

Report on Connectivity Indicators for the Digital Decade Policy Programme



05 December 2024

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Executive Summary

Decision (EU) 2022/2481 of the European Parliament and of the Council of 14 December 2022 establishing the Digital Decade Policy Programme 2030 (DDPP) is intended to guide Europe's digital transformation. It establishes digital targets and objectives in the realms of digital skills, digital infrastructure, digitalisation of business and of public services. Article 5(1) of the DDPP requires the European Commission (EC) to monitor Member States' progress towards the general objectives and the digital targets set out in the DDPP and, to that end, the European Commission is required to set out, by means of an implementing act, the key performance indicators (KPIs) for each digital target. On 30 June 2023 the Commission published the Implementing Decision setting out key performance indicators (among which the ones related to connectivity) to measure the progress towards the digital targets established by Article 4(1) of Decision (EU) 2022/2481 of the EC and of the Council, C(2023)4288_final of 30 June 2023¹.

This BEREC Implementation Report examines how the DDPP and the Implementing Decision are implemented in practice by NRAs/OCAs with reference to connectivity KPIs and looks at the difficulties they encounter and also at the results they achieve.

This Implementation Report shows the difficulties in collecting data for the KPIs to measure the progress towards the DDPP targets which are the result of various reasons. Naturally, the implementation of the DDPP KPIs as of any KPI system need some “warm-up” phase to cope with initial and unexpected issues when actually collecting and processing the data needed for the KPIs (“learning curve”). At the same time, some of the KPIs' definitions (e.g. “homes passed”) are missing or unclear, some are (overly) complex (e.g. 5G coverage per frequency band instead of a technological neutral way across bands). In these cases, NRAs/OCAs are either not able to collect the data fully (at the required granularity) or “customize” the (missing/unclear) definitions so that they can provide at least partially a result to the EC Consultants.

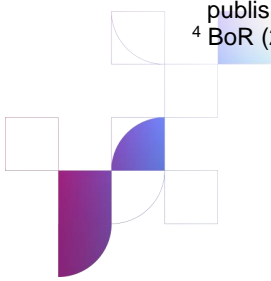
However, as already seen in the BEREC Implementation report on the BEREC Guidelines on Geographical surveys of network deployments² (hereafter, BEREC implementing report on Art. 22 GL), BEREC sees progress in the comparability with reference to 2021³ as many NRAs/OCAs nowadays use the BEREC Guidelines on Geographical surveys of network deployments⁴ (hereafter, BEREC Art. 22 GL) for the collection and aggregation of the data. Also, the number of NRAs/OCAs reporting data directly (instead of operators submitting the data) to the EC Consultants has increased. Moreover, many of these authorities are now able to report the data at a more granular level (grid or address level instead of municipal and sub-municipal level) and, therefore, need no assumptions for the aggregation, both resulting in a better level of data quality and more comparability of national results. But as shown below,

¹ [https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=pi_com:C\(2023\)4288](https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=pi_com:C(2023)4288).

² BoR (24) 146 published in October 2024.

³ BoR (21) 172 – BEREC Report to enable comparable national broadband coverage indicators throughout Europe published in December 2021.

⁴ BoR (20) 42 published in March 2020.



BEREC has seen no progress over time in updating the definitions of homes passed and rural coverage.⁵

More generally, it is important that KPIs are defined in a way that they measure the objectives (in this case the progress towards the DDPP fixed and mobile connectivity targets), but are also proportional to the targets (i.e. do not make distinctions that are not needed to measure these targets) and simple to collect in practice as otherwise the comparability of the data across MSs will suffer because of incomplete results. Considering the complexities of the data collection processes and the uneven distribution of resources and experiences at national level, it should be acceptable to tolerate some degree of non-comparability of figures while there also is a relevant expectation that it will diminish over time.

Thus, the trade-off between full accuracy and “good enough” should be decided case by case by assessing the benefit added by an extra level of accuracy vs. the costs of getting it in practice. According to BEREC’s and NRA experience, adding complexity to the indicators doesn’t necessarily result in more comparability of the outcomes. In this regard, BEREC sees some progress, but also room for further improvement in NRA and OCAs practices in implementing KPIs.

The conclusions of this Implementation Report will flow into both the update of the BEREC Art. 22 GL as well as BEREC’s views on the EC’s Methodology on 5G QoS Coverage Mapping⁶.

Introduction

Objective and scope of the report.

Decision (EU) 2022/2481 of the European Parliament and of the Council establishing the Digital Decade Policy Programme 2030 (DDPP) intends to guide Europe's digital transformation. It establishes digital targets and objectives in the realms of digital skills, digital infrastructure, digitalisation of business and of public services. Article 5(1) of the DDPP requires the European Commission to monitor Member States’ progress towards the general objectives and the digital targets set out in the DDPP and, to that end, the European Commission is required to set out, by means of an implementing act, the KPIs for each digital target.

In March 2023, BEREC published its feedback⁷ to the European Commission’s Draft implementing decision setting out key performance indicators for the DDPP. In its feedback,

⁵ BoR (21) 172 and below.

⁶ 1st Draft presented by the EC to BEREC on 16th July 2024.

⁷ BEREC’s feedback to the European Commission’s draft implementing decision setting out key performance indicators for the Digital Decade Policy Programme 2030, BoR (23) 50, published in March 2023.



BEREC focused on the connectivity KPIs to measure the progress towards the DDPP targets. Based on the BEREC Art. 22 GL, BEREC proposed certain amendments to the definitions and KPIs in the European Commission's draft implementing decision and suggested, among other things, more technologically neutral definitions.

In this implementing report BEREC will look at the final European Commission Implementing Decision⁸ and analyse the connectivity KPIs with specific reference to their measurement in order to effectively monitor the progress towards the DDPP targets.

For this purpose, BEREC asked its members to respond to a questionnaire regarding the implementation of the KPIs. The questionnaire looked at who is reporting (NRAs/OCAs, operators directly) and for which purpose (DESI Report and the EC Broadband Coverage Studies commissioned to Consultants). The questionnaire queried about the difficulties in providing data to the EC Consultants generally, in particular those arising as a consequence of Authorities to implement the indicator's definitions and metrics for fixed and mobile coverage and those that result from raw data not being sufficiently granular, so that the aggregation of information is challenging and subject to "adjustments" and hypothesis of NRAs that may "blur" the results.

Section 1. NRAs/OCAs reporting of coverage data in order to inform the DESI Report and the EC Broadband Coverage Studies

The EC consultant⁹ retrieves coverage data from two sources: i) NRAs and/or OCAs; ii) operators. In some cases, the data are provided partially by the NRA/OCA and partially by the operators.

Mostly, the coverage data are provided by the NRA/OCA, as this is the case for 16 out of 24 MS¹⁰. The data are provided to the EC consultant partially by the NRA/OCA and partially by the operators in further 5 MS and only by the operators in the remaining 3 MS.

The following table summarizes the above-mentioned information.

⁸ EC Implementing Decision setting out key performance indicators to measure the progress towards the digital targets established by Article 4(1) of Decision (EU) 2022/2481 of the EC and of the Council, C(2023)4288_final of 30 June 2023.

⁹ The preparation of the Broadband Coverage Reports and the related data collection have been commissioned by the EC to a series of consultants since the beginning of these studies. These "EC consultants" have developed, revised and applied the Study methodology under the EC supervision. However, the EC consultants do not perform any verification of the data collected, as described above, in some countries operators provide the data and in those cases NRAs see difficulties in verifying the data (checking only inconsistencies).

¹⁰ In two of these cases some of the information provided by the authority is also provided by the operators.

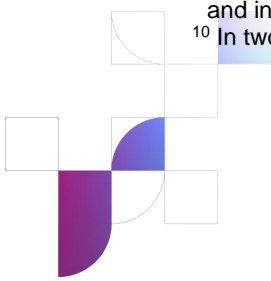


Table 1 Who provides data to the EC consultant?

The coverage data to the EC consultant are provided by:		
NRA/OCA	Partially the NRA/OCA and partially the operators	Operators
16 Countries	5 Countries	3 Countries

One of the Member States which provides the data to the EC Consultants is reporting the indicators to the EC consultants as it directly collects them from the operators (with no treatment at the authority level); these data are provided by the operators as well. Currently, this NRA does not verify these data, it simply treats the data to ensure that the indicators do not exceed 100% coverage, however, it will shortly initiate speed sampling measurements to verify the speed data provided by the operators for mobile technologies. Referring to the quality of the data provided by the operators, the NRA highlights that throughout time these data can be characterized by having a sort of normalized continuity.

In three countries all the information requested by the EC consultant is provided by the operators. The reasons for this are various.

In one case, the NRA cannot verify the data provided to the EC consultant and checks only for inconsistencies related to these data and to the information on the subscribers collected by the NRA itself.

In another case, operators are obliged to submit broadband infrastructure data at address level, but the NRA doesn't have the number of households/homes at individual address and therefore is unable to provide coverage as requested in the questionnaire (on rural and NUTS 3 level). Regarding mobile coverage, the NRA doesn't have accurate information on population at grid level and therefore it is unable to provide up to date population coverage numbers (to proxy for the coverage of homes as requested by the EC consultants' questionnaire). Therefore, in order to deliver the most accurate data (and comparable with previous years) the NRA asks operators to provide data to the EC consultants. The NRA checks the data provided by operators, but because of the lack of information needed to calculate for homes passed finds it impossible to verify whether it is the same information as the one it receives for other activities (broadband mapping); however, the NRA may notice certain inconsistencies (especially when preliminary results are available).

In the last case, when the data collection began the NRA did not have the tools to provide the figures. The NRA cross checks the data provided to the consultant with the figures that the operators share with it for its own purposes, stating that they seem to be pretty much in line.



Referring to the 5 cases where data are partially provided by the NRA/OCA and partially the operators, the following table summarizes which data are provided directly by the operators. It should be noted that one NRA is not aware of which data the consultant collects from the operators.

Table 2 Types of data provided by the operators in the countries where part of the information is provided by a public authority (NRA/OCA) and part of the information by operators.

Type of data directly provided by the operators	Number of MS
Data on homes passed for fixed broadband categories (DSL, VDSL, VDSL 2 vectoring, Cable Modem Docsis 3.0, Docsis 3.1)	One MS
Data on homes passed for FWA	Two MS
Data on homes passed for 5G mobile broadband categories	Two MS
Speed categories for fixed broadband categories (DSL, VDSL, VDSL 2 vectoring, Cable Modem Docsis 3.0, Docsis 3.1)	One MS
Speed categories for FWA	One MS
Speed categories for mobile technologies	Two MS

In general, the data are provided by the operators when the NRA – for various reasons – does not have it. For example, one NRA does not collect data concerning mobile broadband coverage and in another case the main issue is with the accurate calculation of FWA coverage while taking capacity constraints at each cell into account. In one MS, only data regarding VHCN networks are collected by the authority and, in consequence, data regarding the copper network are provided directly by the operators.

In another the NRA has no information regarding mobile coverage on 5G (as the information collected for the Article 22 broadband map still needs validation).

Only one NRAs is able to check the data provided by the operators to the EC consultant to a certain extent.

Going to the level of satisfaction of the authorities about the quality of the data provided by the operators, only one of them declares to be satisfied, while another is not. In this country, the rural figures are based on a mix of information from three operators, along them, the EC consultants make estimations and modelling. However, the data set could be incomplete, since at least in one case the information was provided only by one small operator and this could affect the statistical relevance of the EC consultants' estimates. Therefore, according to the NRA, it is necessary to know the consultant's estimates to solve the problem of inferring

statistics for a country based only on the data of 1 operator, which has fewer demanding obligations compared with other operators. Another NRA states that, because it has no own data, it cannot verify the quality of the data.

Among the 21 MSs which provide some or all of the data to the EC Consultant, mostly the NRAs are responsible for all the activities, i.e. (i) collecting and processing the raw data that nurtures the NUTS-3 and national aggregated KPIs; (ii) aggregating the raw data to NUTS-3 level; (iii) providing the final data to the EC Consultant. It occurs 14 times out of 20. However, in 3 MSs the OCA is responsible for one or two activities as well; this is the case of:

- One MS, where the OCA is responsible of activities (i) and (ii);
- One MS, whereas for activity (i) the OCA collects the raw data and the NRA processes them;
- One MS, where the OCA is responsible of activity (i) as well.

Only in two MS the OCA is responsible for all the activities.

In the remaining cases, different approaches are adopted. The NRA is responsible for activity (i) in 4 cases, for activity (ii) in 2 cases and for activity (iii) in 3 cases, while the OCA is responsible for activity (i) in 1 case, for (ii) in 1 case and for (iii) in 2 cases.

In two cases neither the NRA nor the OCA is responsible for the aggregation of the data to NUTs level.

The following table summarizes this information.

Table 3 Types of authorities in charge of the different tasks required to deliver information to the EC Consultant

	(i) Collecting and processing?	(ii) Aggregating the data to NUTS3 level?	(iii) Sending the final information to the EC consultant?
NRA (all activities)	14 Countries		
OCA (all activities)	2 Countries		
NRA	4 Countries	2 Countries	3 Countries
OCA	1 Country	1 Country	2 Countries

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It should be noted that the activities are mostly done by the NRAs. Indeed, NRAs collect and/or process the raw data in 18 MSs, aggregate the data in 16 MSs and send the information to the EC consultant in 17 MSs. The OCAs collect and/or process the raw data in 3 MSs, aggregate the data in 3 MSs and send the information to the EC consultant in 4 MSs.

Moreover, 15 NRAs/OCAs use a broadband map as a basis to provide the coverage data to the EC consultant¹¹. Among these, only in one case this map is not the Article 22 broadband map¹², while in another it is, but not all elements of Article 22 are yet implemented¹³.

Further 5 NRAs/OCAs do not use a broadband map as a basis to provide the coverage data to the EC consultant, adopting different approaches. Mostly, these NRAs collect the required data from the operators.

In one case, the NRA collects responses from the operators at a low granular level and needs to treat overlaps. It calculates - according to the technology used - either the sum of the coverage values of the operators or the maximum coverage reported by one of them. Consecutively, the NRA forwards these data to the EC consultant, after making some assumptions if considers as necessary, in particular referring modelling the overlap between the different fibre operators, at least in those NUTS 3 areas where the NRA knows that the operators are overbuilding their fibre networks. The same situation is referred to in another MS for fixed broadband and VHCN indicators, which are aggregated from parish level (submunicipal) to NUTS 3 level, excluding overlapping,

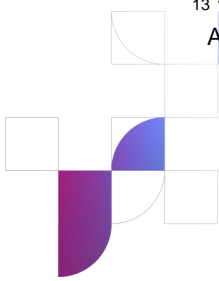
In one MS, the NRA collects yearly coverage data from all operators, containing the number of dwellings passed in each settlement.

One NRA has a web platform, which is a database and not a map, which contains data from the address register (all addresses), the real estate register (residential and commercial premises) and operators (building address, fixed line type). The operators provide yearly information about their existing fixed broadband networks.

¹¹ For one of these MS the broadband map is only used in the case of fixed networks. In the case of mobile networks, the data is collected from the operators, processed, verified and reported by the NRA then.

¹² In this MS this data is collected under other legal remit, but correlated to the Article 22 geographical surveys. The reason is that the NRA had already been performing the mapping of fixed and mobile reach and performance years before the BEREC Art. 22 GL were published and already had those processes in place at the time of their issuing.

¹³ This NRA has specified that new legal regulations will be in place within this year, which enable to implement Article 22 in its entirety in terms of geographical coverage.



Section 2: General difficulties in providing the data to the Consultant

This section provides a broad overview of the difficulties NRAs/OCAs face in providing information to the EC consultants¹⁴. There are 21 public authorities who have informed BEREC that they provide part or all of the information required by the EC to inform the EU broadband coverage reports¹⁵: 13 of those provide information on the basis of the national Article 22 broadband maps, one on the basis of a different broadband map and 6 on the basis of other methodologies.¹⁶

2.1 General difficulties in providing certain types of data

Yet, these authorities do not always provide all the indicators required by the EC consultants. Table 3 shows that whilst the 21 authorities provide information about coverage (homes passed) for wired broadband (at least for one technology), a smaller number provides information for the rest of categories. For example, only 14 provide VHCN coverage information (BEREC definition)¹⁷ and approximately 15 provide information about expected peak time speeds¹⁸ for fixed broadband and even less for 5G.

Table 4 Number of public authorities (NRAs/OCAs) providing information about the different key indicators.

Broadband technologies (homes passed)			
	Wired broadband (Providing information for at least one technology)	FWA	5G
Homes passed	21	13	17
Homes passed- rural areas	16	12	13

¹⁴ The preparation of the Broadband Coverage Reports and the related data collection and verification have been commissioned by the EC to a series of consultants since the beginning of these studies. These “EC consultants” have developed, revised and applied the Study methodology under the EC supervision.

¹⁵ See Digital Decade 2024: Broadband Coverage in Europe 2023 available at: <https://digital-strategy.ec.europa.eu/en/library/digital-decade-2024-broadband-coverage-europe-2023>

¹⁶ BEREC has no information about one country.

¹⁷ In order to better capture the quality of service provided by fixed and mobile broadband networks, in 2022, a new coverage category was introduced in the EU Broadband coverage studies aimed at monitoring coverage of for VHCNs as defined in the EECC and in related BEREC’s Guidelines. This indicator was named: “VHCN coverage (BEREC definition)” to distinguish it from the “Fixed VHCN Coverage” indicator which is based on FttP and DOCSIS 3.1 coverage information.

¹⁸ For the 2022 study, the definition of speed coverage was changed to align with the BEREC definition of “expected peak time speed” as provided in BEREC’s (BoR (20) 42 and BoR (20) 165) from the previous definition of “actual achievable speed”. The new definition was maintained in the 2023 study.

QoS Information¹⁹			
Download peak time speed per tiers - (30 Mbps, 100 Mbps, 1 Gbps).	15	10	9
Download peak time speed per tiers (30 Mbps, 100 Mbps, 1 Gbps). Rural areas	15	10	8
Peak time speed (upload and download) >= 1Gbps	16	9	8
Peak time speed (upload and download) >= 1Gbps. Rural areas	14	8	7
VHCN coverage (BEREC definition)			
Overall VHCN coverage- NUTS 3 areas	14		
Overall VHCN coverage- NUTS 3 & rural areas	14		
Overall VHCN coverage- national	18		
Overall VHCN coverage- national & rural areas	17		

Table 1 in Annex 1 provides further detail on the technologies which authorities inform about (coverage and QoS).

It should be noted that in 5 of these European countries, operators submit some of the data that authorities are not providing to the EC Consultant so that the report can be completed. Moreover, some technologies are not available throughout Europe so one should not expect all authorities to be reporting about those. For example, only two authorities could not report data about FWA when they should have.

Moreover, in several cases, the EC Consultant completes any missing information by providing estimates using the information provided by the authorities- for example this is the case when some information about rural areas is not available and is approximated on the basis of overall coverage and QoS information.

Still, in some cases, the EC Consultant needs to disregard the information provided by the authorities when publishing the EU Broadband Coverage reports since there are many countries for which the information is missing or because the national indicators are deemed “non-comparable”, as a result of methodological differences.

The areas which seem more problematic are information about expected peak time speeds²⁰, VHCN coverage (BEREC definition), coupled with information about 5G coverage for different bandwidths.

¹⁹ It should be noted that in a few cases the NRA/OCA does report expected peak time speeds but other speed parameters. For fixed wired broadband this happens in 3 cases, for FWA in one, and for 5G in a couple of cases.

²⁰ Several authorities are unable to report peak time speed information.

- Expected peak time speed information

As seen, expected peak time speed information is not available in several countries, both for fixed and for mobile broadband. The statement is unsurprising given BEREC's finding that in producing their Article 22 broadband maps (and with reference to fixed broadband): "*MS experience important problems in collecting QoS information at a sufficiently granular level and expected peak time speed plays out as a specially challenging indicator*"²¹. The situation is worse in the case of mobile broadband for which the collection of QoS information is even more complex²² and where there has been no agreed solution on the kinds of QoS information which would better characterize mobile broadband networks²³.

Regarding expected peak time indicators, one authority questions the relevance of collecting information for services which provide 30 Mbps, given the Digital Decade Policy Programme²⁴ connectivity objectives. Moreover, the same authority considers a finding of an upload speed greater of equal to 1Gbps very unlikely since this would require supplementary uplink carriers.

- VHCN coverage

Whilst information about this key indicator seems more widely available than expected peak time information at national level, the situation is reversed for NUTS 3 level, where only 14 authorities provide such information. Most of these 14 authorities are providing this information on the basis of their Article 22 broadband map.

However, it should be noted that sometimes this VHCN coverage indicator is produced by using definitions that only partially correspond to the definition included in the EECC and related BEREC VHCN Guidelines. For example, some authorities provide this VHCN information exclusively based on the coverage of some technologies (for example, FttP and/or DOCSIS 3.1 networks) or on the combination of technology and expected peak time speed information.

Indeed, according to BoR (24) 146, BEREC implementing report on Art. 22 GL, only 9 NRAs/OCAs collect data about VHCN Class 2 and even less (5 NRAs/OCAs) about VHCN classes 3 and 4.

²¹ See page 2 in BoR (24) 146, Implementation report on the BEREC Guidelines on Geographical surveys of network deployments

²² The estimation of speeds on the basis of signal strengths that are the outcome of theoretical radio models is considered particularly challenging and may result in non-robust results, since speeds are determined by many more factors (including, data traffic demand, frequency bands and other features like 4x4 MIMO, etc).

²³ This lack of a common view (see Responses to Question 3 A in BoR (20) 41, BEREC Report on the outcome of the public consultation on the draft BEREC Guidelines to assist NRAs on the consistent application of Geographical surveys of network deployments), is reflected in BEREC Art. 22 GL, which granted authorities the flexibility to choose the performance information to collect for mobile networks, making speed information an optional requirement and recommending "maximum achievable speed" as a possible indicator.

²⁴ Decision (EU) 2022/2481 of the European Parliament and of the Council of 14 December 2022 establishing the Digital Decade Policy Programme 2030



As a consequence of these disparities, the report *Broadband Coverage in Europe 2023* cautioned against any direct cross-country comparisons²⁵ of this indicator.

- 5G coverage information

On top of the 5G overall coverage information, in 2022 the EC introduced in its data collection a metric to examine the progress in the roll-out of 5G networks utilizing the 3.4–3.8 GHz frequency band, and two new 5G categories to measure 5G coverage and QoS in any band achieving a carrier-aggregate 80 MHz bandwidth and 5G coverage using the 3.4–3.8 GHz frequency band or achieving a carrier-aggregated spectrum bandwidth of at least 80 MHz²⁶.

Many countries have been unable to report on these metrics. 14 authorities (out of 21) have provided coverage data regarding the 3-4-3-8 GHz band and 11 about the other two bands. The numbers of authorities reporting on expected peak time speed coverage for these different bands are even smaller.

One authority explains that four levels of 5G disaggregation are computationally challenging and that the considered classification in different frequency bands does not take into account the principle of technology neutrality and the overall contribution of carrier aggregation within 4G and 5G. Moreover, it is unclear what the benefits are of having this information fragmented.

Given the unavailability of information for the 80 MHz and the 3.4–3.8 GHz frequency bands and the fact that the partial results which were received were in line with those obtained for overall 5G, the 2023 report “*Broadband Coverage in Europe*” did not publish the results about these bands.

Finally, the same authority criticises that in the context of the broadband reports there is no clear definition of what it means to be covered by 5G, whether this is based on a certain signal level or a minimum service level and that the application of the principle of technological neutrality is unclear as one is unsure of its taking into account the contribution of 4G in the aggregate 5G service.

2.2 General difficulties in providing coverage (Homes passed) at NUTS 3 level data

²⁵ See Section 4.3.4 in *Broadband Coverage in Europe 2023*, available at [Digital Decade 2024: Broadband Coverage in Europe 2023 | Shaping Europe's digital future \(europa.eu\)](#)

²⁶ According to the *Broadband Coverage in Europe 2023* report the 3-4-3.8 Ghz frequency band “is considered the most appropriate for 5G (5G primary band), capable of delivering high throughput (large contiguous bandwidth) and at the same time traveling significant distances, which in general means an improvement in quality of service and user experience”. The other metrics were introduced to “allow for a more technology-neutral monitoring of the progress of high-quality 5G connectivity that is not reliant on the mid-band spectrum allocation”.



The different coverage and QoS indicators are requested at NUTS 3²⁷ level and national level. Most authorities can provide technology coverage information at NUTS 3 level.

The one authority that provides national information only, has plans to provide a more granular breakdown for some technologies in the future, on the basis of its Article 22 broadband map, which is currently under validation²⁸.

Table 5 Number of authorities providing information at a certain level of geographical disaggregation by source of the information²⁹

Source of information	Level of disaggregation of coverage information (homes passed)	
	NUTS 3 & national Information	Only national information
Article 22 map	12	1
Other broadband maps	1	
Other methodologies	5	

Moreover, several authorities explain that there are no difficulties in providing data at NUTS 3 level. Those reporting difficulties refer to the those described in Section 3, related to the concepts of “homes passed” and “rural areas”.

Section 3. General difficulties in providing information – granularity of data and aggregation of coverage by technologies and by VHCN to NUTS 3 level

When delivering coverage indicators at NUTS 3 level, it is necessary to identify the homes passed by each individual technology and (sometimes) to deal with overlaps of several operators or technologies in the same area or geographical unit of reference. An overlap is identified when more than one operator provides access to broadband for a single spatial unit (e.g. a grid cell, a parish) and as well as when one operator provides access to broadband for a single spatial unit through more than one technology.

²⁷ “The Nomenclature of territorial units for statistics, abbreviated NUTS (from the French version Nomenclature des Unités territoriales statistiques) is a geographical nomenclature subdividing the economic territory of the EU into regions at three different levels (NUTS 1, 2 and 3 respectively, moving from larger to smaller territorial units). The NUTS 2024 classification is valid from 1 January 2024. It lists 92 regions at NUTS 1, 244 regions at NUTS 2 and 1 165 regions at NUTS 3 level.” Source: <https://ec.europa.eu/eurostat/web/nuts/overview>

²⁸ This authority reports difficulties for some DSL technologies since those cannot be characterized at premise/address level and in those cases the location has to be proxied with the information of the cabinet and exchange location.

²⁹ BERECA has no information about two authorities.

BoR (24) 146, the BEREC implementing report on Art. 22 GL informs that, in 2023, 24 European countries collected fixed broadband information at address level, 2 used small grids (this is, smaller than or equal to 100 x 100 m²) and one combined small grids and addresses; for FWA the data collection was either at address level or small grids; and for mobile broadband in all countries but one in small grids.

The availability of such granular information makes dealing with overlaps an easy task and results in more robust coverage indicators, as authorities only need to identify whether an address or small grid is passed, and overlap is treated at this level, with less uncertainty.

According to the BEREC's findings in the context of this report, most of the 21 authorities providing information to the EC Consultant on the basis of granular information, experience no important problems in the aggregation of fixed broadband and VHCN coverage to NUTS 3 level³⁰. One authority that collects fixed broadband coverage with small grids, explains that when a grid is served by more than one operator, they apply to all households in each grid the best specifications of the best operator. Yet, there are 3 authorities that need to deal with overlaps since they do not rely on raw information that is sufficiently granular³¹. These authorities use assumptions and estimates to provide NUTS 3 level coverage data.

In the case of mobile broadband, 13 out of the 17 authorities providing mobile broadband information to the EC Consultant do this by aggregating data collected at small grid level (smaller than 100 m x 100 m) to NUTS 3 level. One uses a slightly larger grid. Several of those deal with overlaps at grid level by considering the coverage of the operator with maximum coverage in the grid.

As a conclusion, the Broadband Coverage in Europe 2023 report reflects on the way in which authorities have developed their broadband maps and provided coverage indicators to the EC Consultants³²: *“With the proliferation of broadband mapping tools used by NRAs in their individual national data collections, the research team increasingly relies on the NRAs to also provide data for the technology combination categories. These typically include granular insights into technology overlaps, often times available on address level”*.

Section 4. Definitions

Several authorities report difficulties in providing coverage and QoS information in terms of “homes passed” and for “rural areas”.

³⁰ Three of those report that they deal with overlaps at address level.

³¹ Data is collected at municipal or submunicipal level.

³² See Section 3.5 in Broadband Coverage in Europe 2023, available at [Digital Decade 2024: Broadband Coverage in Europe 2023 | Shaping Europe's digital future \(europa.eu\)](https://digital.ec.europa.eu/digital-decade/digital-decade-2024-broadband-coverage-in-europe-2023-shaping-europe-s-digital-future)



Concept of “homes passed”

The EC Consultants require that coverage, VHCN, and expected peak time data is provided using the concept of homes passed. This concept is undefined in the EC Consultant’s questionnaire and seems to be interchangeably with the concept of “households passed”³³. The questionnaire includes a series of definitions of what it means for a household to be passed by a certain technology, for example *“A household has FTTP coverage if it can be connected now to a fibre service without requiring the construction of new fibre infrastructure and is available to be connected within reasonable time and cost limits”*.

The BEREC Art. 22 GL provided the definition of “premises passed”, the cornerstone concept of the fixed broadband Article 22 geographical survey. According to the BEREC implementing report on Art. 22 GL in 2023 a wide majority of European countries were collecting fixed broadband technology information using this concept at a very granular level (address).

In BoR (21) 172, the BEREC report to enable comparable national broadband coverage indicators throughout Europe, BEREC recommended that *“instead of relying on “households and households passed”, the Study considers the “premises and premises passed” concepts as defined in the BEREC Guidelines”* and that *“this change is applied in the very short-term, considering its importance and impact on the comparability of data provided throughout Europe”*³⁴.

Some of the difficulties detected by BEREC in the preparation of this report regarding “homes/households passed”, are identical to the ones detected in 2021.

- (i) How authorities interpret “homes passed by a certain technology”

Out of the 21 MSs where a public authority provides information to the EC Consultant, 10 used the definitions provided by the EC Consultants, some with minor interpretations of their own. A couple of other MSs complemented the EC Consultant’s definitions³⁵.

However, several countries adapted the definitions to include non-residential premises or to explain how they detected “residential premises”, a fact that is related to the inability of some authorities to distinguish residential and business premises (see point ii below). One defined ‘home passed’ as the sum of households and business units. Another defined ‘homes passed’

³³ Eurostat defines those as: Either a one-person household, defined as an arrangement in which one person makes provision for his or her own food or other essentials for living without combining with any other person to form part of multi-person household, or a multi-person household, defined as a group of two or more persons living together who make common provision for food or other essentials for living.

³⁴ See Section 2.1 in BoR (21) 172, BEREC Report to enable comparable national broadband coverage indicators throughout Europe.

³⁵ For example, one MS defined ‘homes passed’ as the sum of subscriber connections that are in use or can be activated without construction, and the availability of subscriber connections where a network has been built near the customer’s location. Another considered: ‘home passed’ as including address points and end customers at whose property boundaries there is an empty conduit system in the immediate vicinity on the same side of the street, containing a speed pipe empty conduit or fiber optic cable intended for FTTB/FTTH expansion of the property, or an HFC network is available, both of which can be branched off in a reasonably short time.



as households passed, which are addresses that contain (at least) a residential function. Another considered 'home passed' as residential premises without premises where a business activity is carried out. Lastly, in one case, 'home passed' was defined as dwellings or non-residential or mixed buildings duly prepared to receive electronic communications services supported by optical fiber/DOCSIS3.1 in the parish.

(ii) Inability to distinguish residential and business premises

Ten countries can identify "households" ³⁶ but another 10 cannot distinguish whether a premise is residential or a non-residential or identify whether these residences are actually occupied³⁷.

In three of these cases, the raw coverage data does not differentiate between types of buildings and, (in one case), the information, which is collected by postal code, does not distinguish between residential and business premises.

(iii) National adaptations to the household figures provided by the EC consultant

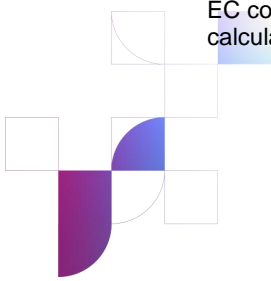
Moreover, in 13 cases, authorities need to substitute the household figures provided by the EC Consultant, with figures that they have available and with which they can provide coverage information. Yet, in another 9 cases authorities use the figures provided by the consultant. Among those using different figures some use the building registry's definition and data for households, residential premises data, households plus business units, or they provide their own household data to consultants. Others use their own denominator, or rely on information from various agencies, government offices, or the National Statistics Office.

(iv) Homes passed for 5G

For the question regarding difficulties in providing 5G coverage data at the homes level, 6 MSs reported no difficulties, while 6 MSs indicated they faced challenges. Some MSs stated that the resulting value was estimated from the calculated percentage of population coverage,

³⁶ In some of these cases, authorities rely on "premises passed" information but can proxy the number of homes passed by using additional databases or information. For example, one has knowledge of whether a dwelling is inhabited by a household or not. Another determines the number of premises with available service and the potential number of households with the help of an auxiliary database. Another authority explains that the coverage data collected in their broadband map refers to address points and that in order to have information on households, the number of households must be added to each building. Combining this information is difficult and not possible for all buildings.

³⁷ One of these authorities explains that it provides the number of premises passed for each NUTS 3 area to the EC consultants, another that the operators are the ones who provide data on homes passed and that household calculations are adapted to include dwellings and non-residential locations.



which is a practise that the EC Consultant admits. Due to the lack of official data on the number of households, information from operators was used in some cases. In one MS the number of households in 5G coverage could be determined, but the built-up area covered by 5G could not be defined due to the lack of a definition for built-up areas.

Concept of “rural households and rural homes passed”

The EC consultant is using the following definition to identify rural areas: “Rural areas are defined as areas with a population density of less than 100 inhabitants per square km”.

Of the 24 MSs from which BEREC has retrieved information, 15 stated that they provided data on rural homes passed at the NUTS-3 level. One MS indicated that they provided data on rural homes passed at the NUTS-3 level only for fixed broadband, not for mobile. 9 reported no problems in identifying rural coverage, although several resort to their own definitions of “rural area” or adaptations.

Indeed, some authorities explain that their demarcation for rural areas in order to calculate broadband coverages does not align with the definition of “rural” provided by the EC Consultants. In 12 cases these authorities need to adapt the calculations of coverage for rural areas and replace the household figures provided by the EC consultant for their own since their definition of rural areas aligns with information provided by various public bodies in each country.

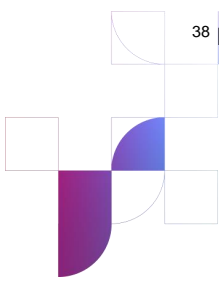
Additionally, some MSs indicate that, despite using the same definition as the EC Consultant, their household data differ from those provided by the EC Consultant.

Several authorities explained that they do not have raw information at the proper level of resolution to report on “rural” areas as required by the EC Consultants. They resort to other resolutions like the municipality level, parish level, or settlement level.

On top of this, several authorities cannot identify rural premises and even if they accept the EC Consultant rural household data, they are unable to verify whether those premises are rural or not.

Similar problems were detected in BoR (21) 172 the BEREC report to enable comparable national broadband coverage indicators throughout Europe (published in 2021). In this report, BEREC concluded that *“to provide for comparable rural coverage indicators across Europe, BEREC holds that a common definition of rural, which can be mapped in small grids, should be available. Unfortunately, such set of resources do not always exist, and therefore rural coverage information can only be proxied. The approach of the EC consultants is a good attempt of dealing with the shortages of information.”*³⁸

³⁸ BoR (21) 172, p. 13.



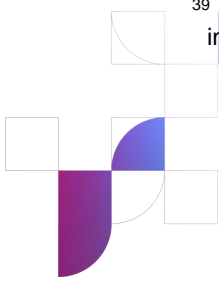
Section 5. Difficulties in providing information about 5G coverage

As a second connectivity indicator, the EC Decision (EU) 2022/2481 and the EC Implementing Decision setting out key performance indicators, C(2023) 4288 of 30 June 2023 defines 5G coverage, measured as a percentage of populated areas covered by at least one 5G network, regardless of the spectrum band used. With this in mind, out of the 17 MSs providing some 5G information to the EC Consultants³⁹, 13 indicate to have defined a certain national framework for collecting information from MNOs regarding their 5G coverage or at least certain rules that operators need to follow when submitting information. All reported these frameworks and rules had been implemented between 2020 and 2023. Other than these frameworks, one MS developed guidelines on how data for mobile broadband needs to be submitted to the authority for broadband mapping. In a couple of MS the coverage of 5G networks to deliver the KPI to the EC Consultant was calculated by the NRA on the basis of infrastructure information provided by the operators. Finally, in one MS the data is reported by the NRA to the EC Consultant as collected from the operators with no further treatment but simple aggregation rules, while yet in another the data is collected from the operators, verified and then submitted to the EC Consultant.

Several of these MSs are using a grid or raster format for the calculation of 5G coverage indicators. In term of verification of the data provided for 5G coverage indicators, only 2 state that they perform validation and/or correction measurements through independent signal measurements or on-site drive tests.

There are several of the NRAs/OCAs providing information on 5G (homes passed) that do not report 5G coverage per frequency bands, especially for 5G with 80 MHz bandwidth (only 11 NRA/OCAs report on this) and 5G in the 3.4-3.8 GHz band or with 80 MHz bandwidth (only 10 NRAs/OCAs report on this). These kinds of indicators are seen by some NRAs/OCAs as particularly challenging. One authority explains that the goal of having the whole European population connected in 5G by 2030, especially in rural areas, will be achieved with a mix of frequencies and, therefore, 5G should be considered in a 'spectrally neutral' manner; in this sense, 5G with 80 MHz bandwidth raises a significant concern as it is too high a reference. Another authority explains that the technology neutrality principle should be considered in connection of not considering to carrier aggregation between different 4G and 5G within

³⁹ These 17 authorities provide at least information on homes passed by 5G networks but may not provide information according to different frequency bands. Several MS report that all 5G data is provided by operators.



different bands. Another that it would be necessary to enable a band-neutral indicator that will be a relatively realistic proxy for the delivery of advanced 5G performance to end users.⁴⁰

In general, some authorities explain that collecting information about 5G and constructing 5G coverage indicators is challenging. One authority explains that there are difficulties in modelling the new capabilities of 5G (massive MIMO, beamforming); another that it is difficult to analyse the impact of the different 5G realisations that may be implemented by MNOs (SA/NSA (including with DSS)) and to decide whether or not different or additional minimum technical requirements would be needed; another that it seems sensible that for 5G networks the field size should be smaller than 100 m x 100 m since, 5G stations are really small and the 100 m standard may be too large).

In general, MSs agree that 5G KPIs are challenging to report and that they currently don't paint the real picture in terms of coverage and quality of 5G. Current 5G networks still heavily rely on 4G and there is also no separation in terms of bands dedicated for one technology only.

Section 6. Difficulties in providing information speed coverage

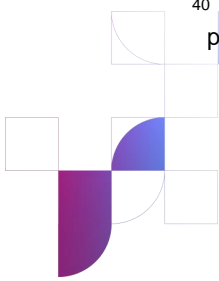
The EC Consultant questionnaire includes 4 speed categories (at least 30 Mbps download, at least 100 Mbps download, at least 1 Gbps download and at least 1 Gbps download and upload) collected for total number of households and for households in rural areas.

The speed definition matches BEREC's "Expected Peak Time Speed" definition outlined in BEREC Art. 22 GL and in BEREC's VHCN Guidelines (BoR (20) 165). According to these "*the expected peak time speed is the speed that an end-user in the address/grid could expect to receive when using a broadband service under the whole peak-time period. The speed should describe the actual capability of the network and not be related to any particular retail service offered at the address/grid.*

"Peak time" is defined as "the time of the day with a typical duration of one hour where the network load usually has its maximum". Peak time may vary among networks and regions. NRAs should (if they find this necessary) provide guidance on this aspect".

Taking into account above mentioned definitions and possible differences between MSs, difficulties in providing information according to the peak time speed definition and proposed tiers were considered for fixed technologies (DSL, VDSL. VDSL 2 Vectoring, FTTP, DOCSIS

⁴⁰ Cf. also BEREC's feedback to the European Commission's Draft implementing decision setting out key performance indicators for the DDPP, BoR (23) 50 – March 2023.



3.0 and DOCSIS 3.1), for FWA and for 5G (in 3.4-3.8 GHz band, with 80 MHz bandwidth and either of those).

Although 10 NRAs/OCAs have reported no difficulties in providing expected peak time speed for fixed wired broadband⁴¹, 6 MSs do not collect any expected peak time speed data for fixed broadband technology categories and one MS cannot produce information for xDSL. 3 of these countries provide information to the EC Consultant using another speed definition. In one country, the speed definition for fixed technologies is the one included in the national Policy Rule on internet speeds: maximum speed as written in end-users' contracts. Another reports technically available maximum speeds for wired technologies and the third one normally available speeds.

In one MS reporting “no difficulties”, the peak time speed data is provided by NRA to the EC Consultant as collected from operators. This NRA will initiate speed sampling measurements in order to verify the speed data provided by the operators for mobile technologies.

There are 10 MS where an NRA/OCA provides expected peak time information for FWA and in 6 cases these authorities report no difficulties in providing this information⁴². Providing expected peak time information for FWA is challenging due to characteristics of this technology. One country explains that small FWA operators cannot produce the expected peak time speed data as required, another refers to the difficulties in modelling capacity constraints for FWA and another refers to this data as being “difficult”. In one country, the NRA reports normally available speeds instead of expected peak time speeds. One country that provides no information to the EC Consultant explains that operators were unable to report on expected peak time speeds for FWA (also 5G) as those are difficult to model. One MS reporting no difficulties would encourage a common definition of FWA in licensed spectrum.

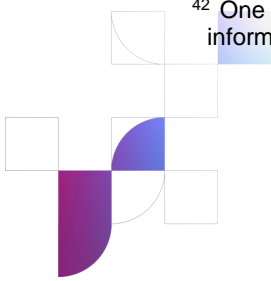
Fewer NRAs/OCAs provide information about expected peak time speed for 5G. Only 7 MSs collect this speed data in at least one band or category. One of these MSs reported that according to their technical analysis, peak-time speeds for mobile coverage are mostly theoretical and burdensome to calculate to justify their collection. In a couple of MSs, the NRAs provides this data using an alternative definition: estimated maximum speeds outdoors in one case, and technically feasible speed per antenna in the other. The remaining NRAs/OCAs do not collect expected peak time speed information for 5G. In some cases, the authorities report that operators find this metric quite difficult to provide.

Finally, one NRA specifies that the expected peak time speed information can be provided but results in outcomes that are neither significant nor practical.

The feedback received from public authorities show that collecting speed data for wireless technologies represents a challenge both for MSs and operators in more ways than for fixed

⁴¹ One of these countries has collected the expected peak time data but has not yet aggregated it to NUTS 3 level so as to provide it to the consultant.

⁴² One of these authorities only started collecting this data in 2023. Another provides the expected peak time information as collected from operators with no further treatment to the EC Consultant.



technologies. Moreover, regarding expected peak time speed information for 5G and per frequency bands, a very large number of MSs haven't started to collect peak time speed data, due to the technical difficulties faced in collecting this information.

Conclusions

This Implementation Report mainly shows the difficulties in collecting/aggregating data for the KPIs to measure the progress towards the DDPP targets which are the result of various reasons. Naturally, the implementation of the DDPP KPIs as of any KPI system is an on-going process by which the MS continue to adapt and improve their data collections in the pursuit of more comparable, relevant and accurate outcomes. In particular, new indicators and definitions need some “warm-up” phase to cope with initial and unexpected issues when actually collecting and processing the data needed for the KPIs (“learning curve”).

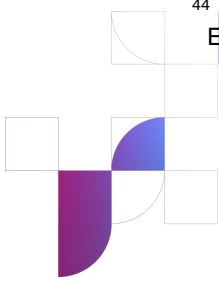
The process is more complex when some of the KPIs' definitions are missing or unclear and do not correspond to the information resources available at national level (“homes passed”) and when some indicators are (overly) complex (e.g. 5G coverage per frequency band instead of a technological neutral way across bands). In these cases, many NRAs/OCAs are either not able to collect the data (at the required granularity) and, as a consequence, some “customize” the (missing/unclear) definitions that they can provide at least partially a result to the EC Consultants. Moreover, in a number of MS operators provide data directly to the EC Consultants – often without a possibility to verify it by the public authority, so that the data may be even less comparable.

Overall, given that the some of the data provided to the EC Consultant is patchy/missing/stems from various (unverified) sources, it is difficult to make robust comparisons of some indicators across MSs, (regarding comparability this is particularly true for expected peak time speed).

However, as already seen in the BEREC Art. 22 GS GL Implementation Report⁴³ BEREC sees progress in the comparability with reference to 2021⁴⁴ as many NRAs/OCAs nowadays use the Art. 22 GS GL for the collection and aggregation of the data. Also, the number of NRAs/OCAs reporting data directly (instead of operators submitting the data) to the EC Consultants has increased. Moreover, many of these authorities are now able to report the data at a more granular level (grid or address level instead of municipal and submunicipal level) and, therefore, need no assumptions for the aggregation, both resulting in a better level of data quality and more comparability of national results. But as shown in the previous

⁴³ BoR (24) 146 published in October 2024.

⁴⁴ BoR (21) 172 – BEREC Report to enable comparable national broadband coverage indicators throughout Europe.



sections, BEREC has seen no progress over time in updating the definitions of homes passed and rural coverage.⁴⁵

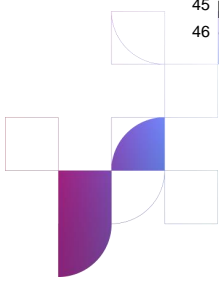
More generally, it is important that KPIs are defined in a way that they measure the objectives (in this case the progress towards the DDPP fixed and mobile connectivity targets), but are also proportional to the targets (i.e. do not make distinctions that are not needed to measure these targets) and simple to collect in practice as otherwise the comparability of the data across MSs will suffer because of incomplete results. Considering the complexities of the data collection processes and the uneven distribution of resources and experiences at national level, one should be able to tolerate some degree of non-comparability of figures while also expect it to diminish over time.

Thus, the trade-off between full accuracy and “good enough” should be decided case by case by assessing the benefit added by an extra level of accuracy vs. the costs of getting it in practice; in other words, “less is sometimes more” because, according to BEREC’s and NRA experience, adding complexity to the indicators doesn’t necessarily result in more comparability of the outcomes. In this regard, BEREC sees some progress, but also room for further improvement aiming simplifying NRA and OCAs practices in implementing KPIs. BEREC remains at the disposal of the EC for further work to deliver relevant and comparable connectivity indicators.

The results/conclusions of this Implementation Report will flow into both the update of the BEREC Art. 22 GS GL as well as BEREC’s views on the EC’s Methodology on 5G Mobile and Fixed QoS Coverage Mapping⁴⁶.

⁴⁵ BoR (21) 172 and above.

⁴⁶ 1st Draft presented on 16th July 2024.



Annex 1

Table 1. Number of authorities providing coverage (homes passed) and QoS information by technology (fixed and mobile broadband)

Broadband technologies ⁴⁷										
	DSL and/or VDSL	VDSL 2 vectoring	FTTP	Cable modem DOCSIS 3.0	DOCSIS 3.1	FWA	5G	5G in the 3.4-3.8 GHz bandwidth	5G with 80 MHz bandwidth	5G in the 3.4-3.8 GHz bandwidth or with 80 MHz bandwidth
Homes passed										
Number of homes passed	19	10	21	17	17	13	17	14	12	11
Number of homes passed rural areas	5	11	16	14	12	12	13	12	11	11
QoS Information										
Download peak time speed per tiers - (30 Mbps, 100 Mbps, 1 Gbps).	15	10	17	14	13	10	9	8	7	8
Download peak time speed per tiers (30 Mbps, 100 Mbps, 1 Gbps). Rural areas	13	9	15	13	11	10	8	7	6	7
Peak time speed (upload and download) >= 1Gbps	13	10	16	11	11	9	8	7	6	6

⁴⁷ It should be noted that not all broadband technologies are available in every European country, so that some NRAs/OCAs do not need to provide information for some technology categories.

Peak time speed (upload and download) \geq 1Gbps Rural areas	11	9	14	10	9	8	7	6	5	6
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