

The State of LTE (November 2016)

LTE continues its march across the world, not just expanding to new countries but also gaining in strength in regions the technology already calls home. We're seeing download speeds approach 50 Mbps in the most advanced 4G countries, and in many more places 3G is receding into the background as a source for our data connections. In our latest global LTE report, we draw on 17 billion measurements collected from a half million OpenSignal 4G users to see how the world's 4G networks stack up.

South Korea leads in 4G availability

It was a close call, but South Korea eked out ahead of neighbor Japan in 4G availability. Our users in South Korea were able to connect to an LTE network 95.7% of the time, making 4G service almost as ubiquitous as 3G in that country.

Singapore wins the speed crown

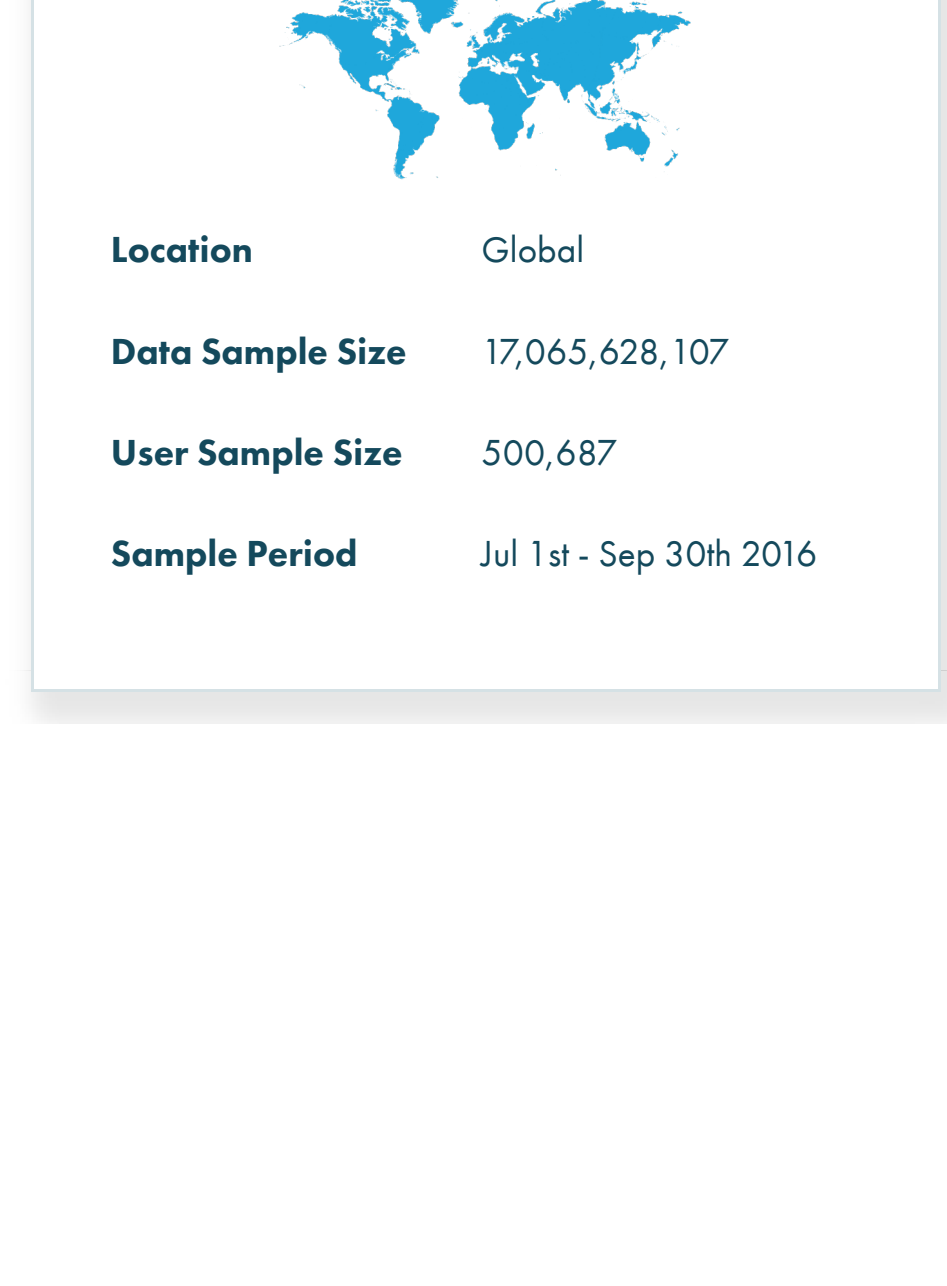
Though South Korea also closely contested our top prize for speed, the honor goes to Singapore, which averaged download connections of 45.9 Mbps. Thanks to new network investment and the latest LTE-Advanced technologies we'll likely soon see some countries pushing past 50 Mbps.

Speed doesn't equate consistency

Though there were several countries that outperformed in both 4G speed and availability, a high score in one category didn't necessarily mean a high score in the other. We found several countries in various stages of development with impressive speeds but low 4G accessibility, and vice versa.

Globally 4G speeds average 17.4 Mbps

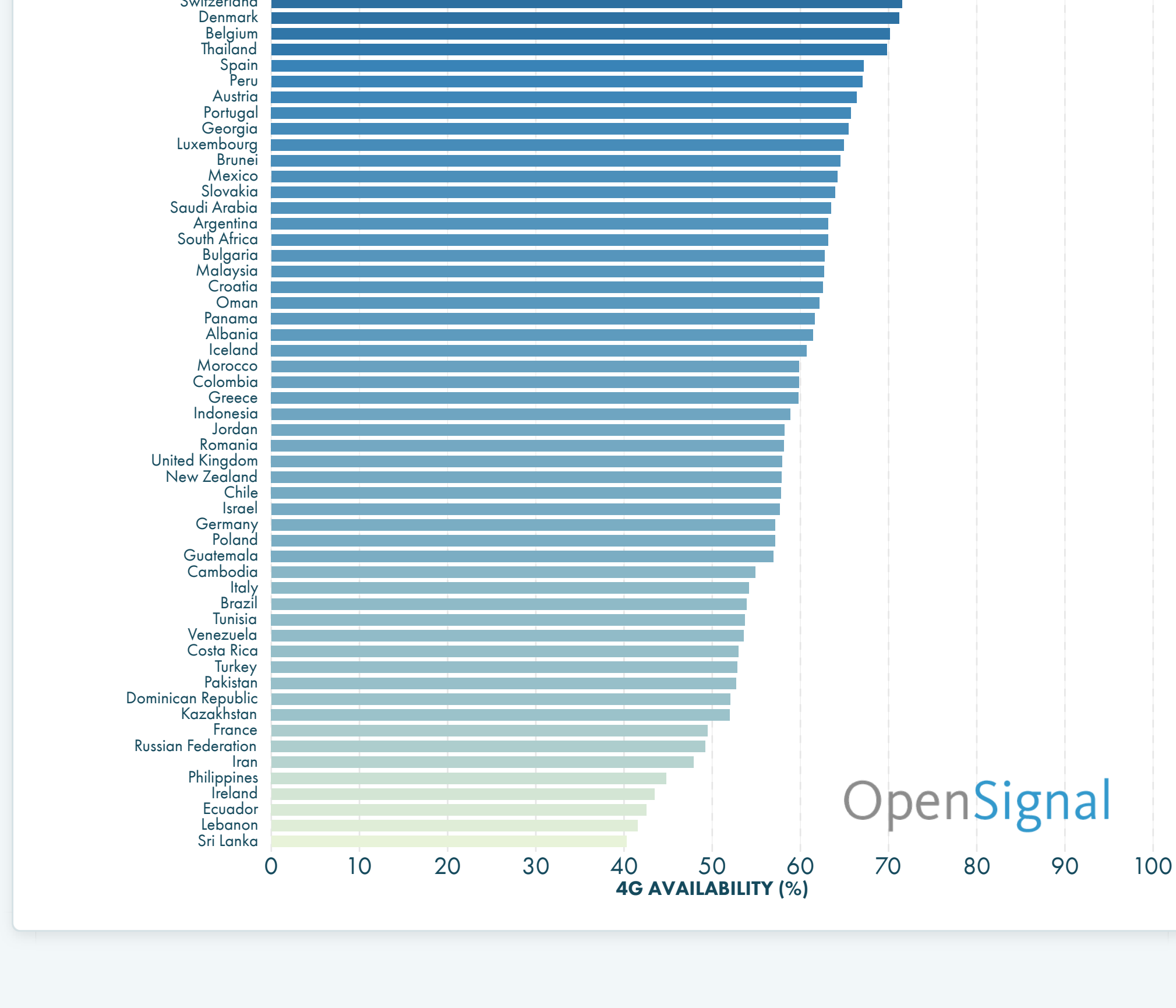
Though most of the countries we analyzed in this report had speeds well over 20 Mbps, the relatively slow connections of some of the largest countries in the world brought down the global average to 17.4 Mbps. Luxembourg's 31.7 Mbps may be impressive, but there are quite a few more smartphones forced to contend with India's average of 6.4 Mbps.



4G Availability

This chart shows how consistently accessible 4G networks are in each country. Rather than measure geographic coverage, OpenSignal's availability metric tracks the proportion of time users have access to a particular network. For example if a country has 50% 4G availability, then on average that country's 4G users can find an LTE signal half of the time.

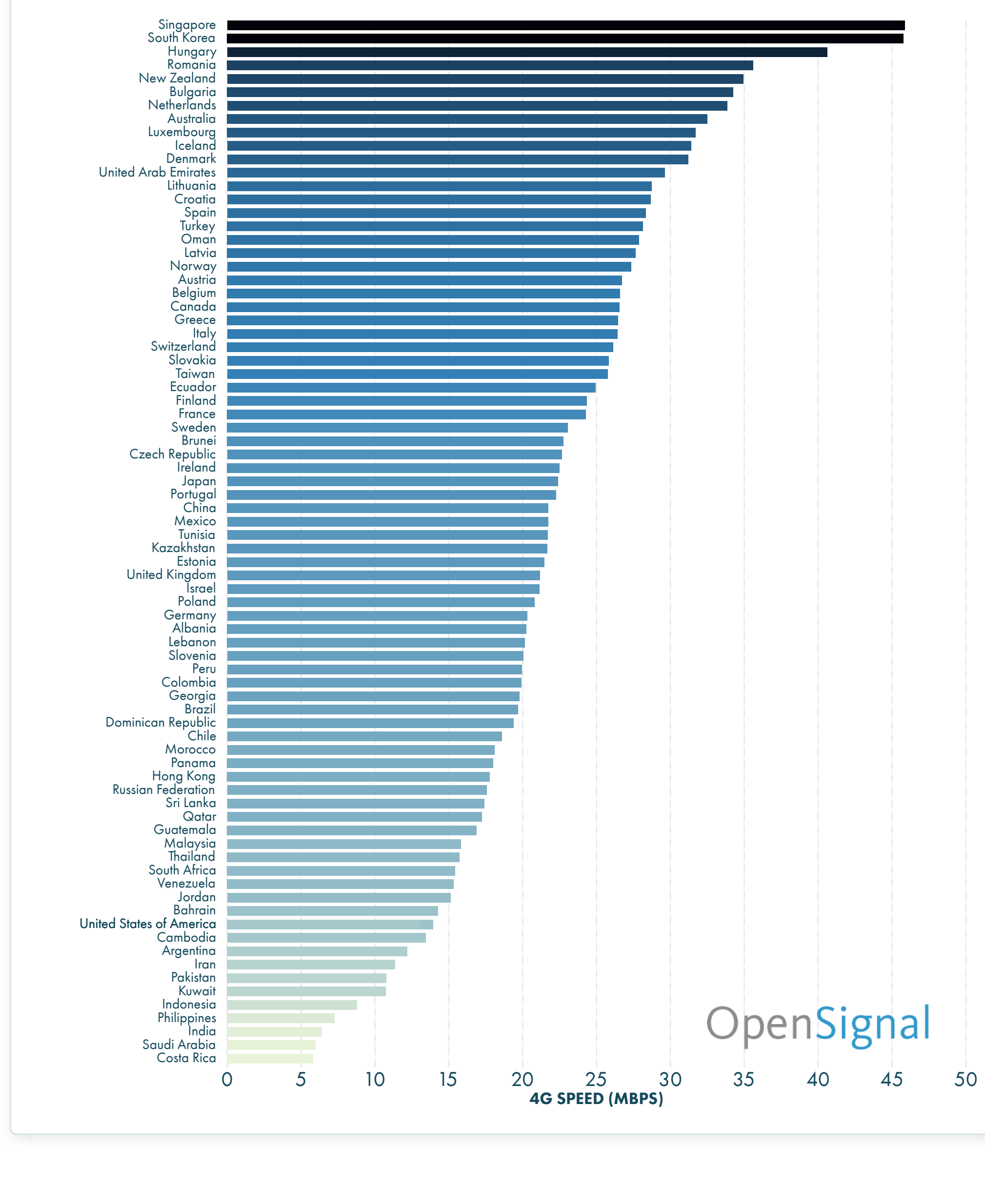
A high 4G availability can be an indication of good geographic coverage, but the metric tracks more than where users can find an LTE signal on a map. It accounts for indoor connections and times of high congestion when it's often difficult to get a 4G signal even on high-coverage networks. Even countries in the earlier stages of their LTE deployments can sometimes have higher 4G availability scores as the numbers of 4G subscribers are typically small and confined to large urban areas where new LTE networks are typically located.



4G Speed

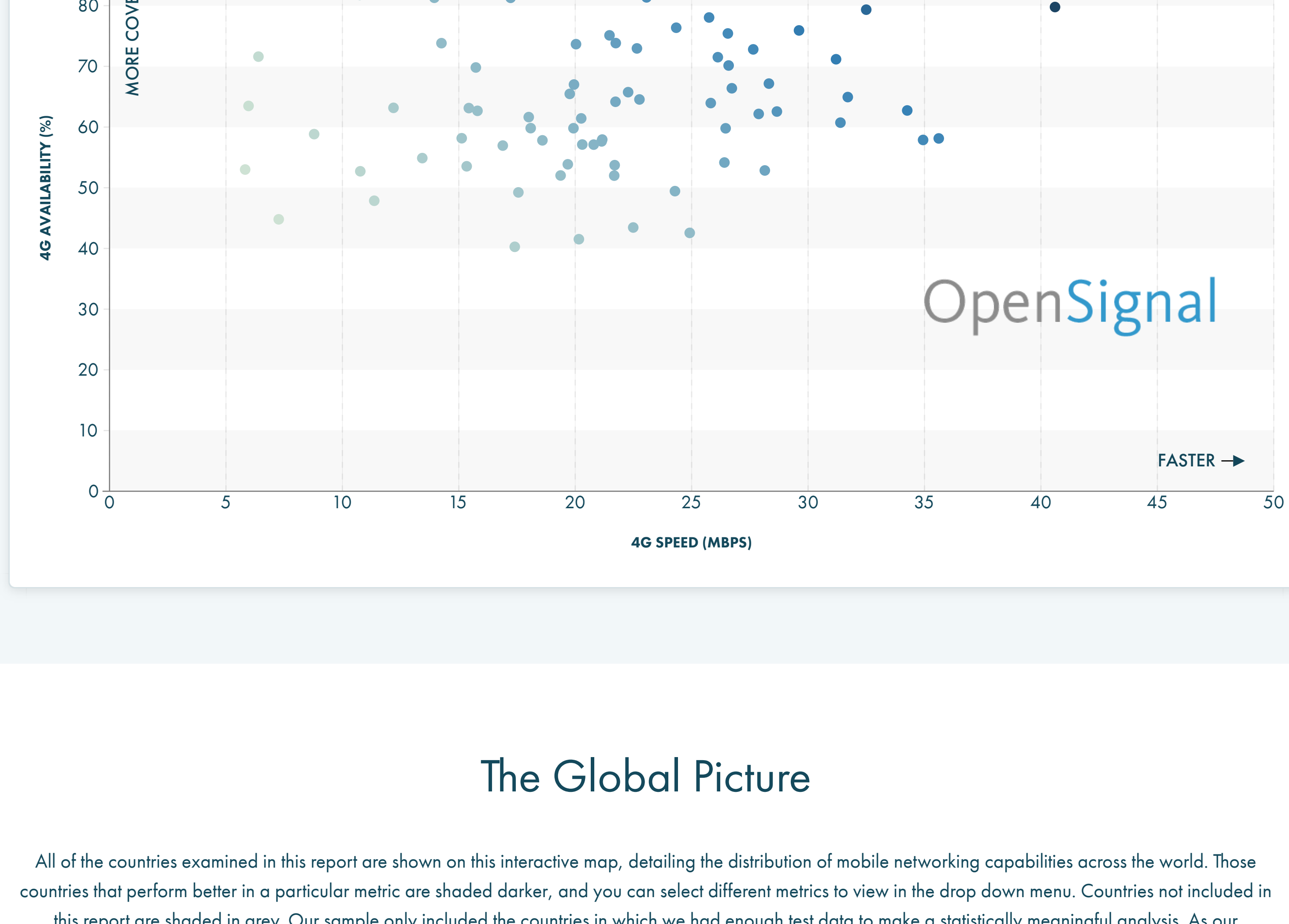
This chart shows the average download connection speed that users in each country see when connecting to LTE networks. Though some operators sometimes refer to HSPA or other technologies as 4G, we only count LTE connections in our 4G speed tests.

How fast a country's 4G speed is can depend on many factors: how much spectrum is devoted to LTE, whether it has adopted new 4G technologies like LTE-Advanced, how densely networks are built and how much congestion is on those networks. In general, though, the countries with the fastest speeds tend to be the ones that have built LTE-Advanced networks and have a large proportion of LTE-Advanced capable devices.



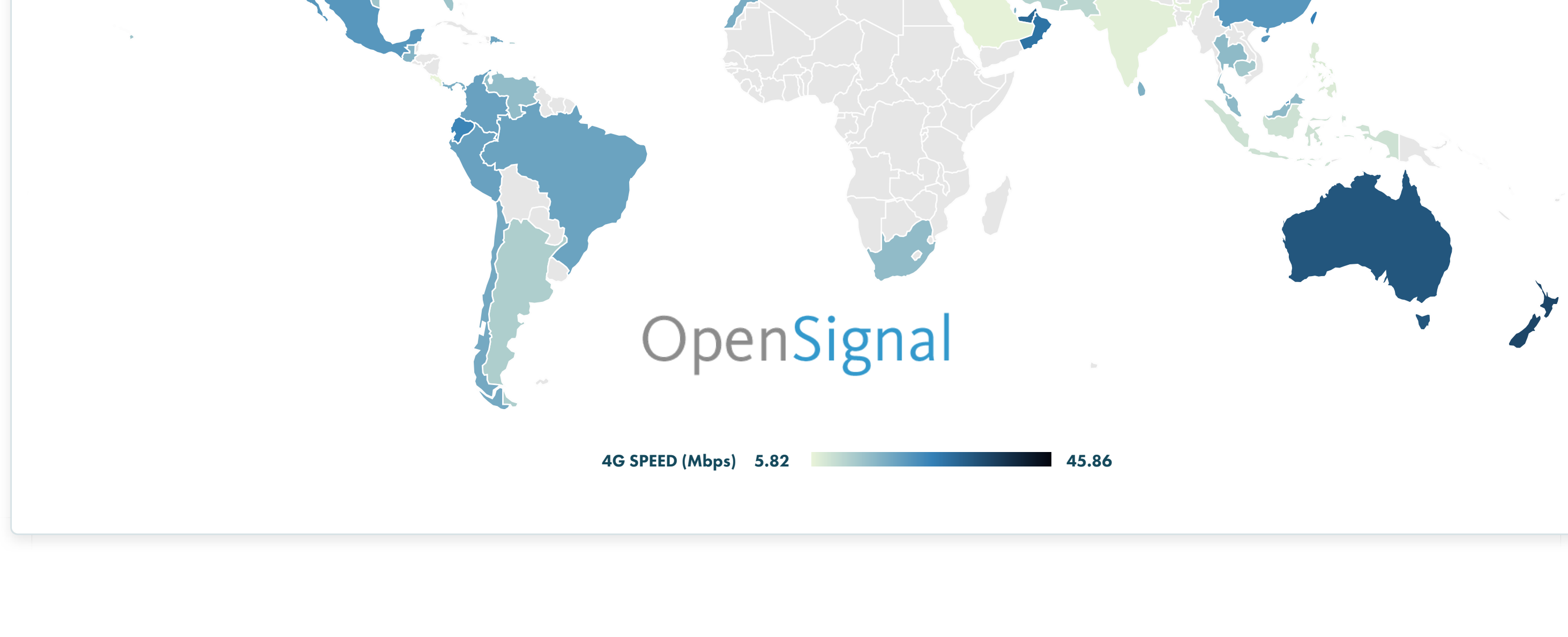
The Full Spectrum of Mobile Performance

This chart compares 4G speed against 4G availability for all of the countries covered in this report. Countries higher up and toward the right in the chart have both fast LTE networks and a high proportion of LTE signals, reflecting more developed 4G infrastructures. Countries in the lower-left hand side of the graph are typically in the early stages of their LTE rollouts. There's no hard and fast rule, though. Countries can have highly accessible networks, but their speeds can be limited by capacity constraints. Meanwhile countries with new LTE networks may have limited 4G availability but, due to their light loads, can support considerably fast speeds.



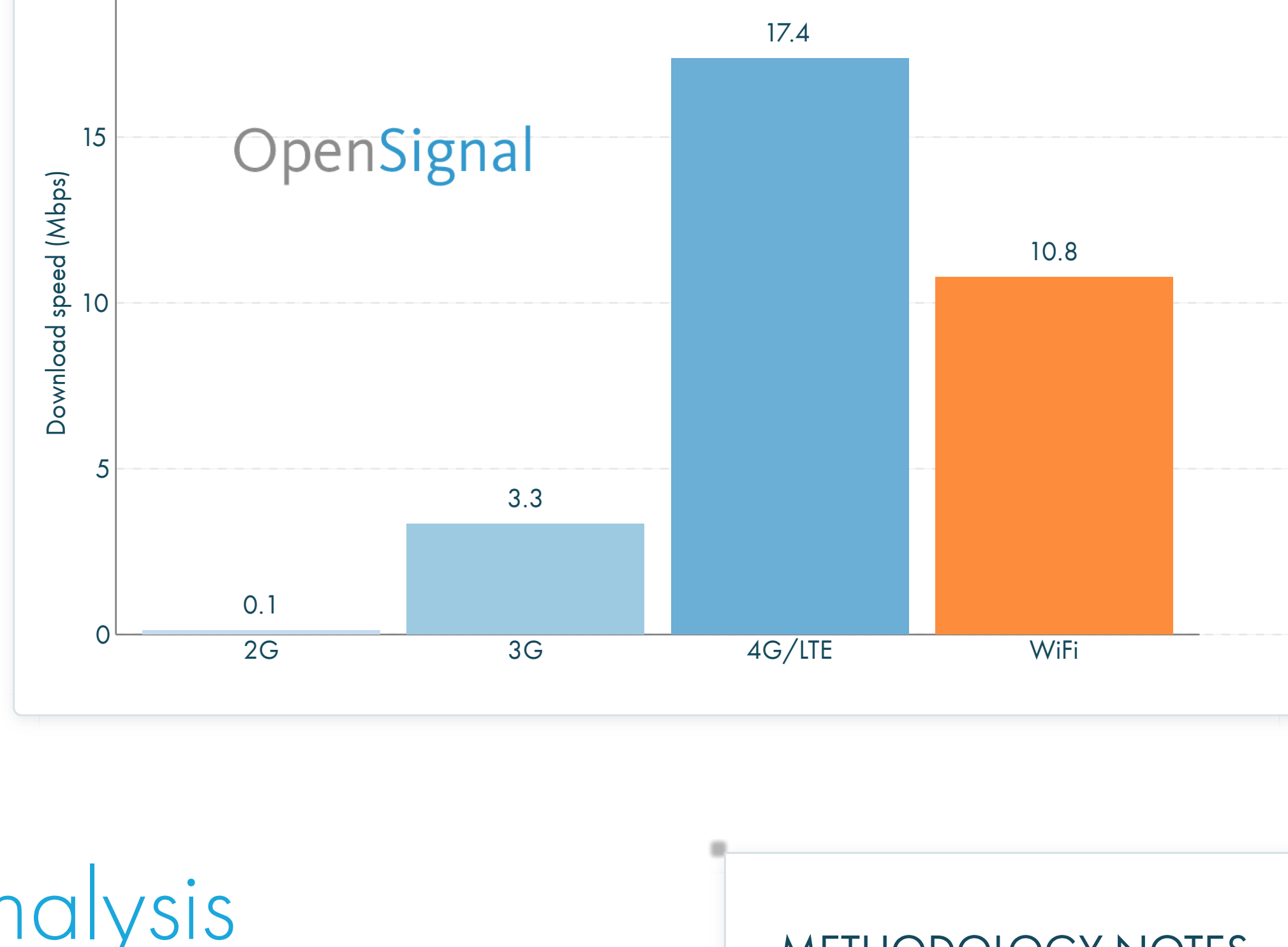
The Global Picture

All of the countries examined in this report are shown on this interactive map, detailing the distribution of mobile networking capabilities across the world. Those countries that perform better in a particular metric are shaded darker, and you can select different metrics to view in the drop down menu. Countries not included in this report are shaded in grey. Our sample only included the countries in which we had enough test data to make a statistically meaningful analysis. As our crowdsourced user base grows, though, we'll continue to add more countries to our reports.



LTE vs. Wifi

This chart compares the average download connection speed globally of the major wireless network technologies. 2G includes GSM and CDMA 1X connections, while 3G includes UMTS, HSPA and CDMA EV-DO connections. OpenSignal defines 4G as LTE technologies only.



Analysis

This summer OpenSignal published its first [Global State of Mobile Networks report](#), which examined the overall speed and accessibility of mobile data connections around the world. While that report took the holistic view of mobile networking, it's time once again to drill down into the specifics of LTE performance. In our seventh State of LTE report, we look at the speed and availability of 4G networks in 78 countries.

While 4G is still in different stages of development around the world, where it has taken hold it's become a dominant force. In many countries, 4G connections are far more prevalent than 3G or 2G connections (we use the terms 4G and LTE interchangeably throughout this report). Meanwhile 4G speeds have only increased as more operators add capacity to their networks and adopt the newest LTE-Advanced technologies. In several places, mobile broadband has become true broadband with average 4G speeds exceeding 30 Mbps.

Since OpenSignal published our [last global LTE report](#), we've made a few changes to our format and methodology. First, we're no longer publishing specific operator metrics in our global reports. Instead, we're focusing our global reports on how countries perform overall, while delving into operator-specific rankings in our State of Mobile Networks country-level reports. Second, OpenSignal has made some adjustments to both the way we collect data from our smartphone apps and the methodology we use to parse that data. The update allows us to make more measurements, examine new types of network metrics and hone the precision of the measurements we've always collected, helping us isolate the typical consumer mobile experience more effectively (for more details, see our [recent blog post](#)). The changes haven't affected our overall rankings of networks around the world, but for the sake of analytical rigor we aren't making any direct comparisons between results collected from the two different methodologies.

For this report we analyzed 17 billion measurements conducted by 500,687 OpenSignal 4G smartphone users between July 1 and Sept. 30. Let's start by looking at how different countries compared in our two key LTE metrics.

How fast and how often

The first metric we examine in this report is 4G availability. Instead of measuring geographic coverage, our [availability metric](#) tracks the percentage of time our users have access to an LTE signal in a particular country. Once again the leader in this category is South Korea, where our testers were able to latch onto an LTE connection nearly 96% of the time. Japan was the only other country to score more than 90% in our availability metric, but 11 countries exceeded the 80% mark. Those countries weren't limited to east Asia, either. We actually saw a pretty even distribution of these nations throughout the continents, including several Northern European and Middle Eastern countries.

A group of European and Asian countries falls into the 70% to 80% 4G availability range, which is an indicator they're able to provide LTE connections on a consistent basis, though still relying on 3G to fill the gaps. All of those ranking in the upper third of our chart tend to be the countries that were among the earliest adopters or most aggressive pursuers of LTE. The bottom third of the chart, however, was only able to supply an LTE signal 60% or less of the time, showing that they still have work to do to offer 4G service to consumers consistently. A lot of developing regions and countries late to deploy 4G services fall in this section, but there are a few surprises. Many of Western Europe's biggest economies are languishing below the 60% mark, including France, Germany, Italy and the U.K.

Our second chart tracks 4G speed around the world, and we're starting to see some impressive measurements emerge. Singapore just beat out South Korea for the fastest average LTE download connections in our tests, both averaging nearly 46 Mbps. Hungary was the only other country with average connection speeds greater than 40 Mbps, but 8 countries fell in the 30 to 40 Mbps range. These speed demons of LTE are pretty evenly distributed between Asia and Europe, though in Europe the fastest networks in the region are concentrated in Eastern Europe and the Benelux countries.

The sweet spot for most countries now appears to be in the 20 Mbps to 25 Mbps range, though the global average LTE speed was 17.4 Mbps. That's explained by the fact that the countries with the biggest populations — and hence the most users in our crowdsourced community — tend to have slower 4G speeds. For instance, India was among the lowest scoring in tests, measuring average speeds of 6.4 Mbps, indicating limitations in its 4G capacity. The U.S. and its average speed of 13 Mbps is also a considerable drag on the global average.

Signal vs. speed

One of the most interesting charts in our report is the plot chart that tracks LTE speed against availability. The best performing countries in both speed and availability fall in the upper righthand quadrant, while the worst performing countries fall in the lower left. In our [Global State of Mobile Networks report](#) in August, we found an interesting pattern when we compiled this same chart, tracking overall speed against overall availability. As countries developed, their overall availability first increased, reflecting large-scale 3G rollouts, and then they began moving to the right on the speed axis as 4G services were layered on top of those 3G networks. When we examine 4G only, though, we see no such pattern.

4G performance is all over the chart. We see several countries with high levels of 4G availability but very low speeds, for instance the U.S., Kuwait and India; and we see countries with fast LTE speeds, but fairly low availability such as Turkey, New Zealand and Romania. And a country's level of development doesn't seem to have much impact on its position on the chart. As we pointed out earlier much of western Europe ranks fairly low in LTE availability, while still providing decently fast LTE connections.

A lot of disparity between countries has to do with their own unique mobile markets. For instance, the majority of Turkey's LTE networks only went online in April, but they did so with a bang. Three of Turkey's major operators all launched LTE on multiple frequency bands and used the latest LTE-Advanced techniques to bond those frequencies into super fast connections. Consequently our Turkish users are seeing impressive speeds on their phones. But they can only find an LTE signal about half the time as Turkey is still building out its 4G infrastructure. The U.S. is in the exact opposite situation. It was among one of the first adopters of LTE technology and it's built one of the most extensive 4G infrastructures in the world, hence its top 10 showing in 4G availability, but it's still limited by spectrum and technology. It can't yet match the new LTE-Advanced networks that we're seeing in many countries in the world.

An easy way to visualize the different capabilities of 4G networks is to see our Global Map. The different map views shows the highest performing regions of the world in the darkest shades. But the map also gives a pretty clear view of where LTE isn't yet a major factor. There are many countries that still haven't launched commercial LTE services. There are also a number of countries for which we don't have enough data to include in our analysis, often because those countries are still in the early stages of their LTE rollouts.

Our final chart shows the average connection speed of the major wireless technologies, from 2G to Wifi. It might seem surprising that average 4G speeds far surpass the typical Wifi connection. That isn't an indictment of Wifi technology. Rather it's a reflection of the limited broadband connections that typically connect most Wifi access points. An 802.11ac link may be capable of carrying hundreds of megabits per second over the wireless airwaves, but if the wire at the backend of the router is limited to a few megabits, that's as fast as the internet connection will be.

The global LTE landscape is a quickly evolving one. We're seeing the first LTE networks debut in many developing countries in Africa and Asia, and we're seeing developed countries upgrade their networks to support more users and ever faster speeds. By the time our next Global LTE report comes out, we could see many new countries appear in our LTE map, while in many entrenched 4G countries we could see LTE speeds pushing beyond 50 Mbps.

METHODOLOGY NOTES

OpenSignal data is collected from regular consumer smartphones and recorded on drives of normal usage. As opposed to collection of test data, which simulates the typical user experience by using the same devices to measure network performance in a small number of locations, we take our measurements from millions of smartphones owned by normal people who have downloaded the OpenSignal app.

Those measurements are taken whenever users happen to be, whether indoors or out, in a city or in the countryside, representing performance the way users experience it. For more information on how we collect and analyze our data see our [methodology page](#).

For this particular report, 17,065,628,107 datapoints were collected from 500,687 users during the period: Jul 1st - Sep 30th 2016

All data has been collected from users of the OpenSignal mobile app for Android or iOS.