

2018 capacity utilization and 5G capacity potential of mobile operator existing macro cell site grids

When will EU28 & OECD operators run out of 4G capacity and how many more gigabytes per subscriber per month can they carry with 5G?

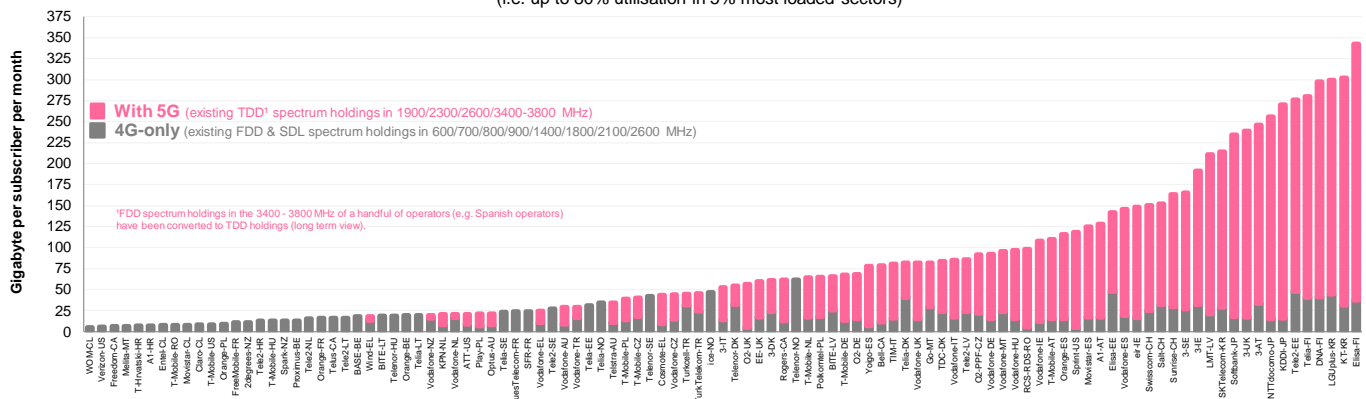
A Rewheel research PRO-study of 143 European, US, Canadian, Japanese, Korean and Australian operators 1st October 2019

Capacity ≈ macro sites X spectrum X spectrum efficiency

- Elisa Finland is currently the operator with the highest 5G capacity potential in the world¹ ~**342 GB/subscriber/month**.
- 3 UK (part of Hutchison) is the operator with the highest 5G capacity potential in the United Kingdom. 3 UK has very substantial 5G capacity potential of ~**240 GB/subscriber/month**. In August 2019 3 UK declared that '5G is in the house' and announced the launch of a 5G home broadband plan with truly unlimited data and fibre-like ultrafast speeds for £35 per month.
- Finnish, Korean, Japanese, Swiss and Hutchison 3 European operators have, currently, the highest 5G capacity potential.
- US operators had the highest 4G capacity utilization levels in 2018 (i.e. most congested macro site mobile networks).
- Play Poland was the European operator with the highest 4G capacity utilization in 2018, 63% up from 55% in 2017.
- Canadian and US operators (e.g. Telus, Verizon, T-Mobile) were among the operators with the least dense macro site grids.

4G and 5G capacity potential - When will mobile operators run out of capacity?

Subscriber monthly usage in gigabytes that can be carried by operator existing macro site grid capacity before saturation (i.e. up to 80% utilisation in 5% most loaded sectors)



Source: Operators, regulators, Rewheel intelligence & analysis. No data available for operators that do not appear in the chart. For operators that did not report their data volume but were present in countries where the total country volume was reported the operator data volumes were estimated based on the operator subscriber share (e.g. United States).

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- Finland was once again the country with the highest mobile data usage per capita. 30.2 gigabytes/person/month in 2018.
- Spectrum usage in 2018 in Canada, a de-facto network duopoly², was among the lowest in EU28 & OECD markets (14x lower than in Finland).
- Canadian mobile data prices are among the highest³ in EU28 & OECD and mobile data usage among the lowest – is mobile spectrum being efficiently used in Canada?

¹Among the 143 mobile operators present in the 41 EU28 & OECD countries

²http://research.rewheel.fi/downloads/Root_cause_weak_competition_Canada_wireless_market_PUBLIC.pdf

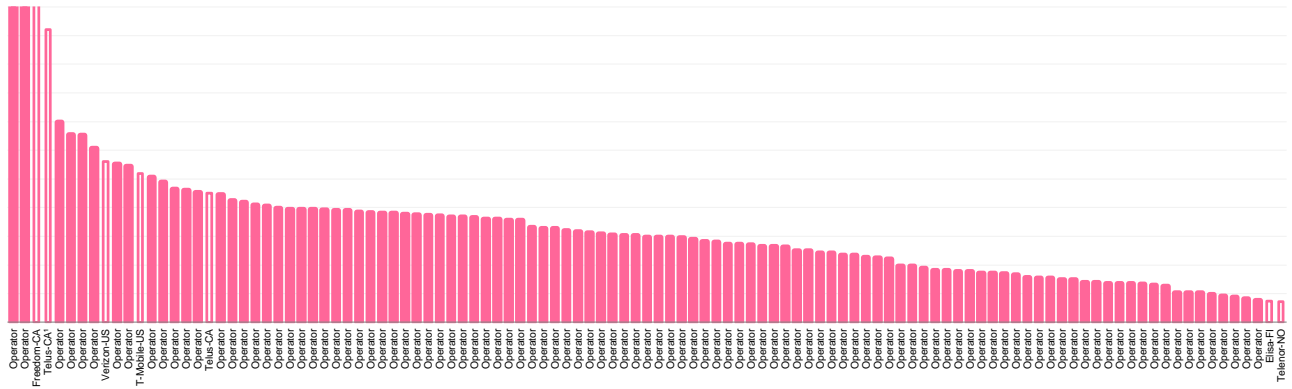
³http://research.rewheel.fi/downloads/The_state_of_4G_pricing_DFMonitor_11th_release_1H2019_PUBLIC.pdf

Operators Mobile network operator name - country code	Total spectrum 2xFDD+SDL+ TDD 600-3800 MHz	TDD spectrum 1900/2300/2600 /3400-3800 MHz	Population per macro cell site 2018	Monthly mobile data usage per subscriber Gigabytes 2018	4G capacity utilization existing macro site grids 2018 annual average, existing FDD & SDL (600/700/800/900/1400/1800/2100/2600) MHz spectrum holdings, existing macro site grid, downlink, 5% most loaded sectors	Capacity potential - Gigabytes per subscriber per month that will saturate the macro site grids Subscriber average monthly usage that can be carried by the operator existing macro site grid capacity before saturation (i.e. up to 80% utilisation in 5% most loaded macro site sectors)	
						4G case existing FDD & SDL (600/700/800/900/1400/1800/2100/2600) MHz spectrum holdings	5G case existing FDD & SDL & TDD* (1900/2300/2600/3400-3800) MHz spectrum holdings
Elisa-FI				17.7	38 %	37.4	342.1
KT-KR				6.6	17 %	31.4	302.1
LGUplus-KR				6.6	12 %	44.6	299.4
DNA-FI				21.0	41 %	41.2	297.4
Telia-FI				10.9	21 %	40.7	279.8
Tele2-EE				9.2	15 %	47.6	276.1
KDDI-JP				5.3	27 %	15.9	270.2
NTTdocomo-JP				5.3	28 %	15.0	255.4
3-AT				19.5	46 %	33.6	245.6
3-UK				5.3	25 %	17.0	238.9
Softbank-JP				5.3	24 %	18.0	234.3
SKTelecom-KR				5.1	14 %	28.8	213.9
LMT-LV				10.9	42 %	20.7	210.5
3-IE				6.5	16 %	31.9	191.5
3-SE				8.1	24 %	26.8	164.9
Sunrise-CH				6.4	17 %	29.4	163.4
Salt-CH				6.4	16 %	32.1	151.9
Swisscom-CH				4.5	14 %	25.2	149.9
eir-IE				6.5	32 %	16.3	148.1
Vodafone-ES				3.2	13 %	19.2	145.5
Elisa-EE				9.2	15 %	48.1	141.4
A1-AT				5.2	25 %	16.9	127.6
Movistar-ES				3.1	15 %	17.1	124.8
Sprint-US				7.0	119 %	4.7	117.9
Orange-ES				1.7	9 %	15.2	115.6
T-Mobile-AT				9.1	48 %	15.1	109.9
Vodafone-IE				6.5	44 %	11.9	107.8
RCS-RDS-RO				1.8	28 %	5.2	98.3
Vodafone-HU				1.8	10 %	15.1	96.5
Vodafone-MT				0.9	3 %	23.9	95.2
Vodafone-DE				1.8	9 %	15.0	91.8
O2-PPF-CZ				3.0	11 %	21.6	91.2
Tele2-LV				10.9	37 %	23.9	85.4
Vodafone-IT				3.2	15 %	16.9	84.7
TDC-DK				8.1	28 %	23.4	83.6
Go-MT				0.9	2 %	29.4	81.6
Vodafone-UK				2.3	12 %	15.3	81.6
Telia-DK				8.4	17 %	40.4	81.4
TIM-IT				2.7	13 %	16.0	80.2
Bell-CA				2.5	17 %	11.5	78.6
Yoigo-ES				1.3	15 %	6.6	78.0
O2-DE				1.2	7 %	15.1	68.1
T-Mobile-DE				1.5	9 %	13.2	67.4
BITE-LV				10.9	34 %	25.5	65.3
Polkomtel-PL				8.5	38 %	17.9	64.9
T-Mobile-NL				3.0	14 %	16.8	64.2
Telenor-NO				4.5	6 %	61.7	61.7
Rogers-CA				2.5	16 %	12.5	61.5
3-DK				9.9	33 %	23.8	61.0
EE-UK				2.4	11 %	16.8	59.7
O2-UK				2.1	34 %	4.9	56.4
Telenor-DK				5.7	14 %	31.9	54.2
3-IT				3.7	21 %	13.9	52.5
ice-NO				3.7	8 %	46.6	46.6
Turk Telekom-TR				3.3	11 %	24.5	44.9
Turkcell-TR				3.3	8 %	31.8	44.7
Vodafone-CZ				3.0	16 %	14.6	44.1
Cosmote-EL				0.7	6 %	9.2	43.1
Telenor-SE				8.6	16 %	42.1	42.1
T-Mobile-CZ				0.8	3 %	17.9	39.8
T-Mobile-PL				5.1	30 %	13.6	38.7
Telstra-AU				3.7	27 %	10.9	34.3
Telia-NO				4.5	10 %	34.2	34.2
Telia-EE				9.2	24 %	30.6	30.6
Vodafone-TR				3.8	18 %	16.7	29.2
Vodafone-AU				5.1	46 %	8.9	29.0
Tele2-SE				7.0	21 %	26.7	26.7
Vodafone-EL				0.9	7 %	10.7	24.1
SFR-FR				4.0	14 %	23.6	23.6
BouyguesTelecom-FR				6.6	22 %	23.4	23.4
Telia-SE				3.6	13 %	23.0	23.0
Optus-AU				3.7	38 %	7.9	20.9
Play-PL				5.4	63 %	6.9	20.9
ATT-US				7.0	64 %	8.8	20.6
Vodafone-NL				2.1	10 %	16.3	20.3
KPN-NL				2.0	21 %	7.7	20.1
Vodafone-NZ				2.0	10 %	15.6	19.4
Telia-LT				6.2	26 %	18.9	18.9
Orange-BE				1.5	7 %	18.8	18.8
Telenor-HU				1.8	8 %	18.5	18.5
BITE-LT				6.2	27 %	18.4	18.4
Wind-EL				0.7	4 %	13.3	17.9
BASE-BE				1.5	7 %	17.7	17.7
Tele2-LT				6.2	31 %	16.0	16.0
Telus-CA				2.5	13 %	15.7	15.7
Orange-FR				4.0	21 %	15.6	15.6
Tele2-NL				6.3	33 %	15.2	15.2
Proximus-BE				1.5	10 %	12.7	12.7
Spark-NZ				2.0	13 %	12.7	12.7
T-Mobile-HU				1.8	11 %	12.6	12.6
Tele2-HR				3.3	21 %	12.5	12.5
2degrees-NZ				2.0	15 %	10.9	10.9
FreeMobile-FR				5.5	41 %	10.7	10.7
Orange-PL				4.4	41 %	8.4	8.4
T-Mobile-US				7.0	67 %	8.3	8.3
Claro-CL				4.2	43 %	7.8	7.8
Movistar-CL				3.6	38 %	7.6	7.6
T-Mobile-RO				1.8	20 %	7.4	7.4
Entel-CL				4.2	47 %	7.1	7.1
A1-HR				3.3	38 %	6.9	6.9
T-Hrvatski-HR				3.3	39 %	6.8	6.8
Melita-MT				0.9	11 %	6.0	6.0
Freedom-CA				2.5	33 %	5.9	5.9
Verizon-US				7.0	100 %	5.6	5.6
WOM-CL				4.2	69 %	4.8	4.8

Operators Mobile network operator name - country code	Country population 2018	Subscribers 2018 total SIMs incl. wholesale but excl. m2m	FDD & SDL low frequency spectrum 600/700/800/900/1400 MHz	FDD & SDL high frequency spectrum 1800/2100/2600 MHz	TDD spectrum 1900/2300/2600/ 3400-3800 MHz	Total spectrum 2x(FDD+SDL)+TDD 600-3800 MHz	Number of macro cell sites 2018	Annual mobile data volume 2018 terabytes	Aggregate Downlink Busy Hour throughput 2018 year average Gbit/s	5G downlink sector capacity at max allowed utilisation up to 80% util. in 5% most loaded macro sectors Mbit/s
A1-AT	8 822 267									
T-Mobile-AT	8 822 267									
3-AT	8 822 267									
Telenor-AU	24 772 247									
Optus-AU	24 772 247									
Vodafone-AU	24 772 247									
TPG-AU	24 772 247									
Proximus-BE	11 413 058									
Orange-BE	11 413 058									
BASE-BE	11 413 058									
A1-BG	7 050 034									
Telenor-BG	7 050 034									
Vivacom-BG	7 050 034									
Bulsacom-BG	7 050 034									
Rogers-CA	36 953 765									
Bell-CA	36 953 765									
Telus-CA	36 953 765									
Freedom-CA	36 953 765									
Swisscom-CH	8 482 152									
Sunrise-CH	8 482 152									
Salt-CH	8 482 152									
Movistar-CL	18 197 209									
Entel-CL	18 197 209									
Claro-CL	18 197 209									
Wdcom-CL	18 197 209									
CYTA-CY	864 236									
MTN-CY	864 236									
Primetel-CY	864 236									
T-Mobile-CZ	10 610 055									
O2-PPF-CZ	10 610 055									
Vodafone-CZ	10 610 055									
T-Mobile-DE	82 850 000									
Vodafone-DE	82 850 000									
O2-DE	82 850 000									
1&1-Digital-DE	82 850 000									
TDC-DK	5 781 190									
Telenor-DK	5 781 190									
Telia-DK	5 781 190									
3-DK	5 781 190									
Telia-EE	1 319 133									
Elisa-EE	1 319 133									
Tele2-EE	1 319 133									
Cosmote-EL	10 738 868									
Vodafone-EL	10 738 868									
Wind-EL	10 738 868									
Movistar-ES	46 659 302									
Vodafone-ES	46 659 302									
Orange-ES	46 659 302									
Yoigo-ES	46 659 302									
Elisa-FI	5 513 130									
Telia-FI	5 513 130									
DNA-FI	5 513 130									
Orange-FR	67 221 943									
SFR-FR	67 221 943									
Bouygues Telecom-FR	67 221 943									
FreeMobile-FR	67 221 943									
T-Hrvatski-HR	4 105 493									
A1-HR	4 105 493									
Tele2-HR	4 105 493									
T-Mobile-HU	9 778 371									
Telenor-HU	9 778 371									
Vodafone-HU	9 778 371									
Vodafone-IE	4 838 259									
3-IE	4 838 259									
eir-IE	4 838 259									
Cellcom-IL	8 452 841									
Partner-IL	8 452 841									
Pelephone-IL	8 452 841									
Golan Telecom-IL	8 452 841									
HotMobile-IL	8 452 841									
Siminn-IS	348 450									
VodafoneIceland-IS	348 450									
Nova-IS	348 450									
TIM-IT	60 483 973									
Vodafone-IT	60 483 973									
3-IT	60 483 973									
Fast-IT	60 483 973									
NTT DoCoMo-JP	127 185 332									
KDDI-JP	127 185 332									
Softbank-JP	127 185 332									
Rakuten-JP	127 185 332									
SK Telecom-KR	51 164 135									
KT-KR	51 164 135									
LG Uplus-KR	51 164 135									
Tele2-LT	2 808 901									
Telia-LT	2 808 901									
BITE-LT	2 808 901									
POSTLuxemburg-LU	602 005									
Tango-LU	602 005									
Orange-LU	602 005									
LMT-LV	1 934 379									
Tele2-LV	1 934 379									
BITE-LV	1 934 379									
Vodafone-MT	475 701									
Go-MT	475 701									
Melita-MT	475 701									
Telcel-MX	130 759 074									
Movistar-MX	130 759 074									
ATT-MX	130 759 074									
KPN-NL	17 181 084									
Vodafone-NL	17 181 084									
T-Mobile-NL	17 181 084									
Tele2-NL	17 181 084									
Telenor-NO	5 295 619									
Telia-NO	5 295 619									
ice-NO	5 295 619									
Vodafone-NZ	4 749 598									
Spark-NZ	4 749 598									
2degrees-NZ	4 749 598									
Orange-PL	37 976 687									
T-Mobile-PL	37 976 687									
Pukcom.pl-PL	37 976 687									
Play-PL	37 976 687									
MEO-PT	10 291 027									
Vodafone-PT	10 291 027									
Nos-PT	10 291 027									
Orange-RO	19 523 621									
Vodafone-RO	19 523 621									
T-Mobile-RO	19 523 621									
RCS-RDS-RO	19 523 621									
Telia-SE	10 120 242									
Tele2-SE	10 120 242									
Telenor-SE	10 120 242									
3-SE	10 120 242									
Telekom Slovenije-SI	2 066 880									
A1-SI	2 066 880									
Telenor-SI	2 066 880									
T2-SI	2 066 880									
Orange-SK	5 443 120									
T-Mobile-SK	5 443 120									
O2-PPF-SK	5 443 120									
Swanmobile-SK	5 443 120									
Turkcell-TR	80 810 525									
Vodafone-TR	80 810 525									
Turk Telekom-TR	80 810 525									
EE-UK	66 238 007									
O2-UK	66 238 007									
Vodafone-UK	66 238 007									
3-UK	66 238 007									
Verizon-US	326 766 748									
ATT-US	326 766 748									
Sprint-US	326 766 748									
T-Mobile-US	326 766 748									

Population per macro site - 2018

Country population divided by the number of operator macro cell sites

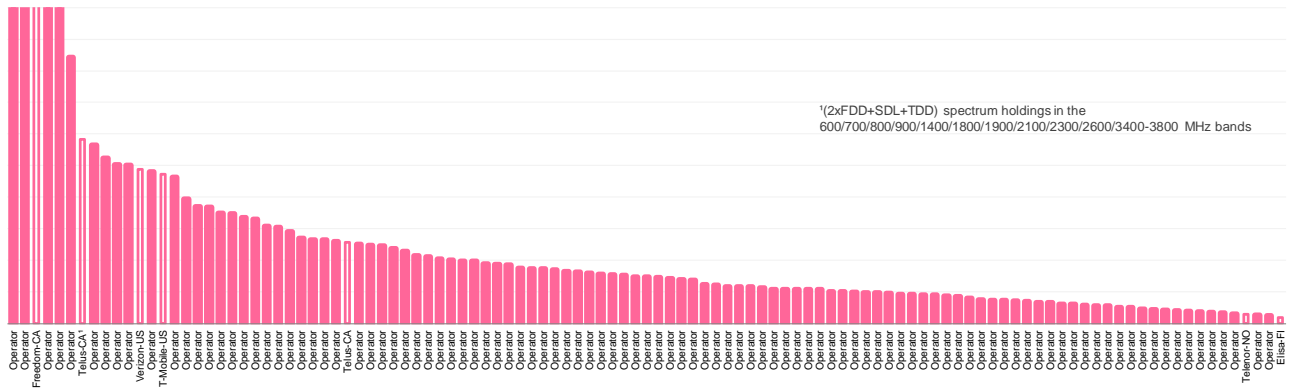


Source: Operators, regulators, Rewheel intelligence & analysis. No data available for operators that do not appear in the chart. *Telus Canada with own sites only i.e. excluding Bell's sites

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Population per MHz per macro site - 2018

Country population divided by spectrum holdings (2xFDD+SDL+TDD MHz)¹ and by macro cell sites

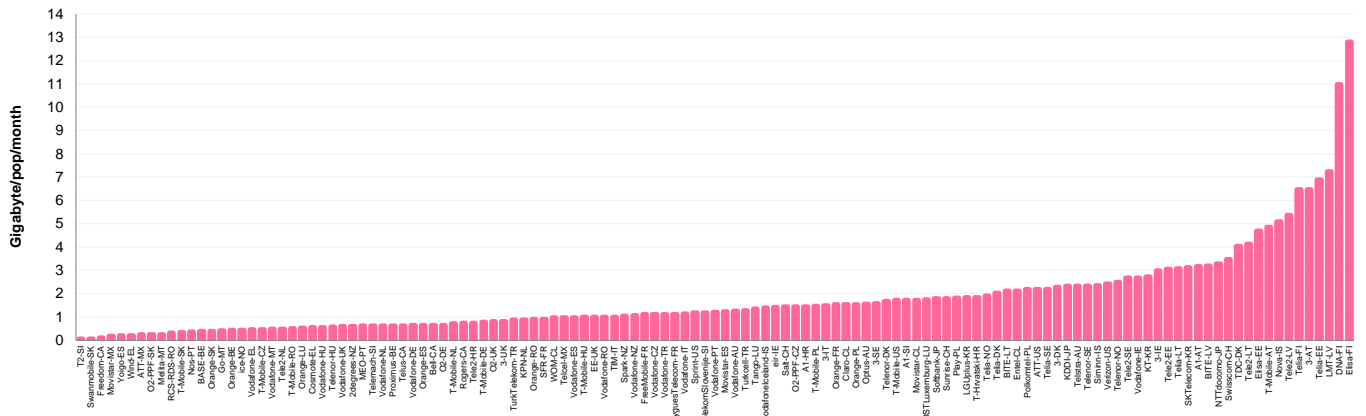


Source: Operators, regulators, Rewheel intelligence & analysis. No data available for operators that do not appear in the chart. *Telus Canada with own sites only i.e. excluding Bell's sites

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Mobile data usage per capita per month - 2018

Operator annual mobile data volume divided by country population and 12 months

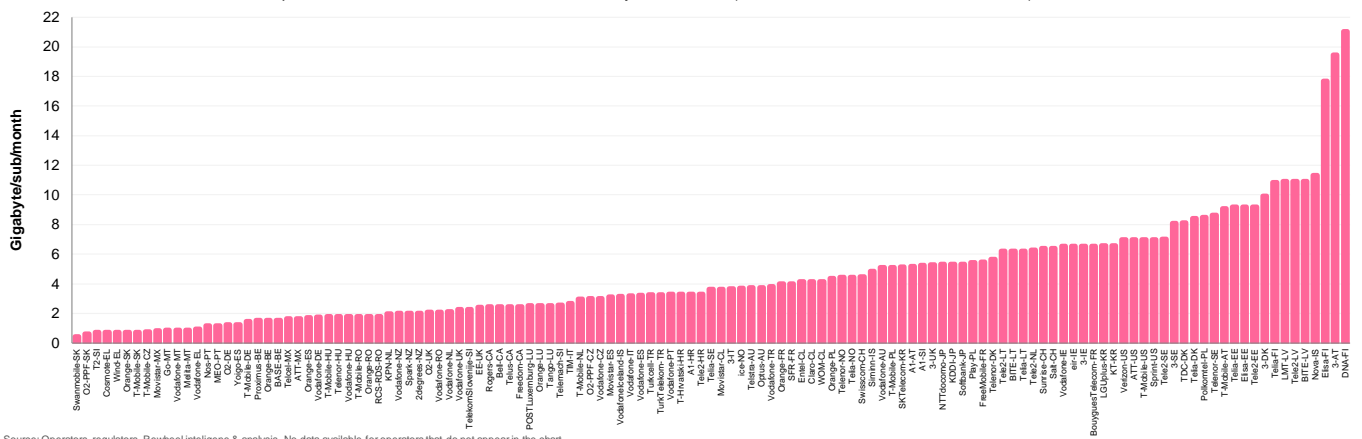


Source: Operators, regulators, Rewheel intelligence & analysis. No data available for operators that do not appear in the chart. For operators that did not report their data volume but were present in countries where the total country volume was reported the operator data volumes were estimated based on the operator subscriber share (e.g. United States).

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Mobile data usage per subscriber per month - 2018

Operator annual mobile data volume divided by subscribers (total SIMs, incl. wholesale, excl. m2m) and 12 months

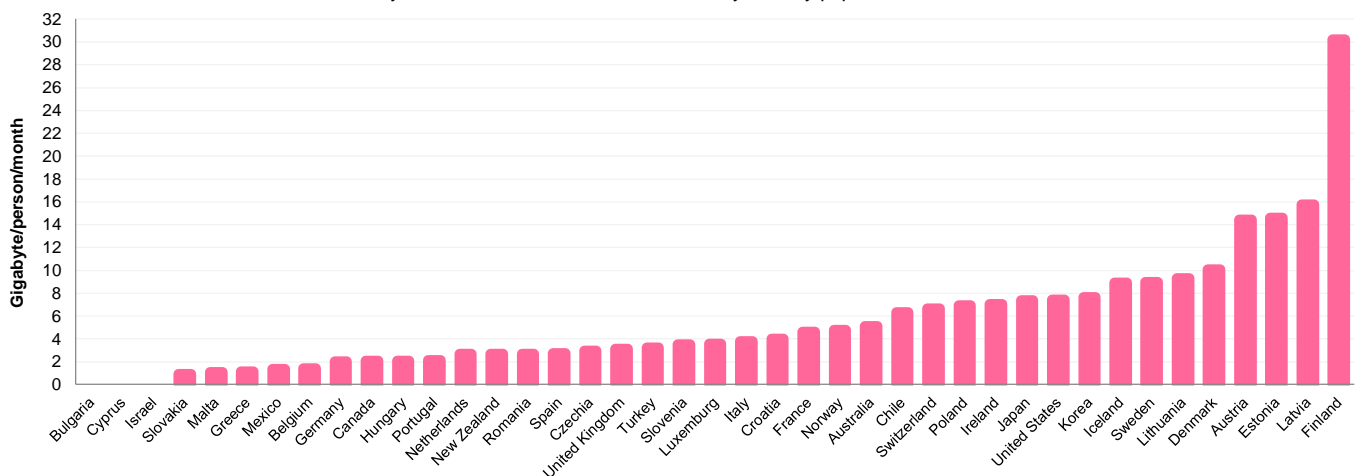


Source: Operators, regulators, Rewheel intelligence & analysis. No data available for operators that do not appear in the chart. For operators that did not report their data volume but were present in countries where the total country volume was reported the operator data volumes were estimated based on the operator subscriber share (e.g. United States).

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Mobile data usage per capita per month - 2018

Country annual mobile data volume divided by country population and 12 months



Source: Operators, regulators, Rewheel intelligence & analysis. No data available for countries with no values.

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Context

Mobile network performance and in particular average speeds measured by crowd sourced specialists such as OpenSignal, Ookla and Tutela or other mobile network analytics vendors such as Rootmetrics, P3 and Omnitele have received a fair amount of media coverage the last two years. Unsurprisingly, operators that achieve top rankings in such benchmarks rush to claim the crown of the 'best network' in a given country or even the title of the 'best network' in the entire world.

While such tests do offer some valuable insights into the current state of mobile network performance, they do have a number of significant limitations. For example, crowd sourced apps measure network performance under very dissimilar network loads, using different measurement protocols and probing methods that often distort the measurements. Crowd sourced benchmarks fail to account for plans where the user speed is intentionally limited by the network (e.g. Finnish speed tiered unlimited volume plans) or plans where speed has been throttled due to the depletion of the plan's finite volume.

More importantly though, these tests shed no light on two very important questions: how heavily utilized are mobile networks today and when – at what usage level – will operators run out from 4G or 5G capacity? Undeniably, the capacity potential of every mobile operator will largely dictate its mobile network performance in the wireless broadband era where average mobile data usage will be measured in hundreds of gigabytes rather than in few gigabytes per month.

The key objective of our third capacity utilization and capacity potential study is to shed light on these two very important questions.

Two and a half years ago we released a novel study⁴ titled '*Capacity utilization and fixed-to-mobile broadband substitution potential – A study of 64 European operators*'. This was our first comprehensive study that examined the state of capacity utilization and estimated the fixed-to-mobile broadband substitution potential of European mobile networks.

Therein we reported the estimated 2016 yearly average capacity utilization and the fixed-to-mobile broadband substitution potential (i.e. capacity potential) of 64 European mobile operators' spectrum holdings and macro site grids. Our main finding concerning the 2016 capacity utilization was that most European mobile operators utilized in 2016 a tiny fraction of their available network capacity and hence there were significant fixed-to-mobile broadband substitution gains that can be realized if operators unleashed the abundant capacity in their networks by offering unlimited data plans. In particular our study showed that many mobile operators could carry 100 gigabytes per person per month and will soon have enough 5G capacity (TDD/massive MIMO) for carrying 200 gigabytes per person per month or ~500 gigabytes per household.

A year ago, we released an update⁵ to our first capacity utilization study titled '*Capacity utilization and fixed-to-mobile broadband substitution potential with existing macro site grids – 2017*'. Therein, we presented the 2017 yearly average radio network capacity utilization estimates for 80 mobile operators: the 64 European operators we included in our first study and 16 more mobile operators from the United States, Japan, Korea, Australia and New Zealand. Similarly, to our first study we calculate the network capacity utilization and fixed-to-mobile broadband substitution potential of the existing operator macro cell site grids.

Our updated capacity utilization analysis showed that most mobile operators – save few exceptions such as Verizon US and Play Poland – utilized a fraction of their available macro site network capacity in 2017. Further to that we showed that many operators have very significant untapped 5G capacity potential.

In this study we present the **4G capacity utilization of 2018**, the **4G capacity potential** and the **5G capacity potential** of existing macro cell site grids for over 100 (out of 143) mobile operators that were present in the EU28 & OECD markets during 2018. Similarly, to our 2016 and 2017 capacity utilization calculations, our 2018 capacity utilization calculations do not include capacity from already built micro and/or small cells or from the future deployment of TDD 1900/2300/2600/3400-3800 MHz spectrum in small cells. See the dedicated sub section below concerning the role of small cells and their limitations.

⁴http://research.rewheel.fi/downloads/Capacity_utilization_fixed_mobile_broadband_substitution_potential_21032017_PUBLIC.pdf

⁵http://research.rewheel.fi/downloads/Capacity_utilization_fixed_mobile_broadband_substitution_potential_2017_PUBLIC.pdf

Herein, we estimate the **4G capacity utilization of 2018** of mobile operators in the 5% of their most loaded sectors by taking into account all of their existing FDD 600/700/800/900/1800/2100/2600 and SDL 700/1400 MHz spectrum holdings, the reported (or in some cases estimated) number of macro cell sites, the reported (or in some cases estimated) 2018 traffic data volume and by applying typical data traffic geo-distribution, busy hour and spectrum efficiency profiles (corresponding to typical 4x4 MIMO and 256QAM macro sector capacity).

Please note that the **4G capacity utilization of 2018** estimations presented herein are neither directly comparable with the capacity utilization figures of 2017 nor with those of 2016. In the 2017 capacity utilization estimation besides the FDD and SDL existing spectrum holdings we took into account the existing TDD 2500/2600 MHz spectrum holdings while in the 2016 capacity calculations we took into account only the existing FDD operator holdings. In the 2018 capacity utilization calculations we decided to exclude all existing TDD 1900/2300/2600/3400-3800 MHz spectrum holdings from the **4G capacity utilization of 2018** and instead included them in **5G capacity potential**.

Due to this reclassification, operators that hold substantial TDD 2500/2600 MHz spectrum holdings appear with much higher capacity utilization in 2018 compared to 2017. For example, by accounting for Sprint US's ~137 MHz of TDD 2500/2600 MHz spectrum holdings we estimated that Sprint's capacity utilization in 2017 was only 15%. In our 2018 estimate Sprint's capacity utilization jumped to 119% – indicating a congested network – because Sprint holds very little FDD spectrum.

However, Sprint has already deployed⁶ TDD 2500/2600 MHz spectrum using massive MIMO in a number of major metropolitan areas across the United States such as New York, Los Angeles, Phoenix, etc. Hence, Sprint's actual average capacity utilization in its 5% most loaded sectors in 2018 was most likely lower than our 119% estimation. When Sprint's substantial TDD 2500/2600 MHz spectrum holdings are taken into account in the **5G capacity potential** calculations Sprint's 5G advantage becomes apparent. Sprint is the US operator that currently has – by far – the highest **5G capacity potential**.

It is important to note that the **4G capacity utilization of 2018** estimations that we present herein assume that operators have deployed – where needed – all of their available FDD and SDL (Supplementary Downlink) spectrum holdings. So, it is the utilization of the readily available macro site grid capacity resources rather than the capacity utilization of the spectrum and equipment actually deployed by operators in their sites in 2018. For example, the 2018 actual capacity utilization of an operator in its top 5% most loaded sectors could be substantially higher than the figures we present herein simply because that given operator has not yet deployed all of its FDD and SDL spectrum holdings (e.g. 2600 FDD and 1400 SDL not yet deployed) and/or because it still uses most of its 900 and 1800 spectrum for GSM service.

Having estimated the **4G capacity utilization of 2018**, in the next step, we estimate the **4G capacity potential** and **5G capacity potential** for every operator. We express the operator 4G and 5G capacity potential in terms of the subscriber average monthly data usage (gigabytes per subscriber per month) that can be carried by the operator's existing macro site grid capacity before saturation i.e. up to 80% utilization in 5% most loaded macro site sectors. In the **4G capacity potential** calculations we use the operator FDD 600/700/800/900/1800/2100/2600 and SDL 700/1400 MHz spectrum holdings while in the **5G capacity potential** calculations we add the operator TDD 1900/2300/2600/3400-3800 MHz spectrum holdings into the mix by assuming that those will be deployed with massive MIMO.

Our latest findings re-confirm our field experience gained through our recent 700/1400/3400-3800 spectrum valuation and fixed-to-mobile broadband substitution business case consulting engagements: most mobile operators are currently utilizing only a fraction of their readily available **4G capacity potential**. So, expect more launches of unlimited mobile data.

⁶<https://newsroom.sprint.com/sprint-lights-up-true-mobile-5g-in-new-york-city.htm>

More importantly, mobile operators that have acquired hundreds of MHz of (sub 6 GHz) TDD spectrum and have dense macro cell site grids (e.g. Elisa Finland, KT Telecom Korea, 3 UK, etc.) have massive **5G capacity potential**. An average user of those operators could be generating – in few years from now – 200 gigabytes every month over the 5G network. An average household with a 5G wireless broadband connection could be generating more than 500 gigabytes per month watching 4K TV and playing games online.

Recent launches of 3 UK's "5G is in the house"⁷ and Sunrise Switzerland's "5G Internet + 4K TV"⁸ propositions are paving the way for a wirelessly connected world.



Latest Company News.

Three switches on 5G today: 5G is in the house

Latest Company News.

Three switches on 5G today: 5G is in the house

Sunrise

- One single 5G home broadband plan with truly unlimited data for £35 per month
- No landline, no fibre and no engineer required
- Three showcases 5G through 5G fuelled living room of the future alongside designer Henry Holland

Internet + TV
5G oder Glasfaser.

FIRST ON 5G

Jetzt im Sunrise Shop

⁷<http://www.threemediacentre.co.uk/news/2019/19-08-2019a.aspx>

⁸<https://www.sunrise.ch/en/corporate-communications/medien/press-releases.html>

Capacity from small cells is not included in our calculations

As of 2018, only a handful of US, Korean, Japanese and Canadian operators have deployed significant numbers of small cells. According to our intelligence, Sprint reported 21,000 small cells in 2018 while T-Mobile US reported 19,000 with a plan to build another 20,000 in 2019. Telus in Canada is another operator that has built⁹ several thousand small cells, primary covering sub-urban residential areas. Now while Korean and Japanese operators have been boosting their capacity potential by complementing their dense macro cell site networks with small cell rollouts, that is not the case for US and Canadian operators.

US and Canadian operators have very weak macro cell site networks (~7x less dense than Finnish mobile networks), hence their small cell rollouts are more like '*pothole road-repair*' than '*building new avenues*'. Small cells can '*super-charge*' the capacity potential of the macro cell site grid, but they cannot substitute the macro grid capacity, not if cost is a factor. Operators will need to deploy hundreds of thousands of small cells in small countries and millions of small cells in big countries to achieve similar level of service that is typical to a dense macro site grid.

Moreover, there are a number of contentious issues with the permits, deployment, safety, aesthetics, upgradability and cost of small cells both in downtown and urban residential environments.

- Permitting could become an increasingly contentious¹⁰ and expensive matter as more and more small cells are deployed
- Higher bandwidth will require proportionally higher emitted RF power exacerbating the already wide-spread health and safety concerns¹¹ from the proximity of small cells to people's houses
- Higher power will increase the physical size of the equipment and will require more supporting structures that might not be feasible to create in the existing poles that small cells are currently mounted
- Similarly, the physical size for massive MIMO antenna arrays and the required supporting structures could become a bottleneck
- Maintenance and field services can become a very costly affair due to the massive amount of site visits required for every upgrade
- Small cell aesthetics will be a factor that will determine acceptance by the local communities especially in western and Northern European cities
- Contingency: there are issues with the small cells power supply, consumption and battery backup (no place for batteries)
- Costs: small cells require many separate backhaul end points



The picture illustrates¹² a so-called small cell site in the US.

⁹http://research.rewheel.fi/downloads/Root_cause_weak_competition_Canada_wireless_market_PUBLIC.pdf

¹⁰<https://www.bizjournals.com/kansascity/news/2019/04/02/5g-small-cell-local-permitting-challenges.html>

¹¹<https://www.abc.net.au/news/2019-01-07/huawei-small-cell-network-comes-to-sydney/10688124?pfmredir=sm>

¹²<http://smallcellsinmontgomerycounty.blogspot.com/2018/10/montgomery-county-zta-18-11-will-allow.html>

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Get the full report

Please contact us at research@rewheel.fi or **+358 44 203 2339** if you wish to get access to the full 34-page report.

About Rewheel

*New radio spectrum bands, 4.5G and 5G technology, unlimited mobile data plans and the Internet of Things radically change mobile network operators' cost, revenue and profitability dynamics. **Rewheel's mission is to help operators prepare for the paradigm shift in network and spectrum strategy, spectrum valuation, network sharing, M&A, MVNO economics and mobile data pricing.***

Founded in 2009, Rewheel is a Finland based boutique management consultancy. Our clients are mainly European mobile network operators, telco groups, MVNO groups, sector regulators, competition authorities, governments, global internet firms, mobile data-centric start-ups, PE and VC investors.

We delivered management consultancy work for clients in the United Kingdom, United States, Ireland, Switzerland, Finland, Sweden, Belgium, Greece, Poland, Slovenia, Hungary, Russia, Romania.

The following authorities have acquired access to our research: The European Commission Directorate for Competition, the United States Department of Justice, the New York, California and many other US State Attorney General Offices, the national competition authorities of Canada, Australia and the Netherlands, the Ministry of Economic Affairs of the Netherlands, the Ministry of Industry and Trade of Czechia, the Korean Electronics and Telecommunication Research Institute, the sector regulators of the United Kingdom, Germany, the Netherlands, Finland, etc.

Rewheel's mobile data technology, network-economics, spectrum, profitability and competitiveness focused reports have been cited by OECD Economic Surveys, The Economist, The Financial Times, The New York Times, Reuters, Bloomberg, WSJ and publicly referenced by the UK telecoms regulator Ofcom, BIPT, Vodafone, Telefonica, Tele2, Elisa, DNA, GSMA, VPs of the EU Commission responsible for Competition, MEPs, IEEE, ITU.

Since 2010 we have been supporting a number of European challenger mobile operators in multiband (700, 700 SDL, 800, 900, 1400 SDL, 1800, 2600, 3.5 GHz) auctions with spectrum valuation and strategic advisory services.

Network economics metrics

For comprehensive data usage, spectrum usage and capacity utilisation metrics in EU28 and OECD markets visit

⇒ <http://research.rewheel.fi/networkeconomics/>

Recent Rewheel research PRO-reports

Root cause of weak competition in the Canadian wireless market

⇒ http://research.rewheel.fi/downloads/Root_cause_weak_competition_Canada_wireless_market_PUBLIC.pdf

4G era – Who got the most out of it?

⇒ http://research.rewheel.fi/insights/2019_may_pro_4G_who_got_most_of_it_revenue_growth/

The state of 4G pricing – 1H2019 – Digital Fuel Monitor 11th release

⇒ http://research.rewheel.fi/insights/2019_apr_pro_1h2019_release/

4G prices as a function market concentration, no. of MNOs, subscriber share, position, group affiliation and country general price level

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⇒ http://research.rewheel.fi/insights/2018_oct_pro_2h2018_release/

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