

# Standards



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## ▼ Contents

- [International standards for telecommunications are developed in a 3 part cycle.](#)
  - [1. Reports](#)
  - [2. Specifications](#)
  - [3. Recommendations](#)
- [5G Standards](#)

## International standards for telecommunications are developed in a 3 part cycle.



### 1. Reports

The International Telecommunications Union (ITU) is a UN organization. IT oversees a binding treaty between 191 member nations. The purpose of the treaty is to ensure telecom technology has some uniformity across those nations. The ITU issues “reports” that define the

- overall concepts,
- technical requirements
- performance requirements,
- service requirements

of future telecom technologies.

### 2. Specifications

The 3rd Generation Partnership Project (3GPP) is an international organization made up of representatives from industry in ITU member nations. This group takes in

- ITU's reports
- recommendations from national standards organizations
- recommendations from regional standards organizations

and generates technical specifications for future technology.

### 3. Recommendations

ITU translates 3GPP's technical specifications into international standards that dictate how technology shall implement specifications. Those standards are formally called “radio regulations” (RR). These are updated every 4 years at an event called World Radio Congress (WRC).

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Perhaps you agree that the names “specifications” and “recommendations” should be swapped? Well, this is the careful language of international treaties.



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You can imagine how this treaty came about; a wide variety of mobile communication technologies developed in different nations/regions, UE manufacturers could not make a device that worked in multiple regions, and users could not take their devices from one region to another. This provided sufficient motivation for universal terrestrial mobile (UTM) treaties starting in 3G. Hence the name 3G Partnership Project.

## 5G Standards

5G standards have an interesting property relative to preceding generations; the standards were developed before the technology that implements them. More accurately, the debate about the standards was made public so that technology developers could start the tech work while specifications were being finalized. Nevertheless, the development of the specifications led the technology, not vice versa. Thus, 3GPP was free to dream big dreams and to make major changes. This is why 5G is able to go well beyond mobile phones into massive IoT etc.

Here are the key capabilities and minimum requirements that ITU's working group IMT2020 laid out for 5G in 2015.

- per device peak data rate of 10GB/s minimum in ideal conditions
- user experienced data rate of 100MB/s but across wide coverage areas
- latency of 1ms across the radio access network (UE to core)
- ability to handle mobility of devices traveling at 500km/h with seamless transition between radio nodes for all radio technologies at all data layers and without loss of QoS
- connection density of  $10^6$  UE per  $\text{km}^2$  in ideal circumstances
- traffic capacity of 10MB/s/ $\text{m}^2$  in regions where cell size has radius 10m
- energy efficiency in bits/joule no higher than 4G, and low consumption of energy by UE when no data is sent or received
- spectrum efficiency in B/s/Hz 3 times lower than 4G

The following diagram compares 5G capabilities (dark green) to those for the last round of specifications for 4G (light green).

# 5G

