

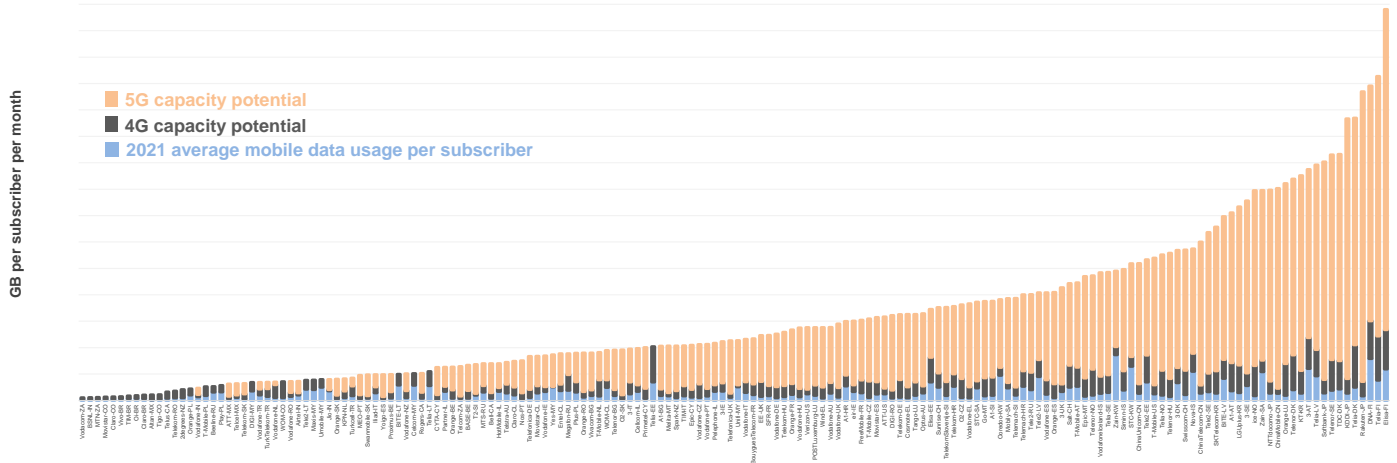
## Mobile data usage in 2021 and 4G & 5G operator capacity potential

When will mobile network operators run out of 4G capacity and how many more gigabytes per subscriber per month can they carry with 5G? A study of 170 mobile network operators from 50 European, American, Asian Pacific, Middle East and African countries.

Rewheel research PRO study – March 2022

### 2021 mobile data usage and 4G & 5G capacity potential

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



Source: Operators, regulators, Rewheel analysis.

Unique subscribers were calculated by multiplying the country population with the operator SIM share. Capacity calculation is based on the number of subscribers reported in 2021. Capacity calculation: operators deploy all of their FDD, SDL, TDD spectrum on the 5% most loaded sectors. Millimeter wave 24-39 GHz spectrum is not included in the calculations.

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### Mobile data usage per subscriber in 2021

- Zain Kuwait had the highest mobile data usage per subscriber in 2021 – 86 gigabytes per subscriber per month.

### 4G & 5G untapped capacity potential

- Elisa Finland has the highest 4G & 5G untapped capacity potential – as much as a terabyte per subscriber per month.

### Radio network site grid density

- Elisa Finland is the operator with most dense site grid – Elisa has 7x more sites per pop than Rogers Canada.

### Spectrum holdings

- TDC Denmark is the operator with the highest FDD, SDL and TDD 600 - 4000 MHz spectrum holdings – 505 MHz in total.
- Verizon US is the operator with the highest amount of mmWave spectrum holdings.

### Radio network utilization in 2021

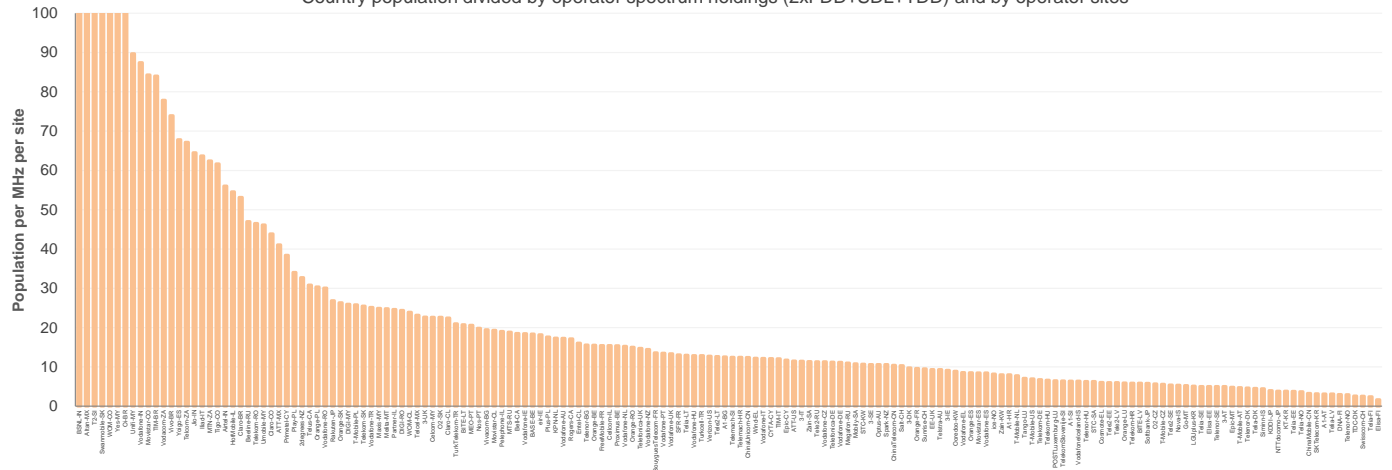
- Malaysian (e.g., Celcom), Lithuanian (e.g., Bite) and Polish (e.g., Play) operators had among the highest radio network capacity utilization in 2021 – Malaysian, Lithuanian and Polish operators had still not gained access to TDD spectrum in 2021.

### Mobile data and spectrum usage per capita in 2021

- Kuwait, followed by Finland, was the country with the highest mobile data (67 gigabytes per pop per month) and spectrum usage per capita in 2021 (1.3 gigabytes per MHz per pop per year).

### Population per MHz per site - 2021

Country population divided by operator spectrum holdings (2xFDD+SDL+TDD) and by operator sites

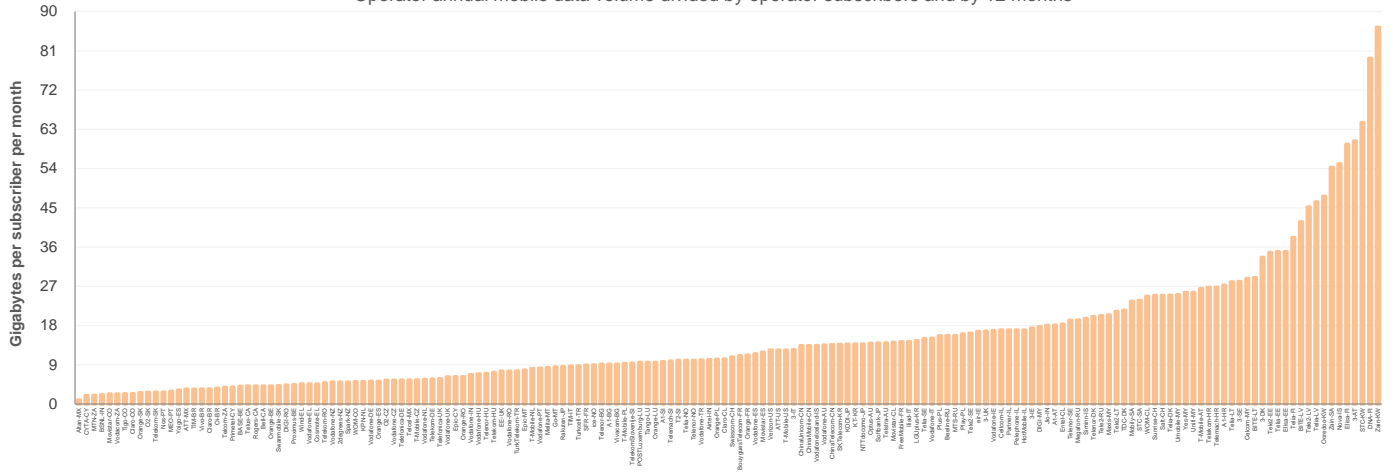


Source: Operators, regulators, Rewheel analysis.

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### Mobile data usage per subscriber - 2021

Operator annual mobile data volume divided by operator subscribers and by 12 months

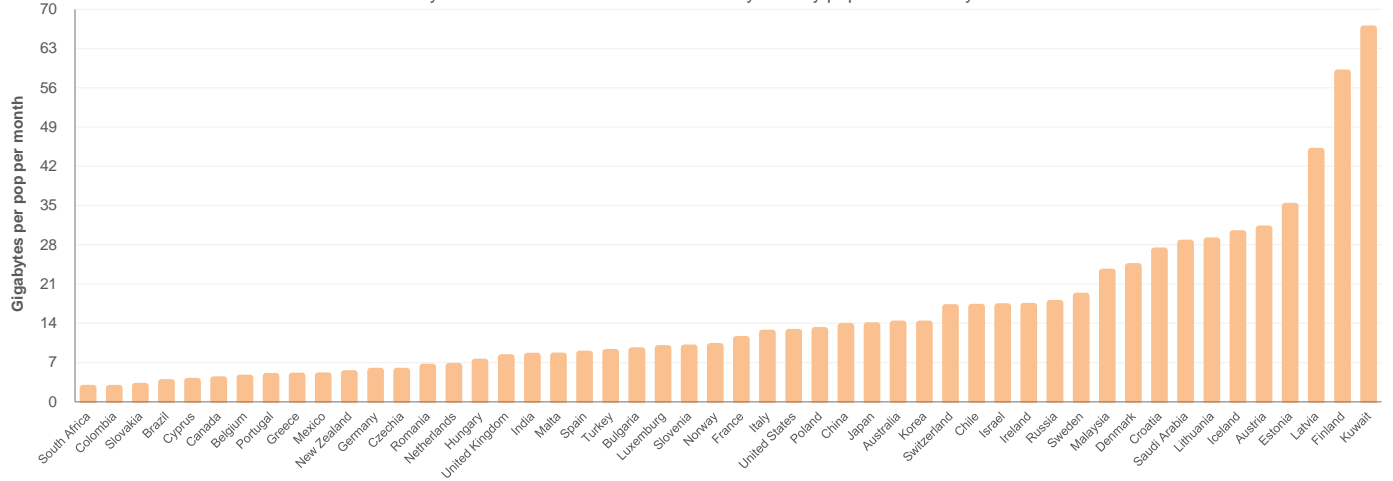


Source: Operators, regulators, Rewheel analysis. Unique subscribers were calculated by multiplying the country population with the operator SIM share.

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### Mobile data usage per capita - 2021

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

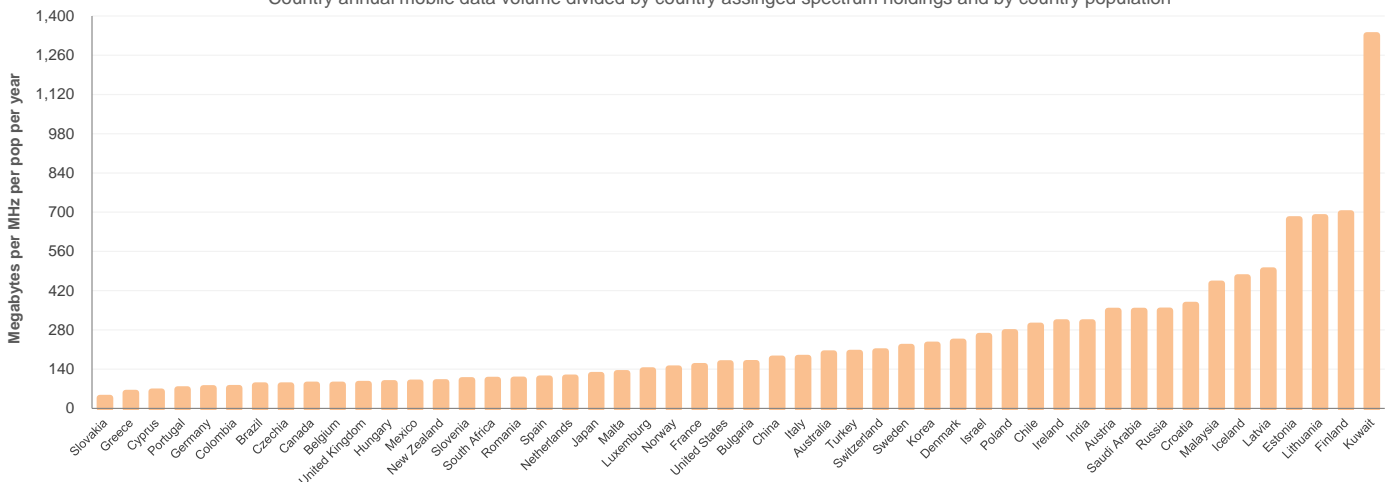


Source: Operators, regulators, Rewheel analysis.

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### Spectrum usage per capita - 2021

Country annual mobile data volume divided by country assigned spectrum holdings and by country population



Source: Operators, regulators, Rewheel analysis. Country assigned spectrum holdings (2xFDD+SDL+TDD). Millimeter wave 24-39 GHz spectrum is not included in the calculations.

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## 1 Study context and methodology

How many gigabytes per month were used in average over mobile networks in 2021? When will mobile network operators run out of 4G capacity and how many more gigabytes per subscriber per month can they carry with 5G? This is Rewheel's fifth study of mobile data usage, spectrum usage, capacity utilization and untapped capacity potential. The study includes usage and capacity figures for 170 mobile network operators that were present in 50 European, American, Asian Pacific, Middle East and African countries.

How heavily utilized were mobile networks in 2021 and when – at what usage level – will operators run out of 4G or 5G capacity? Are there significant differences in mobile data usage and capacity potential between mobile network operators? In the unlimited wireless broadband era where average mobile data usage is measured in hundreds of gigabytes rather than in few gigabytes per month the capacity potential of mobile network operators will undoubtedly dictate their mobile data pricing power and their mobile network performance.

Are there significant differences in mobile data and spectrum usage across the 50 countries? Is spectrum put into efficient use?

As with our fourth study that was released in March 2021 the key objective of this fifth release is to estimate how heavily utilized were mobile networks in 2021 and when – at what usage level – will operators run out of 4G and 5G capacity. In 2020 and 2021 many operators acquired 5G spectrum holdings in the 3400 - 4000 MHz TDD bands and as a result greatly enhanced their 5G capacity potential.

In the fourth study<sup>1</sup>, we estimated the 2019 4G capacity utilization of mobile operators in the 5% of their most loaded macro site sectors by taking into account all of their existing FDD and SDL spectrum holdings, the reported or estimated number of macro sites, the reported or estimated 2019 mobile 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).

In this fifth release, we estimate the 2021 mobile network capacity utilization of mobile operators in the 5% of their most loaded sectors by taking into account all of their existing FDD, SDL and TDD (excl. mmWave) spectrum holdings, the reported or estimated number of sites, the reported or estimated 2021 mobile data volume and by applying typical data traffic geo-distribution, busy hour and spectrum efficiency profiles (corresponding to typical 4x4 MIMO and 256QAM sector capacity).

Please note that the network utilization figures presented herein are the utilization of the operator readily available site grid capacity resources rather than the capacity utilization of the spectrum and equipment actually deployed by operators in their sites in 2021.

The 2021 mobile network capacity utilization figures presented herein, are not directly comparable with the capacity utilization figures of 2019. The 2019 capacity utilization figures only included the operator FDD and SDL holdings – we assumed that operators that held TDD spectrum and had launch 5G TDD service in 2019, a handful of operators, carried an insignificant amount of 5G TDD traffic – while the 2021 capacity utilization figures presented herein include FDD, SDL and as well TDD operator spectrum holdings.

In this fifth release we have logged for the first time in the database mmWave 24-39 GHz spectrum holdings. As of February 2022, 33 out of the 170 mobile network operators tracked herein held mmWave spectrum in the 24-39 GHz bands.

The capacity potential figures presented herein are calculated assuming operators will deploy – where needed – all of their available FDD, SDL and TDD (excl. mmWave) spectrum holdings. mmWave spectrum has not been included in the capacity potential calculations presented herein. According to our knowledge in 2021 still very few mobile network operators (e.g., Verizon US) had deploy mmWave spectrum in substantial parts of their networks.

In all other previous releases, we estimated the capacity utilization and capacity potential of the operator macro site grids. Small cells were not included in the site count. In this fifth release we have included in the number of sites both macro and small cells. This change yields significantly lower utilization and higher capacity potential figures for a handful of operators that have rolled out a significant number of small cells (e.g., US operators).

Elisa in Finland retained its ranking as the mobile network operator with the highest capacity potential. If Elisa were to deploy all of its spectrum across its most loaded sectors it will have enough capacity to carry a terabyte per subscriber per month.

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<sup>1</sup>[https://research.rewheel.fi/downloads/Capacity\\_utilization\\_2019\\_potential\\_169\\_operators\\_48\\_countries\\_PUBLIC\\_VERSION.pdf](https://research.rewheel.fi/downloads/Capacity_utilization_2019_potential_169_operators_48_countries_PUBLIC_VERSION.pdf)

## About Rewheel

Mobile data pricing, mobile operator competitiveness rankings, market modelling & analysis, competition analysis (consolidation, 4 to 3 mobile mergers, effective remedies, new market entries), MNO near-zero marginal data cost, MVNO economics, mobile capacity-only play, mobile centric convergence (MCC) pro-competitive strategies and 4<sup>th</sup> MNO business case.

Founded in 2009 and incorporated in Finland, Rewheel is a privately owned independent telecom research firm and boutique management consultancy. Our clients are mobile network operators, telco groups, MVNO groups, competition authorities, telecom sector regulators, governments, global internet firms, mobile data-centric start-ups, PE and VC investors.

Rewheel has 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 Rewheel's independent pricing, mobile market competitiveness, 4 to 3 merger analysis and remedy assessment 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, the Netherlands and Greece, 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, France, the Netherlands, Ireland, Finland, Portugal, etc.

Rewheel's mobile data pricing, strategy, competition analysis, merger assessment, 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.

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