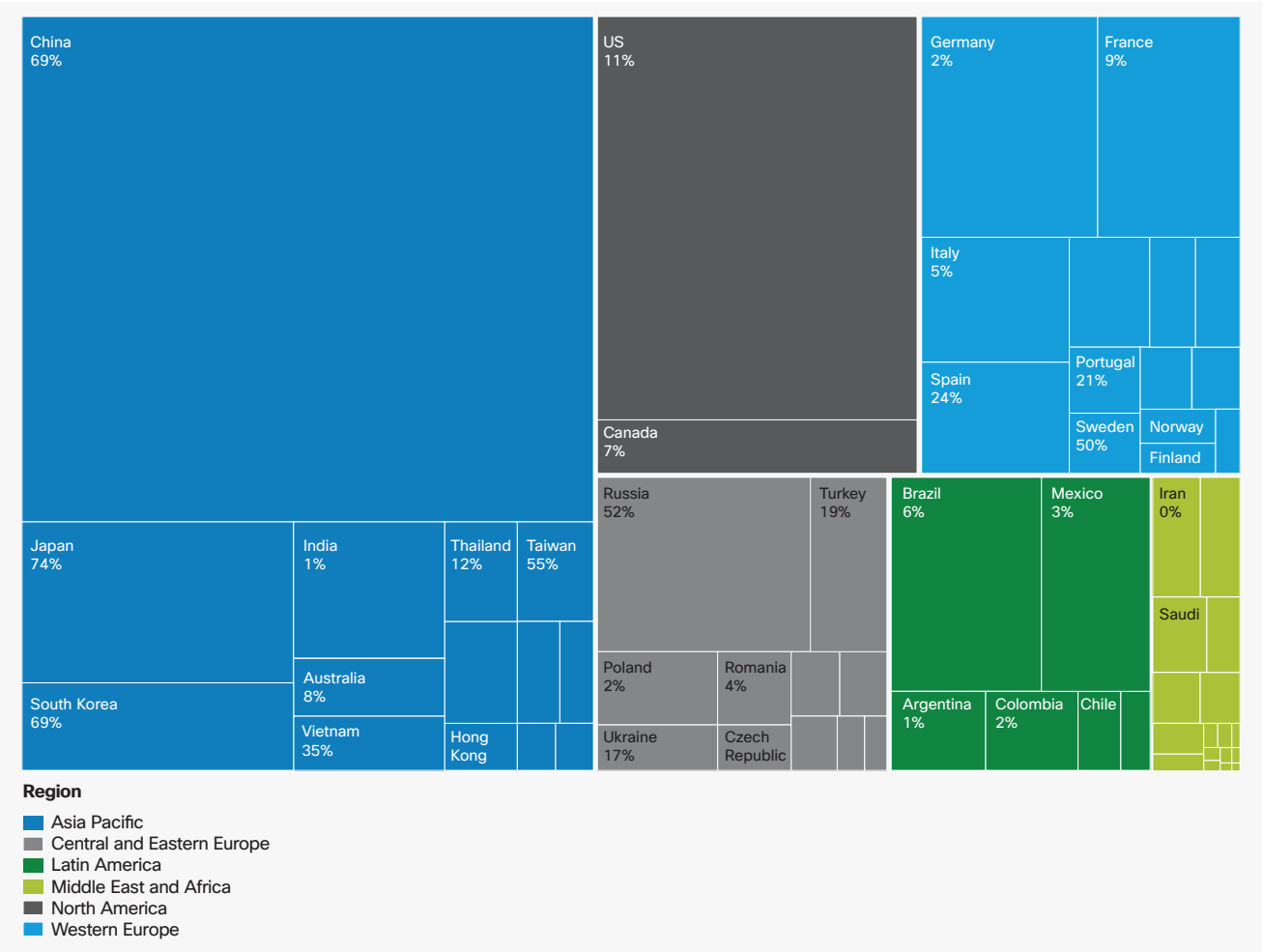


Source: Cisco Global Cloud Index 2016, Ovum/Informa

Network Cloud Adoption Factor: Percentage Fiber Subscribers to All Fixed Broadband Subscribers

An important accelerator to advanced cloud applications such as telemedicine, ultra-high-definition (UHD) video streaming, and virtual offices (as well as other high-end services) is higher fixed broadband quality. The ongoing deployments of residential fiber infrastructures provides the basis for enhanced fixed network performance. Higher broadband speeds and lower latencies enable optimum user experiences. Figure 6 shows the percentage of fiber to all fixed broadband subscribers in 2016.

Figure 6. Percentage of Fiber Subscribers to All Fixed Internet Subscribers. Size of the heatmap rectangle indicates the number of fixed Internet Subscribers per Country

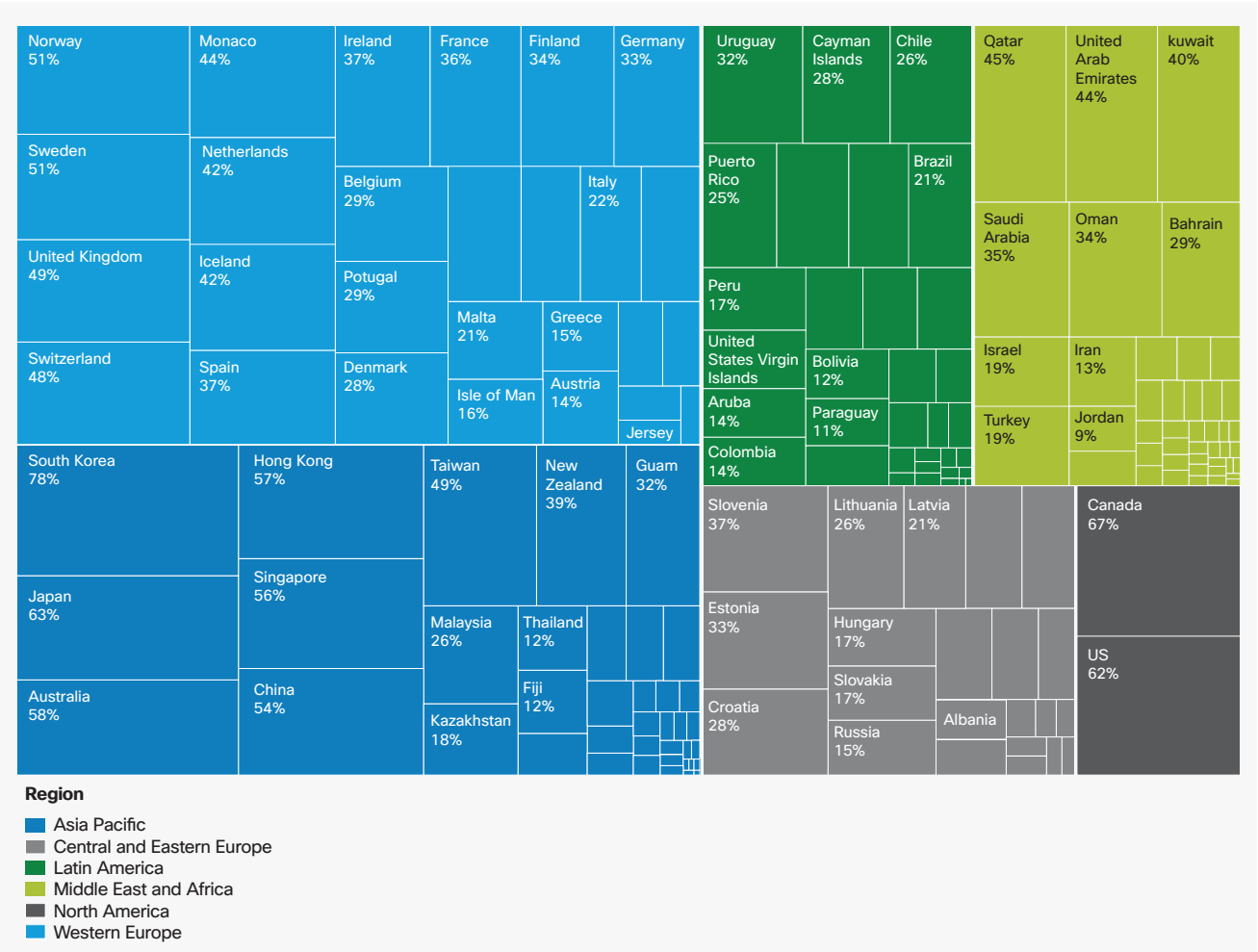


Source: Cisco Global Cloud Index 2016, Point Topic, Ovum/Informa

Network Cloud Adoption Factor: Percentage of 4G Subscriptions Compared to All Mobile Subscriptions

As 4G deployments become more pervasive, connectivity will no longer be the weakest link to cloud adoption. The widespread availability and adoption of 4G will lead to the usage of cloud-based applications almost anywhere, anytime from a user's chosen mobile device. Figure 7 shows the percentage of 4G subscriptions compared to all mobile subscriptions in 2016. The total number of mobile subscribers is depicted by the size of the rectangle.

Figure 7. Percentage of 4G Subscriptions to All Mobile Subscriptions. Size of the heatmap rectangle represents the percentage of 4G subscriptions per total mobile subscriptions

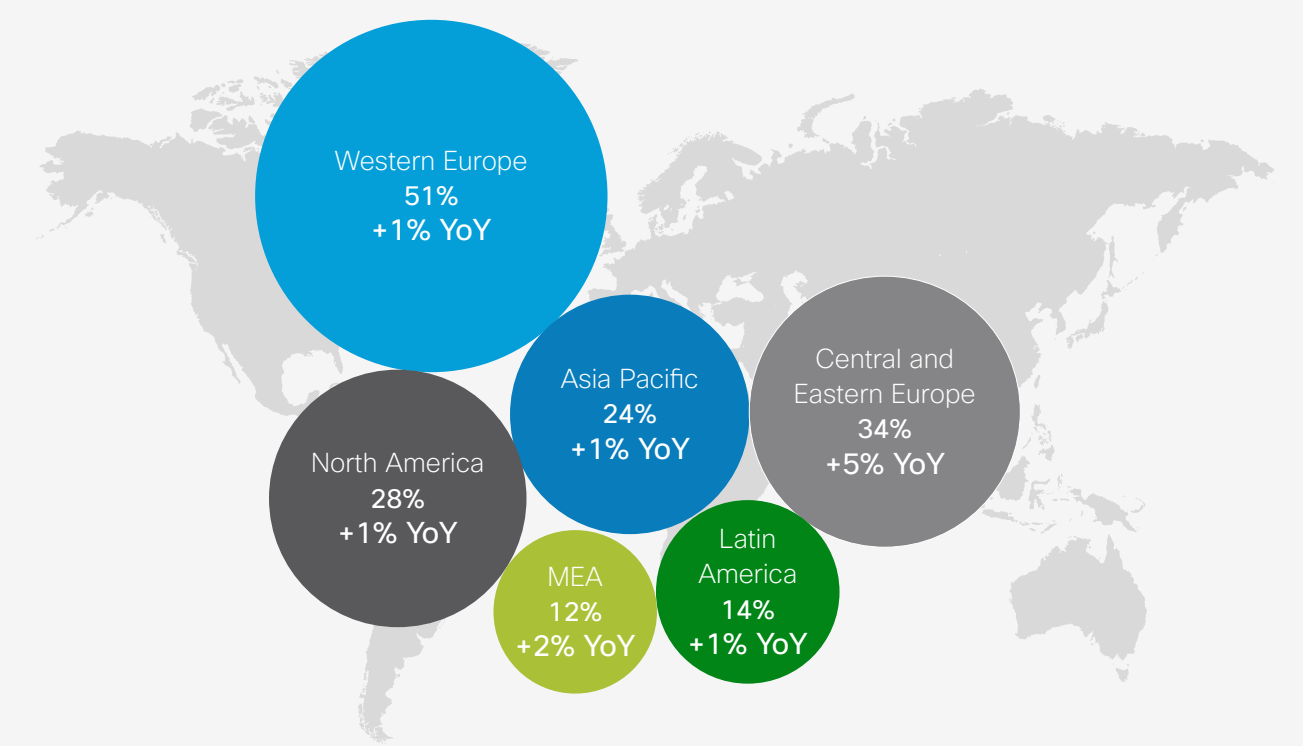


Source: Cisco Global Cloud Index 2016, Ovum/Informa

Network Cloud Adoption Factor: Secure Internet Servers

With more secure Internet servers, service providers, data center operators, and large enterprises are able to establish a larger footprint for security and authentication, and more reliably serve end users with secure transactions and communications. The percentage of secure Internet servers that conduct encrypted transactions over the Internet using a Secure Sockets Layer (SSL) in 2015 to the total number of web-facing servers is shown in Figure 8. In the past year, North America and Western Europe led with the number of secure Internet servers compared to all web facing servers.

Figure 8. Percentage of Secure Internet Servers to Total Web-Facing Internet Servers by Region and change from 2014 to 2015



Source: Cisco Global Cloud Index 2016, Synergy Research, NetCraft, United Nations World Development Indicators

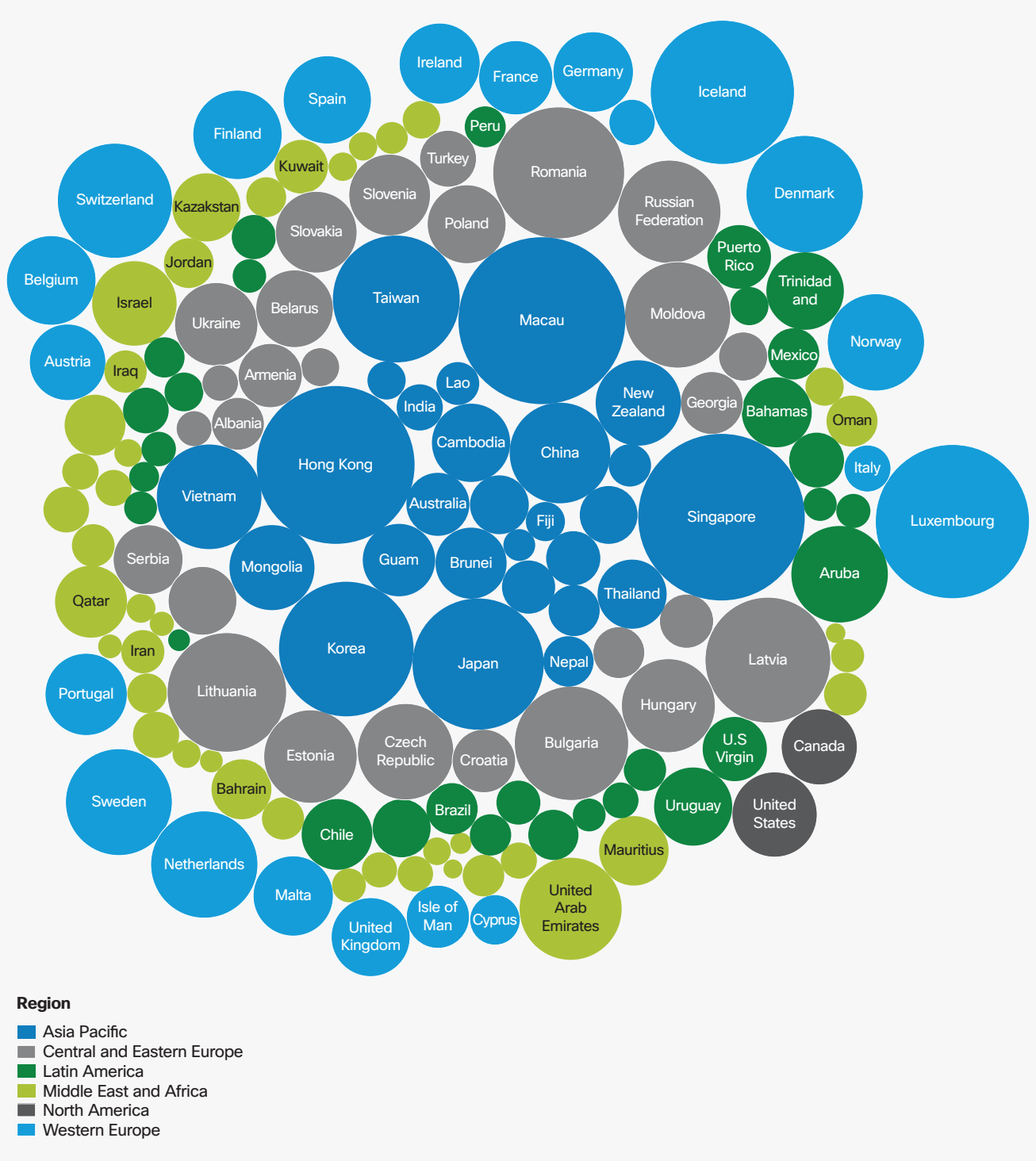
Network Readiness: Download Speed, Upload Speed, and Latency

Cloud computing architectures have made it feasible to run hardware components, operating systems, libraries, and third-party software effectively as virtual machines and containers. Today, data centers contain many thousands of interconnected computers as part of cloud platforms, which can simultaneously host a large number of applications and services for consumer and enterprise users. Applications such as video conferencing, telemedicine, connected vehicle safety applications, and others have high requirements of download and upload speeds in Mbps and stringent requirements of latency in ms.

Download speeds in megabits per second (Mbps), upload speeds in Mbps, and latency in milliseconds (ms) were given equal weights in calibrating each country's network performance. The study has traditionally focused on average or mean download, upload, and latency characteristics. Median download speed in Mbps , median upload speed in Mbps , and the median latency in ms are reported in the study to understand the variability of speeds experienced by the end users within each country. In most countries, median speeds are lower than mean and average speeds because of the higher occurrence of lower speeds in the lower 50th percentile, compared to the longer tail of distribution of the higher speeds. The median of a set of numbers is the midpoint, where half the numbers are lower and half the numbers are higher. The average of a set of numbers is the total of those numbers divided by the number of items in that set.

In analyzing broadband speeds and latencies in more than 200 countries, individual countries may have slightly or significantly higher or lower averages compared to their regional averages for download speed, upload speed, and network latency. In some cases, individual countries did not have enough test results to warrant inclusion in a particular network metric category (for example, fixed or mobile download or upload speed). For normalization and to prevent skewing of the data, we have applied the 5th to 95th percentile methodology to our study (the top 5 percent and bottom 5 percent of results in fixed and mobile performance categories by country are excluded). The download speeds, upload speeds, and latencies were given an equal weightage resulting performance indicator for each country, as seen by the size of the bubbles in Figures 9 and 10. Please refer to the Cisco Cloud Readiness Tool for additional countries and speeds and latency figures.

Figure 9. Fixed Cloud Readiness, 2016. Size of the bubble is based on a formulaic factor where download and upload speeds, and latency are given equal weights for each country and are normalized and ranked



Source: Cisco Global Cloud Index 2016, Ookla Speedtest.net/Ziff Davis

Figure 10. Mobile Cloud Readiness, 2016. Size of the bubble is based on a formulaic factor where download and upload speeds, and latency are given equal weights for each country and are normalized and ranked

Source: Cisco Global Cloud Index 2016, Ookla Speedtest.net/Ziff Davis

Top Performers

Tables 1 and 2 highlight the countries with the top fixed and mobile network performance in 2016. Nine out of 10 countries are in both the fixed and mobile network top-performer categories.

Table 1. Countries with Leading Fixed Network Performance (Top 10) in 2016 (Listed in Alphabetical Order)

Country	Average Download (Mbps)	Average Upload (Mbps)	Average Latency (ms)
Hong Kong	98	100	28
Iceland	53	46	15
Japan	67	58	33
Korea	60	53	21
Latvia	41	39	18
Lithuania	38	36	19
Luxembourg	96	64	20
Romania	65	47	22
Singapore	97	96	19
Taiwan	49	21	17

Source: Cisco Global Cloud Index 2016, Ookla Speedtest.net/Ziff Davis

Table 2. Countries with Leading Mobile Network Performance (Top 10) in 2015 (Listed in Alphabetical Order)

Country	Average Download (Mbps)	Average Upload (Mbps)	Average Latency (ms)
Australia	28	12	43
Denmark	25	13	36
Hungary	31	13	42
Korea	31	14	68
Lithuania	24	12	38
Malta	28	7	31
Netherlands	30	13	64
Norway	29	12	40
Romania	29	18	53
Singapore	38	22	58

Source: Cisco Global Cloud Index 2016, Ookla Speedtest.net/Ziff Davis

Most Improved

Tables 3 and 4 provide details about the countries with the most improved fixed and mobile network performance from 2015 to 2016.

Table 3. Countries with the Most Improved Fixed Network Performance from 2015 to 2016 (Listed in Alphabetical Order)

Country	Improvement (Y/Y)
Dominican Republic	151%
Guatemala	217%
Indonesia	109%
Jordan	97%
Myanmar	173%
Pakistan	97%
Paraguay	102%
Serbia	96%
Spain	100%
Trinidad and Tobago	181%

Source: Cisco Global Cloud Index 2016, Ookla Speedtest.net/Ziff Davis

Table 4. Countries with the Most Improved Mobile Network Performance from 2015 to 2016 (Listed in Alphabetical Order)

Country	Improvement (Y/Y)
Albania	200%
Egypt	170%
Guatemala	228%
Honduras	231%
Jordan	237%
Morocco	240%
Nicaragua	383%
Oman	294%
Pakistan	170%
Venezuela	244%

Source: Cisco Global Cloud Index 2016, Ookla Speedtest.net/Ziff Davis

Individual Country Speed Test Analysis

Six countries from six regions were used to display the variation of download speeds within a country in 2016, as shown in Figures 11 through 16. No specific criteria were used in the selection of a country; selection was random. More frequent occurrences of lower speeds experienced by the end user result in suboptimal experience in usage of cloud applications available to them. Alternatively, users may choose to use a basic or smaller set of applications.

The mean speeds in Mbps in the following figures represent the overall average of the speed tests within each country. The median represents the midpoint of the speed tests. Large variations between the mean and the median represent a skew in the distribution of speeds. Some countries also display various peaks in download speeds, which show the experienced speeds due to the variety of tiered offerings by providers. Also depicted in the figures is the concurrent usage of three sample cloud applications representing basic (Text and IM), intermediate (Augmented Reality (AR) gaming), and advanced (Virtual Reality (VR) streaming) requirements.

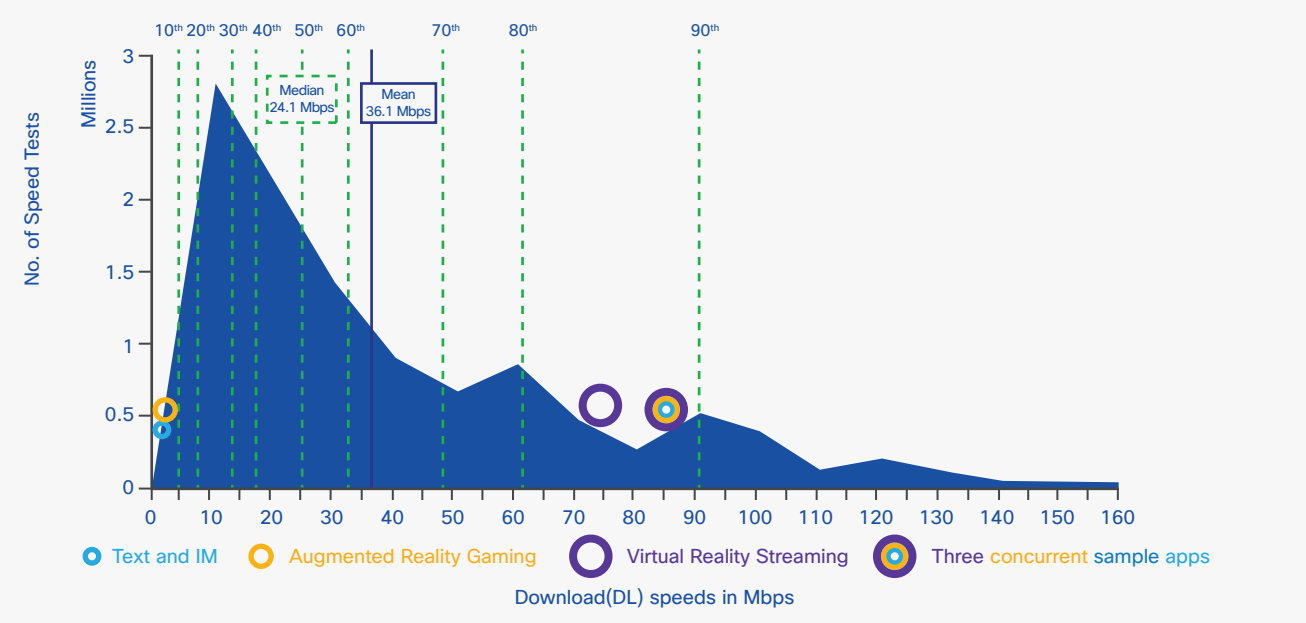
North America Speed Test Distribution Country Spotlight: United States

Figure 11 depicts the distribution of download speed tests around the mean/average or median. In 2016, there were more frequent occurrences of lower download speeds of 5 to 17 Mbps. Besides the 10th through 40th percentile, in 2016 the speed test results also have a higher occurrence between the 70th and 80th percentile, showing a remarkable growth in experienced download speeds. The difference between the mean (the average) and the median speeds is 12 Mbps. A large majority of the users are able to experience the concurrent usage of sample applications optimally.

Latin America Speed Test Distribution Country Spotlight: Mexico

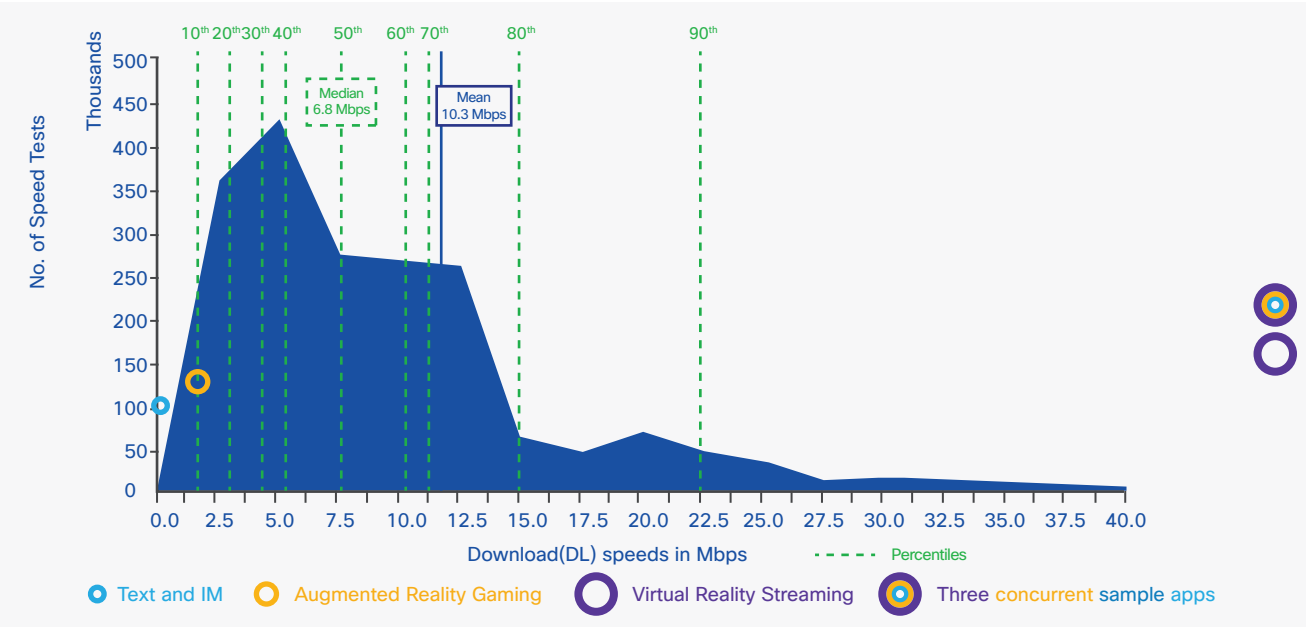
Figure 12 depicts the distribution of download speed tests around the mean/average and the median in Mexico. The majority of the speeds are between 2 and 7 Mbps (10th and 50th percentiles), and there are fewer speed test records around the 80th to 90th percentile range, which is 13 to 22.5 Mbps. There is a wider distribution of higher speeds beyond the 70th percentile. The difference between the mean (average) and the median speeds is 3.5 Mbps. A good majority of the users are able to experience the concurrent usage of sample applications optimally.

Figure 11. Download Speed Distribution Curve: United States



Source: Cisco Global Cloud Index, 2016

Figure 12. Download Speed Distribution Curve: Mexico

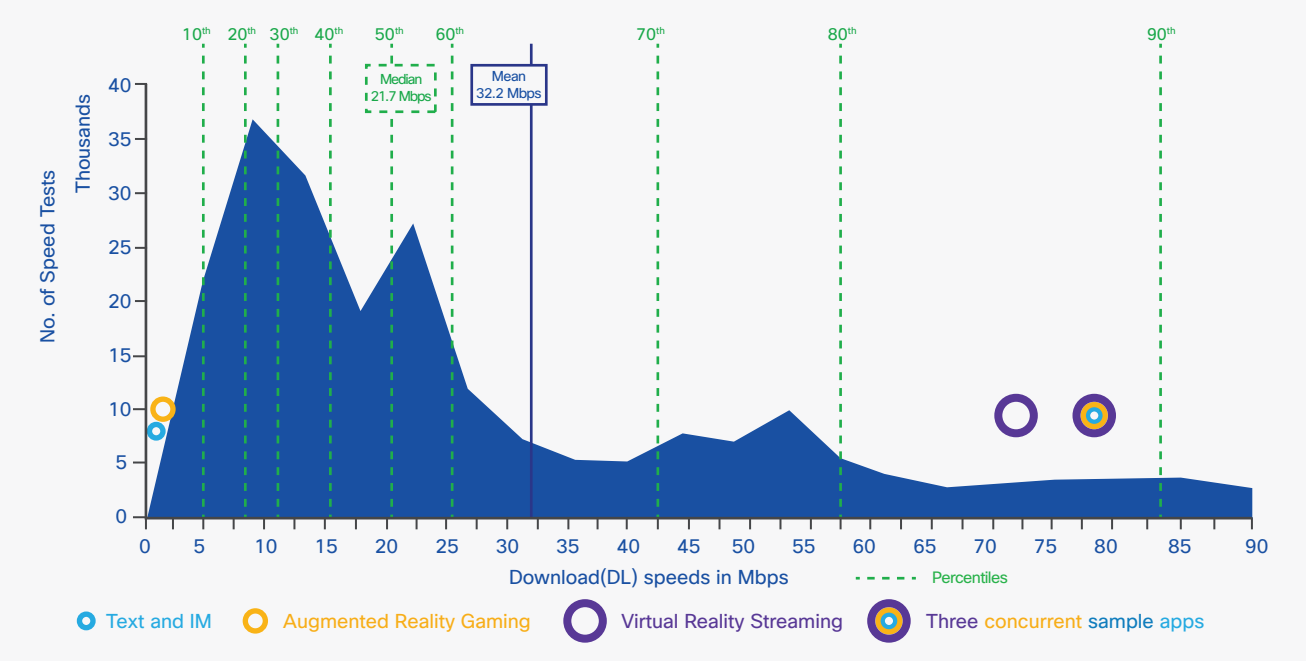


Source: Cisco Global Cloud Index, 2016

Asia-Pacific Speed Test Distribution Country Spotlight: China

Figure 13 depicts the distribution of download speeds around the mean/average and median in China. The most frequent occurrences of speeds are between 5 and 15 Mbps (10th through 40th percentiles), and there are fewer speed test records around the 70th to 90th percentile range (42 to 85 Mbps). The distribution has a long tail of high speeds beyond the 60th percentile. The difference between the mean (average) and the median speeds is nearly 11 Mbps, the largest difference in the samples represented in this section. A large majority of the users are able to experience the concurrent usage of sample applications optimally.

Figure 13. Download Speed Distribution Curve: China

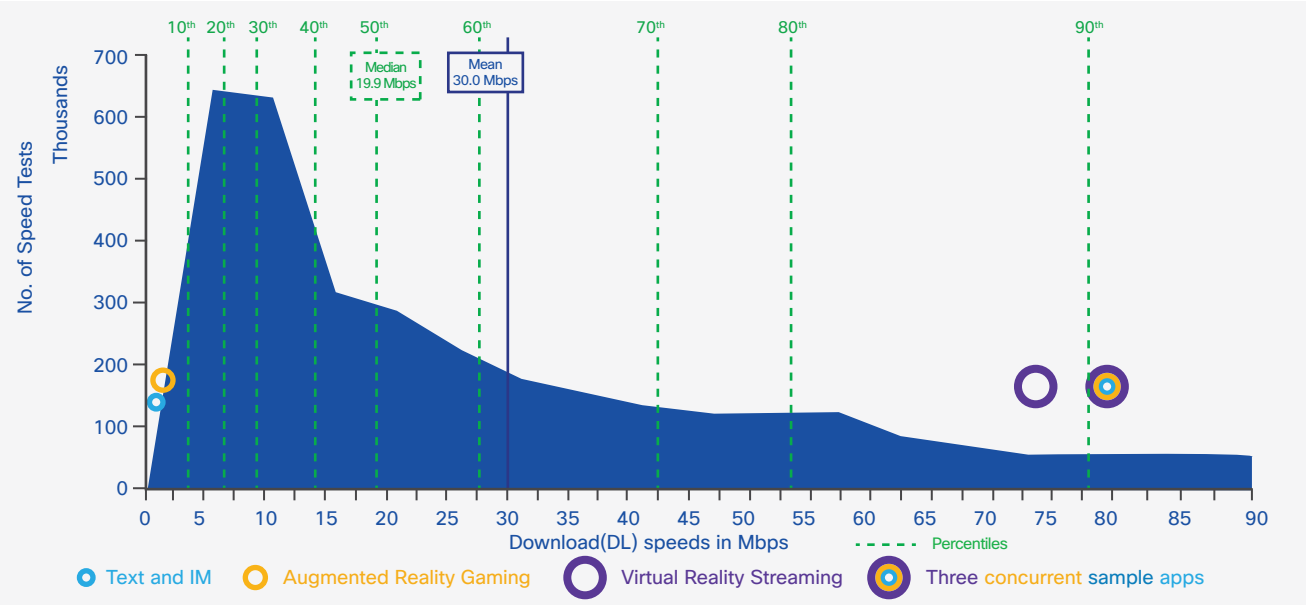


Source: Cisco Global Cloud Index, 2016

Central and Eastern Europe Speed Test Distribution Country Spotlight: Russia

Figure 14 depicts the distribution of download speeds around the mean/average and median in Russia. The largest occurrences of speeds are between 3 and 13 Mbps, which are the 10th to 40th percentiles, and there are fewer speed test records around the 40 and 77 Mbps (70th to 90th percentiles) range. The distribution has a long tail of higher speeds beyond the 50th percentile. The difference between the mean (average) and the median speeds is nearly 10 Mbps. A large majority of the users are able to experience the concurrent usage of sample applications optimally.

Figure 14. Download Speed Distribution Curve: Russia

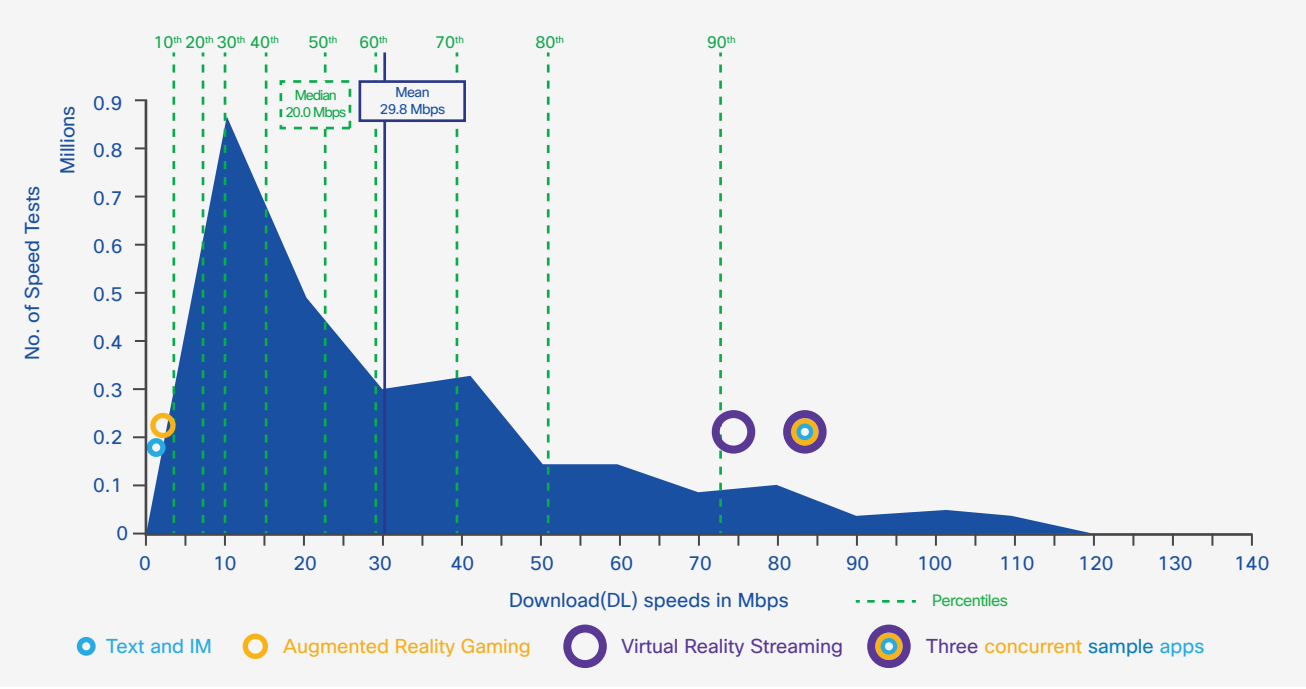


Source: Cisco Global Cloud Index, 2016

Western Europe Speed Test Distribution Country Spotlight: United Kingdom

Figure 15 depicts the distribution of download speed tests around the mean/average and median in the United Kingdom. The largest occurrences of speeds are between 4 and 15 Mbps (10th to 40th percentiles), and there are fewer speed test records between 50 and 72 Mbps (80th to 90th percentiles). There is a longer distribution of higher speeds beyond the 60th percentile. The difference between the mean or average speeds and the median is nearly 10 Mbps. A large majority of the users are able to experience the concurrent usage of sample applications optimally.

Figure 15. Download Speed Distribution Curve: United Kingdom

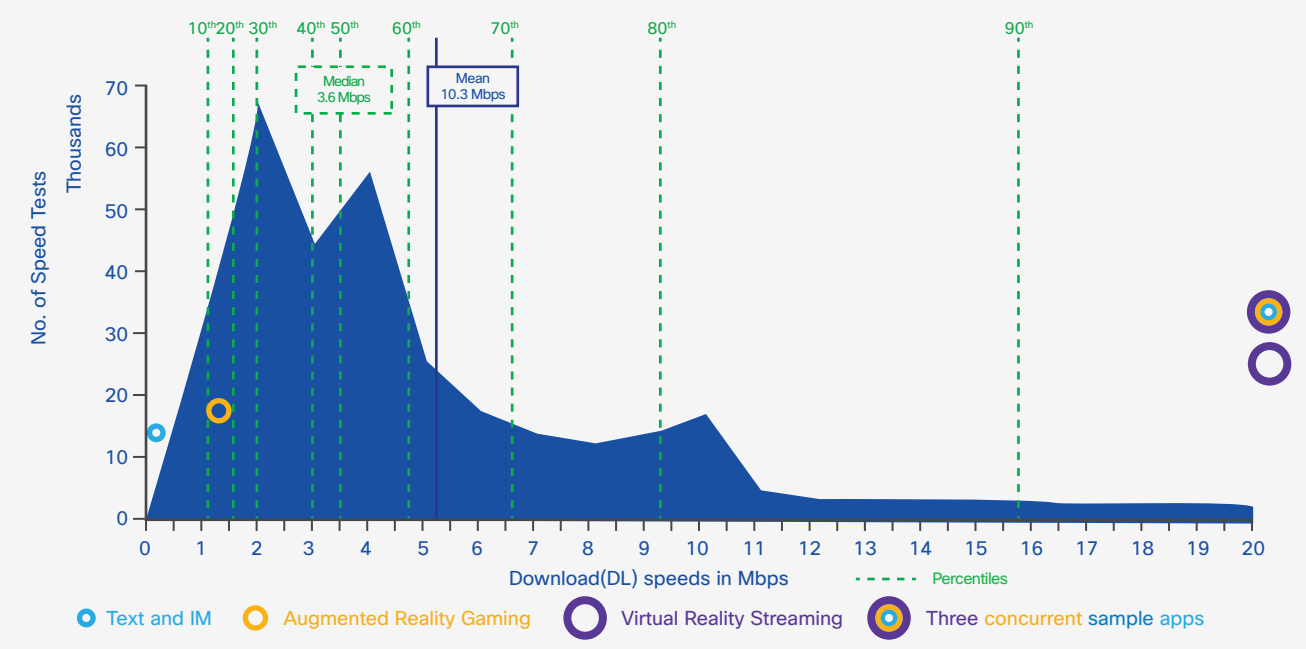


Source: Cisco Global Cloud Index, 2016

Middle East and Africa Speed Test Distribution Country Spotlight: South Africa

Figure 16 depicts the distribution of download speed tests around the mean/average and median in South Africa. The majority of the download speeds occur here between 1 and 3 Mbps (10th to 40th percentiles). The distribution has a long tail of higher speeds beyond the 60th percentile. The difference between the mean or average speeds and the median is nearly 7 Mbps. A smaller majority of the users are able to experience the concurrent usage of sample applications optimally.

Figure 16. Download Speed Distribution Curve: South Africa



Source: Cisco Global Cloud Index, 2016

Conclusion

Numerous demographic, economic, and network factors lead a country toward better cloud readiness, and all the factors are important. Many private and public entities are involved in the ecosystem for the digitization and evolution of a country's future cloud networks performance.

Fixed networks currently offer better upload and download speeds and latencies than mobile networks. However, the gap in performance between fixed and mobile networks is rapidly narrowing. Given the growing global adoption of advanced mobile technologies, such as third- and fourth-generation (3G and 4G, respectively) Long Term Evolution (LTE), and the worldwide demand for wireless support of next-generation devices such as tablets and smartphones, we expect the performance gap between fixed and mobile networks to continue to narrow over the next few years. The commercial deployment of 5G is underway. Along the prospect of being considerably faster than existing technologies, 5G holds the promise of creating a digital society and economy which will result in many new and updated applications. It could potentially provide scalable and efficient telecommunications infrastructure which integrates processing, storage, and networking. The benefits of 5G and Internet of Things (IoT) will be realized when the cloud and big data is leveraged to its full potential.

Several countries have average network performance characteristics that are significantly higher than those of their region. Although an increasing number of countries are currently able to support advanced cloud services, these countries will create significantly greater cloud traffic growth rates because of the high-bandwidth services that they can offer over their networks (for example, UHD video streaming).

From a business cloud services perspective, many networks currently can support intermediate business applications (such as enterprise resource planning, customer resource management, and basic video conferencing), and some can currently support advanced business applications (such as high definition video and audio conferencing). With the necessary infrastructure in place, businesses and enterprises of all sizes can effectively implement these productivity-enhancing applications and communications services.

For More Information

For more information, please visit www.cisco.com/go/cloudindex.