OPENSIGNAL

THE STATE OF MOBILE GAMES EXPERIENCE IN THE 5G ERA

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Opensignal active userbase:

Total Devices	Total Measurements	Data Collection Period
37,836,754	128,131,428,824	Oct 10, 2019 – Jan 10, 2020

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

In Opensignal's unique new measure of multiplayer mobile Games Experience, Singapore took the gold medal with 85.5

It was followed by the Netherlands in second with a score of 85.4 on a 100 point scale, and Japan in bronze position scoring 85.3. Mobile players enjoy an Excellent Games Experience in only four countries. Besides Singapore, the Netherlands and Japan, the Czech Republic was the only other country where players enjoyed a premiere mobile gaming experience.

28 out of 100 countries we analyzed achieved an Excellent or Good mobile Games Experience

But large esports markets, based on player earnings, underperformed. Of the countries we analyzed, the U.S. ranks top in esports earnings, but placed 35th in mobile Games Experience. Similarly, South Korea which is second in esports earnings placed 14th, far below the leading advanced markets.

Players in Asian countries have a more varied Games Experience than in other regions

31% of Asian countries rested in the Poor category, 27% ended up in Fair, 15% achieved Good status and 8% landed in the Excellent category. Key Asian game markets are just mid-table in Games Experience: In Hong Kong, Malaysia, Thailand and Vietnam players' Games Experience is Fair, while Indonesia slipped into the Poor category with a score of just 63.6.

Europe dominated the top twenty countries

Only Australia, South Korea, Singapore and Japan were included from other regions. However, large significant European markets slipped down the rankings with Germany at 21st, the UK in 29th and Italy as low as 39th.

Opensignal has tested a range of mobile game genres to quantify the impact of different network conditions

Our testing basket included sports, multiplayer online battle arena (MOBA), and battle royale genres. In our research, we found game designers try to mitigate poor network connectivity issues through a number of techniques which often means the game AI (Artificial Intelligence) will take over from a player to keep the game flowing, sometimes without the player even realizing that this is happening. But the precise sensitivity of the user experience to underlying mobile network conditions varies depending on the game genre.

For battle royale games, the Netherlands takes first place, knocking Singapore into the silver position

In this genre — popularized by Fortnite, Garena Free Fire, and PUBG — South Korea jumps four places to 10th compared with its overall mobile Games Experience. This highlights that different game genres respond differently to tricky mobile network conditions. Players in a total of seven countries enjoyed an Excellent battle royale mobile Games Experience.

Games Experience uses a scale of 0 to 100:

85<100	Excellent - The vast majority of users deemed this network experience acceptable.
75<85	Good - Most users deemed the experience acceptable.
65<75	Fair - Users found the experience 'average'.
40<65	Poor - Most users found this level of experience unacceptable.
0<40	Very Poor - Nearly all users found this level of experience unacceptable.

Why mobile games matter

Across the world, mobile games generate vast amounts of revenue. Ovum estimates mobile games represent the majority of total video game revenue, this global trend is even greater in emerging mobile first markets.

Mobile games are enormous money makers

Apple App Store and Google Play store mobile game revenue amounted to $9.2 billion in the third quarter of 2019 according to IHS Markit and Priori Data. The U.S. generated the greatest share, with mobile game revenue of over $2.5 billion, followed by Japan with just over $2 billion. Despite having a population of just 51 million South Korea generated over $500 million in mobile game revenue in this one quarter alone. Including China, App Annie forecasts the mobile games industry will generate revenues of $100 billion in 2020.

5G will expand the mobile game opportunity, this is just the beginning

The mobile industry sees that 5G's improved latencies, as well as higher speeds, will greatly increase the appeal of real-time multiplayer mobile gaming and perhaps eventually even lead to a shift to cloud gaming. Already, we have seen break-out smartphone multiplayer games become successful — for example Fortnite, Garena Free Fire, Pokemon Go, PUBG — on today's 4G networks as well as efforts to take multiplayer hits from consoles or PC and translate those titles to mobile with games like Minecraft, FIFA, Hearthstone, or Pro Evolution Soccer (PES). The deployment of 5G will improve the responsiveness and reliability of mobile networks which will make the experience of playing mobile multiplayer games even more enjoyable.

Mobile operators are using games to promote their services

When 4G launched, mobile operators routinely bundled video streaming services such as Hulu and Netflix with mobile tariff plans to highlight the advantages of 4G technology. Now, we are already seeing operators look to mobile game services to fulfill the same role for 5G. Hatch — a spin-off of Angry Birds maker Rovio — has signed mobile game deals with numerous operators including, docomo (Japan); Deutsche Telekom

(Germany); Elisa (Finland); LG Uplus (Korea); SK Telecom (Korea); Sprint (U.S.); Vodafone (Italy & others).

Indonesia's Telkomsel promotes multiplayer mobile games like Arena of Valor and Free Fire as a core part of its offering. It's not alone, across Asia operators are targeting the fast growing mobile game audience. A group of six operators is working on the mobile game opportunity together, including Airtel (India); AIS (Thailand); Globe (Philippines); Optus (Australia); and Singtel (Singapore) and Singtel also has a separate bilateral link-up with SK Telecom.

Apple, Google and device makers are jumping on the mobile game opportunity too

In 2019, Apple launched Apple Arcade, its own subscription mobile game service. Google countered with the launch of its own mobile game and app subscription service, Google Play Pass, while continuing to work on the troubled Google Stadia cloud gaming service.

Device makers have had success with game-specific smartphone models. While most have been offered by smaller makers such as Razer, Asus (ROG) or Xiaomi subsidiary Black Shark, the arrival of high refresh rate displays means we will see mainstream makers follow 2019's Oneplus 7 Pro and Google Pixel 4 and also adopt gaming-friendly high refresh rate technology in order to differentiate.

How we measure mobile Games Experience

Opensignal's unique new mobile Games Experience analyzes multiplayer gaming across different game genres based on our testing of a range of mobile games, including battle royale game Fortnite, Pro Evolution Soccer (PES) and multiplayer online battle arena (MOBA) game Arena of Valor.

We conducted laboratory testing of popular mobile game titles. We asked individuals to play each game under different mobile network conditions and then score the experience on each occasion. From this primary research, Opensignal created a mean opinion score (MOS) model which characterizes the exact relationship between real-world technical measurements and the real gaming experience. This is the first time that an MOS model has been developed specifically to analyze multiplayer mobile games at a global scale.

Our approach to multiplayer mobile games is similar to the ITU-based MOS methodology Opensignal has previously developed to assess the experience of mobile video and voice apps. It enables Opensignal to quantify how the complicated interaction of different individual measures of network conditions affects users' overall mobile Games Experience.

Opensignal uses measurements of real-world mobile network conditions to assess the Games Experience felt by users on different networks and across countries. We quantify the real-world mobile Games Experience users have on mobile networks around the world on a 0 to 100 point scale, based on Opensignal's real-world measurements of mobile network conditions.

Opensignal mobile Games Experience has the following categories:

85<100 Excellent	The vast majority of users deemed this network experience acceptable. Nearly all respondents felt like they had control over the game, and they received immediate feedback on their actions. There was not a noticeable delay in almost all cases.
75<85 Good	Most users deemed the experience acceptable. Gameplay experience is generally controllable, and the user receives immediate feedback between their actions and the outcomes in the game. Most users did not experience a delay between their actions and the game.
65<75 Fair	Users found the experience 'average'. In most cases the game is responsive to the actions of the player with most users reporting that they felt like they had control over the game. The majority of players reported that they noticed a delay between their actions and the outcomes in the game.
40<65 Poor	Most users found this level of experience unacceptable. The majority of users reported seeing a delay in the gameplay experience and they did not receive immediate feedback on their actions. Many users felt a lack of controllability in the Games Experience.
0<40 Very Poor	Nearly all users found this level of experience unacceptable. Almost all users experienced a noticeable delay within the game, with most of them not feeling like they had control of the the gameplay. The vast majority of players didn't receive immediate feedback on their actions.

The mobile Games Experience score focuses on the multiplayer Games Experience. But no single measure is sufficient to record all the parts of users' mobile network experience. For example, Opensignal already has two measures that are relevant for other aspects of mobile games:

- **Video Experience quantifies game video streaming services like Twitch or YouTube Gaming**. When consumers wish to watch recorded highlight streams of games our existing direct measurement of mobile video quality is relevant. In a recent survey, Opensignal found 18.7% of U.S. consumers watched video streams of games. For more, see Opensignal's recent State of Mobile Video Experience report.

- **Download Speed Experience helps to understand how quickly game updates can be ready**. Multiplayer games often require every player to have the most recent version of the game. Often with games like Call of Duty or Fortnite these updates can be hundreds of megabytes in size, sometimes even gigabytes.

Winning & losing in mobile Games Experience

While Singapore and Japan occupy first and third place — offering users an Excellent Games Experience — their East Asian peers don't make their presence felt until much further down the rankings, with esports leader South Korea ranked just 14th and Taiwan ranked 24th and each being in the Good category.

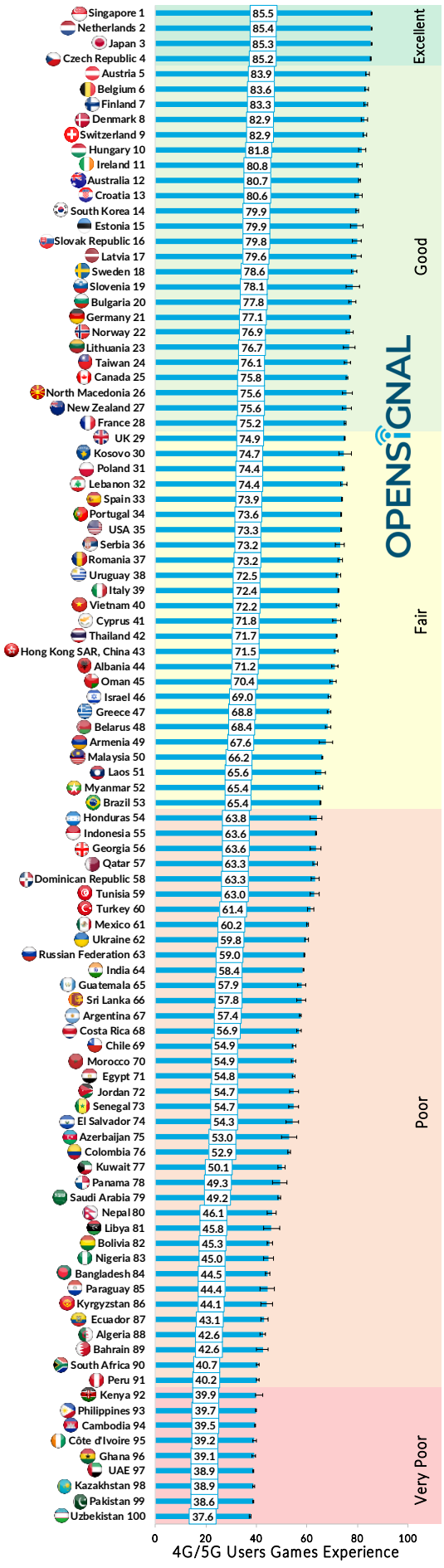
This first look across 100 countries for mobile Games Experience gives a sense of the extent to which mobile gamers and developers need to focus on compensating for latency, jitter and packet loss and other issues which affect players' experience when playing multiplayer games or developing new games for each market. The lower the Games Experience score, the harder it will be to win in challenging multiplayer titles.

Eight out of the top 10 countries hail from Europe. This trend continues as we move down the table with 19 out of the top 25 hailing from Europe. The Baltic States are all within the top 25, with Estonia and Latvia within two places of each other (15th and 17th, respectively) and Lithuania bringing up the rear in 23rd place. Central and Eastern Europe is also well represented, with Bulgaria, the Czech Republic, Hungary and the Slovak Republic all in the top 20.

These countries appear to have squeezed out some of Europe's largest economies, with France, Italy, Germany and the UK all absent from the top 20.

Similarly, North America is conspicuous by its absence from the top quarter of the rankings, with Canada 0.3 points short of tying with Taiwan for 24th place. The U.S. and Mexico fall short in comparison, coming 35th and 61th, respectively.

Mobile Games Experience



Data collection period: Oct 10, 2019 –Jan 10, 2020 | © Opensignal Limited

However, unlike our State of Mobile Video Experience report, the U.S. escaped falling into last place when compared to its G7 peers. Italy won that dubious distinction for mobile Games Experience, ranking 39th and placed in the Fair category.

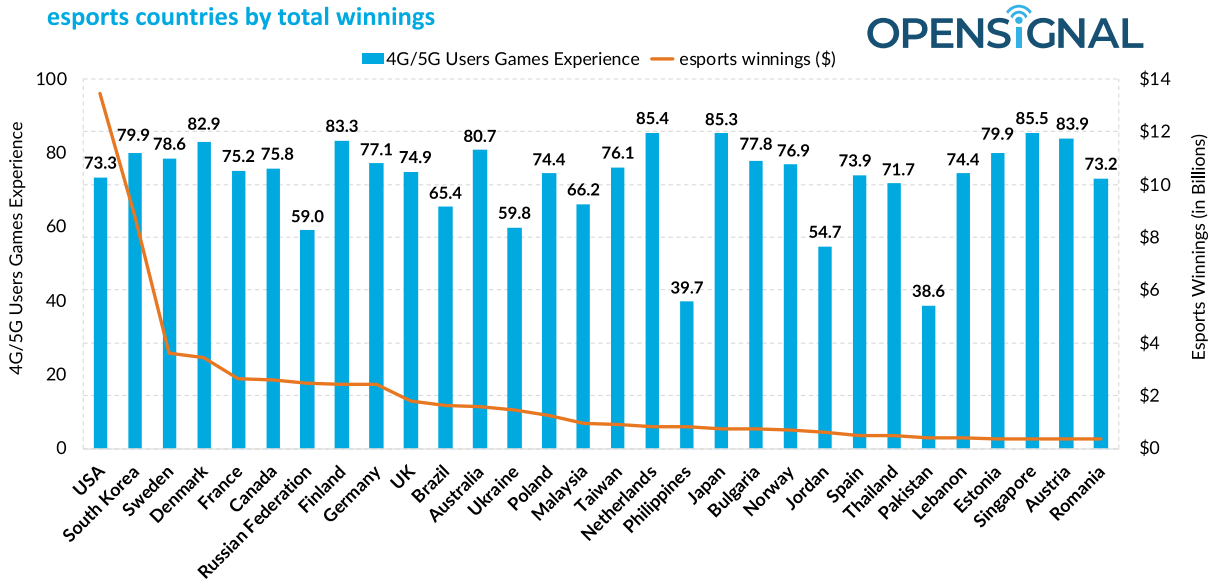
Turning to emerging markets, where smartphone penetration and mobile gaming is rapidly rising, it's interesting to see that some of the most promising countries in this regard, such as Malaysia (50th, 66.2) and Brazil (53rd, 65.4) narrowly make it into the Fair category. This indicates most users thought the gaming experience was average and the majority of users noticed a delay between their actions and the outcomes in the game — hurting their enjoyment and the prospects of winning. Indonesia narrowly falls short of holding the same category with a score of 63.6, but it has less work to do to earn a Fair category rating than India, given the latter's score of 58.4.

Thailand and the Philippines are both outliers, with Thailand surpassing its immediate neighbors and 3.3 points away from securing a Good category position while the Philippines ranks 93th with a score of 39.7 and a Very Poor category rating. With a low mobile Games Experience score, mobile gamers are likely to either play solo games or seek out a good quality Wifi network to play mobile games which defeats the point of a mobile experience.

Esports and mobile Games Experience

Esports have become a large spectator sport. We compared the countries whose players have the largest esports winnings in U.S. dollars with the mobile Games Experience of users. Perhaps surprisingly there is very little correlation, because historically esports have been mostly played on fixed networks. This is changing as mobile esports competitions are becoming more popular. But for now, mobile players in many of these countries lack the conditions to win in multiplayer mobile games unless they travel abroad.

Games Experience compared with esports winnings, for the top 30 esports countries by total winnings



Winnings data source: Esports Earnings | Games Experience data collection period: Oct 10, 2019 –Jan 10, 2020 | © Opensignal Limited

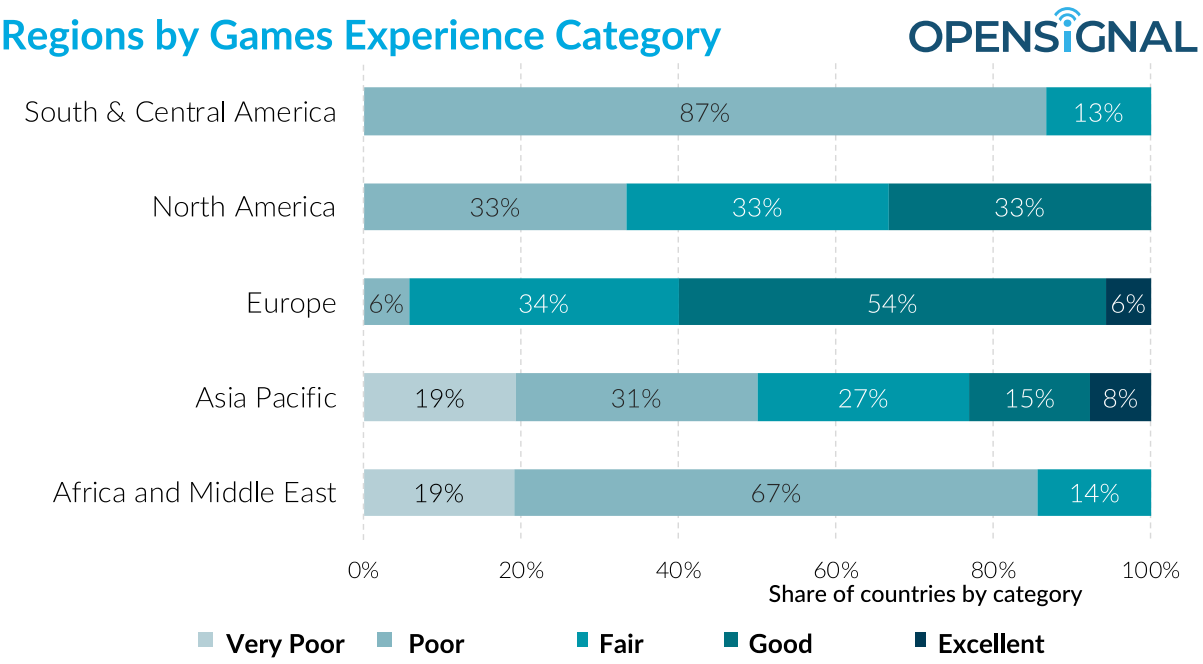
Among the top 30 countries by esports winnings, players in Philippines, Pakistan, Russia and the Ukraine have a mobile Games Experience where most users will find the service provided by the mobile network unacceptable. While in both Brazil and Malaysia, most users will find the experience only average.

Despite having gold, silver and bronze medal positions in terms of esports winnings, users in the U.S., South Korea and Sweden all had a mobile Games Experience below 80. Mobile gamers in many of these top 40 countries would be better placed to win games on mobile networks if there was a better mobile Games Experience available. It's especially striking that South Korea, a country known for its Starcraft obsession and for providing numerous esports players for teams based in the U.S. and across Europe, does not enjoy a stronger mobile Games Experience.

Regional Comparison of Games Experience

Looking at how the different regions break down by category, it is interesting to note that countries in the Excellent category are only present in Asia Pacific and Europe, while these two regions combined with North America account for all those in the Good category. No European countries fell into the lowest category, Very Poor. The Asia Pacific region is the most diverse of the five regions, with representation from countries in all five categories, and more countries in the Very Poor category than in Excellent. Consisting of three countries and with each falling into a different category, North America is something of a mixed bag with the Games Experience becoming worse as one travels from North to South.

Regions by Games Experience Category



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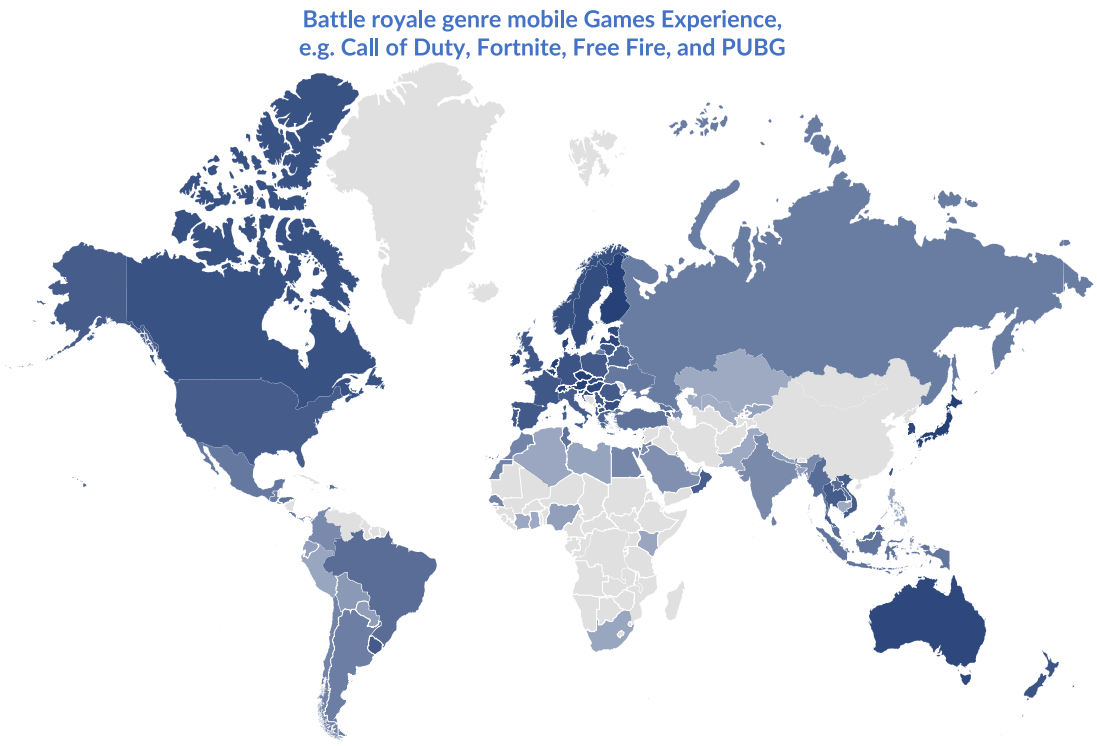
Turning to South & Central America, the region appears to be fairly homogenous from a category perspective, with 87% of all of the featured countries in the region falling into the Poor category and the remainder being Fair. Despite this modest Games Experience, mobile games are still popular. In Brazil over half the online population plays mobile games indicating an opportunity for mobile operators that do offer a good gaming experience. In both South & Central America, Africa and the Middle East, the Games Experience in the vast majority of countries is

either mostly unacceptable or overwhelmingly so and the same holds true for 50% of the countries we've studied in Asia Pacific.

In Asia, mobile games are extremely popular; across Indonesia over 70% of the population plays mobile games. To meet the needs of players in regions where the mobile games are popular but the multiplayer Games Experience is Fair or Poor, game developers often have to design less demanding versions of games. A good example was Tencent and PUBG Corp.'s decision to launch PUBG Mobile Lite. This version has smaller maps battlegrounds and limits the number of players to just 60 rather than 100 players. This title launched in specific areas of Southeast Asia, South Asia, North Africa, and South America.

The battle royale games experience

One of the genres we tested was battle royale, an extremely popular type of multiplayer games genre. For example, Fortnite hit 250 million users in March 2019. Other titles in this genre include Call of Duty, Free Fire, and PlayerUnknown's Battlegrounds (PUBG).



To win in battle royale games, players typically need a very good mobile network because of the large number of players in the game, the resulting large quantity of time-dependent network traffic, and the precision needed to shoot other players and avoid being shot.

The sensitivity of the user experience to underlying mobile network conditions varies depending on the game genre based on our testing. For example, all else being equal, a turn-based two-player game will be more resilient to issues such as poor latency and or high packet loss than a battle royale game, in which a hundred players may be busily fighting each other within a single map with the goal of being the last one standing. Game designers try to mitigate the issues through a number of techniques which often means game artificial intelligence (AI) will take over from a player to keep the game flowing, sometimes without the player even realizing.

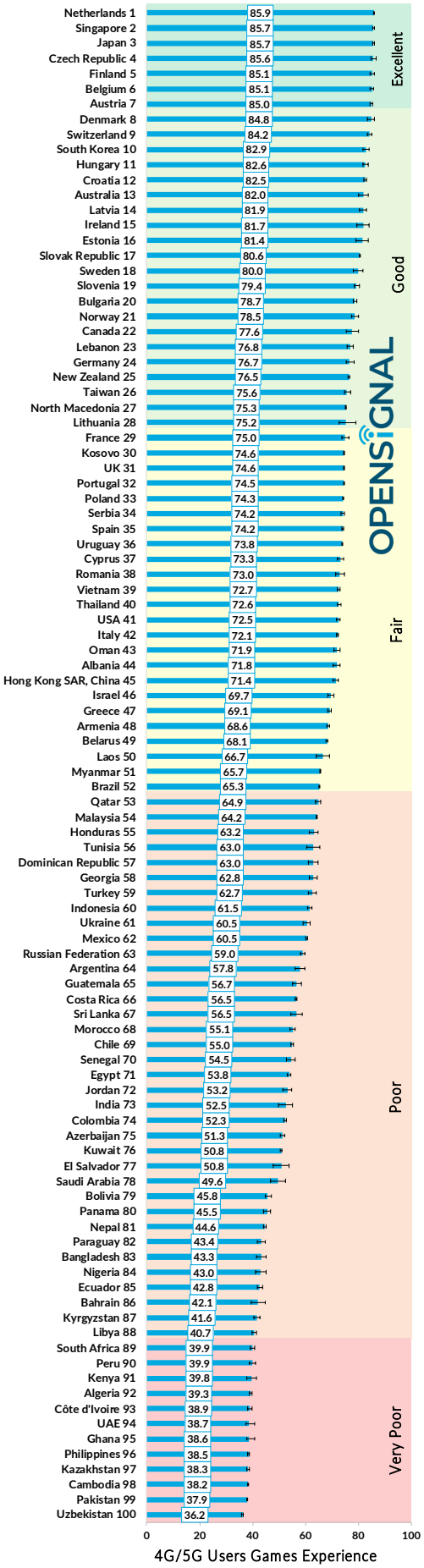
The Netherlands is the last country standing in Opensignal's 'battle royale game' — the genre that includes Call of Duty, Fortnite, Free Fire and PUBG — after narrowly dispatching Japan and Singapore (they both obtained a score of 85.7). But Europe again dominates the scoreboard, accounting for seven of the top 10 spots and 16 of the top 20.

When looking at the five countries which are left after the initial kill-frenzy, Finland is one of the survivors ranking 5th for battle royale Games Experience, despite being ranked two spots lower at 7th for overall mobile Games Experience. Another upset was the early elimination of the United States which does not make the top 40 — it slid six spots to 41st place compared with its 35th ranking for overall mobile Games Experience.

Variations such as these highlight the way that games vary and the extent to which different network conditions affect the real user experience together in complicated and non-linear ways. For each game, a different combination of factors is important.

Our battle map reveals some countries are far better when it comes to delivering a good mobile Games Experience over a mobile connection than other countries in the same region. Good examples of this phenomenon include Uruguay in South America with a score of 73.8, which is

Mobile Games Experience: battle royale
Eg: Call of Duty, Fortnite, Free Fire, and PUBG



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more than 30 points above Paraguay, and 16 points higher than Argentina. Similarly, in the Middle East, Oman's score of 71.9 is streaks ahead of Saudi Arabia's 49.6.

Visualizing how network conditions affect mobile gaming

Poor connectivity,
e.g. high packet loss or a connection break

The top player appears to have stopped moving, likely because the game server is missing too many data packets. By contrast, the lower player is moving as that player intends.

If the animations above do not play please see the videos published on our website.

Different type of poor connection
e.g. poor latency or jitter

The top player appears to jump around — likely because too many data packets are arriving significantly out of order or the latency of the connection is poor, or perhaps a combination of both issues to a lesser extent but which together still cause problems.

To create Opensignal's unique new mobile Games Experience measure, we use a range of technical characteristics as inputs into our model which characterizes the exact relationship between the various real-world technical measurements and users' perceived gaming experience. Our inputs include the following, among other network characteristics:

- **Packet loss is, in essence, the proportion of data packets that never reach their destination**. In a game, in effect this means the player's actions may never take effect, or that the state of the game stops being communicated back to the player. This hurts a player's ability to enjoy a game, as well as making it harder to win. Where a game detects small amounts of packet loss, a game may even temporarily take control from the player, without notifying

players, to keep the game flowing. Of course, this makes winning harder! For larger amounts of packet loss, this is impossible.

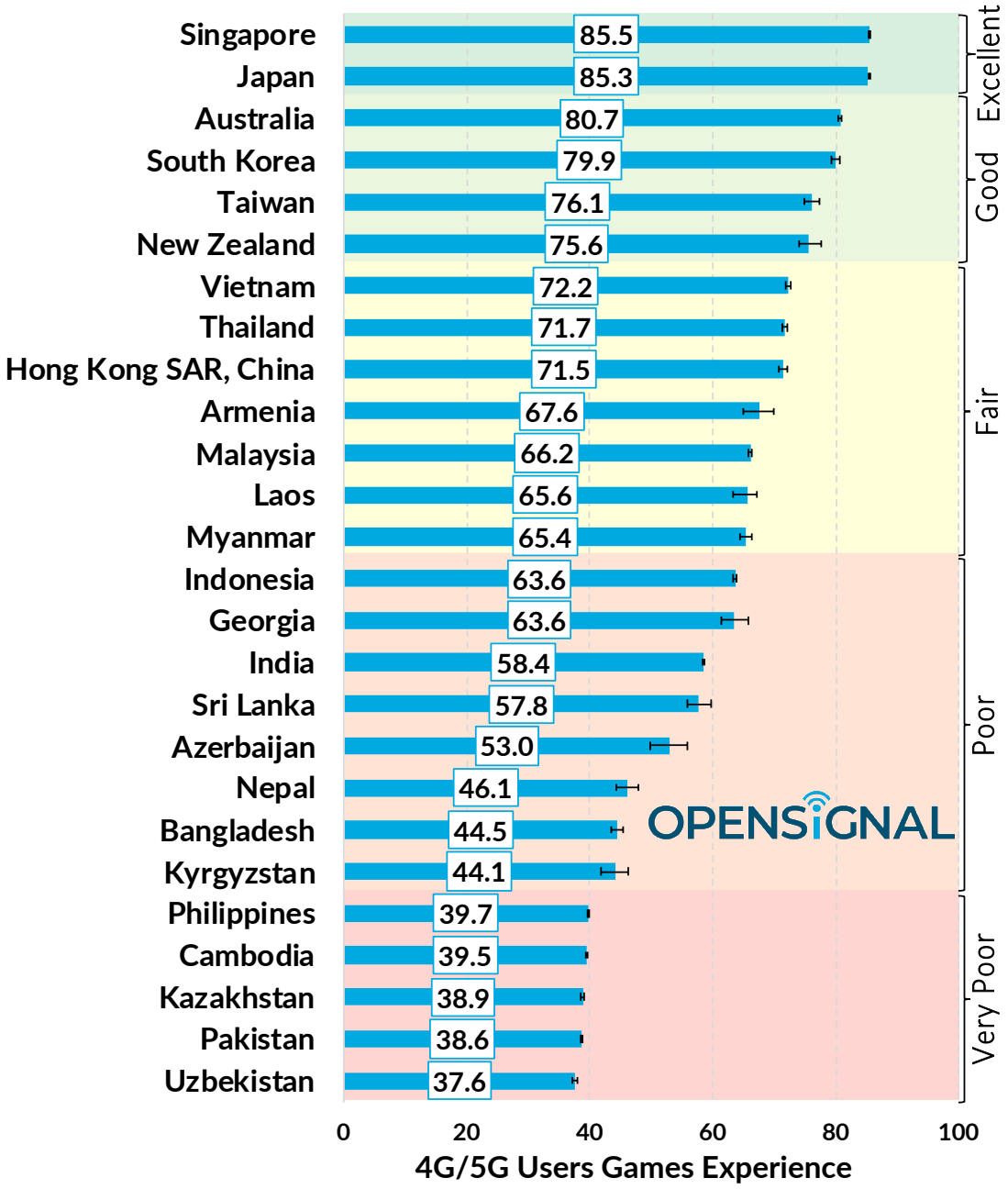
- **Latency, which is a measure of the responsiveness of the network connection**. For real-time multiplayer gaming, latency needs to be low, and consistently low. Even a few brief seconds of poor latency can cause a player to miss a shot and ruin a game. For mobile Games Experience, Opensignal has focused on measures of User Datagram Protocol (UDP) latency rather than Transmission Control Protocol (TCP), as UDP is the preferred protocol for time-sensitive applications such as mobile gaming. Historically, latencies on mobile networks have been significantly poorer than on fixed broadband connections or on Wifi, but 4G has significantly improved latency, and 5G will reduce latency even further, likely meaning there will be little difference between mobile network latency and other kinds of network in the near future.

- **Jitter is a measure of the variability of the arrival time of data packets.** All data packets take time to travel between locations — for example between a player and the game server — but often the amount of delay varies between packets. This variability is jitter. In an extreme situation, if some packets have too much delay, the system will have given up by the time they arrive as they are too late to be useful. Higher jitter levels are often a sign of network congestion, caused by routers struggling to pass on data packets.

In a Mean Opinion Score (MOS) model methodology, there is often a non-straightforward relationship between these inputs and their effect on a player's user experience. For example, once latency deteriorates above a certain threshold, any further reduction in quality may have no further effect on a player's mobile Games Experience because the latency is already terrible. But on a moderate connection, even a few milliseconds of difference, could have a big impact. Similarly, small changes of latency may only affect user experience if both packet loss and jitter are within a fair range, else, the connection may be too bad already for latency to have an impact on the player's experience.

Region by region mobile Games Experience

Asia Pacific Games Experience



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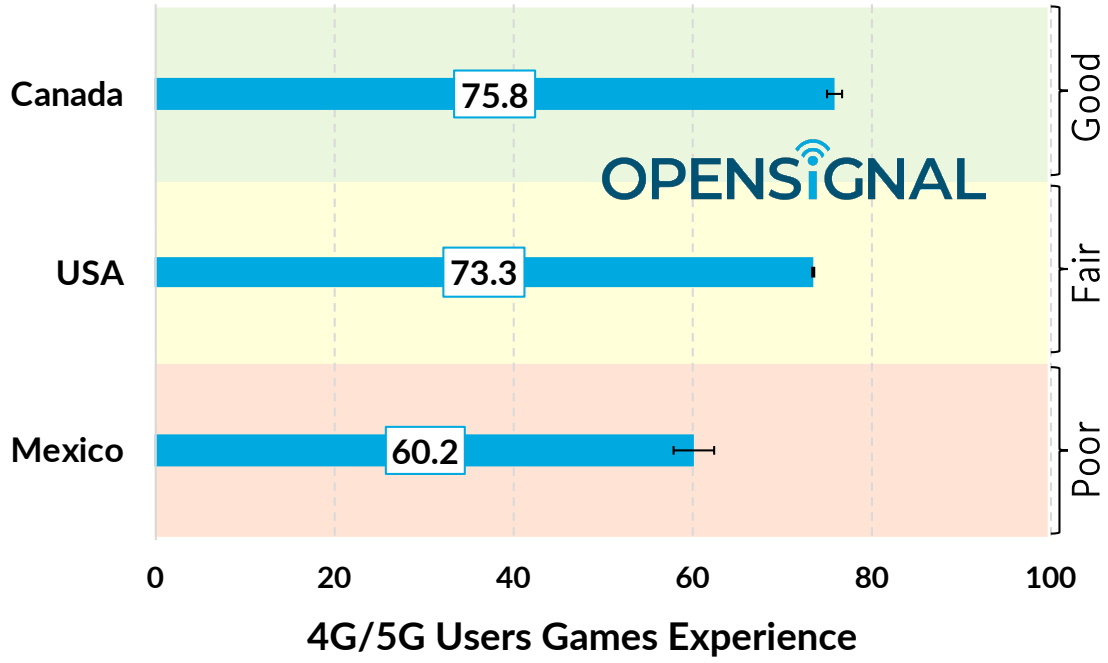
The Asia Pacific region saw the most variation in Games Experience, containing two out of the four countries in the coveted Excellent category (Singapore and Japan), while also including five countries with a score below 40 which translates into the Very Poor category. Australasia has made a strong showing with both Australia and New Zealand offering

players a Good experience, with Australia being the stronger of the two and ranking third in the region.

Turning to some of the countries that make up the fast growing Southeast Asia gaming market, Singapore, Vietnam and Thailand are the strongest performers with Singapore coming first both regionally and globally while Thailand's score of 71.7 means that it is not quite in the same league, although it still outperforms all of its neighbours. Malaysia and Indonesia score slightly higher than the average score observed for this region (61.1), but of the two only Malaysia's score elevates it from the Poor category that applies to the regional average to the Fair category. Users across India enjoy a much better mobile Games Experience than neighbors Pakistan with scores of 58.4 and 38.6 respectively, and also ahead of Bangladesh's 44.5. However, India's Games Experience is tied with users in Sri Lanka.

North America Games Experience



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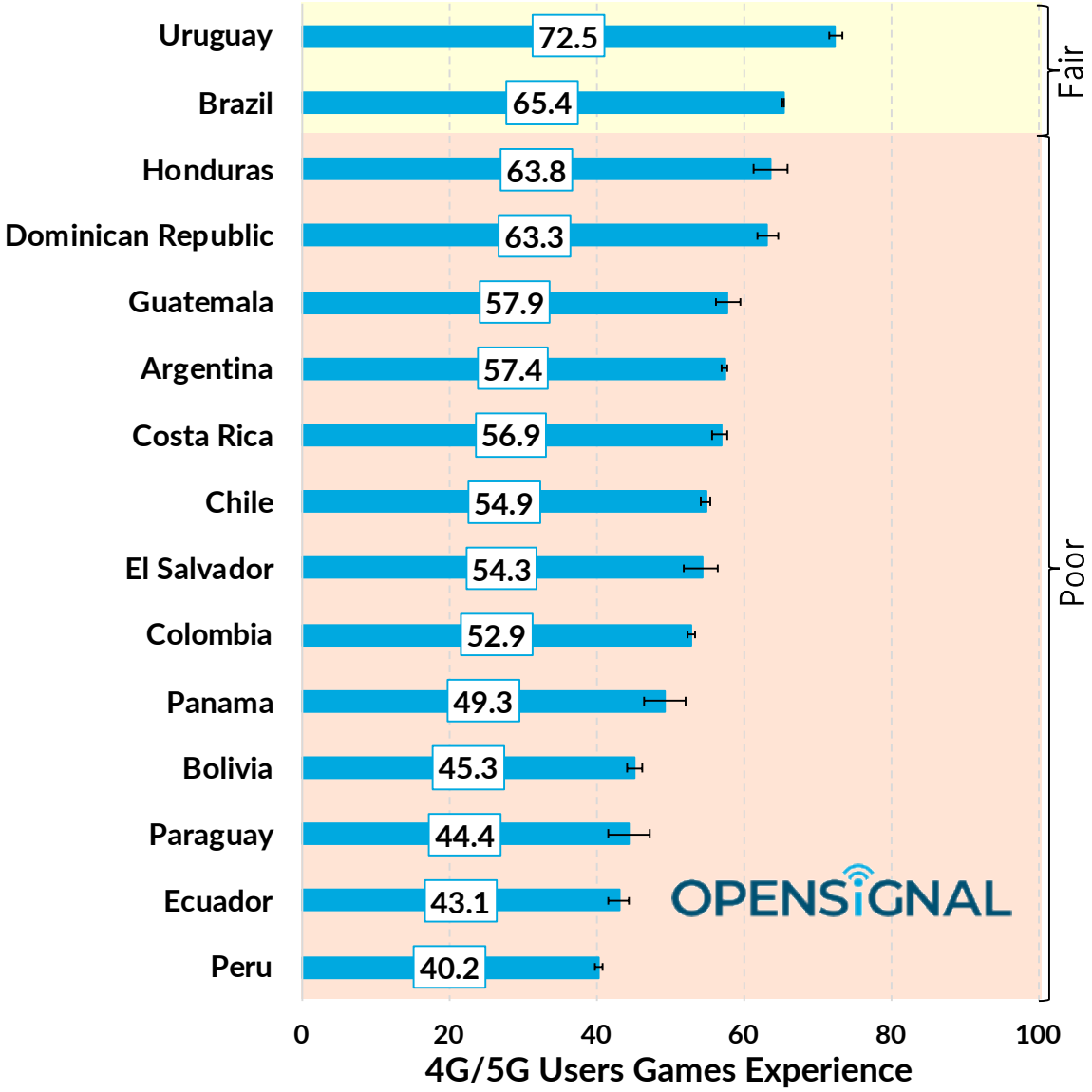
Canada once again is the North American country to beat when it comes to mobile experience, having previously come in top place for Voice App and Video Experience in our reports on these metrics. For mobile Games Experience, Canada's impressive score of 75.8 nudges it into the Good category, which means that most users deemed the service acceptable and the gameplay experience is generally controllable.

While the United States' score is only 2.5 points lower at 73.3 that is enough to drop its average Games Experience down into the Fair category, indicating that users found the service 'average' with most of them noticing delays between their actions and the outcomes in the game. However, with only 1.2 points between it and the Good category there's a good chance that it will rise above the 75-point threshold in the coming year.

South and Central America Games Experience



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The South and Central America regions took fourth place compared with other regions based on the average Games Experience score observed for each region. The region lacks the giddy highs seen in Europe and Asia Pacific, with Uruguay holding the top spot with a score of 72.5 — which

places it in the Fair category — and Brazil narrowly falling within the same category with a score of 65.4. This means that users in both countries found the experience 'average' and the majority noticed a delay between their actions and the game.

Aside from these bright spots, 13 out of the 15 countries in the region that are featured in this report are in the Poor category, which means that nearly all users found this level of service unacceptable. Peru narrowly escaped falling into Very Poor, our lowest possible category, by just 0.2 points.

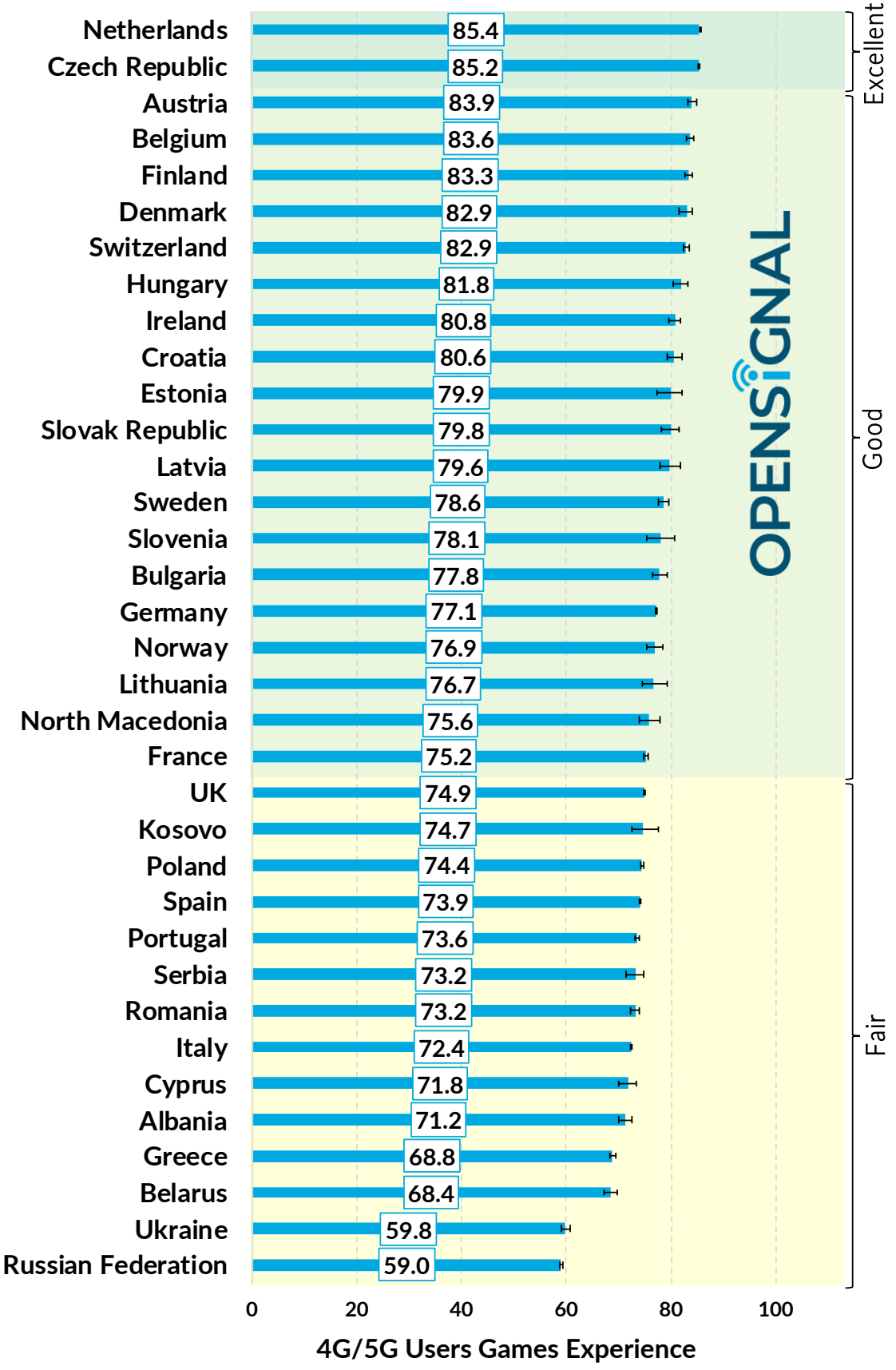
Europe

European countries have the highest average score out of all the regions and also account for exactly 75% of the countries in our analysis that are in either the Excellent or Good categories rankings. The region also holds two out of the four countries in the world to be in the Excellent category, which are the Netherlands and the Czech Republic. It's also worth noting that users in European countries also saw the least variation in scores compared with other regions.

One take-away message is that big economic clout and large populations doesn't necessarily translate into a strong Games Experience. Out of the four European members of the G7, only users in Germany and France enjoyed a mobile Games Experience score which falls into the Good category. The UK rates as Fair, and fell short by just 0.1 of a point, while Italy is 2.6 points from reaching the Good category.

Both Germany and Italy did slightly better in terms of the overall Games Experience metric than they did for our battle royale genre Games Experience — they placed 21st versus 24th and 39th versus 42th, respectively — while France dropped down one place for battle royale, from 28th to 29th. Germany's score of 77.1 was slightly above the average European score of 76.4, but both fall into the Good category, while Italy with a score of 72.4 is towards the lower end of the table but has avoided falling into the bottom five European countries.

Europe Games Experience



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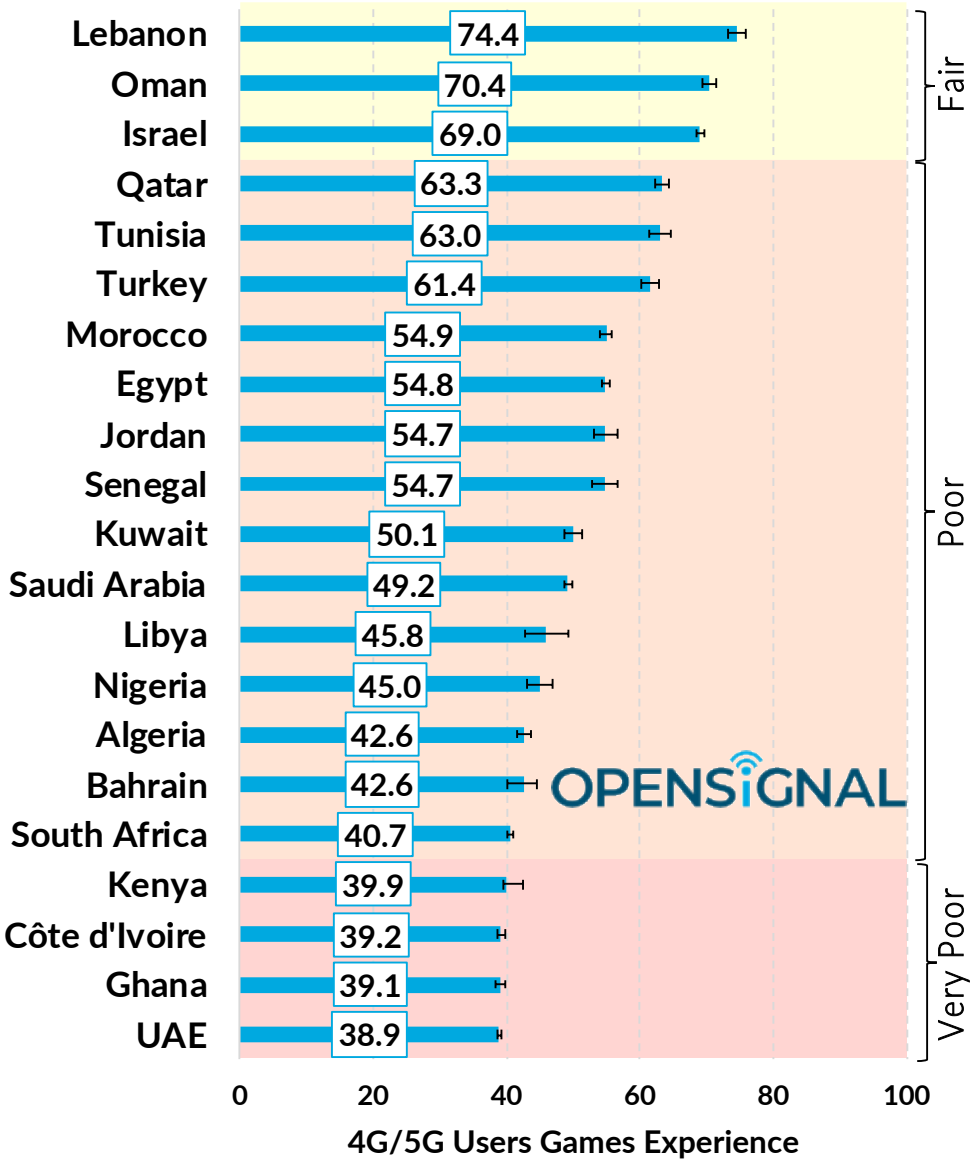
Switzerland was ranked 9th both for Games Experience and when looking at the battle royale genre and had the seventh highest Games Experience score out of the European countries that made the top 100.

Africa and Middle East Games Experience

Africa and the Middle East includes 10 countries with scores of less than 50, with three slipping into Very Poor, our lowest possible category. In fact, 86% of the reported countries in this region are in either the Poor or the Very Poor category.

All in all, 14 countries in total offer a Poor experience, which means that most users found this level of service unacceptable, with a majority of users seeing a delay in the gameplay experience and many feeling a lack of controllability in the Games Experience. While this may seem discouraging, there are a few bright spots with Oman, Lebanon and Israel pulling through to enter the Fair category. Surprisingly, of the three, Lebanon is the strongest performer being just 0.6 points shy of the Good category.

Africa and Middle East Games Experience



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Our Methodology

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

We collect billions of individual measurements every day from many 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

Video Experience

Measures the average video experience of Opensignal users on 3G and 4G networks for each operator. Our methodology involves measuring real-world video streams and uses an ITU-based approach for determining video quality. The metric calculation takes picture quality, video loading time and stall rate into account. We report video experience on a scale of 0-100.

Voice App Experience

Measures the quality of experience for over-the-top (OTT) voice services — mobile voice apps such as WhatsApp, Skype, Facebook Messenger etc. — using a model derived from the International Telecommunication Union (ITU)-based approach for quantifying overall voice call quality and a series of calibrated technical parameters. This model characterizes the exact relationship between the technical measurements and perceived call quality. Voice App Experience for each operator is calculated on a scale from 0 to 100.

Games Experience

Measures how mobile users experience real-time multiplayer mobile gaming on an operator's network. Measured on a scale of 0-100, it analyzes how the multiplayer mobile Games Experience is affected by mobile network conditions including latency, packet loss and jitter to determine the impact on gameplay and the overall multiplayer Games Experience.

4G Availability

Measures the average proportion of time Opensignal users spend with a 4G connection on each operator's network.

Download Speed Experience

Measures the average download speed experienced by Opensignal users across an operator's 3G and 4G networks. It doesn't just factor in 3G and 4G speeds, but also the availability of each network technology. Operators with lower 4G Availability tend to have a lower Download Speed Experience because their customers spend more time connected to slower 3G networks.

Upload Speed Experience

Measures the average upload speed experienced by Opensignal users across an operator's 3G and 4G networks. Upload Speed Experience doesn't just factor in 3G and 4G speeds, but also the availability of each network technology. Operators with lower 4G Availability tend to have a lower Upload Speed Experience because their customers spend more time connected to slower 3G networks.

Latency Experience

Measures the average latency experienced by Opensignal users across an operator's 3G and 4G networks. Latency, measured in milliseconds, is the delay users experience as data makes a round trip through the network. A lower score in this metric is a sign of a more responsive network.

4G Coverage Experience

Measures how mobile subscribers experience 4G coverage on an operator's network. Measured on a scale of 0-10, it analyzes the locations where customers of a network operator received a 4G signal relative to the locations visited by users of all network operators.