



ITU Asia-Pacific Regional Workshop on ICT Indicators  
Ha Noi, Viet Nam  
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**Quality of service, traffic, Indicators revenue,  
investment, employment and Pay TV indicators**

ICT Data and Statistics Division  
Telecommunication Development Bureau  
International Telecommunication Union

# Quality of service (QoS)

- Fixed telephone:
  - Faults per 100 fixed-telephone lines per year
  - Percentage of fixed-telephone faults cleared by next working day
  
- Mobile-cellular services:
  - Mobile-cellular unsuccessful call ratio
  - Mobile-cellular dropped call ratio
  - Complaints per 100 mobile-cellular subscriptions
  
- Fixed broadband
  - Complaints per 100 fixed (wired)-broadband subscriptions
  - Service activation time for fixed (wired)-broadband service

## i146u - Mobile-cellular unsuccessful call ratio (%)

### ➤ **Definition:**

**Mobile-cellular telephony unsuccessful call ratio** refers to the ratio of unsuccessful mobile-cellular calls to the total number of mobile-cellular call attempts in the given year. An unsuccessful call is a call attempt to a valid number, while in a coverage area, where neither the call is answered nor called party busy tone nor ringing tone, is recognized at the access of the calling user within 40 seconds from the instant when the last digit of the destination subscriber number is received by the network. The data should be expressed in percentage.

### ➤ **Clarification on the Scope:**

**This indicator should cover all mobile telephone call attempts which satisfy all the following criteria:**

- *In a coverage area*
- *Within 40 seconds*
- *Valid number*

**The mobile telephone calls attempts will be considered unsuccessful to be generated due to any of the following reasons:**

- *No answer*
- *Busy tone*
- *No ringing tone*

## i146u - Mobile-cellular unsuccessful call ratio (%)

### ➤ **Method of Collection:**

- Service providers should use an automatic data collection system, based on network counters, that register the real traffic of the network.
- The network counters collect information for 24 hours a day, every day of the year, in such a way that they reflect the variations in traffic, which occur during the different days, weeks and months of the year.
- The measurements must provide a relative accuracy greater than 10 % with a level of reliability of 95 %.
- The ratio is calculated by dividing the number of successful calls by the total number of calls during the measurement period.

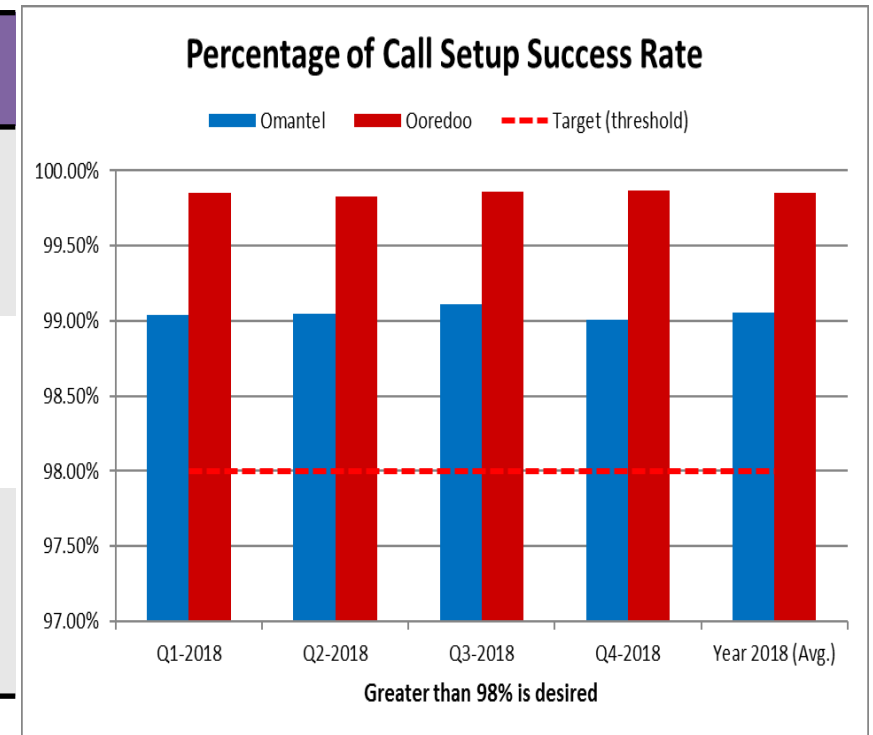
### ➤ **Equation**

$$\left\{ \frac{\text{No. of call attempts} - \text{No. of successful call}}{\text{No. of call attempts}} \right\} \times 100$$

## i146u - Mobile-cellular unsuccessful call ratio (%) : Example from Oman

- ❖ Telecom service providers of mobile and/or fixed, report their QoS achievements to TRA every quarter.
- ❖ QoS achievements are published by TRA on its website and on the service provider's websites and local newspapers.
- ❖ The value of the indicator is an aggregation of the entire network traffic during the course of the quarter.

ITU indicator	Mobile-cellular Unsuccessful Call Ratio (%)						
Equivalent TRA Indicator	Threshold	Service Provider	Q1 2018	Q2 2018	Q3 2018	Q4 2018	Over all 2018 (Avg.)
	<b>&gt;98%</b>	Omantel	99.04%	99.05%	99.11%	99.01%	99.05%
Ooredoo		99.85%	99.83%	99.86%	99.87%	99.85%	



## i146d - Mobile-cellular dropped call ratio (%)

### ➤ **Definition**

**Mobile-cellular telephony dropped call ratio** refers to the proportion of incoming and outgoing mobile-cellular calls which, once they have been correctly established and therefore have an assigned traffic channel, are dropped or interrupted prior to their normal completion by the user, the cause of the early termination being within the operator's network. The data should be expressed in percentage.

### ➤ **Clarification on the Scope:**

**This indicator should cover all incoming and outgoing mobile telephone call with successful establishment under the following condition:**

- *In a coverage area*
- *To valid number*
- *With assigned traffic channels*

**The mobile cellular telephony calls are considered dropped if any cause of interruption before the completion of the call by the user.**

## i146d - Mobile-cellular dropped call ratio (%)

### ➤ **Method of Collection:**

- Service providers should use an automatic data collection system, based on network counters, that register the real traffic of the network.
- The network counters collect information for 24 hours a day, every day of the year, in such a way that they reflect the variations in traffic, which occur during the different days, weeks and months of the year.
- The measurements must provide a relative accuracy greater than 10 % with a level of reliability of 95 %.
- The ratio is calculated by dividing the number of successful calls by the total number of calls during the measurement period.

### ➤ **Equation:**

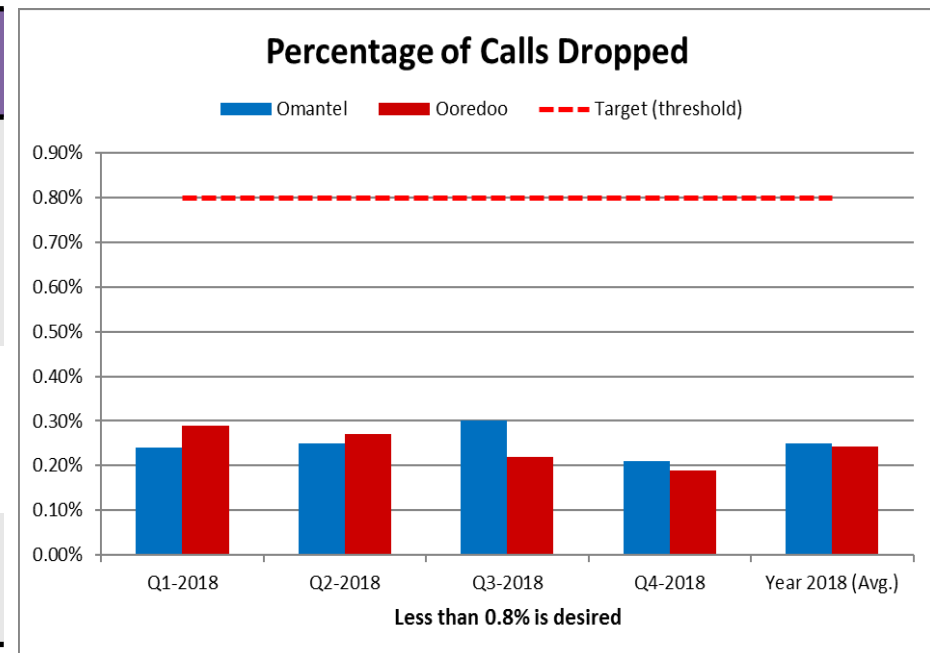
$$\frac{\textit{Total Number of Dropped Calls in the reporting period}}{\textit{Total Number of Calls in the reporting period}} \times 100$$

- **Dropped calls:** Voice calls in Circuit Switch (CS) that can't be completed due to technical problem within the operator's network.
- **Technical problems:** Problems related to network e.g. radio interface failure, equipment failure, signaling/protocol error etc, coverage failure.
- **Number of calls:** Number of voice calls in Circuit Switch (CS) that have been successfully assigned a traffic channel.

## i146d - Mobile-cellular dropped call ratio (%): Country Example - from Oman

- ❖ Telecom service providers of mobile and/or fixed, report their QoS achievements to TRA every quarter.
- ❖ QoS achievements are published by TRA on its website and on the service provider's websites and local newspapers.
- ❖ The value of the indicator is an aggregation of the entire network traffic during the course of the quarter.

ITU indicator		Mobile-cellular Drop Call Ratio (%)					
Equivalent TRA indicator	Thresh old	Service Provide r	Q1 2018	Q2 2018	Q3 2018	Q4 2018	Overa ll 2018 (Avg.)
Call Drop Rate	<b>&lt;0.8 %</b>	Omant el	<b>0.24%</b>	<b>0.25 %</b>	<b>0.30 %</b>	<b>0.21%</b>	<b>0.25%</b>
		Ooredo o	<b>0.29%</b>	<b>0.27 %</b>	<b>0.22 %</b>	<b>0.19%</b>	<b>0.24%</b>







## i147t - Service activation time for fixed broadband service (in days)

### ➤ Definition

- **Service activation time for fixed broadband service** refers to the time from the date of application to date of service activation. The average service activation time of all new applications, **while in coverage area**, received within the 12 months reference period should be provided.

### ➤ Clarification on the Scope:

- **Service activation time for fixed broadband services refers to services included in the indicator fixed broadband subscription (i4213tfbb).** Fixed broadband services are those services categorized of high-speed access to the public Internet (a TCP/IP connection), **at downstream speeds equal to, or greater than, 256 kbit/s. Fixed broadband services covers the following:**
  - *Cable modem, DSL, fibre-to-the-home/building, other fixed (wired)-broadband subscriptions, satellite broadband and terrestrial fixed wireless broadband.*
  - It should include *fixed WiMAX* and any other fixed wireless technologies.
  - This total is measured irrespective of the method of payment.
  - It includes both residential subscriptions and subscriptions for organizations.
  - The indicator should include all the new application of fixed broadband services in **covered area** by both business and residential subscription.
  - It excludes subscriptions that have access to data communications via mobile-cellular networks.

## i147t - Service activation time for fixed broadband service (in days)

### ➤ Method of Collection:

- The service activation time of fixed broadband services' subscriptions should be averaged for the year, which is from the time of requesting the service from the service provider to the activation of the service by the end subscriber. Calendar days should be considered.

### ➤ Equation:

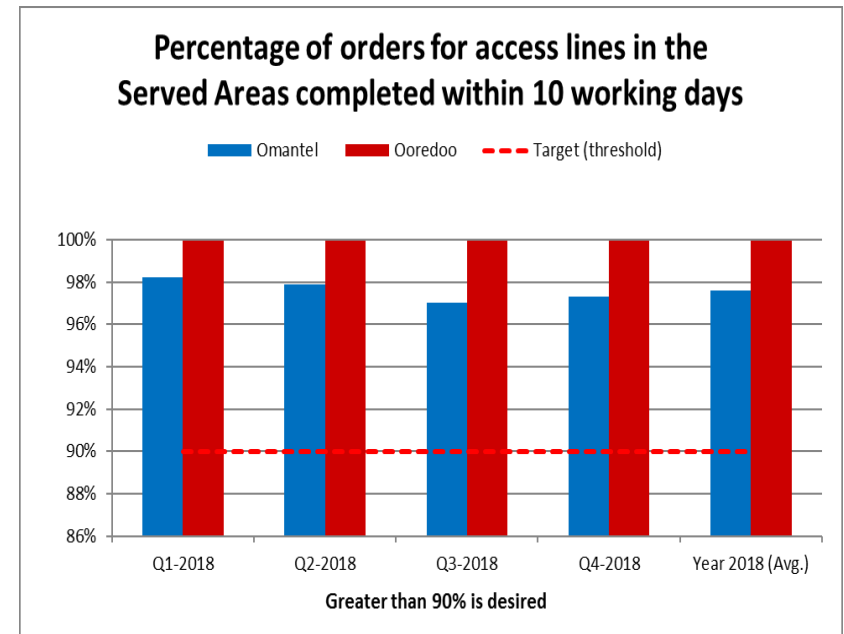
- **Service activation time for FBB:**  $[Time] = \frac{\sum_{i=1}^N (t_{2,i} - t_{1,i})}{N}$
- $(t_{1,i})$  point of time when service event  $i$  is requested
- $(t_{2,i})$  point of time when service supply event  $i$  is activated
- $N$  is the number of service applications

# i147t - Service activation time for fixed broadband service (in days):

## Country Example - from Oman

- ❖ Telecom service providers of mobile and/or fixed, report their QoS achievements to TRA every quarter.
- ❖ QoS achievements are published by TRA on its website and on the service provider's websites and local newspapers.
- ❖ The value of the indicator is an aggregation of the entire network traffic during the course of the quarter.

ITU indicator		Service Activation Time for Fixed Broadband Service (in days)					
Equivalent TRA indicator	Threshold	Service Provider	Q1 2018	Q2 2018	Q3 2018	Q4 2018	Overall 2018 (Avg.)
Percentage of orders for access lines in the served area completed in 10 working days	<b>&gt;90%</b>	Omantel	98.22 %	97.89 %	97.01 %	97.29 %	97.60 %
		Ooredoo	99.95 %	99.97 %	99.97 %	99.95 %	99.96 %



# Traffic

- Fixed telephone: domestic, international minutes
- Mobile cellular: domestic, international minutes and SMS
- Data traffic (**1<sup>st</sup> ITU collection 2013**):
  - Fixed (wired)- broadband Internet traffic (exabytes)
  - Mobile-broadband Internet traffic (inside country)
  - Mobile-broadband Internet traffic (outside, roaming out)

**Measured at the end-user access point**

**Excl. walled-garden, wholesale traffic, IPTV/CATV, any other managed IP traffic**



# Fixed-broadband Internet traffic

Fixed (wired)- broadband Internet traffic (**exabytes**) refers to traffic generated by fixed broadband subscribers measured at the end-user access point. It should be measured adding up download and upload traffic. This should exclude wholesale traffic, walled garden, IPTV and cable TV traffic.



# Definition

*“Fixed Broadband Internet Traffic (FiBIT) refers to traffic generated by fixed broadband subscribers measured at the end-user access point (summing download and upload traffic).”*

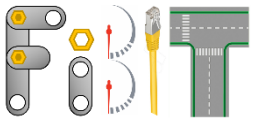




# Clarification

FiBIT should account for traffic generated from all devices connected to the end-user access point to the fixed network (both fixed wired access and fixed wireless access): mobile network traffic should be excluded.





# Clarification



More precisely, this indicator refers to fixed *broadband* traffic, so narrowband fixed traffic should be excluded: if it is not possible, countries should specify it in a note.



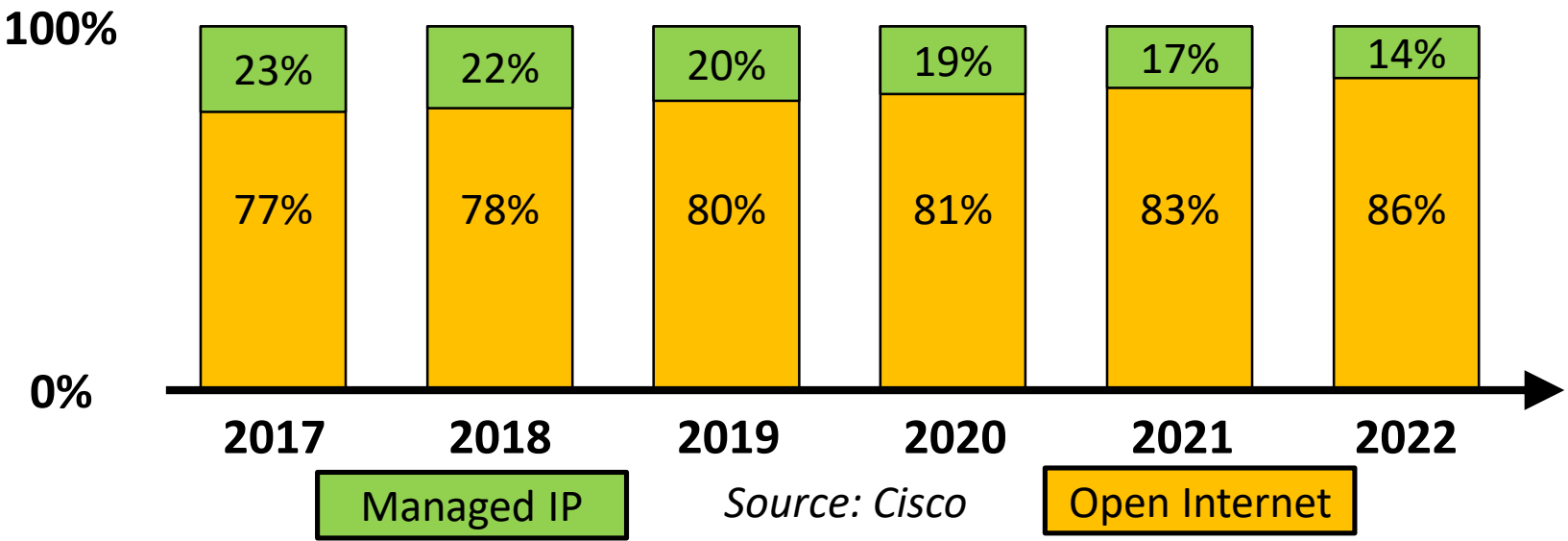




# Clarification



FiBIT should include web, mail, messaging, file sharing, gaming, Internet video, OTT services. Walled garden, managed IP television (IPTV), cable television (CATV) should be excluded: if it is not possible, countries should specify it in a note.

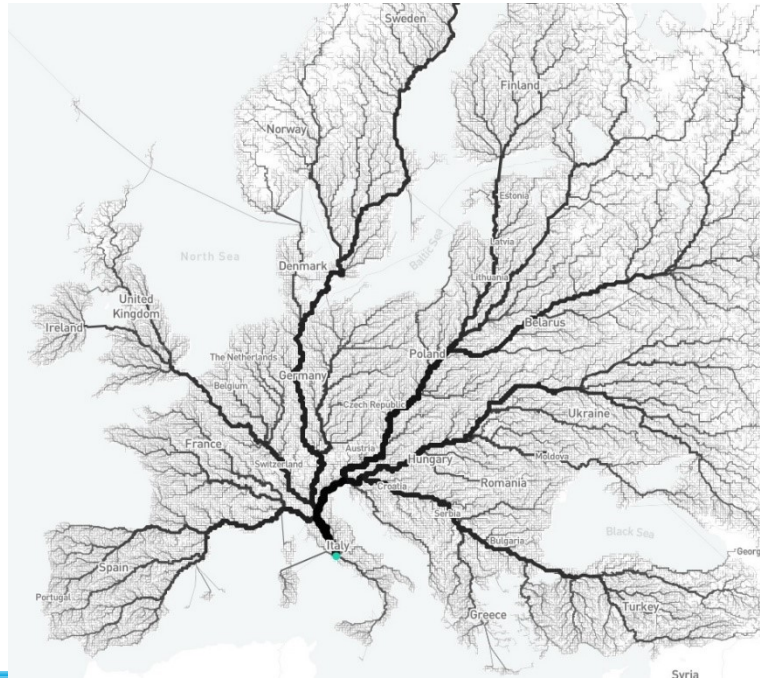




# Methodology



Countries can follow different methodological approaches to collect and report these data. The aim of this document is not to restrict methodological choices, but rather to propose some guideline that can help data collection.





# Methodology

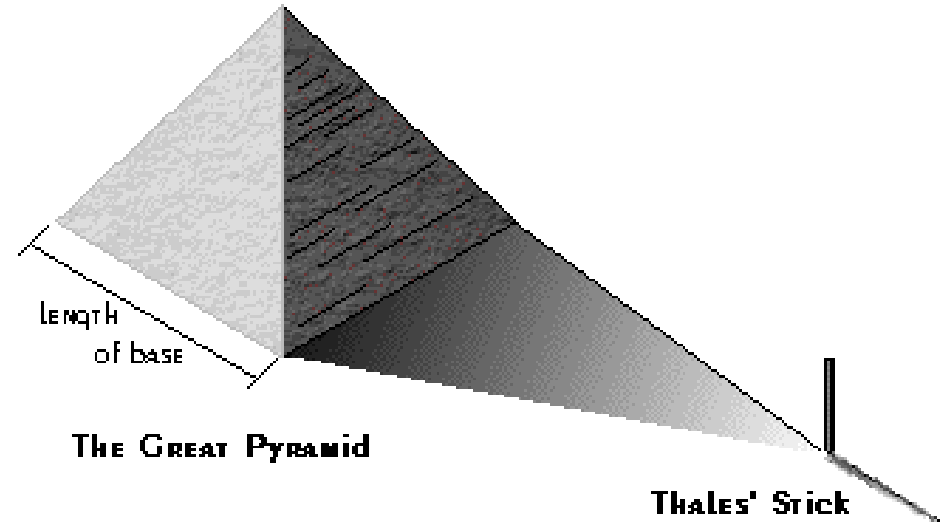


FiBIT can be collected from telecommunication operators (telcos) by national regulatory authorities and ministries. Telcos represent the most spread and reliable source of data for this indicator, since they can provide direct measurement of FiBIT.



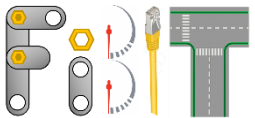


# Direct vs Indirect Measures



[1] [https://en.wikipedia.org/wiki/Thales\\_of\\_Miletus](https://en.wikipedia.org/wiki/Thales_of_Miletus)

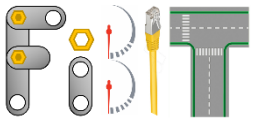
[2] SM KAY – *Fundamentals of Statistical Signal Processing: Estimation Theory*



# Methodology

Direct measurements - Many operators maintain Internet access log records which can be used as a source to compile the total fixed Internet traffic.

Indirect estimates - If it isn't possible to produce a direct measurements of retail Internet traffic, Telco could produce an estimate of FiBIT based on different parameters, (volume of traffic exchanged, average load of the channels, or other proxies). Data should be reported with a note specifying the adopted estimation.



# Methodology



ITU questionnaire ask to every country to provide FiBIT with a predefined unit of measurement, specifically exabytes (EB). The principal decimal prefixes are listed below.

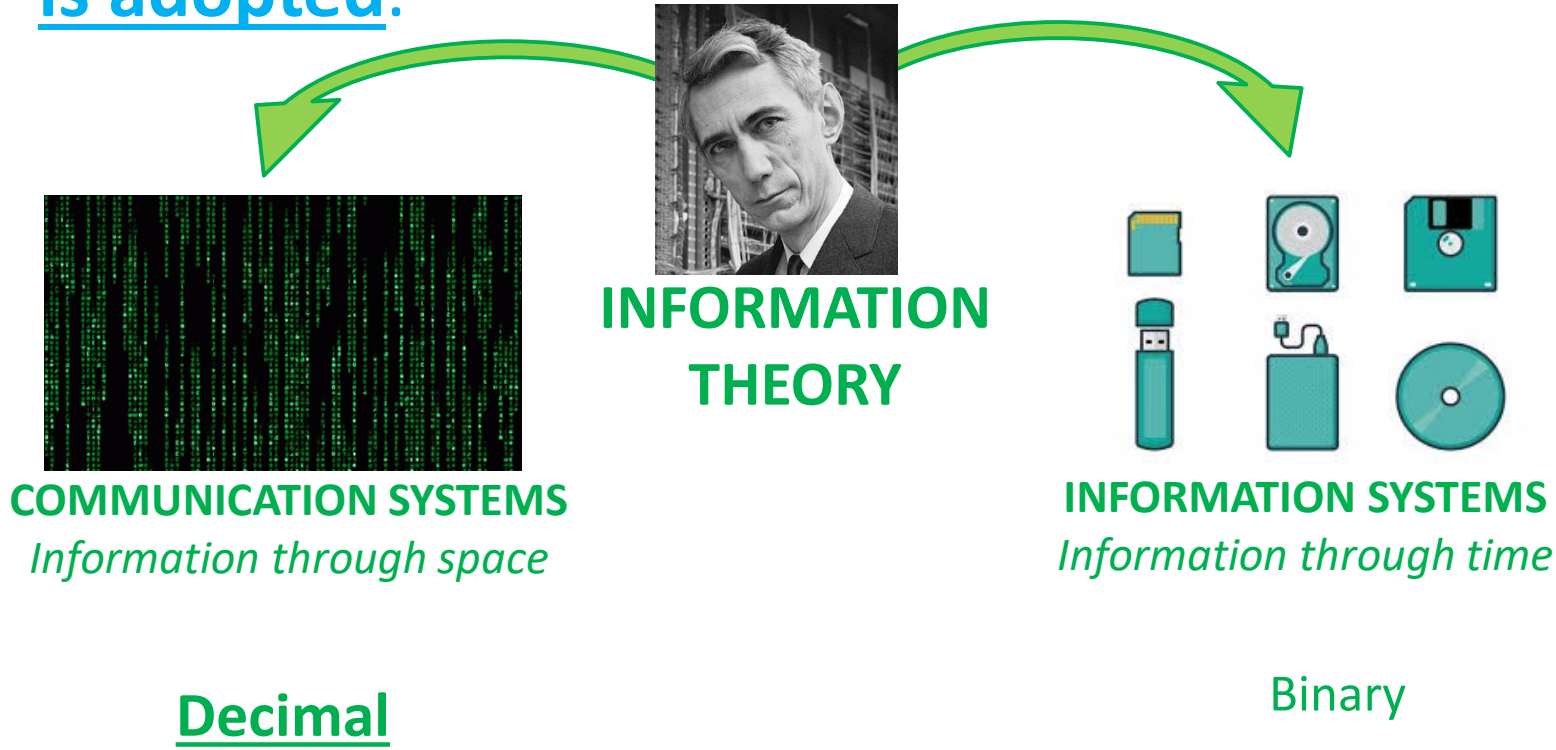
Units of measurement	
1 Kilobyte (KB)	= $10^3$ bytes
1 Megabyte (MB)	= $10^6$ bytes
1 Gigabyte (GB)	= $10^9$ bytes
1 Terabyte (TB)	= $10^{12}$ bytes
1 Petabyte (PB)	= $10^{15}$ bytes
1 Exabyte (EB)	= $10^{18}$ bytes
1 Zettabyte (ZB)	= $10^{21}$ bytes



# Decimal vs Binary System



To avoid any confusion, it is worth stating explicitly that in this guidelines, decimal system is adopted.



[3] [https://en.wikipedia.org/wiki/Bit\\_rate](https://en.wikipedia.org/wiki/Bit_rate)

[4] AS TANENBAUM, DJ WETHERALL – *Computer Networks*

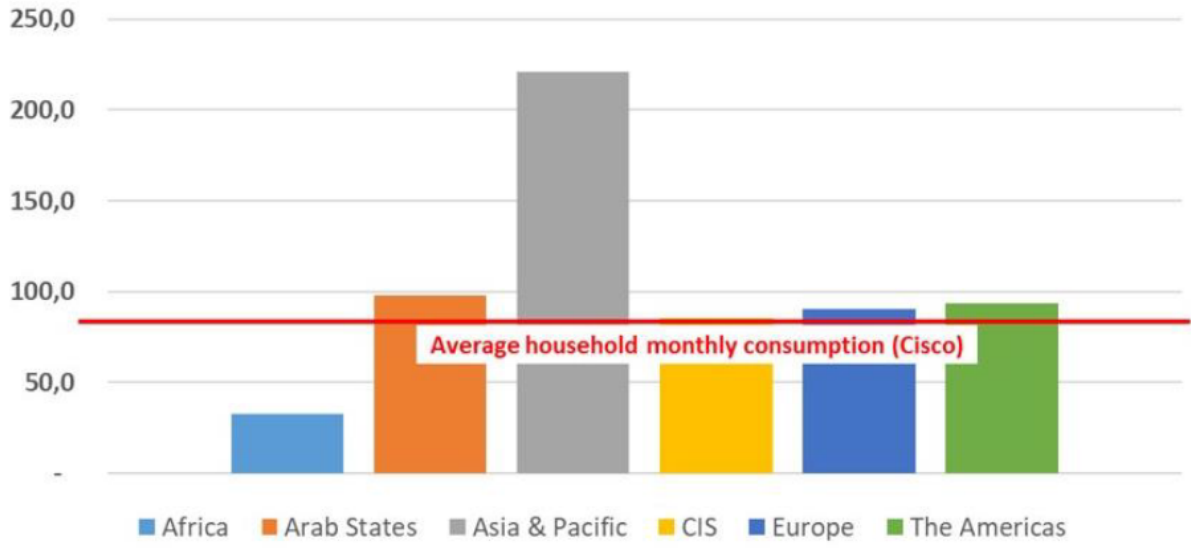


# Methodology



FiBIT is strictly related to Fixed Broadband subscriptions (i4213tfbb). This indicator can be used as guideline to verify the measurement or the estimation of FiBIT: this value usually ranges between 30 and 180 GB/line/month.

**Figure 1:** Monthly Internet traffic (GB) per broadband line in different regions of the world



Source: ITU





# Example – Raw Data



The example starts with the raw data declared by the regulatory authority, for traffic (in TB) and for fixed broadband subscriptions (in unit), with annual periodicity.

**Table 2:** Broadband lines and Internet traffic in Spain

	2013	2014	2015	2016	2017	2018
Broadband lines (unit)	12,242,047	13,004,954	13,542,898	14,112,653	14,668,212	15,176,954
Annual Internet Traffic (TB)	4,920,407.5	6,581,035.4	8,169,488.6	12,803,914.7	16,930,566.2	21,443,021.3

*Source: CNMC*



# Example – From TB to EB



We need to transform the data into different unit of measurements: traffic is measured by the regulatory authority in Terabytes (TB), but in order to declare the traffic to ITU it should be expressed in Exabytes (EB). Note that 1 EB is 1,000,000 TB, hence, dividing the series “Annual Internet traffic (TB)” by  $10^6$ , we obtain the traffic expressed in Exabytes (EB), as reported in the table below.

**Table 3:** Internet traffic in Spain (in TB and in EB)

	2013	2014	2015	2016	2017	2018
Annual Internet Traffic (TB)	4,920,407.5	6,581,035.4	8,169,488.6	12,803,914.7	16,930,566.2	21,443,021.3
Annual Internet Traffic (EB)	4.92	6.58	8.17	12.80	16.93	21.44

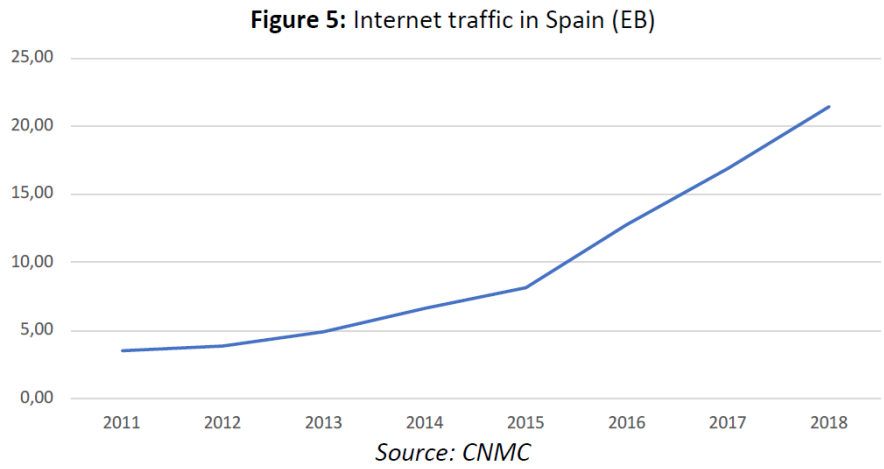
Source: CNMC



# Example – Growth Rate



One possible initial validation of the indicator is by checking its annual rate of growth. Broadband traffic (be it in fixed or in mobile networks) increases every year usually at two digits rates. The expected result by observing a time series of Internet traffic is that it should be increasing constantly at significant rates of growth.





# Example – Monthly Traffic per line

Another possible validation of the indicator is by checking the monthly FiBIT per subscription: we need to perform some additional calculations.

- 1) Transform the traffic measured in Exabytes (EB) into Gigabytes (GB).
- 2) Divide this total traffic by the number of active broadband (fixed) lines.
- 3) Now, in order to provide the indicator on a monthly basis, divide by 12.

**Table 6:** Monthly Internet Traffic per line in Spain

	2013	2014	2015	2016	2017	2018
Monthly Internet Traffic per line (GB/line/month)	33.5	42.2	50.3	75.6	96.2	117.7

Source: CNMC

# Mobile-broadband Internet traffic (within the country)



Mobile-broadband Internet traffic (within the country) refers to broadband traffic volumes originated within the country from 3G networks or other more advanced mobile networks, including 3G upgrades, evolutions or equivalent standards in terms of data transmission speeds.

Traffic should be collected and aggregated at the country level for all 3G or more advanced mobile networks within the country. Download and upload traffic should be added up and reported together. Traffic should be measured at the end user access point. Wholesale and walled-garden traffic should be excluded. The traffic should be reported in **exabytes**.

# Big bites!

Unit	Value	Size
<b>bit (b)</b>	0 or 1	1/8 of a byte
<b>byte (B)</b>	8 bits	1 byte
<b>kilobyte (KB)</b>	$1000^1$ bytes	1,000 bytes
<b>megabyte (MB)</b>	$1000^2$ bytes	1,000,000 bytes
<b>gigabyte (GB)</b>	$1000^3$ bytes	1,000,000,000 bytes
<b>terabyte (TB)</b>	$1000^4$ bytes	1,000,000,000,000 bytes
<b>petabyte (PB)</b>	$1000^5$ bytes	1,000,000,000,000,000 bytes
<b>exabyte (EB)</b>	$1000^6$ bytes	1,000,000,000,000,000,000 bytes
<b>zettabyte (ZB)</b>	$1000^7$ bytes	1,000,000,000,000,000,000,000 bytes
<b>yottabyte (YB)</b>	$1000^8$ bytes	1,000,000,000,000,000,000,000,000 bytes

Can also use online conversion calculators but check by recalculating.

# Quiz

- If mobile broadband Internet traffic adds up to 5,286,000 Gigabytes, how should this be reported?
- What if it was 49,802,881 Terabytes?






# Revenue

- Since 1960, revenue from telecommunications  
On average 141 economies reported
- Since mid-1980's, revenue from mobile services  
139 economies reported

**Issue:** harmonization of data reported in view of international comparisons



# Methodology

- ITU Handbook 
- EGTI reviewed the definitions in 2012
- Chapter 4 in MIS 2012 analysed revenue and investment data
- Input from international organizations



## Methodological note

Methodology for the collection of revenue and investment data on telecommunications



### Background

This methodological note provides detailed guidelines for the collection of internationally comparable data on revenue from, and investment in telecommunication services.<sup>1</sup> It covers three main indicators: (i) Revenue from all telecommunication services, (ii) Revenue from mobile services, and (iii) Annual investment in telecommunication services. The methodology provided receives and complements the information on these indicators included in the ITU Handbook for the Collection of Administrative Data on Telecommunications/ICT by integrating the guidelines of the discussion paper in 2012 within the ITU Expert Group on Telecommunications/ICT Indicators (EGTI),<sup>2</sup> as well as additional contributions from international organizations.<sup>3</sup> It also benefits from the experience gained from ITU 2012 global data collection of these indicators from operators' annual reports<sup>4</sup> and the lessons learned about the international harmonization of these data.

ITU has been collecting data on revenue from telecommunication services since 1965<sup>5</sup> and on investment in telecommunication services since 1985.<sup>6</sup> ITU data are collected through annual questionnaires sent to national administrations, and collect these indicators from operators, and aggregate the data at national level. Revenue and investment data provide an overview of the economic dimension of the telecommunication sector, its structure and the capital expenditure flows that underpin telecommunication development.

Revenue and investment data from telecommunication operators are widely available through operators' annual reports. In addition, data for the telecommunication sector aggregated at a national level are often collected by regulators or included as part of their regular data collection exercises, and also made public. Even if not published, data are usually available internally through administrative records. Confidentiality issues arise in most cases overviews by allowing data combinations at an operator level and publishing only aggregate values for the sector. In those countries where unreported

<sup>1</sup> Throughout the document, the terms 'telecommunication' and 'telecommunication services' are used interchangeably.

<sup>2</sup> Available at [http://www.itu.int/ITU-T/ict/egti\\_08\\_2011](http://www.itu.int/ITU-T/ict/egti_08_2011)

<sup>3</sup> EGTI is ITU's expert group on indicators for the collection of administrative data on telecommunication/ICT (i.e. data collected from operators). It is open to all ITU Member and experts in the field of ICT statistics and data collection. It works through an online discussion forum (<http://www.itu.int/ITU-T/ict/egti>) and reports periodically back to the Global Telecommunications/ICT Indicators Harmonization (GTH).

<sup>4</sup> The following international organizations provided comments on this note: the European Commission, IMF, OECD and UNCTAD.

<sup>5</sup> In the case of revenue from mobile services, ITU has been collecting data since the mid 1990s, because previously mobile services had little relevance in terms of revenues.



# Telecommunications in ISIC 4

## Division 61

Telecommunications includes businesses that operate, maintain and provide access to telecommunication networks. Resellers of telecommunication services are also included.

→ Content & media sector

# Convergence

- Telecommunications or content and media sector?

## Rule:

If a business engages both in the creation of content and its distribution through telecommunication networks, revenue and investment data should be reported only for those activities that relate to the distribution of content, and exclude those that relate to the creation of content



# Revenue from all telecommunication services

- Revenue from all telecommunication services refers to revenue earned from retail fixed-telephone, mobile-cellular, Internet and data services offered by telecommunication operators (both network and virtual, including resellers) offering services within the country during the financial year under review.
- It includes retail revenues earned from the transmission of TV signals
- It excludes revenues from TV content creation.
- Any deviation from the definition should be specified in a note, including clarifications on what TV revenues are included/excluded (e.g. IPTV, cable TV, pay satellite and free-to-air TV).

# Revenues

- Breakdowns: Total / mobile
- Main issues:



Additional breakdowns not comparable because of  $\neq$  revenue allocation

	INCLUDED
Retail revenues from residential customers	YES
Retail revenues from business customers	YES
<b>Wholesale revenues, e.g. interconnection revenues</b>	<b>NO</b>
Revenues from resellers and mobile virtual operators	YES
VAT and excise taxes	NO
Corporate taxes and administrative fees, e.g. numbering fees	YES (not to be deducted from total revenues)
Revenues from device sales and rents	NO
Revenues from added value services, e.g. premium SMS	YES



# Investment

- Since 1965, investment in telecommunication : 128 economies reported
- Only total investment →
- Definition of investment  
≈ gross fixed capital formation (as in SNA 2008)

Difficult to allocate investment to services

**investment** made by entities providing telecommunication networks and/or services (including fixed, mobile and Internet services, as well as the transmission of TV signals) **for acquiring or upgrading fixed assets (usually referred to as CAPEX) less disinvestment owing to disposals of fixed assets**

# Investment

- Main issues

	INCLUDED
Additions less disposals of tangible fixed assets	YES
Additions less disposals of intangible fixed assets	YES
Investment from national-owned operators in the country	YES
Investment from foreign-owned operators in the country	YES
<b>Investment from national-owned operators outside the country</b>	<b>NO</b>
<b>Licence fees</b>	<b>NO</b>
R&D expenditures	YES



# Persons Employed

- Persons employed in full-time equivalents

Persons employed in full-time equivalents refers to the total number of persons, in full-time equivalent (FTE) units, employed by telecommunication operators in the country for the provision of telecommunication services, including fixed-telephone, mobile-cellular, Internet and data services.

- This indicator excludes staff working in broadcasting businesses that offer only traditional broadcasting services. Part-time staff should be expressed in terms of full-time staff equivalents (FTE).





# Persons Employed

- Persons employed by all telecommunication operators, female

Refers to the total female, in full-time equivalent (FTE) units, employed by telecommunication operators in the country for the provision of telecommunication services, including fixed, mobile and Internet services.

–This indicator excludes staff working in broadcasting businesses that offer only traditional broadcasting services.



# Persons Employed

## **Definition of Full-time equivalent:**

Full-time equivalent employment is the number of full-time equivalent jobs, defined as total hours worked divided by average annual hours worked in full-time jobs.

Source Publication: SNA 17.14[15.102.17.28]

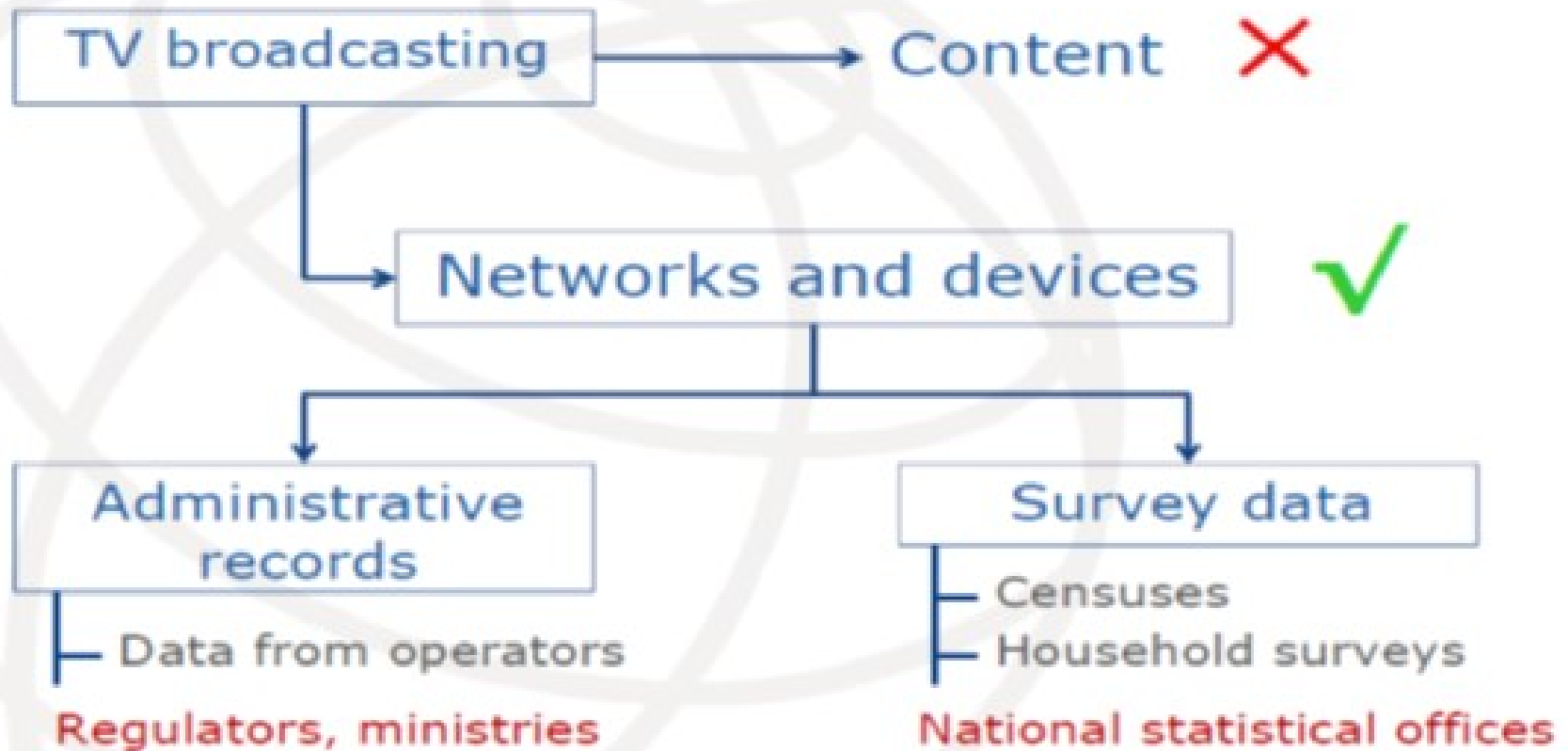


# Example calculation of FTE

- Full time and part time staff at a service provider works 24,960 hours in a given year. There are 2,080 working hours in that year.
- $FTE = 24,960 \div 2,080$  the result is 12 FTEs.
- ILO recommends recording total hours actually worked as the preferred measure of labour input; the use of full-time equivalents is likely to be gradually phased out.

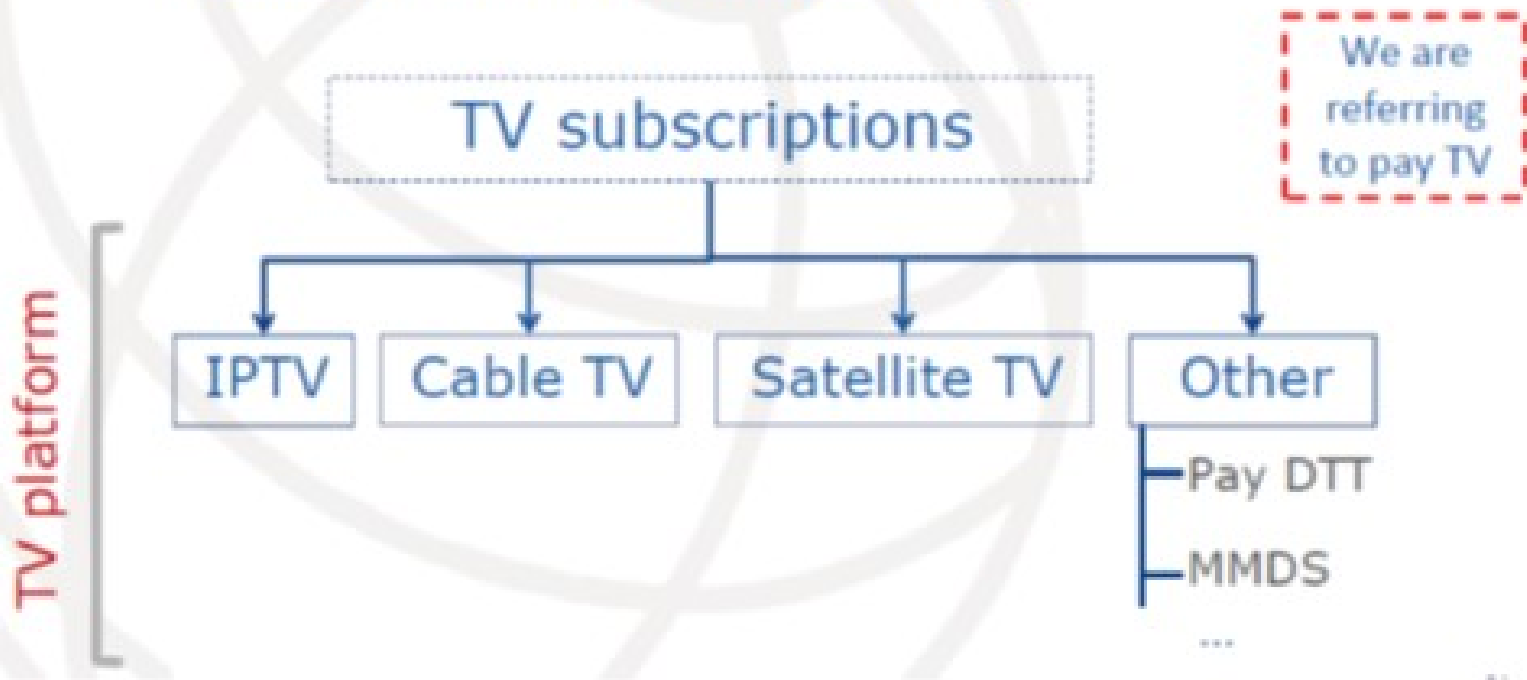
# Broadcasting

## ITU data on TV broadcasting



# TV broadcasting

- EGTI proposed changes to administrative indicators on TV broadcasting:





# IPTV subscriptions

- *IPTV subscriptions* refers to the number of subscriptions to Internet protocol television (IPTV), i.e. TV delivered over an IP-based network managed to support the required level of quality of service, quality of experience, security, interactivity and reliability.
- This does not include video accessed over the public Internet – for example, by streaming – and subscriptions to over-the-top audiovisual content providers.



# Cable-TV

- *Cable-TV subscriptions* refers to multichannel TV programming delivered over coaxial cable networks.
- It includes both analogue and digital cable-TV subscriptions.
- If the breakdown of analogue/digital cable-TV subscriptions is available, data for each type of cable-TV subscriptions should be specified in a note.
- It excludes IPTV delivered over cable-TV networks.



# Satellite TV subscriptions

- *Satellite-TV subscriptions* refers to the number of pay direct-to-home (DTH) satellite subscriptions, i.e. pay TV received via a satellite dish capable of receiving satellite television broadcasts.
- Does not include free-to-air satellite TV.





# Other TV subscriptions

- *Other TV subscriptions* refers to pay-TV subscriptions other than IPTV, satellite TV and cable TV. This includes subscriptions to TV platforms such as microwave multipoint distribution systems (MMDS) and pay digital terrestrial television (pay DTT).
- Free-to-air TV should not be included. The TV platforms corresponding to the data reported should be indicated in a note.

Thank you



For more information  
<http://www.itu.int/ict>  
and  
[indicators@itu.int](mailto:indicators@itu.int)