



WHITE PAPER

# The 450 MHz Band Ecosystem

## Introduction

M2M communications, in which everyday objects and devices are online and able to interact with each other, have seen significant growth in recent years.

Smart meter and smart grid applications represent a massive part of current connected devices. In Europe, for example, 240 million smart meters are expected to be deployed by 2020. By that time 61% of M2M connections will come from the utility sector.<sup>1</sup>

Cellular communications in the 450 MHz band has a unique opportunity to support this growth<sup>2</sup>, due to the combination of standardized mass-market technologies and suitable spectrum for M2M applications.

This paper describes in more detail the large, competitive and long-term 450 band ecosystem for the smart grid/smart meter.

## Cellular communication technologies are the de facto solution for M2M communications and represent the largest ecosystem

Around the world, wireless cellular networks like CDMA or GPRS have become the preferred choice for M2M data connectivity due to:

- A strong foundation of applicable standards;
- The simplicity with which wireless devices can be installed and serviced;
- Economies of scale that are making both devices and connectivity ever more affordable.

In contrast to cellular, wired communications only represent 21% of M2M connections today and these are expected to decline to 7% by 2021.

It is therefore no surprise that cellular technologies and networks have become the go-to choice for companies offering M2M products and services. Regardless of geography or market segment, it is not hard to find M2M applications using cellular solutions and networks. When M2M development started fifteen years ago, M2M modems designed and sold by market leaders like Sierra Wireless, Gemalto or Telit were based on the main cellular technologies like GSM/GPRS or CDMA.

## The 450 MHz band is just another member of the cellular family with focus on M2M

The 450 MHz band is allocated and in use in many regions of the world. In Europe, for example, the band has been largely harmonized and many operators have rolled-out private or commercial networks, as shown in Figure 1.

<sup>1</sup> "M2M device connections, revenue and ARPU: worldwide forecast 2011–2021", Analysis Mason, 2012.

<sup>2</sup> The strategic, technical and financial advantages of the 450 MHz band are described in a set of documents released by the CDG, "The 450 MHz Band for the Smart Grid and Smart Metering", "Wireless Technologies for the 450 MHz band", "Economics of 450 MHz band for the Smart Grid and Smart Metering."

## FOOTPRINT 450 MHz BAND IN EUROPE



Figure 1: Footprint 450 band in Europe

CDMA technology is a natural choice to deploy in the 450 MHz band. The technology is mature and widely used ensuring stability, a sizeable ecosystem and low device cost. In the future it is expected that LTE will also play a prominent role in this band<sup>3</sup>.

Deployments in the 450 band have M2M as a common denominator:

- Private CDMA450 network for Dutch electricity and gas distribution operator Alliander, to support various smart grid and smart meter applications
- Dedicated networks being deployed for M2M applications, in particular smart grid and smart metering, like Inquam in Germany and Kapsch in Austria<sup>4</sup>
- Commercial CDMA450 operators are increasingly focussing on M2M applications, like Net1 in Sweden, Norway and Denmark.

Given this unique combination of available spectrum and available technology it is no wonder that European authorities and utilities are looking at the 450 MHz band to meet the utilities' current and future communication needs. The European Commission, for instance, is currently working with European DSOs to evaluate the need for dedicated spectrum for the utility sector. The 450 MHz band is a good candidate due to the fact that it is already harmonized within Europe and a good match with DSOs' needs as was recently stated by various utilities and associations<sup>5 6</sup>.

<sup>3</sup> For more details, see CDG paper "Wireless Technologies for the 450 MHz band."

<sup>4</sup> See [http://www.kapsch.net/kcc/Press/kcc\\_130821\\_pr](http://www.kapsch.net/kcc/Press/kcc_130821_pr).

<sup>5</sup> See [http://ec.europa.eu/information\\_society/newsroom/cf/dae/document.cfm?action=display&doc\\_id=2881](http://ec.europa.eu/information_society/newsroom/cf/dae/document.cfm?action=display&doc_id=2881).

<sup>6</sup> See "Spectrum needs for Utilities, EUTC position paper", EUTC, April 2013.

## 450 MHz cellular technologies are well positioned to guarantee a long-term ecosystem

Wireless technologies like CDMA450, or LTE in the 450 band in the future, are best positioned to guarantee a long-term ecosystem for M2M applications because of the large existing ecosystem of cellular solutions and the unique positioning of the 450 frequency band for M2M.

A number of factors are going to guarantee the availability and competitiveness of that ecosystem over the years:

### Volumes

Not only are 450 band technologies widely deployed in the world<sup>7</sup> but the number of M2M assets being connected via those networks is going to grow exponentially as those networks address the M2M market. Before 2020, the Dutch DSO Alliander will have deployed millions of meters connected with CDMA450. In terms of connected devices, this will likely exceed the number of smart phones running in Alliander's geographic area.

Those volumes will represent a major opportunity for CDMA450 hardware vendors over the years thereby ensuring long-term support of multiple vendors and further declining device cost to enhance economies of scale.

### Low effort and low risk

M2M applications and assets based on 450 MHz cellular technology are very simple to design as they:

- Use very basic M2M functionalities like connectivity, presence and data transfer—nothing compared to the complicated high-speed, high functionality world of smartphones
- Are based on mature technologies like CDMA that are proven and already widely used for M2M applications worldwide
- Require almost no fundamental innovations: M2M assets are designed to run on the same basic functionalities for years, unlike smartphones which can become old-fashioned after a few months.

Designing a 450 MHz cellular M2M asset represents, therefore, very low effort and technical risk for a vendor.

### Long lifetime and business continuity

M2M assets have very long lifetimes, for example, an average of fifteen years for a smart meter. The "window of opportunity" for vendor products is years compared to months for the high-risk business of commercial smartphone communications.

The combination of mass market, proven 450 MHz band technology and M2M market specifics guarantees volumes, low R&D effort, low risk and business continuity making the CDMA450 M2M business attractive to vendors, which ensures that users will be able to benefit from a large and competitive ecosystem for the 450 MHz band over the long run.

Other spaces like GSM-R (GSM Railway), even though they offer significantly lower business volumes, have already proven that such a combination provides a successful and long-term win-win situation to customers and suppliers over the years.

## 450 band ecosystem

The CDMA technology used in the 450 band is part of the CDMA2000® technology that serves more than 600 million users worldwide, in particular in the U.S. (Verizon, Sprint) and Asia (China Telecom). CDMA450 networks have been deployed in more than 60 countries worldwide. Accordingly, there exists a well-established ecosystem for CDMA450 network infrastructure and devices.

## 450 band network infrastructure

<sup>7</sup> See CDG, <http://www.cdg.org/worldwide/index.asp>, for more details about 450 MHz band worldwide deployments.

Figure 2 illustrates the main blocks of a typical cellular network infrastructure.

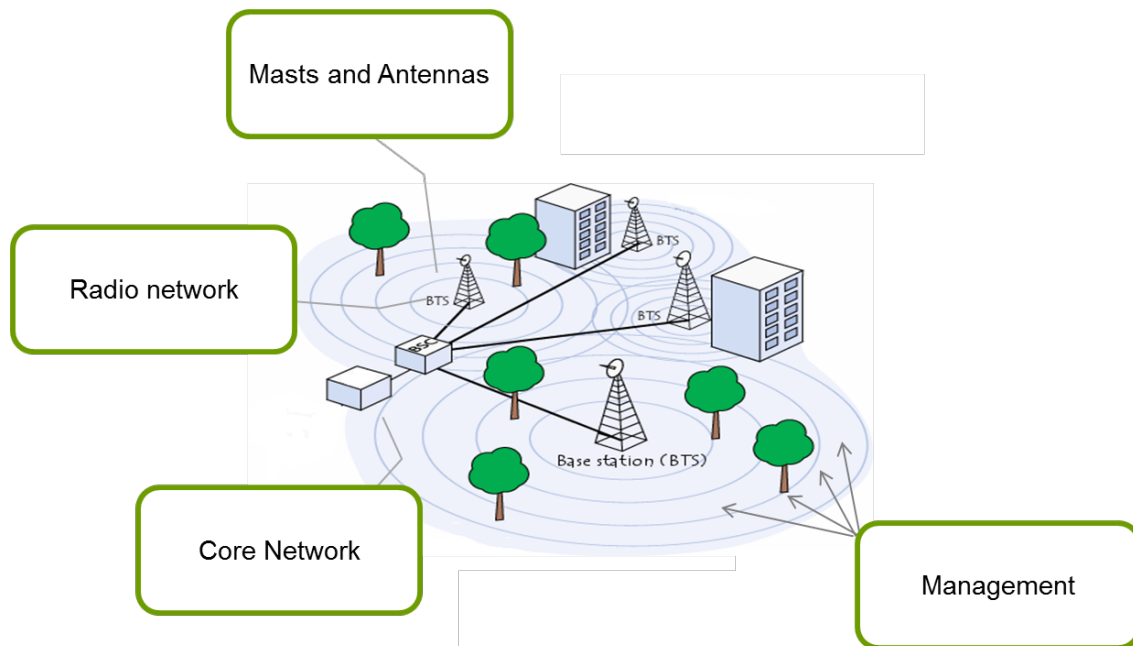


Figure 2: cellular network infrastructure

A cellular infrastructure consists of several elements which can be sourced from multiple vendors:

- The radio (access) network consists of the base station transmitting radio signals to and receiving radio signals from devices in the coverage area. Base stations consist of active radio elements (base band unit and radio head) and passive elements (antennas and cables). The base station further needs a power connection and a backhaul communication transmission to the core network which can be microwave or fixed-line.

Multiple vendors sell mature, proven 450 band radio networks: Alcatel-Lucent, Ericsson, Huawei, and ZTE .

- The base station is typically installed on a rooftop or mast on which space can be rented. Alternatively, masts can be built on owned or leased ground. The installation of a base station on a rooftop or mast usually requires certain steel works on the site to locate equipment and antennas. In each market there are many companies offering all or parts of these services.
- The core network consists of the equipment that manages the radio resources of the base stations and the IP connections of the devices. Functionalities of the core network include authentication, service control, routing of data and gateway to other networks.

Core network equipment is not spectrum/band specific, which means those IP routers or gateways can be purchased from nearly any telecom network infrastructure vendor. Most of those elements are even similar between technologies like CDMA, GPRS or LTE.

- Radio communication systems need to be managed and maintained. Management occurs centrally from a Network Operation Centre (NOC) and maintenance via an on-site field service, both of which can be provided internally or outsourced.

Management systems and interfaces are standardized and common over a wide range of cellular technologies (CDMA, GPRS, UMTS, LTE). They can be purchased from a several vendors.

## 450 band devices

Figure 3 illustrates the main components of a typical M2M cellular device.

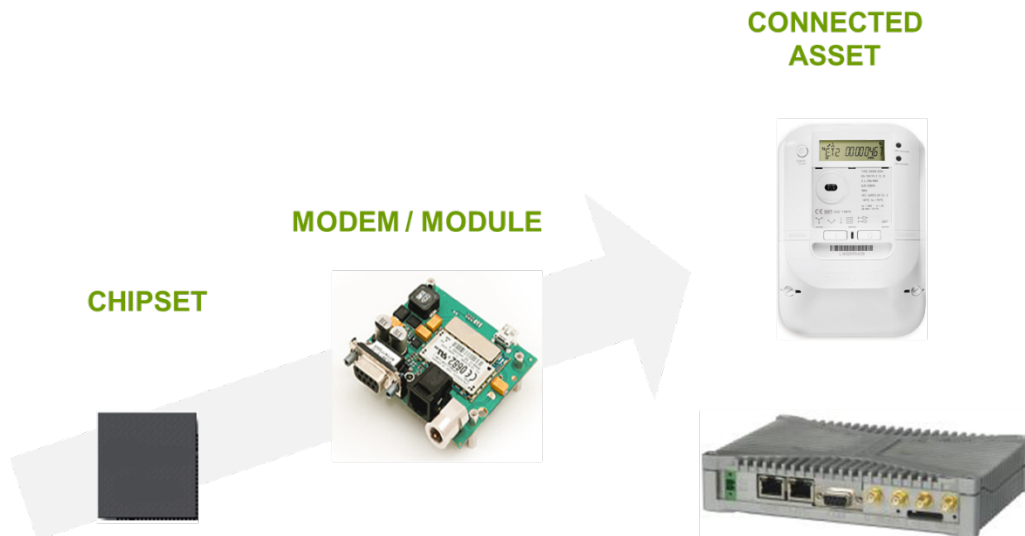


Figure 3: typical device supply chain

A cellular device consists of several components which can be sourced from multiple vendors:

- The chipset consists of miniaturized integrated circuits running core cellular functionalities, such as CDMA or LTE, and commonly referred to as CDMA or LTE chipsets. The established makers of those high technology cores for CDMA450 are Qualcomm and Via Telecom.
- The modem adds peripherals to the chipset such as a power supply, SIM card socket or antenna. A large number of vendors have the expertise to design modems based on chipsets. Already today there are multiple vendors offering CDMA450 modems and the barrier to entry for additional vendors is very low – it is mainly a question of business opportunity/volume that can be well addressed via RFI/RFQ processes.
- A connected asset is an M2M asset adding modem connectivity to its existing functionalities.

Figure 3 illustrates, for example, two typical connected assets used in the utility world:

- A smart meter which allows electricity consumption to be read through a cellular connection like CDMA450
- A smart grid cellular router connecting electrical or gas network sub-stations to a central grid monitoring system (SCADA/EMS).

Suppliers of connected assets, be it industrial routers or smart meters/gateways, typically support a large number of alternative (or even combined) access technologies to ensure that their solutions can work with whatever telecommunication solution is used by their customers. It is basically an integration and testing issue to replace an existing GPRS module with a CDMA450 module as all the main functions of the connected assets remain untouched; only the IP connection is realized via a different underlying technology. Several smart meter vendors offer the same meter with various plug and play compatible communication modems (be it Ethernet, PLC, GPRS or CDMA450).

In summary, chipset, modem and connected asset vendors involved in the cellular world usually support many cellular technologies like CDMA, GPRS, UMTS or LTE, if not all of them. The design and system integration skills involved in the technologies are similar.

Alliander, deploying a private network based on CDMA450 technology for its smart meter and smart grid needs, cited for example the fact that their smart meter supplier was able to migrate their GPRS meter to CDMA450 within six weeks.

## Conclusion

M2M systems have seen significant growth in recent years and their deployments are poised to accelerate in the coming years, due to applications like smart metering.

Wireless cellular communications, and more specifically those deployed in the 450 MHz band such as CDMA450 or LTE in the 450 band, are going to profit from this growth, due to their wide area and deep indoor coverage, ease of installation and low deployment costs, making this spectrum ideal for M2M applications.

Network infrastructure or device vendors in the 450 band will therefore benefit from the volume and economy of scale of this spectrum, which will provide a large and competitive 450 band ecosystem for years to come.

The existing ecosystem in general and in the 450 band specifically is competitive, large and flexible enough to support the long-term needs of utilities, in particular as the barriers to entry for more suppliers are low and the utilities will bring the volume for an attractive supply business.