

May 2023

Private Mobile Networks

The GSA logo is located in the bottom right corner of the page. It features the letters "GSA" in a white, serif font. To the right of the letters are three curved, orange lines that resemble a signal or a stylized wave.

GSA

Market Status Update: Key Messages in 1Q23

- GSA counts customer references as unique organisations or government entities deploying one or more 3GPP-based 4G LTE or 5G networks in a given country that are worth more than €100,000
- The total number of GSA customer references to 1Q23 is 1,148, deploying at least one network. Net additions in the quarter were 69 customer references, up from 1,077 in 4Q22
- On average, 65% of references included in this database are non-public and unique to this database, submitted by members of the GSA Private Mobile Networks Special Interest Group (SIG). This number can be higher for certain industries, with more than 80% of sectors such as military and defence, maritime and power plants not visible in the public domain
- The SIG now has nine members including Nokia, Ericsson, Huawei, Mavenir, Airspan, Keysight Technologies, OneLayer and PrivateLTEand5G.com. Please note that Huawei was not able to confirm additional references for this update
- There are 74 countries around the world that now have at least one private mobile network
- Manufacturing, education, device testing and lab-as-a-service, and oil and gas were the four sectors with the highest growth difference compared with 4Q22. Manufacturing, education and mining remain the top three sectors for customer references, although this does not represent the actual size and scale of deployments, which vary by user type
- There is typically a strong, positive correlation between the number of private mobile network references and countries with dedicated spectrum. Private mobile networks are mainly in the developed world so far, with the US, Germany, China, UK and Japan having the most references. It is sometimes reported that China has a high number of networks, reaching up to 10,000, but we believe a large portion of those networks use the public network and therefore do not meet our definition
- Full information of worldwide allocation of dedicated private network spectrum can now be found in Annex 1 of this report

Introduction

Demand for private mobile networks based on 4G LTE¹, and increasingly 5G² technologies, is being driven by the spiralling data, security, digitisation and mobility requirements of modern enterprise and government entities. Organisations of all types are combining connected systems with big data and analytics to transform operations, increase automation and efficiency or deliver new services. Wireless networking with LTE or 5G enables these transformations to take place even in the most dynamic, remote or highly secure environments, while offering the scale benefits of a technology that has already been deployed worldwide.

The arrival of LTE-Advanced systems delivered a step change in network capacity, throughput and deterministic latency. 5G networks will bring increased densities of users and devices, even greater capacity, and further improvements to latency that enable use of mobile technology for time-critical applications.

Private mobile networks are often part of a broader digital transformation programme. This could include the introduction or development of cloud networking and other digital technologies such as artificial intelligence, machine learning and data analytics. More and more applications of the private mobile network will use these capabilities combined with mobile connectivity.

¹ The set of requirements that need to be fulfilled by a 4G LTE system is defined by the IMT-Advanced specifications. 3GPP implements this in Release 8 through Release 14.

² The set of requirements that need to be fulfilled by a 5G system is defined by the IMT-2020 specifications. 3GPP implements this in Release 15 through Release 18, which is the latest release in current development.



In addition to companies looking to deploy their own private mobile network for the first time, there is a large group of potential customers that currently operate private networks based on technologies such as TETRA, P25, Digital Mobile Radio, GSM-R and Wi-Fi. Many of these customers are demanding critical broadband services that are simply not available from alternative technologies, so private mobile networks based on LTE and 5G could eventually replace much of this market.

The exact number of existing private mobile networks is hard to determine, as details are not often made public. Even trying to track the number of existing customers can also be challenging. To improve information about this market, GSA now maintains a database of customer deployments of private LTE and 5G networks worldwide.

The definition of a private mobile network used in this report is a 3GPP-based 4G LTE or 5G network intended for the sole use of private entities, such as enterprises, industries and governments. The definition includes MulteFire or Future Railway Mobile Communication System. The network must use spectrum defined in 3GPP, be generally intended for business-critical or mission-critical operational needs, and where it is possible to identify commercial value, the database only includes contracts worth more than €100,000, to filter out small demonstration network deployments.

Private mobile networks are usually not offered to the general public, although GSA's analysis does include the following: educational institutions that provide mobile broadband to student homes; private fixed wireless access networks deployed by communities for homes and businesses; city or town networks that use local licences to provide wireless services in libraries or public places (possibly offering Wi-Fi with 3GPP wireless backhaul), which are not an extension of the public network.

Non-3GPP networks such as those using Wi-Fi, TETRA, P25, WiMAX, Sigfox, LoRa and proprietary technologies are excluded from the data set. Network implementations using solely network slices from public networks or placement of virtual networking functions on a router are also excluded. Where identifiable, extensions of the public network (such as one or two extra sites deployed at a location, as opposed to dedicated private networks) are excluded. These items may be described in the press as a type of private network.

GSA has identified 74³ countries and territories where customers have deployed private networks based on LTE or 5G, with Egypt the latest addition. There are private mobile network installations in various offshore locations serving the oil and gas industries, as well as on ships.

GSA has collated information about 1,148 organisations known to be deploying LTE or 5G private mobile networks. Since the last update of this report in February 2023, some organisations have been removed from the database and this analysis, owing to a lack of evidence that they met the definition criteria. These examples may be added again in the future. References are periodically removed for a few main reasons:

- The definition has been revised by the SIG and as such the reference no longer meet the criteria
- More information about the reference has become available meaning that it no longer meets the criteria
- The trial or proof of concept has come to end, or the deployment was only temporary
- A confidential reference has been made public and therefore is removed as a confidential reference and added as a public reference
- The discovery of duplicate entries or double-counted submissions.

More than half of references included in GSA's database have been provided by companies on the basis of anonymity, and information for these private mobile network references will generally not be found in the public domain.

GSA would like to thank its Executive Members Airspan, Ericsson, Keysight Technologies, Mavenir, Nokia and OneLayer for sharing general information about their network deployments to enable this data set and report to be produced.

³ This number has increased by one since the last update. The February report has been reinstated correctly to 73 rather than 74 countries as Korea was mistakenly counted twice.



Players and Market Statistics

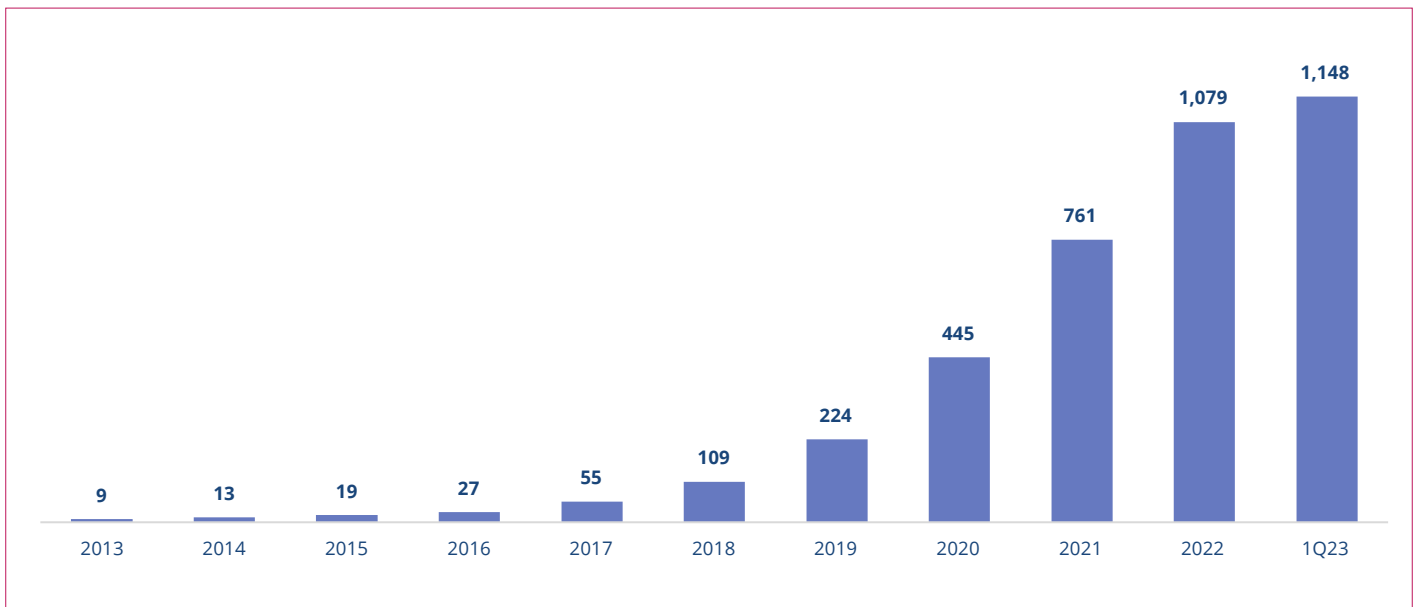
The private mobile network market is home to a wide range of service providers, including equipment and technology suppliers, mobile network operators, system integrators and the private network end users (who sometimes take responsibility for installing or operating their own infrastructure).

GSA has counted over 50 equipment vendors that have been involved in the supply of equipment for private mobile networks based on LTE or 5G. Commercial availability of pre-integrated solutions from several equipment providers increased in 2021; these solutions aim to simplify adoption of private networks, which should add market impetus. In addition, GSA has identified more than 66 telecom network operators (counting national operators within the same group as distinct entities) involved with private mobile network projects. Many other types of player, such as systems integrators, consulting firms and software core vendors are also involved to varying degrees with private mobile network projects.

Also, global-scale cloud providers, often referred to as “hyperscalers”, are offering private mobile network solutions, sometimes in partnership with mobile operators or network suppliers. Their ability to exploit mass-scale cloud infrastructure and their existing presence in commercial enterprises is likely to drive additional growth in the private mobile network market.

Our latest data shows that in 2022, 321 new private network customers categorised by GSA were announced. This number eclipsed net growth in previous years, with 2021 representing 312 announcements. It should be noted that slowdown in the number of announcements is not representative of slowing growth in market activity — rather, existing customers are continuing to scale trials to multisite deployments, and announcements will greatly vary in the size of contract value. Figure 1 shows customer announcements grew at a compound annual growth rate of 81% from 2017 to 2022.

Figure 1. Private mobile network customer references of more than €100,000, by year announced



GSA has been able to categorise 1,148 customers deploying private mobile networks, which as Figure 2 shows, were located in 74 countries around the world at the end of March 2023.

Where organisations have subsidiaries in different countries or territories deploying their own networks, each subsidiary is counted separately.

LTE is used in 853 of the catalogued customers deploying private mobile networks for which GSA has data; 5G is being deployed in 505, or 48%, of these customers (see Figure 3).

Although the proportion of 5G deployments makes up a significant number of references, it must be noted that this number skews toward long-term trials and deployments within educational and test-bed or validation facilities, with a limited number running real operation in industrial situations.

The large addition of device testing references added to this report have therefore been responsible for an increase in 5G references in the December update. With all device testing and lab-as-a-service deployments excluded from the database, 5G accounts for a lower number of 42% of references.

GSM-R, a secure voice and data communication platform specifically for the rail industry, is being deployed in 2% of these customers. Of the 357 private network customers announced since 2022, 5G was used in 53% of references.

Figure 2. Countries and territories with organisations catalogued as deploying private mobile networks

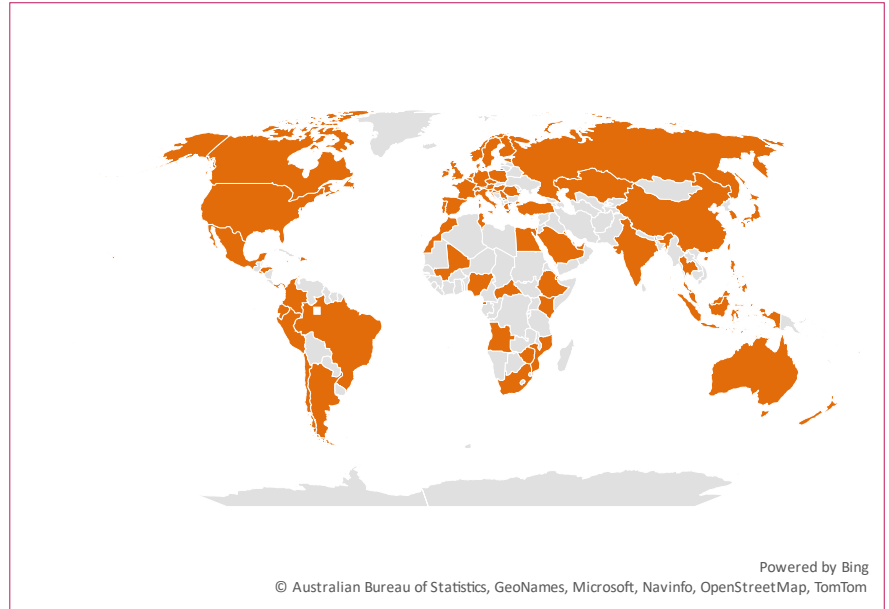
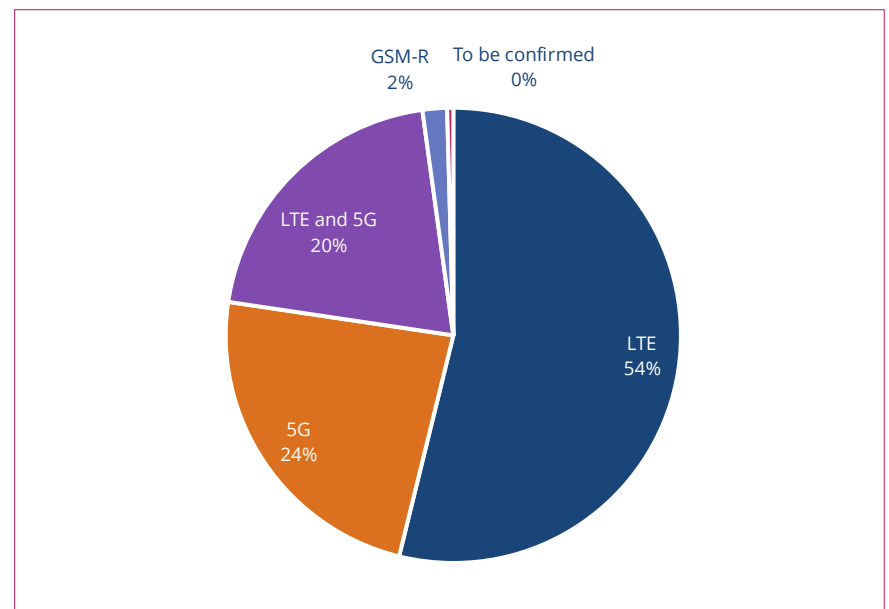


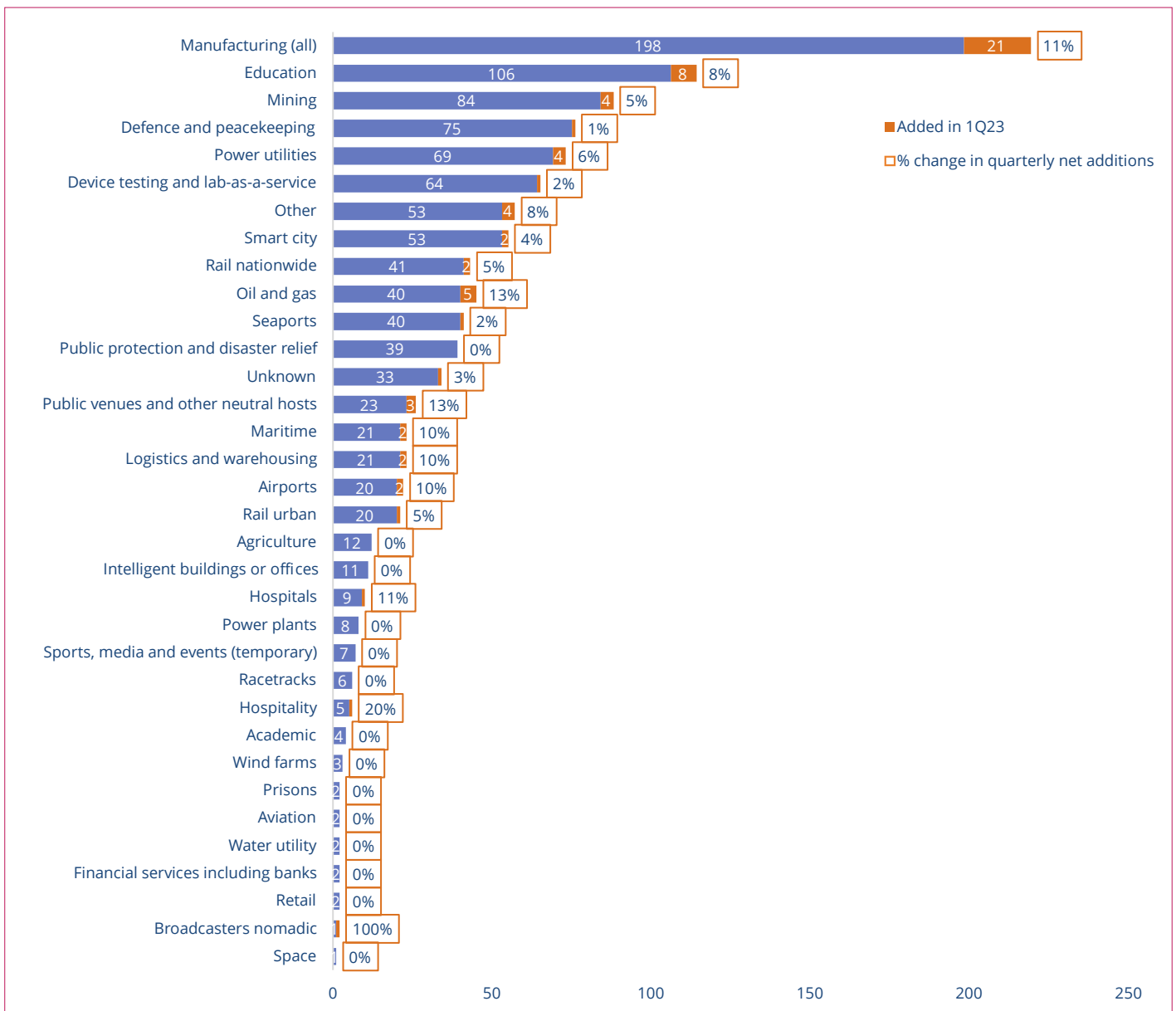
Figure 3. Private mobile network customers by technology used (base: 1,148 catalogued customers deploying private wireless networks with revenue greater than €100,000)





As we build our database, GSA's data suggests that the manufacturing sector is a strong adopter of private mobile networks in terms of the number of customer deployments, with 219 identified companies, up from 129 at the end of 2021. The education sector is the second most-common group, with 114 customers deploying private networks, followed by mining companies (88) and defence and peacekeeping (76). Power utility companies (73) and device testing and lab-as-a-service (69) round out the top five (see Figure 4).

Figure 4. Number of identified customers deploying private mobile networks in trials and commercially, by sector (base: 1,148 organisations deploying private wireless networks with revenue greater than €100,000)



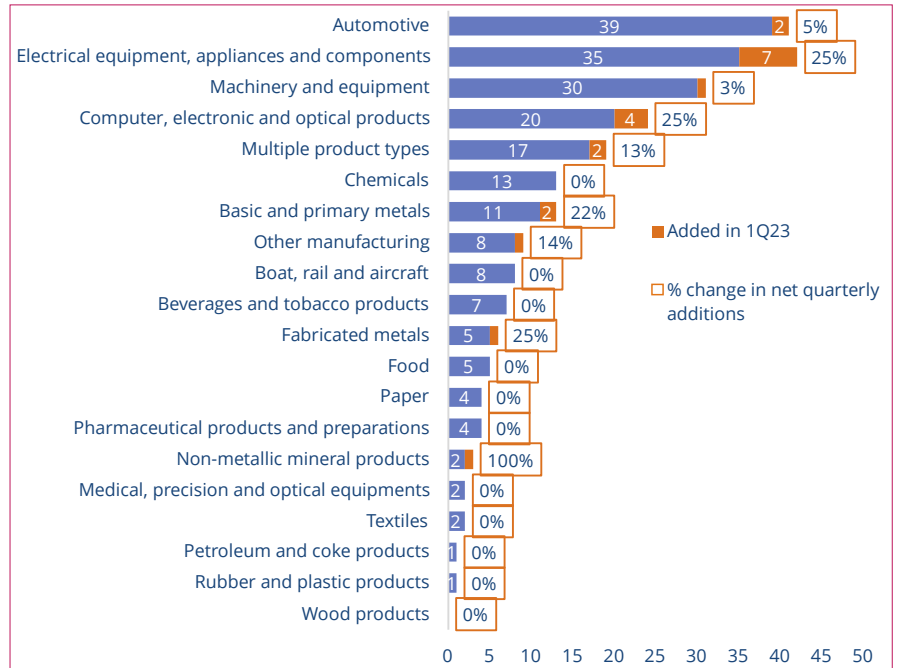


Breakouts of the manufacturing sector, separated into process and discrete with further subcategories, can be found in Figure 5.

Our data shows there are 150 discrete manufacturing customers deploying private networks, compared with 60 process manufacturing, with an additional nine to be confirmed. Of the subcategories, electrical equipment, appliances and components automotive has leapfrogged automotive with the most customer deployments, followed by machinery and equipment, and then computer, electronic and optical equipment.

When viewing these insights, readers should bear in mind that although the data gives an indication of the number of customers deploying private wireless networks, it does not provide a view of the market value of each segment nor a total number of networks deployed.

Figure 5. Number of manufacturing customers deploying private mobile networks in trials and commercially by subcategory where identified (base: 214 organisations deploying private wireless networks with revenue greater than €100,000)



For example, in some market segments, such as utilities or public protection and disaster relief, a customer deployment could represent a nationwide network deployment, equivalent in value to many hundreds or potentially thousands of campus-style private networks.

Figure 6 shows the change in user types over time and the growth of manufacturing and education in the past five years.

Figure 6. Total private mobile network customers by user type per year

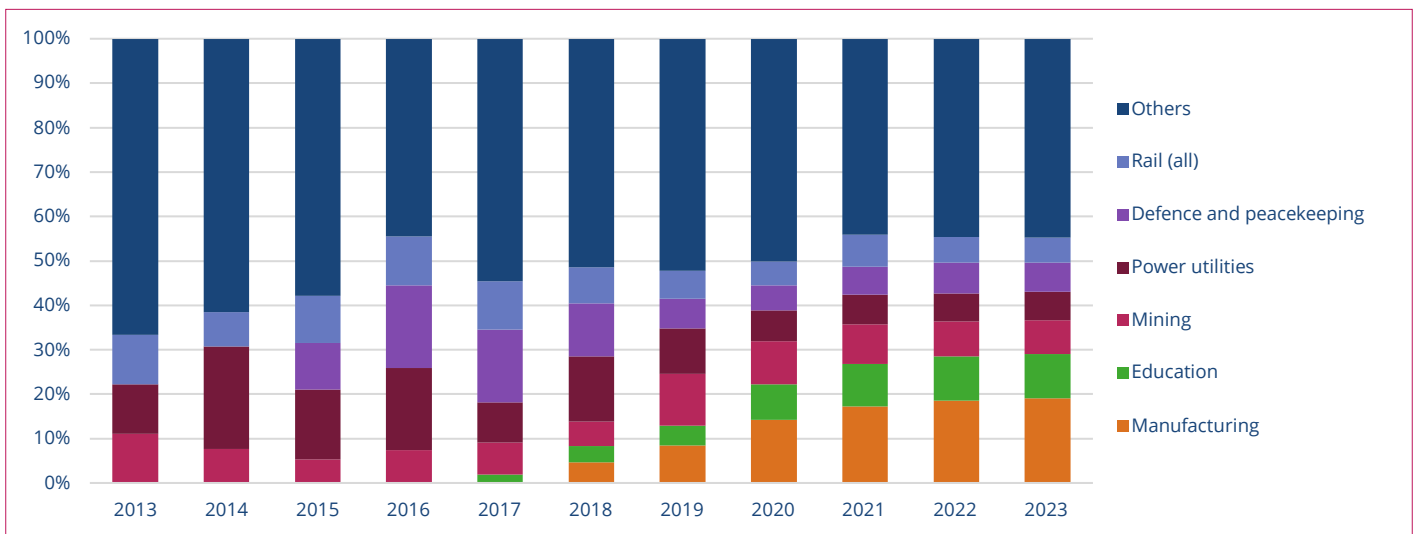
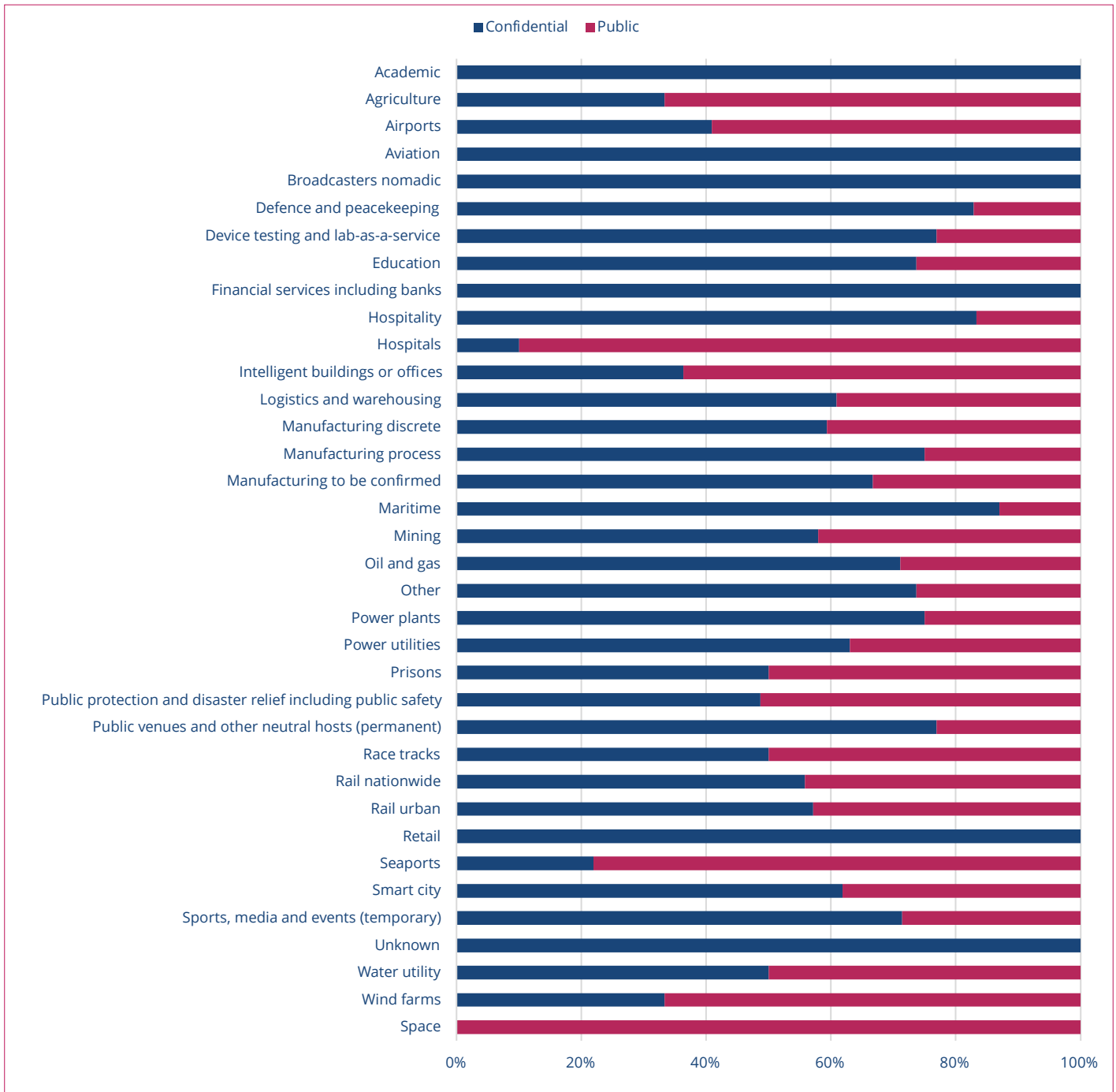




Figure 7 shows customer references by sector, split by those that can be found publicly and those that are confidential as submitted by members of the SIG. Please note that 65% of references included are non-public and some sectors have no public networks at all.

Figure 7. Private mobile network customers by sector, split by confidential and public





GSA also tracks the spectrum bands being used for customer deployments assigned specifically for local or private network purposes.

Figure 8 shows that, including known spectrum assignments and customer deployments, C-band spectrum is the most widely assigned.

After that comes CBRS spectrum (also technically within the C-band, but split out owing to the unusual way it has been assigned in the US).

Telecom regulators are also showing signs of making increased allocations of dedicated spectrum available for private mobile networks — typically small tranches in specified locations. This could be acquired directly by organisations instead of by mobile operators, giving industries an alternative deployment model.

Figure 9 provides a breakdown of customer deployments by region.

Figure 8. Spectrum bands used for private mobile networks; number of customer deployments identified using each band (base: 239 organisations)

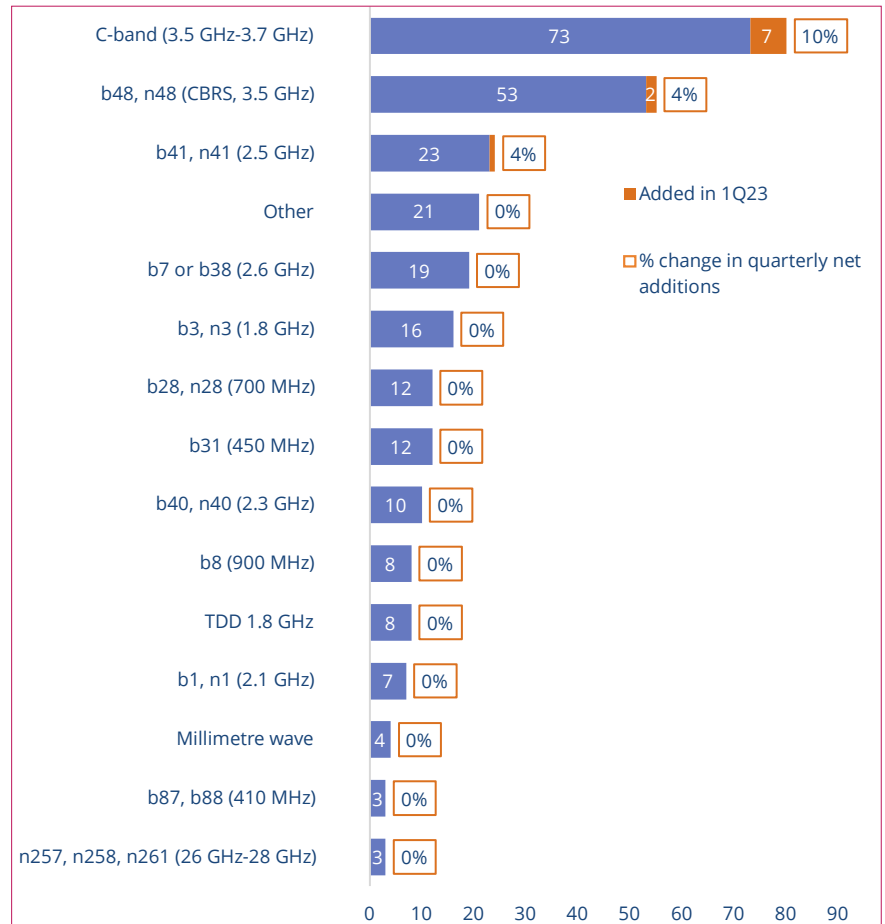
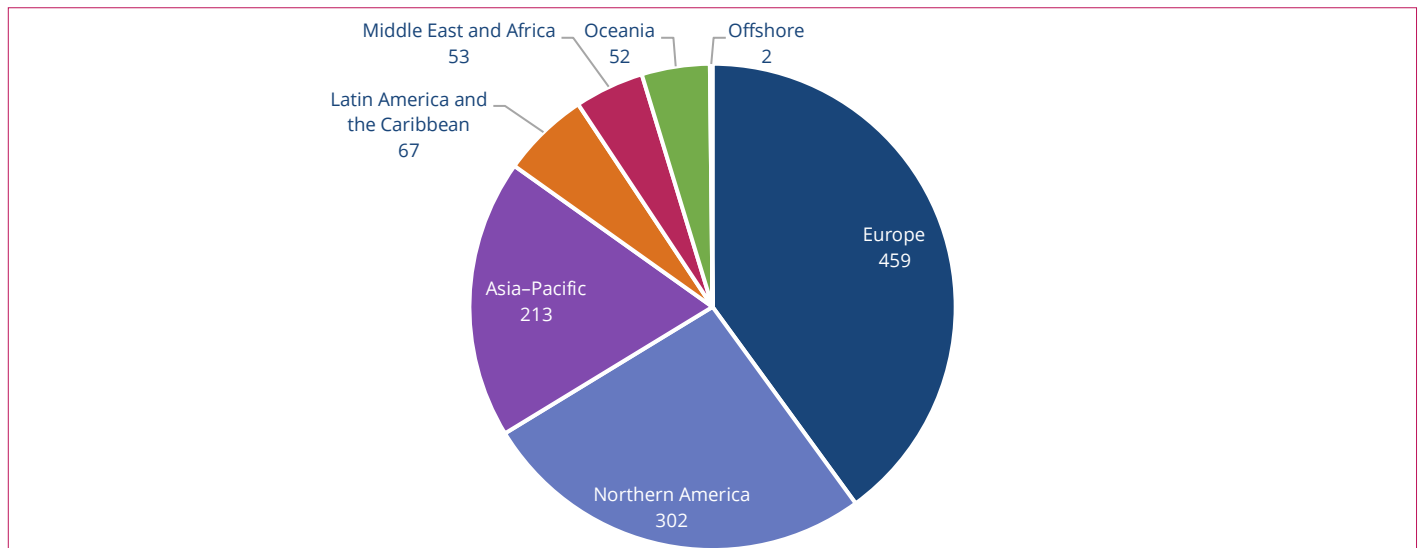


Figure 9. Customer references of private mobile networks, by region (base: 1,148 catalogued customers deploying private wireless networks with revenue greater than €100,000)





Dedicated spectrum of this sort has already been allocated in France, the US, Germany, the UK and India, which recently stated it would reserve part of its next-generation telecom spectrum for private networks. There is typically a strong, positive correlation between the number of private network references and countries with dedicated spectrum. GSA expects this trend to be followed in other countries in 2023.

Although the US does have dedicated spectrum for private mobile networks through the CBRS band PAL and GAA licensees must accept priority for incumbent access users (US department of defence and Naval radar systems) along exclusion zones that cover much of the US coastline. Note that owing to the removal of projects not meeting the new size requirement of at least €100,000, the counts are not directly comparable with those in the previous issue, although the patterns are the same.

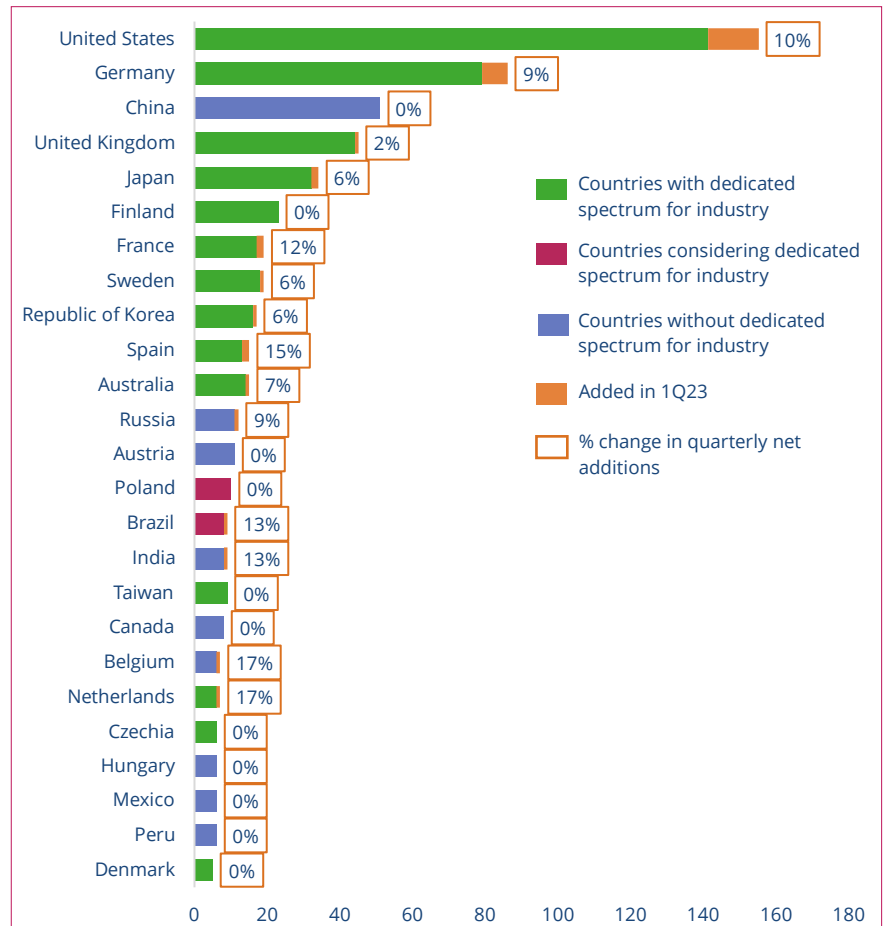
Figure 10 shows the total number of LTE or 5G customer deployments by country. The US currently has the most customers at 155, and Germany (86), China (51), the UK (45) and Japan (34) round out the top five.

It is widely reported that China has a higher number of deployments than those seen here, with various large numbers being quoted, but we believe a large portion of those networks are using the public network and therefore do not meet our definition. Although Germany ranks second-highest by number of customer references, many of these deployments are still in trial and test-bed stage rather than full commercial deployments. Nine of the top 10 countries have dedicated spectrum for industry, with Spain and Norway the latest countries to allocate dedicated spectrum of this sort.

For more detailed information, please refer to Annex 1, which presents all the countries that have dedicated locally licensed or leased spectrum for private enterprise networks. Please note that this table may be updated less regularly than every quarter.

A global overview of the allocation of spectrum for private mobile networks is provided in Annex 2.

Figure 10. Number of private network customers by country (base: 648 organisations deploying private wireless networks with revenue greater than €100,000, where country has been identified)



Summary

A large number and a wide range of market participants are actively engaged in developing and delivering solutions for private mobile networks. With so much opportunity, and so many regulators planning initiatives to make spectrum available for LTE and 5G private usage, we expect significant market developments over the next couple of years. GSA will be publishing further statistical updates covering the private mobile sector during 2023.

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The GSA research team is constantly following market dynamics and activity to ensure the latest data is available to GSA users via the GSA website.

Data is updated monthly and quarterly and can be referenced by users who register for free on the GSA website.

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