Report by the 5G/M2M subgroup to EGTI

EGTI meeting
September 12, 2022

1. Objectives and scope of the M2M/IoT subgroup

The subgroup on 5G/M2M in 2022 is the follow- up of the previous work of the subgroup dedicated to 5G indicators. During the 2019-2020 period the subgroup discussed and proposed to EGTI to consider the adoption of the indicator: "Percentage of the population covered by a 5G mobile network".

During the 2020- 2021 period, the subgroup on 5G discussed and proposed to EGTI the collection of an indicator on "Active mobile broadband subscriptions to 5G / IMT-2020", as well as to explicitly include 5G as a possible standard for the provisioning of broadband service while in mobility, as well as broadband to a fixed location (fixed wireless broadband). Both indicators were approved by EGTI for adoption. EGTI 2021 approved as well the continuation of the working on 5G as regards the connections among machines. The objective of the 5G/ M2M subgroup was:

- to propose a harmonized definition for a set of indicators on 5G (IMT-2020 standard) services, explicitly focusing on machine-to-machine (M2M) subscriptions
- synthesize current practices in measuring M2M subscriptions at the country level
- facilitate the future collection of this new indicator or set of indicators

The subgroup was formed by participants from 10 countries and international organizations, including the OECD, GSMA, Statistics Canada, Serac Partners, Ericsson and Intel. The meetings were held online.

2. Challenges and proposal to EGTI

The starting point for the subgroup is the current ITU definition of M2M[1], which states *"M2M mobile-network subscriptions/ connections refers to the number of mobile-cellular machine-to-machine subscriptions/ connections that are assigned for use in machines and devices (cars,*

[1] Handbook for the collection of Administrative Data on Telecommunications/ICT, 2020 Edition, International Telecommunication Union (available at: https://www.itu.int/en/ITU-D/Statistics/Pages/publications/handbook.aspx)

smart meters, consumer electronics) for the exchange of data between networked devices, and are not part of a consumer subscription.

For instance, SIM-cards in personal navigation devices, smart meters, trains and automobiles should be included. Mobile dongles and tablet subscriptions should be excluded"

With the existing indicator on M2M only the "cellular" activity is captured- i.e., any connection that uses the licensed spectrum managed by registered telecom operators[2]. But, and here lies a deficit, any traffic or activity that may use non licensed spectrum, as wi-Fi, or uses local networks (as private local area networks) is not being measured with the existing M2M indicator. Is there then, any need to extend the existing M2M definition in light of the new applications, uses and connectivity possibilities that 5G is bringing about?

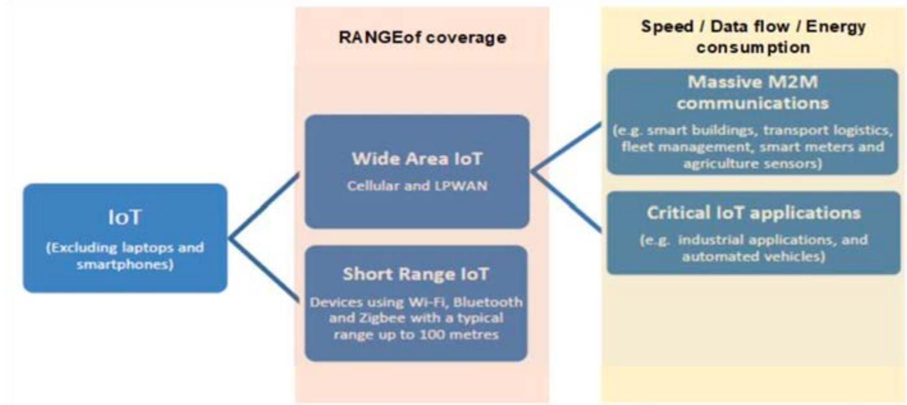
In order to answer this the subgroup has discussed on the scope of both the traditional M2M connections and that of IoT uses and applications observed with 5G networks.

Internet of Things, IoT, by contrast, and based on OECD (2022)[3] *"…. includes all devices and objects whose state can be altered via the Internet, with or without the active involvement of individuals".* IoT not only refers to the connected devices (which is the focus of existing indicators), but to the entire ecosystem in which the "things" sense and communicate, which is composed of various layers:

(1) the enabling infrastructure, which includes telecommunication, cloud and data
(2) the devices embedded in "things", which contain software and APIs to connect to objects, and
(3) the operating platform and the application layer

Figure 1: a taxonomy for the measurement of IoT. *Source:* OECD 2022

Figure 1.1. Underlying criteria of the OECD taxonomy of IoT for measurement purposes



Source: Updated from (OECD, 2018[8]).

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[2] Note as well that this indicator captures M2M susbcriptions sold for the prupose of M2M connectivity and does not include any regular subscription to voice and data that adds as well an M2M connection.

[3] Measuring the Internet of Things, Working Party on the Measurement and Analysis of the Digital Economy, Directorate General for Science, Technology and Innovation, DSTI/CDEP/MADE(2021)9/REV, OECD, March 2022

Proposal for EGTI consideration

Given the wide variety of networks employed in providing IoT services, the very broad scope of IoT- that does not limit to the “connectivity” layer- and the multitude of agents that integrate the provision of services and networks for IoT, the collection of indicators for this development is well beyond what is being collected nowadays worldwide- M2M with its current definition- and, hence, the collection of new indicators is a daunting task as of today.

Regulatory Authorities have the mandate to monitor and regulate the telecommunications industry and to achieve this they collect regularly indicators on the telecommunications market. These agencies have limitations in collecting information from non-registered telecommunication operators. Additionally, some spectrum bands used or potentially to be used for connecting devices and for providing final services are unlicensed bands, i.e., frequency bands free for use for any entity willing to do so. These agents and their activities are not necessarily registered at the telecommunication authority. The collection of information from these agents is, at the moment, unrealistic at a widespread level.

One conclusion reached at the 5G/M2M subgroup is to keep the current definition of the M2M indicator *2.10 Machine-to-Machine mobile network subscriptions*- M2M (i271m2m) as it stands and the collection of this important indicator worldwide[4]. Even if M2M only captures a slice of the whole IoT evolution and business, it still represents a very important part of it.

Based on the current definition of M2M subscription the subgroup recommends to EGTI:

(1) as regards the proposal for an harmonized indicator, the subgroup recommends to keep the current definition of the M2M indicator *2.10 Machine-to-Machine mobile network subscriptions*- M2M (i271m2m) as it stands and the collection of this important indicator worldwide

(2) in order to facilitate the collection of the indicator and adapt it to recent developments the subgroup recommends to include eSIM in the scope of the M2M indicator.

eSIM are embedded in the final user device and allow for the controlling and switching of service provider remotely, without the need to extract and substitute one physical SIM card from the device. Many devices come already manufactured with eSIMs.

Since eSIM may be activated or disactivated by the user any time, an activity criterion is needed in order to count an eSIM as active. Note that for post-payment M2M modality all subscriptions are “active” since the final user pays a recurrent fee for the service. For the pre-payment M2M modality it is recommended to use the same activity criterion as the one used in cellular subscriptions: the SIM device has made a communication in the last 90 days to be counted as an “active M2M”.

[4] see Handbook for the Collection of Administrative Data on Telecommunciations/ICT, 2020, ITU.

(3) the subgroup recommends as well in order to clarify the scope of the M2M indicator to bear in mind that even if the indicator refers to “subscriptions to M2M” in effect what is being measured is “number of connections” via M2M

(4) The existing definition of M2M is useful and collects part of the activity regarding devices being connected- those subscriptions that are sold for the specific purpose of M2M usage-, but clearly there are connections among devices that use other networks, i.e., non- licensed spectrum, private networks or some local area networks, among others, that are not being captured with the existing indicator. It is important to bear in mind this limitation and explore ways in the future for a wider collection of connections of devices.

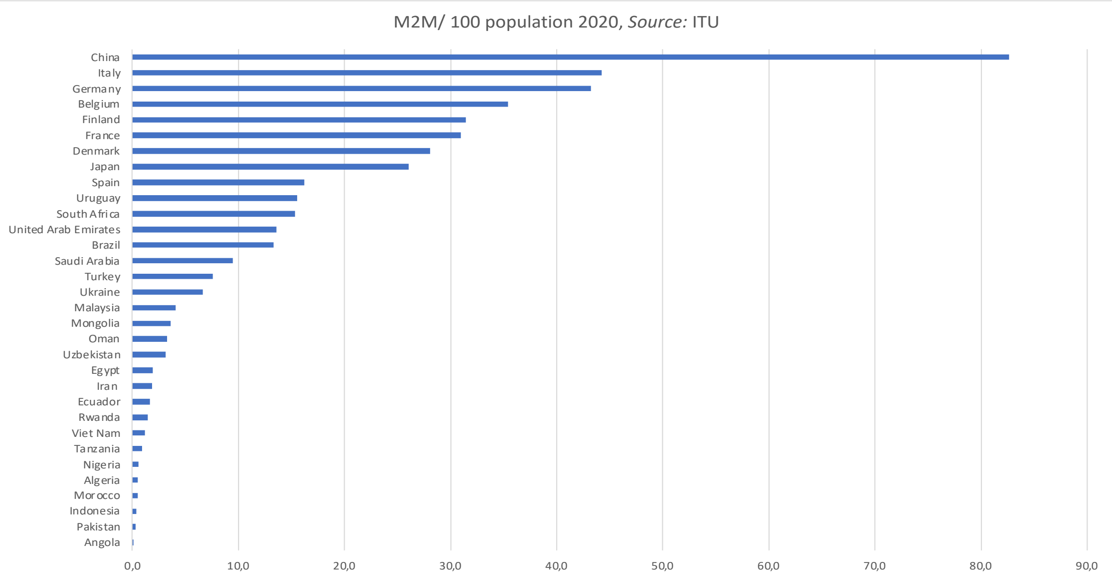
(5) given the rapid evolution of 5G and devices being connected to telecom networks the subgroup recommends to follow up the evolution of IoT in terms of networks being used and the quality of the connection offered, services and applications implemented, case studies of interest if necessary in joint work with the Expert Group on Households Indicators (EGH) of ITU in order to enrich the data sources and analysis that can be performed.

Annex

A.1. Recent evolutions: 5G and the Internet- of- Things (IoT)

M2M subscriptions have been collected by ITU for many years. It is a service that grows all over the world, as measured by the number of active connections declared by the operators. The M2M connectiosn are given as a ratio of total pero 100 inhabitants in order to have some comparable figure.

Figure 2: M2M subscriptions/ 100 population across selected countries. *Source:* ITU



From the evidence recorded in last years it is observed that devices and connections are growing faster than the Internet users. This trend accelerates the increase in the average number of devices per household and per capita being active. A growing number of M2M applications, i.e., smart meters, healthcare monitoring, transportation, and package tracking, among others, are the main drivers in recent years for this signficative growth in M2M connections.

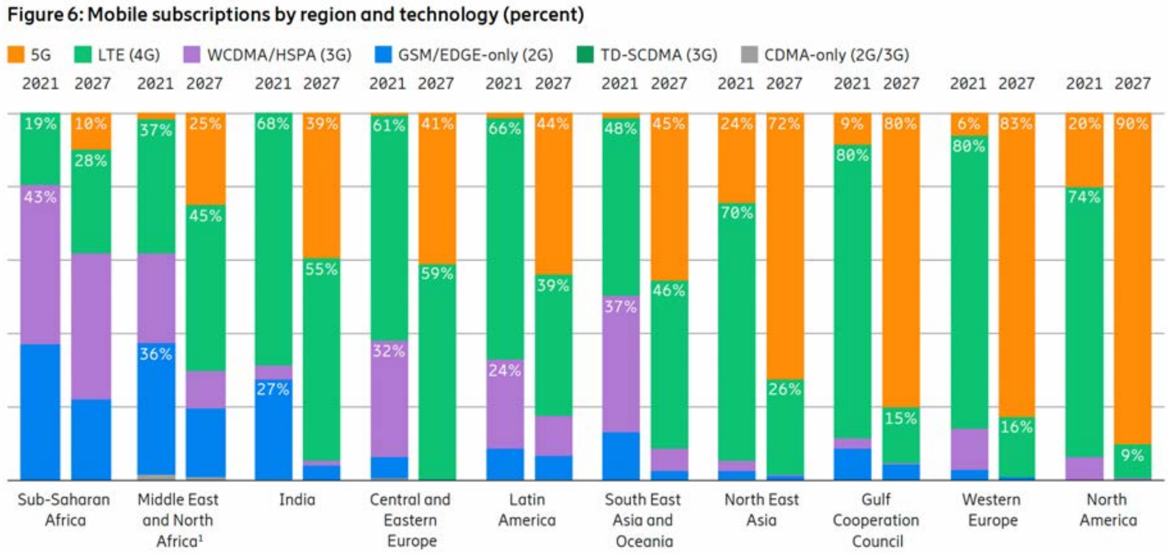
Projections on 5G

The deployment of 5G- IMT 2020 mobile networks that is rapidly taking place in many parts of the world brings the possibility for much higher speed, lower latencies and a variety of new services that are to be provided while in mobility if needed, both for the individual users and for machines, or in general, for things being connected. As operators deploy the 5G networks and coverage amounts to a significant part of the total population operators shall migrate traffic and users towards the new 5G networks.

Ericsson[5] expected that by 2027 some regions of the world will have more than 80% of the mobile users supported mostly by 5G networks, as in Europe, or North America. For other regions the 5G penetration is as well expected to grow significantly high: 45% in Latin America and South East Asia and Oceania and 72% in North East Asia, as examples.

[5] Ericsson Mobility Report, November 2021

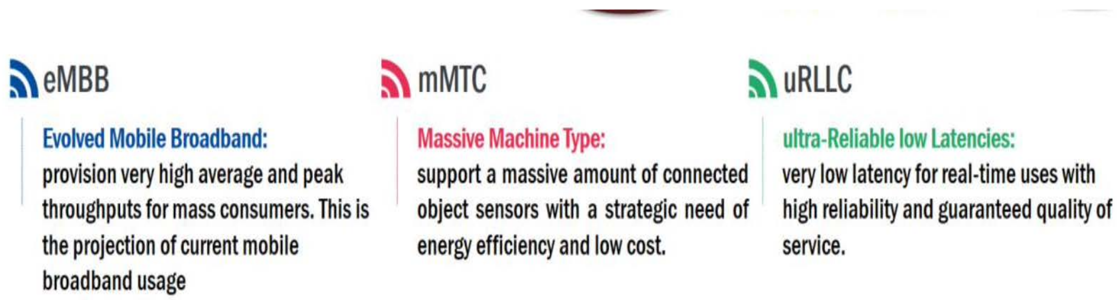
Figure 3: expected mobile subscriptions across the world. *Source:* Ericsson



A.2. 5G networks and the Internet-of- Things (IoT)

5G networks provide a better connection with higher speed (downloading/ uploading) and lower latency in the communications. Some of the main types of usage expected to become widespread with 5G networks[6]:

(1) enhanced mobile broadband (eMBB),
(2) massive machine type communications (mMTC)
(3) ultra-reliable and low latency communications (ULLC)



Source: IDATE DigiWorld

In any case, as 5G specifications evolve more use cases will come about together with more devices for use. The 3GPP meeting recently announced the release 17 which includes reduced capability specifications for medium-high speed connections (RedCap). The expected Release 18 will introduce additional possibilities for more flexible and efficient use of spectrum together with solutions for integrity and power efficiency[7].

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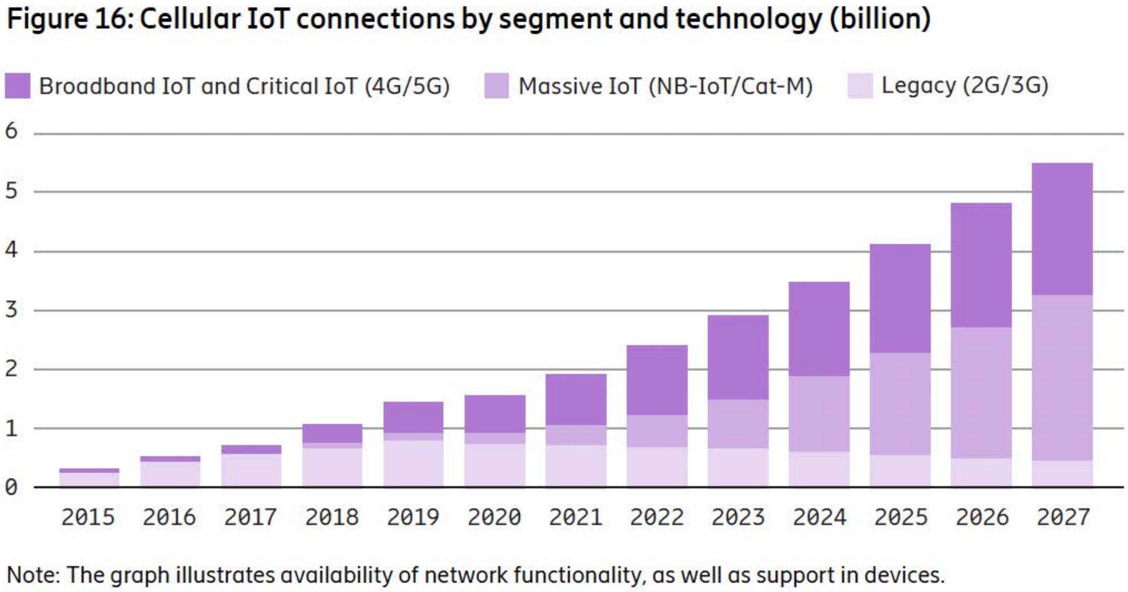
[6] IDATE, DigiWorld 2021.
[7] https://www.nokia.com/about-us/newsroom/articles/5g-advanced-explained/

The deployment and subsequent migration of users of 5G networks is expected to follow rapidly. By 2027 Ericsson expects the usage of "legacy network"·, i.e., 2G/ GSM and 3G/UMTS to diminish not only in absolute volume of consumers but especially in relative terms- it is expected that most of the traffic and users shall be served with 5G for enhanced mobile broadband services, as well as for massive M2M connections in the near future.

Figire 5: projections on the use of massive IoT and critical services with existing and new mobile standards. *Source:* Ericsson



With the existing indicator on M2M only the "cellular" activity is captured- i.e., any connection that uses the licensed spectrum managed by registered telecom operators. But, and here lies a deficit, any traffic or activity that may use non licensed spectrum, as wi-Fi, or uses local networks (as private local area networks) is not being measured with the existing M2M indicator. Is there then, any need to extend the existing M2M definition in light of the new applications, uses and connectivity possibilities that 5G is bringing about?

In order to answer this the subgroup has discussed on the scope of both the traditional M2M connections and that of IoT uses and applications observed with 5G networks.

Wide scope of IoT

Based on OECD (2022)[8] IoT *"…. includes all devices and objects whose state can be altered via the Internet, with or without the active involvement of individuals".* This definition excludes any device already accounted for in the subscriptions indicators to cellular or data services as laptops, tablets and smartphones. The main driver in IoT is its capacity to collect, store and exploit data about the environment and be able to monitor in order to improve a process, or a production system in some way.

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[8] Measuring the Internet of Things, Working Party on the Measurement and Analysis of the Digital Economy, Directorate General for Science, Technology and Innovation, DSTI/CDEP/MADE(2021)9/REV, OECD, March 2022

More importantly, IoT does not only refer to the connected devices (which is the focus of existing indicators), but to the entire ecosystem in which the "things" sense and communicate, which is composed of various layers:

a) the enabling infrastructure, which includes telecommunication, cloud and data
b) the devices embedded in "things", which contain software and APIs to connect to objects, and
c) the operating platform and the application layer

Table 1: different layers in IoT. *Source:* OECD (2022)

Table 1.1. Major players in the IoT value chain

	Technology leaders	New entrants
Application layer	Amazon, Apple, Cisco, GE, Google, IBM, Microsoft	Alibaba, Huawei, Samsung, Schneider, Siemens, Tencent
Data layer	AWS, Google Cloud Services, Infosys, Fortinet, IBM, Microsoft, Oracle, SAS, Tableau	Alteryx, Cloudera, Hortonworks, Dataiku, RapidMiner
Connectivity layer	Nokia, Arista Networks, AT&T, Cisco, Dell, NTT, Ericsson, Orange	Citrix, Coriant, Equinix, Bharti Airtel, China Telecom, Tata Comms
Device layer	AMD, Intel, Nvidia, Apple, Fitbit, Honeywell, Sony	AAC Tech, Garmin, GoPro, LinkLabs, Ambarella, Goertek, HTC

Note: Non-exhaustive list.
Source: (IRENA, 2019[13]).

In a similar vein Eurostat[9] provides an initial definition of IoT as *"….to interconnected devices or systems, often called "smart" devices or systems. They collect and exchange data and can be monitored or remotely controlled via the Internet".* As examples the OECD questionnaire provides the following: smart thermostats, smart lamps or smart meters; Radio Frequency Identification (RFID) or Internet Protocol (IP) tags and sensors for tracking the movement or maintenance needs of vehicles monitored over the Internet.

An important characteristic is that any of the devices connected may be monitored or controlled remotely via the internet. Hence, Eurostat excludes from IoT devices sound, temperature or smoke detectors or sensors when they cannot be controlled remotely.

The European Commission defined the IoT as enabling: *"objects sharing information with other objects/members in the network, recognizing events and changes so to react autonomously in an appropriate manner. The IoT therefore builds on communication between things (machines, buildings, cars, animals, etc.) that leads to action and value creation."*

Australia refers to IoT in a questionnaire launched to firms[10] as *" ….to the System of interrelated computing devices, mechanical and digital machines, objects, animals, or people that are provided with unique identifiers and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction. Examples of IoT*

[9] ICT Business Survey 2021, Eurostat
[10] Australian Bureau of Statistics

devices include: Universal remote control, smart power plug, smart light switch, home voice controller e.g., Google home voice controller."

The National Statistics Offices of Canada, Japan[11], Korea[12] and Eurostat[13] , among others provide as well in their questionnaires to enterprises similar scope for IoT.

The Connectivity Layer

Currently, every IoT/M2M- service depends on some kind of connectivity, e.g. via:

(1) Traditional networks, e. g. usually cellular networks such as 2G, 3G, 4G LTE IoT or CAT-M, NB-IoT or LTE-M and 5G
(2) Commercial networks in unlicensed spectrum (e.g. SigFox, LoRa)
(4) Private networks (e.g. WiFi)

In a recent report BEREC[14] depicted the different networks providing IoT connectivity. In general spectrum is used for connectivity even if fixed networks may be used as well for controlling and interconnecting devices. Spectrum used may be licensed to operators who later use it for data and voice or they may define Low Power Wide Area networks (LPWA) for local provisioning of services.

Agents may use as well unlicensed bands of spectrum where no quality of service may be guaranteed. In this part of spectrum non traditional operators may enter the market and offer

[11] In Canada for the ICT Business Survey, IoT refers to the interconnection via the Internet of computing devices embedded in everyday objects, enabling them to send and receive data. Internet- connected smart devices are electronic devices that can connect to each other and the Internet through a network. These devices are designed to automatically send and receive information from the Internet on a constant basis. Japan in its ICT Business Survey, IoT here means a technology that connects various things (including computers, smartphones, tablets and other information and communications equipment, as well as sensors in general, office equipment, electrical appliances, industrial machines, cars, etc.) with the Internet, LAN and other networks to digitalize their data for collection and accumulation.

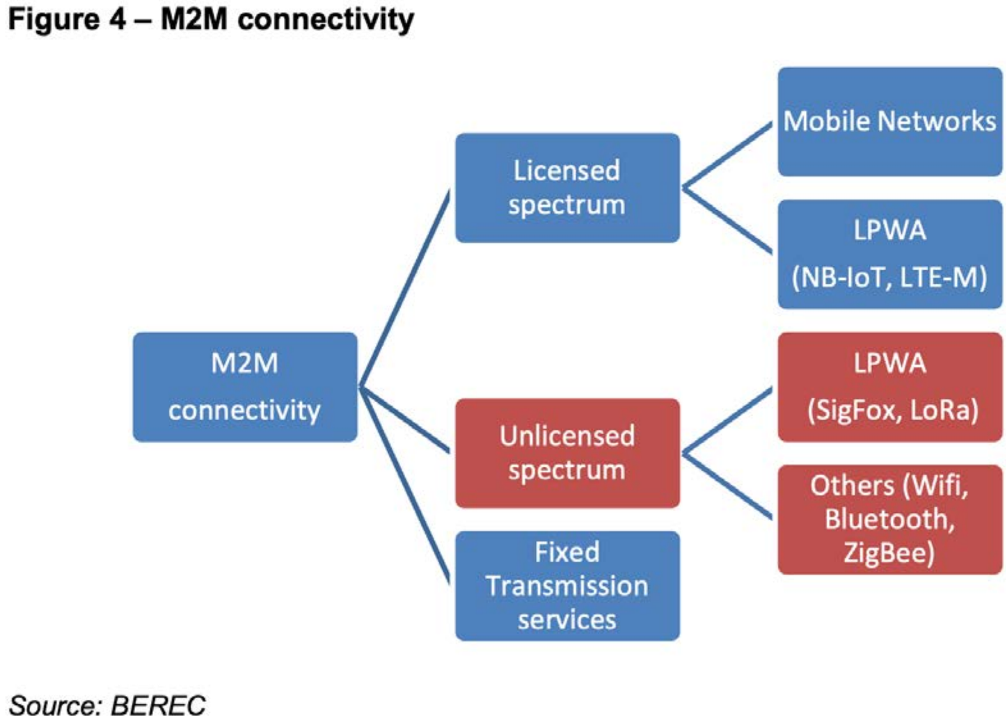
[12] Korea as well for its specific ICT Business Survey provides that IoT is the intellectual technology or service that links various things with the Internet to allow dynamic communication of information between people and things, things and other things, things and systems. This implements the activity of recognition, monitoring, etc. through the physical sensing equipment such as Radio Frequency Identification -Ubiquitous Sensor Network (RFID-USN), etc., and the accumulated data during would be provided through the wire/wireless communication to be used in various fields. e.g.: Smart factory that can be remotely controlled, smart building that controls indoor temperature, the heartbeat monitoring device for patients with arrhythmia, etc

[13] The following questions concern the use of internet connected devices or systems for private purposes that can also be connected to each other to enable advanced services; e.g. remotely controlling the device, adjusting settings, giving instructions for tasks to be performed, receiving feedback from the device etc. In its scope, the module is limited to the individual's use of IoT solutions in the private life context. It concerns mainly the uptake of home automation solutions (domotics), but also the use of wearable devices, e-health solutions or cars with built-in wireless connection. IoT solutions can be connected with e.g. other devices or systems via the Internet (via mobile Internet connections, Wi-Fi) or via Bluetooth…… the use of smartphones, tablets, laptops or desktops is not the objective of the measurement performed in this module, when those devices serve to access the Internet only and not to control an IoT device.

[14] Internet of Things Indicators, BoR (19) 25, BEREC, March 2019

services as well. It is clear that for IoT not only the set of networks is bigger as compared to M2M activity, but the type of agents that may provision the service is enlarged as well.

Figure 6: M2M connectivity modalities. *Source:* BEREC (2019)



The measuring of IoT services and devices being connected may be based on different dimensions:

(1) the use cases

(2) type of network used: local, wide area, private/ public (i.e., non licensed) mobile network and privately allocated spectrum for enterpises or research initiatives.

(3) differentiate services based on Quality of Service (QoS)

In brief, it is clear that IoT is a much wider concept that M2M connectivity. IoT may use different types of networks, a huge variety of devices and different services being provided- not comparable among them-, varied quality of service parameters attached to each service and furthermore, IoT shall bring about new value added on top of the connectivity layer to the final users.

The OECD[15] has proposed a taxonomy that combines types of networks used and some quality characteristics in order to tackle then measurement of IoT evolution. The OECD provides a segmentation that differentiates:

[15] Measuring the Internet of Things, Working Party on the Measurement and Analysis of the Digital Economy, Directorate General for Science, Technology and Innovation, DSTI/CDEP/MADE(2021)9/REV, OECD, March 2022

(1) small range connections (Local Area Networks),
(2) wide area connections, and inside (Wide Area Networks):

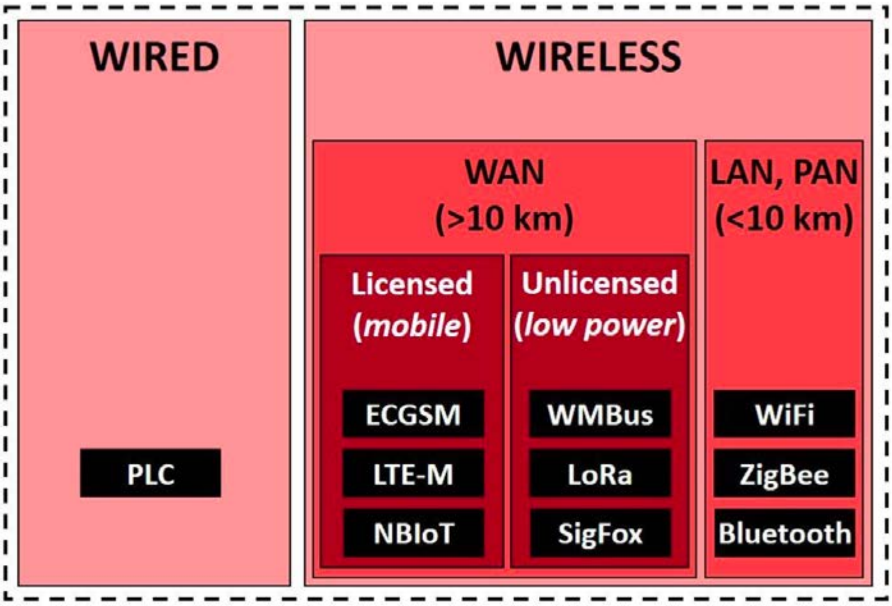
(i) massive IoT
(ii) critical (industrial) applications

One important aspect contemplated in this taxonomy is the diferentiation between short-range connections, e.g., Zigbee, Bluetooth, or Local Area Networks (LAN) and wide area connections, as massive IoT.

The telecommunications regulator in Italy (AGCOM)[16] in an analysis of metering devices in place across households and firms in Italy for water, energy and other utilities related provisioning sketches the technologies and types of networks used and the difficulties in collecting data from all these sources.

Figure 7: networks and technologies used for metering purposes. *Source:* AGCOM (2021)

Figura 12 – Classificazione delle tecnologie abilitanti lo *smart metering*



Fonte: AGCOM

[16] Autorita per le Garanzie nelle Communicazioni (AGCOM), Esiti delle attivita del Gruppo di Lavoro per l analisi delle tecnologie di comunicazioni dei dati nei sistema di Smart metering, 2021