



Preliminary assessment of 5G networks in EU/EEA

Study for the European Commission – Executive Summary

December 2021

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Background and context

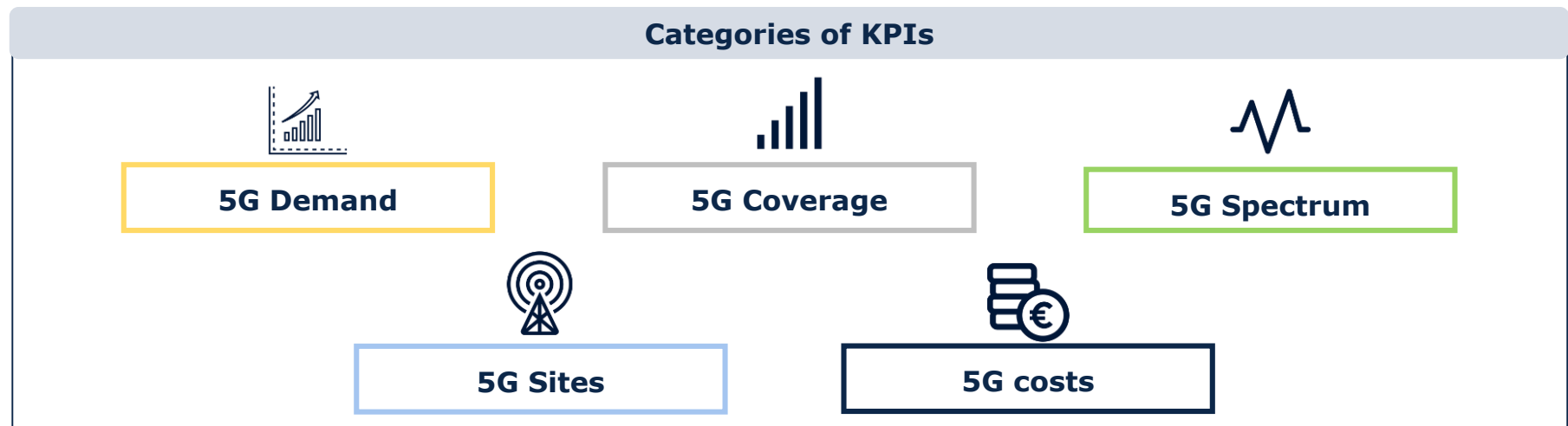
- ▶ On 22nd July 2019, the EC published the results of the “**Mobile cost model for roaming and the delegated act on a single EU-wide mobile voice call termination – SMART 2017/0091**” (hereinafter ‘EC’s mobile cost model’*) developed in conjunction with Axon.
- ▶ That study was initiated in the year 2018 with the objective of obtaining information about operators’ economics in EU/EEA to be used as input for the subsequent EC’s processes consisting in the review of maximum wholesale roaming charges as well as the setting of a single EU-wide mobile voice call termination.
- ▶ The model developed for that study did **not consider the 5G technology** (it considered 2G/3G/4G technologies), since **minimum information was provided in 2018 by operators** about their 5G deployments due to the early deployment stage of these networks at that time.
- ▶ Since the EC’s mobile cost model was developed, operators in EU/EEA have started in recent years the deployment of 5G networks, which are, in most of cases still at an early stage. In light of these latest developments, the EC commissioned Axon to carry out a **preliminary assessment of 5G networks**, whose outcomes are reflected in this presentation.

Objective of this study (1/2)

- ▶ The study strategy has consisted in the assessment of information about 5G networks received from operators in EU/EEA countries through NRAs, with the objective of providing a high level understanding of the recent and expected developments in 5G networks as well as their associated economics.
- ▶ For this purpose, operators and NRAs of EU/EEA countries were involved during May-June 2021 in a data gathering process by means of a questionnaire, where their engagement was established as voluntary.
- ▶ Thanks to the information received through this data gathering process, we have elaborated a **separate module** to the EC's mobile cost model, aimed at providing information about 5G networks and their related economics in the EU/EEA Area. It is important to note that this module is not a bottom-up model as such, but a **preliminary assessment of the relevant information provided** by the Member States. Thus, the level of detail included in this module is significantly lower when compared with the current EC's mobile cost model.
- ▶ It is also worth noting that the assessment has **focused on the new/additional investment/costs required for 5G**. This means that the reused network elements already in place for 2G/3G/4G have not been estimated in this exercise and, in turn, they have been directly extracted from the EC's mobile cost model (SMART 2017/0091)* when applicable.

Objective of this study (2/2)

- ▶ The assessment of the relevant information provided by Member States has allowed the extraction of a set of relevant KPIs about the status of 5G developments and their economics in the EU/EEA Area. Outcomes obtained have been divided in the following categories of KPIs, whose outcomes are presented in the next slides.

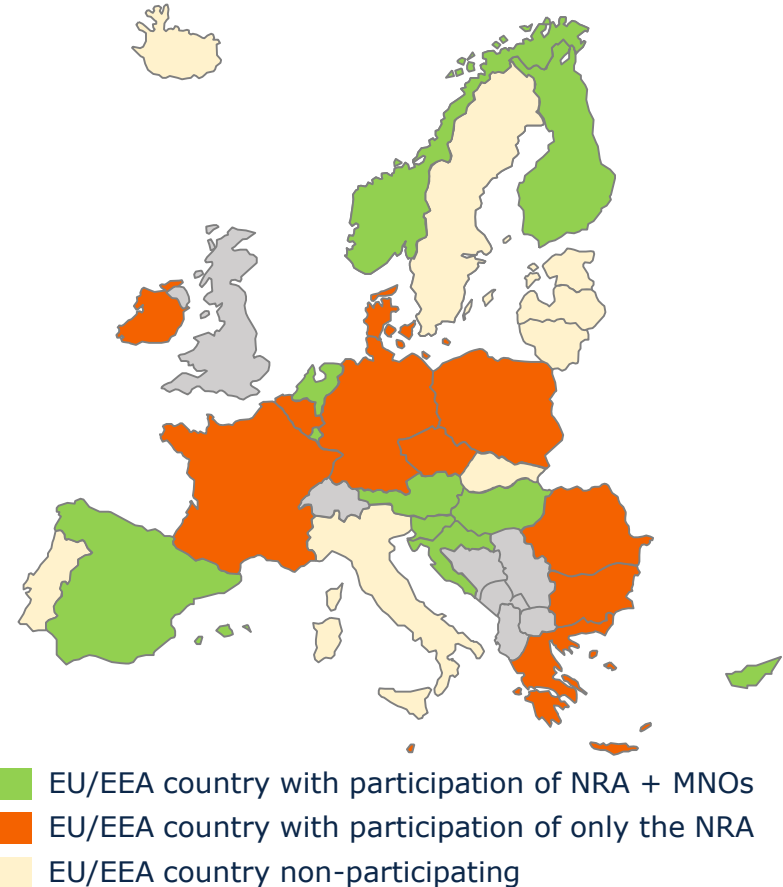


Important note: The results of this study only serve as a first insight of 5G networks and their economics. Even if the current roaming proposal includes a review in 2025, a complete and detailed new model will be needed for such review. Thus, this first exercise on 5G does not intend to replace the cost model that will be developed for the review of 2025. Additionally, outcomes shown in this study do not specifically correspond to roaming broadband costs but to overall broadband costs at national level, where most of the traffic correspond to domestic services.

The study is based on the information provided by 21 Member States, including data from both NRAs and MNOs

- ▶ Thanks to the data gathering process, and despite the voluntary nature of this process, we received information from 21 Member States over a total of 30 countries belonging to the EU/EEA Area.
- ▶ The detail of information provided has varied significantly depending on the Member State, and the level of cooperation can be divided in: i) countries where only the NRA has participated and ii) countries where both the NRA + MNOs (typically one per country) have participated.
- ▶ Additionally, a few Member States have also shown interest in the process and the expected outcomes of the study, but they have finally decided not to participate in the data collection for other different reasons.

Countries contributing to data collection

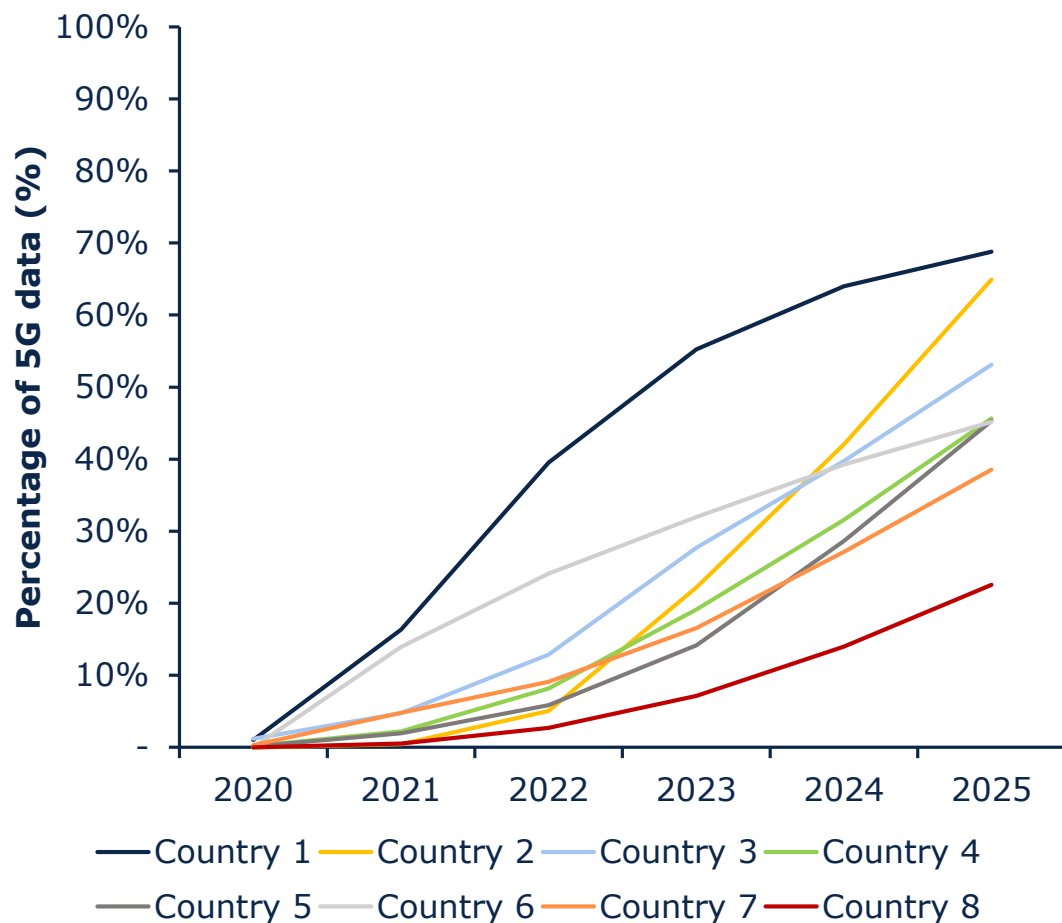


Anonymisation approach followed to ensure confidentiality

- ▶ In order to guarantee the confidentiality of the information received, **no names of specific Member States are displayed in the outcomes of this study**. This entails that, when showing individual values received from Member States (e.g. comparisons across different countries), the name of the corresponding Member State has been removed.
- ▶ When applicable, graphs have been anonymized individually as follows:
 - ❖ **Step 1.** Values have been ordered from largest to smallest in each chart* (and considering values of last year when a time period is assumed)
 - ❖ **Step 2.** Names of the countries/operators have been anonymised
- ▶ We also note that despite the confidentiality exercise performed, values shown in this document have not been adjusted and present the real values derived from the information received from Member States.



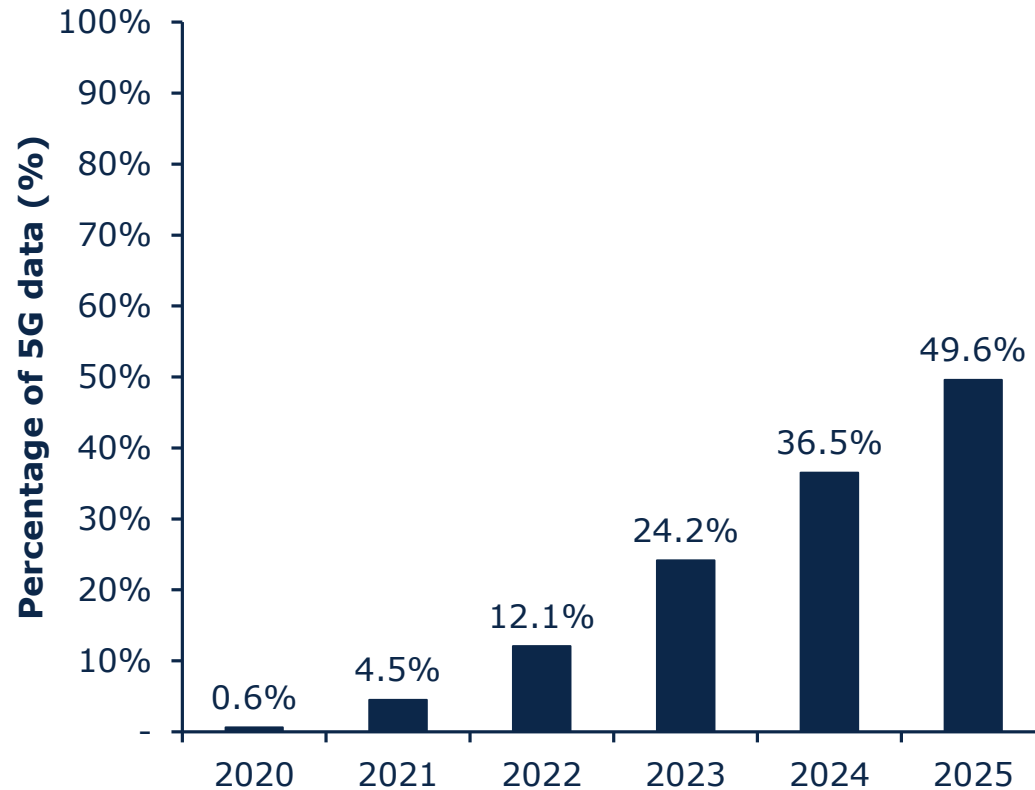
Percentage of broadband data handled by the 5G technology over total broadband data at country level



- ▶ The 5G data is expected to grow across all MS.
- ▶ By 2025, the percentage of 5G traffic is expected to be in the range of 35%-70% for the majority of countries.
- ▶ As exception from the above, it can be observed that 'Country 8' has been more conservative when providing forecasts, having reported a value of 23% for the 5G traffic in the year 2025.
- ▶ On the other hand, 'Country 1' and 'Country 6' present a quicker adoption in the early stages with a smoother adoption in the future.



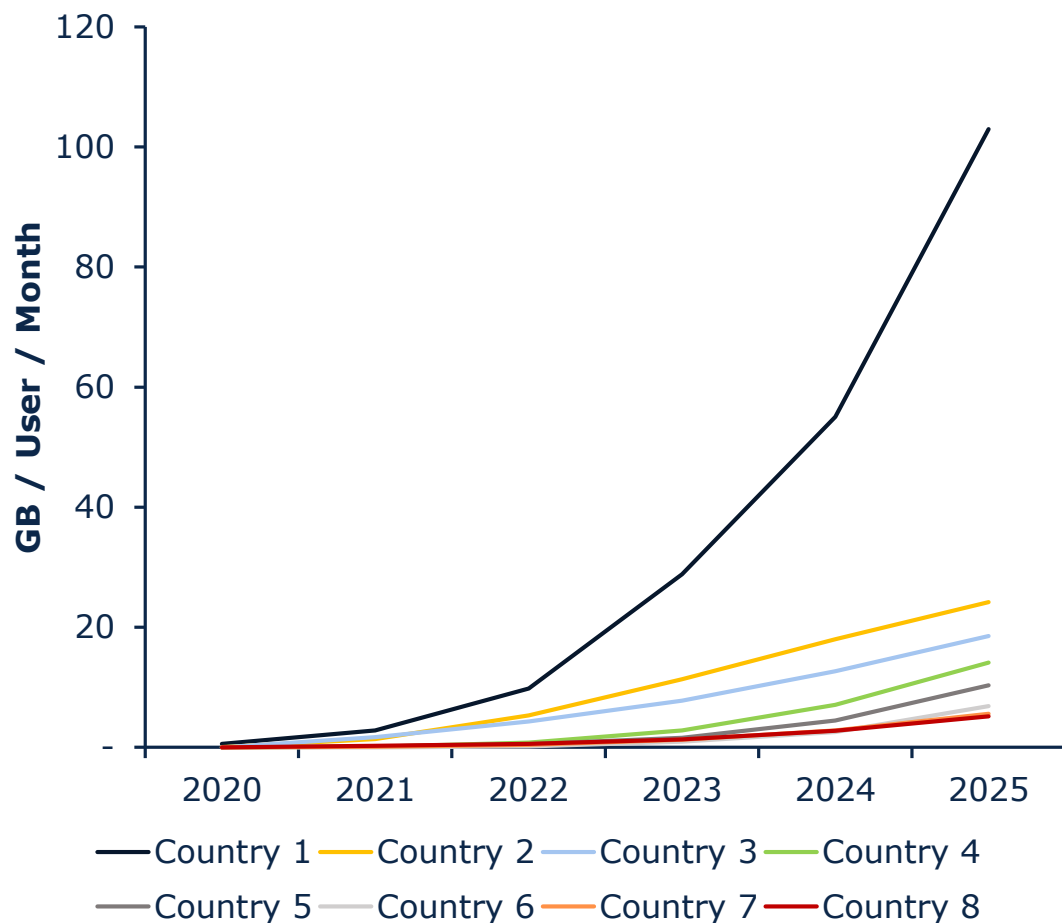
Percentage of broadband data handled by the 5G technology over total broadband data as EU/EEA average



- ▶ The EU/EEA average has been estimated considering the demand of all Member States that have submitted demand information about 5G for this study.
- ▶ It is expected that around one half of the data traffic will be handled by 5G networks already in the year 2025.



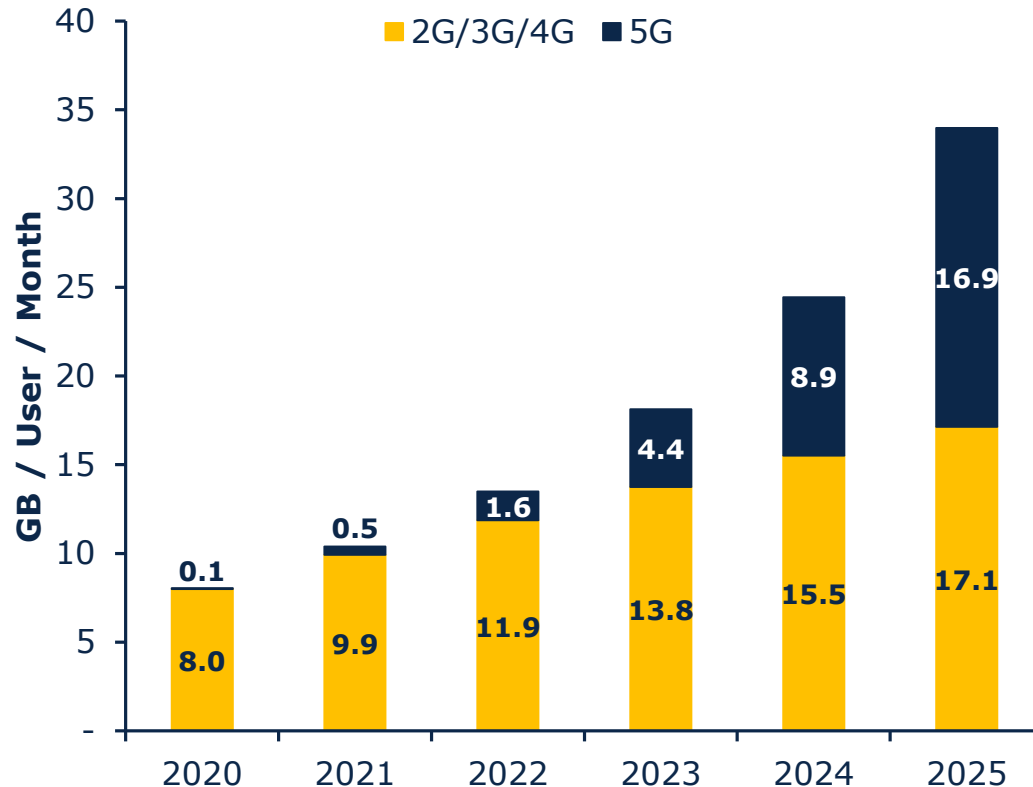
Monthly broadband data consumption per user over 5G networks at country level



- ▶ Average consumption per user in 5G networks is expected to increase notably over the following years.
- ▶ It is specially significant the consumption of 5G data informed by 'Country 1'. By the year 2025, the 5G consumption would represent around 62% in this country.



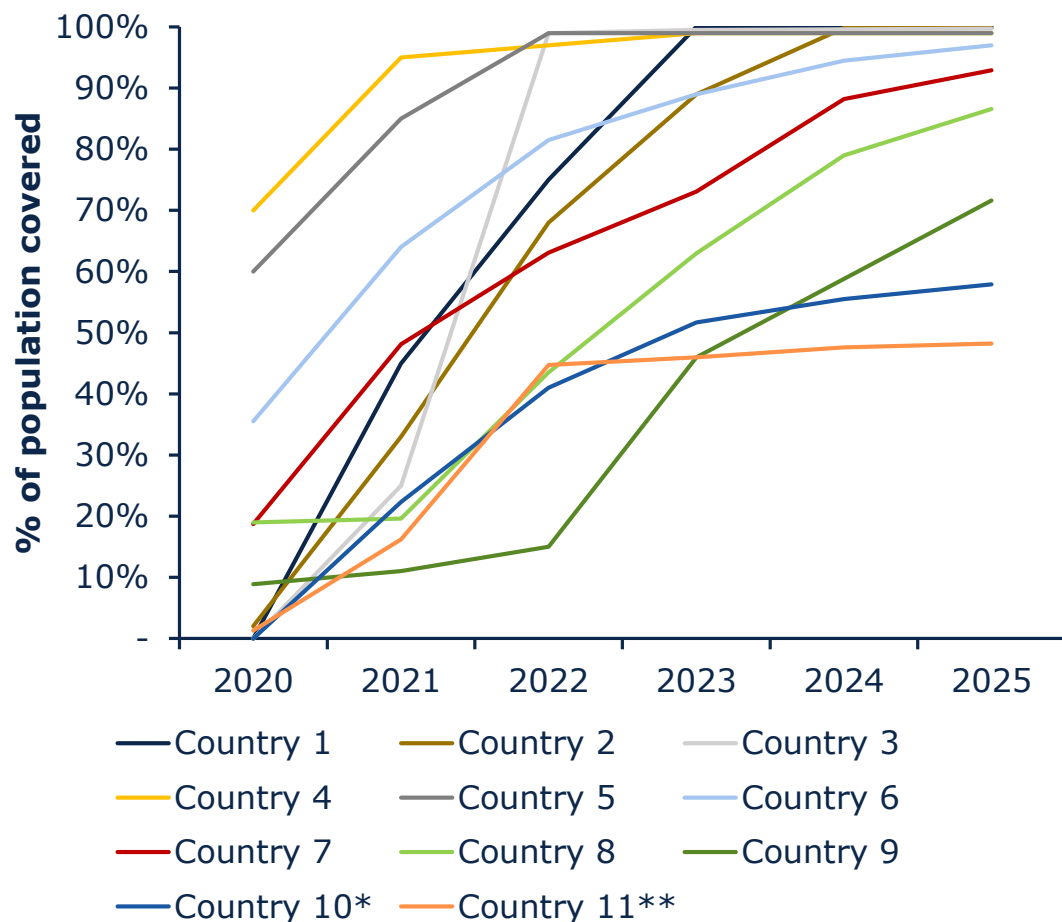
Split of monthly broadband data consumption per technology as EU/EEA average



- ▶ The EU/EEA average has been estimated considering the demand of all Member States that have submitted demand information about 5G for this study.
- ▶ By the year 2025, the consumption forecasted per user is around 34 GB/user/month, where the traffic over 5G will represent around one half.



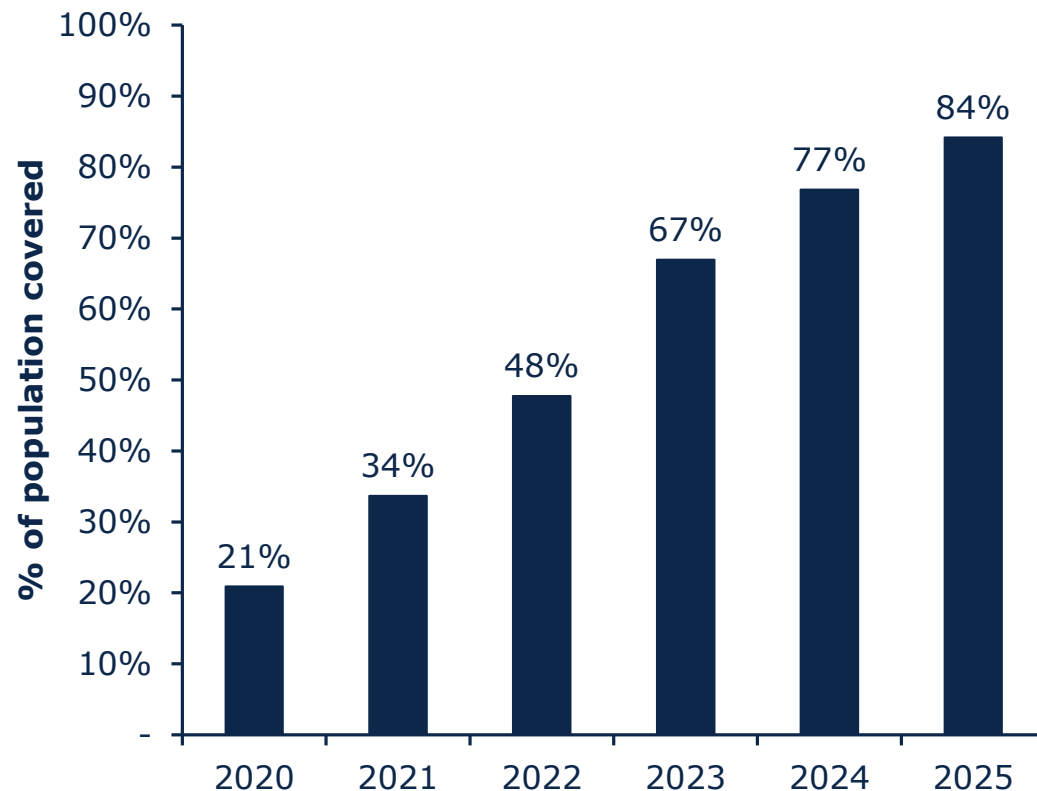
Percentage of population covered by 5G networks at country level



- ▶ The coverage of 5G networks is expected to increase rapidly in the upcoming years, with most of Member States reaching a coverage of 80% by the year 2025.
- ▶ This increase will be helped by the availability of the 700Mhz band across all MS, as countries reporting only 3.6GHz coverage tend to be lower than other countries.

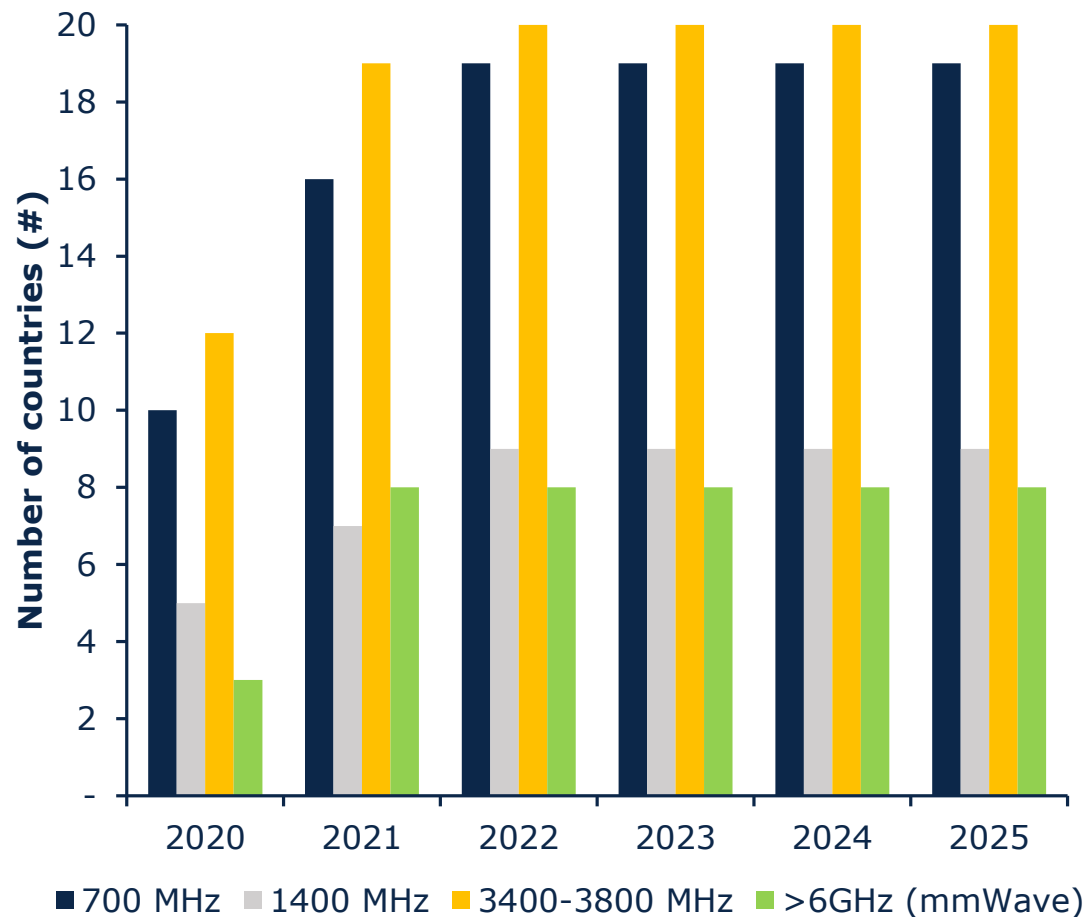


Percentage of population covered by 5G networks as an EU/EEA average



- ▶ The EU/EEA average values of coverage presented in this exhibit represent the weighted average based on population for Member States that have submitted coverage information about 5G for this study*.

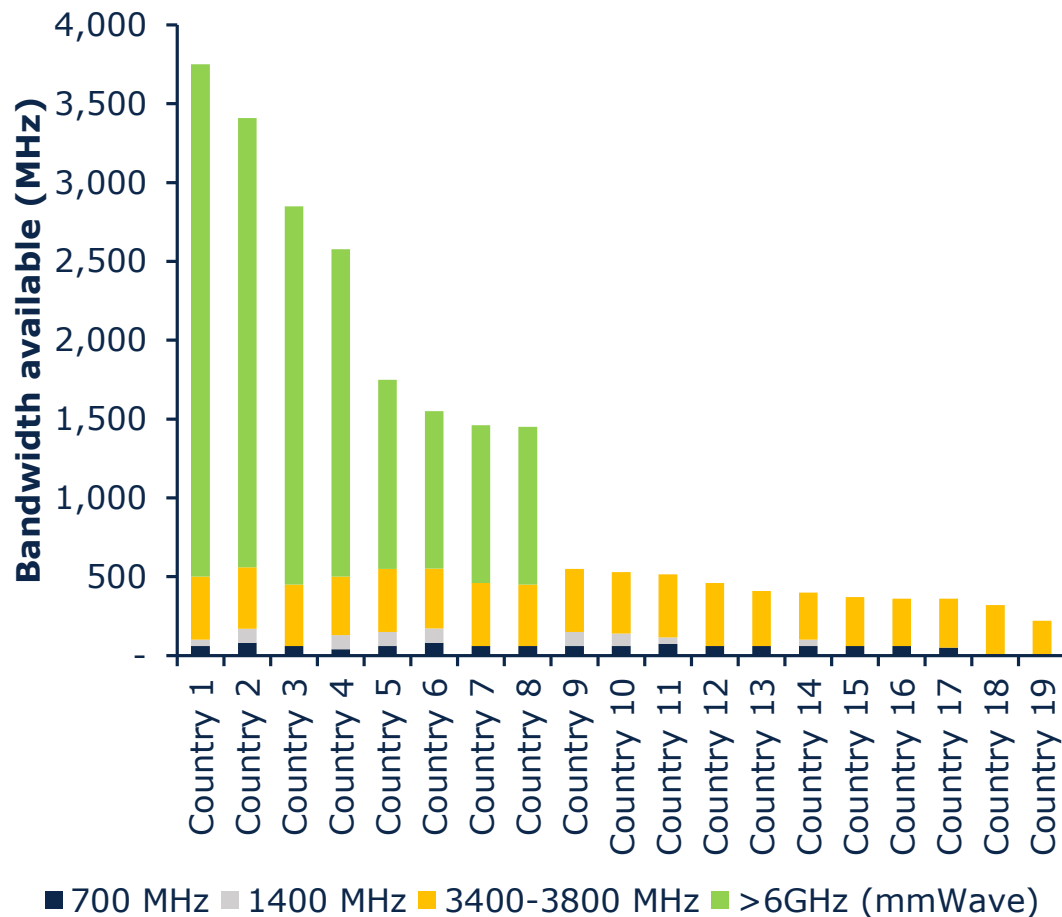
Number of countries with available spectrum bands*



- ▶ Over a total of 20 Member States reporting the information about 5G spectrum, the 700 MHz and 3400-3800 MHz bands have been or will be made available in 19 and 20 countries respectively before the year 2025.
- ▶ On the contrary, the spectrum bands of 1400 MHz as well as the mmWave bands (>6GHz) present a lower availability among Member States.



Available bandwidth per spectrum band range at country level by 2025*



- ▶ The >6GHz (mmWave) band range presents the highest bandwidth available, with typically between 1 GHz and 3 GHz. This bandwidth will be key for permitting operators to comply with capacity constraints arising from the high traffics expected for 5G data.
- ▶ On the contrary, the 700 MHz band, despite its lower bandwidth available (typically 60 MHz), is already playing a key role in the initial roll-outs of operators thanks to their largest reaching capabilities which allows achieving greater coverage levels.



General considerations for 5G sites

- ▶ Regarding the different possibilities of 5G sites, based on the information received from operators of Member States participating in the study, it is observed that, by the year 2025, the 5G sites can be classified according to the following types:

Type of sites (year 2025)	% over total
Macro-sites upgraded from 2G/3G/4G to 5G	97.9%
5G-only small-cell sites	2.0%
5G-only macro sites	0.1%

- ▶ The previous table shows that the vast majority of sites incorporating the 5G technology will correspond to an upgrade of the 2G/3G/4G existing sites*.
- ▶ In the particular case of 5G-only small-cell sites, only very few operators have shown plans for deploying them in the short term.
- ▶ In the particular case of 5G-only macro sites, only one operator has reported future deployments for this type of site, representing a negligible portion of the total sites.



General considerations of 5G costs (1/2)

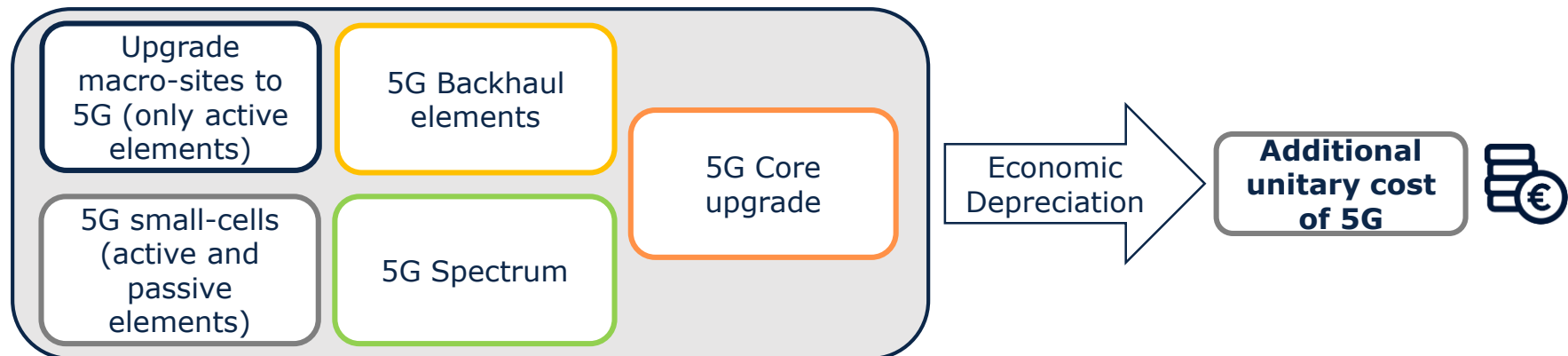
- ▶ The objective of this section on 5G costs is to present how the 5G technology will affect the costs of service provision in the upcoming years.
- ▶ As previously anticipated, when dealing with investments/costs, costs related to the re-use for 5G of previously available network elements already in place for 2G/3G/4G have not been estimated in this exercise. This entails that costs of passive elements of macro-sites and/or spectrum bands already in place for 2G/3G/4G and expected to be reused for 5G have been directly extracted from the EC's mobile cost model (SMART 2017/0091)* when applicable.
- ▶ For the estimation of the additional unit costs that operators will need to incur for providing 5G broadband data services, the required investments have been obtained as the multiplication of the number of 5G sites informed by operators** and the EU/EEA averages for the unit costs of 5G equipment also obtained from operators. Only in the case of spectrum related costs, country-specific values have been employed.
- ▶ Finally, investments related to 5G have been annualized using the economic depreciation, in line with the approach adopted in the existing EC's mobile cost model (SMART 2017/0091).



General considerations of 5G costs (2/2)

- ▶ The following exhibit shows the list of network elements considered in the calculation of new investments required for 5G:

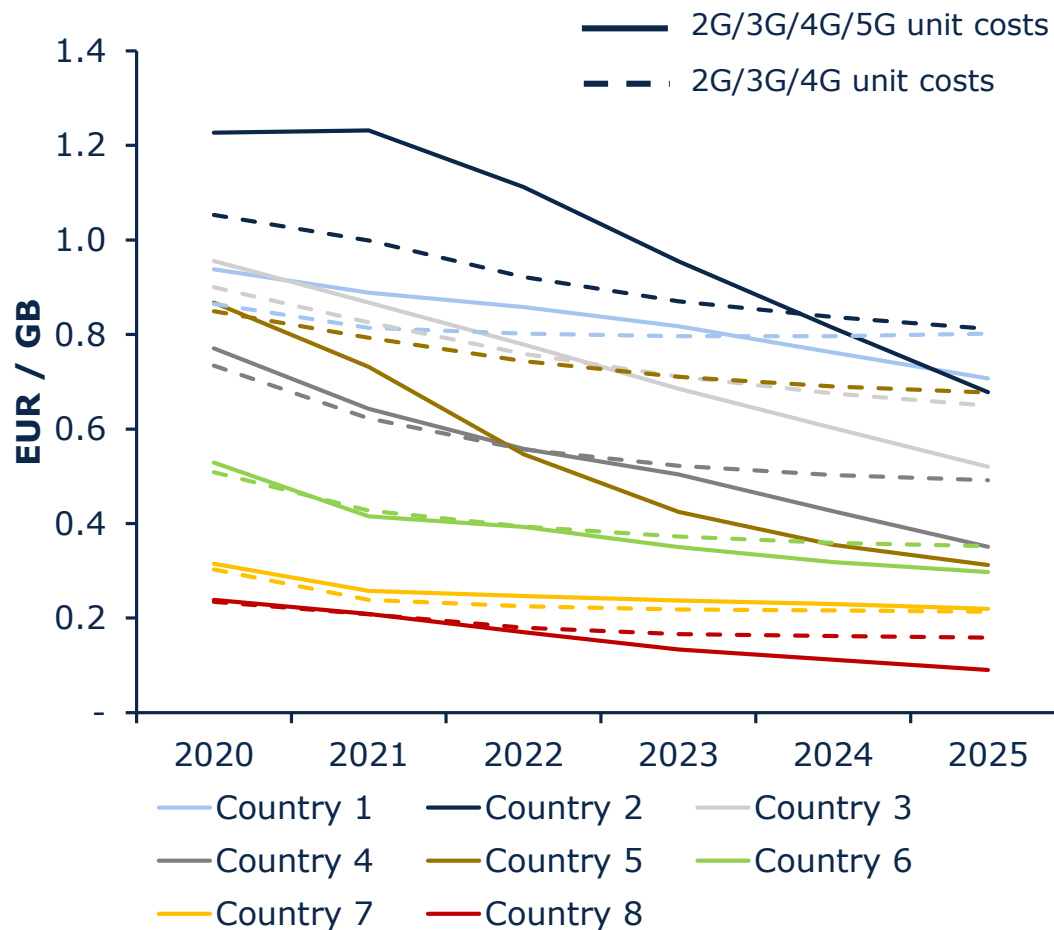
TOTAL INVESTMENT



- ▶ Across this 5G costs section, unless stated otherwise, values presented correspond to the unit costs obtained for the year 2025. This year has been used as reference in certain cases, as the 5G technology is expected to be broadly established in most of Member States in this year, allowing a more adequate comparability among them when contrasted with early stages of roll-out.



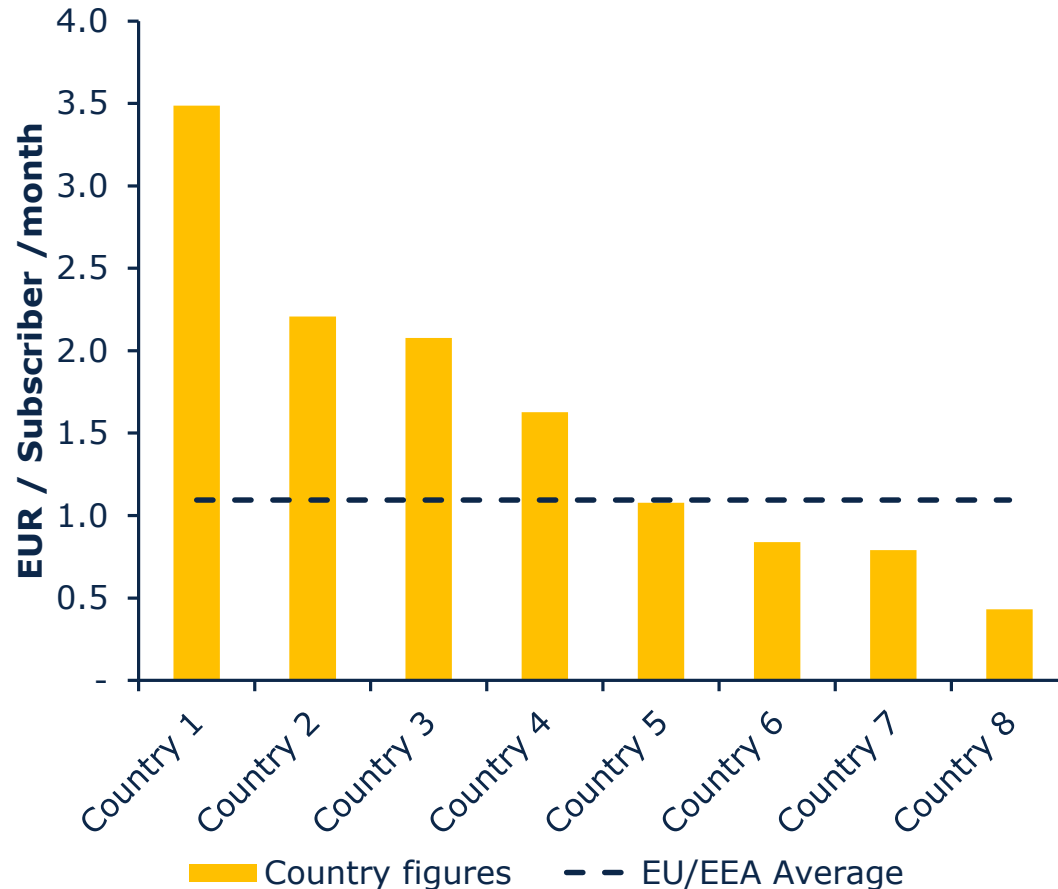
Unit cost per GB at country level



- ▶ The chart on the left shows the unit cost per GB considering: i) 2G/3G/4G* technologies shown with dashed lines or ii) 2G/3G/4G/5G ** technologies shown with continuous lines
- ▶ At the end of the period, the inclusion of the 5G technology already demonstrates the better cost efficiencies of this solution, leading to lower costs after its consideration for the calculation of the unit cost per GB.



Additional monthly cost per subscriber related to the new 5G elements in 2025 at country level

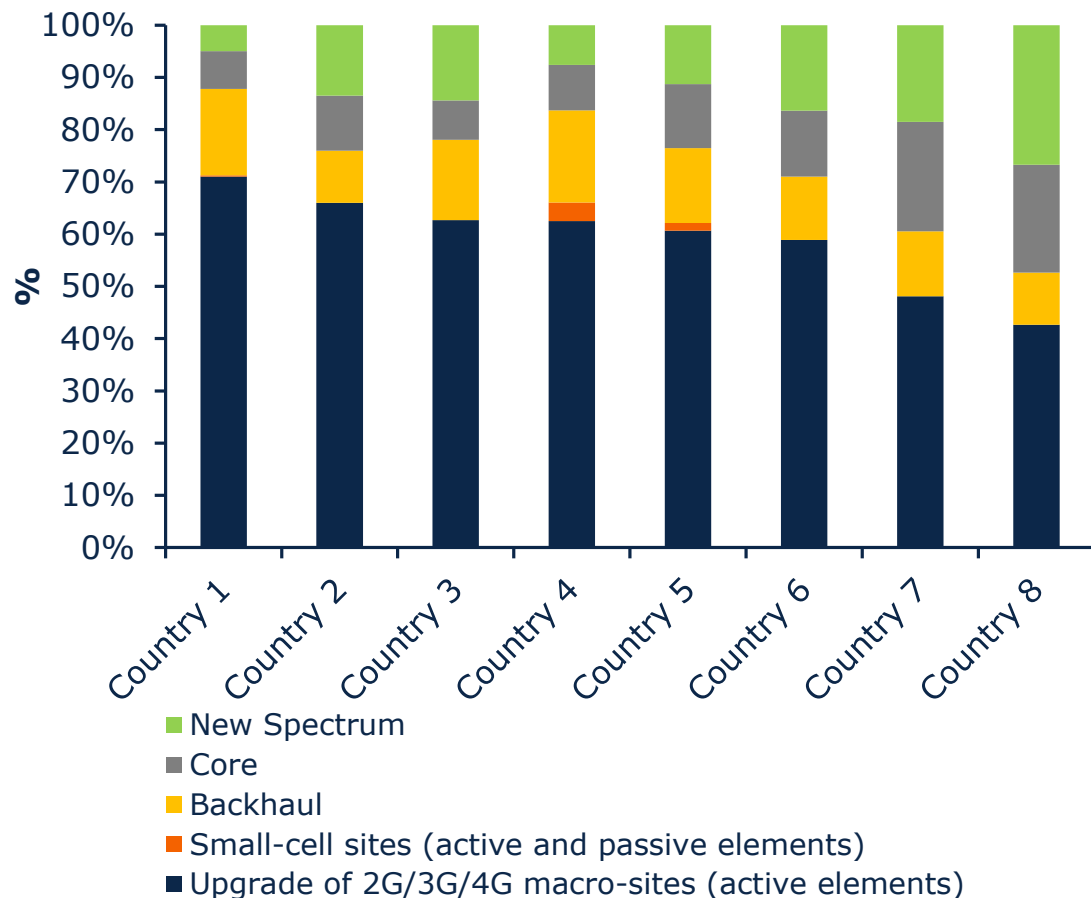


- ▶ The additional monthly cost per subscriber ranges from 0.4 to 3.5 EUR, depending on the country.
- ▶ The EU/EEA average value shown in this chart represents the weighted average based on subscribers of the Member States.

Note: Costs of passive elements in macro-sites and previously existing spectrum bands are not considered, as these elements are expected to be mostly reused for 5G from the existing 2G/3G/4G technologies



Split of unit cost per GB related to the new 5G elements in 2025 at country level



- ▶ The largest portion of cost per GB is generally attributed to the active elements located in the access network.
- ▶ This effect is mainly derived from the upgrade of existing sites to incorporate the 5G technology.

Note: Costs of passive elements in macro-sites and previously existing spectrum bands are not considered, as these elements are expected to be mostly reused for 5G from the existing 2G/3G/4G technologies

Main lessons learned from the study outcomes

The main list of findings observed in assessments carried out in study are as follows:

- ▶ Conclusions extracted in this study have been based on the information of EU/EEA countries that reported data during the data gathering process. In general, replies are expected to have been received mostly from Member States with a relatively advanced deployment of the 5G technology, due to their greater availability of information related to 5G networks. This entails that any conclusion derived from this study should be carefully transposed to other Member States with a lower status of 5G roll-out.
- ▶ Operators who participated plan to have achieved 5G coverage levels of more than 80% by the year 2025, what indicates a rapid roll-out of these networks.
- ▶ When looking at the different possibilities of 5G deployment, operators expect to mostly rely in the initial stages on the upgrade of the 2G/3G/4G technologies for incorporating the 5G technology. On the contrary, small-cell solutions will only represent a small portion (2%) of new 5G sites deployed until 2025.
- ▶ The largest portion of unit cost per GB related to the new 5G network elements is generally attributed to the active elements located in the access network.
- ▶ When assessing the impact of 5G on the services' provisioning costs, 5G shows better cost efficiencies at the end of the analysed period (specially in years 2024-2025).



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