Annual Global Update

Public version

450 MHz Alliance, December 2025

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1 Introduction

This report provides the global status of the use of spectrum in the 410 MHz and 450 MHz bands. The information is gathered from operators and regulators worldwide by 450 MHz Alliance. The 450 MHz Alliance is an interest group fostering deployments in the 380 to 512 MHz band. Primary activities of the 450 MHz Alliance include advocacy for evolution of standards, technical education, advocacy, regulatory affairs, global cooperation's, system and device availability and cooperation to develop new features and services.

Worldwide, there are currently thirty-nine cellular networks with commercial traffic operating in the 410 and 450MHz bands. LTE is the dominant technology in these bands today while regulatory work for converting technology specific licenses is still an obstacle in the progress of evolving to 4G in some countries. Europe is currently leading the conversion from 2G and 3G CDMA to 4G LTE with Africa, Asia and South America in progress. North America and Australia have been dominated by narrowband systems in the 400 MHz bands, but are currently reviewing the possibility of introducing also broadband licenses in these bands. Most licenses today are nationwide, but some larger markets are also evaluating the allocation of regional licenses for specific industry applications. The aim of this report is to provide operators with a simple introduction to the 450 MHz ecosystem for their business and to highlight business opportunities to suppliers who provide equipment and services to operators and end-users.

2 Technology Overview

LTE in 450 MHz bands is a part of the 3GPP specification for 4G. With advanced data and voice capabilities, flexibility and a seamless migration path to next generation cellular technologies, LTE has become a leading wireless technology for delivering voice, broadband and IoT data service with focus on critical communications to densely populated urban areas as well as rural and remote regions in developed and developing markets. LTE450 – or LTE in the 450 MHz frequency bands – is a mature and robust technology for cost-effective provisioning of advanced voice and broadband data services across regions with low population densities or difficult terrain due to the favorable propagation characteristics of the lower frequency band. The robustness of the 400 MHz bands is due to that no consumer devices have native support and that with the lower number of sites required it is affordable to deploy network with extensive power backup. The unique characteristics due to low spectrum give superior coverage compared to any other spectrum bands standardized by 3GPP and ITU. The typical coverage area for different spectrums can be seem in the figure 1, below.

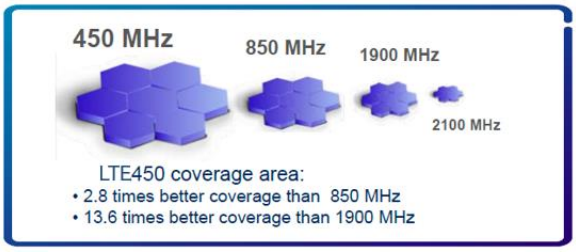


Figure 1. Coverage area for different spectrums

Being part of the 4G/LTE and 3GPP ecosystems brings the advantages of a global technology evolution for wireless connectivity. The fundamental broadband services have evolved to support narrowband and lower power connectivity as well and voice and critical services with access priority and quality of service support. Low power and narrowband support for LTE-M and NB-IoT are available from several suppliers and 5G has been recently

standardized for 410MHz and 450MHz bands in 3GPP releases 18 and 19. Evolution from 4G to 5G follows the general implementation of NR support in 3MHz and 5MHz , since these smaller bandwidths options are required for deployments in the 400 MHz bands. The current view is that both standalone and non-standalone versions of 5G will be implemented.

3 Market Overview

The major development in the last twelve months has been the continued network deployments in the Kingdom of Saudi Arabia Germany, Austria Brazil, Ireland and Poland, the start of network deployment in the Netherlands and Poland and a trial in Malaysia, as well as the progress of spectrum allocation in South Africa and Tunisia and the consultation in France. There are still existing allocations of spectrum in the 400 MHz bands that are not technology neutral and require regulatory updates or changes to the allocation and/or licenses to be able to implement LTE by the local operators. The trend is that the 400 MHz spectrum bands are more and more being allocated to dedicated and private networks in Utility, Public Safety, Industry and Transport sectors. The advantage is the predictability of the operation, it will be stable and controlled since the network is deployed with a dedicated business as a base and customized to the requirements of the user. Due to the conversion of the business model, the total number of operators may decrease temporarily before new allocations have been awarded.

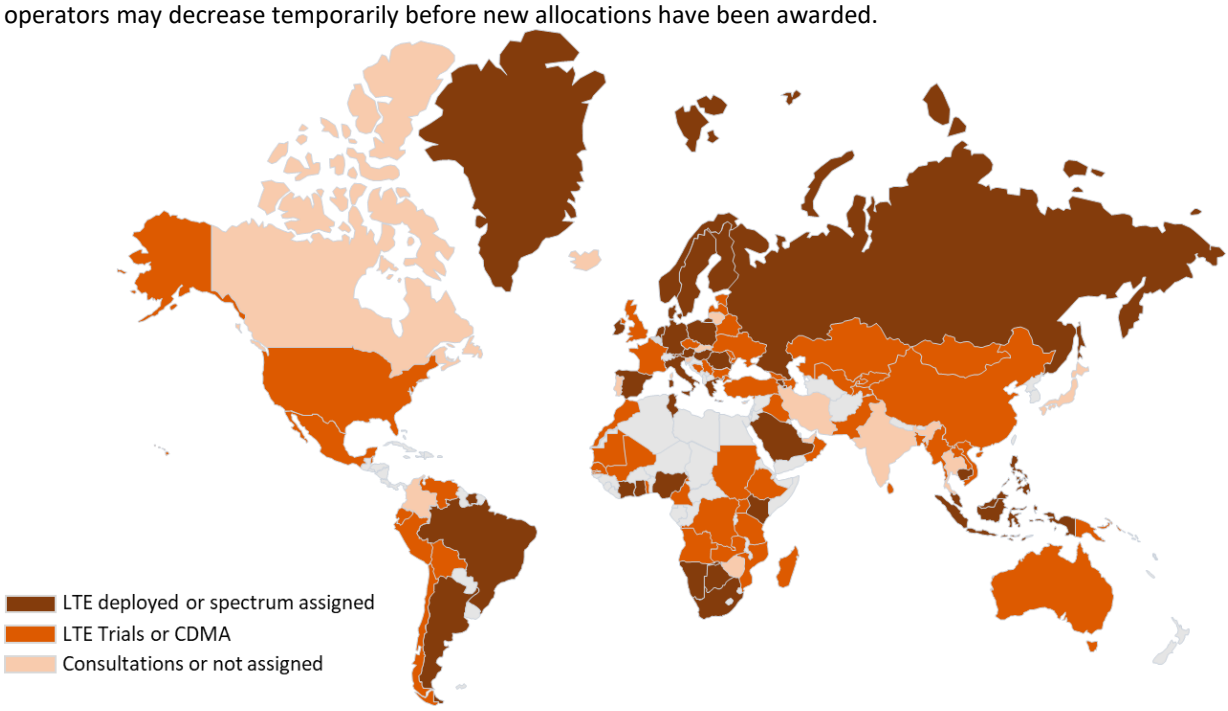


Figure 2. The world map of 380 MHz, 410 MHz and 450 MHz deployment.

Spectrum in the 400 MHz bands is today already allocated or in consultation in countries representing more than 6.8 billion people or 86 percent of the world population, which is a small increase since last year. Networks are being or are already deployed or in trial in countries representing more than 4.2 billion people or 54 percent of the world population, which is a small decrease since last year mainly due to shift in license ownership and changes of technology from CDMA to LTE. 2025 is expected to be the year when there are more LTE spectrum allocations in relation to CDMA.

3.1 Applications

Network deployments in the 400 MHz bands are suitable for many applications both as the primary carrier as well as backup service and are implemented mainly for critical communication needs. The main applications implementing 400 MHz bands can be divided into four main segments: Utility, Transport, Public Safety and Rural connectivity.

Connectivity to support applications and services for **utility** distribution networks evolves to require private and dedicated connectivity due to them supplying critical infrastructure and services in society. This includes connectivity to support smart grids, smart meters, site access management, smart city, decentralized production, electrical vehicle charging stations and field-force. Security of the utilities production, distribution, and delivery of services to their customers is the reason to build dedicated networks. The 400 MHz bands fit for providing the coverage required for these applications and can also cater for the capacity need. The organizations UTC (North America), EUTC (Europe), UTCAL (Latin America), UBBA (USA and Canada) and CIGRE have extensive information regarding Utility application.

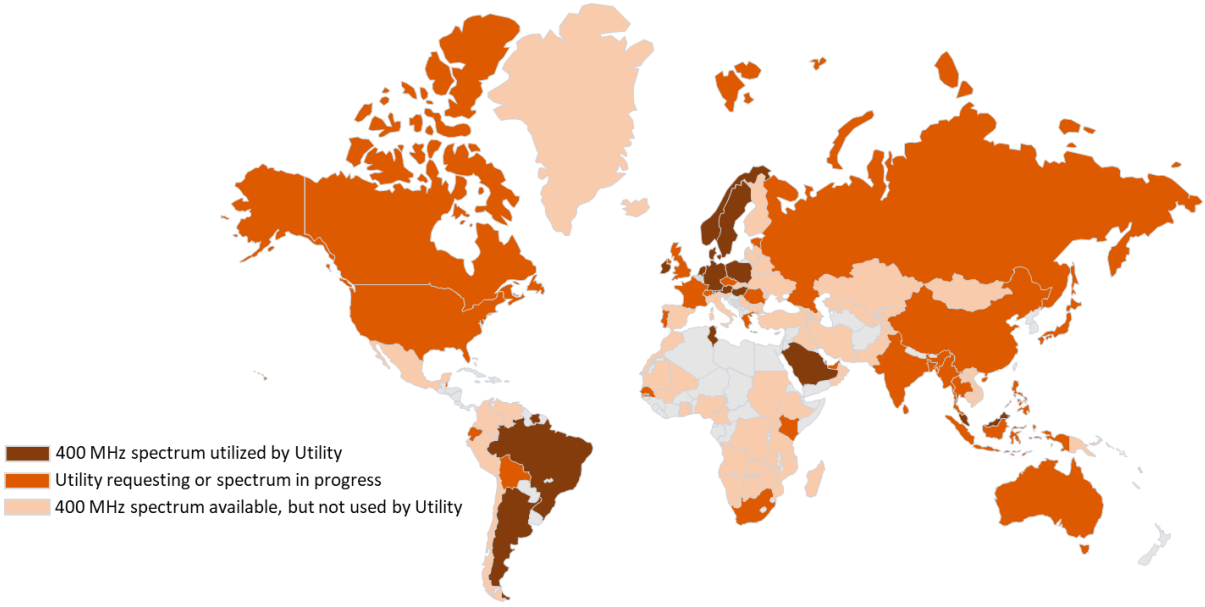


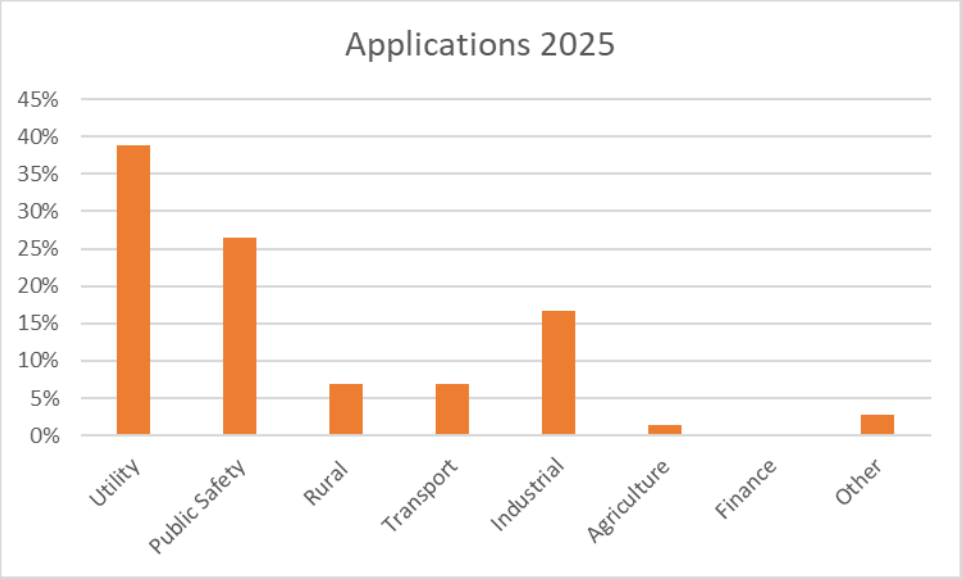
Figure 2. The world map of Utilities interest in the 400 MHz bands.

Public safety would use the 400 MHz bands as part of their connectivity solution either as primary or secondary carriers. Typical service would be voice, push to talk, broadband, air to aground communication for helicopters and drones as well as machine to machine, but not limited to these. Networks are likely to have nationwide coverage but could also be suitable for tactical mobile units with instant wide range coverage. TCCA provides additional information regarding the requirements for public safety application and services.

Applications for **transport** requires coverage over large range of areas, this includes railways, road service, logistics, mining, shipping, timber industry and agriculture. The solutions can vary from simple monitoring to remote control and assisted automation. The 400 MHz spectrum can provide a secure and continues connectivity for many of the applications and with complementary higher spectrum, today supported by most chipsets, be a seamless part of the

overall solution. Like the utility network security of the information and the control of the network drives the requirements for a dedicate and private network.

Industrial use has expanded with Mining and Oil and Gas as the main segments. **Rural connectivity** includes connectivity for rural schools, health care centers, rural ATMs and bank offices broadband also including services for unconnected or poorly connected consumers. This segment enables services that are critical for a modern society.



Graph 1. The global implementation per application.

The 400 MHz bands provide a service for these applications with an attractive business model. This is due to the capacity and coverage possibilities, which enable the desired traffic pattern with an affordable investment.

3.2 Africa

Listed below is a short status update per country for the most active countries in the last twelve to eighteen months.

- South Africa regulator has allocated in the 450-470 MHz band 31 for Transnet for rail ways and there is an ongoing process for the use outside the railway tracks.
- The regulator in Tunisia have allocated 450-470 MHz band for the utility.
- There has been a general spectrum consultation Morocco including the 400 MHz bands.
- In Kenya spectrum in the 450 MHz have been reserved for LTE with utility as the primary focus, the company Cable-Free and Kenya Power (KPLC) are actively working with deployments plans.
- Open Sky Services (MPS) holds the band 31 in Nigeria and have an ongoing procurement of system.
- Ghana has a 450 MHz band 31 spectrum allocation for mission critical communication and are focus on tactical systems, but is evolving to permanent services.
- The regulator in Uganda is looking at awarding the 380 MHz band for PPDR services.

- The band 31 license in Senegal is being evaluated for different industrial verticals.
- Telecom Namibia holds the band 31 license.
- The 450 MHz spectrum in Angola is in progress to evolve from CDMA to LTE by Angola Telecom.
- Botswana regulator BORCA has announced auction of the 450 – 470 MHz band for broadband use.
- Several countries have test or tactical systems deployed.

3.3 Americas

Listed below is a short status update per country for the most active countries in the last twelve to eighteen months.

- The utilities in the USA are seeking opportunities to obtain their own spectrum, mainly to be independent from third parties and to be in control of the connectivity. Both spectrum in the 410 MHz and in 380 MHz is being evaluated.
- Both 410 and 450 MHz bands in Brazil are available for local permits for industry. The focus have been for utilities, agriculture, energy and transport. Band 31 in Brazil are being deployed by more than five utilities and several procurements are progress. The 410 MHz band 87 have a preferred allocation for utilities which give them priority in the band in relation to other industries.
- Colombia allocated 380 MHz band for PPDR and have had a consultation regarding the spectrum in the 450 MHz band.
- Alvis is the first former CDMA operator in Argentina evolving to LTE. The deployment includes both band 31 and band 87 with focus on, but not limited to, rural areas and agriculture.
- In Suriname the utility has a deployed network in the 450 MHz band 31 for IoT services.
- Telmex holds a 450 MHz license in Mexico currently operational on CDMA band A and are evaluating to convert to LTE. Consultation of the 450 MHz band has been held during 2024.
- In Bolivia the utility evaluates the possibility of using the 450 MHz spectrum.
- Utilities in Canada are evaluating test allocation in rural areas in the 450 MHz spectrum.
- On the island of Bonaire the utility WEB Bonaire have deployed a 450 MHz network band 31.

3.4 Asia and Oceania

Listed below is a short status update per country for the most active countries in the last twelve to eighteen months.

- India has had several ongoing investigations for dedicated spectrum for different segments and verticals. 450 MHz has been included in proposals for railway and critical communication.
- China Unicom holds the band 31 license in China. No official statement has been made with regard to services to be delivered using the spectrum at this time. It has been evaluated for power grid and meters as well as railway communication.
- The license holder of band 31 in the Philippines has changed ownership. The new owner has not officially stated the plans for the operation.

- The band 31 and 72 license in Indonesia are held by the government. The expectation is that the operation will be a dedicated network for governmental systems and utilities.
- Band 31 is available in Vietnam. Previous license holder was EVN Telecom.
- TNB in Malaysia have done a procurement of system for Band 31 for initial deployments in four areas. The second phase of deployment is currently in procurement.
- The Telecom Regulator in Pakistan has had consulted to evaluate the interest in evolving the current CDMA license to a technology neutral or LTE license.
- In Bahrain the utility EWA have deployed a network for water meters in band 87.
- Aramco Digital have been awarded the 450 MHz band 72 and initial launch of services will be Q1 2026.
- The Cambodia regulator has awarded 60 MHz from 390-450 MHz to Titan. The focus is to provide broadband services.
- Singapore have allocated the 450 MHz spectrum band 31 for public safety are in service.
- Dialog holds the 450 MHz license in Sri Lanka and are looking to evolve to LTE.
- Thailand is reviewing the use of 450 MHz to 470 MHz-band.
- The utility in Iraq have initiated a trail in 450 MHz band.
- Telecom Armenia holds the 450 MHz license band 31 in Armenia and provides a broadband service.

3.5 Europe

Listed below is a short status update per country for the most active countries in the last twelve to eighteen months.

- The mobile operator Elisa holds the band 31 license in Finland. The license was awarded in 2026.
- The mobile operator and utility Ice/Lyse holds the band 31 license in Norway which is mainly used for consumer broadband in rural areas typical second homes, but during 2024 ice have started to convert the customers from the network to change focus to industrial use. ice is own by Lyse and utility in Nowray. A license for band 87 has been out for consultation with limited interest from the main operators, other industries were not included in the consultation.
- Teracom holds the band 31 license in Sweden. Their main use cases are utilities, public safety and governmental users.
- Cibicom holds the band 31 license in Denmark with the initial focus for the IoT and are focusing on industrial solution. The Danish police holds the license in band 87 and are evaluating the options to progress.
- The utility ESB holds the band 87 license in Ireland and is currently in the deployment phase for network infrastructure and devices. The main initial use case is to deploy connectivity for smart grid.
- PGE holds the band 31 license in Poland and have deployed some region in Poland for the smart grid, smart meter and field service handhelds. Polkomtel/Puls holds the band 87 license and have a nationwide network which launched MCX service in the beginning of 2025.
- Utility Connect holds the band 72 license in the Netherlands which is mainly used for smart meters and smart grid connectivity.

- 450connect holds the band 72 license in Germany. The operator has deployed and launched the first phases of the network and service. The network will be deployed with a focus on emergency voice communication, smart meters, smart grid and communication of other critical infrastructures. There is also a 450 MHz network implemented underground for the nuclear waste facility providing mobile services on the site.
- ArgoNET is holding the band 72 spectrum licenses in Austria. Multiple regional CDMA and LTE networks have been deployed to address various utility applications including smart grid, smart metering and critical voice communication.
- SIRDEE holds the band 31 license in Spain and have given Telefonica the task to build and operate a public safety network. Network deployment has been on hold since 2024.
- EDP have had trial network in Portugal. However, the commercial terms have not been at a level enabling the benefits of the deployment, so the process to award the license is ongoing.
- Rostelecom holds the band 31 license in Russia. The network provides services for Public safety staff, industries and transport.
- HMEI holds the band 31 license in Hungary and the focus is to provide services for governmental and military users.
- Greece have allocated a license in band 87.
- Italy have allocated the 450 MHz spectrum for nomadic use as part of a tactical communication system.
- UK have had several consultations regarding 410 and 450 MHz spectrum and have proposed to progress with an allocation for the utilities within medium term time frame.
- France have done a consultation and there is an interest to move forward with an allocation for the band. Work is ongoing with Agurre and industry users to drive the progress of the allocation. EDF have done a field test during 2025.
- Georgia have started to review the possibility of converting the license to technology neutral.
- Slovenia have an allocation in 450 MHz band 72 for public safety and an ongoing consultation regarding 410 MHz band 87 for utilities.

4 Overview of Spectrum

The LTE bands available in the 380 MHz to 512 MHz are currently:

- Band 31 (450 MHz)
- Band 72 (450 MHz)
- Band 73 (450 MHz), not in use
- Band 87 (410 MHz)
- Band 88 (410 MHz), currently not in use

The 5G bands available in the 380 MHz to 512 MHz are currently:

- Band n31 (450 MHz), 3GPP release 18
- Band n72 (450 MHz), 3GPP release 18

- Band n87 (410 MHz), 3GPP release 19
- Band n88 (410 MHz), 3GPP release 19

All bands are standardized to support NR, LTE, LTE-M and NB-IoT services. Ongoing strategic work with TCCA, EUTC, UTCAL, UTC and other parties in the ecosystem are progressing to identify spectrum allocation in the 380 MHz and 470 MHz bands. The 380 MHz Band is currently ongoing with a plan to be part of 3GPP release 20.

The initial discussion regarding 6G has been initiated.

5 Global spectrum allocations

450 MHz provides a more or less global footprint, and the 410 MHz footprint is increasing rapidly. The number of commercial operations is fairly limited in relation to the global mobile industry. This is due to having only one operator per country. The spectrum attracts interest from many segments and the introduction of LTE has made it easier to deploy networks. CDMA licenses are gradually being converted and narrowband systems that have been widely used in this spectrum are being evolved to commercial mobile networks and to more capable and secure private networks which enable additional bandwidth to be available. The global trend of allocating spectrum for private and dedicated networks drives regulators to find fitting frequency ranges these varies a lot pending on the region.

The global variation of spectrum allocation for dedicated or private network can be seen in the table below.

Spectrum Region	410 MHz 450 MHz	700 MHz	800 MHz 850 MHz 900 MHz	1600 MHz 1800 MHz	2100 MHz 2300 MHz	2500 MHz 2600 MHz	3500 MHz 3700 MHz	4900 MHz	2nd lease
Africa	B31/72/87	B28/68							Yes
Asia	B31/72/87		B26/27			B41		n79	Yes
Europe	B31/72/87	B28/68		B3	B40 n40	B38 n38/n90	B42/43 n77/78		Yes
Middle East	B31/72/87				B1 n65		B43 n77/78		
North America	B31/72/87	B14	B106/111	B54			B48		Yes
Oceania Pacific	B31/72/87		B26/27					n79	Yes
South America	B31/72/87	B28	B26/27		B40 n40	B38 n38	B42/43 n77/78		Yes

Table 1. Private network spectrum allocations per region

The 450 MHz bands are today the only common band for all regions in the world. The bands that are not used by commercial operators are 410, 450, 700 (B68), 850 (B27), 900 (B106) and 4900 (n79) MHz. The deployment of secondary spectrum lease is fairly limited in the world due to poor license conditions given by mobile operators that have the primary license.

5.1 410 MHz and 450 MHz spectrum allocations listed by 450 MHz Alliance

The annual global spectrum update by 450 MHz Alliance collects information from regulators, operators and suppliers. The following information has been obtained from the responses of 74 regulators. In addition to the

regulators, a number of operators, suppliers and industry organizations have made their contributions, which makes the total number of countries with confirmed status 124.

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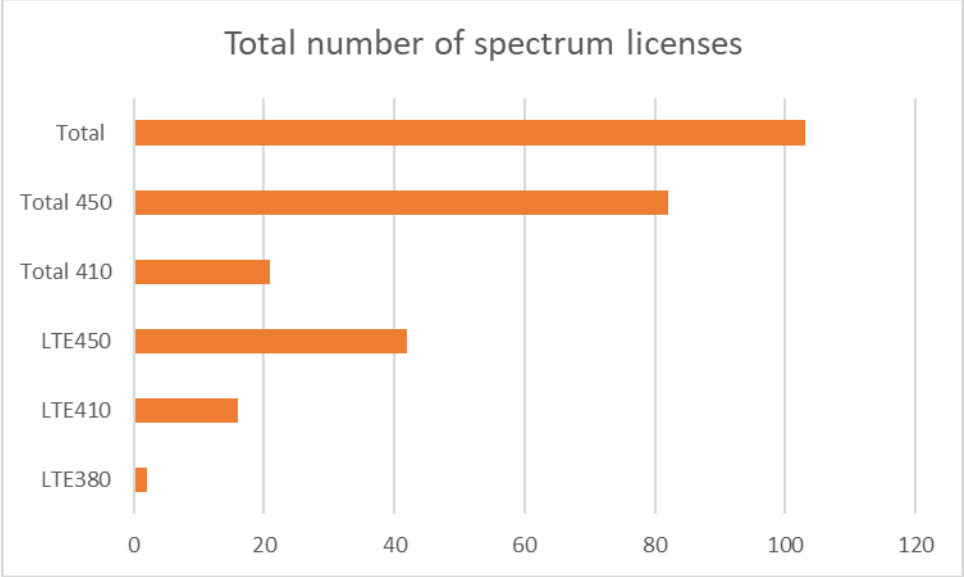
The total number of licenses globally is 103. The progress varies from consultation to deployed and operational networks. Detailed information can be found in the table below.



Graph 2. Number of licenses globally for 380 MHz, 410 MHz and 450 MHz.

Progress of deployments in these spectrum bands is controlled by the individual country. Currently there is no single stakeholder that drives the global progress of evolving or deploying the bands. Below, are the tables showing the status per region globally.

	Deployments	LTE Deployments	Consultation	Not in use
Africa	23	9	2	3
Americas	11	7	7	2
Asia and Oceania	18	6	8	5
Europe	25	17	7	16
Total	77	39	24	26

Table 1. Number of countries per region and globally with 380 MHz, 410 MHz and 450 MHz.

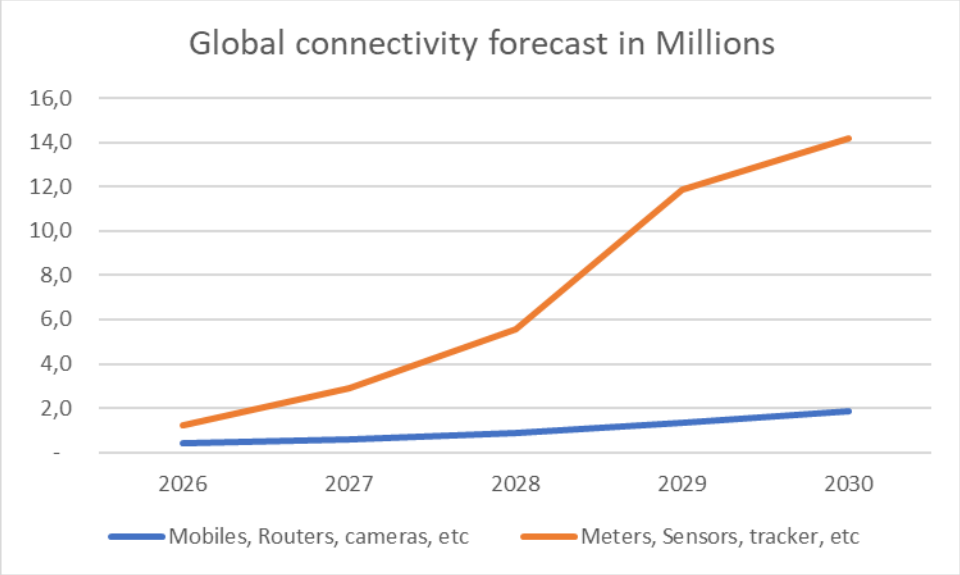
6 General outlook

The evolvement towards LTE of the spectrum in 380 MHz to 512 MHz is expected to increase. Bandwidth and coverage requirements for private and closed networks as well as public networks for rural communication are getting more interest and with this also an increased interest for the lower spectrum bands. With only twenty active operation and spectrum allocated in over seventy countries the expansion can be very fast. The ongoing consultations and the interest from government and companies are likely to drive the ecosystem even faster.

The estimation for connections for the coming years considering the currently known operations in progress are listed in the tables below. Table 6 and Graph 3 lists the forecast based on devices and use cases and Table 7 and Graph 4 lists the forecast based on technologies.

Year	2026	2027	2028	2029	2030
Mobiles, Routers, cameras and other broadband use cases in '000	420	610	892	1 330	1 840
Meters, Sensor, trackers, and other low-capacity use cases in '000	1 228	2 923	5 570	11 840	14 150

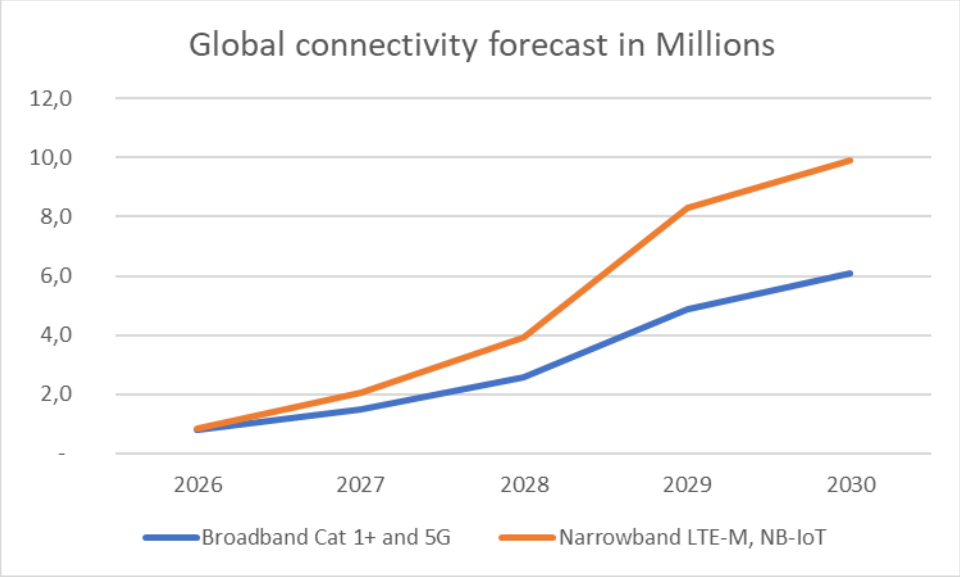
Table 6. Global forecast of connections for services in the 380 to 470 MHz.



Graph 3. Global forecast of connections for services in the 380 to 470 MHz in millions of units.

Year	2026	2027	2028	2029	2030
Broadband device 4G Cat-1+ and 5G in '000	789	1 487	2 563	4 882	6 085
Narrowband devices LTE-M and NB-IoT in '000	860	2 046	3 899	8 288	9 905

Table 7. Global forecast of connections for services in the 380 to 470 MHz.



Graph 4. Global forecast of connections for services in the 380 to 470 MHz in millions of units.

The evolution into 5G is hard to predict. There is currently a limitation of IoT functionality in 5G that is a large part of the use cases for the current deployment. 6G standardization will impact the deployment of 5G deployment specially if important functions for critical communication and industry will be available in the early releases.