



# GLOBAL MOBILE NETWORK EXPERIENCE AWARDS 2022

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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

## The best Video Experience in the world is in the Netherlands

T-Mobile Netherlands and KPN are the Global Winners for Video Experience, with statistically tied scores of 79.4-79.6 points on a 100 point scale. Their domestic rival, Vodafone Netherlands is close behind, sharing third place with three other operators. Norway's operators have also performed strongly with all three placing as Global Leaders for Video Experience. Amid results dominated by Europe, only two Asia Pacific operators are Global Leaders: South Korea's SK telecom and Singapore's StarHub.

## South Korea's LG U+ and SK telecom are top for Games Experience

Opensignal users had their best experience playing multiplayer mobile games on LG U+ and SK telecom's networks. The two operators are the Global Winners for Games Experience with identical scores of 88.4 points on a 100 point scale. Their scores were around 29 points higher than the global average of 59.3 points. KT is third with 86.6 points, ahead of two operators from the Netherlands – T-Mobile and KPN – which are tied in fourth place. The three South Korean operators were the only ones in the Excellent (85 or above) category.

## Three operators are Global Winners for Voice App Experience

LG U+, SK telecom, and Czech Republic's Vodafone have statistically tied for the highest global score for Voice App Experience with scores in the 83.6-84 range. This means that our users had their best experience on these operators' networks when using over-the-top voice apps such as WhatsApp, Skype and Facebook Messenger.

## The fastest average download speeds in the world were seen on SK telecom

SK telecom wins the global Download Speed Experience category as our users reported average download speeds of 143 Mbps. SK telecom's Download Speed Experience was 4.9 times the global average of 29.4 Mbps. While South Korea's other operators – LG U+ and KT – are in second place with statistically tied scores around 100 Mbps, no other operator scored above 80 Mbps.

## Denmark's 3 is the Global Winner for Upload Speed Experience

Our users observed the highest average upload speeds of 20.9 Mbps on Danish operator 3's network, which was 2.4 times the global average of 8.8 Mbps. No other operator breached the 20 Mbps mark, although three Global Leaders had scores above 19 Mbps: Swisscom, LG U+ and SK telecom. 3's success is due to a massive 62.9% increase in its Upload Speed Experience between H2 2020 and H2 2021 – which also makes it a Global Rising Star for Upload Speed Experience.

## Users spent the most time connected to 4G or 5G on LG U+

South Korea's LG U+ is the outright Global Winner for 4G Availability with an almost perfect score of 99.8%. It is closely followed by Japan's au and India's 4G-only operator, Jio. Higher 4G Availability scores mean that our users spent less time on older mobile technology such as 2G and 3G, or without any signal at all. The average global 4G Availability across all operators with a 4G network was 86.5% – which LG U+ exceeded by an impressive 13.3 percentage points.

# Opensignal Global Awards 2022

## The Global Winners and Leaders



<p>Video Experience</p>	<b>T-Mobile</b> The Netherlands	<b>Vodafone</b> The Netherlands	<b>Telenor</b> Norway	<b>SK telecom</b> South Korea	<b>3</b> Sweden
	<b>KPN</b> The Netherlands	<b>TDC</b> Denmark	<b>Telia</b> Norway	<b>StarHub</b> Singapore	<b>Vodafone</b> Czech Republic
		<b>ICE</b> Norway	<b>Swisscom</b> Switzerland	<b>A1</b> Austria	<b>3</b> Denmark
<p>Games Experience</p>	<b>LG U+</b> South Korea	<b>KT</b> South Korea	<b>Vodafone</b> The Netherlands	<b>Singtel</b> Singapore	<b>TDC</b> Denmark
	<b>SK telecom</b> South Korea	<b>KPN</b> The Netherlands	<b>Vodafone</b> Czech Republic	<b>SoftBank</b> Japan	<b>Telenor</b> Denmark
		<b>T-Mobile</b> The Netherlands	<b>StarHub</b> Singapore	<b>T-Mobile</b> Czech Republic	
<p>Voice App Experience</p>	<b>LG U+</b> South Korea	<b>KT</b> South Korea	<b>KPN</b> The Netherlands	<b>Telenor</b> Denmark	<b>Telenor</b> Norway
	<b>SK telecom</b> South Korea	<b>T-Mobile</b> The Netherlands	<b>T-Mobile</b> Czech Republic	<b>TDC</b> Denmark	
	<b>Vodafone</b> Czech Republic				
<p>Download Speed Experience</p>	<b>SK telecom</b> South Korea	<b>LG U+</b> South Korea	<b>Telenor</b> Norway	<b>Bell</b> Canada	<b>Swisscom</b> Switzerland
		<b>KT</b> South Korea	<b>Telus</b> Canada	<b>TDC</b> Denmark	
		<b>KPN</b> The Netherlands	<b>T-Mobile</b> The Netherlands	<b>Telia</b> Norway	
<p>Upload Speed Experience</p>	<b>3</b> Denmark	<b>Swisscom</b> Switzerland	<b>KPN</b> The Netherlands	<b>Vodafone</b> Czech Republic	<b>Telia</b> Norway
		<b>LG U+</b> South Korea	<b>T-Mobile</b> The Netherlands	<b>Telia</b> Denmark	
		<b>SK telecom</b> South Korea	<b>TDC</b> Denmark	<b>Telenor</b> Denmark	
<p>4G Availability</p>	<b>LG U+</b> South Korea	<b>au</b> Japan	<b>Rakuten</b> Japan	<b>NTT DoCoMo</b> Japan	<b>Smartfren</b> Indonesia
		<b>Jio</b> India	<b>TPG</b> Singapore	<b>Airtel</b> India	
		<b>SK telecom</b> South Korea	<b>KT</b> South Korea	<b>T-Mobile</b> The Netherlands	

# Opensignal Global Awards 2022



## Global Rising Stars (most improved)

 <b>Video Experience</b>	<b>Zain</b> Iraq <b>Asiacell</b> Iraq <b>Korek</b> Iraq <b>Claro</b> El Salvador <b>Libyana</b> Libya	<b>Zain</b> Bahrain <b>Jio</b> India <b>Smartfren</b> Indonesia <b>Globe</b> The Philippines <b>XL</b> Indonesia	<b>TrueMove H</b> Thailand <b>Hot Mobile</b> Israel <b>Cellcard</b> Cambodia <b>Claro</b> Honduras <b>Smart</b> The Philippines	<b>Tigo</b> El Salvador <b>Airtel</b> Sri Lanka <b>Play</b> Poland <b>Smart Axiata</b> Cambodia <b>Batelco</b> Bahrain	<b>Indosat</b> Indonesia <b>Viva</b> Bolivia <b>Rakuten</b> Japan <b>Claro</b> Guatemala <b>Telemach</b> Croatia	<b>lifecell</b> Ukraine <b>Maroc Telecom</b> Morocco <b>Vodafone</b> The Netherlands <b>Kyivstar</b> Ukraine <b>Dialog</b> Sri Lanka
 <b>Games Experience</b>	<b>Etisalat</b> UAE <b>du</b> UAE <b>lifecell</b> Ukraine <b>Batelco</b> Bahrain <b>Smart</b> The Philippines	<b>stc</b> Kuwait <b>Ooredoo</b> Kuwait <b>Mobily</b> Saudi Arabia <b>MTS</b> Russia <b>Orange</b> Tunisa	<b>Claro</b> El Salvador <b>Smartfren</b> Indonesia <b>Zain</b> Kuwait <b>Asiacell</b> Iraq <b>Zain</b> Bahrain	<b>STC</b> Saudi Arabia <b>Vodafone</b> Qatar <b>Jio</b> India <b>Claro</b> Guatemala <b>Kyivstar</b> Ukraine	<b>Telenor</b> Serbia <b>GT</b> Taiwan <b>Movistar</b> Argentina <b>Viva</b> Bolivia <b>Vodafone</b> Hungary	<b>DIGIMobil</b> Hungary <b>Zain</b> Iraq <b>Orange</b> Poland <b>3</b> Denmark <b>stc</b> Bahrain
 <b>Voice App Experience</b>	<b>Etisalat</b> UAE <b>Asiacell</b> Iraq <b>Smart</b> The Philippines <b>Zain</b> Iraq <b>Tigo</b> Guatemala <b>du</b> UAE	<b>Libyana</b> Libya <b>Movistar</b> Argentina <b>Globe</b> The Philippines <b>lifecell</b> Ukraine <b>Mobily</b> Saudi Arabia	<b>Claro</b> El Salvador <b>Claro</b> Peru <b>MTS</b> Russia <b>WOM</b> Chile <b>Korek</b> Iraq	<b>BSNL</b> India <b>Smartfren</b> Indonesia <b>Personal</b> Argentina <b>Vodafone</b> Hungary <b>Telenor</b> Serbia	<b>Jio</b> India <b>Jazz</b> Pakistan <b>Batelco</b> Bahrain <b>Telenor</b> Pakistan <b>Claro</b> Guatemala	<b>Telenor</b> Bulgaria <b>O2</b> Czech Republic <b>stc</b> Kuwait <b>GT</b> Taiwan <b>Telia</b> Norway
 <b>Download Speed Experience</b>	<b>Asiacell</b> Iraq <b>Zain</b> Iraq <b>Korek</b> Iraq <b>Claro</b> El Salvador <b>Zain</b> Bahrain	<b>T-Mobile</b> Puerto Rico <b>AIS</b> Thailand <b>SK telecom</b> South Korea <b>KT</b> South Korea <b>NOS</b> Portugal	<b>China Telecom</b> China <b>China Mobile</b> China <b>Jio</b> India <b>T-Mobile</b> USA <b>LG U+</b> South Korea	<b>Smartfren</b> Indonesia <b>Zain</b> Kuwait <b>3</b> UK <b>Smart</b> The Philippines <b>Telemach</b> Croatia	<b>Vodafone</b> Germany <b>Ooredoo</b> Kuwait <b>Claro</b> Honduras <b>eir</b> Ireland <b>China Unicom</b> China	<b>TrueMove H</b> Thailand <b>Telenor</b> Denmark <b>CMHK</b> HK (SAR China) <b>Globe</b> The Philippines <b>Ufone</b> Pakistan
 <b>Upload Speed Experience</b>	<b>Asiacell</b> Iraq <b>Zain</b> Iraq <b>Korek</b> Iraq <b>Airtel</b> Sri Lanka <b>Claro</b> El Salvador	<b>Zain</b> Bahrain <b>Libyana</b> Libya <b>3</b> Denmark <b>Jio</b> India <b>Ufone</b> Pakistan	<b>Ooredoo</b> Oman <b>AIS</b> Thailand <b>Smartfren</b> Indonesia <b>China Mobile</b> China <b>Vodafone</b> Germany	<b>Viva</b> Bolivia <b>Ooredoo</b> Kuwait <b>Digi Mobil</b> Romania <b>Tigo</b> Colombia <b>Claro</b> Honduras	<b>China Telecom</b> China <b>Globe</b> The Philippines <b>SK telecom</b> South Korea <b>eir</b> Ireland <b>Telkomsel</b> Indonesia	<b>stc</b> Kuwait <b>Telia</b> Finland <b>Telemach</b> Croatia <b>Maxis</b> Malaysia <b>Al-Madar</b> Libya
 <b>4G Availability</b>	<b>Claro</b> El Salvador <b>Libyana</b> Libya <b>Claro</b> Honduras <b>eir</b> Ireland <b>Al-Madar</b> Libya	<b>ALBtelecom</b> Albania <b>Claro</b> Guatemala <b>3</b> Denmark <b>Tigo</b> Colombia <b>Cellcom</b> Israel	<b>Tigo</b> El Salvador <b>O2</b> Germany <b>3</b> Sweden <b>Claro</b> Costa Rica <b>U Mobile</b> Malaysia	<b>Vodafone</b> Ireland <b>Globe</b> The Philippines <b>Unifi</b> Malaysia <b>Vodafone</b> Albania <b>Vodafone</b> New Zealand	<b>Movistar</b> Costa Rica <b>Pelephone</b> Israel <b>Orange</b> Slovakia <b>Vi</b> India <b>Vietnamobile</b> Vietnam	<b>DiGi</b> Malaysia <b>Maxis</b> Malaysia <b>Hutch</b> Sri Lanka <b>Vodafone</b> Germany <b>Telenor</b> Bulgaria

# Mobile experience unleashed

In the third Global Awards report, Opensignal once again directly compares operators from around the world to recognize those on which our users had the best mobile experience. In addition, we again highlight the operators where our users have seen the greatest improvement in mobile experience – these operators are the Global Rising Stars. This is the first time that we have awarded Global Rising Stars for Games Experience, which measures how mobile users experience real-time multiplayer mobile gaming on an operator's network.

Unlike the recently published [5G Global Awards](#), this report looks at the overall mobile experience of our users across all mobile network technologies. This means that these results are significantly different. In markets where operators have launched 5G services, both our overall experiential metrics (Video Experience, Games Experience and Voice App Experience) and our measures of speed (Download Speed Experience and Upload Speed Experience) are heavily affected by the proportion of mobile users that have adopted 5G and by the proportion of time that they spent connected to 5G.

The extent to which 5G is making its presence felt in our overall scores for experiential and speed awards is clear from looking at the South Korean operators' strong showing, which is aided by the country's strong 5G adoption. In November 2021, [5G mobile subscriptions rose to 20.19 million](#) or around 28% of the country's total. Other operators where 5G is established also do well, including many from Denmark, Japan, the Netherlands and Switzerland among others.

Using six measures of the mobile network experience, we have analyzed the data provided by our users over the first 180 days of the second half of 2021 and determined the Global Winner(s) using [confidence intervals](#) as we do with all of our reports. If the confidence intervals overlap then the result is a statistical tie and we declare two or more operators to be joint winners.

Also, we have used confidence intervals to determine the Global Leaders and the Global High Performers, which are composed of the top 10 and top 30 scoring operators respectively (excluding Global Winners). The exact number of operators in these categories can vary because of statistical ties between operators' scores.

# Video Experience — Global

Joint winners are the Netherlands' T-Mobile and KPN

## ▶ Video Experience – Global



T-Mobile – NLD 79.6  
KPN – NLD 79.4



Vodafone – NLD 77.9  
TDC – DNK 77.7  
ICE – NOR 77.7  
Telenor – NOR 77.7  
Telia – NOR 77.1  
Swisscom – CHE 76.2  
SK telecom – KOR 76.0  
StarHub – SGP 75.5  
A1 – AUT 75.5  
3 – SWE 75.4  
Vodafone – CZE 75.4  
3 – DNK 75.3



SoftBank – JPN 75.1  
Telia – DNK 74.6  
M1 – SGP 74.5  
KT – KOR 74.4  
Singtel – SGP 74.2  
Chunghwa – TWN 74.1  
Orange – SVK 74.0  
Telenor – DNK 73.8  
Telekom – SVK 73.7  
Telia – LTU 73.7  
O2 – CZE 73.7  
A1 – HRV 73.6  
Telenor – SWE 73.5  
Zain – KWT 73.5  
HT – HRV 73.5  
Telekom – DEU 73.4  
Telekom Slovenia – SVN 73.3  
T-Mobile – CZE 73.2  
Proximus – BEL 73.2  
A1 – SVN 73.2  
A1 – SRB 73.0  
Telia – EST 72.3

Average – Global (Only highest ranked operators listed on chart) 64.2



0 20 40 60 80 100

Video Experience score

Data collection period 1 July – 27 December 2021 | © Opensignal Limited

Opensignal's Video Experience quantifies the quality of video streamed to mobile devices by measuring real-world video streams over an operator's network. The videos tested include a mixture of resolutions and are streamed directly from the world's largest video content providers.

Two Dutch operators, T-Mobile and KPN are Global Winners for Video Experience, with statistically tied scores of 79.4-79.6 points on a 100 point scale. Their domestic rival – Vodafone Netherlands – narrowly missed joining them on the winner's podium, placing as a Global Leader instead. Norway's three operators – ICE, Telenor and Telia – are Global Leaders.

Only two operators from the Asia Pacific region are Global Leaders – South Korean SK telecom and Singapore's StarHub – but it is SK telecom that has the highest score in the region with 76 points. The other 10 Global Leaders all hail from Europe – including Denmark's TDC and 3, Switzerland's Swisscom, Austria's A1 and Sweden's 3. Europe's dominance continues when we turn to our Global High Performers as 16 out of 22 are European, with the rest hailing from the Asia Pacific region (five) along with a solitary operator from Africa and the Middle East – Kuwait's Zain, which is the best performing operator in the region due to its score of 73.5 points.

Over in Japan, only one operator is recognized for Video Experience at the global level – SoftBank, which has placed as a Global High Performer due to its score of 75.1 points. The other Asian Pacific operators that have placed in the same category are South Korea's KT, two of Singapore's operators – M1 and Singtel – and Taiwan's Chunghwa.

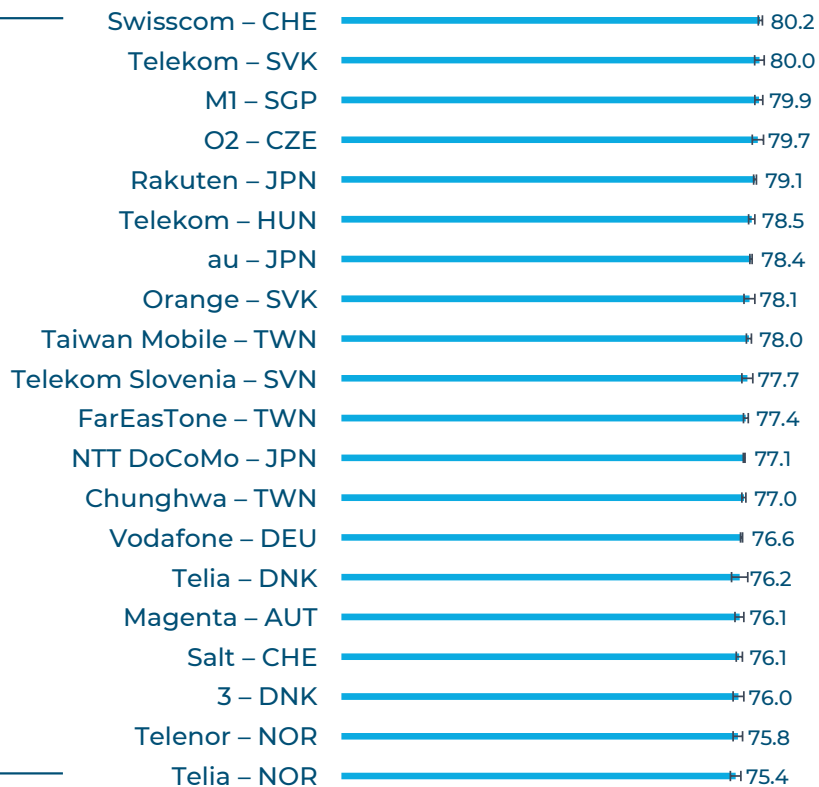
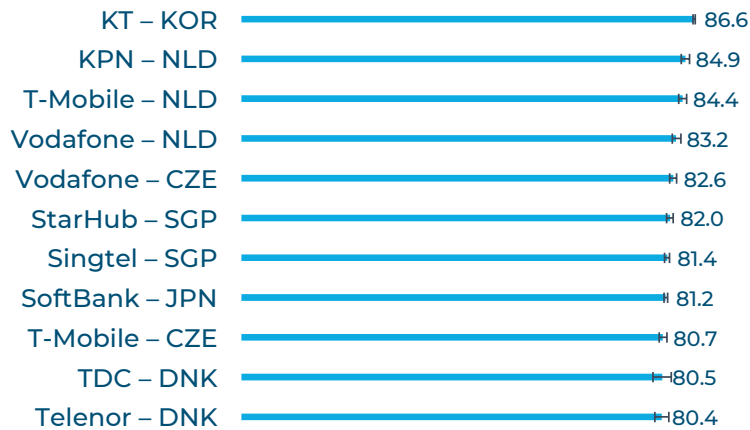
All of the Global Winners and Global Leaders for Video Experience placed in the Excellent (75 or above) category. This indicates a very consistent experience across all users, video streaming providers and resolutions tested, with fast loading times and almost non-existent stalling. In comparison, the global average of 64.2 points translates into a Good rating (55<65), which means a less consistent experience, even from the same video streaming provider and particularly for higher resolutions, with noticeably slower loading times and stalling not being uncommon.

52.9% of all operators analyzed placed in either the Excellent or Very Good (65<75) categories, while less than 2% placed in the Poor (under 40) category. All our Global High Performers had scores that were at least 8.2 points higher than the global average of 64.2 points.

# Games Experience — Global

South Korea's LG U+ and SK telecom jointly win

## Games Experience – Global



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Data collection period 1 July – 27 December 2021 | © Opensignal Limited

Games Experience score

Opensignal's Games Experience is a measure of 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.

South Korea's LG U+ and SK telecom are joint Global Winners in this category with identical scores of 88.4 points on a 100 point scale – which is all the more impressive given the global average of 59.3 points.

Just behind the winners, the Global Leaders include all three operators from the Netherlands, KPN, T-Mobile and Vodafone, two Singaporean operators – StarHub and Singtel – along with Japan's SoftBank and Denmark's TDC and Telenor.

The two winners' scores place them in our highest category for this measure of the mobile experience – Excellent (85 or above). Only one other mobile network in the world also earned an Excellent rating: fellow South Korean operator KT. This means that the vast majority of our users on all three South Korean operators' networks deemed their network experience acceptable, with nearly all respondents feeling like they had control over the game and they received immediate feedback on their actions.

In contrast, the global average of 59.3 points places in the Poor category (40<65) and 57.6% of all operators analyzed for this report placed in either the Poor or Very Poor (under 40) categories. This highlights how much work is required before the typical user around the world can play multiplayer mobile games on a cellular connection without their gameplay being impacted by network conditions. However, this is likely to change over the coming years, given the eventual shift from 5G non-standalone access (NSA) to 5G standalone access (SA) technology, which promises significant reductions in latency, along with the growing interest in mobile edge computing and network slicing. But as enhanced capabilities for mobile gaming become more commonplace, app developers will be more likely to build mobile games that require very low latencies.

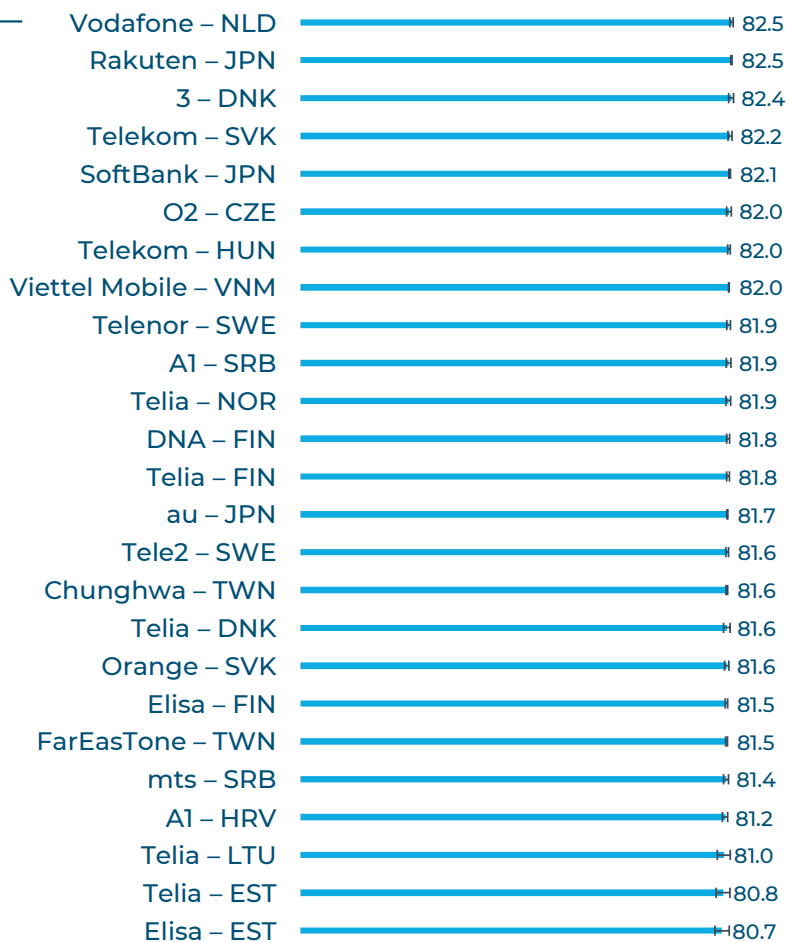
In joint fourth place and directly behind the South Korean operators are two Dutch operators – KPN and T-Mobile – which, with statistically tied scores of 84.4-84.9 points, are also the highest scoring European operators for Games Experience. While it is not one of our Global High Performers, Telus has the highest score out of all the North American operators – 69.7 points – and is closely followed by its domestic peers Bell and Rogers.

All of Japan's operators have been recognized for their Games Experience – SoftBank is the only one that has placed as a Global Leader, due to its score of 81.2 points, while au, NTT DoCoMo and Rakuten are all Global High Performers. Three out of five operators from Taiwan are Global High Performers: Taiwan Mobile, FarEasTone and Chunghwa.

# Voice App Experience — Global

LG U+, SK telecom & Vodafone Czech Republic are top

## Voice App Experience – Global



Average – Global (Only highest ranked operators listed on chart) 76.9

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0 20 40 60 80 100

Data collection period 1 July – 27 December 2021 | © Opensignal Limited

Voice App Experience score

Opensignal's Voice App Experience measures the quality of experience for over-the-top (OTT) voice services 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. Examples of these mobile voice apps include WhatsApp, Skype, LINE, WeChat, Viber and Facebook Messenger.

South Korea's LG U+ and SK telecom, together with Vodafone in the Czech Republic are joint Global Winners for Voice App Experience with statistically tied scores in the 83.6-84 point range. Although South Korea's third operator KT's score of 83.7 points appears to be slightly higher than Vodafone's 83.6 points, unlike Vodafone its upper confidence interval does not overlap with LG U+'s lower confidence interval and as a result KT places in the Global Leader category.

The global average was 76.9 points, which translates into an Acceptable (74<80) rating, while the Global Winners' scores placed them in the Good (80<87) category. 26% of operators analyzed received a Good rating. This means that many users were satisfied, however some experienced minor quality impairments like the background being not quite clear or the volume not being loud enough.

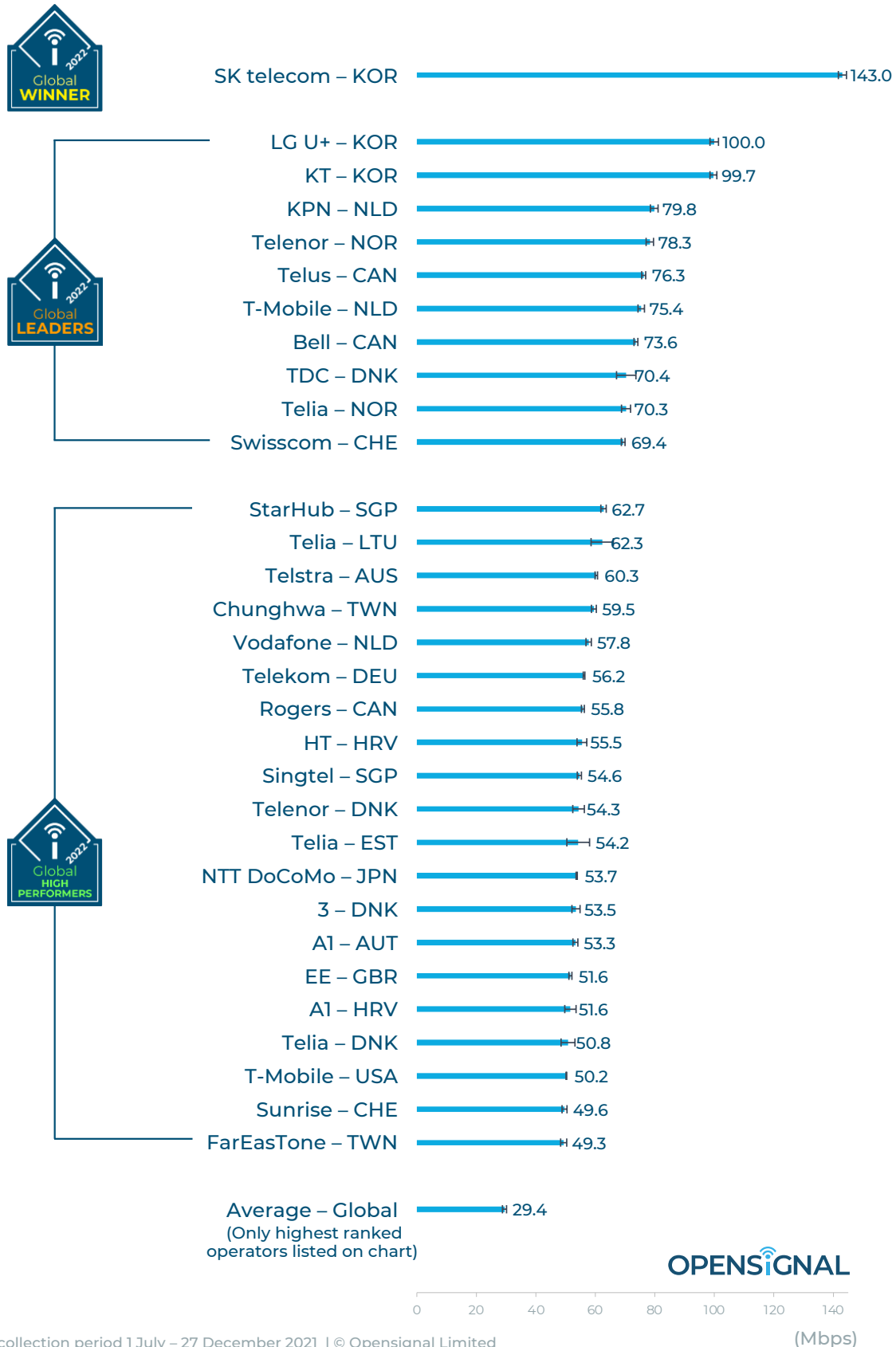
On the other hand, only 3% of operators analyzed placed in the Very Poor (60<66) category and none placed in either of our lowest categories – Unintelligible (45<60) and Impossible to Communicate (under 45).

While two out of three of our Global Winners are based in the Asia Pacific region, European operators dominate the Global Leader and Global High Performer categories – which this time are filled only by operators from Europe or Asia Pacific. Speaking of Asia, three out of four Japanese operators are Global High Performers – au, Rakuten and SoftBank.

# Download Speed Experience — Global

SK telecom's score of 143 Mbps is 4.9 times the average

## Download Speed Experience – Global



Data collection period 1 July – 27 December 2021 | © Opensignal Limited

(Mbps)

The average download speeds observed across all users analyzed was a respectable 29.4 Mbps – more than sufficient for many tasks and a sign of the mobile industry’s growing maturity. There is only one Global Winner in the Download Speed Experience category: SK telecom with its score of 143 Mbps, which is an impressive 4.9 times faster than the global average.

The operator’s South Korean peers are the only other operators globally whose scores were above 80 Mbps – around 100 Mbps – and are the only operators hailing from Asia Pacific recognized as Global Leaders for Download Speed Experience. Six Global Leaders hail from Europe – Dutch KPN and T-Mobile, Norway’s Telenor and Telia, Denmark’s TDC and Switzerland’s Swisscom.

Two out of three Canadian operators – Bell and Telus – are Global Leaders for Download Speed Experience. Rogers is also present, but as a Global High Performer. Telus had the highest score in North America – 76.3 Mbps.

The only U.S. operator to be recognized this time around for Download Speed Experience is T-Mobile, it is a Global High Performer with its score of 50.2 Mbps, likely boosted by its 5G roll out. Similarly, NTT DoCoMo is the only Japanese operator to make the cut, placing in the Global High Performer category. Telstra, alone out of its Australian peers, is a Global High Performer with a score of 60.3 Mbps. Taiwanese operators had slightly more success, with both Chunghwa and FarEasTone placing as Global High Performers.

The Netherlands’ KPN and Norway’s Telenor had the highest average download speeds in Europe, with statistically tied scores of 78.3-79.8 Mbps. In addition, all three Dutch operators are either Global Leaders (KPN and T-Mobile) or Global High Performers (Vodafone).

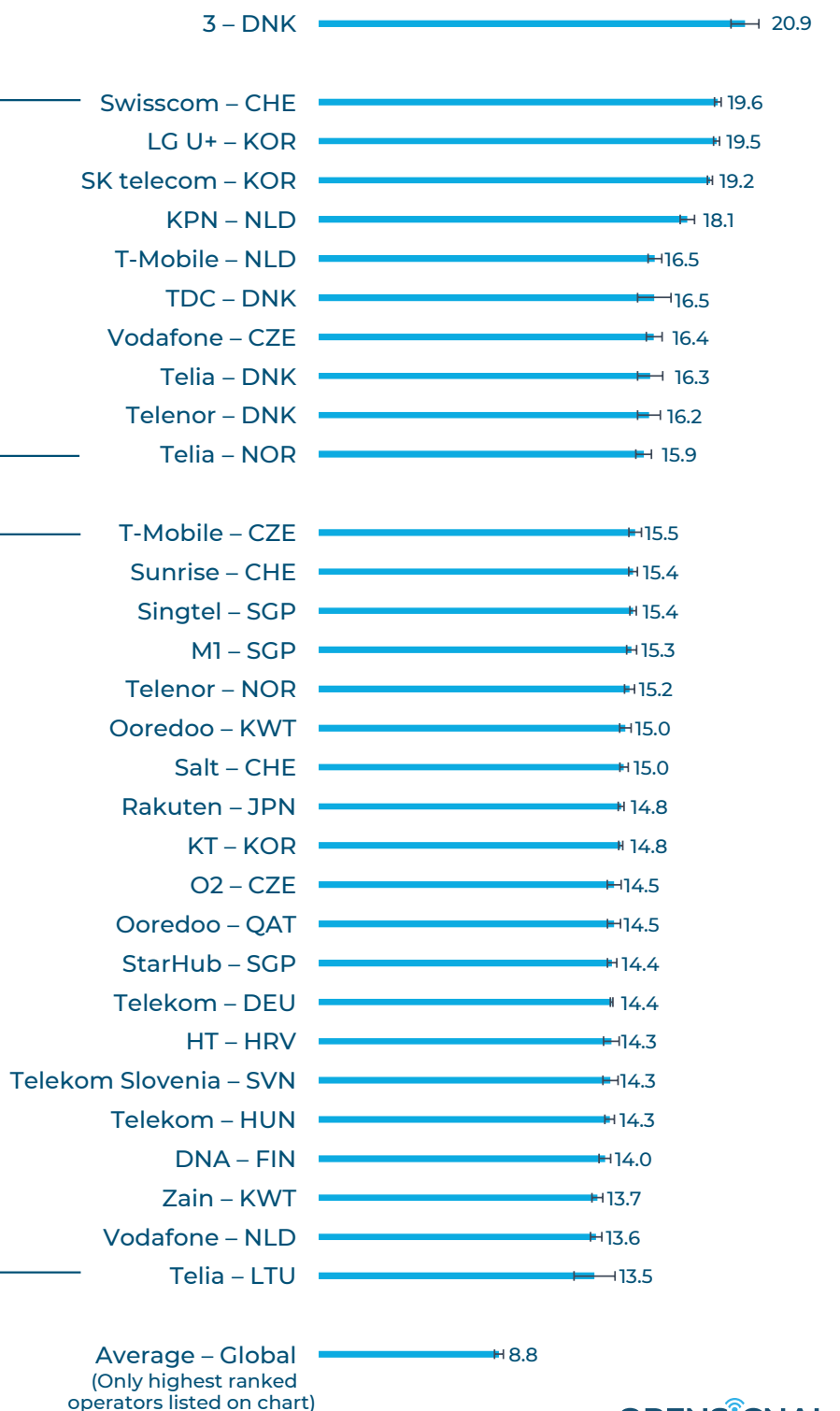
Our users in Africa and the Middle East saw their fastest average download speeds on three operators due to statistical ties: Etisalat in the UAE, Qatar’s Ooredoo and Bahrain’s Zain; with scores in the 40.8-44.7 Mbps range, though none of them received an award in this category this time around.

The average download speeds observed by our users connecting on the Global High Performers’ networks were at least 19.9 Mbps (67.6%) faster than the global average of 29.4 Mbps.

# Upload Speed Experience — Global

3 Denmark's 20.9 Mbps is 2.4 times the average

## ↑ Upload Speed Experience – Global



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0 5 10 15 20 25 (Mbps)

Data collection period 1 July – 27 December 2021 | © Opensignal Limited

Traditionally much of the focus analyzing mobile has been on download speeds given consumers' increasing use of data-intensive services such as video streaming. This is changing now as upload speeds are becoming more and more important given the rise of social media and cloud services which encourage users to upload photos, videos and other bandwidth-intensive content.

Denmark's 3 is the Global Winner for Upload Speed Experience with an impressive score of 20.9 Mbps – the average upload speed seen by Opensignal users on its network. No other operator breached the 20 Mbps mark, although three Global Leaders had scores above 19 Mbps: Swisscom, LG U+ and SK telecom. Swisscom and LG U+ are second for Upload Speed Experience with statistically tied scores of 19.5-19.6 Mbps.

To put these speeds into perspective, the global average was just 8.8 Mbps. All of 3's three Danish peers are Global Leaders. Over in Switzerland, Swisscom has performed the most strongly with its score of 19.6 Mbps putting it in the Global Leader category for Upload Speed Experience, placing it ahead of its fellow Swiss operators, Salt and Sunrise, which are Global High Performers.

Out of the 10 Global Leaders, eight are European operators, while the remaining two are South Korean. In addition, 60% of our Global High Performers are European operators, with the remainder coming from the Asia Pacific region, along with Middle East. The latter region is represented by Kuwait's Ooredoo and Zain, as well as Ooredoo Qatar. Global High Performers' Upload Speed Experience scores were at least 4.7 Mbps faster than the global operator average of 8.8 Mbps.

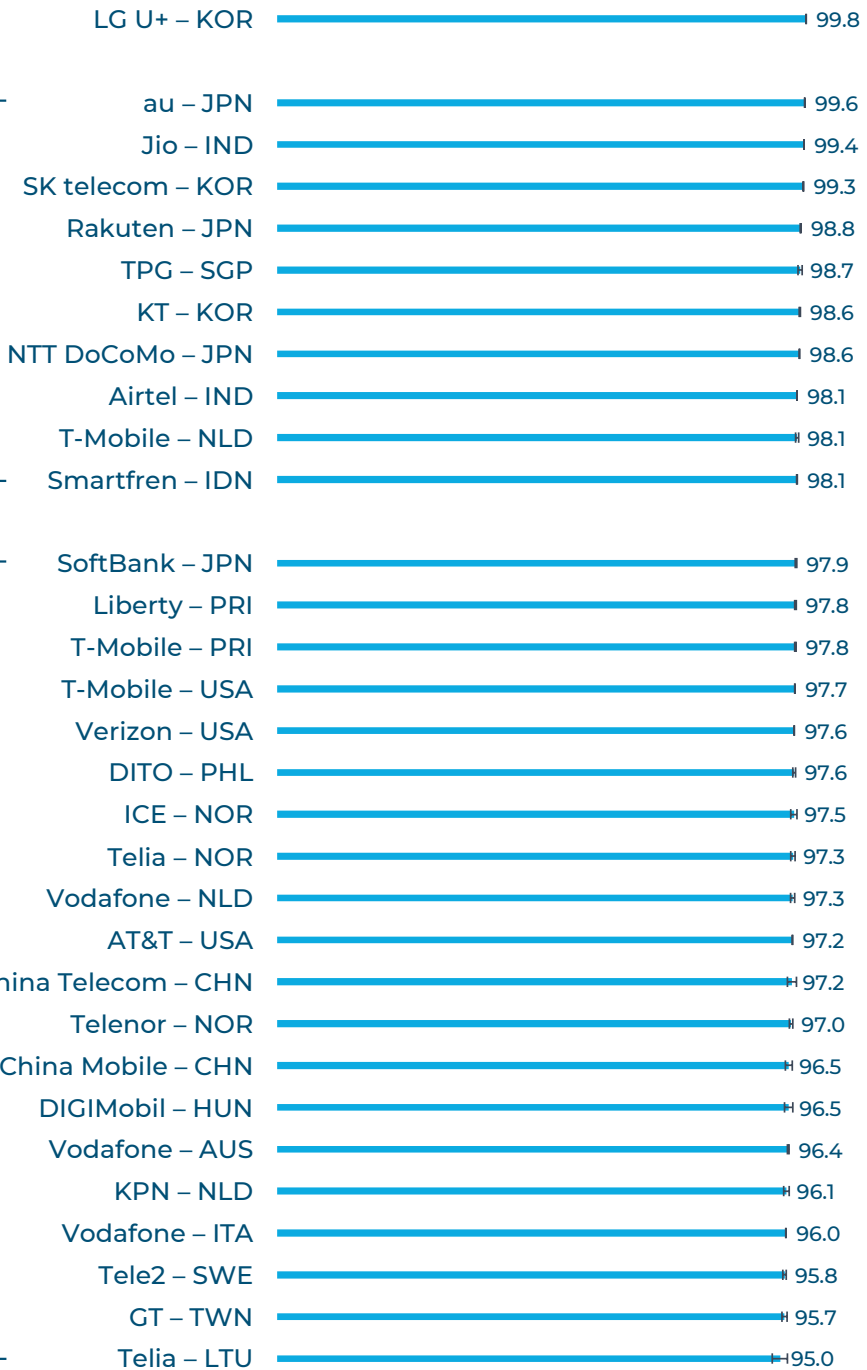
Operators in the Netherlands place in exactly the same categories for Upload Speed Experience – Global Leaders (KPN and T-Mobile) or Global High Performers (Vodafone) – as they did for Download Speed Experience and Voice App Experience.

Turning to Japan, Rakuten is a Global High Performer with a score of 14.8 Mbps and is the only Japanese operator to place in any award category for Upload Speed Experience.

# 4G Availability — Global

## South Korea's LG U+ comes up top

### 4G Availability – Global



Average – Global (Only highest ranked operators listed on chart) 86.5

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4G Availability is the percentage of time that our users spend connected to 4G or better. While it's an older technology, 4G remains essential for users to connect to almost all current 5G services because of the use of 5G non-standalone access (NSA). NSA requires mobile users to be connected to 4G as well as 5G for them to benefit from 5G's enhanced capabilities.

South Korea's LG U+ is the outright Global Winner in this category with an almost perfect 4G Availability score of 99.8%. It is closely followed by Japan's au and India's 4G-only operator, Jio.

The 4G Availability Global Leaders include South Korea's other operators – SK telecom and KT as well as three out of four Japanese operators: au, NTT DoCoMo and Rakuten (SoftBank is a Global High Performer). Two of India's operators are Global Leaders: Airtel and Jio. The only Global Leader not to hail from the Asia Pacific region is T-Mobile Netherlands.

Out of our 20 Global High Performers, nine hail from Europe and six come from Asia Pacific with those from the Americas making up the remainder. The latter include all three US operators – AT&T, T-Mobile and Verizon. The only Australian operator to receive global recognition for 4G Availability this time around is Vodafone – it places as a Global High Performer with a score of 96.4%. Similarly, out of Taiwan's five operators, only GT is a Global High Performer with a score of 95.7%.

Vodafone is the sole Italian Global High Performer for 4G with its score of 96%. This is the only award that an operator from Italy has received in this report across all categories (no Italian operators are Global Rising Stars).

The average global 4G Availability across all operators with a 4G network was 86.5% – which LG U+ exceeded by an impressive 13.3 percentage points. 40.5% of all operators analyzed had a 4G Availability score that was 90% or more, with 12% having a score that was 95% or higher. Our Global High Performers had scores that were at least 8.5 percentage points higher than the global operator average for 4G Availability.

# Opensignal's 2022 Global Rising Stars

We now take a look at our Global Rising Stars: the top 30 operators around the world on which our users have seen the greatest improvement in their mobile network experience in the last year. We compare their experience between the second half of 2020 and the same period in 2021.

We have Global Rising Stars awards for all six key measures of the real-world mobile network experience we have covered above. Five metrics featured in the last Opensignal Global Awards report – Video Experience, Voice App Experience, Download Speed Experience, Upload Speed Experience and 4G Availability – and we include Games Experience Global Rising Stars for the first time.

Global Rising Stars celebrate the recent achievements of those operators that have made rapid progress in improving the experience of their users in a short period of time. By contrast, Opensignal's Global Winner awards highlight the fruits of many years of cumulative effort and investment in comparing the current state of users' mobile experience on different operators.

Some operators have significantly improved the mobile experience of users across most of the metrics we've analyzed. In fact, Claro El Salvador is a Global Rising Star in all six categories, while five operators are Global Rising Stars in five measures of the mobile experience: Globe in the Philippines, Smartfren in Indonesia and Iraq's Asiacell and Zain – driven by their recent ongoing 4G rollouts – and India's Jio.

Looking across India, out of Jio's rivals, only Vi and BSNL have picked up Global Rising Stars – Vi for 4G Availability and BSNL for Voice App Experience.

A further six operators collected four Global Rising Star awards apiece, including the Philippines' Smart, Bahrain's Zain, Libya's Libyana, and Iraq's Korek.

Vodafone Germany picked up three Global Rising Star accolades – for Download Speed Experience, Upload Speed Experience and 4G Availability, while local rival O2 is a Global Rising Star for 4G Availability.

Two Ukrainian operators have also made impressive progress – lifecell is a Global Rising Star in all three experiential categories – Video Experience, Games Experience and Voice App Experience, while Kyivstar is one in the first two of these categories.

In Saudi Arabia, Mobily has picked up the most accolades in this section – it is a Global Rising Star for both Games Experience and Voice App Experience. It is followed by STC, which is a Global Rising Star for Games Experience.

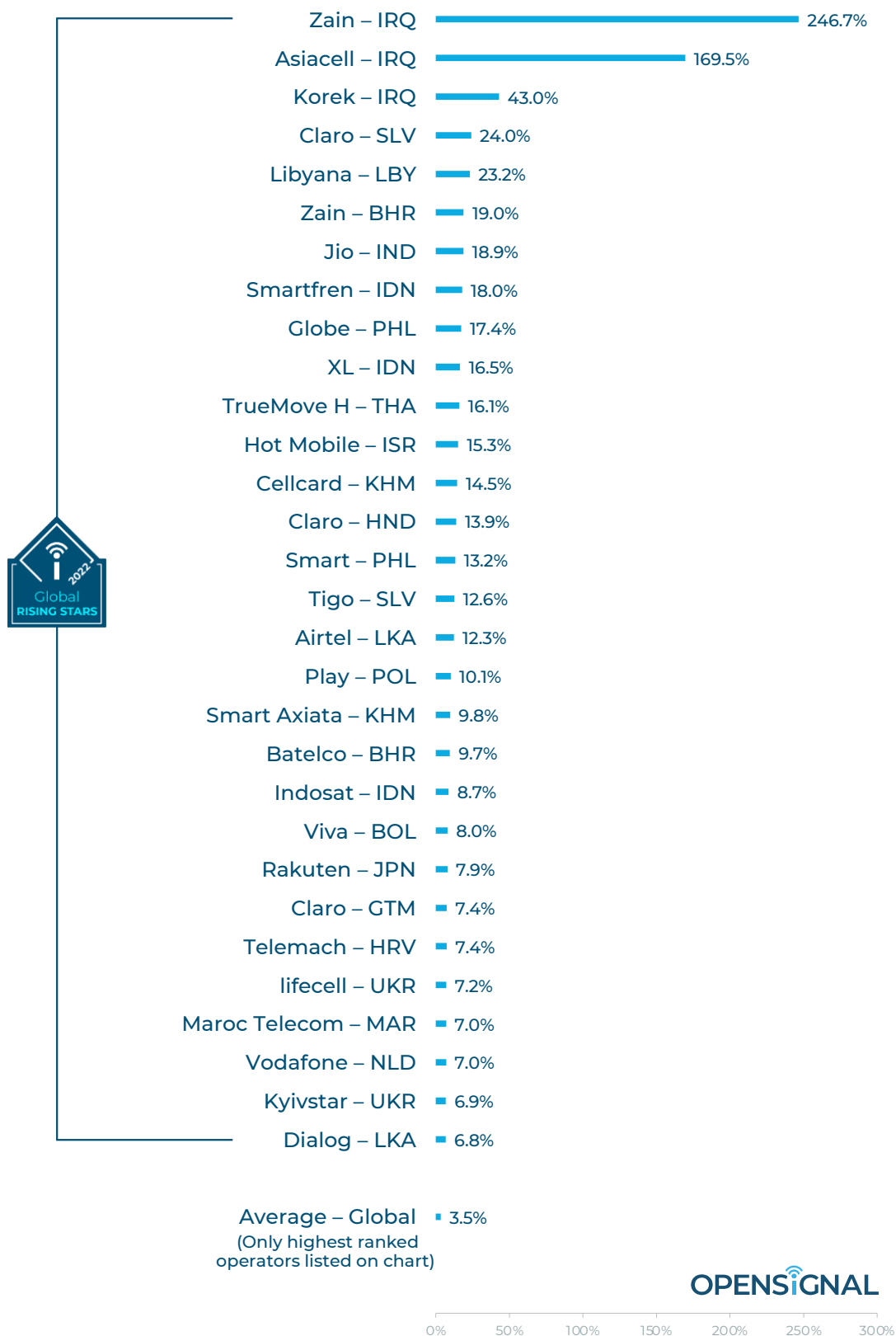
Over in Colombia, Tigo is the only operator to gain recognition at the global level in this report – it is a Global Rising Star for both Upload Speed Experience and 4G Availability.

Turning finally to Taiwan, GT is the only operator to pick up any Global Rising Star awards – the operator achieves this category for both Games Experience and Voice App Experience.

# Video Experience — Global Rising Stars

Zain Iraq's Video Experience score increased by 246.7%

## ▶ Video Experience – Most Improved



Data collection period 1 July – 27 December 2020 & 2021 | © Opensignal Limited

**OPENSIGNAL**  
Video Experience change

Our top three operators for the percentage change in global Video Experience scores between H2 2020 and H2 2021 all hail from Iraq: Zain (246.7%), Asiacell (169.5%) and Korek (43%). Zain and Korek have gone from placing in the Poor (under 40) category to Fair (40<55), while Asiacell has gone from Poor to Good (55<65).

In total, eight operators from Africa and the Middle East have been recognized as Global Rising Stars for Video Experience, including Libya's Libyana, Zain and Batelco in Bahrain, and Israel's Hot Mobile. Of the 12 Global Rising Stars in this category that hail from the Asia Pacific region, India's Jio saw the greatest improvement in its Video Experience score – 18.9%, closely followed by Indonesia's Smartfren with an improvement of 18% just ahead of its Indonesian rival XL on 16.5%. Two Filipino operators – Globe and Smart – also made the top 30, with increases of 17.4% and 13.2%, respectively.

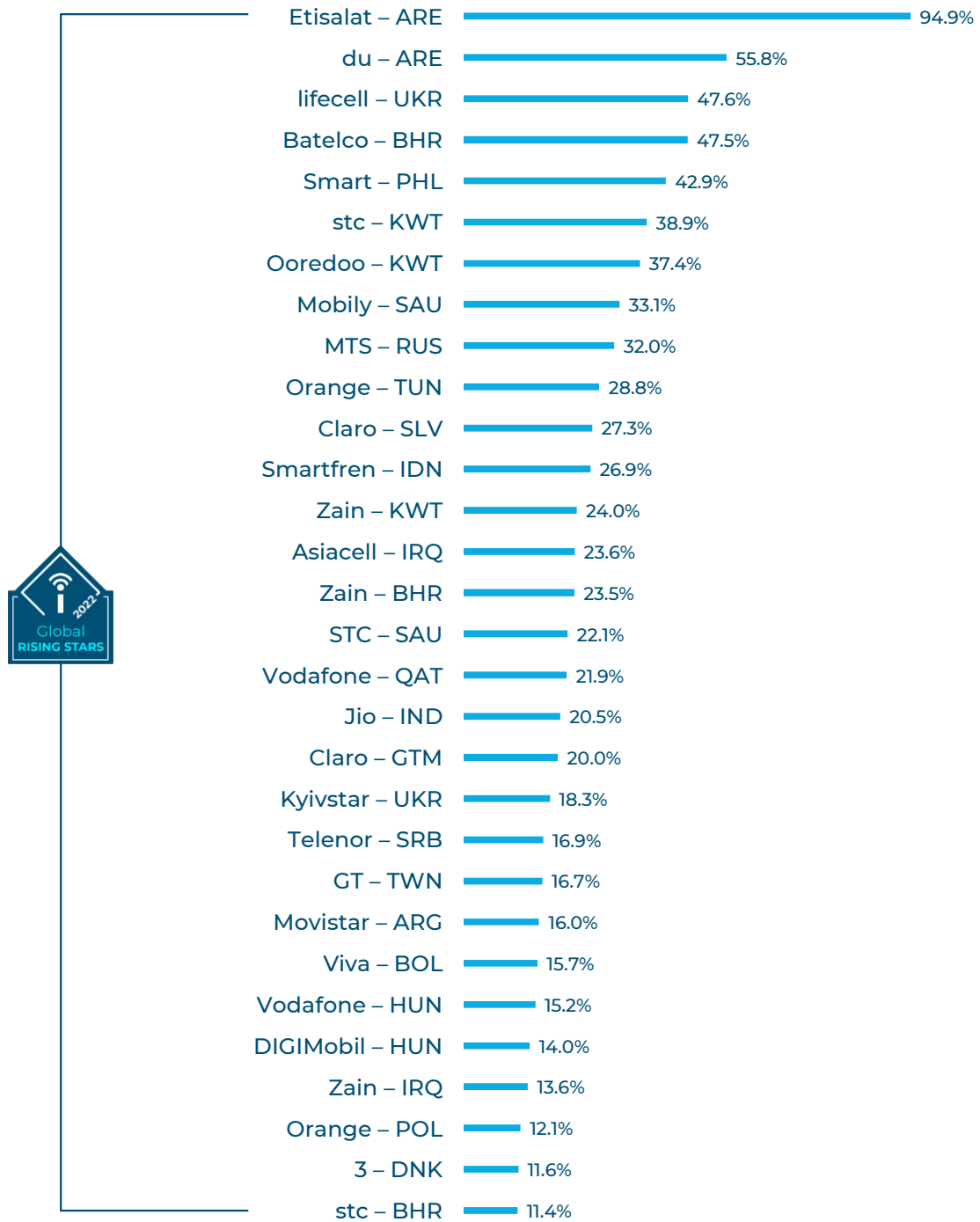
Both Europe and Latin America contributed five operators to the top 30 in this category. The European operator with the most impressive improvement in its Video Experience is Poland's Play – its score rose by 10.1% – while Latin America's best improver is Claro El Salvador with an increase of 24%.

All of the Global Rising Stars for Video Experience increased their scores by at least 3.3 percentage points over the global average of 3.5%. We have used a consistent methodology for both data collection periods to allow valid comparisons. However, due to market changes in how content delivery networks operate, care should be taken if aiming to compare these results with Opensignal data covering other time periods in previous reports.

# Games Experience — Global Rising Stars

## UAE's operators saw the largest percentage increases

### Games Experience – Most Improved



Average – Global  3.9%  
 (Only highest ranked operators listed on chart)

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0% 20% 40% 60% 80% 100%

Data collection period 1 July – 27 December 2020 & 2021 | © Opensignal Limited

Games Experience change

Our first look at how the global Games Experience has evolved between H2 2020 and H2 2021 shows that operators in North Africa and the Middle East have been working especially hard to improve the user experience when playing multiplayer mobile games over cellular connections. 14 out of 30 Global Rising Stars in Games Experience hail from this region including the operator with the greatest global improvement – Etisalat in the UAE with an incredible increase of 94.9%, immediately followed by its domestic rival du – with an improvement of 55.8%.

All three Kuwaiti operators are also Global Rising Stars for Games Experience, as are those from Bahrain and Saudi Arabia’s Mobily and STC. Qatar’s Vodafone also placed in this category – the only occasion in this report that a Qatari operator has been recognized as a Global Rising Star across all the metrics we’ve analyzed.

Turning to the next best represented region – Europe – our users on Eastern European operators have seen some of the largest improvements in their Games Experience. The European operator with the greatest percentage increase in its Games Experience score is Ukraine’s lifecell (47.6%), followed by Russia’s MTS (32%), lifecell’s domestic rival Kyivstar (18.3%) and Telenor Serbia (16.9%).

Both Latin America and the Asia Pacific region have contributed four operators apiece to our top 30 for this category. The operator with the greatest improvement in Asia Pacific is Smart in the Philippines with an increase of 42.9%, followed by Smartfren in Indonesia (26.9%), India’s Jio (20.5%) and Taiwan’s GT (16.7%).

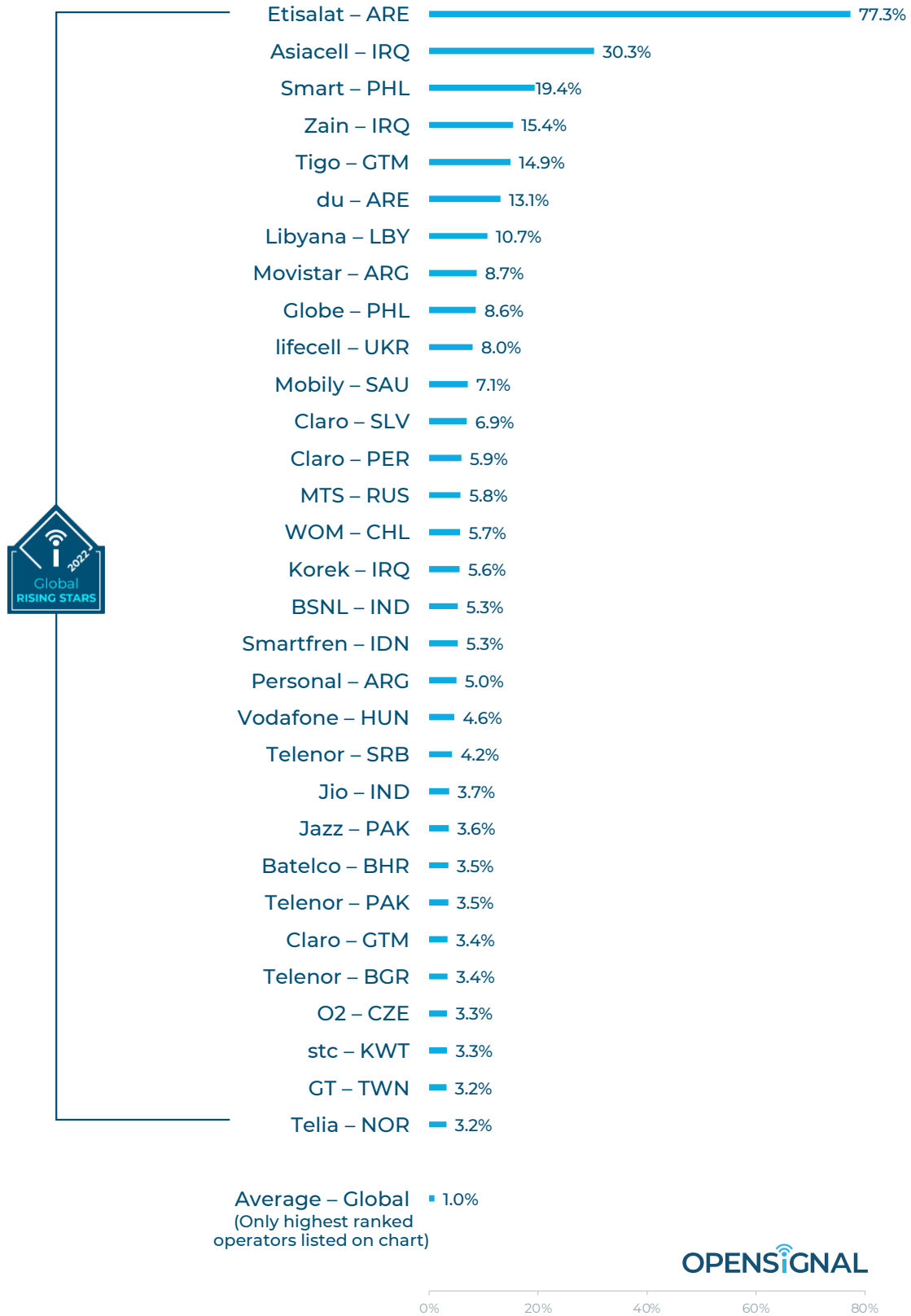
In Latin America, our users on Claro El Salvador’s network saw the greatest rise in Games Experience – 27.3%, followed by Claro Guatemala (20%).

All of our Global Rising Stars for Games Experience increased their scores by at least 7.5 percentage points over the global average of 3.9%.

# Voice App Experience — Global Rising Stars

Etisalat's Voice App Experience increased by over 75%

## Voice App Experience – Most Improved



Data collection period 1 July – 27 December 2020 & 2021 | © Opensignal Limited Voice App Experience change

Etisalat in the UAE has made great progress in Voice App Experience, as its score rose by 77.3% between H2 2020 and H2 2021, jumping from Impossible to Communicate (under 45) to Acceptable (74<80). Opensignal users on fellow UAE operator du also saw a smaller – but still impressive – uplift in their Voice App Experience of 13.1%.

Iraqi operators also saw significant improvements in their Voice App Experience, with Asiacell and Zain seeing the second and fourth highest improvements, respectively. The Philippines' Smart is in third position, with a rise of 19.4%, ahead of its domestic rival Globe, which is also a Global Rising Star in this category with a still respectable increase of 8.6%. This means that Smart saw the largest increase out of all the operators we analyzed across Asia Pacific.

In contrast to some of the other Global Rising Stars categories, those for Voice App Experience were fairly evenly distributed between all regions with the exception of North America, as no operators from that region appear on the list.

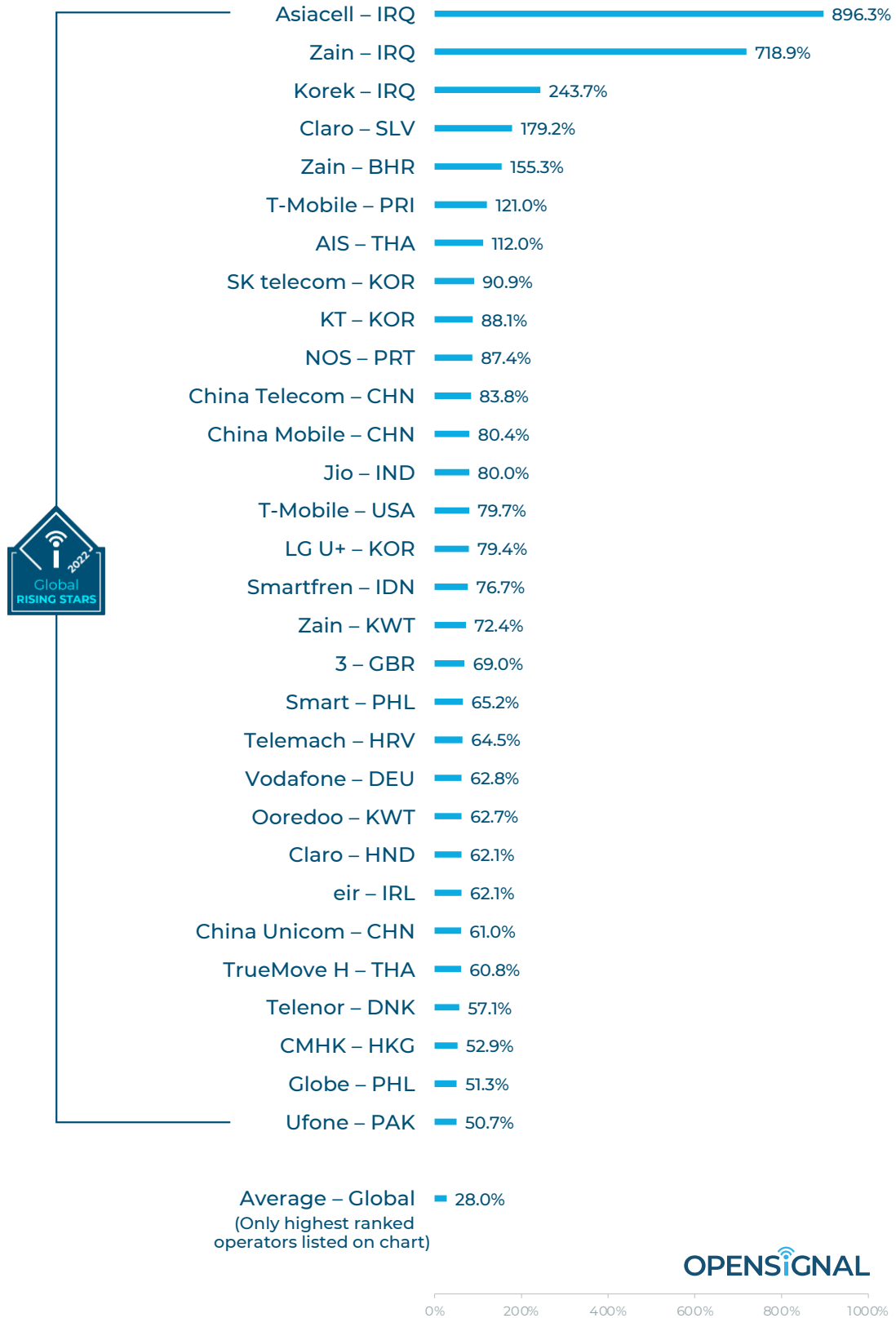
All 31 operators increased their scores by at least 2.2 percentage points more than the global average of 1% compared with a year earlier.

Guatemala's Tigo saw the greatest rise in Voice App Experience in Latin America (14.9%), followed by Movistar in Argentina (8.7%). Over in Europe, it was lifecell in the Ukraine with the largest improvement in percentage terms – 8%.

# Download Speed Experience – Rising Stars

Asiacell's download speeds became 10 times faster

## Download Speed Experience – Most Improved



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Data collection period 1 July – 27 December 2020 & 2021 | © Opensignal Limited

Our users in Iraq have seen spectacular improvements in their average download speeds and as a result, all three Iraqi operators – Asiacell, Zain and Korek – are at the top of the table for percentage changes in Download Speed Experience between H2 2020 and H2 2021, with increases of 3.4-10 times (243.7-896.3%). These improvements are driven by the recent launch of their 4G networks.

All of our Global Rising Stars for Download Speed Experience increased their scores by at least 22.7 percentage points more than the global average of 28%.

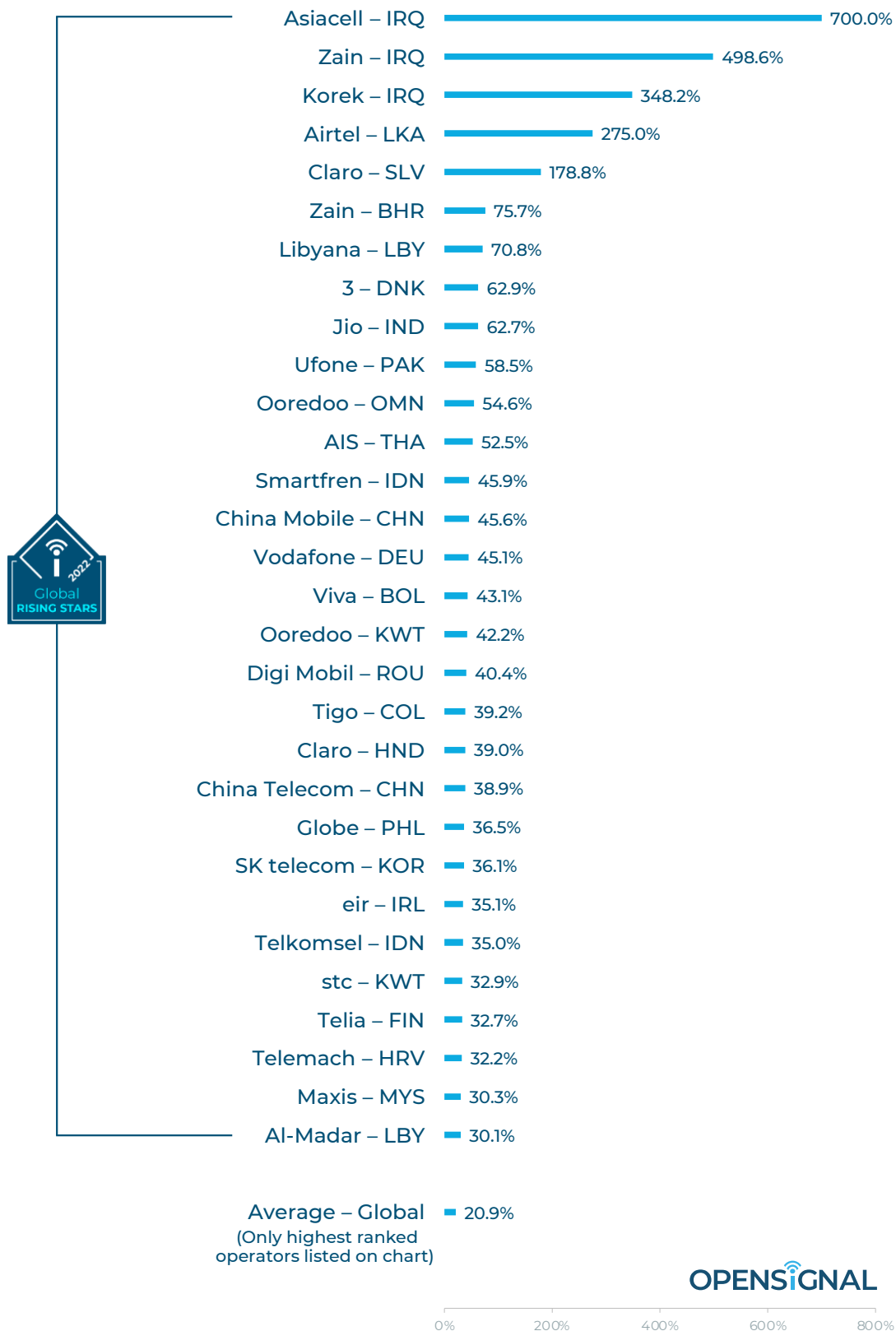
14 out of the 30 Global Rising Stars for this category hail from the Asia Pacific region, with six coming from both Europe and the Middle East. Our users on AIS's network in Thailand saw the greatest percentage improvement in average download speeds out of our users in the Asia Pacific region – 112% and two of the Philippines' operators – Smart and Globe – are in the global top 30 with increases of 65.2% and 51.3%, respectively.

T-Mobile USA is the only North American operator to make it into the top 30 for Download Speed Experience, while the only operators to have done so from the U.K and Germany are 3 and Vodafone, respectively. Claro El Salvador has the greatest increase out of our three Latin American Global Rising Stars – 179.2% – with the others being T-Mobile in Puerto Rico (121%) and Claro Honduras (62.1%).

# Upload Speed Experience — Rising Stars

## Iraqi operators saw the largest percentage increases

### ↑ Upload Speed Experience – Most Improved



Data collection period 1 July – 27 December 2020 & 2021 | © Opensignal Limited

Upload Speed Experience change

As with Download Speed Experience, all three Iraqi operators – Asiacell, Korek and Zain – top the chart for percentage improvement in Upload Speed Experience between H2 2020 and H2 2021. Our Iraqi users saw improvements in their average upload speeds of 4.5-8 times (348.2%-700%), depending on their choice of operator. Two other operators have achieved improvements in excess of 100% – Sri Lanka’s Airtel (275%) and El Salvador’s Claro (178.8%).

All of the Global Rising Stars for Upload Speed Experience increased their scores compared with the previous year by at least 9.2 percentage points more than the global average of 20.9%.

Asian Global Rising Stars for Upload Speed Experience include SK telecom in South Korea, Globe in the Philippines, together with Smartfren and Telekomsel in Indonesia.

In addition to all three Iraqi operators, Global Rising Stars coming from North Africa and the Middle East include Bahrain’s Zain, Libya’s Libyana and Al-Madar, Ooredoo in Oman, as well as two Kuwaiti operators: Ooredoo and stc.

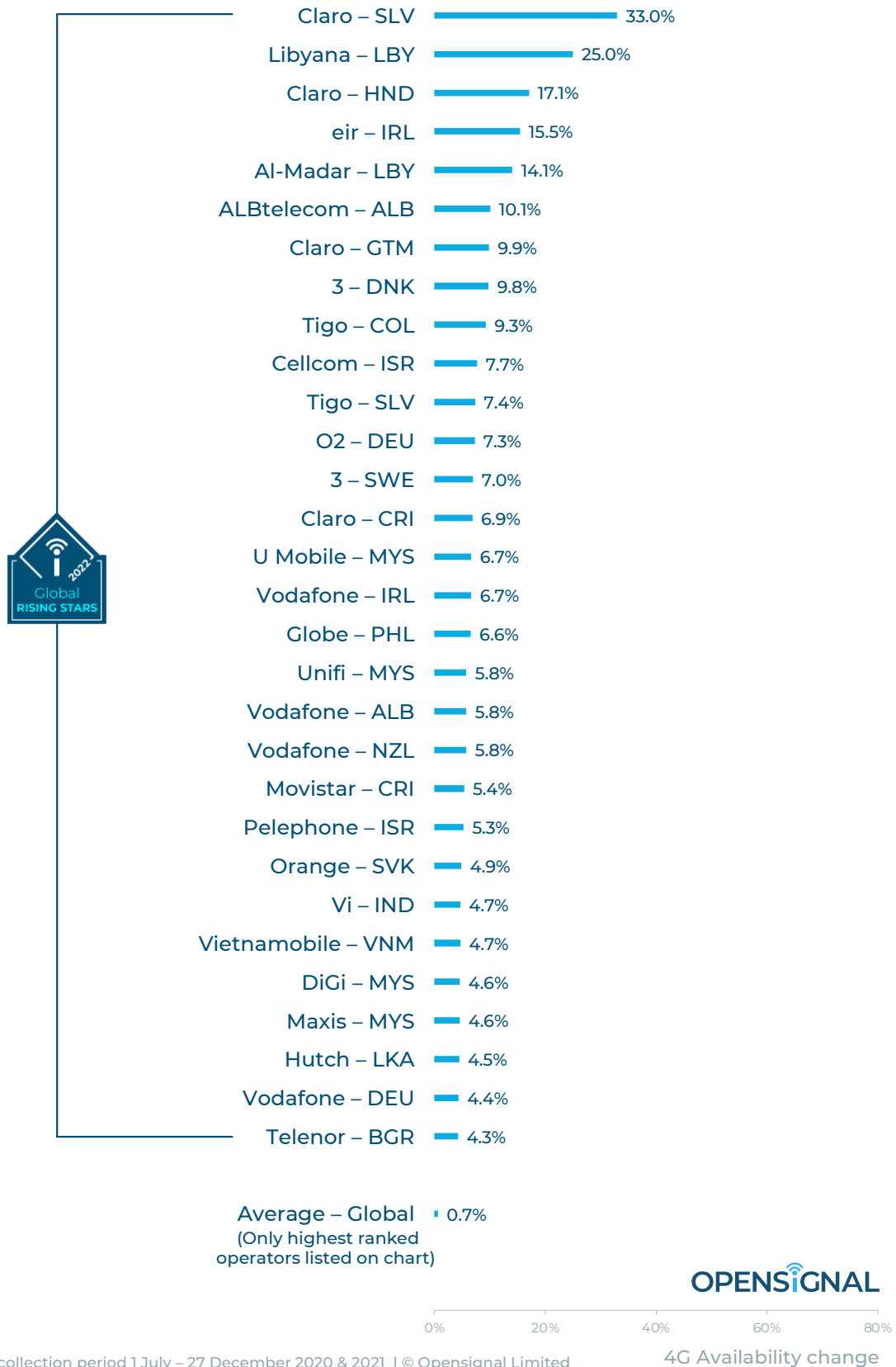
In Europe, our users on Denmark’s 3 – the Global Winner for Upload Speed Experience – saw the greatest increase in their average upload speeds: 62.9%. The European operator with the second largest improvement was Vodafone Germany with 45.1%.

Latin America’s four Global Rising Stars – including Claro El Salvador – achieved improvements of more than 30% – the others being Bolivia’s Viva, Tigo Colombia and Claro Honduras.

# 4G Availability — Global Rising Stars

Claro El Salvador users spent a third more time on 4G

## 4G Availability – Most Improved



Our users on Claro El Salvador's network saw the largest average increase in the percentage of time that they spent connected to 4G or better – 4G Availability – between H2 2020 and H2 2021: an impressive 33%. Only five other of the Global Rising stars in this category reported increases above 10%: Libya's Al-Madar and Libyana, Claro Honduras, Ireland's eir and ALBtelecom from Albania.

While the improvements in 4G Availability are smaller in percentage terms than the largest ones in other categories, achieving such increases at a time when the world is still experiencing disruption due to the COVID-19 pandemic is still an extremely impressive achievement. Increasing 4G Availability aids many other aspects of the mobile experience, as users typically see faster speeds and lower latency on 4G and 5G than when connected to legacy technologies such as 2G and 3G.

Out of the top 30 operators for percentage improvement in 4G Availability, 10 are European – out of which our users on Irish eir reported the largest increase, of 15.5%. The next best represented region is Asia Pacific, with nine operators of which Malaysia's U Mobile had the greatest percentage increase (6.7%), closely followed by the Philippines' Globe (6.6%). Four out of five of Malaysia's national operators – U Mobile, Unifi, DiGi and Maxis – are Global Rising Stars for 4G Availability, while the only operator hailing from New Zealand to receive the same recognition is Vodafone, with an increase of 5.8%

Out of the seven operators hailing from Latin America that are Global Rising Stars for 4G Availability, Claro El Salvador had by far the largest increase in 4G Availability in the region. The two operators with the second and third largest improvements in the region are part of the same operator group – Claro Honduras and Claro Guatemala with increases of 17.1% and 9.9%, respectively. Claro Costa Rica is also a Global Rising Star for 4G Availability, placing behind El Salvador's Tigo. In Colombia, Tigo is the only operator to be recognized as a Global Rising Star and the operator saw the fourth largest improvement in 4G Availability in the region – 9.3%.

All of the Global Rising Stars for 4G Availability increased their scores compared with the previous year by at least 3.6 percentage points more than the global average of 0.7%.

# 5G is a marathon, not a sprint

This report's findings highlight that we are some way into the 5G era. For example, for the first time, we have recognized a Global Winner for Download Speed Experience with a score in excess of 100 Mbps – SK telecom with its score of 143 Mbps, while its fellow South Korean operators' scores were around 100 Mbps. While South Korean operators have performed incredibly strongly this time around – in Games Experience and Voice App Experience as well as in both measures of speed – their success owes a great deal to high levels of 5G adoption. With 5G handsets effectively being the default option for mobile users upgrading to a premium or high-mid tier smartphone model, eventually many other markets will catch up in this regard.

Much of 5G's promise is still to come, given that the majority of users experiencing 5G at the moment are doing so via the initial versions of 5G, such as non-standalone access (NSA) technology which continues to use older 4G to support the 5G service. Once 5G standalone access (SA) – sometimes said to be 'true 5G' – becomes the basis of the 5G experience, users can expect to see further improvements. While these may include faster speeds they should also lead to a more responsive experience – with lower latencies – which will make playing multiplayer mobile games or using real-time communication apps better and smoother. 5G SA rollout is still at a relatively early stage in most markets but should shake up the mobile experience as we move further into the 2020s.

In addition, operators' access to new spectrum capacity to use for 5G varies widely internationally. As we move further into the 5G era, [remaining auctions](#) and 5G network deployments in mid-band spectrum will take place and operators that have been previously reliant on dynamic spectrum sharing (DSS) will see dedicated new 5G spectrum, which will power improvements in mobile experience for both their 5G services and users' overall mobile experience.

The success of this year's Opensignal Global Winners, Global Leaders, Global High Performers, as well as the 98 operators who placed in at least one category as a Global Rising Star, doesn't come from nowhere. It comes from the continuous and collective efforts of the mobile telecommunications industry which is key to [connecting everyone and everything to a better future](#).

# Operators analyzed

ALBtelecom – Albania	Rogers – Canada	Telia – Estonia	XL – Indonesia
One – Albania	Telus – Canada	DNA – Finland	Asiacell – Iraq
Vodafone – Albania	Claro – Chile	Elisa – Finland	Korek – Iraq
Claro – Argentina	Entel – Chile	Telia – Finland	Zain – Iraq
Movistar – Argentina	Movistar – Chile	Bouygues – France	3 – Ireland
Personal – Argentina	WOM – Chile	Free Mobile – France	eir – Ireland
Optus – Australia	China Mobile – China	Orange – France	Vodafone – Ireland
Telstra – Australia	China Telecom – China	SFR – France	Cellcom – Israel
Vodafone – Australia	China Unicom – China	O2 – Germany	Hot Mobile – Israel
3 – Austria	Claro – Colombia	Telekom – Germany	Partner – Israel
A1 – Austria	Movistar – Colombia	Vodafone – Germany	Pelephone – Israel
Magenta – Austria	Tigo – Colombia	Cosmote – Greece	Iliad – Italy
Batelco – Bahrain	WOM – Colombia	Vodafone – Greece	TIM – Italy
stc – Bahrain	Claro – Costa Rica	Wind – Greece	Vodafone – Italy
Zain – Bahrain	Kölbi – Costa Rica	Claro – Guatemala	WindTre – Italy
Banglalink – Bangladesh	Movistar – Costa Rica	Tigo – Guatemala	au – Japan
Grameenphone – Bangladesh	A1 – Croatia	Claro – Honduras	NTT DoCoMo – Japan
Robi – Bangladesh	HT – Croatia	Tigo – Honduras	Rakuten – Japan
Orange – Belgium	Telemach – Croatia	3 – Hong Kong (SAR China)	SoftBank – Japan
Proximus – Belgium	O2 – Czech Republic	CMHK – Hong Kong (SAR China)	Ooredoo – Kuwait
Telenet – Belgium	T-Mobile – Czech Republic	csl – Hong Kong (SAR China)	stc – Kuwait
Entel – Bolivia	Vodafone – Czech Republic	SmarTone – Hong Kong (SAR China)	Zain – Kuwait
Tigo – Bolivia	3 – Denmark	DIGIMobil – Hungary	Bite – Latvia
Viva – Bolivia	TDC – Denmark	Telekom – Hungary	LMT – Latvia
Claro – Brazil	Telenor – Denmark	Telenor – Hungary	Tele2 – Latvia
Oi – Brazil	Telia – Denmark	Vodafone – Hungary	Al-Madar – Libya
TIM – Brazil	Etisalat – Egypt	Airtel – India	Libyana – Libya
Vivo – Brazil	Orange – Egypt	BSNL – India	Bite – Lithuania
A1 – Bulgaria	Vodafone – Egypt	Jio – India	Tele2 – Lithuania
Telenor – Bulgaria	WE – Egypt	Vi – India	Telia – Lithuania
Vivacom – Bulgaria	Claro – El Salvador	3 – Indonesia	Celcom – Malaysia
Cellcard – Cambodia	Movistar – El Salvador	Indosat – Indonesia	DiGi – Malaysia
Metfone – Cambodia	Tigo – El Salvador	Smartfren – Indonesia	Maxis – Malaysia
Smart Axiata – Cambodia	Elisa – Estonia	Telkomsel – Indonesia	U Mobile – Malaysia
Bell – Canada	Tele2 – Estonia		Unifi – Malaysia
			AT&T – Mexico

Movistar – Mexico	MEO – Portugal	T-2 – Slovenia	DTAC – Thailand
Telcel – Mexico	NOS – Portugal	Telekom Slovenia – Slovenia	TrueMove H – Thailand
IAM – Morocco	Vodafone – Portugal	Telemach – Slovenia	Ooredoo – Tunisia
inwi – Morocco	Liberty – Puerto Rico	Cell C – South Africa	Orange – Tunisia
Orange – Morocco	T-Mobile – Puerto Rico	MTN – South Africa	Tunisie Telecom – Tunisia
KPN – Netherlands	Verizon – Puerto Rico	Telkom – South Africa	Türk Telekom – Turkey
T-Mobile – Netherlands	Ooredoo – Qatar	Vodacom – South Africa	Turkcell – Turkey
Vodafone – Netherlands	Vodafone – Qatar	KT – South Korea	Vodafone – Turkey
2degrees – New Zealand	Digi Mobil – Romania	LG U+ – South Korea	Kyivstar – Ukraine
Spark – New Zealand	Orange – Romania	SK telecom – South Korea	lifecell – Ukraine
Vodafone – New Zealand	Telekom – Romania	Movistar – Spain	Vodafone – Ukraine
ICE – Norway	Vodafone – Romania	Orange – Spain	du – UAE
Telenor – Norway	Beeline – Russian Federation	Vodafone – Spain	Etisalat – UAE
Telia – Norway	MegaFon – Russian Federation	Yoigo – Spain	3 – UK
Omantel – Oman	MTS – Russian Federation	Airtel – Sri Lanka	EE – UK
Ooredoo – Oman	Tele2 – Russian Federation	Dialog – Sri Lanka	O2 – UK
Jazz – Pakistan	Mobily – Saudi Arabia	Hutch – Sri Lanka	Vodafone – UK
Telenor – Pakistan	STC – Saudi Arabia	Mobitel – Sri Lanka	AT&T – USA
Ufone – Pakistan	Zain – Saudi Arabia	3 – Sweden	T-Mobile – USA
Zong – Pakistan	A1 – Serbia	Tele2 – Sweden	Verizon – USA
Bitel – Peru	mts – Serbia	Telenor – Sweden	Antel – Uruguay
Claro – Peru	Telenor – Serbia	Telia – Sweden	Claro – Uruguay
Entel – Peru	M1 – Singapore	Salt – Switzerland	Movistar – Uruguay
Movistar – Peru	Singtel – Singapore	Sunrise – Switzerland	MobiFone – Vietnam
DITO – Philippines	StarHub – Singapore	Swisscom – Switzerland	Vietnamobile – Vietnam
Globe – Philippines	TPG – Singapore	Chunghwa – Taiwan	Viettel Mobile – Vietnam
Smart – Philippines	4ka – Slovakia	FarEasTone – Taiwan	Vinaphone – Vietnam
Orange – Poland	O2 – Slovakia	GT – Taiwan	
Play – Poland	Orange – Slovakia	T Star – Taiwan	
Plus – Poland	Telekom – Slovakia	Taiwan Mobile – Taiwan	
T-Mobile – Poland	A1 – Slovenia	AIS – Thailand	

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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.

## Download Speed Experience

Measures the average download speed experienced by Opensignal users across an operator's 3G, 4G and 5G networks. It doesn't just factor in 3G, 4G and 5G speeds, but also the availability of each network technology. Operators with lower 5G or 4G Availability tend to have a lower Download Speed Experience because their customers spend more time connected to slower generation 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.

## 4G Availability

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