
IMT-2020 BACKGROUND

1 IMT evolution

International Mobile Telecommunications-2000 (IMT-2000) systems provide access to a wide range of telecommunication services, supported by the fixed telecommunication networks (e.g. PSTN/ISDN/IP), and to other services which are specific to mobile users.

Resolution ITU-R 56-2 clarifies the relationship between the terms “IMT-2000” and “IMT-Advanced” and assigns a name to those systems, system components, and related aspects that include new radio interface(s) that support the new capabilities “IMT for 2020 and beyond”: IMT-2020. Resolution ITU-R 56 resolves that the term IMT-2000 encompasses also its enhancements and future developments and the term “IMT-Advanced” encompasses also its enhancements and future developments. The term “IMT” is the root name that encompasses IMT-2000, IMT-Advanced, and IMT-2020 collectively.

To meet the ever increasing demand for wireless communication (e.g. increased no. of users, higher data rates, video or gaming services which require increased quality of service, etc.), IMT has been, and continues to be, enhanced.

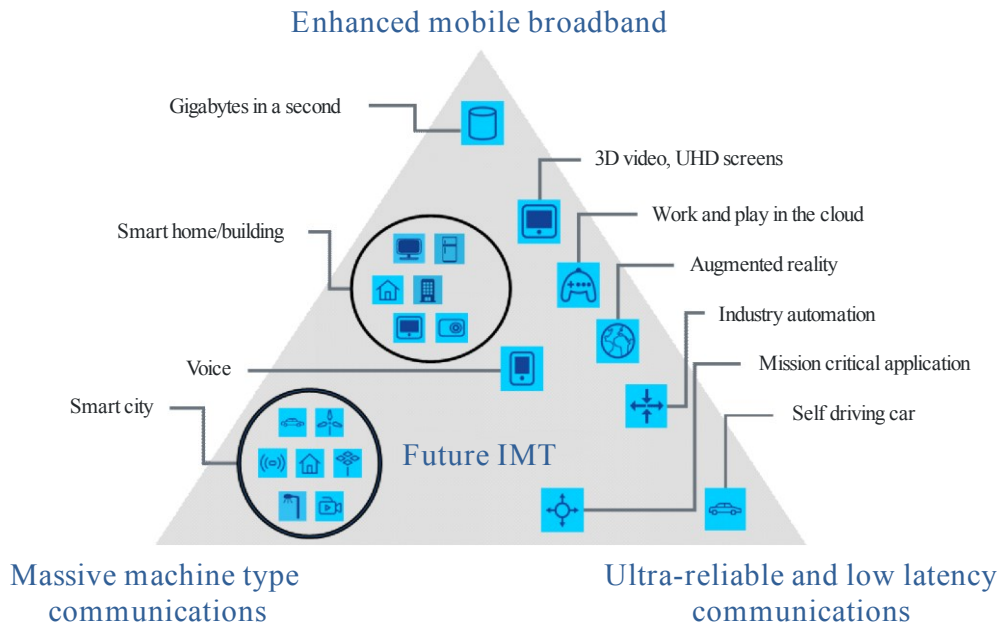
2 Consumer demands

Consumer demands will shape the future development of IMT. In the future, it is foreseen that new demands, such as more traffic volume, many more devices with diverse service requirements, better quality of user experience (QoE) and better affordability by further reducing costs, etc., will require an increasing number of innovative solutions. In addition, technological advancement and the corresponding user needs will promote innovation and accelerate the delivery of advanced communication applications to consumers. Recommendation ITU-R M.2083 “IMT Vision – Framework and overall objectives of the future development of IMT for 2020 and beyond” describes these potential user and application trends, growth in traffic, technological trends and spectrum implications. Also Reports ITU-R M.2370 “IMT Traffic estimates for the years 2020 to 2030” and M.2376 “Technical feasibility of IMT in bands above 6 GHz” detail these expected trends and phenomena for IMT-2020.

IMT-2020 systems will encompass a large number of different features. Depending on the circumstances and the different needs in different countries, future IMT systems should be designed in a highly modular manner so that not all features have to be implemented in all networks.

In order to fulfil these varied demands, IMT-2020 is envisaged to expand and support diverse usage scenarios and applications that will continue beyond the current IMT. Furthermore, a broad variety of capabilities would be tightly coupled with these intended different usage scenarios and applications for IMT-2020. Figure 1 illustrates some examples of envisioned usage scenarios for IMT-2020.

FIGURE 1
Usage scenarios of IMT-2020



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3 Capabilities of IMT-2020

IMT-2020 systems are mobile systems that include the new capabilities of IMT that go beyond those of IMT-Advanced. IMT-2020 systems support low to high mobility applications and a wide range of data rates in accordance with user and service demands in multiple user environments. IMT-2020 also has capabilities for high quality multimedia applications within a wide range of services and platforms, providing a significant improvement in performance and quality of service.

A broad variety of capabilities, tightly coupled with intended usage scenarios and applications for IMT-2020 is envisioned. Different usage scenarios along with the current and future trends will result in a great diversity/variety of requirements. The key design principles are flexibility and diversity to serve many different use cases and scenarios, for which the capabilities of IMT-2020, described in the following paragraphs, will have different relevance and applicability. In addition, the constraints on network energy consumption and the spectrum resource will need to be considered.

The following eight parameters are considered to be key capabilities of IMT-2020:

Peak data rate

Maximum achievable data rate under ideal conditions per user/device (in Gbit/s).

User experienced data rate

Achievable data rate that is available ubiquitously¹ across the coverage area to a mobile user/device (in Mbit/s or Gbit/s).

Latency

The contribution by the radio network to the time from when the source sends a packet to when the destination receives it (in ms).

Mobility

Maximum speed at which a defined QoS and seamless transfer between radio nodes which may belong to different layers and/or radio access technologies (multi-layer/-RAT) can be achieved (in km/h).

Connection density

Total number of connected and/or accessible devices per unit area (per km²).

Energy efficiency

Energy efficiency has two aspects:

- on the network side, energy efficiency refers to the quantity of information bits transmitted to/ received from users, per unit of energy consumption of the radio access network (RAN) (in bit/Joule);
- on the device side, energy efficiency refers to quantity of information bits per unit of energy consumption of the communication module (in bit/Joule).

Spectrum efficiency

Average data throughput per unit of spectrum resource and per cell² (bit/s/Hz).

Area traffic capacity

Total traffic throughput served per geographic area (in Mbit/s/m²).

IMT-2020 is expected to provide a user experience matching, as far as possible, fixed networks. The enhancement will be realized by increased peak and user experienced data rate, enhanced spectrum efficiency, reduced latency and enhanced mobility support.

In addition to the conventional human-to-human or human-to-machine communication, IMT-2020 will realize the Internet of Things by connecting a vast range of smart appliances, machines and other objects without human intervention.

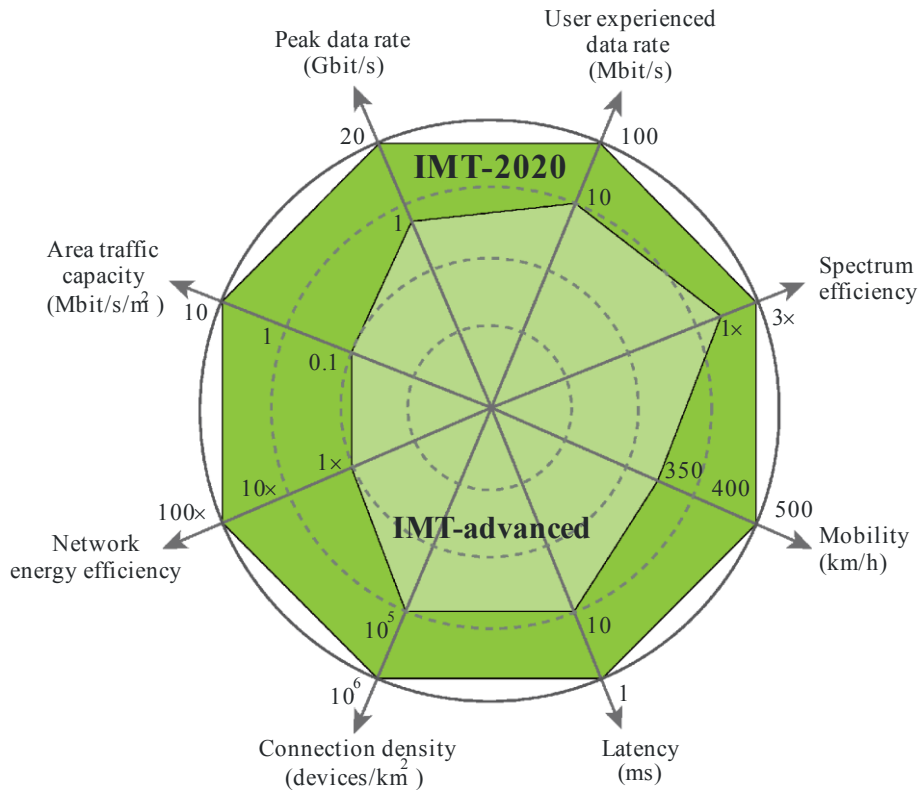
¹ The term “ubiquitous” is related to the considered target coverage area and is not intended to relate to an entire region or country.

² The radio coverage area over which a mobile terminal can maintain a connection with one or more units of radio equipment located within that area. For an individual base station, this is the radio coverage area of the base station or of a subsystem (e.g. sector antenna).

IMT-2020 should be able to provide these capabilities without undue burden on energy consumption, network equipment cost and deployment cost to make future IMT sustainable and affordable.

The key capabilities of IMT-2020 are shown in Fig. 2, compared with those of IMT-Advanced. Those key capabilities of IMT-2020 would be enhanced compared to those of IMT-Advanced.

FIGURE 2
Enhancement of key capabilities from IMT-Advanced to IMT-2020



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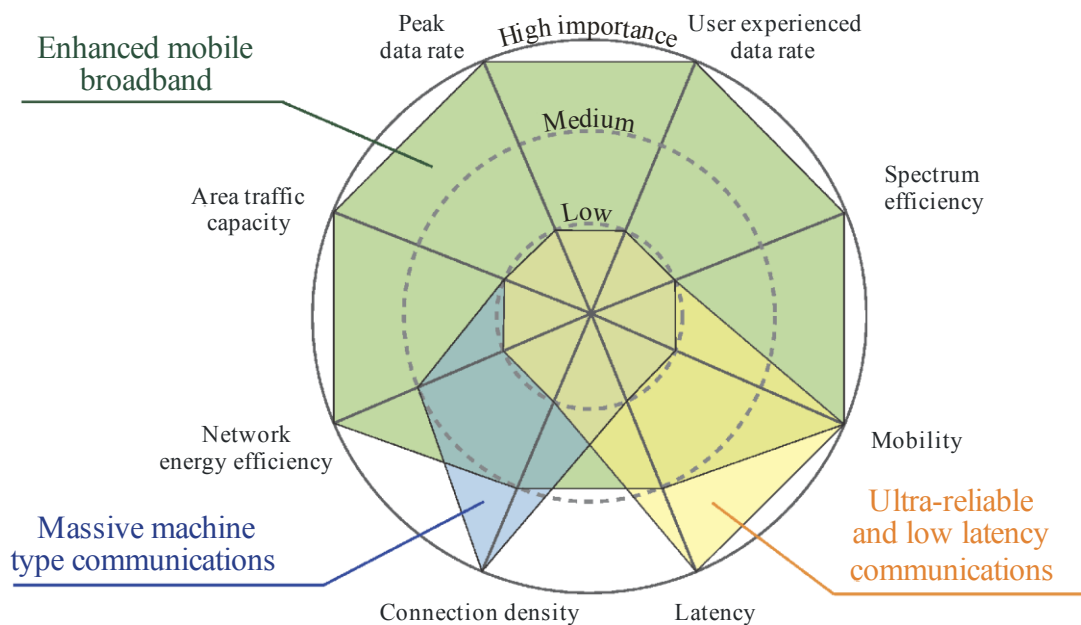
As anticipated above, whilst all key capabilities may to some extent be important for most use cases, the relevance of certain key capabilities may be significantly different, depending on the use cases/scenario. The importance of each key capability for the usage scenarios *enhanced Mobile Broadband*, *ultra-reliable and low latency communication* and *massive machine-type communication* is illustrated in Fig. 3. This is done using an indicative scaling in three steps as “high”, “medium” and “low”.

In the enhanced Mobile Broadband scenario, user experienced data rate, area traffic capacity, peak data rate, mobility, energy efficiency and spectrum efficiency all have high importance, but mobility and the user experienced data rate would not have equal importance simultaneously in all use cases. For example, in hotspots, a higher user experienced data rate, but a lower mobility, would be required than in wide area coverage case.

In some ultra-reliable and low latency communications scenarios, low latency is of highest importance, e.g. in order to enable the safety critical applications. Examples include traffic safety, traffic efficiency, smart grid, e-health, wireless industry automation, augmented reality, remote tactile control and tele-protection. Such capability would be required in some high mobility cases as well, e.g., in transportation safety, while, e.g. high data rates could be less important.

In the massive machine type communication scenario, high connection density is needed to support tremendous number of devices in the network that e.g. may transmit only occasionally, at low bit rate and with zero/very low mobility. A low cost device with long operational lifetime is vital for this usage scenario.

FIGURE 3
The importance of key capabilities in different usage scenarios



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Other capabilities may be also required for IMT-2020, which would make future IMT more flexible, reliable, and secure when providing diverse services in the intended usage scenarios:

Spectrum and bandwidth flexibility

Spectrum and bandwidth flexibility refers to the flexibility of the system design to handle different scenarios, and in particular to the capability to operate at different frequency ranges, including higher frequencies and wider channel bandwidths than today.

Reliability

Reliability relates to the capability to provide a given service with a very high level of availability.

Resilience

Resilience is the ability of the network to continue operating correctly during and after a natural or man-made disturbance, such as the loss of mains power.

Security and privacy

Security and privacy refers to several areas such as encryption and integrity protection of user data and signalling, as well as end user privacy preventing unauthorized user tracking, and protection of network against hacking, fraud, denial of service, man in the middle attacks, etc.

Operational lifetime

Operational life time refers to operation time per stored energy capacity. This is particularly important for machine-type devices requiring a very long battery life (e.g. more than 10 years) whose regular maintenance is difficult due to physical or economic reasons.

These capabilities enable IMT-2020 to address evolving user needs. The capabilities of IMT-2020 systems are being continuously enhanced in line with user trends and technology developments.

4 Relationship between existing IMT and IMT-2020

As indicated in Section 3 above, in order to support emerging new scenarios and applications for 2020 and beyond, it is foreseen that development of IMT-2020 will be required to offer enhanced capabilities. The minimum technical requirements (and corresponding evaluation criteria) to be defined by ITU-R based on these capabilities for IMT-2020 could potentially be met by adding enhancements to existing IMT, incorporating new technology components and functionalities, and/or the development of new radio interface technologies.

Furthermore, IMT-2020 will interwork with and complement existing IMT and its enhancements.

5 Framework of IMT-2020

The framework and objectives including overall timeframes for the future development of IMT for 2020 and beyond are described in some detail in Recommendation ITU-R M.2083.
