OPENSIGNAL

HOW THE SMARTPHONE AFFECTS MOBILE NETWORK EXPERIENCE

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Opensignal active userbase:

Total Devices
23,352,908

Total Measurements
117,846,554,241

Data Collection Period
Apr 1 – Jun 30, 2019

Opensignal is the independent global standard for analyzing consumer mobile experience. Our industry reports are the definitive guide to understanding the true experience consumers receive on wireless networks.

Key Findings

Samsung users experienced faster download speeds than Apple and Huawei users in 35% of countries, across 40 countries analyzed.

Among the three largest smartphone makers, Apple users were faster in 17.5% of countries. And in the remaining 48% none of the three were fastest although Huawei users were joint-fastest in seven countries.

In the U.S., Samsung users experienced download speeds 8.2 Mbps faster than iPhone users.

However, the country with the greatest advantage for Samsung users was Norway, where Samsung users were 12 Mbps faster than Huawei users, and 14 Mbps faster than Apple iPhone users.

Apple users had the biggest edge over Samsung and Huawei users in U.A.E. and Taiwan.

In those countries the download speeds iPhone users experienced were 14.7 Mbps and 8 Mbps faster than Samsung users' speeds.

All smartphones are not created equal; they vary in network capability as well as cameras and displays.

To analyze the differences, Opensignal split smartphone users into three groups — low, mid and high-tier — based on a smartphone's mobile network capabilities. Because high-tier models include more network technologies, they are more sensitive to mobile network improvements and are, in effect, a leading indicator of what the mobile network experience will be in the future.

Smartphone type affects the multiplayer mobile gaming experience too.

High-tier smartphone users experienced latencies 18% — or 11.1 ms — faster than low-tier smartphone users, and 14% faster even than mid-tier smartphone users. Lower latencies help to speed gamers' reaction times.

The high-tier smartphone download experience ranges from 70.4 Mbps in South Korea to 6.6 Mbps in Iraq, comparing all smartphone brands across 73 countries.

Users in Canada and Singapore ranked just behind South Korean users with speeds of 67.1 Mbps and 65.4 Mbps, in second and third place respectively.

Download speeds of high-tier smartphones were at least twice as fast as those of low-tier users in 25 countries.

Notably, in Thailand speeds measured on high-tier smartphones were 4.3 times as fast as those measured on low-tier smartphones; in Canada and the U.A.E, 2.9 times; and in Australia, Singapore and Switzerland, 2.6, 2.5 and 2.5 times respectively.

Each of the three largest smartphone brands' users were the fastest of the three in one tier.

High-tier Samsung users experienced faster speeds than Apple and Huawei users with global download speeds of 26.6 Mbps, 25.1 Mbps and 24.4 Mbps respectively. However, among the mid-tier category, Apple users experienced the fastest speeds of the three largest smartphone brands, while Huawei users were fastest among low-tier users.

How smartphones differ in their mobile network capabilities

All smartphones are not created equal. Just as different smartphones offer a variety of camera qualities or screen sizes, they also differ in the network communication features which enable faster download speeds and smoother video streaming.

Newer and more expensive smartphone models usually support more network capabilities such as newer versions of the 4G standard, and in a few cases, even 5G. Consumers with less-capable smartphones will not be able to enjoy the best mobile network experience that their mobile operator provides.

Instead of relying on the technology claims of smartphone makers, component suppliers or mobile operators, Opensignal has for the first time quantified the experience of users with different kinds of smartphones in 73 countries globally. This analysis highlights the degree to which high-end smartphone users experience a faster mobile connection than those users with mid-range or low-tier smartphone models.

The handset network technologies which can affect the network experience include:

- The ability to connect to more frequency bands (though with over 40 4G bands in use, even industry veterans often struggle to keep track of the importance of every one).
- The ability to connect to more than one radio band at once – called carrier aggregation.
- Technologies that improve the performance on any given radio frequency such as the modulation type (e.g. 64 or 256 QAM) and the use of multiple simultaneous antennas (e.g. 2x2 or 4x4 MIMO).
- The choice of modem supplier and chipset (for example, Qualcomm, Intel, Huawei HiSilicon, Samsung Exynos or Mediatek).

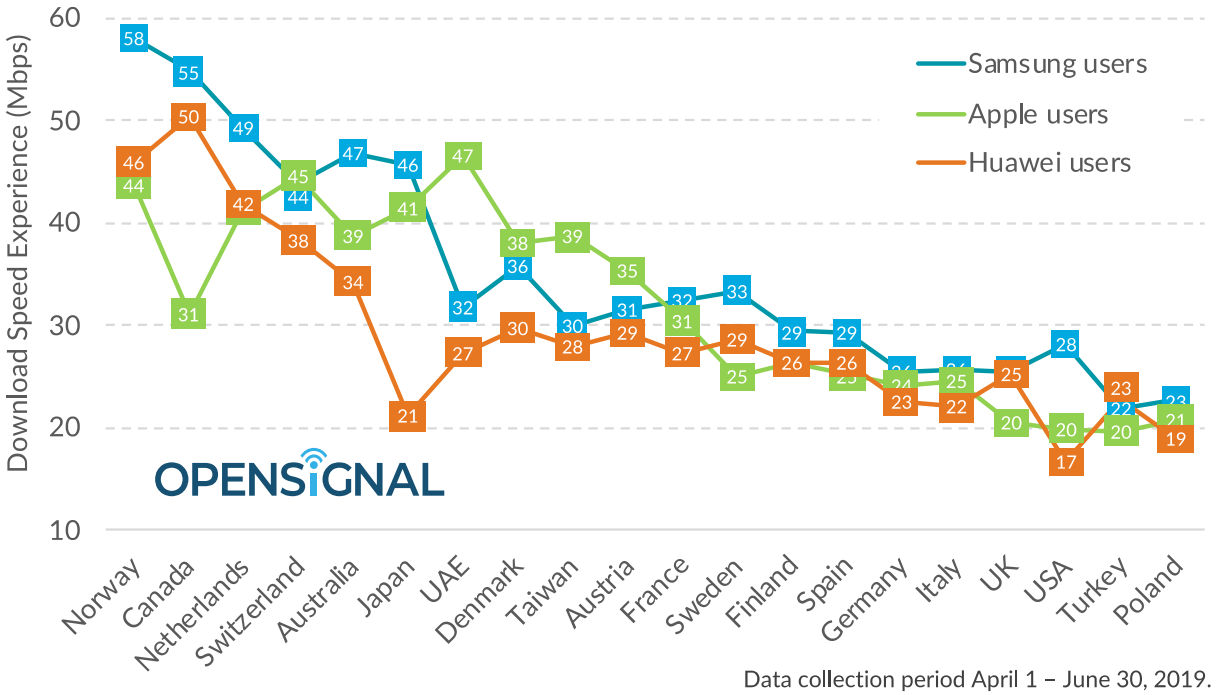
But these network capabilities tend to be technical and hard to describe, so handset makers and mobile operators often do not explain them to the customers in their marketing materials as much as they should.

Across countries, Samsung users tend to experience faster download speeds than Apple or Huawei users

We see over 18,000 unique smartphone models from hundreds of smartphone manufacturers in Opensignal's data. But most of these smartphone brands are niche, and even many of the well-known brands such as Sony or Motorola are no longer truly global. Similarly, large rising stars like Xiaomi, OPPO, Realme and Vivo are still expanding their international footprint and do not operate everywhere. Most small smartphone manufacturers focus on just a few countries.

Therefore, for an international comparison we looked at the three largest smartphone makers by shipment volume — Apple, Huawei and Samsung — because their users are present in sufficient volume in many countries (in the case of Huawei, even in countries where mobile operators do not sell their handsets).

The Download Speed experienced by users of Samsung, Apple and Huawei (the three largest handset makers)

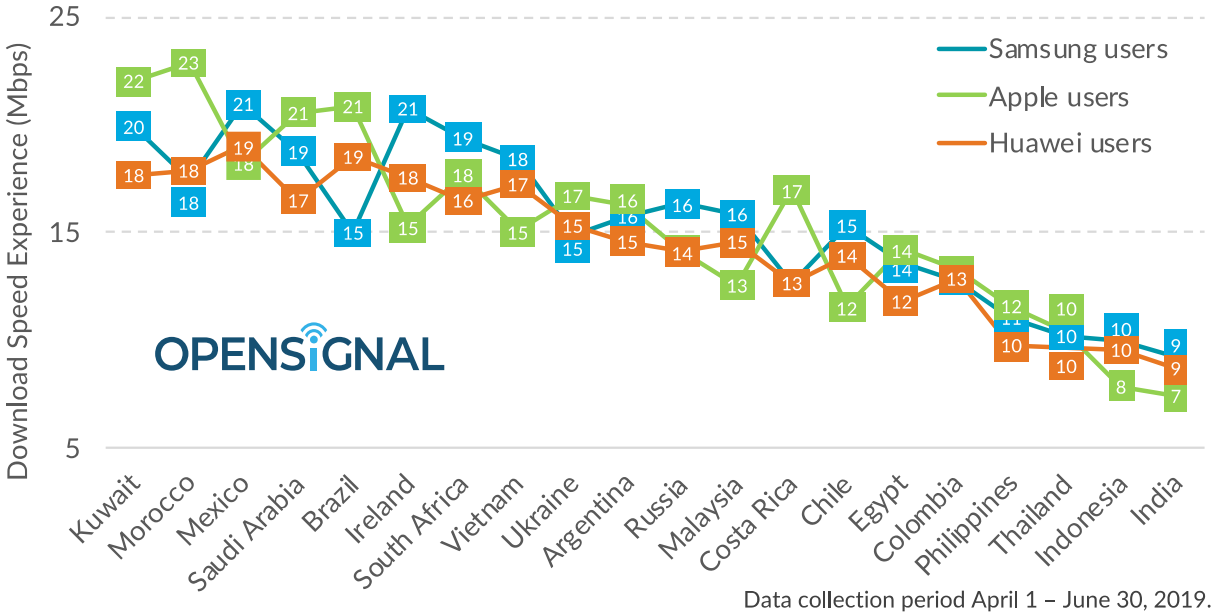


Data collection period April 1 – June 30, 2019.

Across 40 countries, Samsung users experienced faster download speeds than Apple and Huawei users in 35% of countries, Apple users were faster in 17.5% countries, and in the remaining 48% two or more of the brands tied in a statistical dead heat. While none of the countries saw Huawei users experience the fastest download speeds, Huawei was joint first in 17.5% of countries.

Perhaps most striking is the experience of Apple users. In the U.S., a very strong iPhone market, Apple users experienced download speeds 8.2 Mbps slower than Samsung users. Given that Samsung makes a wide range of models from cheap to premium, while Apple only offers premium-priced models, this is an even more impressive result.

The Download Speed experienced by users of Samsung, Apple and Huawei (the three largest handset makers)



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In Brazil, Apple users experienced speeds 2.3 Mbps faster than second-placed Huawei's users. Samsung's position here is more intriguing because it offers a similar range of models to Huawei, but Huawei's users experienced speeds 3.5 Mbps faster than Samsung's.

Samsung users faster than next handset maker	Amount faster (Mbps)		Apple users faster than next handset maker	Amount faster (Mbps)		Huawei users faster than next handset maker	No single winner (allowing for confidence intervals)
Australia	8.0		Brazil	2.3		No countries	Argentina
Chile	1.4		Costa Rica	4.3			Austria
India	0.6		Kuwait	2.1			Canada
Indonesia	0.5		Morocco	5.0			Colombia
Ireland	3.2		Saudi Arabia	1.8			Denmark
Italy	1.1		Taiwan	8.8			Egypt
Malaysia	1.3		UAE	14.7			Finland
Mexico	1.9						France
Netherlands	7.4						Germany
Norway	12.0						Japan
Russia	2.2						Philippines
Spain	2.9						Poland
Sweden	4.7						South Africa
USA	8.2						Switzerland
							Thailand
							Turkey
							UK
							Ukraine
							Vietnam

However, these country differences represent other factors beyond the network capabilities of individual smartphone models. Huawei users experienced notably slower speeds in the U.S. and Japan most likely because they are not strong markets for Huawei, and in those countries their users have chosen cheaper models with less capable modems. Apple's success in markets like Brazil, Taiwan and Costa Rica likely reflects a tendency of their users to be more weighted to premium-priced devices and premium mobile tariffs than in other countries where iPhone adoption is more widespread and mainstream, for example in the U.S.

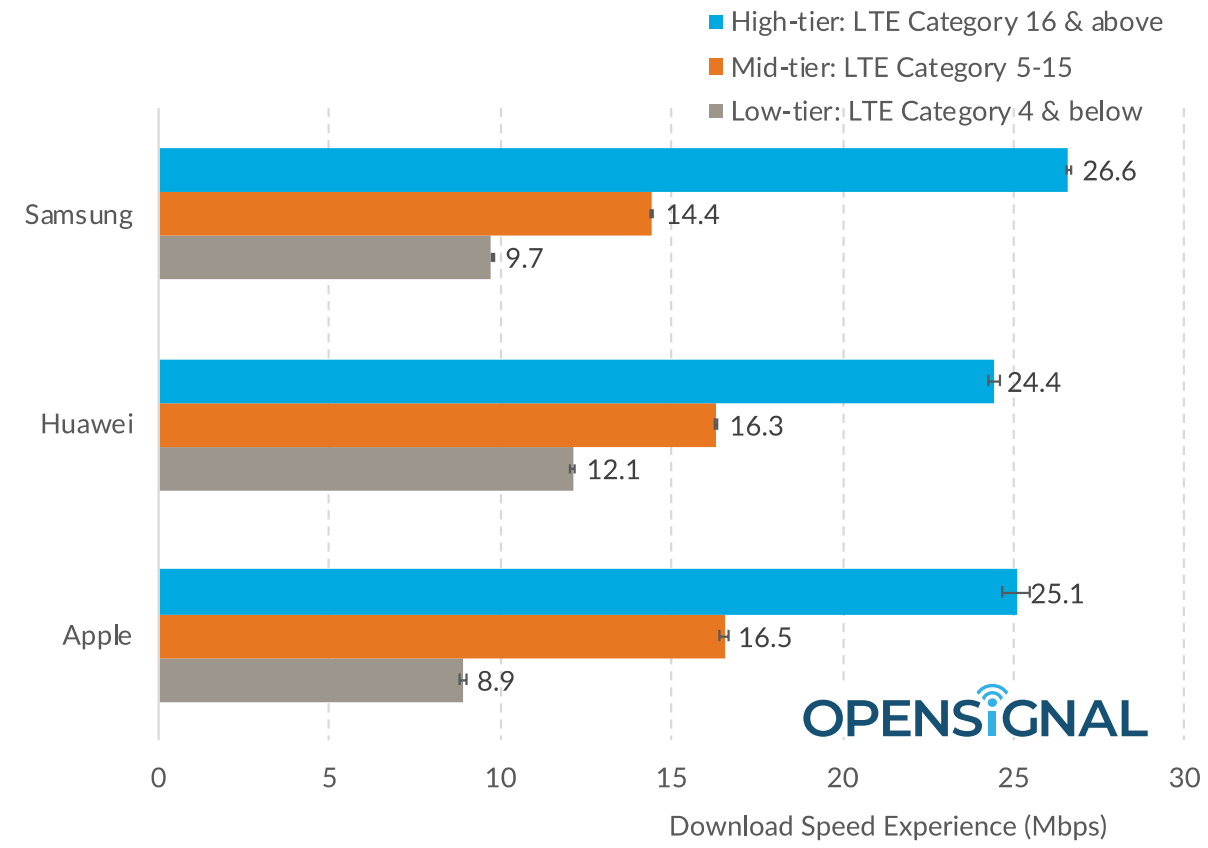
Grouping smartphones by tier highlights a tight race between Apple, Huawei and Samsung

We categorized each brand's users based on their device's LTE Category which is an industry standard reflecting the model's network capabilities. This approach enables us to compare brands that have very different proportions of cheap, low-tier, devices in use among their users. For example, it enables us to compare Apple with Samsung or Huawei because in our installed base, just 18% of Apple users have a low-tier

smartphone compared with 49% of Samsung users. When we look at the overall users of each brand, we would expect the greater proportion of low-tier Samsung smartphone models to pull down Samsung's overall average. But by looking at each tier separately we avoid this effect.

In general, smartphone models with a higher LTE Category tend to be more expensive and support more network technologies. All 5G smartphone models support at least LTE Category 16 and would count as high-tier devices in this grouping; however, there are very small numbers of 5G smartphone devices in the market, at least for now.

The smartphone brand with the fastest users, differs between high, mid & low smartphone tier



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When we compare the users of the three largest smartphone makers into three groups based on the network capabilities of their smartphone, we find each brand has the fastest download speeds on one of the tiers:

- **High-tier smartphones: Samsung users experience the fastest download speeds**. Their users enjoy 26.6 Mbps globally compared with 25.1 Mbps for Apple users and just 24.4 Mbps for

Huawei users. Example models include: Samsung Galaxy S8, S9, S10, Note 8, Note 9; Huawei P20 Pro, P30 Pro, Mate 10, 20; iPhone Xs.

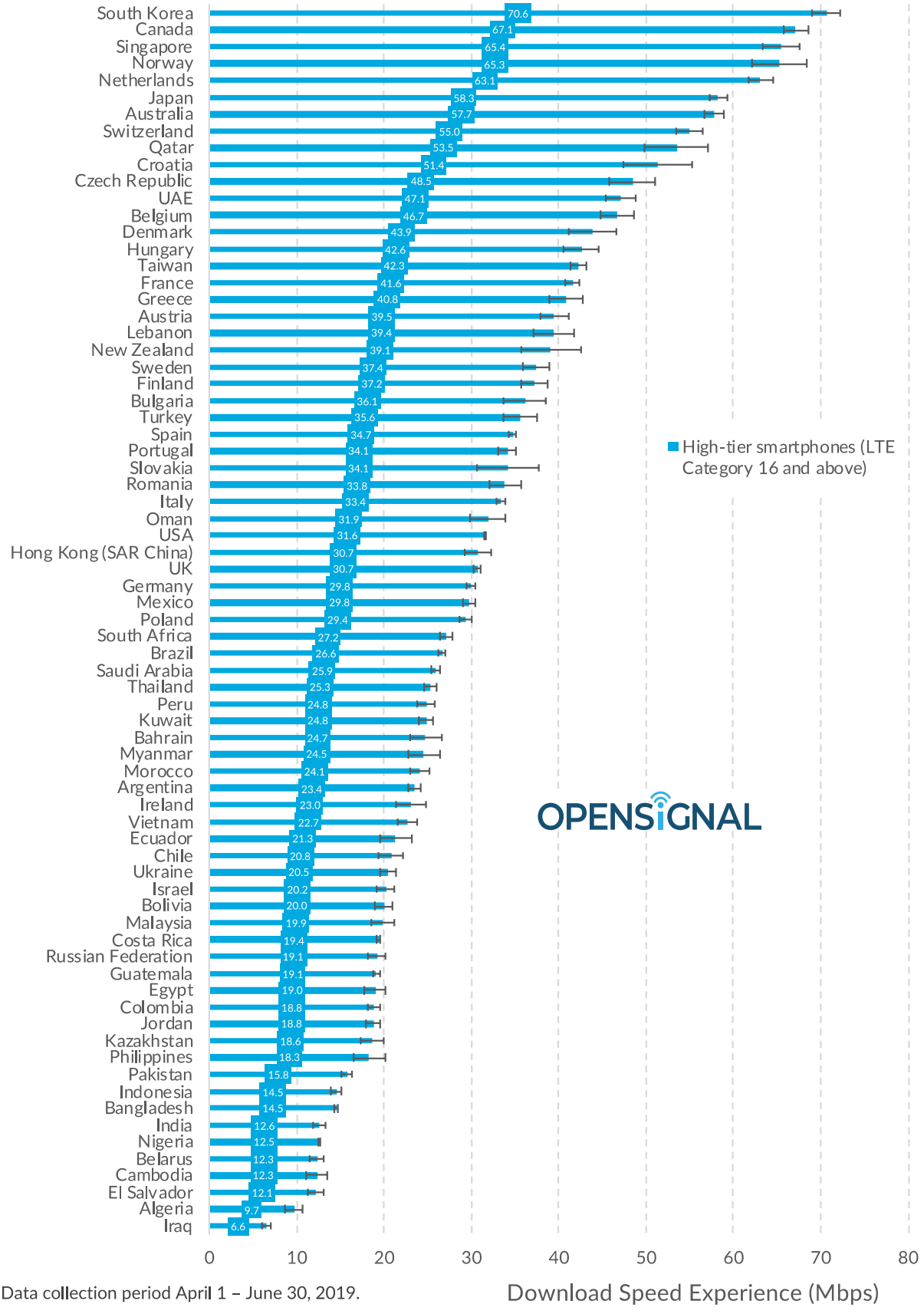
- **Mid-tier smartphones: Apple users are slightly faster than second-placed Huawei users.** iPhone users experience 16.5 Mbps, compared with 16.3 Mbps for Huawei and just 14.4 Mbps for Samsung users. This category makes up the bulk of Apple users, however these iPhone models have often been priced at a similar level to Samsung and Huawei high-end models. Example models include: Samsung M40, A80, A6s; Huawei P30 Lite, Enjoy 9e, Y6; iPhone XR, X, 8, 7, 6s.

- **Low-tier smartphones: Huawei users experience the fastest speeds with 12.1 Mbps.** This compares with 9.7 Mbps for Samsung users and just 8.9 Mbps for Apple users. This category makes up 49% of Samsung users and is the largest tier in Samsung's user base. The Apple devices in this group tend to be older models like the iPhone 6 or the more recent but physically small iPhone SE. Example models include: Samsung A2 Core, J4 Core; Huawei Nova 2, ; iPhone SE or 6.

Apple's challenge is that few of its current models are high-tier devices when we group iPhone models based on their mobile network experience capabilities. In our measurements, just 14% of Apple users are high tier. Instead, Apple has chosen to focus its handset designs on other capabilities such as facial recognition, camera innovation, long battery life, and extremely fast application processors and graphics using Apple's in-house silicon designs.

While all Samsung and Huawei flagship models for the last couple of years have featured so-called "gigabit" capable modem designs — LTE Category 16 and above — only the iPhone XS and XS Max have such capability. Even the current iPhone XR includes a less-capable LTE Category 12 modem, which we therefore class as a mid-tier smartphone on mobile network experience. Apple has chosen to focus on other parts of smartphone design while it settles issues with one supplier, Qualcomm, and acquires the modem assets of Intel, another supplier.

"Gigabit" class smartphones experience real-world average download speeds far lower than a gigabit per second



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“Gigabit” class smartphones are leading indicators of mobile network experience

High-tier smartphone models with an LTE Category 16 or above are often marketed as “Gigabit” class smartphones because their theoretical maximum download speed is approximately 1 Gbps or more. But just as 5G users’ maximum speeds are far higher than the average speeds 5G users experience, we see the same here.

Across 73 countries, the average download speeds experienced by users with high-tier smartphones ranged from 70.4 Mbps in South Korea to Iraq’s 6.6 Mbps. Users in Canada and Singapore ranked just behind South Korea with speeds of 67.1 Mbps and 65.4 Mbps, in second and third place respectively.

Major markets volumes varied widely in the experience users received: the USA ranked just 32nd with 31.6Mbps, India’s high-tier users ranked 68th with 12.5 Mbps, and increasingly important Indonesia faired only a little better with its high-tier smartphone users enjoying 14.5 Mbps — 5 Mbps slower than nearby Malaysia, and 1.3 Mbps slower than the Philippines.

Because high-tier smartphone users have models with more mobile network capabilities such as the ability to combine five or more radio carriers — carrier aggregation — or use advanced 256QAM, this class of users is more sensitive to mobile network improvements deployed by the world’s mobile operators. As they add new network technologies, these users will be the first to experience the benefits.

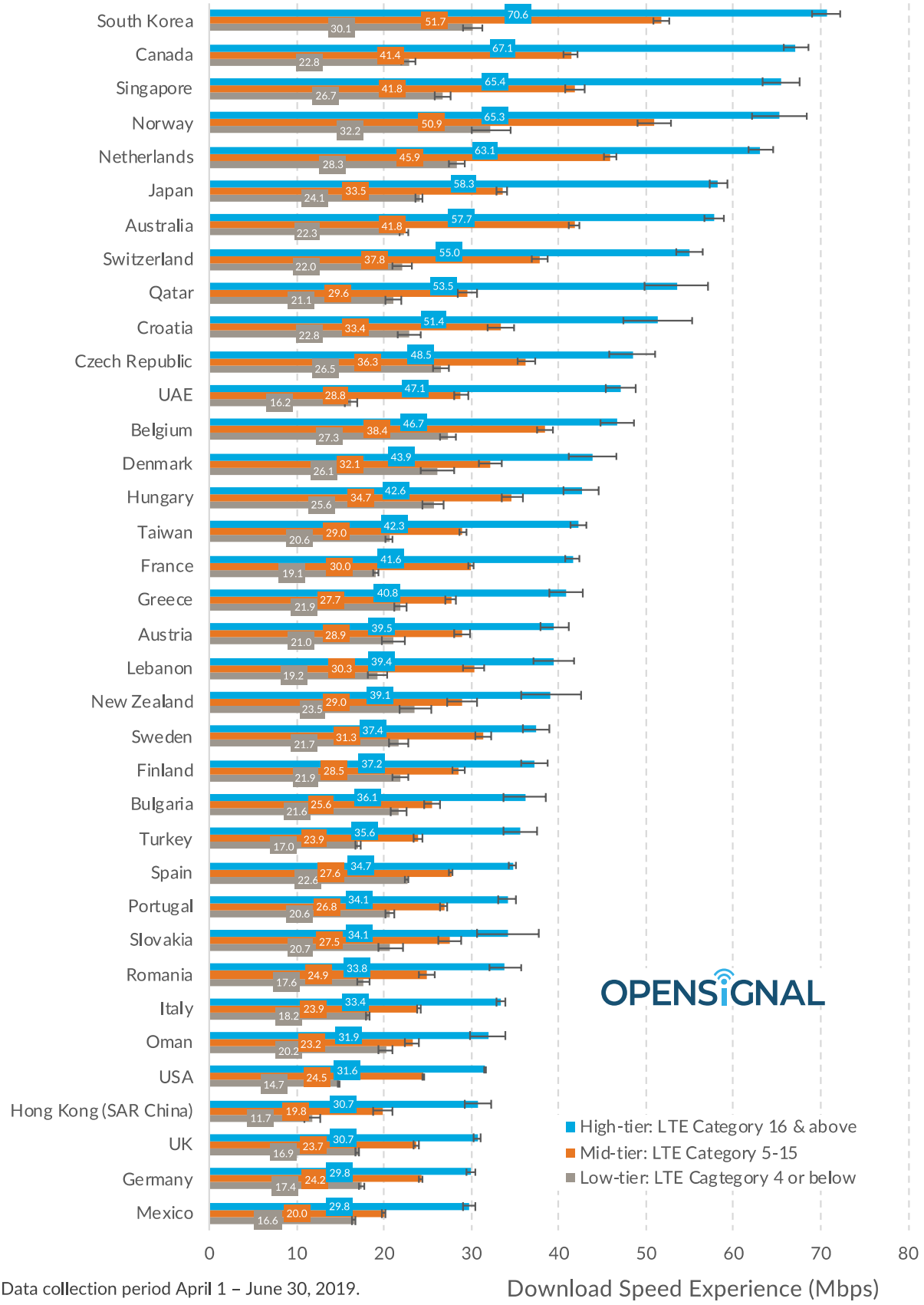
In effect, high-tier smartphone users are a leading indicator of what level of mobile network experience is currently possible in a country. And, as mobile network capabilities trickle down to mid-and low-tier handset models over time, the current experience of high-tier users’ also indicates the direction for the overall future mobile network experience for the population of a country.

There are wide differences in the experience of high, mid and low-tier users between countries

Opensignal analyzed the Download Speed Experience of mid-and low-tier smartphones users, compared with those of high-end users, and found tremendous differences. In Thailand, high-tier users' average download speeds are 4.3 times those of low-tier smartphone users, likely because of the approach of Thai operators to manage speeds on lower-priced unlimited data tariff plans.

In 25 countries, the download speeds experienced by high-tier smartphone users were at least twice as fast as those experienced by low-tier smartphone users. This was most notable in Canada and the U.A.E, where speeds experienced by high-tier smartphone users were 2.9 times as fast, while in Australia, Singapore and Switzerland speeds were 2.6, 2.5 and 2.5 times as fast respectively.

Even in countries with slower download speeds, users with high tier smartphones experience much faster download speeds



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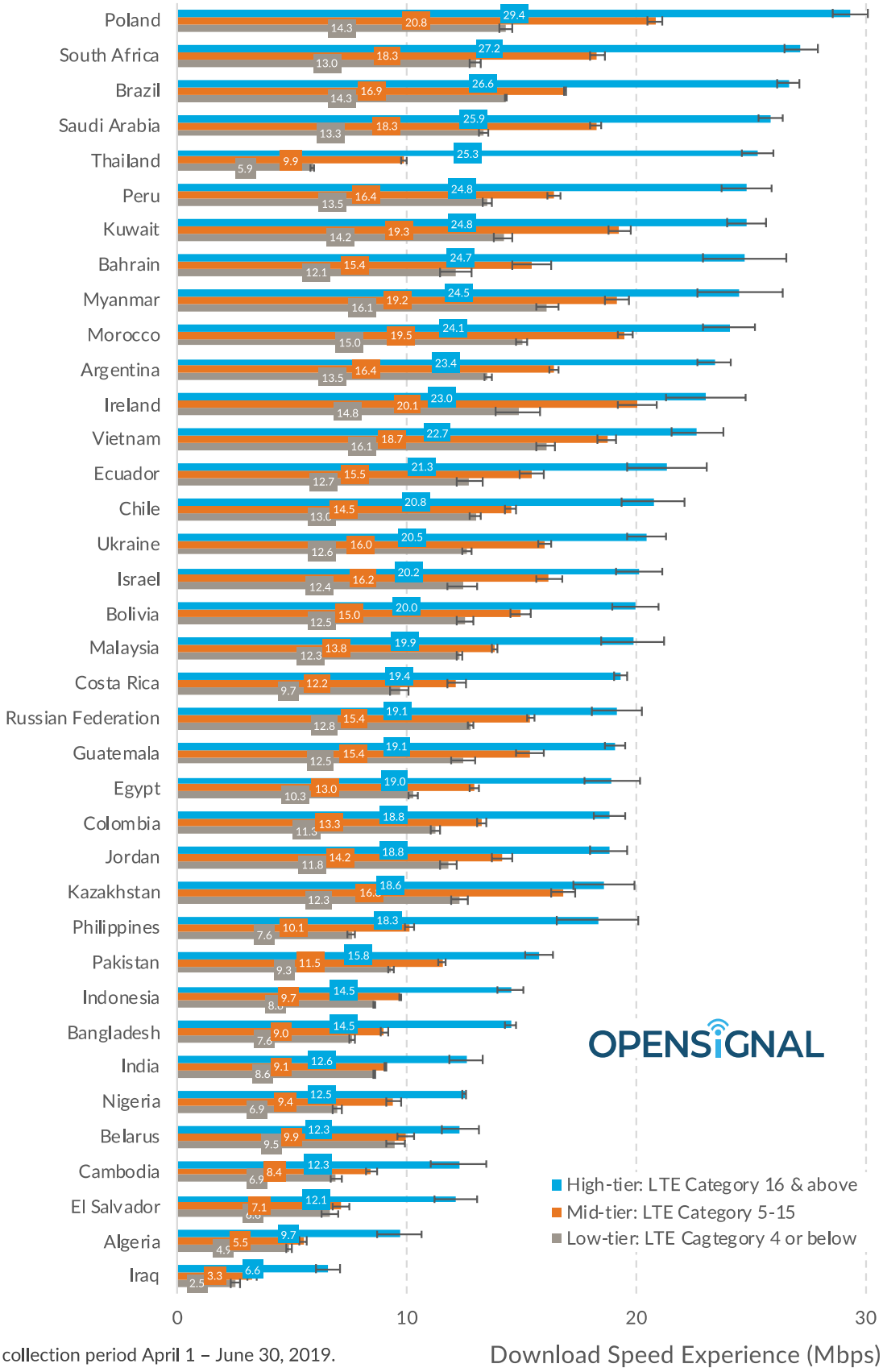

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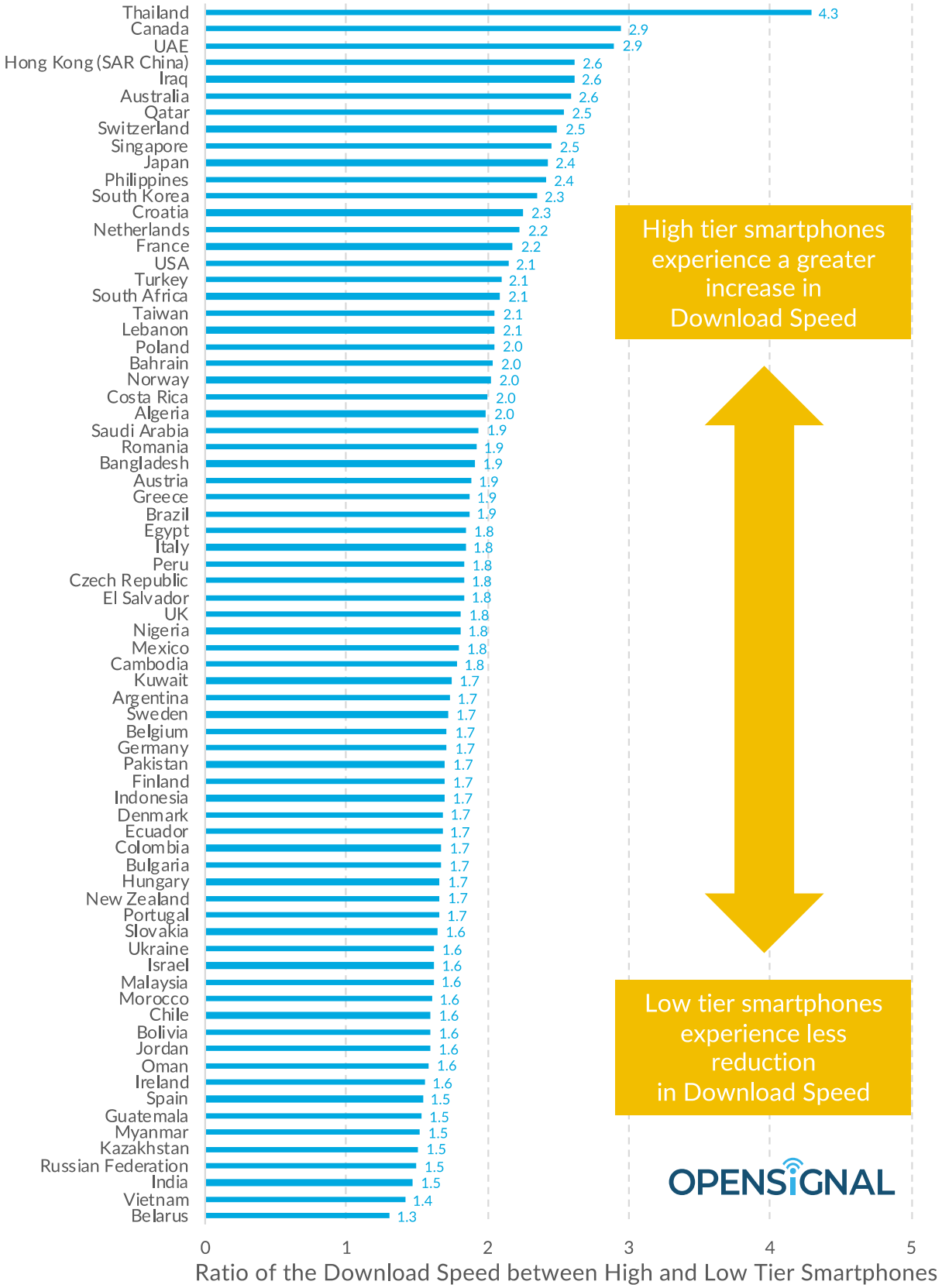
High tier smartphone users experience a greater Download Speed improvement in some countries more than others



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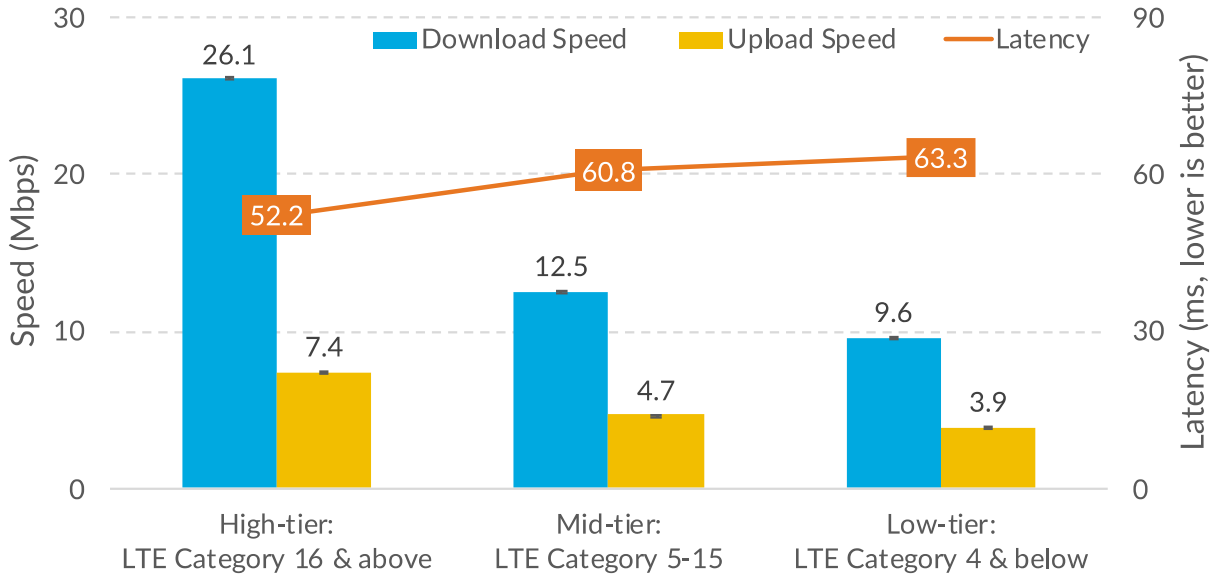
In other markets, high-tier users saw much lower increases in the speeds they experienced. In Russia, Myanmar and India speeds were just 1.5 times faster than those of users with low-tier smartphones. Yet, this is still a very significant difference, and highlights the importance of understanding the experience of high-tier users.

The difference between mid-tier and low-tier was much less significant, highlighting that in many markets, only those with high-tier smartphones experience much faster download speeds. Across Indonesia, Malaysia, India, Chile and Algeria, the download speeds experienced by mid-tier users were just 1.1 times that of low tier smartphone users. In those markets, only users with high-tier models see much improved download speeds.

Multiplayer games will work better for high-tier smartphone users too

When we examined latency — a measure of the responsiveness of the mobile network — we found high-tier smartphone users experience much better latencies which will help with online multiplayer games such as Fortnite or PUBG. Gamers often use the term “ping” to refer to their latency and are acutely aware that high ping means lower scores! High-tier smartphone users experienced latencies 18% or 11.1 ms faster than low-tier smartphone users, and 14% faster even than mid-tier smartphone users.

High-tier smartphone users experience better latency as well as faster speed



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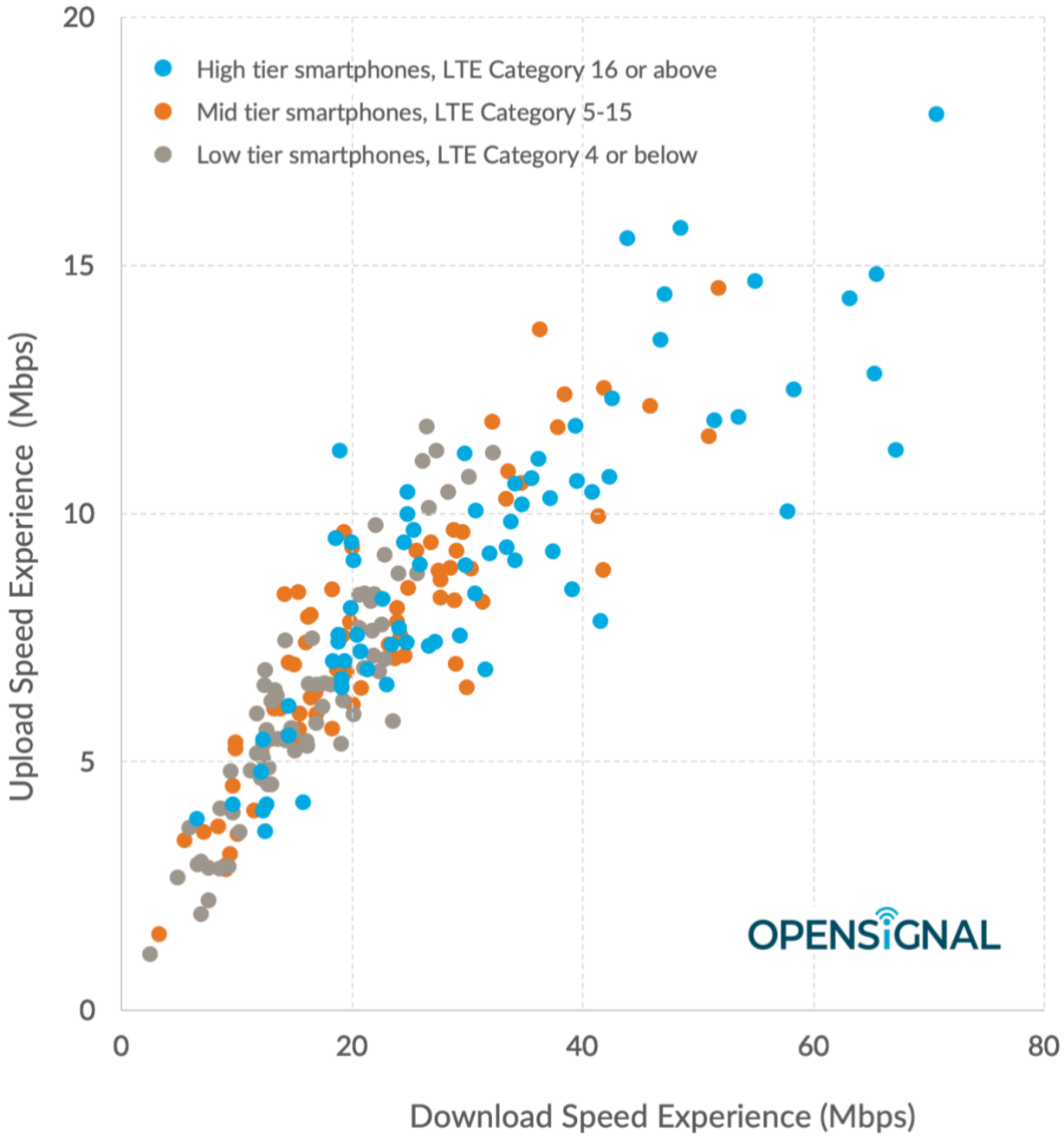
We also found a strong correlation in upload and download speeds experienced between users of all three smartphone tiers. For low-tier smartphones, the linear correlation was 0.92 on a scale of 0-1, where 1 is a strong positive correlation. Similarly, for mid-and high-tier groups, we found correlations of 0.88 and 0.84 respectively, indicating there is slightly more variability in the upload experience, but which is still a strong correlation with download speed.

We also compared the Upload Speed Experience of different types of smartphone users across 73 countries. While our categorization of smartphone users is based on the LTE Category capability for download and not upload, we wanted to understand if smartphones with better download capabilities also demonstrated higher upload speeds and improved latencies.

It's clear from Opensignal's analysis of the real-world experience of different types of smartphones that there are significant differences between smartphone brands and between high, medium and low-tier smartphones. The higher the tier, the better the mobile network experience of users for a range of measures and not only for the download speed experienced.

Across 73 countries, users with all types of smartphones see a correlation between the download and upload speed



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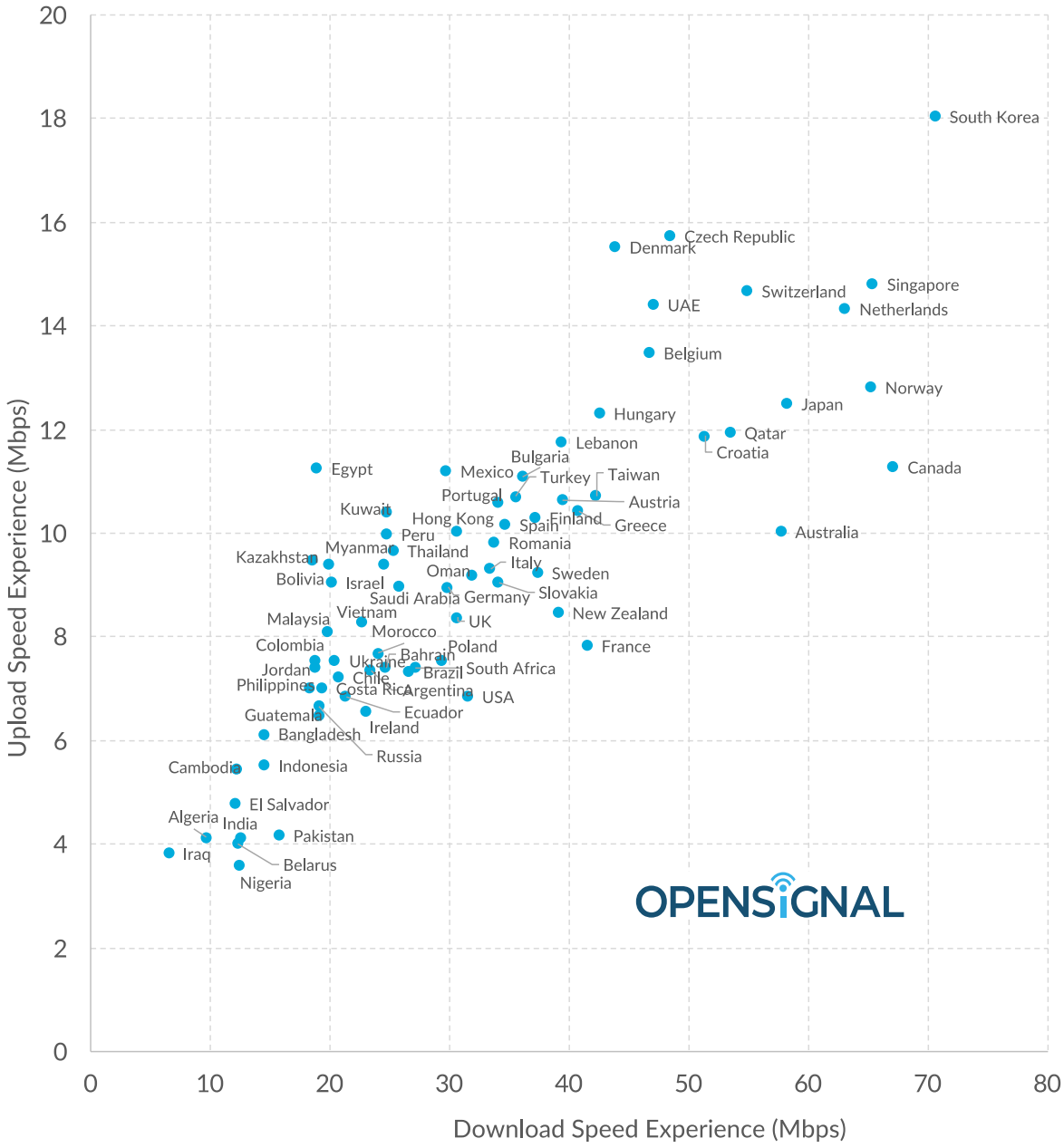
Upload and Download Experience of high tier smartphones by country



Our Methodology

Opensignal measures the real-world experience of consumers on mobile networks as they go about their daily lives.

We collect over 3 billion individual measurements every day from tens of millions of smartphones worldwide. Our measurements are collected at all hours of the day, every day of the year, under conditions of normal usage, including inside buildings and outdoors, in cities and the countryside, and everywhere in between. By analyzing on-device measurements recorded in the places where subscribers actually live, work and travel, we report on mobile network service the way users truly experience it. We continually adapt our methodology to best represent the changing experience of consumers on mobile networks and, therefore, comparisons of the results to past reports should be considered indicative only.

Confidence Intervals

For every metric we calculate statistical confidence intervals indicated on our graphs. When confidence intervals overlap, our measured results are too close to declare a winner. In those cases, we show a statistical draw. For this reason, some metrics have multiple operator winners.

In our bar graphs we represent confidence intervals as boundaries on either sides of graph bars. In our supporting-metric charts we show confidence intervals as +/- numerical values.

Our Metrics

4G Availability

4G Availability shows the proportion of time Opensignal users with a 4G device have a 4G connection. 4G Availability is not a measure of coverage or the geographic extent of a network.

Video Experience

Video Experience quantifies the quality of mobile video experienced by Opensignal users on real-world video streams.

To calculate Video Experience, we directly measure video streams from end-user devices, using an ITU-based approach to quantify factors such as load times, stalling and video resolution over both an operator's 3G and 4G networks. Video Experience for each operator is calculated on a scale from 0 to 100.

4G Video Experience. This metric quantifies the quality of mobile video for each operator on LTE connections as experienced by Opensignal users on real-world video streams.

3G Video Experience. This metric quantifies the quality of mobile video for each operator on 3G connections as experienced by Opensignal users on real-world video streams.

Download Speed Experience

Download Speed Experience shows the average download speed experienced by Opensignal users across an operator's 3G and 4G networks.

It factors in 3G and 4G download speeds along with the availability of each technology.

4G Download Speed. This metric shows the average download speed for each operator on LTE connections as measured by Opensignal users.

3G Download Speed. This metric shows the average download speed for each operator on 3G connections as measured by Opensignal users.

Upload Speed Experience

Upload Speed Experience measures the average upload speeds experienced by Opensignal users across an operator's 3G and 4G networks.

It factors in 3G and 4G upload speeds along with the availability of each technology.

4G Upload Speed. This metric shows the average upload speed for each operator on LTE connections as measured by Opensignal users.

3G Upload Speed. This metric shows the average upload speed for each operator on 3G connections as measured by Opensignal users.

Latency Experience

Measured in milliseconds, latency refers to the delay users experience as data makes a round trip through the network.

Our Latency Experience metric is calculated as an average of the individual 3G and 4G latency measurements based on the proportion of time Opensignal users spend connected to each network type. A lower score in this metric is a sign of a more responsive network.

4G Latency. This metric shows the average latency for each operator on LTE connections as measured by Opensignal users.

3G Latency. This metric shows the average latency for each operator on 3G connections as measured by Opensignal users.