Background document

ICT Development Index 2020: A proposal

The present document was prepared by the ITU Secretariat, ahead of the 8th Meeting of the Expert Group on Household Indicators (EGH) and of the 11th Meeting of the Expert Group on Telecom/ICT Indicators (EGTI) on 14-18 September 2020. The document is available as of 3 September 2020 on the pages of the EGTI meeting and EGH meeting, as well as on the online forums of EGTI and EGH. The document will be available in all six official languages shortly before the EGTI/EGH meetings.

This document presents a possible solution for the release of an ICT Development Index in 2020. The document serves as background for the session "ICT Development Index 2020: A proposal" on 14 September 2020 during the annual meetings of the Expert Group on Household Indicators (EGH) and of the Expert Group on Telecom/ICT Indicators (EGTI). The first part of the document retraces the history of the IDI since its inception in 2009, including the attempts to publish a revised IDI to replace the original IDI that was discontinued in 2017.

The second part introduces the proposed ICT Development Index 2020 (IDI 2020). The *IDI 2020* builds on the *revised IDI* that was adopted in 2017 by the EGTI/EGH to replace the *original IDI* launched in 2009. The revised IDI presented several issues that prevented its adoption. The IDI 2020 is a workable solution that addresses the issues of the revised IDI. Throughout the document, the name *ICT Development Index 2020 (or IDI 2020*) is used to distinguish the proposed version from the two previous versions.

1. ICT Development Index: Background and context

A. Original IDI

The ICT Development Index (IDI) is a composite indicator (i.e. an aggregation of individual indicators) that was launched by ITU in 2009 to assess and benchmark the developments in information and communication technology (ICT) across countries and over time.

The first version of the IDI, called 'original IDI' hereafter, was published annually between 2009 and 2017. This version comprised 11 indicators distributed across the three sub-indices. The IDI was published for the last time in the *Measuring the Information Society Report 2017*. The 2017 edition results of the IDI can be accessed in the IDI 2017 visualisation tool.

B. Revised IDI

The need to improve measurement methods and to update the composition of the IDI in response to technological developments was recognized from the beginning. Indeed, in 2016, as broadband and advanced wireless connectivity became more important to enable countries to fully realize the benefits of ICTs, the need to revisit the indicators of the original IDI was acknowledged. Accordingly,

ITU launched a process for revision of the indicators included in the IDI, through an external consultancy and a subgroup of the Expert Group on Telecommunication/ICT Indicators (EGTI).

The results of the two studies were discussed at an Extraordinary Meeting of EGTI and EGH in March 2017. The meeting adopted a revised set of 14 indicators to be included in a new version of the IDI, called the 'revised IDI' (for reference, the first two columns of Table 1 in Part 2 report the compositions of the original IDI and the revised IDI).

While the Extraordinary Meeting of 2017 agreed on the list of indicators for a revised IDI, it did not engage in the methodological aspects and statistical procedures associated with the development and validation of a composite indicator (e.g. aggregation methods, methods for imputing missing data points, statistical analysis, sensitivity analysis etc.). This work was carried out by the Secretariat in 2017 and 2018.

During this process, the Secretariat identified several important issues with the new indicators: insufficient data availability, poor data quality and conceptual issues (see Part 2 below). The Secretariat concluded that it was not possible to calculate a robust and methodologically sound index. Producing an index under these circumstances would have disregarded fundamental statistical principles and, as a result, undermined the credibility of ITU.

Accordingly, in December 2018, the Secretary General informed the membership of the decision to postpone the publication of the revised IDI until 2019 owing to the identified issues (Circular SG/BDT/010 of 5 December 2018). These issues were presented by the Secretariat at the 16th World Telecommunication/ICT Indicators Symposium (WTIS) in December 2018.

In April 2019, at the Telecom Development Advisory Group (TDAG) meeting, a breakout session on ICT data and statistics was held to inform Member States about the challenges faced with the publication of the revised IDI and to brainstorm on the way forward. Participants suggested to revisit the conceptual framework, develop methodologies on emerging topics and new services, and work in partnership with other relevant organizations, ITU-D Study Groups and other ITU Sectors.

During the summer of 2019, the Secretariat realised that the quality and availability of the data received from countries and needed for the computation of the revised IDI had not improved sufficiently, despite two rounds of capacity building workshops in all the regions, while the conceptual problems persisted. As a result, the revised IDI could still not be published in 2019. This decision was communicated to Members through circular Circular/BDT/DKH/IDA/026 of 3 October 2019.[1] In annex, a background document explained the issues in more detail.[2] That Circular also recommended to exceptionally use the original IDI only for publication in 2019 and announced an informal consultation on that subject.

In Circular/BDT/DKH/IDA/027 of 16 October 2019, the Director of BDT announced that the IDI would not be published in 2019, as the results of the consultation revealed a lack of consensus for reverting to the original IDI.[3] The Director also announced that BDT, in collaboration with the membership and internationally-recognized experts, would continue to work on a more transparent, robust and

[1] Circular/BDT/DKH/IDA/026 in Arabic, Chinese, French, Russian, Spanish.

[2] Background Document in Arabic, Chinese, French, Russian, Spanish.

[3] Circular/BDT/DKH/IDA/027 in Arabic, Chinese, French, Russian, Spanish. Out of the 193 ITU Member States consulted, 76 responded: 49 were in favour of using the methodology used until 2017, 17 were against, and 10 had no preference.

reliable index with the aim of publishing an index in 2020, taking into consideration PP Resolution 131 and WTDC Resolution 8.

C. Towards a new ITU index

To that effect, an Expert Group Meeting on the ITU Index was organised on 10 February 2020 in Geneva. The objective of the meeting was to present a proposal by the Secretariat to ITU Member States for the development of a new composite indicator. Built on the premise that it would be relevant to shift focus to the actual impact of digital technologies, the proposed framework assesses the extent to which digital technologies contribute to achieving the Sustainable Development Goals (SDGs). A Background Document presenting the concept was circulated ahead of the meeting. This new index would have supplanted the IDI. The Summary Report of that meeting noted that participants welcomed the proposal.

In March 2020, a TDAG Web Dialogue on the new ITU index was held where a revised draft concept and framework of the new index was presented and discussed. Participants supported the development of a new index linking digital technologies to the SDGs. Some countries requested more details about the possible indicators and the framework. Others expressed concerns about the tight timeline. The Secretariat was asked to ensure full transparency of the process, regular communication with Member States and consultation with relevant other stakeholders.

On 17 April 2020, a virtual Second Expert Group Meeting on an ITU index was organised to continue the discussion on the progress on the development of a new ITU index. As highlighted in the Summary Report, while the overall approach of linking ICTs to SDGs in the new index was supported by a majority of Member States, there were also many questions and concerns raised on the indicator selection and data availability of the new index. There were also concerns about the process of developing a new index and the status of the IDI (whether the IDI had been officially discontinued).

D. Seeking Council's guidance

The numerous consultations and meetings held between 2019 and 2020 revealed the wide and persisting diversity of views, positions, and expectations among Member States regarding the process for developing an index, as well as the scope and composition of the index. Resolution 131 of the Plenipotentiary Conference (rev. Dubai 2018) does not provide for a mechanism to address such lack of consensus. Therefore, the Director of BDT decided to seek guidance from the virtual Council 2020 on the way forward (Circular/BDT/DKH/IDA/043. Council document, ITU-SG CL Contribution 62 "Report on New ITU index", detailed the reasons for this decision. In addition, the accompanying ITU-SG CL Information Document 17, "ICT Development Index" provided background information and facts about the revised IDI and the issues that prevented its publication.

E. Virtual consultation of councillors (June 2020)

Due to the COVID-19 pandemic, the 2020 physical session of Council was postponed. Instead, a virtual consultation of councillors was held on 9-12 June 2020 during which a new ITU index was discussed.

In her opening remarks, the Director of BDT retraced the history of the IDI and the latest developments that motivated her decision to seek Council's guidance. She insisted that upholding the integrity, quality, and relevance of ITU statistics must remain one of the ITU's highest priorities. She recalled that ITU's ICT Data and Analytics Division has strived to fulfil this objective by producing

high-quality statistics based on scientifically proven sources, methods, and procedures, and which enjoy the public trust. Such trust in ITU statistics is in turn anchored in professional independence and impartiality of the Secretariat and its use of scientific and transparent methods, as well as in the Fundamental Principles of Official Statistics contained in the UNGA Resolution 68/261.

The councillor from the United Arab Emirates, introducing Document VC/3, expressed appreciation for the efforts made by BDT to seek solutions and facilitate reporting under the IDI, in line with Resolution 131 (Rev. Dubai, 2018). He remarked that resuming the original IDI would not be in line with that resolution and was therefore not an acceptable solution. The preliminary new Index, linking use of ICTs to the SDGs, relied too heavily on data reported to other organizations, which could be problematic. His Administration therefore proposed that the 14 indicators of the revised IDI should be reviewed by the expert group, with all administrations represented, to resolve any concerns and allow the IDI to be updated as soon as possible.

The councillor from Saudi Arabia introduced Document VC/14, noting that the failure to report under the IDI for the past two years was a failure to uphold the provisions of Resolution 131 (Rev. Dubai, 2018). The proposed new Index, while excellent in principle, given the clear links between ICTs and sustainable development, required considerable refinement before it could become operational. His Administration proposed that ITU should resume reporting under the existing IDI indicators, while continuing to develop the new Index through EGTI/EGH.

In her concluding remarks, the Director of BDT said that the Secretariat would continue to seek solutions with Member States on those issues and would bring further information to the Council at its next physical meeting. The Council's guidance on how to proceed with the Index would, however, be essential – the Secretariat had made every effort to identify solutions, but a lack of consensus persisted about how to proceed.

As reported in the Summary record of the fourth meeting of the virtual consultation of councillors, the Chairman took it that the virtual consultation, having examined Documents C20/62, VC/3, and VC/14, wished to propose to the next physical meeting of the Council that it consider the issues raised in those documents and advise on the way forward on the development of an ITU index. In the meantime, it encouraged the Secretariat to continue to work with the expert group on the development of an index based on a robust, sound and scientifically proven methodology, and with a view to publishing an accurate index as soon as possible taking into account Resolution 131 (Rev. Dubai, 2018).

In accordance with this conclusion, and since the EGTI and EGH are set to convene in September 2020, the Secretariat decided to work on a possible solution for the consideration at the EGTI/EGH by Member States and experts.

2. ICT Development Index 2020

When looking for a solution, the Secretariat considered four important conclusions reached since 2018:

1. First, the 14 indicators selected for the revised IDI do not allow for a robust, sound and scientifically proven methodology to be produced.
2. At the same time, this set of 14 indicators is the basis on which a consensus was reached during the EGTI/EGH Extraordinary Meeting in 2017.

3. The consultations and meetings held in 2020 revealed the vast diversity of views, positions, and expectations among Member States regarding the possible scope, composition, and methodology of a new ITU index.
4. Many Member States want an index to be released as soon as possible

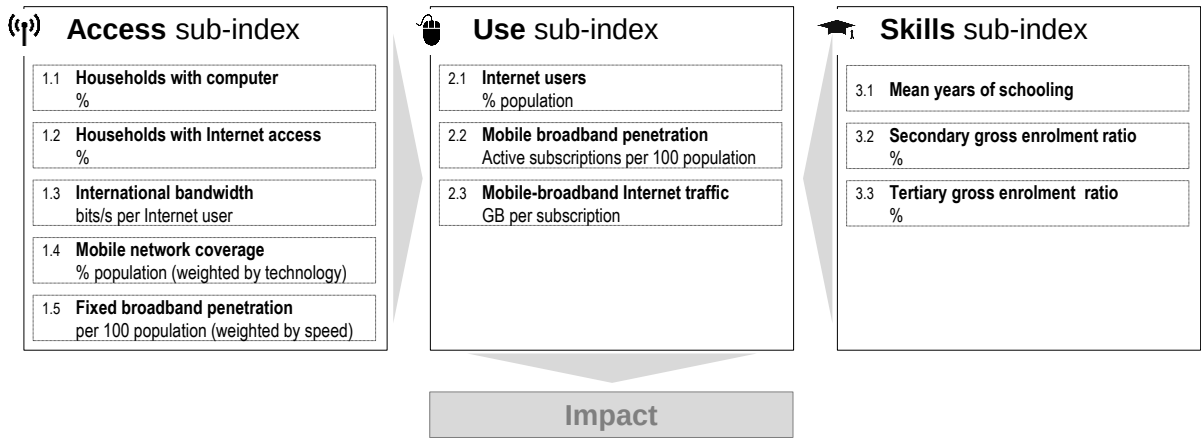
Therefore, as a practical and immediate solution, the Secretariat's proposal is to address the issues identified in the revised IDI relating to data quality, data availability and to the construction of specific indicators. If Member States agree to this proposal, the Secretariat will be in the position to release an index in 2020 (see section "Conclusion and next steps" below).

A. Structure of the ICT Development Index 2020

The key principle that guided the development of the IDI 2020 proposal was to alter the revised IDI as little as possible, by making only the necessary changes to allow for a robust and sound index to be produced.

The proposed ICT Development Index 2020 (IDI 2020) retains the same objective of the revised IDI and, indeed, of the original IDI: to assess countries' level of ICT development. It uses the revised IDI as the starting point and addresses the issues that prevented its release. More specifically, like its predecessors, the IDI 2020 is based on a three-stage conceptual framework aimed to broadly represent the flow of how ICTs contribute to economic and social impacts. First, ICT infrastructure needs to be in place, and it needs to be widely accessible. Second, the ICT infrastructure needs to be used, with skills influencing the quality of that use. These two stages in turn drive impact (third stage). The IDI focuses on the first two stages, and its framework comprises three dimensions: ICT access, ICT use, and ICT skills.

Figure 1: Proposed ICT Development Index 2020
List of indicators and placement



The methods used for the normalization of the indicators and their aggregation are the same as in the revised IDI and indeed of the original IDI. These methodological aspects did not present any issue and were not contentious. This approach is consistent with the principle stated above of only making the changes that are necessary.

The IDI 2020 comprises 11 indicators, distributed across the three sub-indices: Access, Use, and Skills, which are the same as in the original IDI and the revised IDI (Figure 1). Table 1 presents the structure and composition of the three versions of the IDI and highlights the changes across the versions. Those changes are described in the following sections.

Table 1: Main features and structure of the three versions of the IDI

	Original IDI	Revised IDI	IDI 2020 (proposal)	Changes between revised IDI and IDI 2020
Main concepts	Access, Use, Skills	Access, Use, Skills	Access, Use, Skills	No change
Number of indicators	11	14	11	• 3 indicators dropped • Methodology of one indicator adjusted
	List of indicators			
Access sub-index	Percentage of households with a computer	Percentage of households with a computer	Percentage of households with a computer	No change
	Percentage of households with Internet access	Percentage of households with Internet access	Percentage of households with Internet access	No change
	International bandwidth (bit/s) per Internet user	International bandwidth (bit/s) per Internet user	International bandwidth (bit/s) per Internet user	No change
	Fixed-telephone subscriptions per 100 pop.			
	Mobile-cellular subscriptions per 100 pop.			
		Percentage of the population covered by mobile networks - At least 3G - At least LTE/WiMax	Percentage of the population covered by mobile networks - At least 3G - At least LTE/WiMax	No change
		Fixed-broadband subscriptions by speed, as % of total fixed-broadband subscriptions	Fixed-broadband subscriptions (weighted by speed) per 100 population	Methodological change: Indicator now normalized by population. See section "Issue: Fixed-broadband subscriptions" below
Use sub-index	Percentage of individuals using the Internet	Percentage of individuals using the Internet	Percentage of individuals using the Internet	No change
	Fixed-broadband subscriptions per 100 pop.			
	Active mobile-broadband subscriptions per 100 pop.	Active mobile-broadband subscriptions per 100 pop.	Active mobile-broadband subscriptions per 100 pop.	No change
		Mobile broadband Internet traffic per mobile broadband subscription	Mobile broadband Internet traffic per mobile broadband subscription	No change
		Fixed-broadband Internet traffic per fixed broadband subscription		Indicator dropped due to data quality issues. See section "Issue: Fixed-broadband Internet traffic" below
		Percentage of individuals who own a mobile phone		Indicator dropped due to data availability issues. See section "Issue: Data availability" below
Skills sub-index	Mean years of schooling	Mean years of schooling	Mean years of schooling	No change
	Gross enrollment ratio (secondary level)	Secondary gross enrolment ratio	Secondary gross enrollment ratio	No change
	Gross enrollment level (tertiary level)	Tertiary gross enrollment ratio	Tertiary gross enrollment ratio	No change
		Proportion of individuals with ICT skills		Indicator dropped due to data availability issues. See section "Issue: Data availability" below

B. An iterative process

As highlighted in the OECD Handbook on Constructing Composite Indicators (2008): "Index construction is normally a long and iterative process of selecting indicators that are widely available

for many countries and that best fit the index framework and then testing them and retaining those that have explanatory power." This iterative process typically involves the following steps:

1. Develop the framework based on the stated objective.
2. Identify the relevant concepts that fit the framework.
3. Identify potential indicators that capture those concepts.
4. For each considered indicator, assess coverage, methodological soundness, quality of data, and explanatory power.

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5. Based on this assessment, revisit the framework, concepts, and/or indicators (steps 1-4) if necessary.

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6. Identify and treat any outliers and missing data.
7. Define normalization and aggregation methods.
8. Calculate the index.
9. Analyse results and index statistical sensitivity and robustness.

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10. Based on the results of the sensitivity analysis, revisit steps 1-8 if necessary.

In the case of the revised IDI, the Extraordinary meeting of EGTI/EGH convened in 2017 adopted the set of revised indicators (step 3), without performing subsequent steps, crucially step 4. This step would have revealed the issues with several indicators and forced a new iteration of the process.

This situation underscores the necessity for the analysts involved in developing an index to have the freedom to determine which indicators should be included, depending on the outcomes of the steps above, any of which can prompt a revision of the selection of indicators.

It is only in 2018 that the Secretariat completed step 4 and concluded that the index could not be published using the revised set of indicators, thus calling for a new iteration of the process. The reasons leading to this conclusion were detailed in several documents and circulars, as well as below.

C. Issue: Data availability

The most severe issue with the revised IDI is the very low data availability. If the revised IDI were computed for 2019 for the 196 economies considered, only 42% of all data points would be available from official sources.

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% data availability against that of a country with only 50% availability is obviously misguided. Furthermore, the score resulting from the aggregation of a country with 50% availability would provide an inaccurate picture of the real situation. This is obviously problematic if the index is used for making policies and decisions. Finally, limiting the coverage of an index to those countries with full or nearly full data coverage would mean excluding most LDCs, and many developing and emerging economies from the index.

With these considerations in mind and to address the perennial issue of data availability in the revised IDI, the Secretariat adopted the following approach, which only applies to ITU indicators and thus excludes the three indicators sourced from UNESCO.

1. The rule that all the data points for all indicators should be for the same reference year is relaxed. Instead, a range of years is considered. For the IDI 2020, the reference years would

be 2017-2019. If a data point is not available for reference year 2019, the value for 2018 is used instead. If the latter is not available, the value for 2017 is used. If no data is available over the period, the data point is considered as missing. Such measure allows to significantly increase overall data availability for the ITU indicators of the IDI (excluding Fixed-broadband Internet traffic which is excluded due to insufficient data quality – see below) to 62%, compared with only 42% if only 2019 data were used. Trading off data timeliness for data availability has implications. For some indicators and some countries, the index will reflect the situation of three years ago and will not capture the effects of most recently adopted policies and measures. However, in the context of an index, this solution is much preferable to no data, highly inaccurate estimates, or a much-reduced country coverage.

2. Indicators for which data for the period 2017-2019 are available for less than 50% of economies, are excluded (see Figure 2). This threshold is extremely lenient: a threshold of at least 70% would be more in line with good statistical practices but would cause too many indicators to be dropped. Estimating more than 50% of data points for an indicator would be an extremely hazardous and misguided exercise. Estimates would exhibit such large margins of error that they would provide no guidance at all. The high degree of uncertainty of individual estimates would be compounded at the aggregate level. This means that the overall results and rankings of the revised IDI would be fraught with an even higher degree of uncertainty. It must be noted that Resolution 131 considers estimates and other data sources as a method of last resort to address data gaps in the absence of official data.[4]

   Applying this rule leads to the exclusion of two indicators: *Individuals who own a mobile phone* (availability of 36%) and *Individuals with ICT skills*. For the latter indicator, availability varies depending on the computation method: if one includes the countries that reported at least *one* of the nine ICT skills at least once during the 2017-2019 period, data availability is 43%. But computing this indicator based on only one of its nine components would provide an inaccurate depiction of a population's ICT skill set. Availability drops to 20% if one includes only countries that reported data for all nine ICT skills at least once during the period.[5] In both approaches, availability remains well below the 50% threshold.

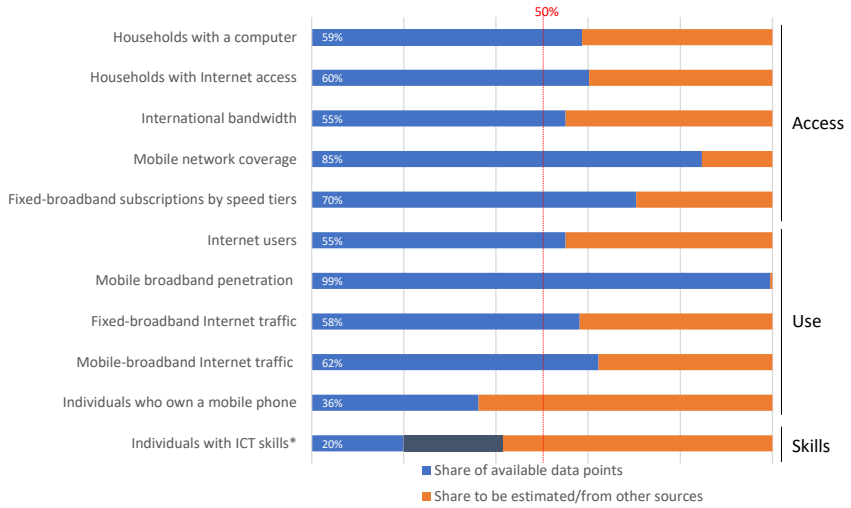
   Excluding these two indicators, as well as fixed-broadband Internet traffic (excluded due to insufficient data quality – see below), improves overall data availability to 69%. Availability by indicator ranges from 55% for Internet users to 99% for Mobile broadband penetration.

[4] Resolution 131 (Rev. Dubai, 2018) 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;"

[5] In addition to insufficient data availability, the ICT skills indicator suffers from data quality issues. The short time period during which this indicator has been collected for those countries that provide data, makes it harder to test how robust the index would be with regard to using data from different years and it showing consistent results. In addition, the definition of this indicator has been modified by EGH, but the collection of data based on this new definition has not yet started. The device-independent new definition is likely to impact significantly on the rates of specific ICT skills, such as sending emails (which can be done from smartphones, which were not included within the scope of the previous definition). For some other skills, the new data will need to be examined once received to understand the effects of the new definition on the values for different skill types.

It must be noted that the exclusion of the two indicators does not mean that these indicators are irrelevant. They capture important aspects of the digital landscape and will continue to be collected and reported with the hope that coverage can be improved.

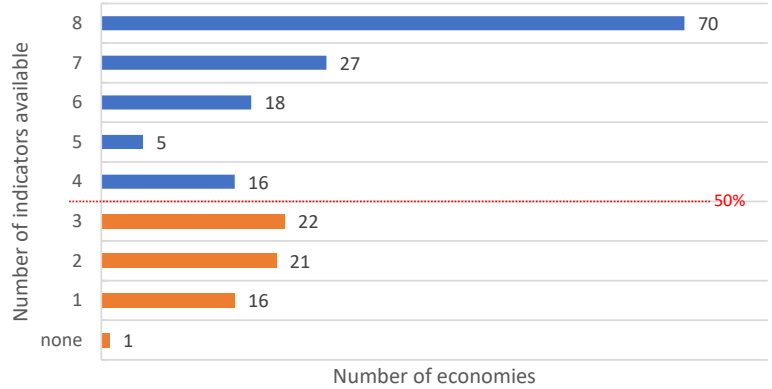
Figure 2: Data availability for ITU indicators in the revised IDI



* See text for details. Note: Only ITU indicators included in analysis.

3. Finally, only economies for which data is available for at least half of the retained indicators (i.e., 4 or more indicators available) are kept (Figure 3). In total, 135 economies would meet this threshold.[6] This is an extremely lenient application of good practices in index building however, it is considered acceptable given that the previous two steps have significantly reduced the number of missing data points. Data availability for the 135 economies retained increases to 87%. With only 13% of data points missing in total, and no indicator with more than 20% of data missing (see Figure 4), it becomes possible to produce reliable estimates to fill all the remaining data gaps.

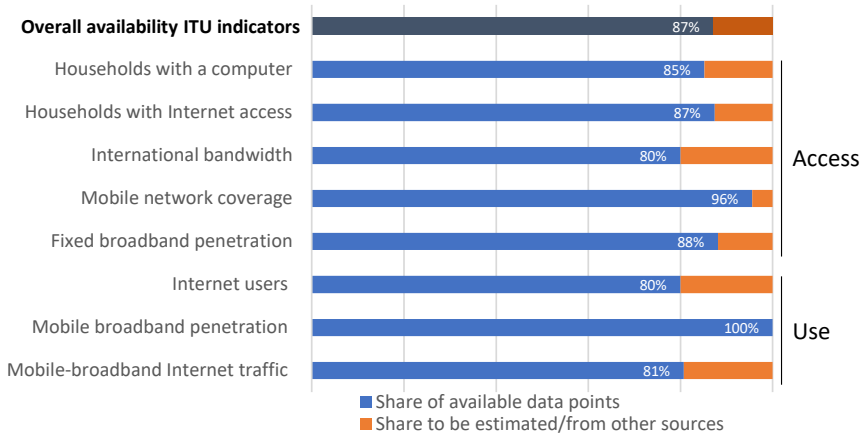
Figure 3: Indicator availability by economy in the proposed IDI 2020



Note: Only ITU indicators included in analysis.

[6] Monaco meets the criterion (4 of the 8 indicators are available), but there is no education data available for Monaco.

Figure 4: Data availability for the ITU indicators in the proposed IDI 2020



Note: share among 135 economies. See text for details. Only ITU indicators included in analysis.

The objective with the proposed IDI is to achieve the largest possible country coverage. However, in an index, it is preferable to exclude a country from an index due to low data availability than to force its inclusion and compute an aggregated index score based on limited data. The assessment would not reflect the real situation and would not be helpful and even potentially harmful. The annex reports tentative data availability as of August 2020 for the reference period 2017-2019 by indicator and economy.

Based on a preliminary assessment of the data situation as of then, it would be possible to cover 135 economies in the proposed IDI 2020. Actual data availability and coverage might differ after the additional data collected through the 2020 edition of the Long Questionnaires are received and after additional data checks are performed. If Member States agree to the proposed IDI, the Secretariat will consider official data already submitted and additional data submitted via the Long Questionnaires through 30 September 2020. Any remaining missing data points will be carefully estimated, and the estimates will be shared with Member States for information.

ITU efforts to improve availability and quality of ICT data

Data coverage and data quality have been improving over the years. But this is a very slow process. For instance, it can take two years to design, set up and administer an ICT household survey for the first time, and its results might not be available for another year, resulting in significant time lag.

Through its statistical capacity building activities, in-country support, and the work of EGTI and EGH to develop statistical standards and collection methods, ITU and its constituents strive to improve data coverage and quality to deliver the most accurate, comparable, and timely statistics possible for the largest number of countries. This is an integral part of ITU's mission to enable evidence-based and data-driven decision-making.

In parallel, big data is a very promising field for delivery of a new generation of more complete, more granular, more accurate, and timelier statistics, both for existing topics and new topics. The ITU Secretariat has run a number of projects as part of its initiative on Big Data for Measuring the Information Society and looks forward to expanding this initiative towards mainstreaming this new approach to data collection and addressing data availability issues.

D. Issue: Fixed-broadband subscriptions

In the revised IDI, the indicator "Fixed-broadband subscriptions by speed tier as a % of total fixed-broadband subscriptions" (shorted as "Fixed-broadband subscriptions by speed tier" hereafter)

captures the average speed of fixed-broadband subscriptions. It is derived from data on the number of subscriptions with a maximum speed below 2 Mbps ("slow" speed tier), between 2 and 10 Mbps ("medium" speed tier), and above 10 Mbps ("fast" speed tier). This indicator captures the *quality* of broadband access but does not consider *penetration* at all. This indicator only considers the respective share of slow, medium, and fast subscriptions, *regardless of the respective number of subscriptions.*

The revised IDI does not have a measure of fixed-broadband penetration but has the indicator Active mobile-broadband subscriptions, thus creating an imbalance and a bias towards mobile infrastructure, even though mobile broadband technology is not yet a substitute for wired connections, particularly fiber optic, which remains critical for businesses. Furthermore, availability of fixed broadband lines is arguably more important than the speed, particularly when many popular video and audio streaming applications operate adequately with bandwidth of less than 5 Mbps. The omission of fixed broadband penetration reduces the likelihood that the index reflects the infrastructure needed to generate positive economic outcomes.

To illustrate this major issue with this indicator, let us imagine a country, Country A, with a population of 10 million and with a total of 1000 fixed-broadband subscriptions, all at high speed (10 Mbps or faster). This country would achieve the perfect mark of 100 in the indicator of the revised IDI. Formally, we have:

$$\frac{0.1 * \text{slow} + 0.35 * \text{medium} + \text{fast}}{\text{slow} + \text{medium} + \text{fast}} * 100$$

The weighting scheme in the formula allows the index to place a premium on faster connections: a fast connection (10 Mbps) gets 10 times and about 3 times more weight than a slow connection (2 Mbps or slower) and medium-speed connection, respectively.[7]

In the example above, *slow* = *medium* = 0, while *fast* = 1000. The sum of all subscriptions is thus 1000. Plugging these numbers in the equation yields the maximum score of 100.[8]

Let us suppose that Country B also has a population of 10 million and 500,000 fast-speed fixed-broadband subscriptions and a further 500,000 medium-speed subscriptions, for a total of 1 million fixed-broadband subscriptions. Country B's score on the indicator would be 67.5, significantly *lower* than Country A's score, despite having 500 times more fast-speed subscriptions, and 1,000 times more fixed-broadband penetration than Country B for the same population size. Fixed-broadband penetration in Country B is 10 per 100 population, half of them at fast speed, whereas in Country A it is only 0.1 subscription per 100 population. And yet Country A's score would be 30 points higher than Country B's. If two countries have the same share of slow, medium, and fast connections (e.g. 33.3%, 33.3%, 33.3%), the score on the indicator *will always be the same, regardless of the number of subscriptions* in each country.

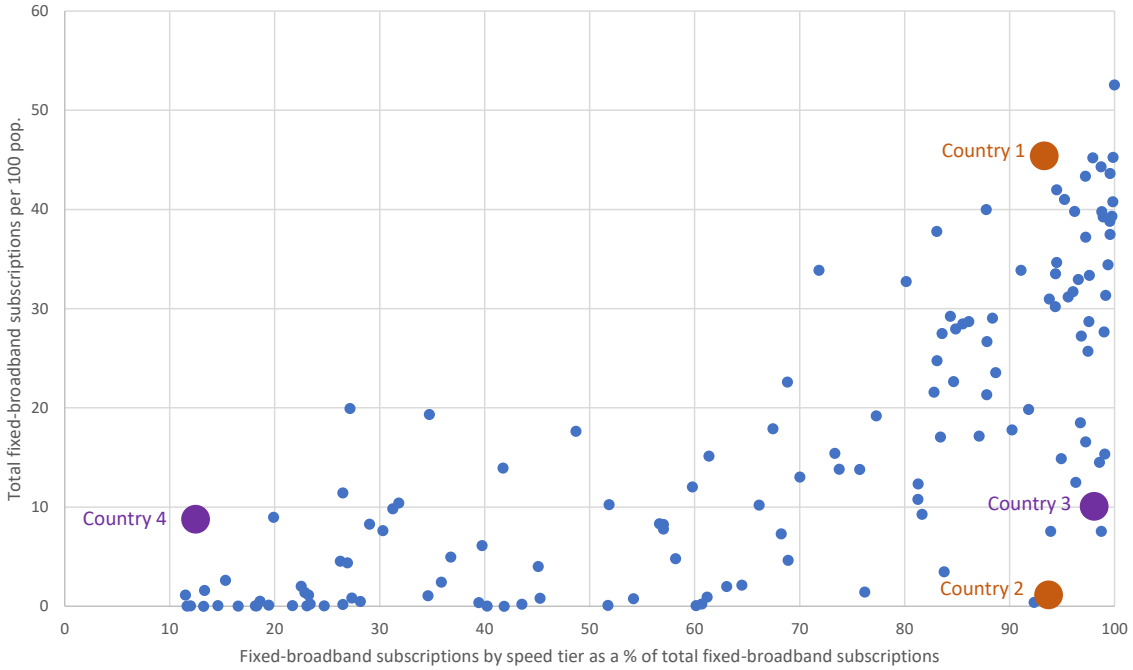
Based on actual values for 137 economies for which fixed-broadband subscriptions by speed tiers is available, Figure 5 plots the indicator from the revised IDI (x axis) against fixed-broadband subscriptions per 100 population (y axis). Countries 1 and 2 obtain almost the same score (93 and 94, respectively) on the indicator "Fixed-broadband subscriptions by speed tier" despite country 1 having a penetration rate almost 40 times larger (45 vs 1.2 per 100 pop.). Countries 3 and 4 have

[7] See methodology here.

[8] Multiplying by 100 aligns the score for this indicator with the score of other indicators which are also normalized on a 0-100 scale, which allows to aggregate them.

almost the same penetration rate (9 vs 10 per 100 pop.), but the former scores almost 10 times better than the latter (98 vs 12) on "Fixed-broadband subscriptions by speed tier".

Figure 5: Fixed-broadband speed versus penetration



Note: See text for methodology.

It is possible to construct an indicator that combines both the speed (quality) and penetration (quantity) dimensions, by taking the weighted sum of subscriptions by speed tier (thus assigning more weight to faster connections), divided by population, instead of total subscriptions. Formally, we have:

$$\frac{0.1 * \text{slow} + 0.35 * \text{medium} + \text{fast}}{\text{population}} * 100$$

This indicator, called *Fixed-broadband subscriptions (weighted by speed) per 100 population*, is included in the proposed IDI 2020 in replacement of Fixed-broadband subscriptions by speed tier.

Table 2 presents (anonymised) real-world examples. Countries 5 and 6 have a similar penetration rate (33.9 vs 34.4). Almost all subscriptions are at fast speed in Country 6 (99%) and only 60% in Country 5. Accordingly, the score of Country 6 on this indicator is higher (34.2 vs 24.3), as expected. Similarly, if two countries have an equal share of subscriptions across the three speed-tiers, the country with a higher penetration rate gets a higher score, again as expected. Countries 7 and 8 have similar shares but Country 8's broadband penetration is three times higher, and its score is therefore three times higher.

Table 2: Examples of scores for indicator Fixed-broadband subscriptions (weighted by speed) per 100 population

	Similar penetration rate		Similar speed-tier shares	
	Country 5	Country 6	Country 7	Country 8
Share of slow-speed subscriptions	3%	0%	0%	0%
Share of medium-speed subscriptions	39%	1%	5%	4%
Share of fast-speed subscriptions	58%	99%	94%	96%
Fixed-broadband subscriptions per 100 pop.	33.9	34.4	12.5	37.2
Fixed-broadband subscriptions (weighted by speed) per 100 pop.	**24.3**	**34.2**	**30.1**	**90.5**

Instead of population, other demographic measures have been suggested. One of them is the number of households, which 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. However, population is a far superior denominator. First, reliable household data are not widely available, notably because the definition of household varies across countries. Second dividing by the number of households assumes that only households subscribe to fixed-broadband, which is clearly not the case, as a large share of fixed-broadband connections are subscribed to by businesses and that the number of businesses per population varies greatly across countries. The hypothetical example in Table 3 demonstrates the superiority of population as a denominator. If dividing the number of fixed-broadband subscriptions (all of the same speed for the sake of simplicity) by the number of households, penetration rate would be twice as high in Country 9 than in Country 10 (40 vs 20 per 100 households). Dividing by the number of businesses produces the exact opposite result: Country 10 has twice as many subscriptions per 100 businesses (180 vs 90). Dividing by households or businesses would provide in both cases a highly inaccurate picture of the true state of broadband penetration in both countries. In the absence of reliable disaggregated data on subscriptions by user type and data on the number of households and businesses, dividing by population is a much better solution. In this example, it suggests that the broadband penetration is similar, which is more accurate than stating that broadband penetration in a country is twice higher than in another.

Table 3: Simulations of penetration rates using different denominators

	Country 9	Country 10
Total fixed-broadband subscriptions	90,000	90,000
Population	1,000,000	1,000,000
Subscriptions per 100 pop.	9	9
Households	225,000	450,000
Subscriptions per 100 households	40	20
Businesses	100,000	50,000
Subscriptions per 100 businesses	90	180

E. Issue: Fixed-broadband Internet traffic

In addition to the data availability issue, a second issue with the revised IDI relates to the indicator Fixed-broadband Internet traffic per fixed-broadband subscription, within the Use sub-index of the revised IDI. Although it is a relevant indicator for gauging the intensity of Internet use alongside the indicator Mobile-broadband Internet traffic, the quality of the data is not sufficient.

One reason is that this is a relatively new indicator, for which a refined methodology has only been finalised at the end of 2019.[9] Detailed clarifications were not available at the start of the data collection, and once these were available, they may have changed time series submitted by

[9] ITU collects data on "Fixed-broadband Internet traffic" since 2013. Following the request for more details on the method of collection of this indicator, ITU produced a detail methodological note in 2018, which was presented at the 9th EGTI meeting in October 2018. A subgroup was created to finalize the methodological document, which was presented at the 10th EGTI meeting in September 2019. During the meeting it was agreed to allow delegates a month for comments, after which the document was finalised and included in the ITU Handbook for the Collection of Administrative Data on Telecommunications/ICT, which was released in August 2020. The revised methodology of the indicator has been first applied for the ITU WTI Short Questionnaire 2019 to which only 42% of the economies provided data, and will be fully incorporated in the Long Questionnaire 2020.

countries, leading to inconsistent data. As a result, the indicator is not mature enough to be included in the IDI.

Furthermore, as it is a new indicator, availability remains relatively low (although above the 50% threshold). Unlike mobile traffic, far fewer operators publish data on fixed broadband traffic, one reason being that unlike mobile data, caps are generally high and flat rate pricing prevalent. Many missing data points would need to be estimated, without established methods to produce reliable estimates, precisely because of the novelty of the indicator and the only recently finalised methodology.

In addition, the comparability of the indicator is problematic as countries with many institutional and business subscriptions and few individual subscriptions score disproportionately high. Yet data does not allow to disentangle these. This yields some counter-intuitive and questionable results in the context of ICT development. By using the number of fixed-broadband subscriptions as denominator, a country with a low number of subscriptions that are all intensive data users (i.e., typically, businesses and institutions rather than households) would score higher than a country with a high share of subscriptions with less intensive data usage.

Finally, it must be noted that although Internet traffic is normally seen as continuously increasing, more than 15% of economies for which data is available exhibit a decrease in the average monthly traffic between 2018 and 2019, suggesting possible issues with the quality of the data in at least one of the two years.

F. Statistical coherence and sensitivity analysis of the proposed IDI 2020

Using the proposed set of 11 indicators and applying the same normalization and aggregation rules as for revised IDI, very preliminary results for the IDI 2020 were computed, thus allowing to test the statistical soundness of the proposed IDI.

A sound composite indicator requires that the statistical properties of the indicator framework and the conceptual framework be aligned. A preliminary statistical coherence analysis based on principal component analysis (PCA) confirmed the coherence of the proposed framework. The first principal component captures 76%, 78% and 85% of the total variance in the indicators within the three sub-indices Access, Use, and Skills, respectively, and the indicators contribute in a relatively balanced way to these components. Considering the three sub-index scores, they also share a single latent dimension that captures 90% of the total variance with a balanced loading. The findings from the PCA are as expected given the strong and positive pairwise correlation observed for the component indicators of the IDI within the sub-indices.

Cross-correlation between the indicators and sub-indices, as well as between sub-indices and the overall IDI, further confirms the internal coherence of the indicator framework. Each of the indicators is well assigned to the sub-index to which it shows the highest correlation, while they are also positively associated to other sub-indices as well. This indicates that there are no trade-offs between the different aspects of ICT development, and a high IDI ranking necessitates strong performance in all sub-indices (Table 4).

Table 4. Statistical coherence in the IDI 2020: Cross-correlations

Indicators / Sub-index	A. Access	B. Use	C. Skills	IDI
A. Access	1.00			
B. Use	0.87	1.00		
C. Skills	0.85	0.80	1.00	
IDI	0.97	0.97	0.90	1.00
Households with a computer	0.95	0.85	0.83	0.93
Households with Internet access	0.94	0.88	0.81	0.93
International bandwidth	0.76	0.73	0.66	0.76
Mobile network coverage	0.80	0.79	0.69	0.81
Fixed broadband penetration	0.89	0.72	0.75	0.83
Internet users	0.93	0.92	0.85	0.96
Mobile broadband penetration	0.78	0.93	0.71	0.88
Mobile-broadband Internet traffic	0.58	0.79	0.57	0.69
Mean years of schooling	0.84	0.77	0.91	0.87
Secondary gross enrolment ratio	0.79	0.77	0.91	0.85
Tertiary gross enrolment ratio	0.80	0.78	0.92	0.85

In sum, the correlation-based analyses of statistical coherence showed that the observable indicators of IDI are not just conceptually, but also statistically related as expected, showing slightly different aspects of the same unobservable phenomenon of ICT development.

Sensitivity analysis

Next, a preliminary sensitivity analysis was conducted to evaluate how the indicators of the proposed IDI 2020 contribute to the variance of the sub-index to which they belong and to the overall index score. At the sub-index level, the global sensitivity analysis shows that all indicators are important for explaining the composite score outcomes, although some indicators are somewhat more important than others.

For the overall IDI, which is an aggregate of the three sub-index scores, the sensitivity analysis confirms the conceptual choice of assigning higher weights to sub-indices Access and Use (40% for each as opposed to 20% for Skills), as both sub-indices built on ITU data are of equal importance, and more important than skills. Given the high correlation between the three sub-index scores, any further adjustment of weights would have very little impact on changing importance.

Overall, multivariate analyses described above indicate that the statistical and conceptual frameworks are closely related, meeting international best practices of composite indicator development. The sensitivity analysis further offers users information on the revealed importance of indicators that should help better interpret country performances.

3. Conclusion and next steps

If a consensus on the proposed ICT Development Index 2020 described above is reached during the EGTI/EGH session on 14 September 2020, the ITU Secretariat will be in the position to release the index by December 2020.

Annex: Data availability by economy and likely coverage

This annex reports data availability by economy for the eight ITU indicators proposed for the ICT Development Index 2020. This is based on a preliminary assessment of the data situation as of August 2020 for reference years 2017-2019, as described in Section 2.C. Economies with four or more indicators available (i.e. 50% or more) would be included in the proposed IDI 2020. Actual data availability and coverage might differ after additional data is submitted through the 2020 edition of the Long Questionnaires and additional data checks are performed.

Economy	Sufficient data availability	1.1 Household computer	1.2 Household Internet	1.3 Bandwidth	1.4 Network coverage	1.5 Fixed broadband	2.1 Internet users	2.2 Mobile broadband	2. 3 Mobile traffic
Afghanistan	Yes				Yes	Yes		Yes	Yes
Albania	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Algeria	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Andorra	Yes	Yes	Yes	Yes	Yes		Yes	Yes	
Angola	Yes				Yes	Yes		Yes	Yes
Antigua and Barbuda								Yes	
Argentina	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Armenia	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Australia	Yes	Yes	Yes	Yes	Yes		Yes	Yes	Yes
Austria	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Azerbaijan	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bahamas					Yes			Yes	
Bahrain	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bangladesh	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Barbados	Yes				Yes	Yes		Yes	Yes
Belarus	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Belgium	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Belize	Yes	Yes	Yes		Yes	Yes		Yes	Yes
Benin	Yes				Yes	Yes		Yes	Yes
Bhutan	Yes	Yes	Yes		Yes	Yes		Yes	Yes
Bolivia (Plurinational State of)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Bosnia and Herzegovina	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Botswana	Yes	Yes	Yes		Yes	Yes		Yes	Yes
Brazil	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Brunei Darussalam	Yes	Yes	Yes	Yes	Yes		Yes	Yes	
Bulgaria	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Burkina Faso	Yes				Yes	Yes		Yes	Yes
Burundi	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cabo Verde	Yes	Yes	Yes	Yes	Yes		Yes	Yes	
Cambodia	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cameroon	Yes	Yes	Yes	Yes	Yes		Yes	Yes	Yes
Canada	Yes	Yes	Yes		Yes	Yes		Yes	Yes
Central African Rep.						Yes		Yes	Yes
Chad					Yes			Yes	Yes
Chile	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
China	Yes			Yes	Yes	Yes	Yes	Yes	Yes
Colombia	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Comoros					Yes	Yes		Yes	
Congo (Rep. of the)								Yes	Yes
Costa Rica	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Côte d'Ivoire	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Croatia	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Economy	Sufficient data availability	1.1 Household computer	1.2 Household Internet	1.3 Bandwidth	1.4 Network coverage	1.5 Fixed broadband	2.1 Internet users	2.2 Mobile broadband	2. 3 Mobile traffic
Cuba	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cyprus	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Czech Republic	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Dem. People's Rep. of Korea								Yes	
Dem. Rep. of the Congo					Yes			Yes	Yes
Denmark	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Djibouti	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Dominica					Yes			Yes	
Dominican Rep.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Ecuador	Yes	Yes	Yes		Yes	Yes		Yes	Yes
Egypt	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
El Salvador	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Equatorial Guinea								Yes	
Eritrea								Yes	
Estonia	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Eswatini								Yes	
Ethiopia					Yes	Yes		Yes	
Fiji					Yes			Yes	
Finland	Yes	Yes	Yes	Yes	Yes		Yes	Yes	Yes
France	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Gabon					Yes			Yes	
Gambia					Yes	Yes		Yes	
Georgia	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Germany	Yes	Yes	Yes	Yes		Yes	Yes	Yes	Yes
Ghana					Yes			Yes	Yes
Greece	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Grenada						Yes		Yes	
Guatemala								Yes	
Guinea	Yes	Yes	Yes	Yes	Yes		Yes	Yes	
Guinea-Bissau						Yes		Yes	Yes
Guyana					Yes	Yes		Yes	
Haiti	Yes	Yes	Yes	Yes	Yes		Yes	Yes	
Honduras	Yes	Yes			Yes	Yes		Yes	Yes
Hong Kong, China	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Hungary	Yes		Yes	Yes	Yes	Yes	Yes	Yes	Yes
Iceland	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
India	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Indonesia	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Iran (Islamic Republic of)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Iraq	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Ireland	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Israel	Yes	Yes	Yes	Yes	Yes		Yes	Yes	
Italy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Jamaica	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Japan	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Jordan	Yes				Yes	Yes		Yes	Yes
Kazakhstan	Yes	Yes	Yes	Yes	Yes		Yes	Yes	Yes
Kenya	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Kiribati					Yes	Yes		Yes	
Korea (Rep. of)	Yes	Yes	Yes	Yes	Yes		Yes	Yes	Yes
Kuwait	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Kyrgyzstan					Yes			Yes	Yes
Lao P.D.R.					Yes	Yes		Yes	

Economy	Sufficient data availability	1.1 Household computer	1.2 Household Internet	1.3 Bandwidth	1.4 Network coverage	1.5 Fixed broadband	2.1 Internet users	2.2 Mobile broadband	2. 3 Mobile traffic
Latvia	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Lebanon	Yes				Yes	Yes		Yes	Yes
Lesotho					Yes			Yes	Yes
Liberia								Yes	
Libya								Yes	
Liechtenstein					Yes	Yes		Yes	
Lithuania	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Luxembourg	Yes		Yes	Yes	Yes		Yes	Yes	
Macao, China	Yes	Yes	Yes	Yes			Yes	Yes	
Madagascar	Yes				Yes	Yes		Yes	Yes
Malawi	Yes	Yes	Yes		Yes	Yes		Yes	Yes
Malaysia	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Maldives					Yes			Yes	
Mali	Yes	Yes	Yes		Yes	Yes		Yes	
Malta	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Marshall Islands								Yes	
Mauritania					Yes			Yes	
Mauritius	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mexico	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Micronesia					Yes			Yes	
Moldova	Yes	Yes	Yes		Yes	Yes		Yes	Yes
Monaco					Yes	Yes		Yes	Yes
Mongolia	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Montenegro	Yes		Yes	Yes	Yes	Yes	Yes	Yes	Yes
Morocco	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Mozambique	Yes				Yes	Yes		Yes	Yes
Myanmar	Yes	Yes		Yes	Yes	Yes	Yes	Yes	Yes
Namibia					Yes	Yes		Yes	
Nauru								Yes	
Nepal (Republic of)					Yes			Yes	
Netherlands	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
New Zealand	Yes				Yes	Yes		Yes	Yes
Nicaragua					Yes			Yes	
Niger	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Nigeria	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
North Macedonia	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Norway	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Oman	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Pakistan	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Palestine*	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Panama	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Papua New Guinea								Yes	
Paraguay	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Peru	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Philippines	Yes	Yes	Yes	Yes	Yes		Yes	Yes	Yes
Poland	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Portugal	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Qatar	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Romania	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Russian Federation	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Rwanda	Yes	Yes	Yes		Yes	Yes		Yes	Yes
Saint Kitts and Nevis								Yes	
Saint Lucia						Yes		Yes	Yes

Economy	Sufficient data availability	1.1 Household computer	1.2 Household Internet	1.3 Bandwidth	1.4 Network coverage	1.5 Fixed broadband	2.1 Internet users	2.2 Mobile broadband	2. 3 Mobile traffic
Saint Vincent and the Grenadines	Yes	Yes	Yes		Yes			Yes	
Samoa					Yes			Yes	
San Marino					Yes	Yes		Yes	
Sao Tome and Principe	Yes				Yes	Yes		Yes	Yes
Saudi Arabia	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Senegal					Yes			Yes	
Serbia	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Seychelles					Yes			Yes	
Sierra Leone					Yes			Yes	
Singapore	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Slovakia	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Slovenia	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Solomon Islands					Yes			Yes	
Somalia					Yes			Yes	
South Africa	Yes	Yes	Yes		Yes	Yes		Yes	Yes
South Sudan	Yes				Yes	Yes		Yes	Yes
Spain	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sri Lanka					Yes			Yes	Yes
Sudan					Yes	Yes		Yes	
Suriname	Yes	Yes	Yes		Yes	Yes		Yes	Yes
Sweden	Yes		Yes	Yes	Yes	Yes	Yes	Yes	Yes
Switzerland	Yes		Yes	Yes	Yes	Yes	Yes	Yes	Yes
Syrian Arab Republic					Yes	Yes		Yes	
Tajikistan								Yes	
Tanzania					Yes			Yes	
Thailand	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Timor-Leste					Yes			Yes	
Togo	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Tonga					Yes			Yes	
Trinidad and Tobago	Yes				Yes	Yes		Yes	Yes
Tunisia	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Turkey	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Turkmenistan								Yes	
Tuvalu								Yes	
Uganda					Yes			Yes	Yes
Ukraine	Yes	Yes	Yes	Yes	Yes		Yes	Yes	
United Arab Emirates	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
United Kingdom	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
United States	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Uruguay	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Uzbekistan	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Vanuatu					Yes	Yes		Yes	
Vatican									
Venezuela					Yes	Yes		Yes	
Viet Nam	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Yemen					Yes			Yes	
Zambia	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Zimbabwe	Yes				Yes	Yes		Yes	Yes

*Palestine is not an ITU Member State; the status of Palestine in ITU is the subject of Resolution 99 (Rev. Busan, 2014) of the ITU Plenipotentiary Conference.