



Annual Equipment Report

Public version

450 MHz Alliance, April 2022

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1 Introduction

This report provides the global status of the 410 MHz and 450 MHz ecosystem with focus on the devices and systems currently available. There are currently twenty-four LTE operations and another twelve licenses in consultation. CDMA networks are still very dominant technology in the 410 MHz and 450 MHz and the regulatory work for converting the licenses is an obstacle in the progress of evolving to 4G. Europe is currently leading the evolution from CDMA to LTE with Asia and South America moving. The aim with this report is to enable operators a simple entry to the 450 MHz ecosystem for their business and enable market opportunities for the supplier to provide equipment to the operators.

2 Market Overview

The major developments in the last twelve months have been the procurements in Germany and Poland, which are currently two of the main markets driving LTE progress for the lower bands. The license consultation in the Kingdom of Saudi Arabia is also a big step in the global trend of private spectrum allocations. Most operators that have the spectrum licenses in the 400 MHz bands are still not technology neutral and require regulatory changes to be able to implement LTE. The trend is that the 400 MHz spectrum band are allocated to private networks typical Utilities, Public Safety and Transport. 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. Due to the conversion of the business model the number of operators will decrease temporarily before new allocation have been awarded. There are more than twenty networks actively investing in LTE globally.

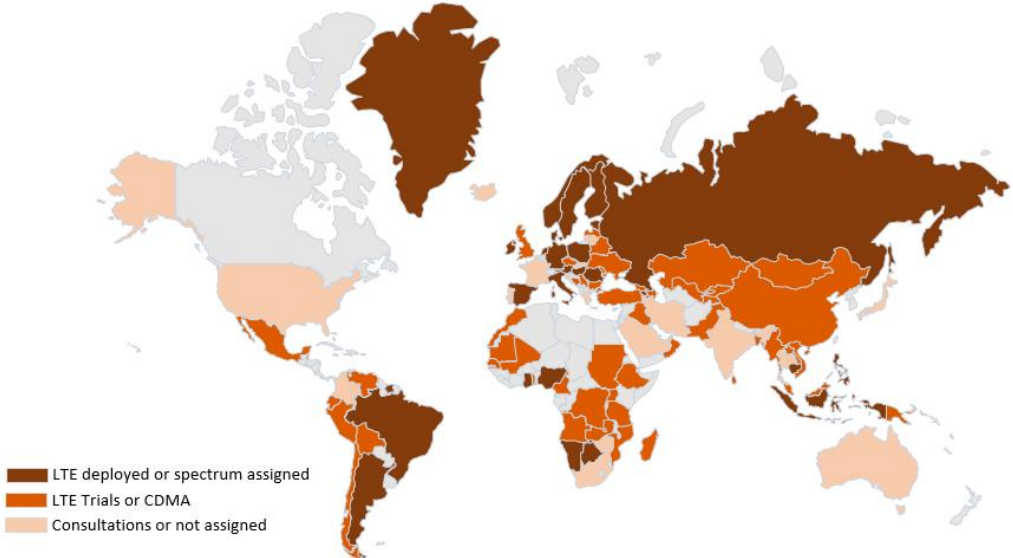


Figure 1. the world map of 380MHz, 410 MHz and 450 MHz deployment.

| Region | Deployments | LTE Deployments | Consultation | Not in use |
|------------------|-------------|-----------------|--------------|------------|
| Africa | 21 | 4 | 1 | 1 |
| Americas | 9 | 3 | 2 | 1 |
| Asia and Oceania | 18 | 2 | 5 | 5 |
| Europe | 26 | 15 | 4 | 9 |
| Total | 74 | 24 | 12 | 16 |

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

3 Spectrum of overview

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)
- Band 87 (410 MHz)
- Band 88 (410 MHz)

All bands are standardized to support LTE, LTE-M and LTE-NB (NB-IoT). Ongoing strategic work with TCCA, EUTC, UTC, UTCAL and other parties in the ecosystem are progressing to identify spectrum allocation in the 380 MHz and 470 MHz bands.

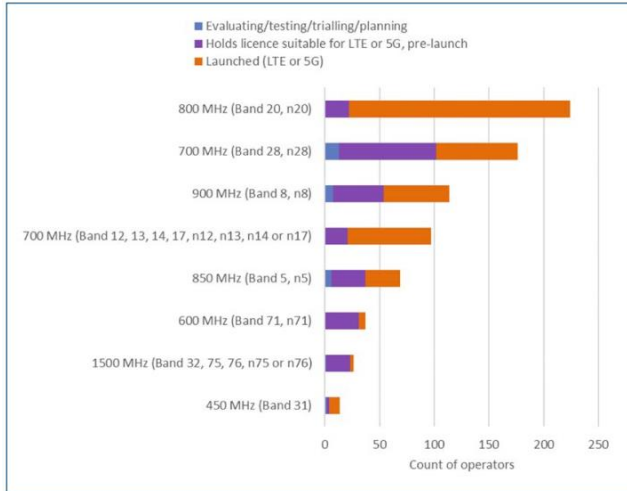
4 Device and Network market

The range of devices in the 410 MHz and 450 MHz is good in relation to the number of commercial operations and fairly limited in relation to the total global mobile industry with main volumes in different router devices. Other types of devices are meters and handhelds mobiles, these have increased in availability during the last twelve months. The router types available range from simple consumer product to advance specialized industrial routers. The handheld devices are mainly rugged and robust smartphones. Most of devices supports multiple spectrum bands. To give complete view of the ecosystem this report also includes eNB, chipset, modules and antennas for both network and devices. Modules are the enabler of many devices and the devices suppliers are to a high degree sourcing this from third parties. Currently NB-IoT and LTE-M are the dominant technologies for chipsets and modules and therefore narrowband devices, but router and handheld devices are still mainly based on Cat.4 modules.

4.1 Devices and Spectrum data from GSA (the Global mobile Suppliers Association)

The GSA report for Sub 1 GHz Spectrum for LTE and 5G lists the spectrum allocations and the number of devices in each spectrum. There are 14 operations investing in systems globally and 187 devices available according to the January 2022 report.

All networks



Private Networks

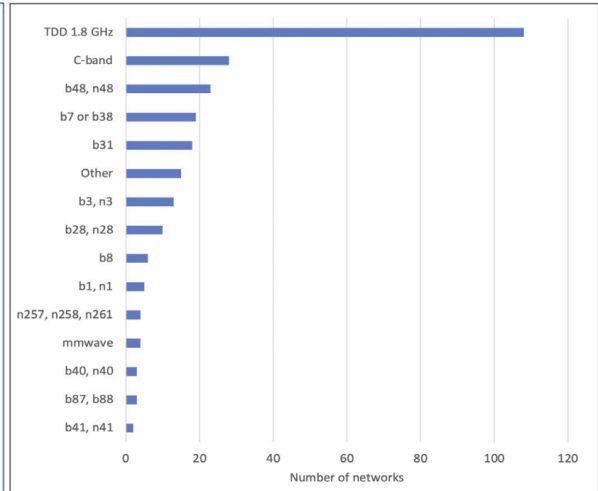


Figure 2. GSA table of Spectrum allocations in sub 1 GHz as of January 2022, for all and for private networks.

| Band | Number of devices | % phones |
|---------------------------------|-------------------|----------|
| 450 MHz (Band 31) | 187 | 0.50% |
| 600 MHz (Band 71) | 251 | 34.30% |
| 700 MHz (Bands 12, 13,14 or 17) | 4926 | 50.60% |
| 700 MHz (Band 28) | 2965 | 50.90% |
| 800 MHz (Band 20) | 7473 | 61.30% |
| 850 MHz (Band 5) | 7369 | 58.50% |
| 900 MHz (Band 8) | 7053 | 55.20% |

Table 2. GSA table of devices supporting sub 1GHz spectrum bands as of December 2020.

Modules are the key for IoT and router integrations. The number of modules available in the 400 MHz bands is high in comparison to the number of devices available, but this allows many suppliers to provide engineering samples of their product. These products have been shown to be hard to track and are often missing in the number of available devices.

| LTE Technologies | Characteristics | Devices announced |
|------------------|----------------------------------|--|
| LTE Cat-1 | Up to 10 Mbit/s; 20 MHz | 708 (304 modules, 233 industrial and other CPE/routers, 84 asset trackers, 36 vehicle OBUs, 51 others) |
| LTE-M (Cat-M1) | Up to 1 Mbit/s; 1.4 MHz | 561 (199 modules, 185 asset trackers, 95 industrial and other CPE/routers, 81 others) |
| NB-IoT (Cat-NB1) | 10s of kbit/s to 100s of kbit/s; | 456 (191 modules, 131 asset trackers, 72 industrial and other CPE/routers, 33 data loggers/IoT sensors, 29 others) |

Table 3. GSA table of modules available for IoT as of December 2022.

Source: GSA (the Global mobile Suppliers Association).

GSA have only reported Band 31. Majority of the chipsets have support for Band 72 and the devices have it as option.

4.2 410 MHz and 450 MHz devices listed by 450 MHz Alliance

The annual inventory by 450 MHz Alliance collects information from all operator and supplier with any connect to the organization. A change from last year is that only LTE devices are included, given that no new CDMA devices have been release over the last two years and that delivery status of chipsets is not clear. The categories used are:

- Handheld mobiles
- Routers and MiFi’s
- Utility meters (Electricity, gas, water...)
- Modules
- Chipset
- eNB/NR
- eNB antennas
- Device antennas
- Other (including wearables, cameras, dongles etc.)

The products and devices reported to 450 MHz Alliance can be seen in figure 3 and include both the commercially available, engineering sample availability and the devices in road map.

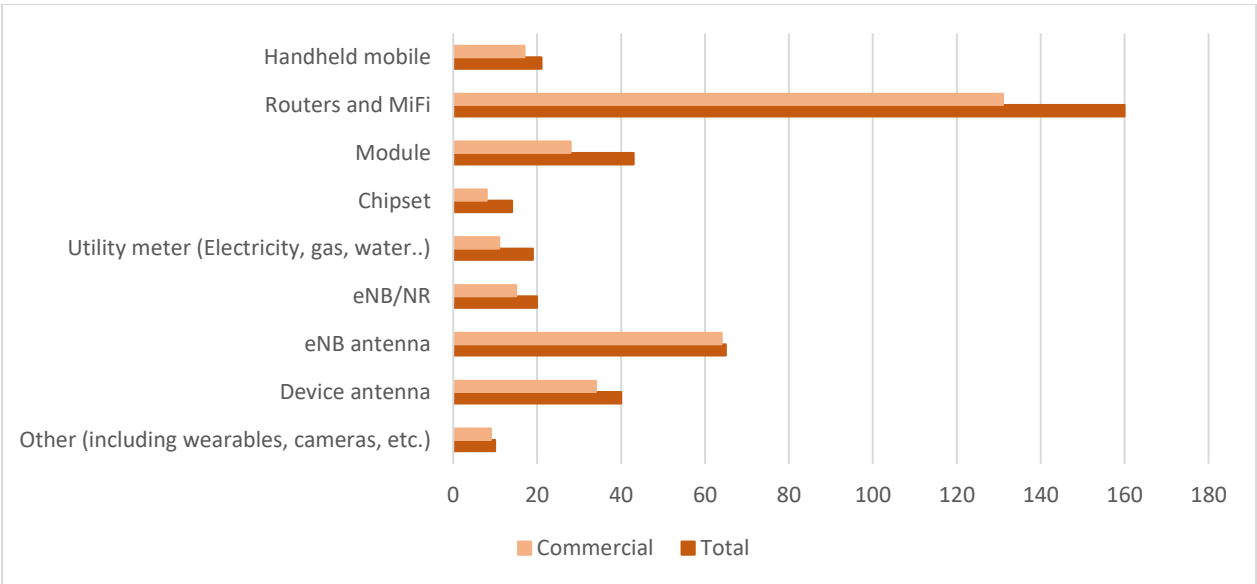


Figure 3. Global 450 MHz device status.

5 General outlook

The evolvement toward LTE of the spectrum in 380 MHz to 512 MHz is expected to increase. Bandwidth and coverage requirements for private and dedicated network as well as public network for rural communication are getting more interest and with this also an increased interest for the lower spectrum bands. With only twenty active operations 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. There is a great interest from Utilities to evolve smart grid, smart meters and smart cities, including charging poles, especially with more and more local production of energy via typical solar power and windmills.

During 2021 about two million devices were ordered and delivered globally, the main volume was utility meters. It is expected that the annual volume of connection will grow to about ten million within three years. The number of base stations delivered per year is still unclear due to that the solutions to be deployed with different antennas and areas rollout have not been communicated. It can be assumed to be in the range of thousands base station per years.

Service provided in the networks are focused on LTE-M and Cat-1 in the initial phases. It is likely that the development will follow the evolution of other networks in the world, which would be that additional capacity will be required overtime and the Cat-4 and higher categories in combination with additional spectrum in high-capacity areas. This trend is already reality in the 400 MHz networks that have been in service for more than four to five years.