Methodology of the ICT Development Index 2023: Version 1

Prepared by the ITU Secretariat. April 2023.

Note: This version of 24 April 2023 addresses some minor typos and layout issues. It supersedes the version of 21 April.

Contents

1 Introduction

Created to measure the level of development of the information and communication technology sector (ICT), the ICT Development Index (IDI) was a composite indicator published by ITU from 2009 until 2017. It was discontinued in 2018, owing to issues of data availability and quality (see Box 1).

In October 2022, ITU's Plenipotentiary Conference 2022 in Bucharest adopted a revised text of Resolution 131. This new text (Rev. Bucharest, 2022) defines, *inter alia*, the main features of the process for developing and adopting a new IDI methodology and of the IDI itself (see Box 2). Consistent with the urgency imposed by Resolution 131, the objective is to launch the IDI in 2023 (see process and timeline in Annex 1).[1]

In this context, and in line with *instructs 8 to the BDT Director*,[2] the Secretariat prepared a 'Zero draft' document, which described a possible framework and structure for the IDI, to inform, facilitate and expedite the process. This document was posted on a discussion forum dedicated to the new IDI (IDI Forum), where the members of the Expert Group on ICT Household Indicators (EGH) and the Expert Group on Telecommunication/ICT Indicators (EGTI) were invited to share feedback on the draft methodology, comments and suggestions.

More than 200 members signed up for the IDI Forum and almost 100 comments were posted. A document with a compilation of all the comments received on the content and the respective responses from the ITU

[1] Resolution 131 instructs the BDT Director to "urgently perform the tasks set out in *resolves* above".
[2] "to facilitate the work of EGTI/EGH in fulfilling the tasks set out under resolves above, including through correspondence";

Secretariat was produced and posted on the IDI Forum. That document is also appended to this document as Annex 4. The 'Zero draft' document was revised in light of the comments received to produce this 'Version 1' document, which also contains additional proposals related to the treatment of outliers, aggregation and weightings.

In Circular BDT/DKH/IDA/009, Focal Points of Member States' Administrations were invited to register to access the IDI forum and post comments on this 'Version 1' document, on behalf of their respective Administrations. Comments must be submitted on the IDI Forum by 19 May 2023.

The rest of the document is organized as follows: Section 2 presents the conceptual framework (step 1 of the process of developing an index – see Table 1); Section 3 presents a set of selection criteria which combined with the conceptual framework help identify candidate indicators for inclusion (step 2) and the statistical analysis (step 3) used to narrow down and confirm the choice of indicators. Section 4 describes the approach to identify and treat outliers and missing data (step 4). Section 5 describes the approach to normalize indicators and aggregate them (step 5). Section 6 concludes.

Box 1: A brief history of the IDI

The IDI was published from 2009 to 2017. In the last published edition in 2017, 11 indicators were combined into a composite score.

In March 2017, an extraordinary meeting of the Expert Group on ICT Household Indicators (EGH) and Expert Group on Telecommunication/ICT Indicators (EGTI) adopted a revised set of 14 indicators to be included in the IDI. However, following the shift from 11 to 14 indicators, countries were facing challenges in collecting and submitting quality data. For the calculation of the 2018 IDI for example, 58 per cent of the data points would have to be estimated. Furthermore, there were issues with the harmonization and quality of the data used, and the methodology applied to derive some of the newly adopted indicators. Because of these flaws it was not possible to compute a methodologically sound index that reflected the true state of ICT development.

Since 2018, attempts either to publish the IDI in line with the Plenipotentiary Conference Resolution 131 "Measuring information and communication technologies to build an integrating and inclusive information society" (Rev. Dubai, 2018) or to develop an entirely new index have been unsuccessful, as no consensus could be reached.

To address these implementation challenges, Resolution 131 was revised at the 2022 Plenipotentiary Conference 2022 in Bucharest. Refer to the ITU website for more on the history of the IDI.

Box 2: Main implications of Resolution 131 for the development of the IDI

Resolution 131 (Rev. Bucharest, 2022) describes the main features of the process for developing the IDI methodology and of the IDI itself (relevant paragraphs of the resolution appear in brackets):

- ITU must publish a new IDI "urgently" (*instructs to BDT Director 1*);
- The new IDI will be published without ranking (*resolves 3*);
- ITU should establish a valid structure and methodology for the IDI, working through EGTI/EGH, and through formal consultations (*resolves 3*);
- ITU should establish the criteria on the minimum data availability for Member States to feature in the IDI, working through EGTI/EGH (*resolves 6*);
- The BDT Director should facilitate the work of EGTI/EGH (*instructs to BDT Director 8*);
- Methodology will be submitted to Member States for approval and adopted if 70 percent of respondents approve it (*resolves 3*);
- If adopted, the methodology will be valid for four editions, namely 2023-2026 (*resolves 4*);
- Member States will have with the option to decline to participate in the IDI during the given period of validity, though with the choice to re-join the exercise on an annual basis (*resolves 5*);

- A meeting of EGTI/EGH will be convened following a formal consultation of Member States with a view to resolving any contentious issues and seeking consensus (*instructs to BDT Director 9*);
- Integrity of all ITU's statistical work must be preserved, in strict adherence to UN principles on good statistics (*instructs to BDT Director 12*).

In addition to the IDI, Resolution 131 covers other topics not discussed here.

2 Conceptual framework (step 1)

ICT development is an inherently multidimensional concept. An evidence-based assessment of country performance therefore requires multiple indicators. An aggregate measure, or composite indicator, serves the purpose of summarizing a range of metrics into a single number. There are both advantages and disadvantages to using composite indicators, summarised in Table 1.

Table 1: Pros and cons of a composite indicator

Pros	Cons
• Can summarise complex, multi-dimensional realities with a view to supporting decision-makers. • Are easier to interpret than a battery of many separate indicators. • Can assess progress of countries over time. • Reduce the visible size of a set of indicators without dropping the underlying information base, making it possible to include more information within the existing size limit. • Uses the power of numbers to advocate an issue of concern and introduce it in the policy arena. • Facilitate communication with the public (i.e., citizens, media, etc.) and promote accountability. • Help to construct/underpin narratives for lay and literate audiences. • Enable users to compare complex dimensions effectively. • Bring public attention to the need to develop and refine statistical data collection.	• May send misleading policy messages if poorly constructed or misinterpreted. • May invite simplistic policy conclusions. • May be misused, e.g., to support a desired policy, if the construction process is not transparent and/or lacks sound statistical or conceptual principles. • The selection of indicators and weights could be the subject of political dispute and may be biased by data availability. • May disguise serious failings in some dimensions and increase the difficulty of identifying proper remedial action if the construction process is not transparent. • May lead to inappropriate policies if dimensions of performance that are difficult to measure are ignored, or if measurement lags are not taken into consideration. • May hide, inequalities within territorial units and trade-offs between alternatives, by presenting the average of averages. • May give the false impression that units are independent competitors, while hiding interdependencies and common underlying processes transcending borders.

Source: Based on OECD (2008).

Aggregation necessarily involves simplification. To guarantee a conceptually and statistically sound index, its construction must follow an iterative process, as formalised in the *OECD-JRC Handbook on Constructing Composite Indicators* (2008) and *Your 10-Step Pocket Guide to Composite Indicators & Scoreboards* from the European Commission (2019) and presented in Table 2.

Table 2: Steps for developing a composite indicator

	Step
1	Develop the conceptual framework based on the stated objective.
2	Identify potential indicators that capture those concepts.
3	For each considered indicator, assess coverage, methodological soundness, quality of data.
	Based on this assessment, revisit the framework, concepts, and/or indicators (steps 1-3) if necessary.
4	Identify and treat any outliers and missing data.
5	Define the suitable normalization, weighting, and aggregation methods.
6	Calculate the index.
7	Assess the statistical and conceptual coherence of the index.
8	Conduct sensitivity analyses and assess the impact of uncertainties on resulting scores.
	Based on the results of the sensitivity analysis, revisit steps 1-8 if necessary.
9	Make sense of the data and validate the results.
10	Communicate the results and underlying information.

Source: OECD (2008) and European Commission (2019).

Step 1 consists in developing a conceptual framework based on the objective of the composite indicator. When the IDI was developed in 2009, the objective was to assess the development of the ICT sector. Such development was seen as a simple progression from *access* to *use* to *impacts*, a sequence that provided the framework for the old IDI. However, the framework focused on the quantity of ICTs and less on the qualitative aspect.

This shortcoming is addressed by the concept of *universal and meaningful connectivity* (UMC). UMC is defined as the possibility for everyone to enjoy a safe, satisfying, enriching, productive and affordable online experience. Digital connectivity must be universal *and* meaningful to maximize its impact on society and the economy. UMC reflects the need for a holistic strategy for closing all aspects of the digital divide, across and within countries.

UMC has gained significant traction over the past two years. The concept of UMC was formalised in 2021, in the context of the implementation of the UN Secretary-General's Roadmap for Digital Cooperation. The ITU and the Office of the UN Secretary-General's Envoy on Technology convened a multi-stakeholder sub-working group (SWG) to work on a baseline and aspirational targets for UMC. The baseline and targets were launched in April 2022 along with a background document detailing the concept of UMC.

At the World Telecommunication Development Conference (WTDC) 2022 and ITU's Plenipotentiary Conference (PP) 2022, universal and meaningful connectivity was front and centre. The concept is mentioned multiple times in the Final Report of WTDC 2022: notably in Resolution 2 (Study Groups), Resolution 87 (Connecting every school to the Internet), Resolution 88 (Partner2Connect), Regional initiatives (Europe, Arab States). UMC is also captured in the first Strategic Goal ("Universal Connectivity: Enable and foster universal access to affordable, high-quality and secure telecommunications/ICTs") of the Strategic Plan 2024-2027, adopted at PP 2022.

For these reasons – its relevance and its recognition by ITU constituency – the concept of UMC has been selected to guide the development of a new IDI. Indeed, many comments by EGTI and EGH members on the IDI Forum were to express support for this concept. The remainder of this section describes the concept of UMC. More details about the concept are available in ITU and OSET (2022).

Figure 1 illustrates the two dimensions of UMC: use – ranging from *none* to *universal*; and quality – ranging from *no connectivity* to *meaningful connectivity*. "Universal connectivity" means connectivity for all. The two dimensions are complementary: neither universal connectivity with poor quality nor meaningful connectivity for the few will yield significant, society-wide benefits. At the same time, the two dimensions reinforce each other: more use can lead to more meaningful connectivity, and vice versa. Based on the definition of universal and meaningful connectivity, the SWG developed a conceptual framework (Figure 2).

Achieving *universal connectivity* (top half of Figure 2) calls for dedicating attention to the connectivity of people, households, communities, and businesses, rather than merely that of the average population.

- Focusing on people helps achieve universality by ensuring that anyone can connect regardless of their urban or rural location, gender, level of education, etc.
- Focusing on households, communities and businesses helps ensure that the main places where people can connect are represented: at home, in schools and community centres, and at work.

Figure 1: The two dimensions of connectivity

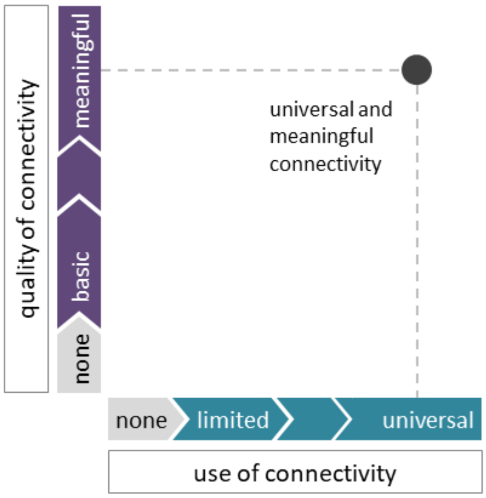
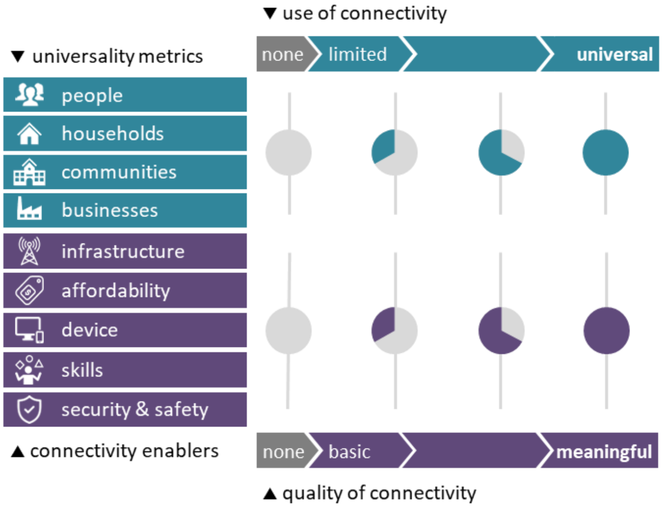


Figure 2: Conceptual framework of universal and meaningful connectivity



Source: ITU and UN OSET (2022).

Meaningful connectivity depends on several factors, called "connectivity enablers": infrastructure, affordability, device, skills, and safety and security (bottom half of Figure 2).

- Meaningful connectivity requires high-quality infrastructure that is not only in place and functioning but allows for a fast and reliable connection. The framework adopts a technology-neutral approach. Satellite connectivity, and fixed and mobile terrestrial networks, all can contribute to connecting people to the Internet.
- Affordable devices and ICT services are essential for enabling people to go online. Affordability is a relative concept that depends on people's social and economic conditions.
- Access to an Internet-enabled device is required to go online. These can be either mobile phones or desktop computers, considering that the most basic models of the former are cheaper, while the latter allow for a richer experience. For mobile phones, it is important to distinguish use from ownership, recognizing that mere access without full possession of a device imposes constraints, including when and for how long one can be online.
- An important barrier keeping people from going online or fully benefiting when they are online is a lack of skills. Meaningful use of the Internet requires that people are digitally literate.
- A safe and sec*ure Internet* is important for people to have the trust to go online.

A country with a highly developed digital eco-system is a country where there is a high Internet usage among the population, empowered by high quality enablers. This means that everyone that wants to can connect to high-quality, affordable and safe Internet and benefit fully from its services.

The analytical framework defines the scope, but also sets the boundaries of the exercise. The following aspects of connectivity are out of scope:

- **Levers.** Enablers of connectivity representing areas where policymakers and other stakeholders can intervene using tools such as investment, policies, and regulation. They are not included in the framework as it is deliberately agnostic about the means to improve on the various factors, as there is no single pathway and no one-size-fits-all policy mix that can be prescribed to all countries.
- **Catalysts.** Broader factors and trends, such as economic development and technological innovation, that contribute to improving the quality enablers.
- **Content and services.** These are treated as a lever: the more content and services are available, accessible, and relevant, the more likely people are to connect. Content and services are an enabler of connectivity, but they do not directly influence the quality of connectivity, which is what the frameworks aims to assess.
- **Applications.** The framework is deliberately agnostic about what people do with connectivity. The exercise is about measuring the use and quality of connectivity, rather than assessing what people do online.
- **Impacts.** By extension, the societal, environmental, and economic impacts of connectivity and its applications are well beyond the scope of the exercise.

3 Indicator selection and quality assessment (steps 2 and 3)

The next step in the process is to identify potential indicators that capture the concepts of the conceptual framework. Table 3 summarises the criteria for selecting an indicator as candidate for inclusion in the index. These criteria include the instructions from resolution 131.

Table 3: Indicator selection criteria

	Criterion	Rationale
1	Relevance to the concept	An indicator should measure one aspect of the concept retained for the index, in this case universal and meaningful connectivity and have policy relevance.
2	Clarity/interpretability	Indicators should be easy to interpret and the impact on universal and meaningful connectivity clear.
3	Source	Indicators should rely primarily on official data provided by Member States, based on internationally recognized and transparent methodologies (as per *Instructs to BDT Director 4* of Resolution 131).
4	Reliability	The indicator should be coherently collected and provided by countries according to the harmonized methodology developed by ITU's expert groups EGTI/EGH, or by another international organisation.
5	Applicability to measure country performance	The indicator should have a sufficiently high variation to allow a meaningful distinction of country performance in any single year and have the capacity to signal progress over time. Quantitative indicators are preferred over qualitative indicators.
6	Availability and timeliness	Recent data should be available for as many of the 196 considered economies as possible[3], to ensure the broadest coverage possible and reduce the number of estimates, as per *resolves 3* of Resolution 131.

[3] For the purpose of the index, 196 economies are considered: the 193 ITU Member States plus Hong Kong (China), Macao (China), and Palestine.

The first two criteria are self-explanatory steps for any kind of index construction. The third, fourth and sixth criteria stem directly from Resolution 131. The fifth criterion is a best practice in index construction.

The most problematic aspect is data availability. In the context of a composite indicator, maximizing data availability for the countries included is crucial for enabling meaningful comparison. Comparing the performance of a country with 100 per cent data availability against that of a country with only 50 per cent availability is obviously misguided and problematic if the index is meant to help decision making. In addition, limiting the coverage of an index to the sole countries with full or nearly full data coverage would mean excluding most LDCs, and many low- and middle-income economies from the index.

Data availability and reference period

With these considerations in mind, we follow a two-step approach to indicator selection: 1) indicators that fit the conceptual framework and comply with the criteria 2-5 from Table 3 are considered; 2) data availability is assessed (criterion 6), using the percentage of economies for which official data exists.

To assess data availability, we first must identify a *reference period*, which is the period of the majority of the data points. ITU's data collection cycle plays an important role in determining the reference period.

In the ITU questionnaires, countries usually submit data for the previous year. Furthermore, the results of the long questionnaire (LQ), which is conducted in the third quarter of each year and provides more – and more final – data than the short questionnaire (SQ) conducted in the second quarter of each year, are available at the very end of the year. In addition, all estimates are computed and validated by countries by the end of year, too. The end of the year is therefore a natural cut-off date and defines the reference year. Therefore, to assess data availability in 2023, we use the results of the questionnaires of 2022, which contain mostly 2021 data.

To maximize data availability and reduce the number of estimates, we extend the reference period to the year preceding the reference year, 2020 in the present case. The reason is that not all data are collected annually, especially those derived from household ICT surveys.[4] Therefore, the reference period to assess data availability for candidate indicators is 2020-2021. When computing the percentage of economies for which data exists, only official data for 2020 and 2021 are considered. Estimated values are *not* considered as available data. Annex 2 reports data availability for all indicators for the reference period 2020-2021. Some EGTI/EGH members suggested to extend the reference year to 2019, but we believe this would be going back too far (see the discussion in the section *Reference period* of Annex 4 for more information).

Beyond assessing data availability to guide the *development of the index*, the same reference period will be used for the *computation of the index* in 2023 and in subsequent years. That is, for an edition of the IDI released in year *t*, the reference period will always be *t-3* and *t-2*.[5] Of course, within this reference period, if data is available for both years t-2 and t-3, the most recent (i.e., *t-2*) will be used. For example, for the 2023 edition, the reference period will be 2020-2021. For the 2024 edition, the reference period will be 2021-2022, and so on. The only difference with the 2023 edition is that subsequent editions will be launched much earlier in the year.[6]

[4] In a handful of cases (typically fewer than 10), countries manage to submit data for household indicators for the current year, if they administered their household survey early in the year and managed to compute and submit the results in the household long questionnaire.

[5] This is different from what was proposed in the 'Zero draft' document, where the proposal was that for subsequent editions of the index, we would use *t-1* as reference year for an edition *t* of the index. Upon further investigation, this option proved not feasible, as explained in the text.

[6] If the methodology is approved, the 2023 edition of the IDI will be launched in later November/early December (see Annex 1). The 2024 edition would then be launched in the first half of 2024 (to allow for six months between two editions). Subsequent editions of the index would be launched at the end of the first quarter of each year.

Indicators for which official data for the reference period 2020-2021 are available for less than 50 per cent of economies (i.e., fewer than 98 economies), are in principle excluded, except if there are compelling reasons to keep them. Estimating more than 50 per cent of data points for an indicator would be a hazardous exercise. This threshold is already very lenient: a threshold of 65 per cent is more in line with good statistical practices (see for example EC (2019)). But in the case of ICT indicators, this would cause too many indicators to be discarded. In addition, Resolution 131 limits the use of estimates and other data sources to the strict minimum.[7] Finally, estimating many data points is extremely time-consuming and would delay the release.

The exclusion of an indicator based on data availability does not mean that it is irrelevant. Indeed, it may capture an important aspect and must be collected and reported with the hope that coverage can be improved, so that it can be included in a future revision of the index.

Based on these criteria, various indicators are considered that fit the conceptual framework and determine whether they could be included based on data availability and reliability.

The rest of this section takes into account the comments by EGTI/EGH members. Three indicators proposed in the 'Zero draft' document have been excluded from the selection: *Percentage of population within reach of transmission networks, by distance (10 km, 25 km, 50 km)*, *Gross secondary enrolment rate*, and *Gross tertiary enrolment rate*. Three indicators have been added: *Percentage of individuals owning a mobile phone*, *Mean years of schooling*, and *School life expectancy*. The reasons for these changes are listed below and in Annex 4.

Indicator selection: Universal connectivity

As mentioned above, the notion of universality encompasses four categories: people, households, communities, and businesses. The latter three represent the main places where people can connect: at home, in schools and community centres, and at work. The following indicators are therefore natural candidates for inclusion: **individuals using the Internet, households with Internet access, business using the Internet** and **schools using the Internet**.[8] In addition, using the Internet requires a subscription to a service, so **mobile broadband subscriptions** and **fixed broadband subscriptions** are added to the list of candidates (for more information, see the ITU Secretariat's responses in the section *Fixed-broadband subscriptions per 100 inhabitants* of Annex 4).

Regarding *Internet use by individuals*, some commenters noted that countries submit data for different age ranges, proposing to align all countries based on the same population range (e.g., based on 16 to 74 years). This is a very important and relevant point. Although ITU's *Manual for measuring ICT access and use by households and individuals* (Chapter 7, page 171) recommends collecting data for all individuals aged 5 and above, many countries do not survey children and/or older persons. This creates comparability issues, particularly where older persons are not surveyed. Countries with available data consistently report that they are less likely to use the Internet. One option as suggested is to use only the 16-74 age bracket. Though some differences in survey scope would remain, this option has the clear advantage of increasing the comparability between countries. However, there are costs to this approach. First, many countries that provide overall Internet use data do not provide breakdowns by age. Availability of official data for 2020 or later drops from 96 countries to 64 when requiring data for the 16-74 age range – below the threshold set for inclusion in the index. If this indicator was included despite the lack of data, more estimation would be required. In addition, using Internet use for only the 16-74 age range for the purposes of the index diminishes the importance of

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[7] Resolution 131 (Rev. Kigali, 2022) instructs the BDT Director "to rely primarily on official data provided by Member States based on internationally recognized and transparent methodologies, while also taking into account their level of ICT and statistical database development; only in the absence of such information may other sources be used, after consulting with the focal points of the Member States concerned in advance on other sources used to obtain the information by means of which ITU fulfils the role referred to in considering a) above;"

[8] Internationally comparable data on community centres with Internet access unfortunately do not exist.

children and older persons when assessing ICT development in countries, which would be in contradiction with the concept of universality. Therefore, the costs outweigh the benefits.

For fixed broadband subscriptions, the breakdown by speed tier could be considered for inclusion as well. The argument is that subscriptions using a faster connection speed allow for better quality online content, a better experience for customers and more connected devices. Some of the comments on the IDI forum highlighted this as well. While this is certainly true, there are some limitations. First, the indicator reflects *advertised* speed, and not *actual* speed.[9] There are other indicators that provide a direct measure of speed or an indicator on fixed broadband traffic. These are discussed below, in the infrastructure section. A second consideration is conceptual. The definition of meaningful connectivity implies that a user should be able to do whatever they want, without prescribing any specific online behaviour. While a faster connection is preferrable, it is not possible to set a goal post as this would amount to prescribing an ideal speed, which in turn would prescribe a certain type of usage. Finally, using the indicator for total fixed broadband subscriptions instead of the breakdown by speed tiers increases the availability of data (for more information, see the ITU Secretariat's response in the section *Fixed-broadband subscriptions by speed tier* of Annex 4).

The indicator fixed broadband subscriptions is divided by population. Instead of population, other demographic measures have been suggested, in particular the number of households. Dividing by households has the advantage of taking into account that fixed-broadband subscriptions are often shared within one household and that the average size of households varies across countries. Indeed, several EGTI/EGH members argue that – conceptually – household is a better denominator than population. An EGTI subgroup is addressing this question, but its conclusions will not be ready in time to feed into the IDI consultations.

While there are arguments in favour and against both household and population, data availability is ultimately the deciding factor. Data availability on the number of households is very poor. The UN Population Division provides the most complete data on household size (which can then be used to derive number of households). Unfortunately, these data are reported mainly through decennial censuses or other non-regular surveys. *Only 35 countries have reported data on household size to the UN Population Division since 2019.* We would need to estimate the size of households for well over 100 economies. This is outside the expertise and mandate of ITU In addition to the UN Population Division's database, other data sources on household size and composition exist, such as census microdata and national household surveys. However, these sources are not harmonized.

All things considered, while we acknowledge that using household as the denominator has some merit (although it is not clear if the advantages offset the disadvantages), the reality of data availability means that is not possible to compute the indicator fixed-broadband subscriptions per household for enough countries. This leads us to recommend using population as the denominator (for more information, see the comments and ITU Secretariat's responses in the section *Fixed-broadband subscriptions per 100 inhabitants* of Annex 4).

The potential universal connectivity indicators in detail

Indicator	**Percentage of individuals using the Internet**
Relevance	This is the main indicator for universal connectivity.
Availability	2021: 84 economies 2020-2021: 96 economies
Reliability	The indicator is an SDG indicator, defined in the ITU Household Manual (ITU, 2020a). It is also one of the core indicators of the Partnership on Measuring ICT for Development.
Source	The source is usually ICT household surveys conducted in countries, often by the national statistical office, but sometimes by other entities as well, such as the regulator. At the international level, data are collected from countries by ITU. Data are also collected by Eurostat for their member countries, as well as by the OECD.

[9] In general, differences between advertised speed and actual speed are due to network overload, user congestion, or more devices being added to the network (connected devices). Other factors that may also affect performance are, for example, interference or environmental factors.

Preliminary assessment	Although availability is just below the threshold, the indicator is retained because of its importance in the conceptual framework.

Indicator	**Percentage of households with Internet access**
Relevance	This indicator covers the most common place where people connect to the Internet: at home.
Availability	2021: 81 economies 2020-2021: 94 economies
Reliability	The indicator is defined in the ITU Household Manual (ITU, 2020a). It is one of the core indicators of the Partnership on Measuring ICT for Development.
Source	The source is usually ICT household surveys conducted in countries, often by the national statistical office, but sometimes by other entities as well, such as the regulator. At the international level, data are collected from countries by ITU. Data are also collected by Eurostat for their member countries, as well as by the OECD.
Preliminary assessment	Although availability is just below the threshold, the indicator is retained because of its importance in the conceptual framework.

Indicator	**Percentage of businesses (10+ employees) using the Internet**
Relevance	This indicator covers a common place where people connect to the Internet: at work.
Availability	2021: 3 economies 2020-2021: 8 economies
Reliability	The indicator is defined in the UNCTAD Manual (UNCTAD, 2021). It is one of the core indicators of the Partnership on Measuring ICT for Development.
Source	The source is usually ICT business surveys conducted in countries, often by the national statistical office, but sometimes by other entities as well. At the international level, data are collected from countries by UNCTAD. Data are also collected by Eurostat for their member countries, as well as by the OECD.
Preliminary assessment	While this is a very relevant indicator, as highlighted by some of the commenters on the Forum, the indicator is excluded for data availability reasons.

<table>
<tr><td>Indicator</td><td colspan="3">Percentage of schools using the Internet</td></tr>
<tr><td>Relevance</td><td colspan="3">This indicator covers a common place where people connect to the Internet: at school.</td></tr>
<tr><td rowspan="4">Availability</td><td></td><td>2021</td><td>2020-2021</td></tr>
<tr><td>Primary education</td><td>47</td><td>69</td></tr>
<tr><td>Lower secondary education</td><td>49</td><td>71</td></tr>
<tr><td>Upper secondary education</td><td>50</td><td>70</td></tr>
<tr><td>Reliability</td><td colspan="3">This is an SDG indicator, defined by the UNESCO Institute for Statistics (UIS) in the SDG 4 Data Digest (UIS, 2019). It is also one of the core indicators of the Partnership on Measuring ICT for Development.</td></tr>
<tr><td>Source</td><td colspan="3">UIS collects these data from Ministries of Economies from all economies in the world. A secondary source is Giga, the ITU-UNICEF joint initiative to connect all schools to the Internet by 2030.</td></tr>
<tr><td>Preliminary assessment</td><td colspan="3">While this is a very relevant indicator, as highlighted by some of the commenters on the Forum, the indicator is excluded for data availability reasons.</td></tr>
</table>

Indicator	**Active mobile-broadband subscriptions per 100 inhabitants**
Relevance	A subscription is necessary to use the Internet, and a mobile phone is the most common way for people to go online. In order to allow for a meaningful connection, the

	subscription needs to be to a broadband network, which is a 3G or more advanced technology.
Availability	2021: 160 economies 2020-2021: 170 economies
Reliability	The indicator is defined in the ITU Handbook (ITU, 2020b). It is one of the core indicators of the Partnership on Measuring ICT for Development.
Source	The data are usually collected by the ICT regulator, which collects the data from the various operators in the country. At the international level, data are collected from countries by ITU. Data are also collected by Eurostat for their member countries, as well as by the OECD.
Preliminary assessment	Indicator retained.

Indicator	**Fixed-broadband subscriptions per 100 inhabitants**
Relevance	An indicator on fixed-broadband subscriptions is necessary to complement the indicator on mobile broadband subscriptions, to avoid an imbalance with and a bias towards mobile infrastructure. Mobile broadband technology is not yet a perfect substitute for wired connections, particularly fibre optic, which remains critical for businesses. The inclusion of fixed broadband penetration increases the likelihood that the index reflects the infrastructure needed to generate positive economic outcomes (for additional justification, see the ITU Secretariat's response in the section *Fixed-broadband subscriptions per 100 inhabitants* of Annex 4).
Availability	2021: 161 economies 2020-2022: 170 economies
Reliability	The indicator is defined in the ITU Handbook (ITU, 2020b). It is one of the core indicators of the Partnership on Measuring ICT for Development. For the reasons outlined above, population is used as denominator.
Source	The data are usually collected by the ICT regulator, which collects the data from the various operators in the country. At the international level, data are collected from countries by ITU.
Preliminary assessment	Indicator retained.

Indicator selection: Meaningful connectivity

The UMC framework features five connectivity enablers: infrastructure, affordability, device, skills, and safety and security. Ideally, the index would feature indicators capturing each of these areas provided they satisfy the criteria of data availability and data quality.

Meaningful connectivity: Infrastructure

Access to a signal is a prerequisite for using the Internet. The minimum requirement for meaningful use of the Internet is access to a 3G mobile network. The **population covered by at least a 3G mobile network** should therefore be included. Since **higher quality networks** are preferred, these would be assessed at the same time. If and how these different indicators are aggregated is to be determined later.

In a similar vein, the **number of households passed by a fixed network** could be included in the index, as this is a prerequisite for subscribing to a fixed broadband service.

Another indicator of the quality of the fixed network quality is the percentage of the **population that lives within physical reach of (fiber) nodes on core terrestrial transmission networks**. The indicator was defined by EGTI and approved at the 10th World Telecommunication/ICT Indicators Meeting in 2012 (see the report), where it was decided that the data would initially be collected through an ITU pilot project, with external collaborators obtaining the data from operators to create interactive transmission maps. The data thus collected would be shared with national regulators or ministries for verification, ahead of their publication. This practice has evolved into the ITU Broadband Map initiative, run by the Infrastructure Division of ITU-D. On the definitional side, the nodes are fiber nodes. The indicator is relevant as a proxy for infrastructure density or territorial distribution. Data on the nodes are mostly collected by ITU through desk research, and are subsequently validated by telecom and network operators, with Member States's focal points copied on the correspondence. It is possible that some nodes are missing. The calculation of the percentage of population within a certain distance of the nodes is done by ITU, using a variety of (open) sources. Because of limited resources, the data may not be up to date.

Based on comments received and considering that the data for this indicator is not necessarily updated annually, coverage of nodes may be partial, and that various are used sources in addition to official ones, the indicator has been dropped from this Version 1 of the proposed IDI methodology (for more information on why this indicator was dropped, see the ITU Secretariat responses in the section *Percentage of population within reach of transmission networks, by distance (10 km, 25 km, 50 km)* of Annex 4).

International bandwidth capacity and bandwidth usage statistics provide information about the availability and utilisation of infrastructure for international data linkages (including submarine or overland cables, satellite linkages, etc.). These statistics can also signal the presence of barriers to international connectivity. The indicator is normalised by dividing by the number of Internet users in the country. However, international bandwidth usage measures suffer from several limitations. First, end-user experience (which is a key concern for meaningful connectivity) is not only determined by international, but also by middle-mile and last-mile connectivity. However, ITU is not collecting statistics on many of the middle mile elements that influence international bandwidth usage (such as local cache, off-peak load, presence of CDN). Second, while low values of the indicator can signal lack of connectivity for users, high values can often be biased if a country is a connectivity transit hub. Third, many countries do not collect this indicator, and many are estimating it based on domestic traffic data, thus limiting international comparability. The problem is made worse by the fact that a non-negligible share of traffic is not carried over the open Internet and by a lack of transparency of international cable operators about pricing and usage. For these reasons, this indicator is not a suitable candidate for inclusion.

It would be relevant to include measures of **middle-mile and last-mile connectivity**. One example is statistics on Internet exchange points, such as the number in a country, their size measured in terms of traffic or peering partners, or their environmental footprint. The 13th meeting of EGTI in 2022 recognized both the relevance of statistics on middle-mile connectivity, as well as the need to investigate the feasibility to develop internationally comparable measures, given the limitations of information readily available at sources such as Packet Clearing House or IXPDB. This was added to the work programme of EGTI for 2023, but at this stage, given the limitations, it is premature to propose middle-mile connectivity indicators for inclusion.

Internet traffic generated over both mobile and fixed networks is another measure of the development of ICT infrastructure. Since Internet traffic is measured at the level of the end-user, it offers a direct comparison across countries of the actual amount of data consumed and is an indication of infrastructure barriers. To account for country size, the indicator is normalised by the number of subscriptions. There are some limitations, though. High shares of traffic generated by institutional and business users limits international comparability. Variation in Internet service providers' traffic monitoring practices and reporting obligations and the application of estimation techniques by countries may limit data reliability.

Meaningful use of the Internet requires a fast connection. High quality data on the **speed of Internet connections** or user experience metrics would be relevant to include in the index, which was highlighted by a number of commenters as well. Various data sources exist, such as crowd sourced speed test data from Ookla, OpenSignal, or M-Lab. These are all non-official sources and there are limitations to the data (such as means of collection and number of observations), therefore no indicator on the speed of the Internet connection is proposed.

The potential indicators for infrastructure

Indicator	**Percentage of population covered by a mobile network**		
Relevance	Access to a signal is a prerequisite for using the Internet. The minimum requirement for meaningful use of the Internet is access to a 3G mobile network. More advanced technologies with increased capacity and faster connection speeds facilitate more meaningful Internet usage.		
Availability		2021	2020-2021
	At least 3G	158	170
	At least LTE/WiMAX	156	168
	At least 5G	44	55
Reliability	The indicator is defined in the ITU Handbook (ITU, 2020b). The population covered by a 3G mobile network is one of the core indicators of the Partnership on Measuring ICT for Development.		
Source	The data are usually collected by the ICT regulator, which collects the data from the various operators in the country. At the international level, data are collected from countries by ITU.		
Preliminary assessment	Indicator retained. ‘At least 3G’ and ‘at least LTE/WiMAX’ will be included. While ‘at least 5G’ is very relevant, it cannot be included yet, because of poor data availability. A proposal to combine the different technologies is made in the *Weighting and aggregation* section below.		

Indicator	**Percentage of households covered by a fixed network**
Relevance	Being covered by a fixed network at home is a necessary condition to contract a fixed broadband subscription.
Availability	2021: 66 economies 2020-2021: 71 economies
Reliability	The indicator is defined in the ITU Handbook (ITU, 2020b). Regarding the denominator, as highlighted above as well when discussing fixed broadband subscriptions, household data are not widely available as they are most often collected in decennial censuses. In countries where these data are available the definition of household often varies – this raises questions about comparability.
Source	The data are usually collected by the ICT regulator, which collects the data from the various operators in the country. At the international level, data are collected from countries by ITU.
Preliminary assessment	The indicator is excluded for data availability reasons.

Indicator	**International bandwidth usage (bit/s) per Internet user**
Relevance	International bandwidth provides information about the availability and utilisation of infrastructure for international data linkages.
Availability	2021: 86 economies 2020-2021: 103 economies
Reliability	The indicator is defined in the ITU Handbook (ITU, 2020b). Data for the denominator are defined in the ITU Household Manual (ITU, 2020a). It is one of the core indicators of the Partnership on Measuring ICT for Development, although with a different denominator. Publicly available data sources are limited or missing, and many countries only provide estimates. The indicator is not collected by many of the countries with high volumes of Internet traffic. This creates systematic data gaps and limits the benchmarking capacity of the indicator. Transit hub bias further limits international comparability.

Source	The data are usually collected by the ICT regulator, which collects the data from international connectivity providers in the country. At the international level, data are collected from countries by ITU.
Preliminary assessment	The indicator is excluded for data quality reasons.

Indicator	**Mobile broadband Internet traffic per mobile broadband subscription**
Relevance	This indicator measures the intensity of Internet usage by mobile broadband subscribers. A range of specific connectivity needs can only be accommodated through the availability of data-intensive connections at the disposal of users who are able to change their physical location. The indicator reflects the quality of the ICT infrastructure from the end-user's perspective.
Availability	2021: 131 economies 2020-2021: 143 economies
Reliability	The indicator is defined in the ITU Handbook (ITU, 2020b). Variation in traffic monitoring practices or the treatment of zero-rated services by operators may limit data reliability.
Source	The data are usually collected by the ICT regulator, which collects the data from the various operators in the country. At the international level, data are collected from countries by ITU.
Preliminary assessment	Indicator retained. The indicator may require a cap, which will be established in the next step.

Indicator	**Fixed-broadband Internet traffic per fixed broadband subscription**
Relevance	This indicator measures the intensity of Internet usage by fixed Internet subscribers. Given today's most widely available technologies, certain user needs can only be accommodated by data-intensive, fast fixed broadband connections. The indicator reflects the quality of the ICT infrastructure from the end-user's perspective.
Availability	2021: 109 economies 2020-2021: 115 economies
Reliability	The indicator is defined in the ITU Handbook (ITU, 2020b). High shares of traffic generated by institutional and business users limits international comparability. Variation in Internet service providers' traffic monitoring practices and reporting obligations and the application of estimation techniques by countries may limit data reliability.
Source	The data are usually collected by the ICT regulator, which collects the data from the various operators in the country. At the international level, data are collected from countries by ITU.
Preliminary assessment	Indicator retained. The indicator may require a cap, which will be established in the next step.

Meaningful connectivity: Affordability

One of the main barriers for people to go online is affordability, of an Internet enabled device as well as of the Internet service. It is also an important enabler to move from basic to meaningful connectivity. For the affordability of an Internet enabled device, there isn't yet an indicator available that is widely enough collected and internationally comparable. For the affordability of going online, two indicators are considered, the **price of a data-only mobile broadband basket as a percentage of GNI per capita** and the **price of a fixed mobile broadband basket as a percentage of GNI per capita.**

Three observations are opportune, based on comments received by EGTI/EGH members. First is the choice for a data-only mobile broadband basket. In addition to the data-only mobile broadband basket (2 GB) proposed, ITU statistics are also available for baskets including voice and SMS services alongside data, such as the mobile broadband data & voice high-consumption basket (2 GB, 140 min, 70 SMS). Preference was given to the data-only basket for a number of reasons. First, because policy targets on affordability, such as the UN Broadband Commission's 2% GNI per capita target, refer to the data-only mobile broadband basket (and fixed broadband basket). For the sake of coherence, it was decided to use that indicator. Second, according to the rules defined by EGTI, bundled plans may be included in data-only mobile baskets if they are cheaper than mobile data-only plans (which is actually the case in many countries). Finally, the two indicators (data-only mobile broadband 2GB and mobile data and voice high-consumption baskets) are very highly correlated (0.88); replacing the indicator would make little difference, most of the impact would adversely affect 5 LDCs.

The second observation concerns the choice of the denominator, GNI per capita, rather than an absolute price measure, such as purchasing power parity (PPP) dollars. The main reason is that affordability is a *relative* measure. Expressing the price of a monthly service ('basket') as a share of gross national income per capita per month is therefore the most appropriate approach. In contrast, prices expressed in purchasing power parity allows to compare prices across countries. This approach accounts for differences in purchasing power, without regard for difference in income levels. Our analysis reveals that the correlation between PPP measures and other indicators in the universal and meaningful groups are significantly weaker, thus reducing the robustness of the framework.

Finally, questions were raised on the size of the data allowance of the plans. Although ITU currently does not collect ICT price baskets with unlimited data allowance, the point raised is captured in the affordability indicator to a fair degree. Two baskets are proposed for inclusion: a data-only mobile broadband basket with 2 GB and a fixed broadband basket with at least 5 GB monthly allowance. For the fixed broadband basket in the overwhelming majority of cases, the minimum is overshot by far, and the actual plan used for the basket comes with unlimited data allowance in 140 economies, and over 100 GB in an additional 10 economies. The mobile broadband baskets come with a data cap in all economies but one though.

The potential indicators for affordability in detail

Indicator	**Data-only mobile broadband basket as a percentage of GNI per capita**
Relevance	Affordability is one of the main barriers to a meaningful use of the Internet.
Availability	2021: 183 economies 2020-2021: 186 economies
Reliability	The indicator is defined in the ITU Handbook (ITU, 2020b); the methodology can also be retrieved from the price methodology on the ITU website. It is one of the core indicators of the Partnership on Measuring ICT for Development.
Source	The source of retail price data are the non-promotional advertised prices of selected services for residential customers effective at the time of data collection, from operators with the largest market share in an economy, measured by the number of subscriptions. Data are submitted by countries to ITU, complemented by ITU research. GNI per capita levels are from the World Bank World Development Indicators, referring to the preceding year.
Preliminary assessment	Indicator retained.

Indicator	**Fixed broadband basket as a percentage of GNI per capita**
Relevance	Affordability is one of the main barriers to a meaningful use of the Internet.
Availability	2021: 171 economies 2020-2021: 175 economies
Reliability	The indicator is defined in the ITU Handbook (ITU, 2020b); the methodology can also be retrieved from the price methodology on the ITU website. It is one of the core indicators of the Partnership on Measuring ICT for Development.

Source	The source of retail price data are the non-promotional advertised prices of selected services for residential customers effective at the time of data collection, from operators with the largest market share in an economy, measured by the number of subscriptions. Data are submitted by countries to ITU, complemented by ITU research. GNI per capita levels are from the World Bank World Development Indicators, referring to the preceding year.
Preliminary assessment	Indicator retained.

Meaningful connectivity: Device

Access to an Internet-enabled device is required to go online. The index could consider both mobile phones and desktop computers, recognizing that the most basic models of the former are cheaper, while the latter allow for a richer experience. For computers, the indicator considered is **households with access to a computer**. For **mobile phones**, the indicator considered is **ownership**, recognizing that mere access to a device imposes constraints, including when and for how long one can be online. The potential indicators for device in detail

Indicator	**Percentage of households with a computer**
Relevance	A computer is one of the devices that allows a user to go online.
Availability	2021: 53 economies 2020-2021: 67 economies
Reliability	The indicator is defined in the ITU Household Manual (ITU, 2020a). It is one of the core indicators of the Partnership on Measuring ICT for Development.
Source	The source is usually ICT household surveys conducted in countries, often by the national statistical office, but sometimes by other entities as well, such as the regulator. At the international level, data are collected from countries by ITU.
Preliminary assessment	The indicator is excluded for data availability reasons.

Indicator	**Percentage of individuals owning a mobile phone**
Relevance	A mobile phone is one of the most common devices used to go online.
Availability	2021: 47 economies 2020-2021: 59 economies
Reliability	The indicator is an SDG indicator, defined in the ITU Household Manual (ITU, 2020a). It is one of the core indicators of the Partnership on Measuring ICT for Development.
Source	The source is usually ICT household surveys conducted in countries, often by the national statistical office, but sometimes by other entities as well, such as the regulator. At the international level, data are collected from countries by ITU.
Preliminary assessment	While the indicator falls below the availability threshold, there was a broad call for inclusion by EGTI and EGH members, therefore the indicator is retained. Some commenters argued for ownership of a smartphone, rather than a mobile phone. In the ITU data collection, smartphone is a subcategory of mobile phone, but unfortunately not enough countries submit data – only 26 countries have reported data on smartphone ownership since 2019. In addition, ownership of any mobile phones including non-smart phones is still relevant to ICT development. An individual who owns a mobile phone is already more connected than an individual that does not. For these reasons, overall mobile phone ownership remains the best option for the IDI.

Meaningful connectivity: Skills

Digital literacy is a requirement for fully leveraging connectivity. **The percentage of individuals with ICT skills** is a proxy for digital literacy. Because self-reporting of individuals' ICT skills may be subjective, ICT skills are measured based on whether an individual has recently performed certain activities that require different types of skill. The assumption is that performing these activities implies that one has a certain level of the required skills. Activities are grouped into five categories of digital skills: communication/collaboration; problem solving; safety; content creation; and information/data literacy. These categories would need to be aggregated into one indicator that could then be included.

In the old IDI, in the absence of data for ICT skills, three alternate indicators were used: mean years of schooling, gross enrolment ratio for secondary education and gross enrolment ratio for tertiary education. These three indicators were proposed in the 'Zero draft' document and received a fair amount of comments on the IDI forum. These comments pointed in two directions regarding the use of education proxies for ICT skills. The first direction is not to use any proxy, as education level is not a good predictor of ICT skills. The second direction is to use education indicators, but not the ones used in the past. Instead, one of the possibilities raised was to use the two indicators that are used as the knowledge pillar in the HDI: **Expected years of schooling** and **Mean years of schooling**. The advantage of this approach is that the data are already available from the HDI, including estimates made by UNDP for the purpose of the HDI. The statistical assessment will show how good the fit will be to the conceptual framework.

The potential indicators for skills in detail

Indicator	**Percentage of individuals with ICT skills**
Relevance	Meaningful use of the Internet requires that people are digitally literate.
Availability	2021: 61 economies 2020-2021: 69 economies
Reliability	The indicator is an SDG indicator, defined in the ITU Household Manual (ITU, 2020a). It is also one of the core indicators of the Partnership on Measuring ICT for Development. The assumption is that performing certain activities implies that one has a certain level of skills. Furthermore, the aggregation of the various activities into one score, which would be required for the index, is complex and untested.
Source	The source is usually ICT household surveys conducted in countries, often by the national statistical office, but sometimes by other entities as well, such as the regulator. At the international level, data are collected from countries by ITU.
Preliminary assessment	The indicator is excluded for data availability reasons as well as for the complexity of aggregating the various activities into one score.

Indicator	**Expected years of schooling (school life expectancy)**
Relevance	This indicator is one of the proxies for ICT skills in conjunction with mean years of schooling.
Availability	2021: 192 using the data used for the HDI[10]
Reliability	The methodology is defined by the UNESCO Institute for Statistics (UIS). For a child of a certain age, the school life expectancy is calculated as the sum of the age specific enrolment rates for the levels of education specified. The part of the enrolment that is not distributed by age is divided by the school-age population for the level of education they are enrolled in, and multiplied by the duration of that level of education. The result is then added to the sum of the age-specific enrolment rates. Estimates are made by UNDP for use in the HDI.
Source	UIS and UNDP
Preliminary assessment	The indicator is retained for testing against the conceptual framework.

[10] 2021 or last available year, actual year not specified by the source.

Indicator	**Mean years of schooling (ISCED 1 or higher), population 25+ years**
Relevance	This indicator is one of the proxies for ICT skills in conjunction with expected years of schooling.
Availability	2021: 190 using the data used for the HDI
Reliability	The methodology is defined by the UNESCO Institute for Statistics (UIS). It is defined as the average number of completed years of education of a country's population aged 25 years and older, excluding years spent repeating individual grades. Estimates are made by UNDP for use in the HDI.
Source	UIS and UNDP
Preliminary assessment	The indicator is retained for testing against the conceptual framework.

Meaningful connectivity: Safety and security

There are no good stand-alone direct measures of safety and security from official sources that can be included in the index. ITU's Global Cybersecurity Index (GCI) assesses countries' *commitments* to cybersecurity. As such, it does not fit in this framework, which focuses on outputs rather than inputs. In addition, the GCI's methodology is still evolving and is not 'stable' yet. Introducing it in the index would affect comparability over time, as a change in this indicator may be due to a change in the methodology rather than a in the performance.

Country coverage

In this step, the preliminary list of indicators is assessed by looking at how many economies can be included in the index. Table 4 lists the indicators retained in the previous step for further consideration and data availability for each. The objective is to include as many economies as possible. Resolution 131 requires that the methodology of the IDI be established so as "to cover a majority of Member States" (*resolves 3*). As explained in the *Data availability and reference period* section above, the assessment is based on the criterion of having at least one non-estimated data point available within the reference period, which is 2020-2021 in the case of the 2023 edition. Data availability for the 2020-2021 reference period is reported in the right-most column of the table.

Table 4: Indicators selected for further exploration

	Category/Code	Indicator	countries with data available ≥2021	≥2020
Universal connectivity				
1	yHH7	Proportion of individuals who used the Internet (from any location) in the last 3 months	81	**94**
2	xHH6	Proportion of households with Internet access at home	81	**94**
3	i911mw	Active mobile-broadband subscriptions per 100 inhabitants	160	**170**
4	i992b	Fixed broadband subscriptions per 100 inhabitants	161	**170**
Meaningful connectivity - Infrastructure				
5	i271G	Percentage of the population covered by at least a 3G mobile network	158	**170**
6	I271GA	Percentage of the population covered by at least an LTE/WiMAX mobile network.	156	**168**
7	i136mwi_subs	Mobile broadband Internet traffic per mobile broadband subscriptions (GB)	131	**143**
8	i135tfb_subs	Fixed broadband Internet traffic per fixed broadband subscriptions (GB)	109	**115**
Meaningful connectivity - Affordability				
9	i271mb_ts_GNI	Data-only mobile-broadband basket price (as % of GNI per capita)	183	**186**
10	i154_FBB_ts_GNI	Fixed-broadband Internet basket price (as % of GNI per capita)	171	**175**
Meaningful connectivity - Device				
11	xHH18	Percentage of individuals owning a mobile phone	47	**59**
Meaningful connectivity - Skills				
12	MYS	Mean years of schooling	190	**190**
13	EYS	Expected years of schooling	192	**192**

Estimating data points adds uncertainty to the calculation of index scores. By setting a higher threshold for data availability, the number of data points to be estimated decreases (implying that the index would be more robust), but so does the number of economies for which the index can be computed. This requires striking a balance. As Table 5 shows, setting the country inclusion threshold at 70 per cent of indicators available would allow 130 economies to be included. In the extreme case where no estimates would be used, the index could be computed for just 42 economies.

Table 5: Number of economies that can be included in the index with various thresholds

Economy inclusion threshold (% of 13 indicators available in the 2020-2021 reference period)	50%	60%	70%	80%	90%	100%
Nr. of economies meeting the threshold requirement:	168	163	130	89	75	42
Nr. of missing data points to be estimated	361	331	184	61	33	101
% of total data points to be estimated	*17%*	*16%*	*11%*	*5%*	*3%*	*0%*

The inclusion threshold is set to 50 per cent. That is, an economy would be included if official data is available for at least 50 per cent of the indicators of the index. With this threshold, and based on data availability as of January 2023, 168 economies could be included in the index.[11]

[11] A benefit of an index without ranking is to allow for partial assessment of countries: a country that would normally be excluded for not meeting the overall data availability criterion, could still be assessed on selected components of the index for which sufficient data exists, even though it would not get an overall index score. Without ranking, the inclusion of this country in selected components would be without consequence for other countries. This alternative to outright exclusion would allow to increase the number of countries studied and may incentivise countries to improve data availability.

Statistical assessment of the selected indicators

An indicator needs to have certain statistical properties both on its own and vis-à-vis the other indicators of the index in order to add relevant quantitative information to an aggregate index score. A list of indicators was selected in the previous section for the ICT Development Index framework based on conceptual grounds and data availability. This section summarizes the results of several statistical analyses to determine if each selected indicator fits in the index.

Specifically, we aim to:

- identify the presence of outliers and recommend treatment methods;
- identify potential constraints in the explanatory power of indicators; and
- explore the statistical association between a set of indicators and the latent structure of the dataset.

The analyses entail an in-depth look at the data, making use of two statistical tools: first, exploring each variable separately and describing them through their descriptive statistics (such as mean, median, min, max, among others), followed by a correlation analysis to explore the statistical relationships between indicator pairs and groups.

The assessments are conducted along the subsequent steps (outlier detection and treatment, normalization, weighting and aggregation) and provide additional information to help better interpret and understand the strengths and weaknesses of the indicators selected on a conceptual basis. The assessments constitute an integral part of the iterative process of indicator selection and confirmation that ultimately aims at ensuring that the framework is both conceptually and statistically coherent.

4 Identifying and treating outliers and missing data (step 4)

The indicators identified based on conceptual grounds contain outlier values and data gaps. The aim of this step is to ensure that IDI scores can be computed based on a statistically solid dataset. This involves identifying and treating outliers and setting goalposts where relevant, and next defining the strategy for treating missing values.

Identifying outliers

An indicator is a useful benchmark if it can meaningfully distinguish performance across units (i.e., economies in the present case) and over time. From a statistical perspective, the range of values (the distance between the minimum and maximum) should not be too narrow, and the distribution not too skewed or peaked (a case when the bulk of the values is concentrated within a small range, with some outlying values further apart). The presence of outliers is particularly problematic in the context of composite indicators. Outlying values are not necessarily errors, but if present in component indicators of a composite indicator, they can significantly bias aggregation results. Outliers would not only become unrealistic or unintended targets, but also imply that a significant portion of the data range will remain empty, while small, marginal differences between countries may be inflated or larger differences underestimated. They can also bias diagnostic tools such as statistical coherence analysis. It is therefore essential in the process of developing an index to identify and treat outliers.[12] Statistical methods are available for treating outliers, depending on the nature of the data, e.g., applying a log transformation or trimming the distribution (i.e., applying caps).

[12] There is no single definition for outliers (Aguinis et al, 2013), it depends on the nature of the indicators and the measurement purpose. As a rule of thumb, composite indicator development practitioners typically identify outliers when the absolute skewness (a measure of distribution asymmetry) exceeds 2.0 and kurtosis (a measure of the weight of the tails relative to the centre of the distribution) exceeds 3.5, or if kurtosis alone exceeds 10 (see European Commission, 2019).

Before identifying outliers, some indicators must be scaled by the appropriate size measure (e.g., divided by population, Internet users, GDP, subscriber, etc.) to ensure a valid comparison across economies. This was done in the previous step, the indicator selection.

Key descriptive statistics for each of the indicators identified based on conceptual considerations are presented in Table 6, which reports the number of observations (i.e., economies) for each indicator for the reference period 2020-2021. The other columns present information on range and distribution (minimum and maximum values, mean, standard deviation, median and the 25th and 75th percentile – the range between which half of the observations can be found) as well as skewness and kurtosis (measures of difference from normal distribution).

Table 6: Descriptive statistics for the list of indicators retained for testing

	Code	Indicator	N	N*/ 196	Min	Max	Mean	St.dev.	25th pctile	Median	75th pctile	Skew.	Kurt.
Universal connectivity													
1	yHH7	Proportion of individuals who used the Internet (from any location) in the last 3 months	94	48%	6.1	100.0	80.3	18.6	75.6	84.8	91.9	-2.1	5.0
2	xHH6	Proportion of households with Internet access at home	94	48%	11.9	100.0	81.3	18.8	79.6	87.3	94.0	-1.7	2.6
3	i911mw	Active mobile-broadband subscriptions per 100 inhabitants	170	87%	2.6	285.1	84.1	43.5	54.5	84.3	107.6	1.0	3.2
4	i992b	Fixed broadband subscriptions per 100 inhabitants	170	87%	0	57.7	17.6	15.5	2.0	14.5	31.6	0.5	-1.1
Meaningful connectivity – infrastructure													
5	i271G	% of the population covered by at least a 3G mobile network	170	87%	15	100.0	92.2	14.1	92.2	98.4	99.9	-2.9	9.5
6	i271GA	% of the population covered by at least an LTE/WiMAX mobile network.	168	86%	0	100.0	83.6	24.3	80.0	96.0	99.3	-1.7	1.7
7	i136mwi_subs	Mobile broadband Internet traffic per mobile broadband subscriptions (GB)	143	73%	0	1’104.8	93.8	126.0	28.4	62.9	113.5	4.7	31.3
8	i135tfb_subs	Fixed broadband Internet traffic per fixed broadband subscriptions (GB)	115	59%	0	10’484.5	2’273.9	1’892.0	922.3	2’029.7	3’260.7	1.5	3.7
Meaningful connectivity – affordability													
9	i271mb_ts_GNI	Data-only mobile-broadband basket price (as % of GNI per capita)	186	95%	0.1	41.0	3.9	5.5	0.7	2.1	4.8	3.2	14.3
10	i154_FBB_ts_GNI	Fixed-broadband Internet basket price (as % of GNI per capita)	175	89%	0.3	164.2	10.0	18.6	1.4	3.5	11.0	4.9	32.3
Meaningful connectivity – device													
11	xHH18	Percentage of individuals owning a mobile phone	59	30%	41.2	100.0	85.4	15.2	75.4	91.3	97.4	-1.2	0.8
Meaningful connectivity – skills													
12	MYS	Mean years of schooling	190	97%	2.1	14.1	9.0	3.2	6.2	9.3	11.4	-0.4	-1.0
13	EYS	Expected years of schooling	192	98%	5.5	21.1	13.5	2.9	11.5	13.4	15.6	0.0	-0.2

Notes: *) N refers to 2021 for all indicators, except those sourced from ICT household surveys (yHH7, xHH6) and the education indicators (MYS and EYS), where it reflects data available in the 2020-2021 range.

The descriptive statistics reveal two issues in the dataset: the presence of outliers and the concentration of variation within a very limited range.

- The values for the indicator *Mobile broadband penetration (i911mw)* range from 2.6 to a maximum of 285 subscriptions per 100 inhabitants. Apart from eight countries, values are less than 150 subscriptions per 100 inhabitants. Setting a cap is justified from a statistical as well as a conceptual standpoint to set a more realistically achievable target and allow for a more meaningful cross-country comparison.
- The indicator *Fixed broadband subscriptions per 100 inhabitants (i992b)* ranges between 0 and 57.7, with a median of 14.5, with 95 per cent of the values not exceeding 43.5 subscriptions per inhabitants. One value may be considered as an outlier.
- Considering the *mobile broadband coverage* indicators, the *percentage of population covered by at least a 3G mobile network* (i271G) has limited discriminatory power (differences between country performance are often in the decimal digits). Apart from a few lower outliers, three-fourth of the observations are found between 92 and 100 per cent. Country performance is somewhat more dispersed for the other indicator, *percentage of population covered by at least an LTE-WiMAX mobile network* (4G, or i271GA). Outlier treatment is not warranted for any of the two, as outliers are only in the lower ranges that do not affect the target.
- Outliers were detected for both Internet traffic indicators. The distribution of *Mobile broadband traffic per subscription* (i136mwi_subs) values is highly skewed, and while the median is 62.9, around 5 per cent of the countries reported values between 265 to 681 GB per subscription. Such a skewed distribution warrants capping the indicator. A goal post must be forward looking, considering that Internet traffic is growing by 20 per cent annually.
- *Fixed broadband traffic per subscription* (i135tfb_subs) values are more evenly spread compared to mobile broadband traffic per subscription. However, a few outlying values require treatment before including it in the aggregation for a composite indicator. The median value is 2,030 GB/user, and 95 per cent of the observations are below 5,250 GB/user. Like the previous indicator, setting a cap should take into consideration the fact that traffic is expected to increase for the next four years.
- Both affordability indicators have a very skewed distribution, with a median of 2.1 for mobile and 3.5 per cent of GNI per capita, and 95 per cent of the observations less than 14 and 42 per cent of GNI per capita for mobile and fixed broadband, respectively. However, outliers reach up to 41 and 164, respectively. Trimming the distribution is advisable to increase variance across countries, especially because this is an indicator where, contrary to others, the best performer country has the lowest values, thus the direction will have to be reversed at the normalization step.

Table 7 summarizes the key statistical issues identified and the solutions to address those. These solutions will be applied as part of the computation of the index.

Table 7: Conclusions on statistical issues and proposed solutions

Indicator	Statistical issue	Solution
Universal connectivity		
Proportion of individuals who used the Internet (from any location) in the last 3 months (yHH7)		
Proportion of households with Internet access at home (xHH6)		
Active mobile-broadband subscriptions per 100 inhabitants (i911mw)	Outliers in high values	Set a cap
Fixed broadband subscriptions per 100 inhabitants (i992b)	Outlier in high values	May set a cap
Meaningful connectivity: infrastructure		
Percentage of the population covered by at least a 3G mobile network (i271G)	Limited discriminatory power; some outliers in the low values	Combine with LTE/WiMAX
Percentage of the population covered by at least an LTE/WiMAX mobile network (i271GA)	Some outliers in the low values	Combine with 3G
Mobile broadband Internet traffic per mobile broadband subscriptions (GB) (i136mwi_subs)	Outliers in high values	Set a cap
Fixed broadband Internet traffic per fixed broadband subscriptions (GB) (i135tfb_subs)	Outliers in high values	Set a cap
Meaningful connectivity: affordability		
Data-only mobile-broadband basket price (as % of GNI per capita) (i271mb_ts_GNI)	Outliers in high values	Set a cap
Fixed-broadband Internet basket price (as % of GNI per capita) (i154_FBB_ts_GNI)	Outliers in high values	Set a cap
Meaningful connectivity: device		
Percentage of individuals who own a mobile phone (xHH18)		
Meaningful connectivity: skills		
Mean years of schooling (MYS)		
Expected years of schooling (EYS)	Outliers in high values	May set a cap

Treating outliers and setting goal posts

Outliers identified for the indicators above will be treated by applying winsorization. This is an adjustment necessary for improving the statistical properties of the indicator within the context of the IDI framework. For each of the concerned indicators, a cut-off threshold is calculated by adding two standard deviations to the mean for each indicator concerned. Values above the threshold are replaced by the cut-off value.

Table 8 shows which indicator will be subject to outlier treatment based on the statistical assessment. Since the dataset will change following the inclusion of outliers, specific values are not provided at this point.

In addition to the outlier treatment, goal posts are introduced which represent desired target values. If a country scores at least as high as the goal post, it receives a score of 100 for the given indicator. Table 8 also shows indicative thresholds. For the two traffic indicators, goalposts will be projected considering the double-digit annual growth of global median traffic. For the affordability indicators, goalposts will reflect the reverse directionality.

Table 8: Outlier treatment, indicative goal posts and indicative thresholds

Code	Indicator	Outlier treatment	*Indicative* threshold (at or	*Indicative* goal post (at or above

			below which value, score is zero	**which value, score is 100)**
yHH7	Proportion of individuals who used the Internet (from any location) in the last 3 months	Not applicable	0%	95%
xHH6	Proportion of households with Internet access at home	Not applicable	0%	95%
i911mw	Active mobile-broadband subscriptions per 100 inhabitants	Winsorize above Mean+ 2 x St.Dev	Min. value	95th percentile
i992b	Fixed broadband subscriptions per 100 inhabitants	Winsorize above Mean+ 2 x St.Dev	Min. value	95th percentile
i271G	% of the population covered by at least a 3G mobile network	Not applicable	0%	100%
i271GA	% of the population covered by at least an LTE/WiMAX mobile network.	Not applicable	0%	100%
i136mwi_subs	Mobile broadband Internet traffic per mobile broadband subscriptions (GB)	Winsorize above Mean+ 2 x St.Dev	Min. value	95th percentile, projected
i135tfb_subs	Fixed broadband Internet traffic per fixed broadband subscriptions (GB)	Winsorize above Mean+ 2 x St.Dev	Min. value	95th percentile, projected
i271mb_ts_GNI	Data-only mobile-broadband basket price (as % of GNI per capita)*	Winsorize above Mean+ 2 x St.Dev	Min. value	95th percentile
i154_FBB_ts_GNI	Fixed-broadband Internet basket price (as % of GNI per capita)*	Winsorize above Mean+ 2 x St.Dev	Min. value	95th percentile
xHH18	Percentage of individuals owning a mobile phone	Not applicable	0%	95%
MYS	Mean years of schooling	Not applicable	Min. value	Max. value
EYS	Expected years of schooling	Winsorize above Mean+ 2 x St.Dev	Min. value	Max. value

Notes: *) The directionality of the affordability indicators is reversed, hence score of 100 will be assigned to values *below* the goal post. Scores of 0 will be assigned to values *above* the threshold.

Estimating missing data

As explained in the *Country inclusion* section and shown in Table 5 above, a relatively less stringent data availability threshold allows the inclusion of more economies, however, many of them will have missing values for several indicators. This inevitably affects the accuracy of the assessment of the IDI for those countries. Values for ITU indicators that were not submitted by countries in the reference period 2020-2021 will be estimated, when possible, using a model-based approach tailored to the indicator.

The models used to estimate missing values for indicators typically collected in ICT household surveys are based on a diverse range of widely available national indicators on mobile-broadband subscriptions, ICT affordability, GNI per capita and so on, and accounting for their changes over time. In addition to data submitted by Member States, other sources may be used to obtain data and/or cross-check estimates.

In other cases, univariate time series models (such as autoregressive integrated moving average (ARIMA) models may be applied to historical data to predict missing recent values.

Missing data points for indicators obtained from sources external to ITU (e.g., mean years of schooling) will not be estimated.

Estimates will not be calculated where a lack of auxiliary indicators or historical data does not allow the application of models. In this case, the value will be missing and the computation of the index for the affected country and the index will be computed using only available values, provided that the number of indicators with missing values is lower than half the total number of indicators in the index.

Consistent with the iterative nature of the IDI development, the dataset containing estimated values will be subject to outlier detection and treatment as needed. Adding model-based estimates – especially considering that data are not missing at random – will likely change distributions, which will have an impact on thresholds.

5 Normalization, weighting, and aggregation (step 5)

Normalization

The indicators selected are measured on various scales and expressed in different units. Normalization is applied to bring all indicators on a common scale. The most commonly used method is the min-max approach, which rescales indicators onto an identical range of 0 to 100 by subtracting the minimum value for the given indicator across all economies from each value and dividing by the range of the indicator values.

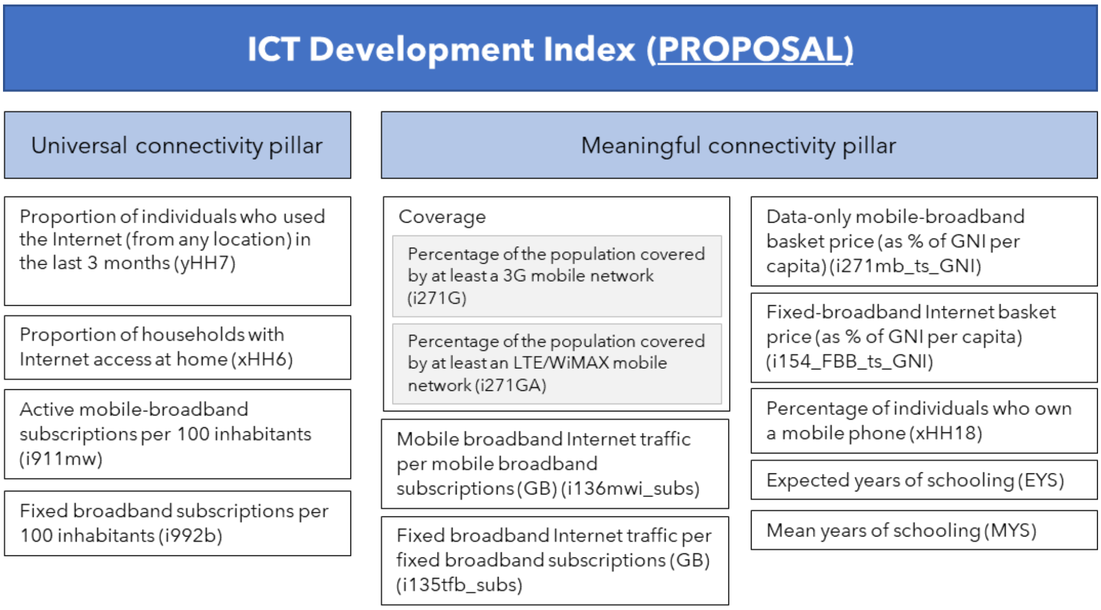
Prior to applying normalization, the directionality of the two affordability indicators is adjusted in order to ensure that higher indicator scores correspond to better performance – which is the case for all other indicators.

Weighting and aggregation

Conceptually, there are two groups of indicators: universal connectivity indicators and meaningful connectivity indicators. The correlation analysis (presented in detail in Annex 3) showed that all indicators are positively correlated with one another (affordability indicators considered in reverse direction) which suggests that these measure different aspects of the multidimensional concept of ICT development. While no significant trade-offs were identified between the indicators, some compensability cannot be ruled out (i.e., weakness in one indicator may be compensated by strength in another). In order to retain as much of the information contained in the indicators, it is advisable to follow a two-step approach in aggregating the indicators into an overall IDI composite score: first calculate a score for universal or meaningful connectivity pillars, which would then be aggregated into an IDI score in a next step. The proposed structure of the IDI is shown in Figure 3.

Various proposals were made in the IDI discussion forum regarding the weighting of individual indicators. In the absence of a clear, conceptually justified overall weighting scheme, this proposal applies a neutral approach, whereby equal weights are applied to the individual indicators within each pillar to compute the pillar scores, and – similarly – to the two pillars to compute the overall IDI score, so that they provide a balanced summary of the underlying information. The subsequent statistical analysis, as described below, does not reject this neutral and intuitive approach.

Figure 3: Proposed structure of the IDI



The universal connectivity pillar

The pillar consists of four indicators, in accordance with the conceptual framework. Correlation analysis and the preliminary results of a principal component analysis (PCA)[13] confirm that the four indicators capture a single latent dimension strongly associated with the four indicators, each of which contribute in a fairly similar way to the aggregate measure. This suggests that equal weighting can be applied in this pillar.

The meaningful connectivity pillar

The pillar consists of nine indicators, two of which – % of the population covered by at least a 3G and 4G (LTE/WiMAX) mobile network – are combined to a mobile broadband coverage score, applying 0.4 and 0.6 as the weights, respectively. This is based on feedback from the IDI forum and expert advice and takes into consideration that having at least 4G network technology allows for a more meaningful online experience than having at least 3G technology. It is noted that in practice, the two networks often overlap, in which case often 3G is used for voice and 4G for data communication.

The meaningful connectivity indicators positively correlate with one another, but the structure shows heterogeneity among the indicators. In brief, a moderate compensability was found between the two broadband traffic indicators and the rest of the indicators in the pillar[14] (even after outliers were removed). However, there is no clear statistical justification for departing from the most intuitive approach of applying equal weights to compute the average of the indicator scores in the pillar. One conclusion, in any case, is that it is reasonable to consider the different indicators also by themselves for a comprehensive benchmarking of meaningful connectivity, in addition to using pillar summary scores and the overall aggregate index. This helps understand strengths and weaknesses for each country, delivering more nuanced information for policies.

The IDI scores will be computed by taking the simple average of the meaningful and universal connectivity scores. This *ex-ante* assessment on the structure should, in any case, be revisited in a statistical coherence analysis after the calculation of aggregate scores and after outlier treatment and normalization, as the structure may need some refinements to ensure the statistical soundness of the IDI. This upcoming step will

[13] Principal component analysis is applied to explore the underlying multivariate structure of a set of indicators and helps identify latent dimensions. Only the main conclusions from the analyses are reported in this document, as it is based on a restricted set of economies for which all indicators are available.
[14] Preliminary PCA results on a very restricted number of observations indicate the presence of a second component, associated with the traffic indicators.

also take into consideration the results of the statistical audit carried out by the Competence Centre on Composite Indicators of the European Commission's Joint Research Centre.

6 Conclusion and next steps

The Version 1 of the IDI methodology proposed in this document is an evolution of the 'Zero draft' document, based on the extremely constructive feedback provided by EGTI/EGH members. Version 1 is submitted to Member States for comments during a formal consultation phase that will conclude in May. The feedback received during the consultation will inform the next iteration of the methodology ("Version 2") to be prepared by the Secretariat. It will also help define the agenda of the joint EGTI/EGH meeting on the IDI in June, which will aim to resolve any contentious issues.

The document first introduced the approach to be followed for developing a composite indicator, which should be conceptually relevant and statistically robust. This approach structured the rest of the document. The first step consisted in defining the framework. The concept of universal and meaningful connectivity (UMC) – the possibility for everyone to enjoy a safe, satisfying, enriching, productive and affordable online experience- appeared as the framework of choice: it is both rooted in earlier editions of the IDI and consistent with the latest ITU resolutions and strategic goals. It captures both the quantitative aspects (universal) and qualitative aspect of connectivity (meaningful). In step 2, the conceptual framework of UMC and a set of selection criteria – such as reliability, availability, and quality – guided the identification of indicators for potential inclusion from a large universe of ICT indicators. In step 3, statistical analysis was carried out to narrow down the choice of indicators, which led to the selection of 13 indicators.

Based on the results of the statistical analyses conducted on the selected indicators in isolation as well as on indicator groups, in steps 4 and 5, the methodologies were presented to reach a harmonized dataset that is free of outliers and missing values, where economies can be benchmarked against reasonable goalposts. This was concluded by the proposal of an intuitive, multi-pillar aggregation framework.

A preliminary statistical analysis revealed that the proposal is statistically sound. Following the aggregation of indicators into a universal and a meaningful connectivity pillar and next to an overall index will lead to an IDI that will be a fair summary of the information contained in the 13 component indicators. Nevertheless, by its nature, the IDI will simplify the richness of information contained in the individual indicators.

Limited data availability and quality place enormous constraints for the development of the index and impose difficult trade-offs between the depth, completeness, and timeliness of the assessment on the one hand and country coverage on the other. The next iteration of the methodology will need to consider these constraints and trade-offs, while ensuring conceptual relevance and statistical soundness, as per Resolution 131.

The proposed selection of 13 indicators allows to cover important aspects of universal and meaningful connectivity, but not all. There are many concepts for which no indicator exists or for which indicators exist, but country coverage is either insufficient or sources are not official ones. Therefore, regardless of its final structure, the assessment of the IDI will necessarily be partial. Additional data and information will always be needed to complement the IDI and provide a more accurate picture of a country's state of universal and meaningful connectivity. In this context, the dozens of ICT indicators maintained by ITU and that do not meet the eligibility criteria for inclusion in the IDI are as relevant as ever. In fact, some of the most insightful ITU indicators have the lowest data availability, which disqualifies them for the IDI. Even if they are not part of the IDI, Member States must thrive to collect as many of them as possible on a regular basis.[15] The IDI indicators alone will not provide the necessary information for policymaking.

[15] The technological, policy or market relevance of indicators were recently highlighted in the report of the EGTI subgroup on the review of the indicators collected in the ITU World Telecommunication/ICT Indicators Long Questionnaire, as well as in similar work carried out by the EGH.

The current selection of indicators would allow to cover *approximately* 168 economies, which meets the requirement in Resolution 131 “to cover a majority of Member States” (*resolves 3*). In addition, *approximately* 17% of data points would need to be estimated, which is a satisfactory ratio and consistent with the requirement in Resolution 131 to “rely primarily on official data provided by Member States” (*instructs 6 to the BDT Director*).

Finally, the long and complex process of developing an index is also an iterative one. The next steps (6-8) may force a review of the conclusions drawn at this point.

References

Aguinis, H., Gottfredson, R. K., & Joo, H. (2013), Best-Practice Recommendations for Defining, Identifying, and Handling Outliers, *Organizational Research Methods*, 16(2), 270–301, https://doi.org/10.1177/1094428112470848

European Commission (EC) (2019), *Your 10-Step Pocket Guide to Composite Indicators & Scoreboards,* https://knowledge4policy.ec.europa.eu/sites/default/files/10-step-pocket-guide-to-composite-indicators-and-scoreboards.pdf

International Telecommunication Union (ITU) (2020a), *Manual for Measuring ICT Access and Use by Households and Individuals*, 2020 Edition, https://www.itu.int/en/ITU-D/Statistics/Pages/publications/manual.aspx

ITU (2020b), *Handbook for the Collection of Administrative Data on Telecommunications/ICT*, 2020 Edition, https://www.itu.int/en/ITU-D/Statistics/Pages/publications/handbook.aspx

ITU and United Nations Office of the UN Secretary-General's Envoy on Technology (UN OSET) (2022), *Achieving Universal and Meaningful Digital Connectivity. Setting a Baseline and Targets for 2030*, https://www.itu.int/itu-d/meetings/statistics/wp-content/uploads/sites/8/2022/04/UniversalMeaningfulDigitalConnectivityTargets2030_BackgroundPaper.pdf

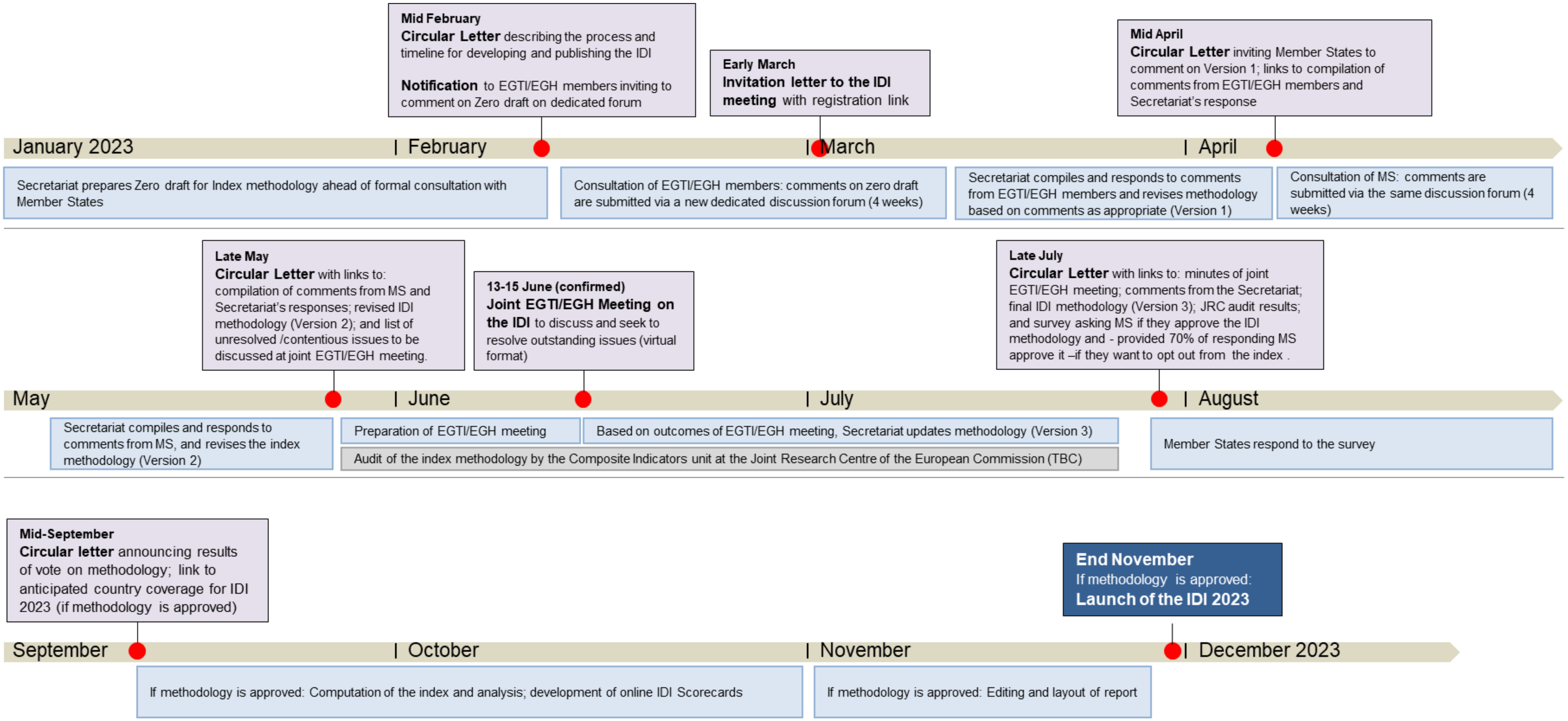
Organisation for Economic Co-Operation and Development (OECD) (2008), *Handbook on Constructing Composite Indicators: Methodology and User Guide*, https://www.oecd.org/sdd/42495745.pdf

UNESCO Institute for Statistics (UIS) (2019), *SDG 4 Data Digest. How to Produce and Use the Global and Thematic Education Indicators*, https://uis.unesco.org/sites/default/files/documents/sdg4-data-digest-2019-en_0.pdf

UNESCO-UIS, OECD and Eurostat (2020), *UOE data collection on formal education. Manual on concepts, definitions and classifications*, https://uis.unesco.org/sites/default/files/documents/uoe-data-collection-manual-2020-en.pdf

United Nations Conference on Trade and Development (UNCTAD) (2021), *Manual for the Production of Statistics on the Digital Economy*, 2020 Revised Edition, https://unctad.org/webflyer/manual-production-statistics-digital-economy-2020

Annex 1: Indicative timeline for the development of the ICT Development Index (IDI) 2023



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Annex 2: Data availability by economy and indicator

Economy (ISO code)	Proportion of individuals who used the Internet (from any location) in the last 3 months yHH7	Proportion of households with Internet access at home xHH6	Active mobile-broadband subscriptions per 100 inhabitants i911mw	Percentage of the population covered by at least a 3G mobile network i271G	Percentage of the population covered by at least an LTE/WiMAX mobile network. i271GA	Fixed broadband subscriptions per 100 inhabitants i992b	Mobile broadband Internet traffic per mobile broadband subscriptions (GB) i136mwi_subs	Fixed broadband Internet traffic per fixed broadband subscriptions (GB) i135tfb_subs	Data-only mobile-broadband basket price (as % of GNI per capita) i271mb_ts_GNI	Fixed-broadband Internet basket price (as % of GNI per capita) i154_FBB_ts_GNI	Percentage of individuals who own a mobile phone xHH18	Mean years of schooling (ISCED 1 or higher), population 25+ years MYS	Expected years of schooling EYS	Indicators available for the reference period Number	Share	>50%?
Afghanistan (AFG)			2020	2020	2020	2020	2020	2020	2021	2021		2021	2021	10	77%	Y
Albania (ALB)	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021		2021	2021	12	92%	Y
Algeria (DZA)			2021	2021	2021	2021	2021	2021	2021	2021		2021	2021	10	77%	Y
Andorra (AND)			2021	2021	2021	2021						2021	2021	6	46%	N
Angola (AGO)			2021	2021	2021	2021	2021	2021	2021	2021		2021	2021	10	77%	Y
Antigua and Barbuda (ATG)			2020	2020	2020	2020			2021	2021		2021	2021	8	62%	Y
Argentina (ARG)	2021	2021	2020	2021	2021	2021	2021		2021	2021	2021	2021	2021	12	92%	Y
Armenia (ARM)	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021		2021	2021	12	92%	Y
Australia (AUS)			2021	2021	2021	2021	2021	2021	2021	2021		2021	2021	10	77%	Y
Austria (AUT)	2021	2021	2021	2021	2021	2021	2021		2021	2021		2021	2021	11	85%	Y
Azerbaijan (AZE)	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	13	100%	Y
Bahamas (BHS)			2020	2020	2020	2020			2021	2021		2021	2021	8	62%	Y
Bahrain (BHR)	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	13	100%	Y
Bangladesh (BGD)	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	13	100%	Y
Barbados (BRB)			2021	2021	2021	2021	2021		2021	2021		2021	2021	9	69%	Y
Belarus (BLR)	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	13	100%	Y
Belgium (BEL)	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	13	100%	Y
Belize (BLZ)		2021							2021	2021		2021	2021	5	38%	N
Benin (BEN)			2021	2021	2021	2021	2021		2021	2021		2021	2021	9	69%	Y
Bhutan (BTN)	2021	2021	2021	2021	2021	2021	2020		2021	2021	2021	2021	2021	12	92%	Y
Bolivia (Plurinational State of) (BOL)	2021	2021	2021	2021	2020	2021			2021	2021	2020	2021	2021	11	85%	Y
Bosnia and Herzegovina (BIH)	2021	2021	2021	2021	2021	2021	2021	2020	2021	2021		2021	2021	12	92%	Y
Botswana (BWA)			2021	2021	2021	2021	2021	2021	2021	2021		2021	2021	10	77%	Y
Brazil (BRA)	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	13	100%	Y
Brunei Darussalam (BRN)			2021	2021	2021	2021		2021	2021	2021		2021	2021	9	69%	Y
Bulgaria (BGR)	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021		2021	2021	12	92%	Y
Burkina Faso (BFA)			2021	2021	2021	2021	2021		2021	2021		2021	2021	9	69%	Y
Burundi (BDI)			2021	2021	2021	2021	2021	2021	2021			2021	2021	9	69%	Y
Cabo Verde (CPV)			2021	2021	2021	2021	2021	2021	2021	2021		2021	2021	10	77%	Y
Cambodia (KHM)			2021	2021	2021	2021	2021		2021	2021	2020	2021	2021	10	77%	Y
Cameroon (CMR)			2021	2021	2021	2021	2020	2020	2021	2021		2021	2021	10	77%	Y
Canada (CAN)	2020	2020	2021	2021	2021	2021	2021	2021	2021	2021		2021	2021	12	92%	Y

Economy (ISO code)	Proportion of individuals who used the Internet (from any location) in the last 3 months yHH7	Proportion of households with Internet access at home xHH6	Active mobile-broadband subscriptions per 100 inhabitants i911mw	Percentage of the population covered by at least a 3G mobile network i271G	Percentage of the population covered by at least an LTE/WiMAX mobile network. i271GA	Fixed broadband subscriptions per 100 inhabitants i992b	Mobile broadband Internet traffic per mobile broadband subscriptions (GB) i136mwi _subs	Fixed broadband Internet traffic per fixed broadband subscriptions (GB) i135tfb _subs	Data-only mobile-broadband basket price (as % of GNI per capita) i271mb _ts_GNI	Fixed-broadband Internet basket price (as % of GNI per capita) i154_FBB _ts_GNI	Percentage of individuals who own a mobile phone xHH18	Mean years of schooling (ISCED 1 or higher), population 25+ years MYS	Expected years of schooling EYS	Indicators available for the reference period Number	Share	>50%?
Central African Rep. (CAF)									2021			2021	2021	3	23%	N
Chad (TCD)			2021	2021	2021	2021	2021		2021			2021	2021	8	62%	Y
Chile (CHL)			2021	2021	2021	2021	2021	2021	2021	2021		2021	2021	10	77%	Y
China (CHN)	2021		2021	2021	2021	2021	2021	2021	2021	2021	2020	2021	2021	12	92%	Y
Colombia (COL)	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	13	100%	Y
Comoros (COM)			2021	2021	2021	2021	2021	2021	2021	2021		2021	2021	10	77%	Y
Congo (Rep. of the) (COG)			2021	2021	2021	2021	2021	2021	2021	2021		2021	2021	10	77%	Y
Costa Rica (CRI)	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021		2021	2021	12	92%	Y
Côte d'Ivoire (CIV)			2021	2021	2021	2021	2021	2021	2021	2021		2021	2021	10	77%	Y
Croatia (HRV)	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	2020	2021	2021	13	100%	Y
Cuba (CUB)	2021	2021	2021	2021	2021	2021	2021	2021	2020	2020	2021	2021	2021	13	100%	Y
Cyprus (CYP)	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021		2021	2021	12	92%	Y
Czech Republic (CZE)	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	13	100%	Y
Dem. People's Rep. of Korea (PRK)													2021	1	8%	N
Dem. Rep. of the Congo (COD)			2021	2021	2021	2020	2021		2021			2021	2021	8	62%	Y
Denmark (DNK)	2022	2022	2021	2021	2021	2021	2021	2021	2021	2021		2021	2021	12	92%	Y
Djibouti (DJI)			2021	2021	2021	2021	2021	2021	2021	2021		2021	2021	10	77%	Y
Dominica (DMA)			2021	2021	2021	2021	2020		2021	2021		2021	2021	9	69%	Y
Dominican Rep. (DOM)	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	13	100%	Y
Ecuador (ECU)	2022	2022	2021	2021	2021	2021	2021	2021	2021	2021	2022	2021	2021	13	100%	Y
Egypt (EGY)	2022	2022	2021	2021	2021	2021	2021	2021	2021	2021	2022	2021	2021	13	100%	Y
El Salvador (SLV)	2020	2020	2021	2021	2021	2021			2021	2021		2021	2021	10	77%	Y
Equatorial Guinea (GNQ)									2021	2021		2021	2021	4	31%	N
Eritrea (ERI)												2021	2021	2	15%	N
Estonia (EST)	2021	2021	2021	2021	2021	2021	2021		2021	2021		2021	2021	11	85%	Y
Eswatini (SWZ)			2021	2021	2021	2021			2021	2021		2021	2021	8	62%	Y
Ethiopia (ETH)	2021		2021	2021	2021	2021			2021	2021		2021	2021	9	69%	Y
Fiji (FJI)			2020	2020	2020	2020			2021	2021		2021	2021	8	62%	Y
Finland (FIN)	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021		2021	2021	12	92%	Y
France (FRA)	2021	2021	2020	2020	2020	2021	2020		2021	2021	2021	2021	2021	12	92%	Y
Gabon (GAB)			2021	2021	2021	2021	2020		2021	2021		2021	2021	9	69%	Y
Gambia (GMB)									2021			2021	2021	3	23%	N
Georgia (GEO)	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	13	100%	Y
Germany (DEU)	2022	2022	2021	2021	2021	2021	2021	2021	2021	2021		2021	2021	12	92%	Y
Ghana (GHA)	2021		2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	12	92%	Y

Economy (ISO code)	Proportion of individuals who used the Internet (from any location) in the last 3 months yHH7	Proportion of households with Internet access at home xHH6	Active mobile-broadband subscriptions per 100 inhabitants i911mw	Percentage of the population covered by at least a 3G mobile network i271G	Percentage of the population covered by at least an LTE/WiMAX mobile network. i271GA	Fixed broadband subscriptions per 100 inhabitants i992b	Mobile broadband Internet traffic per mobile broadband subscriptions (GB) i136mwi_subs	Fixed broadband Internet traffic per fixed broadband subscriptions (GB) i135tfb_subs	Data-only mobile-broadband basket price (as % of GNI per capita) i271mb_ts_GNI	Fixed-broadband Internet basket price (as % of GNI per capita) i154_FBB_ts_GNI	Percentage of individuals who own a mobile phone xHH18	Mean years of schooling (ISCED 1 or higher), population 25+ years MYS	Expected years of schooling EYS	Indicators available for the reference period Number	 Share	>50%?
Greece (GRC)	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021		2021	2021	12	92%	Y
Grenada (GRD)			2021	2021	2021	2021	2020		2021	2021		2021	2021	9	69%	Y
Guatemala (GTM)	2021	2021	2020	2021	2020	2020			2021	2021	2021	2021	2021	11	85%	Y
Guinea (GIN)									2021	2021		2021	2021	4	31%	N
Guinea-Bissau (GNB)			2021	2021	2021	2021	2021	2021	2021	2021		2021	2021	10	77%	Y
Guyana (GUY)									2021	2021		2021	2021	4	31%	N
Haiti (HTI)									2021	2021		2021	2021	4	31%	N
Honduras (HND)			2021	2021	2021	2021	2021	2021	2021	2021		2021	2021	10	77%	Y
Hong Kong, China (HKG)	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	13	100%	Y
Hungary (HUN)	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021		2021	2021	12	92%	Y
Iceland (ISL)	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021		2021	2021	12	92%	Y
India (IND)			2021	2021	2021	2021	2021	2021	2021	2021		2021	2021	10	77%	Y
Indonesia (IDN)	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	13	100%	Y
Iran (Islamic Republic of) (IRN)	2021	2021	2021	2021	2021	2021	2021	2021	2020	2020	2021	2021	2021	13	100%	Y
Iraq (IRQ)			2021	2021	2021	2021	2021	2021	2021			2021	2021	9	69%	Y
Ireland (IRL)	2020	2020	2021	2021	2021	2021	2021	2021	2021	2021		2021	2021	12	92%	Y
Israel (ISR)	2021	2021	2021	2021	2021	2021			2021	2021		2021	2021	10	77%	Y
Italy (ITA)	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021		2021	2021	12	92%	Y
Jamaica (JAM)	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021		2021	2021	12	92%	Y
Japan (JPN)	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	13	100%	Y
Jordan (JOR)			2021	2020	2020	2021	2021	2021	2021	2021		2021	2021	10	77%	Y
Kazakhstan (KAZ)	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	13	100%	Y
Kenya (KEN)			2021	2021	2021	2021	2021	2021	2021	2021		2021	2021	10	77%	Y
Kiribati (KIR)			2021	2021	2021	2021	2021	2021	2021			2021	2021	9	69%	Y
Korea (Rep. of) (KOR)	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	13	100%	Y
Kuwait (KWT)	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	13	100%	Y
Kyrgyzstan (KGZ)	2020	2020							2021	2021	2020	2021	2021	7	54%	Y
Lao P.D.R. (LAO)	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021		2021	2021	12	92%	Y
Latvia (LVA)	2022	2022	2021	2020	2021	2021	2021	2021	2021	2021		2021	2021	12	92%	Y
Lebanon (LBN)			2020	2020	2020	2020	2020	2020	2021	2021		2021	2021	10	77%	Y
Lesotho (LSO)			2021	2021	2021	2021	2021	2021	2021	2021		2021	2021	10	77%	Y
Liberia (LBR)									2021			2021	2021	3	23%	N
Libya (LBY)									2021	2021		2021	2021	4	31%	N
Liechtenstein (LIE)			2021	2021	2021	2021	2021	2021	2021	2021		2021	2021	10	77%	Y
Lithuania (LTU)	2021	2021	2021	2021	2021	2021	2021		2021	2021	2020	2021	2021	12	92%	Y

Economy (ISO code)	Proportion of individuals who used the Internet (from any location) in the last 3 months yHH7	Proportion of households with Internet access at home xHH6	Active mobile-broadband subscriptions per 100 inhabitants i911mw	Percentage of the population covered by at least a 3G mobile network i271G	Percentage of the population covered by at least an LTE/WiMAX mobile network. i271GA	Fixed broadband subscriptions per 100 inhabitants i992b	Mobile broadband Internet traffic per mobile broadband subscriptions (GB) i136mwi_subs	Fixed broadband Internet traffic per fixed broadband subscriptions (GB) i135tfb_subs	Data-only mobile-broadband basket price (as % of GNI per capita) i271mb_ts_GNI	Fixed-broadband Internet basket price (as % of GNI per capita) i154_FBB_ts_GNI	Percentage of individuals who own a mobile phone xHH18	Mean years of schooling (ISCED 1 or higher), population 25+ years MYS	Expected years of schooling EYS	Indicators available for the reference period Number	 Share	>50%?
Luxembourg (LUX)	2021	2021	2021	2021	2021	2021	2021		2021	2021		2021	2021	11	85%	Y
Macao, China (MAC)	2021	2021							2021	2021				4	31%	N
Madagascar (MDG)			2021	2021	2021	2021	2021	2021	2021	2021		2021	2021	10	77%	Y
Malawi (MWI)			2021	2021	2021	2021	2021	2021	2021	2021		2021	2021	10	77%	Y
Malaysia (MYS)	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	13	100%	Y
Maldives (MDV)			2021	2021	2021	2021	2021	2021	2021	2021		2021	2021	10	77%	Y
Mali (MLI)			2021	2021	2021	2021	2021	2021	2021	2021		2021	2021	10	77%	Y
Malta (MLT)	2021	2021	2021	2021	2021	2021	2021		2021	2021		2021	2021	11	85%	Y
Marshall Islands (MHL)										2021		2021	2021	3	23%	N
Mauritania (MRT)			2021	2021		2021	2021		2021	2021		2021	2021	8	62%	Y
Mauritius (MUS)	2020	2020	2021	2021	2021	2021	2021	2021	2021	2021	2020	2021	2021	13	100%	Y
Mexico (MEX)	2021	2021	2021	2021	2021	2021	2021		2021	2021		2021	2021	11	85%	Y
Micronesia (FSM)									2021	2021		2021	2021	4	31%	N
Moldova (MDA)		2021	2021	2021	2021	2021	2021		2021	2021		2021	2021	10	77%	Y
Monaco (MCO)			2021	2021	2021	2021	2021							5	38%	N
Mongolia (MNG)	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	13	100%	Y
Montenegro (MNE)	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021		2021	2021	12	92%	Y
Morocco (MAR)	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	13	100%	Y
Mozambique (MOZ)			2021	2020	2020	2021	2020		2021	2021		2021	2021	9	69%	Y
Myanmar (MMR)			2021	2021	2021	2021	2021	2021	2021	2021		2021	2021	10	77%	Y
Namibia (NAM)			2021	2021	2021	2021	2021		2021	2021		2021	2021	9	69%	Y
Nauru (NRU)									2021				2021	2	15%	N
Nepal (Republic of) (NPL)									2021	2021		2021	2021	4	31%	N
Netherlands (NLD)	2021	2021	2021	2021	2021	2021	2021		2021	2021	2021	2021	2021	12	92%	Y
New Zealand (NZL)			2021	2021	2021	2021	2021	2021	2021	2021		2021	2021	10	77%	Y
Nicaragua (NIC)			2021	2021	2021	2021			2021	2021		2021	2021	8	62%	Y
Niger (NER)									2021	2020		2021	2021	4	31%	N
Nigeria (NGA)			2021	2021	2021	2021	2021	2021	2021	2021		2021	2021	10	77%	Y
North Macedonia (MKD)	2020	2020	2021	2021	2021	2021	2021	2021	2021	2021		2021	2021	12	92%	Y
Norway (NOR)	2021	2021	2020	2020	2020	2020	2020		2021	2021	2021	2021	2021	12	92%	Y
Oman (OMN)	2020	2020	2021	2021	2021	2021	2021	2021	2021	2021	2020	2021	2021	13	100%	Y
Pakistan (PAK)	2020	2020	2021	2021	2021	2021	2021	2021	2021	2021	2020	2021	2021	13	100%	Y
Palestine (WBG)	2022	2022	2021	2021	2021	2021	2021	2021	2021	2021		2021	2021	12	92%	Y
Panama (PAN)			2021	2021	2021	2021			2021	2021		2021	2021	8	62%	Y
Papua New Guinea (PNG)									2021	2021		2021	2021	4	31%	N

	Proportion of individuals who used the Internet (from any location) in the last 3 months	Proportion of households with Internet access at home	Active mobile-broadband subscriptions per 100 inhabitants	Percentage of the population covered by at least a 3G mobile network	Percentage of the population covered by at least an LTE/WiMAX mobile network.	Fixed broadband subscriptions per 100 inhabitants	Mobile broadband Internet traffic per mobile broadband subscriptions (GB)	Fixed broadband Internet traffic per fixed broadband subscriptions (GB)	Data-only mobile-broadband basket price (as % of GNI per capita)	Fixed-broadband Internet basket price (as % of GNI per capita)	Percentage of individuals who own a mobile phone	Mean years of schooling (ISCED 1 or higher), population 25+ years	Expected years of schooling	Indicators available for the reference period		>50%?
Economy (ISO code)	yHH7	xHH6	i911mw	i271G	i271GA	i992b	i136mwi_subs	i135tfb_subs	i271mb_ts_GNI	i154_FBB_ts_GNI	xHH18	MYS	EYS	Number	Share	
Paraguay (PRY)	2021	2021	2021	2021	2021	2021			2021	2021		2021	2021	10	77%	Y
Peru (PER)	2021	2021	2021	2021	2021	2021			2021	2021	2021	2021	2021	11	85%	Y
Philippines (PHL)			2020	2020	2020	2021	2021		2021	2021		2021	2021	9	69%	Y
Poland (POL)	2021	2021	2021	2021	2021	2021	2021		2021	2021		2021	2021	11	85%	Y
Portugal (PRT)	2021	2021	2021	2020	2021	2021	2021	2021	2021	2021		2021	2021	12	92%	Y
Qatar (QAT)	2020	2020	2021	2021	2021	2021	2021	2021	2021	2021	2020	2021	2021	13	100%	Y
Romania (ROU)	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	13	100%	Y
Russian Federation (RUS)	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	13	100%	Y
Rwanda (RWA)	2020		2021	2021	2021	2021	2021	2021	2021	2021	2020	2021	2021	12	92%	Y
Saint Kitts and Nevis (KNA)			2021	2021	2021	2021			2021	2021		2021	2021	8	62%	Y
Saint Lucia (LCA)			2021	2021	2021	2021	2020		2021	2021		2021	2021	9	69%	Y
Saint Vincent and the Grenadines (VCT)			2021	2021	2021	2021	2020		2021	2021		2021	2021	9	69%	Y
Samoa (WSM)									2021	2021		2021	2021	4	31%	N
San Marino (SMR)			2021	2021	2021	2021						2021	2021	6	46%	N
Sao Tome and Principe (STP)			2021	2021		2021	2021	2021	2021	2021		2021	2021	9	69%	Y
Saudi Arabia (SAU)	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	13	100%	Y
Senegal (SEN)			2021	2021	2021	2021			2021	2021		2021	2021	8	62%	Y
Serbia (SRB)	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	13	100%	Y
Seychelles (SYC)			2021	2021	2021	2021	2021	2021	2021	2021		2021	2021	10	77%	Y
Sierra Leone (SLE)			2021	2021	2021	2021			2021			2021	2021	7	54%	Y
Singapore (SGP)	2022	2022	2021	2021	2021	2021	2021		2021	2021	2021	2021	2021	12	92%	Y
Slovakia (SVK)	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	13	100%	Y
Slovenia (SVN)	2021	2021	2021	2021	2021	2021	2021		2021	2021	2021	2021	2021	12	92%	Y
Solomon Islands (SLB)									2021	2021		2021	2021	4	31%	N
Somalia (SOM)		2020	2021	2021	2021	2021			2021	2021				7	54%	Y
South Africa (ZAF)		2021	2021	2021	2021	2021	2021	2021	2021	2021		2021	2021	11	85%	Y
South Sudan (SSD)			2021	2021	2021	2021		2021				2021	2021	7	54%	Y
Spain (ESP)	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	13	100%	Y
Sri Lanka (LKA)		2020	2021	2021	2021	2021	2021	2021	2021	2021		2021	2021	11	85%	Y
Sudan (SDN)			2021	2021	2021	2021			2021			2021	2021	7	54%	Y
Suriname (SUR)			2021	2021	2021	2021	2021	2020	2021	2021		2021	2021	10	77%	Y
Sweden (SWE)	2022	2021	2021	2021	2021	2021	2021		2021	2021		2021	2021	11	85%	Y
Switzerland (CHE)	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	13	100%	Y
Syrian Arab Republic (SYR)			2021	2021	2021	2021	2021	2020				2021	2021	8	62%	Y
Tajikistan (TJK)									2021	2021		2021	2021	4	31%	N

Economy (ISO code)	Proportion of individuals who used the Internet (from any location) in the last 3 months yHH7	Proportion of households with Internet access at home xHH6	Active mobile-broadband subscriptions per 100 inhabitants i911mw	Percentage of the population covered by at least a 3G mobile network i271G	Percentage of the population covered by at least an LTE/WiMAX mobile network. i271GA	Fixed broadband subscriptions per 100 inhabitants i992b	Mobile broadband Internet traffic per mobile broadband subscriptions (GB) i136mwi_subs	Fixed broadband Internet traffic per fixed broadband subscriptions (GB) i135tfb_subs	Data-only mobile-broadband basket price (as % of GNI per capita) i271mb_ts_GNI	Fixed-broadband Internet basket price (as % of GNI per capita) i154_FBB_ts_GNI	Percentage of individuals who own a mobile phone xHH18	Mean years of schooling (ISCED 1 or higher), population 25+ years MYS	Expected years of schooling EYS	Indicators available for the reference period Number	 Share	>50%?
Tanzania (TZA)			2021	2021	2021	2021	2021	2021	2021	2021		2021	2021	10	77%	Y
Thailand (THA)	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	13	100%	Y
Timor-Leste (TLS)			2021	2021	2021	2021			2021	2021		2021	2021	8	62%	Y
Togo (TGO)			2021	2021	2021	2021	2021	2021	2021	2021		2021	2021	10	77%	Y
Tonga (TON)			2021	2021	2021	2021	2021	2021	2021	2021		2021	2021	10	77%	Y
Trinidad and Tobago (TTO)	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	13	100%	Y
Tunisia (TUN)			2021	2021	2021	2021	2021	2021	2021	2021		2021	2021	10	77%	Y
Türkiye (TUR)	2022	2022	2021	2021	2021	2021	2021	2021	2021	2021	2022	2021	2021	13	100%	Y
Turkmenistan (TKM)									2021	2021		2021	2021	4	31%	N
Tuvalu (TUV)									2021	2021		2021	2021	4	31%	N
Uganda (UGA)	2020		2021	2021	2021	2020	2021	2021	2021			2021	2021	10	77%	Y
Ukraine (UKR)	2021	2021	2021	2021	2021	2021			2021	2021	2021	2021	2021	11	85%	Y
United Arab Emirates (ARE)	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	13	100%	Y
United Kingdom (GBR)	2020	2020	2021	2021	2021	2021		2021	2021	2021		2021	2021	11	85%	Y
United States (USA)			2021	2021	2021	2021			2021	2021		2021	2021	8	62%	Y
Uruguay (URY)			2021	2021	2021	2021	2021	2021	2021	2021		2021	2021	10	77%	Y
Uzbekistan (UZB)	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	13	100%	Y
Vanuatu (VUT)			2021	2021	2021	2021	2021	2021	2021	2021		2021	2021	10	77%	Y
Vatican (VAT)														0	0%	N
Venezuela (VEN)			2021	2021	2021	2021	2021	2021				2021	2021	8	62%	Y
Viet Nam (VNM)	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	2021	13	100%	Y
Yemen (YEM)									2020	2020		2021	2021	4	31%	N
Zambia (ZMB)			2021	2021	2021	2021		2021	2021	2021		2021	2021	9	69%	Y
Zimbabwe (ZWE)	2020	2020	2021	2021	2021	2021	2021	2021	2021	2021	2020	2021	2021	13	100%	Y
Nr. economies with data available for the reference period (2020-2021)	94	94	170	170	168	170	143	115	186	175	59	190	192			

Annex 3: Correlation analysis

Correlation analysis is an essential statistical tool for composite indicator development. By helping to understand the statistical relationships among the indicators considered for inclusion, it provides an early indication of the strength of an index and of possible internal consistency problems.

Correlation coefficients indicate overlaps, complementarities, and trade-offs across indicators, which are often not evident when indicators are selected purely for their conceptual relevance. For instance, the stronger the correlation between two indicators, the higher the statistical overlap between them. Near collinearity (i.e., a coefficient close to 1) signals that the two indicators contain the same information with regards to establishing country scores. Conversely, if there is no statistical association between two indicators (correlation coefficients close to 0), the two indicators fully complement one another, each providing very different information about the country performance. Negative correlation would indicate unintended trade-offs (i.e., improving one dimension comes at the detriment of another).

While there is no optimal degree of correlation in the context of an index, it is important to ensure that the selected indicators fit in the aggregation framework based on positive correlation with the other indicators in the same index component (e.g., a pillar) and the overall index. A composite indicator that is the average of uncorrelated component indicators is confusing, because how countries perform according to the index will look very different from how countries perform according to the individual indicators. Yet, component indicators should not be perfectly aligned, as this would not only weaken the case for having multiple indicators instead of using just one, but also imply double-counting of the same information. Therefore, components should be positively correlated, but not statistically identical (coefficients close to 1), so that the aggregate index is a summary measure, with the added value that it helps reduce dimensionality in a larger underlying dataset.

Correlation analysis can also inform weighting (e.g., to avoid double counting in case of near collinearity), as well as the structuring of indicators (e.g., if multiple dimensions or pillars are used, ensuring that each indicator is assigned to the dimension with which it shares the highest statistical commonality to ensure coherence of the framework.

Table9: Correlation table for tested variables

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
yHH7 (1)	1.00	0.81	0.55	0.59	0.46	0.58	0.39	0.32	-0.55	-0.74	0.87	0.71	0.71
xHH6 (2)	0.81	1.00	0.58	0.59	0.52	0.51	0.30	0.31	-0.41	-0.66	0.79	0.55	0.56
i911mw (3)	0.55	0.58	1.00	0.54	0.44	0.59	0.28	0.35	-0.53	-0.38	0.54	0.60	0.55
i992b (4)	0.59	0.59	0.54	1.00	0.50	0.60	0.20	0.31	-0.53	-0.47	0.51	0.78	0.76
i271G (5)	0.46	0.52	0.44	0.50	1.00	0.81	0.21	0.34	-0.55	-0.52	0.55	0.54	0.55
i271GA (6)	0.58	0.51	0.59	0.60	0.81	1.00	0.25	0.36	-0.62	-0.55	0.56	0.63	0.63
i136mwi_subs (7)	0.39	0.30	0.28	0.20	0.21	0.25	1.00	0.22	-0.25	-0.21	0.32	0.28	0.26
i135tfb_subs (8)	0.32	0.31	0.35	0.31	0.34	0.36	0.22	1.00	-0.29	-0.14	0.22	0.35	0.36
i271mb_ts_GNI (9)	-0.55	-0.41	-0.53	-0.53	-0.55	-0.62	-0.25	-0.29	1.00	0.59	-0.47	-0.58	-0.59
i154_FBB_ts_GNI (10)	-0.74	-0.66	-0.38	-0.47	-0.52	-0.55	-0.21	-0.14	0.59	1.00	-0.64	-0.54	-0.49
xHH18_IDI (11)	0.87	0.79	0.54	0.51	0.55	0.56	0.32	0.22	-0.47	-0.64	1.00	0.54	0.59
MYS (12)	0.71	0.55	0.60	0.78	0.54	0.63	0.28	0.35	-0.58	-0.54	0.54	1.00	0.78
EYS (13)	0.71	0.56	0.55	0.76	0.55	0.63	0.26	0.36	-0.59	-0.49	0.59	0.78	1.00

Notes: Pairwise Pearson correlation coefficients shaded by strength and significance.
Indicators (1) to (4) refer to universal connectivity; (5) to (13) refer to meaningful connectivity, among which (5) to (8) refer to infrastructure, (9) to (10) measure affordability, (11) measures device ownership and (12)-(13) measure skills. See Table 6 for indicator names.

Table9 shows the correlation coefficients for the selected indicators. This analysis was carried out before any treatment, so some of the patterns are driven by the outliers (see identification in Step 4), and the test should be repeated on the treated dataset. The tests revealed the following information about indicator groups and indicator pairs:

- Overall, the correlation coefficients show the expected signs in the selected indicators set. The negative correlation of the two affordability indicators with the other indicators is also expected, since those indicators are measured in an opposite direction: the lower the prices, the better the situation (this means that the direction should be reversed when normalizing these indicators).
- The four indicators in the **universal connectivity group** are positively and moderately to strongly correlated with one another. The two survey-based indicators (share of individuals using the Internet and households accessing the Internet) share the highest degree of similarities, while the somewhat weaker coefficients between the fixed and mobile broadband penetration indicators show that the two technologies are complementary to one another. Similarly, the moderate correlation between the two survey-based measures and the penetration measures based on administrative data shows complementarities between the two approaches. It is possible though that the difference can be explained, to some extent, by the pattern of missing data. Combining indicators of the universal connectivity group into a dimension aggregate appears to make sense from a statistical perspective, as it would not result in a significant loss of information.
- Correlation across indicators in the **meaningful connectivity group** shows greater heterogeneity. Not only does the group stand somewhat apart from the universal connectivity indicators group, but there is also considerable heterogeneity across its different subsets.
- In the **meaningful connectivity – infrastructure group**:
    - The strong positive correlation between the pair of indicators for mobile broadband coverage by at least 3G and 4G technologies suggests that the two indicators can be combined into a single indicator.
    - The two Internet traffic indicators – at least prior to outlier treatment stand apart from the other indicators of the infrastructure group and are also complementary to one another.
    - All this indicates that aggregating these indicators to a single component would involve some degree of compensability among the indicators: countries scoring high on the traffic indicators do not necessarily score high on other indicators in the group. When aggregated, this implies that weaker performance in traffic may be compensated by stronger performance in other indicators.
    - The correlation analysis should be revisited after outlier treatment and possible sub-aggregation of the broadband coverage indicators to better understand statistical coherence.
- The **affordability indicators** for the two technologies (mobile and fixed broadband basket price as a percentage of GNI per capita) are complementary to one another. Interestingly, considering the correlation pattern with the other indicators across the table, while one may expect that all indicators relating to the same technology but measuring different aspects of it (e.g., penetration, traffic, affordability) show greater statistical similarities with one another, correlation patterns show no evidence of that.
- The two **skills proxy indicators** (mean years of schooling and expected years of schooling) are both strongly and positively correlated with one another as well as with many of the other indicators, including those in the universal connectivity group.

Annex 4: Comments by EGTI/EGH Members on the 'Zero draft' document and responses from the ITU Secretariat

See next page.

Comments by EGTI/EGH Members on the ‘Zero draft’ document and responses from the ITU Secretariat

Contents

Introduction

In October 2022, ITU’s Plenipotentiary Conference 2022 in Bucharest adopted a revised text of Resolution 131. This new text (Rev. Bucharest, 2022) defines, inter alia, the main features of the process for developing and adopting a new IDI methodology and of the IDI itself. Consistent with the urgency imposed by Resolution 131, the objective is to launch the IDI in 2023.

In this context, and in line with *instructs 8 to the BDT Director*,[1] the Secretariat prepared a ‘zero draft’ document, which describes a possible framework and structure for the IDI, to inform, facilitate and expedite the process. This document was posted on a discussion forum dedicated to the new IDI. Between 21 February 2023 and 22 March 2023, the members of the Expert Group on ICT Household Indicators (EGH) and the Expert Group on Telecommunication/ICT Indicators (EGTI) were invited to share feedback and suggestions.

More than 200 members signed up for the IDI Forum and almost 100 comments were posted. This document contains a compilation of all the comments received and the respective responses from the ITU Secretariat. Comments related to the process were responded by the Secretariat directly on the IDI Forum and are not reproduced here.

Seven topics were created on the Forum:

1. Welcome to the IDI Forum
2. Methodology of the ICT Development Index 2023: Zero draft
3. Feedback on the proposed conceptual framework
4. Feedback on the proposed universal connectivity indicators

[1] “to facilitate the work of EGTI/EGH in fulfilling the tasks set out under resolves above, including through correspondence”;

5. Feedback on the proposed meaningful connectivity indicators
6. Feedback on the statistical assessment of the proposed indicators
7. Any other feedback on the 'Zero draft' document

The first and second topic were not meant to receive feedback. Nevertheless, several comments were posted under the second topic "Methodology of the ICT Development Index 2023: Zero draft". Some of these comments were to thank the ITU for the document and its efforts, or/and to mention that the person posting the message had no comments.

The rest of this document follows the structure of the 'Zero draft' document. Under each topic, comments were regrouped by theme (e.g., a discussion on a specific indicator), with the Secretariat's response appearing below the group of comments. Some comments were moved from the topic under which they were posted to the topic under which they fit best. Some comments were lightly edited for readability and conciseness. The original 'verbatim' text is available on the IDI Forum. Finally, within a group of comments, some comments called for additional elements of response by the Secretariat to complement its general response to the group of comments. In this case, the Secretariat's specific response appear below the comment and is indented.

Feedback on the proposed conceptual framework

Gerry Wall, Wall Communications Inc. Canada: "In agreement with approach for conceptual framework."

Shamil Polukhov, Ministry of Digital Development and Transport, Azerbaijan: "No objections. The framework was built reasonably by considering both the spread and the quality of Internet connection and by excluding the elements beyond the scope. We find also the indicator selection criteria relevant."

Marcelo Pitta, CETIC, Brazil: "The conceptual framework adopts two dimensions: universal connectivity and meaningful connectivity. Both dimensions, as described, tangle the goal of determining the maturity of ICT adoption – concerning access, use and appropriation. The dimension of meaningful connectivity ensembles the quality and skills needed for better use of ICT; it is a new development in relation of past IDI. This is an advance in relation of past version of the indicator."

Roderick Gusman, Malta Communications Authority, Malta: "I agree with having a harmonised index that aggregates specific indicators to reflect each country's ICT Development. However, I would also consider other similar indices, such as the EU Digital and Economical Social Index, to obtain a form of cross-relation with other indices."

> **Response from the ITU Secretariat:** Data availability and Resolution 131 impose major constraints on the selection of indicators and therefore the scope and depth of the future index. In this context, the depth and breadth of tools like DESI are unfortunately impossible to achieve.

Jens Behrendt, CRA, Qatar: "This document is a solid piece of work. The revised IDI index is a step forward from earlier versions."

Arseny Plossky, Radio Research & Development Institute (NIIR), Russian Federation: "Russian Federation generally supports the conceptual approach to the formation of a new version of IDI. We would like to receive the information on the concepts considered for assessing the development of telecommunications/ICT."

Response from the ITU Secretariat: The 'Zero draft' describes the concept of universal and meaningful connectivity in general terms. For more information on this concept, refer to the document *Achieving universal and meaningful digital connectivity: Setting a baseline and targets for 2030*.

Samih Qabaha, Ministry of Telecom and IT, Palestine: "State of Palestine support this framework, we expect a little bit more details as said by colleagues above in the comments."

Anisa Duncan, Telecommunications Authority of Trinidad and Tobago, Trinidad and Tobago: "The proposed conceptual framework, universal and meaningful connectivity, is certainly a natural progression from the existing conceptual framework. It represents the next phase in measuring a country's progress in ICT development."

Teddy Woodhouse, Ofcom, United Kingdom: "As with others, the proposed conceptual framework around universal and meaningful connectivity and the alignment with the IDI with other related activities makes sense."

Response from the ITU Secretariat: These comments reflect a broad support from EGTI/EGH Members for using the concept of "Universal and meaningful connectivity" as the framework guiding the development of the future index.

Feedback on the proposed universal connectivity indicators

General

Shamil Polukhov, Ministry of Digital Development and Transport, Azerbaijan: "No comment. Everything is in order and justified."

Arseny Plossky, Radio Research & Development Institute (NIIR), Russian Federation: "Russian Federation generally supports the indicators proposed for this sub-index."

Percentage of individuals using the Internet

Shahbaz Nasir, Pakistan Telecommunication Authority, Pakistan: "In financial sector, penetration / financial inclusion measures are considered as per 15+ age whereas, telecom indicators are used as per inhabitant / population. It may be noted that small age children cannot subscribe internet services, therefore, ITU may consider using population of certain age and above or HH/businesses for connectivity / penetration indicators. In general, developing countries have higher number of small age population and therefore using all the population in denominator also results in lower penetration number for these countries."

Jonathan Lim, Infocomm Media Development Authority, Singapore: "On 'Percentage of individuals using the Internet' indicator – Singapore notes that countries tend to provide data on different population age range (e.g., some countries provide based on 16-74 years old while others provide based on the full population). Until such time where every country is able to provide data based on full population, we recommend ITU to look into aligning all countries based on same population range (e.g., based on 16 to 74 years). Otherwise, this would inadvertently leads to non apple-to-apple comparisons which would result in misinterpretation of data as well as any subsequent analysis, thus weighing down the value-addedness of the report towards policy making."

Response from the ITU Secretariat: These are very important and relevant points. Although ITU's *Manual for measuring ICT access and use by households and individuals* (Chapter 7, page 171) recommends collecting data for all individuals aged 5 and above in the, many countries do not survey children and/or older persons. This creates comparability issues as noted – particularly where older persons are not surveyed. Countries with available data consistently report that older persons are less likely to use the Internet.

One option, as suggested, is to use only the 16-74 age bracket. Though some differences in survey scope would remain, this option has the clear advantage of increasing the comparability between countries. However, there are costs to this approach. First, many countries that provide overall Internet use data do not provide breakdowns by age. Availability of official data for 2020 or later drops from 96 countries to 64 when requiring data for the 16-74 age range – below the threshold set for inclusion in the index. If this indicator was included despite the lack of data, more estimation would be required. In addition, using Internet use for only the 16-74 age range for the purposes of the index diminishes the importance of children and older persons when assessing ICT development in countries.

Tegar Satrio, Ministry of Communications and Informatics, Indonesia: "For indicator proportion of individuals who used the internet, there are two different information provided in the document, on page 17, it is mentioned that the indicator is 'in the last 3 months', while on page 20 it is mentioned 'in the last 12 months'."

Fabio Storino, CETIC, Brazil: "Tables 6 and 7, it says Proportion of individuals who used the Internet (from any location) in the last 12 months. 12 or 3 months? 12 would not meet the "Internet user" definition threshold."

Response from the ITU Secretariat: We acknowledge the mistake. The correct period is 3 months – not *12 months*. This has been corrected in the new document.

Percentage of households with Internet access

Tegar Satrio, Ministry of Communications and Informatics, Indonesia: "For indicator proportion of households with internet access at home, we would like to have better understanding on the term "household" in this indicator. If one of household members have internet access, could we consider the household as a household with internet access. How to determine that the household meet the criteria? Furthermore, as for "at home" terminology, does it imply that a house should has internet connection installed (the fixed broadband is installed)? or it just imply that the location of the internet access should be at home, regardless how he/she get the internet connection? For information, Indonesia can provide the indicator proposed which the definition refers to 'minimum a member of household accessed the internet at home location, with any type of network technology'."

Response from the ITU Secretariat: In the *Manual for measuring ICT access and use by households and individuals* (Chapter 4, page 79), *Proportion of households with Internet access at home* is defined as follows:

> *'Household with Internet access' means that the Internet is generally available for use by all members of the household at any time, regardless of whether it is actually used. The connection and devices may or may not be owned by the household but should be considered household assets.*

If one member of the household has a mobile phone with connection to the Internet and makes it available for all members, then it should be considered that the household has access to the Internet.

[…]

An Internet connection in the household should be working at the time of the survey.

Percentage of businesses (10+ employees) using the Internet and Percentage of schools using the Internet

Shahbaz Nasir, Pakistan Telecommunication Authority, Pakistan: "While ITU has excluded indicators on % of businesses and schools using internet due to data availability reasons; these are good indicators of productive usage of internet in the society. Can ITU deliberate further and facilitate the states to make available the required information in the national surveys."

Emanuele Giovannetti, Anglia Ruskin University, United Kingdom: "While understanding the data limitations we should reflect on how to improve (at least for future editions) data availability for the excluded indicators: Percentage of schools using the Internet and Percentage of businesses (10+ employees) using the Internet. As discussed in the contextual framework this distinction of use is key for the analysis of the ICT infrastructure."

Response from the ITU Secretariat: These are indeed very relevant indicators, which would ideally be included in the index. However, data availability for both indicators remains insufficient. In addition, both these indicators are outside the mandate of ITU. *Business use of the Internet* is collected by Eurostat, the OECD and UNCTAD. UNCTAD has resumed the collection of this indicator only recently. Data availability is expected to increase in the coming years. *Schools with Internet access*, which is also an SDG indicator, is collected by the UNESCO Institute for Statistics. Data availability is already close to the threshold for inclusion in the IDI. Data availability will hopefully improve in the coming years for the indicator to be included in the next version of the index. Of note is that the organisations mentioned above are all members of the Partnership on Measuring ICT for Development.

Active mobile-broadband subscriptions per 100 inhabitants

Shahbaz Nasir, Pakistan Telecommunication Authority, Pakistan: "Though coverage of 3G/4G networks have increasingly expanded in developing countries, 2G handsets still consist of around 40% of the total handsets on the mobile networks, therefore, subscribers are still accessing internet on 2G networks, whereas connectivity indicators include only active BB subscribers and do not include connected people through 2G networks. On the other hand, HH indicators still include general usage of internet without any bar on the technology i.e. 2G, 3G, 4G. GSMA also report number of global connected people based on internet connectivity, not BB connectivity. Therefore, ITU may consider including active 2G data subscribers to reflect the overall connected population."

Response from the ITU Secretariat: As per *The Handbook for the Collection of Administrative Data on Telecommunications/ICT*, *broadband Internet* requires 3G or more advanced technology, because the minimum connection speed was set at 256 kbps. 2G GPRS technology has slower connection speeds (around 40 kbps), which is insufficient for meaningful connectivity.

Tegar Satrio, Ministry of Communications and Informatics, Indonesia: "For indicator active mobile-broadband subscriptions per 100 inhabitants and fixed broadband subscriptions per 100 inhabitants, we need clarification if the required data is only subscription data or member states should provide it in "per 100 inhabitants" data. Previously, we only provide subscriptions data and ITU will adjust it by using population data based of ITU proxy. If member states need to provide final data, ITU are recommended to provide the right formula or clear definition for this indicator."

Response from the ITU Secretariat: No additional data collection will be necessary for the IDI. ITU will continue to collect the indicators *active mobile-broadband subscriptions* and *fixed broadband subscriptions* and will compute the indicator normalised by population using population data from the UN Population Division.

Fixed-broadband subscriptions per 100 inhabitants

Saeed Mashkoor, Telecommunications Regulatory Authority, Bahrain: "The retained indicators include "Fixed-broadband subscriptions per 100 inhabitants" which we have raised concerns on it previously, and ITU has established a discussion to explore changing the methodology of calculating fixed broadband penetration rate. Therefore, the new IDI should consider the outcome of the discussion."

Jean Bosco Nsengiyumva, Rwanda Utilities Regulatory Authority (RURA), Rwanda: "Normally, more than 70% of fixed broadband subscriptions in Rwanda are HHs and the remaining are enterprises. The concept framework mentioned that the total population will be considered in the computation of fixed broadband subscriptions per 100 inhabitants' indicator which doesn't reflect the reality at all. Even if, the target is fixed at 50%, it's around impossible for some developing countries to reach there as most of the population or individuals are subscribed to mobile network instead of fixed network. Therefore, I am proposing to HHs to be the denominator even we still have some corporate subscriptions. Even HH members vary across the globe, ITU can collect the number of HHs and even enterprises from NSOs and be divided over the subscriptions from ICT regulator. If this is divided by population, it's around 0.2% and 1.0% by number of HHs which is also the smallest value."

Jens Behrendt, CRA, Qatar: "When reading ITU's comments on the construction of the indicator, it makes me think of an old story. At night a man is outside and suddenly loses his keys. He asks himself, 'shall I look for them here where I lost them or go over to the light post where I can see'. In my opinion, ITU has chosen to look under the light post and even argues that this is the superior place to look. I could not disagree more. ITU writes: 'Dividing by households (instead of inhabitants) has the advantage of taking into account that fixed-broadband subscriptions are often shared within one household and that the average size of households varies across countries'. Under proposed indicator Percentage of households with internet access, ITU writes: 'This indicator covers the most common place where people connect to the internet: at home'. As a fixed connection is inevitably linked to a physical address, the household is in our opinion the most correct denominator. We agree that the use of households also has limitations, such as poor data availability of number of households, and the fact that fixed connections are also used by organizations. However, it is our belief that the advantages outweigh the drawbacks, and in conclusion households are preferable to population. In the document in the Annex below we argue that ITU jumps to conclusions when arguing that population is a superior indicator to households. Therefore, we recommend to rather call population an alternative indicator to households as we cannot accept that it is labelled superior. We also argue that the use of population rather than households results in a systematic bias favoring developed nations to developing nations. We do not believe this is ITU's intention, but it is nevertheless the result. Finally, we believe that the current analysis is not sufficiently based on scientific evidence. We therefore advise ITU to produce a comparison of the value of the indicator when using households respectively population as denominator. We furthermore recommend performing this analysis on a representative sample of nations and include China, India, USA, Brazil, Nigeria, Australia, Switzerland, Singapore, Qatar and Rwanda in the sample, provided that these nations do not object to being used as sample countries. The results could finally be cross referenced to the calculated score in the draft IDI Index."

Shahad Albalawi, Communications, Space & Technology Commission (CST), Saudi Arabia: "Regarding fixed broadband subscriptions, we agree with the comments from Rwanda and Qatar, proposing that households should be the denominator."

Smail Smail BERRABAH, Ministère de la Poste et Télécommunications, Algeria: "Il y a lieu de noter que la méthodologie, proposée, contient un indicateur qui ont fait objet de désaccord et l'objection de plusieurs pays et a conduit au refus de l'IDI 2020 (calcul du taux de pénétration internet fixe par rapport au nombre de ménage et non pas par rapport au total de la population). "

Samiha Semaine, Ministère de la poste et des télécommunications, Algeria: "In terms of proposed indicators, I bring to your attention that the "fixed broadband subscription per 100 inhabitant" indicator was a subject of debate and non-consensus in the IDI 2020 methodology, so I do not see why it is again proposed as it is, calculated in relation to the population. On this point I support the others (Saudi Arabia, Qatar and Rwanda, Tunisia) that this indicator must be calculated in relation to the number of households, being the fixed technology targets households and not individuals."

> **Response from the Secretariat:** The reasons for the lack of consensus that prevented the publication of the IDI 2020 were several and not limited to the treatment of this indicator.

Dr. Hedaia Nabil, Ministry of Communication and Information Technology, Egypt: "Egypt supports proposals from distinguished delegates of Saudi Arabia, Qatar and Rwanda regarding fixed broadband subscriptions. We support the proposal of household being the denominator."

Nasreddine Bahri, Instance Nationale des Télécommunications de Tunisie, Tunisia: "Update the calculation method of the 'Fixed broadband subscriptions per 100 inhabitants' indicator based on the number of households instead of the number of inhabitants. Indeed, there is generally only one fixed internet subscription per household, unlike mobile internet subscriptions where you can find several subscriptions in a single household. In addition, the average number of individuals in a household differs from country to country, and countries with the highest number of individuals in a household will be penalized compared to countries with the highest number of individuals in a household. lower number of individuals within a household if the number of inhabitants is adopted in the calculation of the penetration rate."

Jonathan Lim, Infocomm Media Development Authority, Singapore: "On 'Fixed broadband subscriptions per 100 inhabitants' indicator – We would like to express Singapore's concerns about including 'Fixed-broadband subscriptions per 100 inhabitants' into IDI 2023. We agree that an indicator on fixed broadband is necessary to complement the indicator on mobile broadband subscriptions. However, by reflecting fixed broadband subscription on a per capita basis, the penetration rate will not account for the fact that fixed broadband is subscribed to on a household basis. It is unclear why there is a need to factor for business broadband subscribers as businesses have various means of accessing broadband – many companies actually lease dedicated leased lines/leased circuits rather than subscribing to a broadband package. We note that ITU has shared the difficulties of measuring on a per household basis in the 'zero draft'. Therefore, an alternative here would be to consider proxy indicators such as 'Proportion of households with internet access'. This is an indicator which ITU currently reports as well."

Response from the ITU Secretariat: An indicator on fixed-broadband subscriptions is necessary to complement the indicator on mobile broadband subscriptions, this to avoid a bias towards mobile technology. Mobile broadband technology is not yet a perfect substitute for wired connections, particularly fibre optic, which remains critical for businesses. Furthermore, Internet broadband has gone through different phases since its inception. Started in fixed networks, development continued with both fixed and mobile networks, as well as by different technologies driven by increased demand and new applications. *Network convergence*, defined by ITU Recommendation Q.1761 (page 2) as "Coordinated evolution of formerly discrete networks towards uniformity in support of services and applications", implies that different types of networks are connected to each other, meaning that it enables a service to operate on any combination of networks. In addition, the development of IP-based protocols enabled the provision of services that were previously provided by stand-alone networks, resulting in convergence at technical level. Over time, this expanded the portfolio of plans and services offered by ISPs. Therefore, not considering fixed broadband subscriptions implies missing a key aspect of the study object.

Several comments argue that – conceptually – *household* is a better denominator than *population*. An EGTI subgroup is addressing this question, but its conclusions will not be ready in time to feed into the IDI consultations.

While there are arguments in favour and against both household and population, data availability is ultimately the deciding factor. Data availability on the number of households is very poor. The UN Population Division provides the most complete data on household size (which can then be used to derive number of households). Unfortunately, these data are reported mainly through decennial censuses or other non-regular surveys. Only 35 countries have reported data on household size to the UN Population Division since 2019. We would need to estimate the size of households for well over 100 economies. This is outside the expertise and mandate of ITU. In an exchange between ITU and the UN Population Division, the latter explained that households have a much higher order of complexity, partly due to the lack of international harmonization. The UN publishes its World Population Prospect publications every three to four years where they reconcile and reconstruct the whole population dynamics over time accounting for fertility, mortality, and migration trends. Households, however, have their own dynamics: they can split or merge and household membership can often be fluid. To create a full set of international estimates for all countries and years would require additional statistical modelling and substantial assumptions to impute and extrapolate time series.

In addition to the UN Population Division's database, other data sources on household size and composition exist, such as census microdata and national household surveys. However, these sources are not harmonized. Harmonizing the numbers into a single database would require expertise and considerable resources that ITU does not have, and the coverage issue would persist.

Household surveys offer two possible alternative indicators. The first is *Proportion of households with Internet, by type of service (Fixed broadband network)*. However, data availability is extremely poor for this indicator with only 25 countries having reported data since 2019. The second is *Proportion of households with Internet access at home*. For this indicator, data availability is higher with 94 countries providing data since 2019. This indicator is less precise though as it includes access to the Internet by any service including narrowband or mobile networks. For example, if a member of the household has a mobile phone with connection to the Internet and makes it available for all members, then it is considered that the household has access to the Internet.

All things considered, while we acknowledge that using household as the denominator has some merit (although it is not clear if the advantages offset the disadvantages), the reality of data availability means that is not possible to compute the indicator *fixed-broadband subscriptions per household* for enough countries. This leads us to recommend using population as the denominator.

Fixed-broadband subscriptions by speed tier

The 'Zero draft' document explains why the indicator *Fixed broadband subscriptions by speed tier* is not included in the proposed methodology. Nonetheless, the indicator generated some comments:

Fabio Storino, CETIC, Brazil: "Despite the unit of measurement not being clear -- and the proposal suggesting against 'speed tier' as an indicator to the new index --, as a concept it is important not to limit speed to bandwidth. Other important metrics of Internet speed are latency and jitter. For many online activities, including streaming, a user's perception of connection speed is due more to latency and/or jitter than to bandwidth. This might add further elements not to include this indicator from a data availability perspective. If included, suggestion to use 'nominal speed' instead of 'advertised speed'. Despite the footnote being clear about some of the factors impacting the actual speed perceived by users, 'advertised speed' might convey an idea of 'false advertisement' when confronted with 'actual speed'."

Response from the ITU Secretariat: These are relevant points. However, the IDI will primarily be based on indicators that are currently collected by ITU. *The Handbook for the Collection of Administrative Data on Telecommunications/ICT* defines speed tiers as advertised speeds. Changing the definitions of indicators is beyond the scope of the index development and would need to be discussed within EGTI. In the future, quality of service (QoS) indicators related to fixed broadband may provide additional qualifying information. For now, data coverage and quality are low. A consultation on QoS indicators was launched on the EGTI Forum in 2023.

Rita Vala, ANACOM, Portugal: "Regarding of the penetration of broadband subscriptions it would be useful to understand the penetration by speed-tiers, at least for the fixed broadband. A threshold can be defined: e.g. less or equal to 100 Mbps / higher than 100 Mbps."

Response from the ITU Secretariat: Distinguishing by speed tiers is reasonable from a conceptual (faster speeds allow for more meaningful connectivity) and statistical (slower speed tiers, especially below 10 Mbps, have low or no correlation with the rest of the universal connectivity indicators) standpoint. Our analysis reveals that: 1) data availability is a restriction for using the *100 Mbps and above* tier (i992b_G100). While 74% of the economies provided data for at least one of the years since 2020 for the *10 Mbps and above* tier (i992b_G10), only 58% of economies provided data for i992b_G100; 2) for the countries with available data, the correlation between i992b_G10 and i992b_G100 is very high (0.86). 3) Indicators i992b_G10 and i992b (*Total*) are identical from a statistical perspective (corr. = 0.98). In this case, it is preferable to use only one indicator, the one with higher data availability – which is *Total fixed broadband penetration*, which achieves 87% coverage. Thus, the only effect of adding speed tiers would be to reduce data availability.

Joana Nuviadenu, National Communications Authority, Ghana: "The operators are unable to give a breakdown of subscriptions per speed for the fixed broadband although we request such data. It will need a lot of conversations on how we can get this index if we look forward to including it."

Response from the ITU Secretariat: The indicator *Fixed-broadband subscriptions by speed tier* was considered, but not included in the 'Zero draft' methodology, for reasons detailed in the document.

Jonathan Lim, Infocomm Media Development Authority, Singapore: "Singapore notes that the proposed IDI 2023 consist of indicators related to Fixed-broadband. Given the huge advancement in broadband technology which has brought about significant improvements in capacity and reliability, lower latency and faster speeds, there is a need to re-consider how present day's broadband connection/speed is being benchmarked. With websites and applications requiring higher speeds, a 256kbps connection may not be such a viable option to give users an optimal experience for even basic tasks like web browsing. Therefore, it is recommended that in the construct of IDI 2023, ITU takes both a present & forward-looking approach to benchmark broadband connections as those having speed of at least 1Gbps and above."

Response from the ITU Secretariat: Raising the 256 kbps threshold currently applied would require an agreement by EGTI. Currently, the highest speed tier for which ITU collects data is 100 Mbps or above. Introducing a 1 Gbps or above tier would require an agreement by EGTI. At the same time, on a global scale, the share of subscriptions at the slowest speed tier (256 kbps to 2 Mbps) is less than 1%. There are still many subscriptions below 10 Mbps, though. Finally, data availability is a restriction for using speed tiers: 74% of the economies provided data for at least one of the years since 2020 for i992b_G10 but only 58% for i992b_G100.

Feedback on the proposed meaningful connectivity indicators

Percentage of population covered by a mobile network

Teddy Woodhouse, Ofcom, United Kingdom: "The rationale for retaining the relevant indicators in this section (on universal connectivity indicators) make sense and are well-justified. It would be good to have some consideration whether the retained indicators *MBBcov* and *Trans* may be more appropriately placed in this category as they relate to the preponderance of available infrastructure, which might be more conceptually aligned with the principles of universality (who has coverage/who does not) and less about meaningfulness (which would be more conceptually aligned with the retained traffic indicators and the discussed speed indicators). Comments made by Portugal on the traffic indicators (within the meaningful connectivity indicators discussion) help illustrate this point."

Response from the ITU Secretariat: These are valid points. The rationale for considering *Mobile network coverage* as an indicator of meaningful connectivity (rather than universal connectivity) is that there is a qualitative dimension to it: 4G allows for a more meaningful online experience than 3G. Even though 3G allows for universal connectivity, meaningful connectivity needs more advanced technology. Spreading these indicators in two different components would be confusing. The weights will reflect a preference for the more advanced 4G technology on conceptual grounds, anchoring the sub-aggregate "coverage" indicators in the meaningful group.

Dr. Hedaia Nabil, Ministry of Communication and Information Technology, Egypt: "Egypt supports excluding 5G from the indicator "% of population covered by mobile network due to the unavailability of data."

Samiha Semaine, Ministère de la poste et des télécommunications, Algeria: "I support the exclusion of the 5G mobile network from the indicator "% of population covered by the mobile network" due to the unavailability of data."

Gerry Wall, Wall Communications Inc. Canada: "The differences in mobile network speed (3G, 4G and 5G) to the ease and efficiency of online activity make them important indicator considerations. Weighting will be important (although the document states that will be a follow up issue). At Pg. 25

there seems to be a suggestion that 3G and 4G can be combined. I agree. Need to look for empirical data on effectiveness (maybe user satisfaction levels?) of different speeds. Table on Pg. 11 suggests dropping 5G due to poor data availability but I think it should be included for 2021 anyway even though only 44 countries gather the data. It will be useful going forward to at least have an initial point of comparison."

Roderick Gusman, Malta Communications Authority, Malta: "'% of population covered by a mobile network'. Clarification is required whether access to a 3G network only or whether the indicator captures any mobile network from 3G upwards."

Rita Vala, ANACOM, Portugal: "The most important indicators to assess connectivity are:

- Fixed broadband coverage, by technology (% households/ buildings/ inhabitants);
- Mobile broadband coverage"

Fabio Storino, CETIC, Brazil: "A4AI argues that a "4G-like speed" is the minimum threshold."

Response from the ITU Secretariat: The percentage of population covered by a 5G mobile network is a relevant indicator, but it must be excluded in this version of the IDI owing to the lack of data. But availability will surely improve in coming years, allowing to include this indicator the next iteration of the index. Weighting of the subcomponents will depend on the results of the statistical analysis based on the final set of indicators.

Percentage of households covered by a fixed network

Marcelo Abreu, Universidad de Montevideo, Uruguay: "'Percentage of households covered by a fixed network'. We consider it necessary to differentiate the physical layer of connection: FTTH, Copper, Wireless. The QoE of Internet connectivity strongly depends on it."

Rita Vala, ANACOM, Portugal: "The most important indicators to assess connectivity are:
- Fixed broadband coverage, by technology (% households/ buildings/ inhabitants);
- Mobile broadband coverage
The indicator 'Households covered by a fixed network' is one of the most relevant indicators to assess availability of broadband and should be included despite the number of countries with data currently available. In addition, similarly to Mobile broadband coverage, Fixed BB coverage should also be collected by technology. Eg. Fixed: FTTx, DOCSIS3.1, xDSL..."

Response from the ITU Secretariat: The indicator is relevant to the concept and would be a natural complement to the indicator *Percentage of population covered by a mobile network,* ideally including the breakdown by technology. Unfortunately, data availability is insufficient for the indicator to be included in the index. In 2022, an EGTI subgroup reviewed the list of indicators collected in the WTI Long Questionnaire and flagged cross-country differences in how this indicator was collected and how households are counted, limiting the reliability of this indicator (see report).

Percentage of population within reach of transmission networks, by distance (10 km, 25 km, 50 km)

Shahad Albalawi, Communications, Space & Technology Commission (CST), Saudi Arabia: "The indicator '% of population within reach of transmission networks (10, 25 and 50 km)' is invalid and irrelevant and provides an incomplete picture of the level of connectivity in a given area. There are several reasons why this is the case:

- Distance does not equal access: An individual's distance to a transmission network does not necessarily guarantee access to high-quality broadband services. Other factors, such as topography, weather, infrastructure maintenance, or the lack of last-mile infrastructure, may prevent individuals from accessing the network. As such, this indicator may overestimate the number of people who have access to the network.
- Infrastructure type and quality matters: Different types of transmission networks (e.g., fiber, copper, wireless) have different characteristics in terms of capacity, reliability, and performance. Measuring infrastructure based solely on distance to beneficiaries does not consider the type of infrastructure that is available in a given area."

Dr. Hedaia Nabil, Ministry of Communication and Information Technology, Egypt: "Egypt proposes removing the indicator '% of population within reach of transmission network' based on the weak relevance to the IDI purpose. The logic of inclusion, the definition and the calculation methodology are also unclear."

Samiha Semaine, Ministère de la poste et des télécommunications, Algeria: "For the indicator "Percentage of the population within range of transmission networks, by distance (10 km, 25 km, 50 km)' this indicator has never been included in the ITU questionnaires, on this point it is considered new, no visibility on collection mode, data source, and in our opinion it is not significant."

Nasreddine Bahri, Instance Nationale des Télécommunications de Tunisie, Tunisia: "We wonder about the definition, the detailed calculation method and the official source of the indicator 'Percentage of population within reach of transmission networks, by distance (0 km, 25 km, 50 km)' as well as the questionnaire which reflects this information."

Shamil Polukhov, Ministry of Digital Development and Transport, Azerbaijan: "We are skeptical about the relevance of the following indicator: % of population within reach of transmission networks. It is correct that nodes are significant as access points. However, bare existence of a transmission at a large distance does not mean much. It is not possible for us to provide Internet to a point directly from a node 20 km away. This data is unavailable in Azerbaijan. We can provide the data for the number or the share of population covered by terrestrial Internet network instead (i.e., in % of individuals or households). Currently, we cannot determine the share of population falling withing the circle of nodes according to the distances (10 km, 25 km, 50 km). Because we cannot identify the people residing within the exact distance ranges from the transmission nodes."

Jean Bosco Nsengiyumva, Rwanda Utilities Regulatory Authority (RURA), Rwanda: "As the source of 'Percentage of population within reach of transmission networks, by distance (10 km, 25 km, 50 km)' is ITU, it will be better to mention how this will be computed across all member states meaning estimation assumption, procedures and methodologies."

Anqi Zheng, China MIIT, China: "It is hard to count and compare % of population within 10/25/50km reach of transmission networks. To begin with, the indicator is relatively new and not mature enough. As the related data collection method has not yet been specified in detail, the use of the indicator may change the time series submitted by countries, resulting in data inconsistency. Next, the indicator is relatively less available. Fewer operators publish this data (including China's operators), leaving a wide data gap."

Jonathan Lim, Infocomm Media Development Authority, Singapore: "On 'Percentage of population within reach of transmission networks, by distance (10km, 25km, 50km)' indicator – Singapore understand that EGTI is at the origin of this indicator. Given that this is new, we would like to understand how does ITU intend to collect data for these indicators."

Tegar Satrio, Ministry of Communications and Informatics, Indonesia: "For indicator transmission networks, we need clarification on the definition of transmission network in the indicator if it only fixed broadband network or also includes wireless broadband network? If it only fixed broadband network, we need clarification on the scope of this indicator, is it ONT, OLT, or else. In Indonesia we can provide data until ONT."

Jorge Veloso, Anatel, Brazil: "Concerning the indicator 'Percentage of population within reach of transmission networks, by distance (10 km, 25 km, 50 km)', we can see on Annex 2 page 28 the information that this data is available for Brazil in 2021, but Anatel could not identify such figures or its method of calculation. We understand this is calculated by ITU, is that correct? If so, would it be possible for you to clarify how those figures are calculated, and if possible make this data available?"

Response from the ITU Secretariat: The indicator was defined by EGTI and approved at the 10th World Telecommunication/ICT Indicators Meeting in 2012 (see the report), where it was decided that the data would initially be collected through an ITU pilot project, with external collaborators obtaining the data from operators to create interactive transmission maps. The data thus collected would be shared with national regulators or ministries for verification, ahead of their publication. This practice has evolved into the ITU Broadband Map initiative, run by the Infrastructure Division of ITU-D. On the definitional side, the nodes are fiber nodes. The indicator is relevant as a proxy for infrastructure density or territorial distribution. There are three different statuses possible: *planned*, *under construction*, and *operational*. The maps and the indicator only capture *operational* nodes. Data on the nodes are mostly collected by ITU through desk research, and are subsequently validated by telecom and network operators, with Member States's focal points copied on the correspondence. It is possible that some nodes are missing, for example if operators do not want to share the information. Details on the sources are available in the research and validation system. The calculation of the percentage of population within a certain distance of the nodes is done by ITU, using a variety of (open) sources. Because of limited resources, the data may not be up to date.

Based on comments received and considering that the data for this indicator is not necessarily updated annually, coverage of nodes may be partial, and that various are used sources in addition to official ones, the indicator will be dropped from the Version 1 of the proposed IDI methodology.

International bandwidth usage (bit/s) per Internet user

Hussien Ibrahim, Telecommunications and Digital Government Regulatory Authority, United Arab Emirates: "I would suggest that three indicators that were dropped from the original IDI 2017 structure for unavailability to be included again as to avoid any kind of backwards step and also to encourage countries to collect these important indicators (Bandwidth per internet user, Households with computer and Mean years of schooling)."

Emanuele Giovannetti, Anglia Ruskin University, United Kingdom: "While understanding the stated limitations of this indicator, it is really detrimental not to have any indication about the international connectivity of country. This is relevant not only in terms of bandwidth but also in terms of number of international gateways. It is at the core of the idea of meaningful connectivity since it captures also resilience and possibly control/market power. Every effort should be made to overcome the data shortcomings in view of being able to use these data."

Response from the ITU Secretariat: As highlighted in the 'Zero draft' document, *international bandwidth usage* suffers from several limitations that prevent its inclusion. First, end-user experience (which is a key concern for meaningful connectivity) is not only determined by international, but also by middle-mile and last-mile connectivity (see Marcelo Abreu's comment below about the elements influencing international bandwidth usage). Second, while low values of the indicator can signal a lack of connectivity for users, high values can often be biased if a country is a connectivity transit hub. Third, many countries do not collect this indicator, and many are estimating it based on domestic traffic data, thus limiting international comparability. The problem is made worse by the fact that a non-negligible share of traffic is not carried over the open Internet and by a lack of transparency of international cable operators about pricing and usage. For these reasons, this indicator is not a suitable candidate for inclusion.

Mobile broadband Internet traffic per mobile broadband subscription and Fixed broadband Internet traffic per fixed broadband subscription

Hussien Ibrahim, Telecommunications and Digital Government Regulatory Authority, United Arab Emirates: "The internet Traffic (MBB and Fixed broadband) may not be very relevant due to two reasons: first, it is not connected to the number of subscriptions a country has, whether it is a few thousand or tens of millions; second, there may not be much variation in usage between countries."

Response from the ITU Secretariat: Both mobile and fixed broadband traffic are measured at the end-user point, so the indicators are directly related to subscriptions and reflects usage. It is an even better measure of usage than international bandwidth, which is prone to be affected by transit hub bias. Variation in the data of this indicator is relatively large, as indicated in Table 6 of the 'Zero Draft' document.

Saeed Mashkoor, Telecommunications Regulatory Authority, Bahrain: "In relation to the mobile broadband Internet traffic per subscription and fixed broadband Internet traffic per subscription, we need to think about applying a cap on these indicators."

Response from the ITU Secretariat: Indeed, our statistical analysis confirmed the presence of outliers in the upper end of the distribution, which warrant a cap – see Table 7 of the Zero Draft.

Jonathan Lim, Infocomm Media Development Authority, Singapore: "On 'Mobile broadband Internet traffic per mobile broadband subscription (GB)' indicator – Singapore would like to express its concerns about including this indicator into IDI 2023. We note that the values for this indicator are highly skewed, possibly because of data quality as it is not clear if data on mobile broadband traffic are accurate/consistent across all countries. In the 'zero draft', ITU has proposed imposing a cap as a solution to this statistical issue and we would like to ask ITU how would implementing a cap help in reflecting each country's performance more accurately.

> **Response from the ITU Secretariat:** *The Handbook for the Collection of Administrative Data on Telecommunications/ICT* provides clear guidelines on how to collect mobile broadband traffic indicators at the end-user point. A review of the indicators for the WTI Long Questionnaire carried out by an EGTI subgroup in 2022 did not flag concerns with this indicator. Eventual inaccuracies in data submitted to ITU should, in principle, not affect countries other than the one submitting that figure, since countries are not ranked. Nevertheless, establishing a cap ensures that the highest values are not implicitly treated as targets for all countries, especially in the unlikely case that the highest proves to be inaccurate.
>
> Concretely, analysing the distribution of actual values reveals that half of the values were between 28.4 to 113.5 GB/subscription, with an average of 93.8 and a median of 62.9 (see Table 6 of the 'Zero draft' document). These values correspond, in increasing order, to 2.3,

5.2, 7.8 and 9.5 GB/subscription/month – which appear to be reasonable. Arguably, a value of concern is the maximum of 1'105 GB/subscription [or 92 GB monthly]; four additional countries have values beyond two standard deviations from the mean (a frequently used threshold for flagging outliers – that would be 345.7 GB/subs or 28.8 GB/subs/month). Capping not only removes eventual errors, but also ensures a better data variation.

On 'Fixed-broadband Internet traffic per fixed broadband subscription (GB)' – Singapore has significant reservations towards including this indicator into IDI 2023. We note that this is another indicator where ITU has indicated the issue of skewed data. While ITU attempts to solve this by similarly imposing a cap, we remain very hesitant on the effectiveness of such an approach as a cap simply reduces the impact while the probable issue of data quality persists. We note that ITU's rationale for considering this indicator is on the basis that it reflects the quality of ICT infrastructure given that certain user needs can only be accommodated by data-intensive, fast fixed broadband connections. In this case & as mentioned in the other forum thread, it would then be arguably more crucial to consider Fixed-broadband speeds above certain speeds (e.g., to look beyond 256kbps & instead consider 1Gbps and above as a barometer of the infrastructure's quality)."

Response from the ITU Secretariat: For conceptual issues, see response above. The actual data values show rather high values for fixed broadband traffic. Values range between 0 and 10'485 GB/subscription [874GB/subs/month]; with average of 2'274 GB/subscription and a median of 2'030 GB/subscription. There are a total of four values above mean + two standard deviations, which is 6'057 GB/subscription or 505 GB/subscription/month. A cap is useful to keep values within a reasonable range.

On the alternatives: currently, the fastest speed tier for which fixed broadband subscriptions are collected is 100 Mbps and above. The introduction of a new indicator is a good suggestion but goes beyond the scope of the IDI development and would need to be brought to EGTI's agenda. Please also note that data availability is a restriction for using higher speed tiers: 74% of the economies provided data for at least one of the years since 2020 for i992b_G10 but only 58% for i992b_G100.

Jens Behrendt, CRA, Qatar: "Traffic is calculated per subscription. I suggest to also calculate traffic per inhabitants and publish this ratio as complementary information that is not used for calculating the IDI index. It would add significant value if ITU also published this number as it is rather relevant for general comparison."

Rita Vala, ANACOM, Portugal: "Note that these metrics should be assessed together with the penetration. A high average traffic per user may refer to a small number of users with connection."

Response from the ITU Secretariat: We support the idea of adding in the country scorecards a few 'contextual' indicators that would *not* be included in the IDI (i.e., not part of the calculation), but would provide additional insight.

Winston Oyadomari, CETIC, Brazil: "Also relevant to note how the IXP issue might reflect regional traffic rather than national one, which makes it challenging to apply at a framework designed to compare countries or economies."

Response from the ITU Secretariat: To avoid double-counting, ITU is measuring traffic at the end-user point.

Tegar Satrio, Ministry of Communications and Informatics, Indonesia: "For indicator 'mobile broadband internet traffic per mobile broadband subscription' and 'fixed broadband internet traffic per fixed broadband subscription', we would like to have clarification if the data be collected by ITU World Telecommunication/ICT Indicators Short Questionnaire (WTI SQ)? Previously, ITU only collected data on mobile broadband internet traffic and fixed broadband internet traffic without "per mobile broadband subscription" aspect."

Response from the ITU Secretariat: No extra data collection will be necessary for the IDI. We will continue to collect the traffic and subscriptions indicators separately and perform the required calculations ourselves.

Marcelo Abreu, Universidad de Montevideo, Uruguay: "Since local cache and offpeak load usually impacts on International Bandwith Usage, CDN presence and traffic should be considered."

Response from the ITU Secretariat: This is a valid point which emphasises that international bandwidth indicator alone – without crucial, complementary indicators on middle-mile infrastructure and traffic – can only paint partial picture of the situation. Developing indicators on middle-mile connectivity is part of the EGTI work agenda, but it goes beyond the time horizon of the IDI 2023.

Speed of Internet connections

Gerry Wall, Wall Communications Inc. Canada: "Download speed (and to a somewhat lesser extent upload speed) is a very important indicator but capturing the number of users in each tier will be problematic. Service providers generally do not make that data public. Some government agencies do require suppliers to report that data but those instances are limited. If enough government agencies eventually require its collection then it can be utilized but for now I do not recommend adoption."

Gerry Wall, Wall Communications Inc. Canada: "The available speed indicators for fixed broadband may not be "official" but they are generally credible within the industry and widely used by both suppliers and users. Suggest revisiting."

Shahbaz Nasir, Pakistan Telecommunication Authority, Pakistan: "Internet speed is an important indicator for meaning connectivity. To include indictors on internet speed, non-official sources e.g. Ookla may be studied further to develop an appropriate indicator for internet speed."

Fabio Storino, CETIC, Brazil: "The sample is also biased due to adverse selection (people tend to use those services when they perceive a deviation from the expected speed)."

Jens Behrendt, CRA, Qatar: "As you write there is currently no agreed methodology for measuring actual speeds and the results from Ookla, OpenSignal, etc., may follow different procedures. I would recommend that ITU establishes common international standards/guidelines for speed measurement. Then independent audit firms could audit whether these speed measurements comply with the standards. If they do, then the results can be used as valid and reliable measurements. Actual speeds are becoming increasingly important and the area would benefit greatly from standardization of measurement methodologies."

Edward Musisi, Data Fundi, Uganda: "I agree with the proposal by Jens Behrendt (Qatar), in this thread, that ITU establishes common international standards/guidelines for speed measurement; and wish to add that the development of a volume measurement standard is a pre-requisite for the speed measurement standard (the latter is derivative of the former). In practice, Operators employ various technical approaches to measure (in reality, to estimate) end-user data IP data traffic throughput volumes, leading to varying levels of accuracy."

Response from the ITU Secretariat: The comments highlight the important of Internet speed. Unfortunately, ITU will not be able to set any standards soon, which is why no speed indicator is proposed for inclusion in the IDI. Existing indicators on Internet speed are not from official sources.

Affordability

Tegar Satrio, Ministry of Communications and Informatics, Indonesia: "For indicator 'data-only mobile-broadband basket price (as % of GNI per capita)' and 'fixed-broadband internet basket price (as % of GNI per capita)', could ITU please clarify whether the requested data will be basket price data only as it already asked in ITU ICT Price Basket Questionnaire, or member states would need to provide data that includes gross national income (GNI)?"

Response from the ITU Secretariat: No extra data collection will be necessary for the IDI. We will continue to collect price baskets through the ITU ICT Price Basket Questionnaire, and we will make the required calculations ourselves.

Hussien Ibrahim, Telecommunications and Digital Government Regulatory Authority, United Arab Emirates: "Plans that include voice and SMSs to be used to measure Affordability, data only plans may not be a perfect measure."

Anisa Duncan, Telecommunications Authority of Trinidad and Tobago, Trinidad and Tobago: "The meaningful connectivity-affordability indicators are limited to mobile data-only and fixed broadband prices. In Trinidad and Tobago, mobile data is typically offered with mobile voice services, while mobile data-only is less popular. As a result, the indicator capturing mobile data-only price produces a misleading measure of affordability because most of the population subscribes to mobile data and voice. The indicator mobile broadband data and voice basket should be considered instead."

Gerry Wall, Wall Communications Inc. Canada: "Somewhat concerned with using a 'data-only' mobile basket (unless you mean differentiation by data volume but still including calls and texts). If you mean to restrict to just 'data-only' plans, very few G7 countries offer data only plans except as add-ons. Better to use plans that include calling and texting (unlimited domestic?) and then separate by data volumes."

Jens Behrendt, CRA, Qatar: "It makes sense to raise your point of using mobile data-only baskets for affordability. In ITU price data collection rules applicable from May 2021 it is stated as point 11. that bundled plans may be included in data-only mobile baskets if they are cheaper than mobile data-only plans, so there is no issue here. Qatar thus supports ITU's choice of indicator."

Arseny Plossky, Radio Research & Development Institute (NIIR), Russian Federation: "Russian Federation supports the comment of Canada on ICT Price Baskets. Choosing data-only baskets will limit the results of Member States who prefers the convergence tariffs, included data, voice, SMS, etc."

Roderick Gusman, Malta Communications Authority, Malta: "'Data-only mobile broadband basket as a percentage of GNI p.c.' The understanding is that the info will reflect data-only tariffs. Is it the case? Why limit to data-only packages and not include other mobile telephony services such as voice and SMS?"

Response from the ITU Secretariat: In addition to the *Data-only mobile broadband basket*, ITU statistics are also available for *Mobile data and voice high-consumption basket* (2 GB, 140 min, 70 SMS). As Jens Behrendt highlighted, bundled plans may be included in data-only mobile baskets if they are cheaper than mobile data-only plans (which is the case in many countries). Policy targets on affordability, such as the UN Broadband Commission's 2% GNI p.c., refer to the *Data-only mobile broadband basket*. For the sake of consistency, it is proposed to use this basket. The two baskets – *Data-only mobile broadband* and *Mobile data and voice high-consumption* – are very highly correlated (0.88). Replacing the former with the latter would therefore make very little difference.

Edward Musisi, Data Fundi, Uganda: "I agree with the post by Gerry Wall on using 'data-only' mobile basket; but I also have the following comment comments on broadband pricing methodology. Comparison of mobile broadband Internet prices will always be a daunting task, especially for volume-based (as opposed to speed-based) pricing regimes. So many variables are involved in the price-packaging of 'data bundles': volume, duration, time of use, user application etc. Fundamentally, as stated in the ITU Handbook 2020 Edition (p.190), the structure of the price baskets places emphasis on fixed charges (based on speed) rather than usage (i.e. volume) charges. Unfortunately, volume- based pricing is the norm in economies where the predominant Internet network infrastructure is for mobile services (e.g., 3G, 4G, 5G), rather than fixed service (FTTH, FWA etc,). The ITU rules require selection, from the 'largest' Operator, of only one out of a larger repertoire of available plans and ignores all other Operators in the economy. This choice, though probably justified for simplicity, has drawbacks, as evidenced in its practical application – twelve no-so-straightforward rules must be applied (p.207 of the Handbook). In online research, I have tumbled upon an alternative methodology for price comparison of data bundle prices across economies. This methodology can be accessed at: https://www.cable.co.uk/mobiles/worldwide-data-pricing/. The methodology gives the 'the average price of one gigabyte (1GB) of mobile data' and it appears to cure some of the ills of the ITU methodology. Researchers first establish the mobile data providers in each country before selecting one SIM plan from each data amount they offer. It is however not clear from the methodology whether weighting is undertaken on the selected plans i.e., volume of data bundle sales for a particular plan as a fraction of date volume of data bundles sold in the period under consideration. It is also not clear how the methodology handles variability in expiry durations (day, week, month) and time of use (day, night). When I compared the outputs of the two methodologies (USD prices for 1GB for Cable.UK and 1.5 GB for ITU) for Sub-Saharan economies, the results were not correlated at all, probably implying that there is more work to be done in perfecting either one or the other (or both) methodologies. If it is not outside the scope of our present task, we could do a detailed review of the Cable.Uk methodology and pick some positives. If it is outside of our scope, we could make an appropriate recommendation for the next review of the ITU methodology. More details can be found here: https://www.itu.int/itu-d/meetings/idi/wp-content/uploads/sites/16/2023/03/Meaningful-Connectivity-Affordability-post-updated-1.pdf. My main worry about the current ITU methodology is that the 1.5 GB data only monthly for mobile broadband may not be representative of general usage patterns."

Jens Behrendt, CRA, Qatar: "Just a comment on your suggestion to use cable.co.uk methodology. Let us imagine that you go to a restaurant where they offer all you can eat for 100 USD. They only serve turkeys and have 100 of them. However, you can only eat 1. Is the price for each turkey then 100 USD or 1 USD? Cable.co says it is 1 USD, because they basically calculate the average price of the turkeys, which is 100/100, even though you do not consume them all. If we imagine the restaurant offers unlimited amounts of turkeys, then what is the average price? For this reason, it is recommended to rather use baskets that represent general usage patterns, which then corresponds to a turkey price of 100 USD in the above example. For this reason, Qatar supports that ITU still uses baskets for comparison."

Samih Qabaha, Ministry of Telecom and IT, Palestine: "The price baskets are good to be used, but these baskets need further review and updates."

Response from the ITU Secretariat: This discussion is beyond the scope of the IDI development. The index will use existing ITU price indicators, which reflect the outcome of periodical reviews and updates agreed by EGTI. The latest revision of the methodology applied by ITU was carried out in 2020 and stipulated in the detailed ICT Price data collection rules to be applied from May 2021. These rules were designed to reflect the market realities around the world for all four mobile- and fixed-broadband baskets. Suggestions to modify the data collection rules would need to be brought up at EGTI.

Cable.co.uk's approach of comparing the price of 1 GB data is reasonable and indeed appealing, However, the fine print matters when signing up for new subscriptions or comparing the actual prices and fees. Cable.co.uk does not seem to have a fully transparent set of rules referring to validity period, time of use, treatment of promotions and availability restrictions, modality and termination fees, one-off and recurrent charges and fees, etc., which is also reflected in the wide range of actual options on the market based on which a weighted average is calculated, again, with no clearly defined weights. E.g., in the case of France, the table shows that 1 GB may cost as little as 0.17 EUR and as much as 49.9 EUR.

Shahbaz Nasir, Pakistan Telecommunication Authority, Pakistan: "While measuring affordability in terms of GNI p.c.; Purchasing power parity may also be considered to make it comparable across countries."

Rita Vala, ANACOM, Portugal: "Consider to use also the price with PPP (for a cross-country comparability."

Marcelo Pitta, CETIC, Brazil: "The main concerns are related to the meaningful connectivity dimension. In first place, affordability indicators as percentage of GNI p.c. could have issues in cross-country comparability for making comparisons without considering purchasing power parity in baskets."

Teddy Woodhouse, Ofcom, United Kingdom: "On affordability, the design of the indicator should match to its intention within the index. If the focus is on the affordability barrier, it feels more appropriate to use real market reference prices rather than creating an indicator calculated on the average cost of broadband services. As matches with our domestic research on pricing trends, consumers with lower smaller bundles for communications services might face different pricing pressures than the rest of the market (see pg. 46 for more information). The consistency of the retained indicators match with this principle. However, a further indicator built around the averages of the multiple volumes may be more appropriate for an indicator focused on the average affordability of data services as felt by all consumers. This may conceptually align more with a principle of meaningfulness, while the aforementioned indicator might be more relevant to the principle of universality."

- on average of multiple volumes: could be informative;

Response from the ITU Secretariat: Affordability is a *relative* measure. Expressing the price of a monthly service ('basket') as a share of gross national income per capita per month is therefore the most appropriate approach. In contrast, prices expressed in purchasing power parity allows to compare prices across countries. This approach accounts for differences in purchasing power, without regard for difference in income levels. Our analysis reveals that the correlation between PPP measures and other indicators in the universal and meaningful groups are significantly weaker, thus reducing the robustness of the framework.

Fabio Storino, CETIC, Brazil: "One aspect of meaningful connectivity missing here, according to A4AI's definition, is having enough data. More affordable subscription plans to mobile services often come with more restrictive data caps, and data scarcity limits what people with access, skills, appropriate device etc. are able to do online. Even if we pinned this aspect under affordability (having 'affordable unlimited data plans'), it might be important to distinguish limited from unlimited data plans, as the following paragraph does with 'access vs. possession' and 'mobile phones vs. computers'."

Response from the ITU Secretariat: Although ITU currently does not collect ICT price baskets with unlimited data allowance, the point raised is captured in the affordability indicator to a certain extent. The 'Zero draft' document proposes the inclusion of two baskets: a data-only mobile broadband basket with 2 GB of monthly allowance and a fixed broadband basket with at least 5 GB of monthly allowance. In an overwhelming majority of cases, the minimum is overshot by far, and the actual plan used for the basket includes unlimited data allowance in 140 economies (and over 100 GB in an additional 10 economies). (By contrast, the mobile broadband baskets come with a data cap in all economies but one.)

Sifiso Tshabalala, Eswatini Communication Commission, Eswatini: "There is a need to explore alternative indicators for Meaningful connectivity – affordability, as GNI does not seem to be a strong indicator statistically as a measure of household income and affordability. Alternatively, the following indicators could be explored:

1. *Average Household and individual income data collected from Household and Expenditure or Labour force surveys as % of fixed and mobile broadband baskets; and or*

2. *The weight of household expenditure on ICT services in the Consumer Price Index (CPI) basket*

Conceptually these indicators could be better approximation of household and individual's affordability of ICT services."

Response from the ITU Secretariat: There is ample evidence that gross national income per capita is a very good proxy for household income. We also strongly believe that the affordability indicators are meant to be expressed as a share of income – not the other way around. On the second point, this would require considerable additional work as the composition and weight of CPI baskets vary across countries.

Marcelo Abreu, Universidad de Montevideo, Uruguay: "Affordability: We think that these two items must be considered:

1. Public places called 'Internet Cyber Cafes' where you can connect for an hour-rate.
2. Public Internet-free Access, provided by states, local government."

Response from the ITU Secretariat: Public free access Wi-Fi is a widely used option for increasing connectivity. However, it comes with serious limitations in time and space, which is at odds with the concept of meaningful connectivity ("anytime, anywhere"). ITU is not aware of the availability of globally comparable statistics on the subject, and a general consideration was using indicators that are available, sourced from official data.

Mobile phone ownership

Fabio Storino, CETIC, Brazil: "This paragraph generated multiple interpretations among our team. For some, it was unclear why it started with 'access to' and ended on an 'access vs. possession' note.

Others understood access as the 'bare minimum' and possession as more desirable; likewise, mobile phones as the 'bare minimum' and a computer as more desirable."

Hussien Ibrahim, Telecommunications and Digital Government Regulatory Authority, United Arab Emirates: "The inclusion of the percentage of individuals owning a mobile phone as an indicator of the Sustainable Development Goals (SDG) is highly recommended in order to motivate countries to collect this data."

Saeed Mashkoor, Telecommunications Regulatory Authority, Bahrain: "The retained indicators lack indicator that measures the availability of devices which can be used for the communication. We believe that the new IDI could include at least mobile ownership."

Dr. Hedaia Nabil, Ministry of Communication and Information Technology, Egypt: "Egypt believes it is important to re-include the excluded indicator '% of individuals owning a mobile phone' due to its importance and relevance to the IDI theme."

Max Ruiz, SUTEL-CR, Costa Rica: "We would like to know why mobile phone penetration is removed, as it is an indicator of high availability worldwide and is also a good indicator of people's access to telecommunications."

Nasreddine Bahri, Instance Nationale des Télécommunications de Tunisie, Tunisia: "Re-emphasize the importance of the removed indicator 'Percentage of individuals owning a mobile phone' given that most internet connections today are made using a mobile connection, adding of this indicator is essential in the conceptual framework of the index. This indicator can be collected from different sources, either generally by the ICT surveys on households carried out in the countries, or by the national institute of statistics, also it can be requested from other national entities such as the regulator."

Anisa Duncan, Telecommunications Authority of Trinidad and Tobago, Trinidad and Tobago: "The meaningful connectivity-device indicators were all dropped, and none were proposed as replacements. Access to a device is an important connectivity enabler as it influences meaningful connectivity. Furthermore, as the report states, 'it is important to distinguish use from ownership, recognizing that mere access without full possession of a device imposes constraints, including when and for how long one can be online.' Thus, consideration should be given to mobile phone ownership and the percentage of households with a computer as indicators to measure 'device' as a connectivity enabler."

Linah Ngumba, KNBS, Kenya: "We are pleased to propose that the indicator on mobile ownership be retained, given the significant role mobile phones play in connectivity, as confirmed in the paper. It's encouraging to note that the paper supports our position. Moreover, including the indicator on mobile phone ownership in the IDI rank would be particularly beneficial to African countries, which have substantial but relatively lower mobile phone penetration rates compared to developed nations. In addition, we believe that countries can easily collect data on this indicator, given its straightforward nature. We hope that our proposal will be positively received and considered as we work towards enhancing the IDI rank in collaboration."

Response from the ITU Secretariat: developing and calculating the new index involves trade-offs between relevance and data availability. We established a threshold for data availability, which is why this indicator was initially excluded. However, considering the relevance to the concept, the strong support from EGTI/EGH members for its inclusion, and we have experience in computing estimates for this indicator (and that country-level estimates exist), we will include this indicator in version 1 of the proposal.

Max Ruiz, SUTEL-CR, Costa Rica: "Regarding the indicator 'percentage of individuals owning a mobile phone', Costa Rica proposed a change, and rename it "percentage of individuals with access to a mobile phone". This is due to the lack of ownership information available in surveys conducted in Costa Rica. Instead, surveys ask for access to the device. This means that if any person in a household has access to a cellular phone service, regardless of whether it is in their name or not, irrespective of whether they pay for it or not, but it is used on a regular basis, and they can use the service through the mobile phone without borrowing it from someone who is not a member of that household."

Response from the ITU Secretariat: Mobile phone ownership is a different indicator and is more relevant in the context of the IDI. Mobile phone ownership indicates that an individual has exclusive access to a mobile phone and the services it provides. This is important because if someone has access to a mobile phone, but does not own it, they do not have the on-demand access to its opportunities and benefits. This is also a reason why ownership – not access or use – is an SDG indicator . From the ITU's *Manual for measuring ICT access and use by households and individuals* (see page 108):

> *Sustainable Development Goal 5 (SDG5) includes the indicator "Proportion of individuals who own a mobile telephone, by sex" (5.b.1). Mobile phone ownership, in particular, is important to track gender equality since the mobile phone is a personal device that, if owned and not just shared, provides women with a degree of independence and autonomy, including for professional purposes. A number of studies have highlighted the link between mobile phone ownership and empowerment, and productivity growth. Existing data on the proportion of women owning a mobile phone suggest that the proportion of women who own a mobile phone is lower than for men. This indicator highlights the importance of mobile phone ownership, to track and to improve gender equality, and to help design targeted policies to overcome this gender divide.*
>
> *The indicator [...] is used to monitor SDG Target 5.b: "Enhance the use of enabling technology, in particular information and communications technology, to promote the empowerment of women"*

Emanuele Giovannetti, Anglia Ruskin University, United Kingdom: "Individuals who own a smart telephone (Refers to the proportion of individuals who own a smart telephone. An individual owns a smart telephone if he/she has a smart phone device with at least one active SIM card for personal use.) This is crucial information given the indirect externalities provided by Smartphones in the diffusion of Mobile Social networks (See for example Giovannetti, E., Hamoudia, M. The interaction between direct and indirect network externalities in the early diffusion of mobile social networking. Eurasian Bus Rev 12, 617–642 (2022). https://doi.org/10.1007/s40821-022-00208-1)."

Samih Qabaha, Ministry of Telecom and IT, Palestine: "The Percentage of individuals owning a mobile phone it is excluded because of availability but it is also not very relevant because we have to ensure that this phone is 'smart phone'"

Response from the ITU Secretariat: Smart phone is a subcategory of mobile phone, but data availability is very poor: only 26 countries have reported data on smartphone ownership since 2019. In addition, ownership of any mobile phones including non-smart phones is still relevant to ICT development. An individual who owns a mobile phone is more connected than an individual who doesn't. For these reasons, overall mobile phone ownership remains the best option for the IDI.

Marcelo Pitta, CETIC, Brazil: "Devices do not have enough data availability. There are implications in skills, since they are strongly interrelated."

Response from the ITU Secretariat: We fully agree and can only lament the lack of data.

ICT skills

Marcelo Pitta, CETIC, Brazil: "The availability issue, commented above, is the real problem to consider this indicator into the index. Concerning the aggregation, an EGH group is studying possibilities and this year there may have an aggregate measure of skill based in HH survey data."

Shahad Albalawi, Communications, Space & Technology Commission (CST), Saudi Arabia: "The current indicators for ICT skills and the suggested indicators in this document are both unrelated and irrelevant to ICT skills and need to be updated. We believe that these indicators should be directly related to ICT skills, considering data already collected annually by the ITU, such as data for the Digital Development Dashboard. We believe that we can use the three sub-indicators of the Digital Development Dashboard to indicate ICT skills in a given country, including (i) individuals with basic skills, (ii) individuals with standard skills, and (iii) individuals with advanced skills."

Response from the ITU Secretariat: As noted, there is an active EGH subgroup who is working on this issue. Last year's conclusion was to phase out the previous method of aggregation by skills level (i.e., *basic*, *intermediate*, and *advanced*). This approach will be replaced with an aggregation by skill areas. However, this work is still ongoing and has not yet been finalized.

Regardless of the subgroup's conclusion, the primary problem with this indicator is poor data availability. As noted in the zero draft only 69 countries have provided data in recent years. Even these data are often incomplete with only a subset of skills assessed.

<u>Comments to exclude the education proxies</u>

Marcelo Pitta, CETIC, Brazil: "Indicators related to schooling and enrolment are linked to the education strategies/curricula in each country. The comparison between countries is not direct and sometimes do not reflect the actual digital skills acquired in school."

Gerry Wall, Wall Communications Inc. Canada: "Not sure how well tertiary and secondary education levels reflect ICT skill levels. Would be hesitant to use without some empirical validation. If retained, would weight conservatively. Time spent online might be a better indicator 'user capability'."

Roderick Gusman, Malta Communications Authority, Malta: "'Gross enrollment ratio for…..' indicators. These two indicators do not necessarily reflect the development of ICT skills. Additional indicators are necessary to extract the development related to ICT skills."

Anqi Zheng, China MIIT, China: "Indicators related to digital skills need to be reconsidered. The two indicators gross enrollment rate of secondary education and gross enrollment rate of higher education are still retained, as no other indicators are available to reflect the skills for using digital technologies, but they are not the thresholds for residents' Internet access. At present, user interfaces of both cellphones and personal computers are user-friendly, and elderly-oriented cellphones have been rolled out in China, so that less educated elderly people and other groups can use electronic devices easily. Furthermore, popular mobile services such as short videos, videos and voice calls have no threshold for educational background."

Arseny Plossky, Radio Research & Development Institute (NIIR), Russian Federation: "Russian Federation supports the non-relevance of current selected indicators of the ICT skills sub-index, because there is no direct connection between secondary/tertiary education and digital skills."

Shahbaz Nasir, Pakistan Telecommunication Authority, Pakistan: "It has been observed that people in developing countries are users of internet and other digital services with good knowledge base despite their low educational background. Therefore, indicators of secondary and tertiary education to proxy for the digital literacy / knowledge may be reviewed in a developing country context and in pursuit of a better measure."

<u>Comments to use different education proxies</u>

Hussien Ibrahim, Telecommunications and Digital Government Regulatory Authority, United Arab Emirates: "It is not necessary to include both the Gross Enrolment Ratio for Secondary Education (%) and Tertiary Education (%). The Gross Enrolment Ratio for Secondary Education combined with Mean Years of Schooling would be sufficient to reflect the education level required for the use ICT services."

Shamil Polukhov, Ministry of Digital Development and Transport, Azerbaijan: "'Mean years of schooling' is rightfully excluded for data availability reasons. But even if data availability requirements were satisfied, we could argue against its full applicability. Standard lengths of education programmes vary across countries. In some countries, primary and secondary education may take 11 years whereas they may last 12 years in others. The undergraduate program length is not unique either. It can be three or four years depending on the country. So, a greater number of education years does not always translate to a stronger educational background. Instead, the 'share of population having school or university diplomas' could be a relatively better measure.

When it comes to gross enrollment ratios, they are more appropriate measures than mean years of schooling. The only minor issue is that grade repetition is rewarded in this computation (it increases the numerator) which is not necessarily always a positive thing."

Jonathan Lim, Infocomm Media Development Authority, Singapore: "On 'Gross enrolment ratio (GER) for secondary/tertiary education (%)' indicator – We note that GER may exceed 100% for the reasons such as the inclusion of over-aged and under-aged pupils because of early or late entrants, and grade repetition. If adopted, we would like to suggest for ITU to consider assessing the performance of countries through a banding approach rather than solely referring to the GER ratios by themselves as a high GER % may be due to the reasons mentioned above."

Teddy Woodhouse, Ofcom, United Kingdom: "On skills, these indicators might require the greatest amount of attention between the zero and next draft. I share the concern that others have mentioned around relevance, as these indicators have been scoped so broadly as to use gross enrolment ratios as proxies for having ICT skills. In addition, using gross enrolment ratios could create a theoretical omission where those who are above schooling age and whatever education or digital skills they have are not reflected by any means within the index, given that both enrolment ratios use the related schooling age group as a denominator. Thus, the index as drafted holds a limitation around the digital skills of older age groups above schooling age. This concern may be mitigated by the inclusion of an indicator of overall literacy rates (although relevancy may remain a parallel concern). In addition, the next draft of this section may benefit from further discussion that compares the choices made here and similar indices, such as the Human Development Index. The HDI formerly used gross enrolment ratios but has moved to expected and means years of schooling in more recent editions. Is there a justification (other than the noted data unavailability of the means years of schooling indicator) for the choice made here?"

Response from the ITU Secretariat: The comments point in two directions regarding the use of education proxies for ICT skills. The first direction is not to use any proxy, as education level is not a good predictor of ICT skills. The second direction is to use education indicators, but not the ones used in the past. Instead, one of the possibilities is to use the two indicators that are used in the HDI: *Expected years of schooling* and *Mean years of schooling*. The advantage of this approach is that the data (including estimates) are already available from the HDI. The statistical assessment will show how good the fit will be to the conceptual framework.

Fabio Storino, CETIC, Brazil: "The availability criterion is quite important but, in the present exercise, it excluded new important indicators related to skills. These indicators are regarded as critical for the development and appropriation of ICTs and are part of the meaningful connectivity concept."

Emanuele Giovannetti, Anglia Ruskin University, United Kingdom: "It would be essential to include data on gender and rural/urban skills divide and if possible data Business Digital Skills."

Response from the ITU Secretariat: Unfortunately, there are not enough data for the ICT skills indicator.

Tegar Satrio, Ministry of Communications and Informatics, Indonesia: "'For indicator meaningful connectivity – skill, we notice that on page 30 of the Zero Draft there is no data from Indonesia. We would like to seek clarification if the data is gathered from UNESCO Institute of Statistics (UIS), and UIS did not have data from Indonesia for 2021? For information, we actually have the required data, so questions for this indicator could be included in the household indicator."

Response from the ITU Secretariat: the data are indeed sourced from UIS.

Feedback on the statistical assessment of the proposed indicators

General

Gerry Wall, Wall Communications Inc. Canada: "Excellent work – very helpful."

Anisa Duncan, Telecommunications Authority of Trinidad and Tobago, Trinidad and Tobago: "The statistical assessment of the proposed indicators has been sound and provides positive feedback on the effectiveness of the proposed indicators to measure universal and meaningful connectivity."

Requests for more information

Saeed Mashkoor, Telecommunications Regulatory Authority, Bahrain: "We need to have a visibility on the weight for each indicator and sub-indices which will be used for calculating the IDI and based on what."

Smail Smail BERRABAH, Ministère de la Poste et Télécommunications, Algeria: "Aussi il importe de signaler que la pondération pour les indicateurs proposés n'a pas était mentionné dans la proposition de l'UIT. Par conséquent le contenu de cette version tel que proposé n'est pas suffisant."

Dr. Hedaia Nabil, Ministry of Communication and Information Technology, Egypt: "More elaboration about the weights and calculation methodology is needed."

Samiha Semaine, Ministère de la poste et des télécommunications, Algeria: "The methodology as presented is not clear, in the absence of visibility on the weighting of indicators and sub-indices."

Jean Bosco Nsengiyumva, Rwanda Utilities Regulatory Authority (RURA), Rwanda: "Under this draft document, there is a need to include more information about imputation techniques for missing data, normalization of data, reference values or targets and weights of each indicator, weighting and aggregation formulas to obtain the composite indicator or ICT Development Index."

Jonathan Lim, Infocomm Media Development Authority, Singapore: "we would like to request for more details especially in areas such as the calculation of scores (within each pillar & as the Index on the whole), proposed weightage towards each pillar/indicator and where data is unavailable, how performance of the indicator will be accounted for.

Jens Behrendt, CRA, Qatar: "I agree that the weighting technique must be addressed. The first 3 pillars are clearly related to telecom and the internet, while the 4th pillar regarding skills is more broadly related to skill levels in general and as such is not collected by NRAs. I would therefore propose that the 3 first pillars are weighted equally with 2/7 each, while the 4th pillar on skills is weighted with half the weighting equal to 1/7."

Response from the ITU Secretariat: Several comments called for more information related to the goal posts and the weighting of indicators. These are important steps that will be addressed in version 1. It would have been premature – and presumptuous – to cover these in the 'Zero draft' document, which cover the first three steps of the process of developing an index: definition of the conceptual framework, selection of indicators based on that framework, preliminary statistical analysis of candidate indicators in isolation and collectively (see Table 2).

Other comments

Max Ruiz, SUTEL-CR, Costa Rica: "Costa Rica suggests expanding the use of correlation analysis. After evaluating the data quality, the calculation of correlations is proposed to assess the relationship between the indicators. This analysis aims to detect if there is redundant information, as well as to verify if the indicators have the same direction according to the proposed dimensions.

Costa Rica suggests reinforcing the method with a multivariate analysis, specifically a factorial analysis (perhaps the principal component analysis). Factorial analysis aims to determine whether the number of factors obtained, and their loadings, correspond to what would be expected (based on a prior theory about the data). The a priori hypothesis is that there are certain predetermined factors, and each of them is associated with a specific subset of variables, then, a confirmatory factorial analysis provides a level of confidence to accept or reject this hypothesis and more robust conclusions can be reached when you can determine which indicators have similar patterns to establish a relationship within each dimension."

Response from the ITU Secretariat: This is a good suggestion. We already ran elaborate multivariate analyses but decided not to include a detailed analysis to avoid making the analysis too technical, and because the correlation patterns already give a good indication the relationships, which PCA or factor analysis would confirm. If multiple Member States ask for more advanced analysis, we will include those results in the document that will be produced following the Member States' consultation (Version 2).

Following the expectation that a group of indicators that are conceptually associated with a certain concept also refer, statistically, to a single latent dimension, the findings were as follows: the 4 indicators in the "universal" group have 1 principal component with an eigenvalue above 1 (2.6 in this case), explaining 67% of total variance, with component loadings fairly balanced, between 0.44 (mobile broadband penetration) to 0.55 (households with internet access). The universal group, as also observed in the zero draft, is more heterogenous, with 3 principal components having an eigenvalue greater than 1. If only the first p.c. was retained, it would explain only 49% of total variance, with which the two traffic indicators are least correlated (taking loadings of 0.16-0.18), followed by trans10 (0.26), while the rest are fairly well associated (0.30-0.37 /the affordability indicators considered with reversed direction/). The second p.c. would take higher loadings for the 3 transmission indicators (increasing total variance explained to 64%), and the third for fixed broadband traffic and affordability (increasing total variance explained to 75%). In sum, it shows that further grouping indicators in the meaningful connectivity block is reasonable.

We also note some limitations: the number of observations used in the multivariate analyses is limited to those with data available for all indicators concerned, that drops significantly – e.g., to 83 for the universal group and 66 for the meaningful group.

Jean Bosco Nsengiyumva, Rwanda Utilities Regulatory Authority (RURA), Rwanda: "The proportion of individuals who used the internet, and proportion of households with Internet access needs to be considered as single indicator as these two indicators are almost similar. Individuals using internet are the ones living in HHs accessing internet. Those indicators are almost similar and no need to double count them as there are a strong relationship with them as shown correlation analysis Table 8."

Response from the ITU Secretariat: There is indeed a very strong positive correlation (0.81) between the two indicators, but not the point where including both indicators would be considered as double counting (it would be the case for coefficients above 0.9. This can be taken into consideration when defining weights.

Arseny Plossky, Radio Research & Development Institute (NIIR), Russian Federation: "In case of the decision to restrict the upper limit of the values of indicators included in the new version of the IDI, it is reasonable to proceed from reaching the threshold of 90-95% of the values of each of these indicators. At the same time, one of the possible solutions that could improve the importance of IDI is the introduction of a cluster system for countries based on the different levels of development with a separate calculation of IDI for each of the clusters."

Response from the ITU Secretariat: Setting goalposts will come in a next step. It was not done for the zero draft but will be included in Version 1. Note that thresholds of 90% or 95% would only apply to those indicators that are expressed in percent and range from 0 to 100 (e.g., Individuals using the Internet, Individuals owning a mobile phone). Setting goal posts for indicators expressed in different units, some of which with open-ended range (e.g., traffic indicators) will require a different approach.

The analysis of the IDI results will definitely consider differences in development levels and most likely use regional and income group averages/median (weighted by population).

Any other feedback on the 'Zero draft' document

This topic in the IDI Forum allowed users to post additional comments.

General issues

Arseny Plossky, Radio Research & Development Institute (NIIR), Russian Federation: "As part of the next version of the IDI calculation methodology, information should be provided on the number of countries that have a match for the entire set of indicators to be included in the IDI, in order to minimize the use of missing data recovery mechanisms."

Response from the ITU Secretariat: This information is provided in Annex 2 of the 'Zero draft' document.

Shahbaz Nasir, Pakistan Telecommunication Authority, Pakistan: "It may be noted that availability of many important ICT indicators (e.g. household survey based internet usage) proposed for IDI do not have regular availability from developing countries; however, these indicators have been included in IDI due to their utmost importance. It is proposed that methodology to estimate such indicators in case of their non-availability may also be proposed, deliberated and adopted in a transparent manner. The estimation methodology should be developed in a manner that countries that do not generate such indicators should not be at dis-advantage."

Response from the ITU Secretariat: A general overview of our estimation procedures can be found here: https://www.itu.int/itu-d/reports/statistics/2022/11/24/ff22-methodology/.

Marcelo Pitta, CETIC, Brazil: "The document presents in detail the concepts of the framework, the rules for selecting the indicators and a first descriptive analysis of availability, comparability in a transparent and clear way. Regarding pros and cons of a composite indicator, it would be good to explicitly consider the presentation of the aggregate number with the separate measures. Only with the separate measurements it is possible for the stakeholder to make the right decisions on where to invest."

Response from the ITU Secretariat: If the IDI is published, we will indeed create country profiles showing the detailed results, down to the individual indicators.

Winston Oyadomari, CETIC, Brazil: "In Box 1, other relevant paragraphs under Res 131 could include Resolves 5 that ITU will formally consult Member States to provide them with the option to decline to participate in the IDI during the given period of validity, though with the choice to rejoin the exercise on an annual basis; and resolves 6 that ITU should establish the criteria on the minimum data availability for Member States to feature in the IDI, working through EGTI/EGH;"

Response from the ITU Secretariat: Box 1 has been amended.

Thiago Meireles, CETIC, Brazil: "Despite the 'power of numbers' it could turns into a naive view since there is a strong assumption of neutrality in data production. As choices are made, outcomes are dependent on them even with clear justifications."

Response from the ITU Secretariat: This a valid point. Where there is a way to measure these choices (e.g., contrasting alternative definitions, calculations, etc.), global sensitivity analysis can be applied to quantify the impact of these choices on possible country scores, and present the ultimately selected option against a range of possible outcomes.

Arseny Plossky, Radio Research & Development Institute (NIIR), Russian Federation: "It is reasonable to propose an approach by which a number of indicators with sufficient collectability can be included in the IDI 2023 version, and those indicators that are relevant to the telecommunication/ICT development, but currently do not have sufficient collectability, could be included as a list of candidates for inclusion in the IDI (2027 version), which will ensure continuity of work in measuring telecommunication/ICT development."

Response from the ITU Secretariat: This is a good suggestion, and it is indeed our intention to maintain such a list of candidate indicators to be considered for the next version of the Index.

Suggestions for additional indicators

Hussien Ibrahim, Telecommunications and Digital Government Regulatory Authority, United Arab Emirates: "Relevance is more important to focus on than availability, so it would be useful to include indicators that are relevant even if they are not available since there is no[2] ranking for the new IDI-2023. I would suggest that three indicators that were dropped from the original IDI 2017 structure for unavailability to be included again as to avoid any kind of backwards step and also to encourage countries to collect these important indicators:

- Bandwidth per internet user
- Households with computer
- Mean years of schooling

Given that there will be no ranking for the IDI, I suggest that more relevant indicators be added, even if they are not readily available, to motivate Member States to collect them. An example of this would be:

- Fibre-to-the-home/building Internet subscriptions (infrastructure).
- Proportion of Households with computer (access).
- Percentage of Individuals owning a mobile phone (SDG)"

Response from the ITU Secretariat: the first three and the last two indicators are discussed in the 'Zero draft' document. Concerning 'Fibre-to-the-home/building Internet subscriptions', data availability is below the 50% threshold since there are 85 economies with data (43%) in the 2020-2021 window.

Chengjie Xie, Huawei, China: "To bridge the digital divide and foster an inclusive information society, it is essential to deliver broadband services to rural and underserved areas. However, due to geographical constraints or construction conditions, deploying cables or fiber can be challenging in some cases. The ITU-R Handbook on IMT indicates that as technology advances, telecom operators are increasingly utilizing wireless networks to offer broadband services for homes and businesses. As of June 2021, a total of 436 operators in 171 countries or regions are employing LTE or 5G for fixed wireless access (FWA). In 2021, EGTI approved the inclusion of "Fixed broadband with fixed wireless access via 5G" as a subcomponent of fixed broadband subscriptions. Last year, ITU PP approved FWA as a subcomponent of outcome indicators for the percentage of fixed and mobile broadband subscriptions in the ITU strategic plan for 2024-2027 (Res.71). We propose incorporating FWA into ICT Development Index document, such as in the sections on fixed broadband subscriptions per 100 inhabitants and/or the percentage of households covered by a fixed network indicator."

Anqi Zheng, China MIIT, China: "Overall, the new version of the IDI performs better in reflecting the current situation of ICT development in a country. Firstly, there is no fixed broadband indicator to measure infrastructure quality. The existing indicator system measures the 'quality' of infrastructure with the proportion of population covered by 3G and 4G networks, which only reflects the

[2] The poster omitted the word "no", but it is clear it was meant to be included.

development of mobile broadband, but cannot indicate the accelerated upgrade of fixed broadband to high-speed fiber broadband. It is recommended to add ‘the proportion of fiber broadband users in fixed broadband users’ as a supplemental dimension of fixed broadband network quality evaluation.”

Response from the ITU Secretariat: As per *The Handbook for the Collection of Administrative Data on Telecommunications/ICT*, *Total fixed broadband subscriptions* (the numerator used for fixed broadband penetration) already includes fixed wireless access (FWA) (via any technology) and fiber. Using a distinct indicator for FWA, fiber or any other technological breakdown is not feasible due to low data availability. It would also present the daunting task of defining weights for the different technologies.

Shahbaz Nasir, Pakistan Telecommunication Authority, Pakistan: “The conceptual framework at page 3 describes meaningful connectivity in terms of ‘productive’ online experience; however, does not include productive usage of internet in the society. For example, use of internet for business and other economic activities to enhance productivity and efficiency come under ‘productive’ usage, whereas many other uses of internet are not considered as productive rather become counter-productive for the society. It is proposed that meaningful connectivity may also include some indicators on the productive usage of internet.”

Response from the ITU Secretariat: Business use of the Internet was considered, but ultimately dismissed due to the lack of data. We welcome proposals for alternative indicators, which would need to come from official sources and offer good coverage and comparability.

Samih Qabaha, Ministry of Telecom and IT, Palestine: “we would like to note that the indicators selected in this section are measuring the take-up of service by individuals households and entities. but that does not reflect the universality of service itself, so it deserve to think about adding coverage indicators.”

Response from the ITU Secretariat: Coverage indicators have been proposed under Infrastructure.

Jens Behrendt, CRA, Qatar: “In 2022 you had a presentation about measuring the middle mile. Would you be able to construct a composite index for this area as well when the IDI index has been completed? Many member states would benefit greatly from this, as it would provide an internationally agreed frame of reference and would help in collecting the data from SPs in this market that is typically more diverse than the telecom market.”

Response from the ITU Secretariat: This is indeed a critical aspect of connectivity which we notably discussed in the *Global Connectivity Report 2022*. However, we are not in the position of producing a composite indicator for this topic, owing to the lack of data and resources.

Emanuele Giovannetti, Anglia Ruskin University, United Kingdom: “Additional indicators from ITU collected data, would also be very useful to understand ICT infrastructure in relation to UMC. These are:

1. Number of Internet exchange points (IXPs)
2. IXP Governance indicators
3. Number of Internet service providers (ISPs)
4. Type of connection to international transit (Direct national connection to international Internet, By using IP hub Tier 1, By using IP hub Tier 2, Both by using IP hub and IP transit, National Gateway, By using IP transit, By using IP hub Tier 3)

5. International bandwidth usage (Refers to average usage of all international links including fiber-optic cables, radio links and traffic processed by satellite ground stations and teleports to orbital satellites (expressed in Mbps))
6. Interconnection charges. This while being more related to affordability, reflects an essential element of a country infrastructure. Ideally an indicator reflecting the data on: Charging principle adopted, Charges revision, Charging regime fixed services, Number of geographic tariff zones, Charging regime mobile services, Approach applied for costing fixed termination rates, Approach applied for costing fixed origination rates, Approach applied for costing mobile termination rates, Approach applied for costing mobile origination rates Approach applied for costing national transit rates."

Response from the ITU Secretariat: The fifth indicator on the list is discussed in the 'Zero draft' document – all the other indicators are not collected.

Fabio Storino, CETIC, Brazil: "In Brazil, Ceptro.br, a department of NIC.br, has several initiatives aiming at assessing Internet quality in the country that could be replicated to other countries. One of them is Simetbox, a firmware that can be loaded into Internet appliances (routers, access points) plugged into a network. It measures several connection quality metrics (bandwidth, latency, jitter, packet loss etc.) every three hours (on average) and feeds the data into a central database, allowing us to have an overview of the quality of Internet connections all over the country. It is currently installed in over 60,000 schools, among other places. More at https://simet.nic.br/simetbox.html (in Portuguese only)."

Marcelo Abreu, Universidad de Montevideo, Uruguay: "Since local cache and offpeak load usually impacts on International Bandwidth Usage, CDN presence and traffic should be considered."

Response from the ITU Secretariat: International Bandwidth Usage and traffic are discussed in the document; the other indicator is not collected. Moreover, quality of services indicators on mobile broadband and fixed broadband do not meet coverage and reliability criteria.

Anqi Zheng, China MIIT, China: "The new IDI cannot reflect the development of new services driven by digital technologies; the role of new services in boosting economic growth and improving people's wellbeing should also be considered a 'meaningful connectivity'. For example, new forms of Internet business in the fields of online retail, life services, transportation and short-term rental. It is recommended to consider adding indicators related to e-commerce that reflect residents' individual consumption, such as the proportion of total online retail sales in total retail sales of consumer goods, and the share of mobile payment."

Response from the ITU Secretariat: These are good suggestions. Unfortunately, poor data availability prevents the inclusion of these indicators in the index.

Rita Vala, ANACOM, Portugal: "It would be useful to collect the percentage of individuals using the Internet also by education level (to cross with affordable indicators below)."

Response from the ITU Secretariat: Poor data availability for education-disaggregated indicators prevents their inclusion in the index.

On the importance and relevance of data availability

Hussien Ibrahim, Telecommunications and Digital Government Regulatory Authority, United Arab Emirates: "Relevance is more important to focus on than availability, so it would be useful to include indicators that are relevant even if they are not available since there is no[3] ranking for the new IDI-2023."

Shahad Albalawi, Communications, Space & Technology Commission (CST), Saudi Arabia: "Regarding the issue of data availability, we should not exclude important and relevant indicators for availability reasons. As mentioned in RESOLUTION 131 (REV. BUCHAREST, 2022) Resolve 6, that ITU should establish the criteria on the minimum data availability for Member States to feature in the IDI, working through EGTI/EGH; and Resolve 7 that ITU should consult and seek agreement from Member States not meeting these criteria about proposed methods for supplementing data, including from other sources or from estimations, to enable their inclusion in the IDI."

Response from the ITU Secretariat: One of the reasons for which the revised IDI (in 2017) could not be published is that data availability was not duly considered, leading to the selection of indicators that were certainly relevant, but did not have sufficient coverage. It is not sound to have too many estimates in the index and the computing estimated is an extremely complex and time-consuming exercise which can be conducted only for a limited number of data points.

Anisa Duncan, Telecommunications Authority of Trinidad and Tobago, Trinidad and Tobago: "The proposed universal connectivity indicators are an effective way to measure the development of connectivity focusing on the connectivity of people and households. However, there are some concerns regarding how the low data availability issues for the following indicators will be resolved: Percentage of individuals using the Internet and Percentage of households with Internet access. Data availability concerns for these two indicators are also present in the existing IDI, which resulted in data estimation. How does the ITU intend to treat data availability issues, especially for these household indicators?"

Response from the ITU Secretariat: This is the reason why we have set criteria in the 'Zero draft' document. If we adhere to these principles, we will be able to produce the necessary estimates.

Arseny Plossky, Radio Research & Development Institute (NIIR), Russian Federation: "Indicators that do not have statistical significance, such as indicators of the ICT skills sub-index, and indicators for which there is insufficient data collection, which may lead to a situation similar to 2018, shouldn't be introduced in the current version of IDI."

Response from the ITU Secretariat: We agree with this statement.

Anisa Duncan, Telecommunications Authority of Trinidad and Tobago, Trinidad and Tobago: "Option 2 is preferred – the use of 2021 as the reference year for the indicators from administrative sources, and at least one year in the 2020-2021 range for the survey-based indicators and the skills proxy indicators. Given that some counties do not conduct household surveys every year, it is recommended that this approach is maintained going forward."

Rita Vala, ANACOM, Portugal: "Data from a wider range than 2020-2021 should be also accepted (e.g., 2018). There is a risk of excluding important indicators, or the main indicators, because most countries do not have up-to-date data. There is a list of indicators that, considering the relevance for the index, should not be excluded."

Winston Oyadomari, CETIC, Brazil: "One alternative to minimize the estimates to the strict minimum would be to accept data from a wider range, such as 2018 for example, an option 3 with a wider range. This could improve the availability and reduce the estimates. This could be relevant

[3] The poster omitted the word "no", but it is clear it was meant to be included.

especially considering how the pandemic heavily impacted the capacity of countries to collect household data."

Response from the ITU Secretariat: While the argument is true that it will increase data availability, it will be at the expense of timeliness. Considering the pace of development in the field of ICTs, 2019 is too far away from 2021 to be able to serve as a proxy value for 2021.

Teddy Woodhouse, Ofcom, United Kingdom: "I agree with the comments made by Brazil around further testing of indicators and data availability with consideration of how the Covid-19 pandemic particularly affected data availability in 2020 and 2021."

Teddy Woodhouse, Ofcom, United Kingdom: "I wonder to what degree the index would benefit from being more explicit about its limitations by design. The data availability question is crucial to whatever iteration of the index comes forward, but given member state interest, it may be a useful tool for signalling towards data collection of further key indicators. As such, the index may benefit from having two classes of indicators: core indicators (those within the framework now, with sufficient data availability) and ambition indicators (those in discussion here and more broadly that have been deemed important but fail on the data availability threshold). I would hope that the index not only supports ICT development but also comes with further intention to guide and support data collection on this theme, as well. This echoes the idea of candidate indicators mentioned in the thread on conceptual framework.

This might, if required, be a middle-step option for skills. Where a lack of data means that the index cannot include more granular indicators around ICT skills, but a lack of relevancy may stop use of what is available, the index's framework could signal towards key indicators that are near the threshold or are considered conceptually critical to ICT development and may help member states and their administrations prioritise data collection of the indicators where capacity and resources permit."

Response from the ITU Secretariat: Indeed, privileging official data and ITU indicators impose huge constraints on the design of the index. It is a big limitation of this exercise. One possibility we are considering and mentioned in several comments, would be to feature in the country profiles a few additional indicators to complement the IDI indicators. Among them, there could be indicators considered for inclusion in the IDI but rejected because of poor data availability. They would be reported for countries where data is available.

We advocate for more resources to be dedicated data collection, in addition to our capacity building activities. Highlighting the data gaps and the absence of certain countries in an index and in other data tools, such as the DataHub and the Digital Development Dashboard, supports this advocacy effort.

Reference period

ZOUBIR MIDOU, Ministry of Post and Telecommunications, Algeria: "(…) why we neglect data for 2022, we think that we can delay this version one or two months but we should take the last data, that will add more data (2020, 2021 and 2022) and results will reflect the last state in countries."

Samiha Semaine, Ministère de la poste et des télécommunications, Algeria: "I propose for the publication of the IDI 2023 to wait for the completion of the long questionnaire in September 2023, in order to have the most recent data, and that the ITU secretariat support the countries which have difficulties in collecting the data , to try to help them solve the difficulties encountered in collecting the data, before the publication of the IDI 2023."

Response from the ITU Secretariat: The resolution insists on the urgency of resuming the publication of the index. If we wait for the results of the 2023 questionnaires to be available, the publication of the IDI will be delayed by at least six months, because we would need to process the data, compute the estimates and compute the index. This means that the IDI would be launched in 2024 with 2022 data. The time lag between the index edition (2024) and the reference year (2022) would therefore still be two years. Instead, we propose to publish the IDI still in 2023 and use 2021 as reference year. The lag will be two years, but the index will be released still in 2023.

Jens Behrendt, CRA, Qatar: "If/when the IDI index has been approved, I would also suggest that ITU calculates it back till say 2017. This way member states can get a solid reference for the historic performance of your own country and in international comparison for the period 2017-2022."

Response from the ITU Secretariat: This would require making estimates for three more years, which is impossible.

Nasreddine Bahri, Instance Nationale des Télécommunications de Tunisie, Tunisia: "In addition, the INTT draws attention to the relevance of the other indicators which have been eliminated for lack of available information, this means that the limited availability and reliability of the data pose a huge obstacle to the development and evolution of the index. To this end, the INTT insists on raising awareness of the importance of 'Data' and asking all countries to act usefully on this point in order to provide all the necessary and relevant indicators for the evolution and especially the improvement of the next versions of the index."

Response from the ITU Secretariat: We agree with this comment.

Arseny Plossky, Radio Research & Development Institute (NIIR), Russian Federation: "Calculations for approbation the methodology of the new version of the IDI can be carried out according to data from 2020-2021, but in the future the IDI should be calculated according to data no older than two years. For instance, in 2024 the Index should be calculated based on data of 2022-2023."

Response from the ITU Secretariat: This is indeed our intention, as explained in the 'Zero draft' document: "the reference year for the IDI 2023 will be 2021. The reason is that the timeline for developing and adopting the IDI (see Annex 1) spans most of 2023 and runs parallel to the regular data collection and processing activities of the ICT Data and Analytics Division. Data for 2022 will be collected in 2023. For 2022 to be the reference year for the IDI 2023 would have required knowing the structure of the index *before* starting the data collection. Since this is not possible, the IDI 2023 will use data for reference year 2021. Once the IDI methodology for the IDI is adopted, future editions will use the previous year as reference year."

On rankings

Hock Eng Koay, Independent consultant, Malaysia: "Although no ranking will be made in the new index; it might be helpful to create bands such as "High", "Upper Middle", "Lower Middle" and "Low" based on quartiles (or other quantiles equally spaced or otherwise) of the ogives of scores and choosing appropriate terms to name these bands. Countries can then see who their peers are and set their sights to move their UMC agenda forward to the next higher band. However, this may conflict with Resolves 3 since grouping into bands by scores may be seen as a form of ranking."

Response from the ITU Secretariat: It is a valid approach. However, it means classifying countries into different tiers based on their scores, which amounts to a form of 'soft ranking' (Tier 1, Tier 2, Tier 3...), which would contradict Resolution 131. In addition, it would require establishing arbitrary thresholds to define the groups which is problematic. Two countries with a very similar performance may end up in two different tiers (say Tier 2 and Tier 1) if they are just below and above, respectively, a threshold. The Tier 1 country may be very far from the best country in that tier. This may lead to misguided conclusions.

Jonathan Lim, Infocomm Media Development Authority, Singapore: "While it is proposed that IDI will be published without ranking, we would also like to know how then would each country's performance be benchmarked."

Response from the ITU Secretariat: Resolution 131 imposes the publication of the index without rankings. The scores represent the best way to benchmark performance and is far superior to a ranking. A ranking is purely ordinal. It only indicates if a country performs better or worse than another. The ranking approach loses three critical pieces of information:

1) By *how much* the performance of differ (a country can be ranked first and second, but the second may be very far from the first)? Consider the scores for countries A, B and C are 1.25, 1.26 and 10, respectively. There is a huge performance gap between B and C, whereas the difference between A and B is negligible. However, when converted to ranks, the distance between A and B becomes the same as between B and C, which is obviously wrong.
2) How far are the countries from the ideal state (being ranked first among countries does not necessarily mean everything is perfect)?
3) How has the performance evolved over time (being ranked the same does not mean performance has not changed)?

In addition, if the number of countries covered vary over time, a country's rank may change just because of countries entering or exiting the index even if that country's performance has not changed. For these reasons, using rankings can lead to misguided conclusions, decisions, and policies.

If the IDI methodology is approved and the IDI published in 2023, the Secretariat's analysis will focus on the 'distance to frontier' (how close each country is to an ideal state represented by the 100 mark), performance of regions, income groups, and special groups.