Translation

# The Federal Government's Mobile Communications Strategy

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# The Mobile Communications Strategy – measures taken by the Federal Government to pave the way for nationwide and forward-looking mobile communications coverage

We need future-proof and nationwide mobile communications coverage so that all regions, households and businesses alike can enjoy the benefits of the digital revolution – not only in the major conurbations but also, in particular, in rural areas.

Seamless mobile voice and data communications coverage is long overdue. Dead spots will soon be a thing of the past.

- An important step is our agreement with the mobile network operators. For example, 4G will already be available in 99 % of households by the end of 2020.
- With the Federal Network Agency's coverage obligations imposed by the 5G spectrum awards, we will ensure 5G connectivity on motorways and federal highways.
- The requirements will also ensure mobile communications coverage on all regional and federal state roads as well as on major waterways and the entire rail network.
- Network coverage for members of the public is also dependent on the network operator they use. Sometimes they think there is a dead spot where there is actually coverage. The requirements will create incentives for the collaborative rollout of networks, including in sparsely populated areas. The mobile network operators have already announced that they will jointly develop and use up to 6,000 new mobile communications sites to eliminate dead spots in sparsely populated areas and along transport routes. This will significantly improve coverage across all networks.

With these measures alone, 99.7 percent of households and 95 percent of the federal territory will be covered by mobile communications services across all networks by the end of 2024 at the latest. This is a big step towards nationwide coverage and will lay the foundations for the 5G network of the future. The "5G super network" will not be available on an area-wide basis overnight, but will be gradually developed. However, where there is already a 4G network, it can quickly be upgraded to 5G.

We have already achieved quite a lot. But we will not stop there. We want to achieve a convergence of living conditions. The first objective of this Mobile Communications Strategy is to deliver coverage to households that are not likely to be served without public intervention. For universal door-to-door mobile communications coverage, we also need to include district and municipal roads.

We will therefore support the development of up to 5,000 mobile communications sites as part of the gigabit rollout with around 1.1 billion euros from the special fund Digital Infrastructure, which will also cover the provision of services on district and municipal roads. In addition, we have agreed that the Federal Government will establish a mobile communications infrastructure company to actively speed up and support the rollout of mobile communications networks. The mobile communications infrastructure company (MIG) will be established as soon as the conditions laid down in section 65 of the Federal Budget Code have been met and the qualified spending freeze on the funds has been lifted by the Bundestag.

- We will create transparency actual coverage situation and this will be visible to the public and will constantly monitor the progress of the rollout.
- We will relieve the pressure on local authorities and ensure that the rollout happens in an effective and economical manner.
- We will identify infrastructures that can be provided by the Federal Government (for instance conduits on roads or waterways).
- Together with the federal states and the local authorities, we will identify scope for acceleration from a practical point of view, for instance with regard to approval procedures or building law.
- We will support the exploitation of acceleration potential by the federal states, for instance by creating a single contact point for mayors, members of parliament, district commissioners, to help to specifically solve problems at the local level.

With these measures, we will achieve coverage of at least 97.5 percent of the territory of Germany and 99.95 percent of households. Given limited resources, we have to decide where to start. Deployment must first take place where the public requires coverage in order to be able to talk to one another on the phone – including in rural areas. We will also ensure coverage through appropriate technologies for the remaining, particularly remote areas with households that can currently only be connected with great effort and at a very high cost. We will also examine how to ensure an emergency response function in emergency situations, including in remote nature reserves, with complementary technologies.

To enable the agricultural and forestry sectors to take advantage of modern technologies, we will provide a high-performance spectrum (3.7-3.8 GHz) for their own, local networks at very low cost. In order to make it possible to deploy such networks tailored to the specific needs of farmers and thus leverage the potential for innovation inherent in digital agriculture, we will support the establishment of such networks with a funding programme.

The protection of the general public and the environment with regard to electromagnetic fields is a valuable asset and will continually be ensured. The Federal Government will also ensure the existing level of protection as 5G is rolled out. We will intensify concomitant research into human and environmental impacts and the trialling of 5G applications.

Better mobile network coverage cannot be achieved by the Federal Government alone. This is a responsibility that we jointly shoulder – the Federal Government and the private sector. On the part of the Federal Government, this can only be achieved if the federal states and local authorities also play their part. This applies in particular to speeding up of approval procedures which, at present, often take too long, thus delaying the deployment of the network. Only by acting in concert, we will achieve our goal: future-proof and nationwide mobile communications coverage in Germany.

# Chapter 1: The mobile communications market in Germany

# A. Mobile communications as a key technology

Germany needs a mobile communications infrastructure that supports the digital transformation of the economy and society on a sustained basis and makes Germany a more attractive place to do business. The aim of the Federal Government's Mobile Communications Strategy is to make Germany an international frontrunner in the field of mobile communications on the basis of universal LTE coverage<sup>1</sup>. In doing so, Germany will also create an important prerequisite for the speedy rollout of 5G and, in turn, to further consolidate its global pioneering role in the fields of "Industry 4.0" and "Digital Farming", among others.

Not even the Internet became as widespread in such a short time after its market launch as did digital, cellular mobile communications. Within the first 15 years, it attracted more than two billion customers worldwide<sup>2</sup>. Today, 28 years after the introduction of digital, cellular mobile communications, there are 7.9 billion mobile subscriptions, of which 6 billion are for broadband services<sup>3</sup>. According to figures provided by the Federal Network Agency, there were 137 million SIM cards in Germany at the end of 2018 (statistically 1.7 SIM cards per inhabitant)<sup>4</sup>. It is impossible to imagine the everyday lives of the public without mobile communications. On the contrary: The capabilities of mobile communications technology are developing at such a rapid pace that mobile communications have become a key technology of the digital transformation of the economy and society.

The introduction of the 5th generation of mobile communications (5G) will not only make higher-quality mass market applications possible. The focus will now be primarily on industrial sectors. 5G will be the backbone of industrial connectivity, intelligent networking or the implementation of real time applications. 5G has the potential to become a catalyst of productivity enhancements in areas such as intelligent mobility, Industry 4.0, smart grid, smart logistics, eHealth and smart farming.

The worldwide race to introduce and use 5G has already started, and Germany is one of the frontrunners. The Federal Network Agency has made available to the market at an early stage the frequencies in the 3.6 GHz band, which were earmarked as a pioneer band for 5G. The Federal Government expects competition between networks and services to intensify further as a result of the great opportunities associated with 5G and that there will thus be more incentives to systematically progress network deployment and the development of 5G-based business models. Some operators have already begun the commercial rollout of 5G.

<sup>&</sup>lt;sup>1</sup> The Mobile Communications Strategy covers exclusively public mobile communications.

**<sup>2</sup>** Masanet, et al., Exploring Environmental Applications and Benefits of Information and Communication Technology, Journal of Industrial Ecology 2010, pp. 687-691.

<sup>&</sup>lt;sup>3</sup> Ericsson Mobility Report, June 2019, p. 4 ff..

<sup>&</sup>lt;sup>4</sup> Federal Network Agency, Annual Report *2018*, p. 56.

To cater for the specific requirements of individual user groups, the Federal Network Agency will make available additional frequencies for local 5G applications in the 26 GHz and 3.7-3.8 GHz frequency bands. The frequencies for local applications will provide industry or agriculture, for instance, with the opportunity to deploy user-oriented 5G themselves or to have them established, independently of the deployment of the public mobile communications networks. In addition, the establishment of state-funded 5G pilot regions is designed to develop, trial and demonstrate the technological potential inherent in 5G.

In the case of 5G deployment, however, it is not only the radio resources that should be considered. The transition to high-speed mobile communications networks will confront the market players in the telecommunications industry with new challenges of a technological, economic and organizational nature. Network operators will have to make significant investments. Providing a nationwide coverage with the 5G technology, requires a significantly higher number of stationary transmitters than the current mobile communications infrastructure. In addition, an indispensable prerequisite for high-capacity 5G networks is that the transmitter sites are connected to fibre optic. Every metre of fibre optic cable that is installed, especially for fixed-line broadband connections, also contributes to an improvement of the mobile communications infrastructure. To complement deployment by the private sector, the Federal Government's Funding Programme for Fixed Broadband will ensure that there is a rollout and corresponding densification of fibre optic infrastructures, especially in rural areas. Within the concept on technical conditions in this funding programme, it is already possible today, in suitable cases and to a limited extent, to connect mobile communications sites with fibre optic or move them closer to fibre optic infrastructures. In the last parliamentary term alone, projects were launched that involved the installation of 320,000 km of fibre optic cable.

To enable mobile communications to completely exhaust their potential as a key technology of the digital transformation, all resources must be pooled for continuing network deployment. The objective is universal LTE mobile communications coverage that lays the foundations for Germany continuing to enjoy a leading position in 5G in the years ahead.

# B. Objective of the Mobile Communications Strategy: speedy nationwide coverage

Implementation of the Mobile Communications Strategy is to result in the speedy establishment of nationwide mobile voice and data services coverage (LTE/4G). There is also a need for high momentum in the rollout of 5G – including in rural areas.

The experiences of the general public and businesses show that in Germany, primarily in rural regions and especially along the transport routes, there is still some catching up to be done and improvements are urgently required.

As we move towards establishing a convergence of living conditions, access to high-speed Internet and high-capacity mobile communications is of elementary importance. High-speed broadband is vital for businesses and public institutions and is a major factor influencing the competitiveness of Germany in the global economy. Thus, the provision of broadband and mobile communications infrastructure is a prerequisite for political, social and economic inclusion in all spheres of life. In the "Convergence of Living Conditions" Commission, the Federal Government, federal states and local authorities have, for this reason, agreed that they – together with the mobile communications companies – want to reach a common understanding of what "nationwide" coverage actually means. Accordingly, technical/physical, legal, economic and topographic aspects are to be addressed, as is the great importance of nationwide mobile coverage for the convergence of living conditions.

This is where the Federal Government's Mobile Communications Strategy comes in. The objective is to make Germany an international frontrunner in mobile communications. The individual measures are to be interlinked in such a way that their combination makes it possible for mobile voice and data services to be used across the country. At the same time, this will also lay the foundations for the rollout of the 5G network.

The objective is for the public to be provided with mobile communications in the very places where they are often to be found and where they rely on mobile communications. Mobile surfing and calling is to be possible everywhere – in households and businesses, on roads, railway lines, waterways and at tourist attractions as well as on land used for agricultural purposes. With the measures set out in this strategy, we will achieve coverage of at least 97.5 percent of the territory of Germany. However, nationwide coverage does not mean that all white spots far from transport routes or built-up areas, however small they may be, have to be removed. Network deployment, including in rural areas, is to take place first where the public and businesses require it urgently and where they perceive this urgency. For this reason, the prime focus of our measures is on providing areas covered by households – here, we will achieve 99.95 percent coverage with the measures. At the same time, we must also provide coverage on the district and municipal roads in order to ensure door-to-door mobile connections.

Matters relating to mobile communications operated by the authorities and organizations with security and safety tasks and the Federal Armed Forces are not the subject of this strategy and should be addressed separately.

To bring about a rapid and tangible improvement in coverage in settlements and areas not yet covered, it is necessary to expedite the rollout of mobile communications and to remove obstacles to rollout and gaps in coverage. Following the Federal Network Agency's spectrum auction with its ambitious coverage obligations and the deployment drive recently agreed contractually by the mobile network operators with the Federal Government, the strategy completes the Federal Government's action plan for a rapid improvement in mobile communications coverage in Germany.

The Federal Government will review the development in mobile communications coverage and the measures set out in this strategy at regular intervals to check whether they are being implemented and whether they are effective in improving mobile communications coverage. If necessary, the Federal Government will, on the basis of these reviews, adapt the measures it has taken so far and take any further measures that may be required. This also means that the Federal Government will, as a next step, consider commissioning itself the deployment of passive mobile communications infrastructure such as mobile communications masts if neither commercial deployment nor deployment supported by funding instruments have achieved the Federal Government's targets.

# C. Analysis of the situation: mobile communications coverage, demand and obstacles to network deployment

Mobile communications coverage in Germany currently does not meet the expectations of businesses and society, which have grown continuously. In addition to gaps in coverage, frequent dropped calls spoil the users' experience. The shortcomings are to be remedied as quickly as possible.

# C.1 Status quo: status of deployment and obstacles to network deployment

The deployment of the mobile communications networks is influenced by the business strategies of the mobile network operators, by coverage obligations and the intensity of cooperation between the operators plus, of late, also by mobile communications funding programmes launched by the federal states<sup>5</sup>.

The status of deployment of the three incumbent mobile network operators is currently very different, since the deployment activities vary depending on the different business models of the companies. According to a study conducted by the Federal Network Agency (as of 2019), it is true that an estimated 98.8 percent of households are currently provided with LTE by at least one mobile network operator and can use mobile data services. However, this does not mean that every mobile network operator has already reached the threshold of 98 percent of households stipulated for the end of 2019 in the 2015 coverage obligations. In the years ahead, with the implementation of the coverage obligations from the 2015 and 2019 auctions, there will be a further increase in the number of households and areas covered by at least one mobile network operator.

According to the calculations in the study published by the Federal Ministry of Transport and Digital Infrastructure, the geographical coverage of LTE provided by the three incumbent mobile network operators is currently between 69 and 90 percent. In total, the LTE geographical coverage across all three incumbent mobile network operators is currently over 90 percent.

**<sup>5</sup>** There is currently a funding programme in Bavaria; further funding programmes are at the planning stage (Hesse, Brandenburg).



Figure 1: Mobile communications coverage in Germany – geographical<sup>6</sup>

<sup>6</sup> WIK-Consult/P3 Communication, Mobile Communications Cost and Coverage Study, commissioned by the Federal Ministry of Transport and Digital Infrastructure, 2019.



Figure 2: Combined mobile communications coverage, early 2019<sup>7</sup>

<sup>7</sup> WIK-Consult/P3 Communication, Mobile Communications Cost and Coverage Study, commissioned by the

## Measures taken so far to improve mobile communications coverage

The rollout of the German mobile communications networks is currently determined to a large extent by the Federal Network Agency's coverage obligations from 2015 and 2019 and by the pledges given by mobile network operators at the 2018 Mobile Communications Summit, which were made binding by the agreement of 5 September 2019.

Under the coverage obligation imposed by the 2015 spectrum auction, each of the three incumbent mobile network operators must ensure nationwide broadband coverage for the population using mobile communications-based transmission technologies that achieve a transfer rate of at least 50Mbit/s per antenna sector in the downlink. This is designed to ensure that, as a rule, transfer rates of 10 Mbit/s and more in the downlink are available per subscriber. By 1 January 2020, every frequency assignment holder must achieve coverage at the specified data transfer rate for 98 percent of households nationwide (at least 97 percent of households in each federal state). At the same time, the federal motorways and ICE (high-speed train) lines must have coverage of the same quality.

With the 2019 spectrum auction, the coverage obligations were widened. For the first time, they establish requirements for regional roads and the entire rail network, seaports and the core waterway network. Specifically, the following coverage obligations are to be met:

- (1) by the end of 2022, at least 98 % of households in each federal state to have at least 100 Mbit/s;
- (2) by the end of 2022, all federal motorways to have at least 100 Mbit/s and a maximum latency of 10 milliseconds (ms);
- (3) by the end of 2022, all federal highways of link function levels 0/1 to have at least 100 Mbit/s and a maximum latency of 10 ms;
- (4) by the end of 2024, all other federal highways to have at least 100 Mbit/s and a maximum latency of 10 ms;
- (5) by the end of 2024, all regional and federal state roads to have at least 50 Mbit/s;
- (6) by the end of 2024, all seaports as well as the core inland-waterway network to have at least 50 Mbit/s;
- (7) by the end of 2022, all railway lines carrying more than 2,000 passengers per day to have at least 100 Mbit/s;
- (8) by the end of 2024, all other railway lines to have at least 50 Mbit/s;
- (9) put into operation 1,000 "5G base stations" and 500 base stations with at least 100 Mbit/s in "white spots" by the end of 2022.

In addition to the coverage obligations imposed by the Federal Network Agency, the three incumbent mobile network operators undertook, in an agreement signed on 5 September 2019 as a follow-up to the 2018 Mobile Communications Summit, to provide mobile communications coverage to 99 percent of households nationwide by the end of 2020 and to 99 percent of households in each federal state by the end of 2021. Within the scope of the

Federal Ministry of Transport and Digital Infrastructure, 2019.

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associated deployment drive, the operators will join forces to deploy or upgrade at least 100 new 4G sites at traffic hotspots where there has so far been no coverage - and at least 1,000 new 4G sites in white spots. In addition, they want to deploy at least 10,000 new 4G sites or upgrade existing ones in areas away from the white spots. Newcomer Drillisch Netz AG has also contractually undertaken to invest all the money it saves from reduced interest rates enjoyed as a result of Federal Government's facilities for payment in the deployment of mobile communications masts in areas that have so far no coverage. As a result, it is likely that at least 400 mobile communications sites will be established in white spots. The pledges given by all four mobile network operators mean that a total of at least 1,400 new 4G sites will have been established by the end of 2021. In return, the Federal Government will allow network operators to spread the payment of the liabilities from the 2019 spectrum auction by paying in annual instalments over the period to 2030. These agreements have fleshed out the pledges given by the incumbent mobile network operators at the 2018 Mobile Communications Summit.

In the years ahead, the deployment activities involved with this will result in a significant improvement in mobile communications coverage, especially in rural areas, thereby providing large sections of the territory of Germany with coverage. Gaps in coverage that continue to exist despite this deployment drive are to be removed with state subsidy. The basis for this is a recent study<sup>8</sup> commissioned by the Federal Ministry of Transport and Digital Infrastructure which, alongside an analysis of the current coverage situation, also forecasts the network deployment that is likely over the years ahead. According to forecasts by the mobile network operators and on the basis of the findings of the study, meeting the coverage obligations from the 2019 auction will result in around 95 percent of the territory and 99.7 percent of households having LTE coverage by the end of 2024.

<sup>8</sup> WIK-Consult/P3 Communication, Mobile Communications Cost and Coverage Study, commissioned by the Federal Ministry of Transport and Digital Infrastructure, 2019.



Figure 3: Forecast of combined mobile communications coverage after the coverage obligations have been met and location of the remaining white spots plus their relevance on the basis of the number of households

## Use-based requirements to be met by mobile communications services

To be able to estimate the requirements to be met by mobile communications networks, the Federal Government has acquired an overview of the data volumes required by the major services used today. With 5 Mbit/s, consumers can use services such as video applications, streaming, web browsing and messenger without restrictions. Here, it becomes clear that video-based services, which account for around 60 percent of the mobile data volume, require high-capacity mobile communications infrastructure. This is also illustrated by the following table:

Services	Average 4G upload traffic (kbytes)	Average 4G download traffic (kbytes)
Web browsing	358.4	593.92
Navigation	184.32	440.32
Cloud upload (upload a picture (size = 2.5 MB))	2,580.48	92.16
Cloud download (download a picture (size = 2.5 MB))	102.4	2,641.92
Video play (length = 60 s, size = 5 MB)	194.56	5,089.28
AR (augmented reality)	20.48	163.84
VR video (virtual reality video, length = 65 s, size = 58 MB)	389.12	61,440
Send voice message (length = 10 s)	18.37	2.63
Receive voice message	3	26
Send picture message (size = 2.67 MB)	2,810	132
Receive picture message (size = 2.67 MB)	43	2,793
Audio chat (60 s)	358.4	307.2
Video chat (60 s)	4,321.28	5,514.24

Table 1: Average transmission capacity for individual mobile communications services<sup>9</sup>

**<sup>9</sup>** Ming Yan et al., Modeling the Total Energy Consumption of Mobile Network Services and Applications, Energies 2019, 12, p. 184.

# Mobile communications service coverage in Germany – objective and subjective reasons why mobile communications coverage is perceived to be inadequate

How members of the public perceive mobile communications coverage depends on numerous factors. A subjective user experience is also influenced by where an individual subscriber moves in the cell and how many other subscribers are also logged on in the cell. Mobile communications are a "shared medium", which means that the subscribers within a cell have to share the transmission capacity provided. In areas frequented by many people ("hot spots"), the network operators have to provide correspondingly higher network capacity than in places that are scarcely frequented.

## Coverage in grey spots

Although around 98.8 percent of households and around 90 percent of the territory in Germany currently enjoy mobile communications coverage, this is only true if the mobile communications networks operated in Germany are taken together. Network coverage for members of the public depends on which network operator they use. Here, there are regional differences. In some regions, only one operator has so far deployed its network, which means that customers of other network operators think that they are in a dead spot whereas there is actually coverage.

There will be a marked improvement in this situation in the years ahead. Because of the rollout commitments resulting from the coverage obligations and the rollout agreements with the Federal Government, the network operators will have to significantly expand their networks. By the end of 2020 at the latest, each individual network operator must be providing coverage to 99 percent of households nationwide and by the end of 2021 also in every single federal state.

Alongside this, collaborative ventures between the network operators can help to bring about an overall improvement in mobile communications coverage for customers. By making joint use of infrastructure, the operators will be able to reduce their costs and the coverage of these areas will be more economic. Vice versa, the customers in the areas concerned will also benefit. They will have a greater choice of mobile providers and can opt for the company that has the most attractive terms for them.

# Dropped calls

In addition to the "white spots", in which mobile communications services cannot be used at all because no provider operates a mobile communications network, there are also restrictions on coverage resulting especially from dropped calls. Mobile communications users experience these disconnections mainly when travelling by car or train.

The reason for dropped calls is not only physical obstructions but also the structure of the network. A mobile communications network consists of a large number of cells that are interlinked in a "honeycomb" pattern. A dropped call may occur, for instance, if the hand-over from one cell to the next is not successful because of a lack of capacity (including in the

sphere of signalling) in the receiving cell. Another reason for dropped calls is the technical complexity of the hand-over between different mobile communications technologies (2G, 3G, 4G). As soon as LTE networks with nationwide coverage are in place, which will soon be the backbone of voice transmission, the Federal Government believes that there will be a significant reduction in the number of dropped calls.

However, dropped calls can also be prevented by using specific mobile devices. Thus, the subjectively perceived quality of coverage when telephoning in a car is considered to be higher if an external antenna is used. This makes it possible to noticeably reduce the number of dropped calls, because the signal strength outside the car is significantly higher than in the car. In this respect, optimum use can be made of the existing coverage by means of certain user behaviour. According to information provided by the mobile network operators, they try, as part of their network planning, to prevent dropped calls by undertaking "in-car" planning in the provision of coverage on transport routes.

In trains, the coverage situation is different. Here the signal strength is additionally reduced by metal oxide coated windows that can hardly be penetrated by radio signals. In this case, the coverage provided to passengers can be improved by a combined approach, namely not only deploying the sites required for coverage along the rail network but also equipping the trains themselves with more repeaters and radio-frequency transparent windows to support mobile voice and data applications.

Another challenge is the parallel use of public mobile communications services and radiobased railway applications (GSM-R), which are essential for the operation of trains. The way in which public mobile communications services are used on trains must be such that compatibility with railway applications in the 900 MHz frequency range is ensured. It has been apparent that these railway services have increasingly suffered interference when the public mobile network operators use 900 MHz frequencies to provide broadband coverage to trains. The interference suffered by railway communications services can be prevented by reducing the transmission output power for public mobile communications signals or establishing a minimum distance between a public network base station and the railway line. However, the consequence of both measures is poorer coverage for customers on trains.

The Federal Government is thus aware that measures to improve the possible use of mobile communications services that target solely the mobile network operators do not go far enough. Thus, the measures set out in the Mobile Communications Strategy impact further stakeholders such as railway undertakings, who can and should make a contribution towards improving mobile communications coverage.

#### Access to the LTE network

One of the crucial factors determining how consumers perceive their mobile communications coverage is whether they have access to the LTE network. If they are to be able to benefit from the better quality of the LTE network and its greater geographical coverage, users have to be in possession of an LTE-enabled mobile device and a mobile subscription with LTE network access. At present, not all mobile communications users have access to the LTE

network. In 2018, 50.5 million of a total of 107.5 million actively used SIM cards<sup>10</sup> had been activated for LTE use<sup>11</sup>. This meant that the proportion of SIM cards activated for LTE had risen by just under 15 percent compared with the previous year to around 47 percent.

In many cases, customers' decisions when selecting subscriptions are based on price and they book options in which LTE cannot be used and data is sent solely via the operators' UMTS network. For this reason, too, the market shares of the providers for price sensitive customers in Germany are considerably higher than the reference values of other European countries.<sup>12</sup> In Germany, they were 25.6 percent of the total market in 2017/2018, whereas the reference values in the United Kingdom and France (14.8 percent and 11.4 percent respectively) were significantly lower<sup>13</sup>.

Because of the rollout obligations currently in force, however, the companies today no longer have any significant incentive to expand their 3G networks. As the LTE network continues to be deployed, it is not only the network coverage for users that will improve but also the quality of services as a result of fewer dropped calls. In the medium term, therefore, the network operators will gradually scale down their 3G networks for reasons of cost among others. Many companies have thus already started to offer their customers only tariffs with LTE network access. The Federal Government welcomes these changeovers because this is the only way in which members of the public can take part in the improvements in the mobile communications network – especially with regard to network coverage in rural areas. Where such changeovers have not yet taken place, it is up to the mobile providers to ensure that the customers affected gain access to the LTE network as soon as possible.

#### International comparison

An international comparison of mobile communications services shows that mobile communications coverage in Germany has so far not sufficiently met the requirements of a highly developed economy. Whereas coverage in conurbations has been deployed to a very large extent and two German network operators rank in the upper middle level in an international comparison, there is an urgent need for improvements in coverage in rural areas and thereby especially along the transport routes.

Transnational drive and walk tests for 17 mobile network operators in five countries illustrate that no German mobile operator occupies a leading position. The following table shows the values measured in the drive tests for voice and data links for the incumbent German mobile network operators in towns and cities and along transport routes and compares them with the coverage situation in the United Kingdom, Austria, the Netherlands and Switzerland.

<sup>10</sup> These are SIM cards about which was communicated in the previous three months or for which an invoice was issued in the same period.

<sup>&</sup>lt;sup>11</sup> Federal Network Agency (2019): Annual Report 2018, p. 56.

<sup>&</sup>lt;sup>12</sup> Cf. KNect 365, Shaping the European MVNO Market 2018, 2018.

<sup>13</sup> Cf. for Germany: Federal Network Agency, Annual Report 2018, p.56, and for other markets: KNect 365, Shaping the European MNVO Market 2018, 2018.

2018		Tele	kom	Voda	afone	Telef	onica
		Test value	Place/of	Test value	Place/of	Test value	Place/of
Maior cities	Voice	96 %	5/17	96 %	5/17	57 %	17/17
	Data	95 %	8/17	90 %	12/17	67 %	17/17
Smaller towns	Voice	95 %	6/17	95 %	6/17	43 %	17/17
and cities	Data	89 %	12/17	88 %	15/17	58 %	17/17
Roads	Voice	92 %	6/17	88 %	10/17	27 %	17/17
	Data	92 %	11/17	90 %	14/17	64 %	17/17
Trains	Voice	44 %	13/17	49 %	11/17	28 %	15/17
	Data	38 %	14/17	40 %	13/17	21 %	17/17

 Table 2: Performance of the German mobile communications networks in an international comparison, 2018 (source: WIK-Consult)

The following table compares the quality of coverage provided by the individual mobile network operators on trains. It is apparent that of all the mobile network operators compared, it is T-Mobile in the Netherlands that offers its customers the best mobile communications coverage on trains. Here, the mobile communications networks in Germany provide a significantly lower level of quality.



Figure 4: International comparison of the quality of data links in trains14

<sup>14</sup> WIK-Consult, 2018.



Regarding the provision of data services along transport routes, the international comparison shows that two of three German mobile network operators have a mid-level ranking.

Figure 5: International comparison of the quality of data links along transport routes<sup>15</sup>

# C.2 Looking for sites for new mobile communications base stations

In Germany today, around 74,000 sites are used for public mobile communications. To comply with the coverage obligations, undertake necessary capacity enhancements on their mobile communications networks and deliver new innovative 5G applications away from local 5G networks, the incumbent mobile network operators and the newcomer have to develop thousands of new sites. Today, it is already becoming increasingly difficult to develop new sites for mobile communications networks. It has to be assumed that it will take two years on average from the planning to the delivery of a single site in Germany.

For the erection of a communications mast, building permission normally has to be obtained – unless it is a case where permission is not required. Mobile communications equipment is initially permissible – in general or by way of exception – in almost all types of territory

<sup>15</sup> WIK-Consult, 2018.

Translation

covered by the Federal Land Utilization Regulations<sup>16</sup>. In some cases, however, various entities are responsible in the case of permit granting procedures that involve obtaining more than one permit. In addition, compliance with other public law requirements, such as the law relating to protection of the built heritage and nature conservation, has to be ensured. In addition, the permission of, for instance, the authority responsible for the construction and maintenance of public ways may be required in order to obtain rights of way (section 68 of the Telecommunications Act) or the permission of the explosive ordnance disposal service may be required. The various permits may have to be obtained from more than one tier of the administration at the same time, i.e. Federal Government, federal states and local authorities. The way in which the different competent authorities are organized and interact varies from one federal state to the next.

In the opinion of the mobile network operators, the reasons for the lengthy duration of procedures to grant building permission include long coordination processes before the application for permission is submitted and subsequent requirements imposed by the building authorities.

Another obstacle to the erection of base stations is, according to information provided by the mobile network operators, the lack of willingness on the part of some owners to let their property for use as an antenna site or pricing that is significantly higher than the market level. This is all the more serious if the sites are urgently needed in order to comply with specific coverage obligations. In addition, more and more citizens' initiatives are being formed which lobby against network deployment in their local area<sup>17</sup>. The outcome of these deployment constraints on just one of the suppliers of mobile communications masts operating on the market is that just under 800<sup>18</sup> sites are already affected by one of the various obstacles to speedy erection.

<sup>16</sup> In its judgement of 30 August 2012 – 4 C 1.11, the Federal Administrative Court ruled: "When planning a site for mobile communications equipment, local authorities will, in order to avoid an error in weighing (...) have to bear in mind that there is great public interest in the provision of nationwide, appropriate and adequate mobile communications services to the population. The Senate has already proceeded on this assumption in decisions concerning the benchmarks for exemptions in favour of the mobile communications operators (...). In the meantime, the use of mobile communications services has increased perceptibly, in terms of both quality and quantity; in particular, the number of services that can be used with mobile devices has increased, which means that the weight of public interest has, if anything, grown."

<sup>17</sup>Cf. <u>https://www.faz.net/aktuell/wirtschaft/diginomics/5g-mobilfunk-braucht-glasfaserkabel-und-neue-sendemasten-15885467.html</u> (last retrieved on 29 July 2019); <u>https://www.zeit.de/2019/15/mobilfunknetz-infrastruktur-ausbau-sendemast-funkloch-bundesnetzagentur/seite-2</u> (last retrieved on 29 July 2019).

<sup>&</sup>lt;sup>18</sup>Cf. dfmg.de; number includes orders placed by the three incumbent mobile providers; as of 7 November 2019.



Figure 6: Number of problem sites in federal states (source: Deutsche Funkturm)

To improve coverage, it is thus imperative that the situation concerning building permission be scrutinized and that the provision of suitable public sector properties be expedited. The willingness to provide land used for agricultural and forestry purposes is likely to increase with the increase in the demand-related area-wide commercial usability for the agriculture and forestry sectors.

5G deployment will result not only in the erection of new or the conversion of existing macro sites but also in the erection of new sites for "small cells". For small cells to be established, infrastructures are required such as street furniture, street lamps, traffic lights and building roofs and walls that can be equipped with active technology for the small cells.

In some cases, small cells require different support infrastructures to macro sites. The Federal Government's appraisal of the suitability of various support infrastructures for small cells and macro sites is shown in the following table.

	Enlargement of macro sites	Construction of new macro sites	Construction of new small cell sites
Antenna masts	Highly suitable	Highly suitable	Not very suitable
Overhead line masts		Not very suitable	Suitable
Lighting masts		Not very suitable	Highly suitable
Traffic control signals ("traffic lights")		Not very suitable	Not very suitable
Traffic sign poles for (large) traffic and information signs		Not very suitable	Suitable
Passenger information boards and information signs ("underground railway")		Not very suitable	Highly suitable (depending on type)
Building roofs, roof edges	Highly suitable	Highly suitable	Suitable
Building frontages		Suitable	Highly suitable

Table 3: Exemplary assessment concerning the suitability of alternative support infrastructures for 5G deployment<sup>19</sup>

Approaches to providing or developing new tailor-made sites for mobile communications coverage have so far also been hampered by the fact that there is no collection of information on properties, already existing passive infrastructures and support structures that can be shared or on the coverage situation and a preview on upgrades.

If mobile communications coverage in Germany is to rapidly improve, there has to be intensive communication with members of the public, landlords of properties and land plus authorizing authorities in order to enhance acceptance of the necessary network deployment.

It goes without saying that the mobile communications rollout will not affect preventive health protection. The Federal Government takes it seriously that parts of the population have concerns regarding possible health impacts. For this reason, the Federal Government is actively communicating and providing information, entering into dialogue in appropriate places and establishing concomitant research into unresolved issues regarding possible effects and exposure.

<sup>19</sup>A complete overview of the technological properties of 5G and the requirements to be met by support infrastructures for 5G can be found in the brochure entitled "*Mitnutzungspotenziale kommunaler Trägerinfrastrukturen für den Ausbau der nächsten Mobilfunkgeneration 5G*" (July 2019).

The Federal Government will take possible effects on humans, nature and the environment into account in the rollout of mobile communications.

## C.3 Looking ahead: Growing demand for mobile communications services

The quality of the services offered on the public mobile communications networks has so far been guided by the demand from the mass market. However, the performance characteristics of LTE marked the start of a phase in which the spectrum of applications of mobile communications has significantly widened. With "Private LTE", for instance, there is already a product on the market that has found its market in trade and industry. 5G follows on from this with shorter response times (latency) and higher transmission capacity per cell and will once again significantly widen the range of possible applications for mobile communications. Mobile communications will become a key technology for the ongoing digital transformation of industry and the economy. Whereas LTE will remain the most-used technology in mass-market applications for a few years yet, 5G can exploit its technological advantages – shorter latency and higher data transfer rates – in the sphere of industrial production (Industry 4.0), motor vehicles (connected driving) or agriculture in particular.

## Trade and Industry

Information and communications services already play a key role in the manufacturing industry. This is shown by a survey according to which 30 percent of businesses are already using advanced Industry 4.0 applications.<sup>20</sup>

In the manufacturing industry environment, the term Industry 4.0 has caught on in Germany and refers to the connectivity of physical and digital elements in manufacturing. Cyber-physical systems (CPS) embed sensors, actors, facilities, machines, workpieces and products in a software-based system. This makes it possible to control, automate or optimize data-based production processes. In turn, the generation and provision of data and their processing can incentivize new, innovative business models and services. It is forecast that, between 2013 and 2025, Industry 4.0 solutions will make possible a cumulative increase in productivity of 23 percent in heavy engineering and plant manufacturing, the production of motor vehicles and vehicle components, electrical equipment, the process industry, the ICT sector and agriculture.

In cyber-physical systems, connectivity is the key, crucial enabler. In the context of connected factories, the use of LTE today and 5G in the future means that existing Wi-Fi and Bluetooth-based data transmission channels will be increasingly replaced, because the latter cannot match up to 5G in terms of latency and security. As the importance of latency for an application increases, so does the interest in the deployment of 5G technology. By replacing existing cable-based data transmission by wireless transmission, it will be possible to more flexibly rearrange production equipment. In this way, it will be possible, by means of 5G connectivity, to respond more flexibly to shorter market and technology cycles. With the

**<sup>20</sup>** VDMA, Industrie 4.0 – Qualifizierung 2025, 2016, p. 12.

increasing number of connected devices, the data volume and the importance of latency for an application, the interest in the deployment of 5G technology will also increase. 5G is superior to other technologies (including LTE) in connecting production facilities, enabling real-time communication between machines, acting as a basis for assistance systems (augmented reality and virtual reality) or supporting autonomous vehicles and transport systems.

#### Agriculture

Smart farming, digital farming or e-Farming are terms used to describe the intelligent deployment of information and communications technology in agriculture. Smart farming involves, among other things, the automation of work sequences and a reduction in the use of resources and inputs, of monotonous tasks and working capacity, for instance by deploying robots, autonomous vehicles, automated feeding or remotely pilotable agricultural drones. In short: if used properly, smart faming enhances the sustainability of agricultural production. Another important aspect is enhancing the economic efficiency of the farms.

A large number of communications solutions are currently already in use for various purposes. Sensors, agricultural machines or the monitoring of farm animals today use GSM or LPWAN (low power wide area networks). In the future, it will also be necessary to connect vehicles in the field in the context of autonomously operating agricultural machines in order, for instance, to coordinate scheduling between several vehicles (D2D) or download video streams from autonomous vehicles or drones. Data offloading for non-real time critical data is also being discussed. This involves data in the field being "gathered" by vehicles or drones and transmitted to the farm management system (FMS) at the agricultural holding by means of Wi-Fi and the broadband connection. FMS are frequently a major component of digital applications in agriculture. They can compile and evaluate, for instance, (image) data from the field (e.g. soil conditions, temperature, humidity, pest infestation) and from external data sources such as meteorological services or seed data and make it available to the holdings. Digital applications make site-specific cultivation possible. Thus, for instance, areas in which the soil is richer in nutrients are fertilized less, thereby saving fertilizers and placing less pressure on the ecosystems. A major proportion of the productivity potential of Agriculture 4.0 applications is accounted for by the compilation of information from various data sources in the FMS and the adaptation of processes based on this.

Thus, there is already a sharp rise in the volume of data to be processed online in the agricultural sector. At any rate, given the more demanding requirements of innovative technologies, the capacity of an LTE/4G network is required.

If the advantages of the digital revolution are to be exploited, taking into account the evolution of technologies such as cloud-based applications, drone flights, field robots/autonomous machines, cloud-based machine-to-machine communication, Al applications and blockchain, the provision of connectivity in rural areas is required. The land required for connectivity has to be seen as a function of the technical solution selected. In addition to delivering connectivity via public mobile communications networks, it is also

possible to deliver user-specific connectivity (4G/5G) independently of the public networks as a local non-public network. In the agricultural sector, these can be deployed as "ad hoc networks" and tailored to meet requirements.

Overall, the deployment of telecommunications services based on 4G/5G will boost the innovative capacity and sustainability of agricultural production and play a crucial role in reducing the use of pesticides and fertilizers, which is being increasingly called for by society and lawmakers, and in expediting ecological farming.

## Smart mobility

In the sphere of mobility along transport routes, the availability of connectivity is increasingly assuming key importance.

Whereas some manufacturers favour a Wi-Fi-based technology, other manufacturers consider an LTE-based technology and, in the medium to long term, 5G as a more workable solution for the communications needs of vehicles. Regardless of the technology for which the automotive manufacturers initially opt, there will in the medium to long term be hybrid networks comprising autonomous systems and public mobile communications networks. There is demand for connectivity along transport routes which, especially if it is safety-critical, must be reliable and fail-safe and provide the necessary data transfer capacity. From a user perspective, recourse to LTE is the first step for a large number of applications. Once 5G is available, performance in the field of latency and data transfer will be enhanced once again. Of key importance for the applications is information about where along the transport routes there is adequately dimensioned connectivity in public mobile communications networks. Accordingly, transparency regarding the quality on the networks will become increasingly important.

# Chapter 2: A package of measures for the rollout of mobile communications

# A. Overarching measures to improve mobile communications coverage – in white spots, grey spots and with 5G

Removing the white spots is currently the most pressing task in the improvement of mobile communications coverage. However, this strategy is not to focus solely on this objective. Deployment in "grey spots"<sup>21</sup> and the rollout of 5G must be expedited in parallel by the mobile network operators working at full strength. Some of the measures identified are directly aimed at filling in gaps in coverage in areas that are not likely to be covered by mobile voice and data services (LTE/4G) in the medium to long term ("white spots"), even if the current rollout obligations are taken into account. Other measures, on the other hand, are aimed primarily at expediting the rollout of 5G and improving the coverage situation in areas in which mobile voice and data services (LTE/4G) provided by at least one network operator can be used, which means that individual providers so far have no network coverage. One of the main purposes of these overarching measures is to provide optimum support to rollout by the private sector and strengthen collaborative schemes between the operators. The private sector will continue to bear by far the largest burden of network deployment on a commercial basis. A constant exchange of ideas and experience with the key stakeholders is thus of crucial importance.

The overall aim of the measures is to expedite rollout by:

- simplifying administrative approval procedures and reducing the duration of the procedures;
- increasing the number of sites that can be used;
- boosting shared use; and
- enhancing the acceptance of network deployment.

# A.1 Simplification and acceleration of approval procedures

If there is to be nationwide mobile voice and data service coverage (LTE/4G) as well as a dynamic rollout of 5G networks, it will be necessary, in the years ahead, to establish numerous additional mobile communications sites and upgrade a considerable proportion of existing sites.

However, according to information provided by the mobile network operators, this significant need for rollout is currently hampered by the fact that it takes on average two years from the

<sup>&</sup>lt;sup>21</sup> A grey spot exists when coverage is provided by at least one mobile network operator but not by all operators.

planning to the erection of a base station in Germany. They state that one of the reasons for this is that, before the base station can be commissioned, they have to obtain various approvals and exemptions that ensure that the requirements relating to any given project resulting from construction, telecommunications, immission control, heritage conservation and nature conservation law are met. According to information provided by the mobile network operators, the existing land use law provisions and building regulations, which have been fleshed out by rulings of the supreme court, are applied very differently from one municipality to the next. In some cases, they say, the way in which local authorities plan and control the rollout of mobile communications results in significant delays in approvals being granted. For this reason, it is necessary to identify and exploit the potential for acceleration and simplification without restricting the protective standards of *lex specialis* rules, for instance from the sphere of nature conservation law.

In addition, the use of "small cells" is needed in order to increase the density of the mobile communications network in conurbations. These are to be installed to an increasing degree in the public street environment and in or on buildings and installations in the public realm (street furniture).

#### A.1.1 Land use law

If they are visually discernible in the cityscape and landscape, mobile communications antennae are classified as projects within the meaning of section 29 of the Federal Building Code. This means that they are subject to the land use law rules governing the permissibility of projects and installations in the individual specific land use areas under section 1(2) and section 3 ff. of the Federal Land Utilization Regulations,

On white land, telecommunications installations are deemed to be "privileged projects" in accordance with section 35(1)(3) of the Federal Building Code, which are permissible unless they run contrary to public interests. In its judgement of 20 June 2013 (4 C 2.12), the Federal Administrative Court "relaxed" the privilege requirements. In order to enjoy the privileges as a public utility under section 35(1)(3) of the Federal Building Code, it now suffices that mobile communications base stations are bound to a specific region or area rather than to a specific place. The client of mobile communications equipment has to be referred to technically suitable alternative sites on land allocated for development only if he can be reasonably expected to accept them.

It could be possible to significantly reduce this verification effort in cases in which, because of a coverage obligation (e.g. to ensure coverage on a rural road), a specific site on white land is imperative.

In connection with the deployment of mobile communications equipment along trunk roads, aspects of road law have to be examined alongside the issues relating to land use law. At present, structures along trunk roads have to be at a distance of at least 40 m from federal motorways and 30 m from federal highways. Consideration should be given as to whether, as a result of the greater need for coverage due to connected driving, this rule governing mobile communications equipment is still appropriate.

Enforcement of land use law is a federal state responsibility. The Federal Government will lobby to ensure that a federal state working group, with the participation of the Federal Government, develops enforcement guidelines on issues relating to the urban planningbased management of the rollout of mobile communications by means of development planning, to the exercise of discretion regarding the granting of exceptions and exemptions for mobile communications equipment on land allocated for development (with and without a local plan) and assessment criteria for the permissibility of mobile communications equipment on white land. In addition, it will join forces with the local government associations to identify examples of best practice regarding local authority approval decisions.

#### A.1.2 Building regulations

Building regulations are a federal state responsibility. For this reason, only suggestions for amendments can be made within the scope of this strategy. The continuing rollout of the mobile communications network, especially the evolution to the 5G standard, requires not only the delivery of additional new sites but also the upgrading of existing mobile communications equipment, including the heightening of antennae. Mobile network operators believe that antennae with a height of around 15 m (land allocated for development) and around 20 m (white land) will be required, which means that the existing limit for projects that do not require planning permission will no longer be adequate. The amendments to the Model Building Regulations, adopted by the standing Conference of Federal State Ministers and Senators responsible for Urban Development, Building and Housing, widening the range of antenna construction projects that do not require planning permission and clarifying the design basis for the height that does not require planning permission are welcomed by the Federal Government. Likewise, the Federal Government supports all measures taken by the federal states that result in a uniform decision-making practice, for instance regarding the design basis for the height of antennae.

If, in certain constellations, it is necessary to apply for exceptions, exemptions or derogations from building regulations, deadlines for the issuance of official notifications of three months could achieve an acceleration of the procedure.

In some cases, various entities are responsible in the case of permit granting procedures that involve obtaining more than one permit. Concentrating the decision-making process for all the different approvals in a "one-stop shop" is difficult to implement. One thing that could help, however, is the establishment of a "mobile communications pilot" as a coordinating body that is the point of contact for the network operators and local authorities on all issues relating to approvals. The pilot is to consolidate all the information required by the local authorities or operators and coordinate the approval process within the administration. In this way, a situation could be prevented in which the applicants are referred on to many different points of contact. The aim is to have official notifications of the approval of mobile communications sites issued within a period of three months. The organization of the approval procedures and all issues related to the establishment of a mobile communications pilot is a federal state responsibility.

To speed up the applications procedures for the establishment of mobile communications base stations, it is to be possible for applications to be increasingly processed online. This will standardize, digitize and thus also significantly accelerate processes for the applicants. The issuance of approval by the authority responsible for the construction and maintenance of public ways to building works such as the installation of a feeder line to mobile communications masts in accordance with section 68 of the Telecommunications Act is already part of a pilot procedure for implementation of the Online Access Act. To outline the standardized procedure, the Network Alliance has developed a prototype that is to be the basis for the first pilot projects to implement the Online Access Act. We will lobby to ensure that the same also applies to the issuance of approval to mobile communications base stations under building law and nature conservation law and all procedures at the Federal Network Agency.

Measures	Schedule
Establish a federal state working group, with the participation of the Federal Government, to develop enforcement guidelines on issues relating to the urban planning-based management of the rollout of mobile communications within the scope of development planning, to the exercise of discretion regarding the granting of urban planning exceptions and exemptions for mobile communications equipment on land allocated for development (with and without a local plan) and assessment criteria for the permissibility of mobile communications equipment on white land.	Federal states
Strengthen the importance of mobile communications as a concern of development planning within the context of the planned recast of land use legislation.	4Q 2019
Identify "fast-track" approval procedures with the aim of providing local authority decision-makers with "best practice models"	2Q 2020
Extend access rights on access routes in the white area	Part of the major recast of the Telecommunications Act (2020)
Consider incorporation of the adopted amendment to the Model Building Regulations raising the height for which planning permission is not required to 15 m in the white area and clarifying the design basis for the height of masts/antennae on buildings for which planning permission is not required (up to 10 m from the point of intersection with the roofing) into the building regulations of the individual federal states.	Federal states

Exploit possibilities for reducing the deadlines for the issuance of official notifications to three months.	Federal states
Exploit potential for acceleration to establish innovative forms of the coordination of approval procedures, for instance the establishment of mobile communications pilots.	Federal states
Reduce the distance space of mobile communications masts from federal trunk roads by adapting the Federal Trunk Roads Act.	2020
The Federal Government supports initiatives taken by federal states and local authority associations to establish milestones for implementation and the progressive digitalization and standardization of (building) approval procedures.	Federal states, local authorities

# A.1.3 Establishing parameters

It would be possible to facilitate the deployment of base stations if the procedure followed by the Federal Network Agency in "establishing parameters" (establishment of site-specific spectrum use parameters), which has to be carried out before base stations are constructed, were to be simplified. More specifically, this would mean that these verification procedures did not always have to be conducted in advance. This Federal Network Agency is currently exploring the extent to which this would be possible. This involves examining in which frequency ranges there is a low likelihood of interference in relation to other radio applications.

Measures	Schedule
Identify frequency ranges used for mobile communications in which there is a low likelihood of interference in relation to other radio applications.	4Q 2019
Simplify the parameter establishment procedure in the aforementioned ranges.	4Q 2019
Encourage nationwide mobile network operators to reach more domestic operator agreements.	Immediately

# A.1.4 Improving coverage in areas close to borders

A significant proportion of white spots are located in border regions. The "white spots" could be provided with coverage more quickly if it were possible to simply increase the transmission output power at existing sites in regions close to borders. In the delivery of mobile communications services in border areas, Germany has to coordinate its activities regarding the shared use of one frequency with a total of nine neighbouring countries. In the past, administrative arrangements were first made between the spectrum management authorities before services with a possible impact on the neighbouring country were provided. In some cases, these never materialized at all. In the future, there will be an ex post procedure: The base station close to a border will normally be approved. Only in the case of actual interference during operation will case-by-case solutions be necessary.

The network operators estimate that, as a result of the new procedure, around 780,000 households in the border regions throughout Germany will be able to benefit from better mobile communications coverage.

Measure	Schedule
Simplify spectrum coordination in border regions by means of a simplified approval procedure: Federal Network Agency establishes a simplified (ex post) procedure for the deployment and use of mobile communications masts in regions close to borders.	Implemented

#### A.1.5 Site certification procedures

Site certification procedures for mobile communications base stations are governed by the Regulation concerning the Method of Verification for the Limitation of Electromagnetic Fields (BEMFV)<sup>22</sup>. The purpose of the method of verification is to ensure the protection of individuals in the electromagnetic fields created by the operation of stationary radio equipment.

The current site certification procedure, which is uniform throughout Germany, is recognized by the federal state authorities responsible for immission control and health protection. Carrying out the site certification procedure is the responsibility of the Federal Network Agency. As the central point of contact for the issuance of site certification, it ensures, for the operators of base stations, that transparent statutory rules apply to all market players on a non-discriminatory basis and that a scrutiny authority certifies the safety of the equipment for the population (provided the safety distances are complied with).

In addition, the central performance of functions by the Federal Network Agency makes it possible to create further facilitations for the mobile network operators and their network deployment. Today, the notification procedure for the commissioning of new or the modification of existing sites is already largely digitalized. In this context, cities and municipalities have access to the database (on which the procedure is based) for sites

<sup>22</sup> The BEMFV regulation is closely dovetailed with the 26th Regulations implementing the Immission Control Act (Regulations on Electromagnetic Fields – 26th Immission Control Regulations, 26. BImSchV) in order to rule out any regulatory gaps. The legal basis of these Regulations is the Act on the Provision of Radio Equipment on the Market (Radio Equipment Act - FuAG), which transposes Directive 2014/53/EU (Radio Equipment Directive – RED) into national law.

located within their boundaries. This means that the information is available to the parties involved in a transparent manner and with no time lag. Continuous evolution of the softwarebased site certification procedure will ensure further simplification and acceleration of the procedure and of communication with the authorities.

In addition, the BEMFV Regulation contains facilitations: For stationary radio equipment (at one site) with effective isotropic radiated power (EIRP) not exceeding 10 watts, site certification does not have to be applied for. There is merely a notification requirement. This notification can also be made electronically. Micro-equipment with transmission output power not exceeding 100 mW EIRP is completely exempted from the approval and notification procedures.

Measure	Schedule
Continuous evaluation and evolution of the software-based site certification procedure	Starting in 3Q 2019
Enhancing transparency of the site certification procedure by publishing information on calculation methods and bases and measuring processes.	Starting in 1Q 2020

## A.2 Increasing the number of usable sites, boosting shared usage

#### A.2.1 Better use of existing infrastructure and public sector property

The costs of delivering coverage to poorly served households and areas can be reduced by making better use of the resources of private sector suppliers and of the public sector for deployment.

#### Making greater use of public sector property and infrastructures

The Federal Government, as well as the federal states and local authorities, have property and infrastructures that are suitable for the installation of mobile communications masts or additional 4G/5G antennae on existing masts. The Federal Government alone is in possession of the over 18,000 properties, which are managed by the Institute for Federal Real Estate. There are also an additional approximately 5,000 properties for which the federal states are responsible and which are used for, among other things, the digital radio operated by the authorities and organizations with security and safety tasks (BOS) plus 120,000 parcels of land managed by the Waterways and Shipping Administration. These are augmented by properties of, for instance, the road maintenance depots, the Federal Police, the Federal Armed Forces and the German Meteorological Service.

For the fibre optic connection of the mobile communications masts, free (conduit) capacity can be shared. In the waterway sector, there are up to 2,300 km of such capacity. A survey and documentation of Federal Government conduit infrastructures along the federal

highways is currently underway. Appropriate funds have been provided for this purpose. The study will determine the extent to which shareable infrastructures in the form of fibre optic, conduits and antenna sites and support structures exist along the 53,000 kilometres of federal highways and motorways.

On the one hand, the properties and land can serve as low-cost sites for the state-backed erection of mobile communications masts for macro base stations. In this way, it will be possible to significantly simplify and accelerate the protracted and often laborious search for and acquisition of private sector sites. On the other hand, the provision of public sector property and land can also facilitate private sector network deployment. To make better use of the property managed by the Institute for Federal Real Estate, a model agreement is currently being developed between the institute and the operators, with the participation of the Federal Government. This will ensure that the interests of safety and security are not affected. The sites are to be made available for a moderate fee. A longer lifetime of the agreements and generous periods of notice are designed to ensure that the network operators have investment certainty. The Federal Government will establish a uniform procedure for the rental of Federal Government property and infrastructures.

Agreements have already been concluded for the use of existing (fibre optic and conduit) capacity along federal waterways and federal motorways and highways.

The new infrastructures created as part of broadband funding are also to be used for the rollout of the mobile communications networks. The concept on technical conditions in the Federal Government's Funding Programme for Fixed Broadband has thus been designed to ensure that conduits are dimensioned and installed and distribution equipment, manholes and backhaul links are constructed in such a way that these infrastructures can also be used by mobile communications.

For the establishment of "small cells", which play a major role in the deployment of 5G in particular, we are seeking to conclude a model agreement that regulates access to local authority support structures such as information signs, street lamps, traffic lights or advertising hoardings and secures the local authorities' rights of participation. In addition, the local authorities are exploring the possibility of making information on the aforementioned support infrastructures available on a geographic information (GIS) platform. The Federal Government's Broadband Atlas can also be used for this purpose. Here, the Federal Government and the federal states will also make support structures from their sphere of influence – for instance traffic signs – transparent.

#### Better use of private sector infrastructures

Lessons have already been learned from the implementation of the Act to Facilitate the Deployment of High-Speed Digital Networks (DigiNetzG) regarding the sharing of existing public sector utility infrastructures with broadband infrastructures and regarding coordinated trench sharing during construction work. These lessons concern, for instance, the conditions of sharing including prices. Better access to these data and information via the data

deposited in the Infrastructure Atlas will create a marketplace from which the mobile network operators will also benefit.

In addition, the Telecommunications Act enables access to physical structures of an SMP operator no longer just as an ancillary measure but as a separate access measure. For this to happen, the physical structures (including antennae, towers, masts, conduits, manholes and street cabinets) do not have to be part of the relevant market. However, the measure must be necessary and proportionate with regard to a competition problem identified in the market analysis. In the legal implementation of this Act, care must be taken to ensure consistency with regard to access options existing in parallel, especially for the symmetrical options under the Act to Facilitate the Deployment of High-Speed Digital Networks.

We also want to explore whether, and if so how, greater use can be made than in the past of alternative support structures that are widely available nationwide, such as electricity poles. Free conduit and fibre optic capacity of Deutsche Bahn also constitutes a sharing option and greater use can be made of it than in the past for the deployment of digital infrastructures. For this purpose, DB has established a separate company – "broaDBand".

Measure	Schedule
Survey the public sector properties and infrastructures suitable for shared use	Starting in 2020
Include public sector properties, land, infrastructures and support structures of the Federal Government, federal states and local authorities and network deployment plans in a joint electronic portal	Starting in 1Q 2020
Possibility of general access to shareable public sector properties, land, infrastructures and support structures via a new electronic Federal Government portal and transparency of the respective terms of use	Starting in 2020
Consolidate existing GIS planning tools (especially Broadband Atlas, Infrastructure Atlas) and inclusion of the planned rollout of mobile communications	Starting in early 2020
Draw up a model agreement between the Institute for Federal Real Estate and network operators	In progress
Create the possibility in the Telecommunications Act for the Federal Network Agency to order that access be granted to conduits of the SMP operator	Starting in 4Q 2020 (major recast of the Tele- communications Act)

Explore whether, and to what extent, greater use can be made of alternative private sector transmission sites that are available nationwide	Starting in 1Q 2020
Take account of the needs of mobile communications with regard to fibre optic access to connect transmission sites in the concept on technical conditions of the Federal Government's Funding Programme for Fixed Broadband	Ongoing
Systematically market and use of DB's digital infrastructures by establishing a broaDBand GmbH	Completed

## A.2.1 Boosting cooperative deployment by the mobile network operators

Cooperation between the mobile network operators when deploying their sites can make a major contribution towards increasing the coverage provided by the individual mobile communications networks, thereby making coverage possible in white spots. The shared use of sites can thus reduce the number of additional mobile communications masts. The network operators gave a voluntary commitment to do so for the first time back in 2001. Additional synergies and an even more efficient distribution of financial burdens will be achieved if operators go further and also cooperate in the field of active infrastructure elements (active infrastructure sharing). This concerns both voluntary cooperation and binding requirements. A cooperative approach by the network operators will also help the local authorities to speed up the search for and the approval of sites.

With the coverage obligations and rollout agreements following the most recent Mobile Communications Summit, we have already incentivized network operators to agree on infrastructure sharing that is as extensive as possible, in line with antitrust rules. Against this background, the Federal Government welcomes the announcement by Deutsche Telekom, Vodafone und Telefonica of 11 November 2019 that they intend to deploy and use up to 6,000 new mobile communications sites in a coordinated way in order to remove dead spots in sparsely populated areas and along transport routes. Despite these positive effects of the cooperation, it must at the same time also be ensured that the network operators continue to have sufficient incentives to deploy their networks better and further than their competitors. Because this is the only way that consumers can be certain in the long run that they will continue to benefit from technological innovations and better network standards in the future. For this reason, there must be compliance with the antitrust and telecommunications law frameworks.

To give operators more legal certainty for cooperation, information from the Federal Cartel Office on the permissible extent of cooperation is helpful. Where voluntary negotiations on cooperation fail, we will create, by transposing the requirements of the European Electronic Communications Code within the scope of the major recast of the Telecommunications Act, enhanced possibilities for the Federal Network Agency to issue orders, limited to a specific

locality, for cooperation such as the shared use of infrastructures or local roaming if there are insurmountable physical or economic barriers to an operator deploying its own network and there are no access alternatives. At the same time, it must be ensured that it is still worthwhile investing in mobile communications masts in white spots. "Free riding" must be avoided.

Measure	Period
Establishment of statutory conditions for the ordering of cooperation	4Q 2020 (major
limited to a specific locality, such as the shared use of infrastructures	recast of the
or local roaming.	Telecommunications
	Act)
Reach agreement with network operators on cooperation during the	1Q 2020
second Mobile Communications Summit	

# A.3 Communication with the public and technological impact assessment regarding network deployment and 5G technology

# Creating more understanding and acceptance of the rollout of mobile communications by means of information, transparency and dialogue

Everyone wants high-capacity and nationwide mobile communications coverage. But the deployment of sites for mobile communications masts is sometimes thwarted by local resistance. The reason for this is often reservations against mobile communications masts – for optical reasons or for fear of additional exposure to radiation.

Given the intensive discussions in the public and media, the Federal Government will – across departmental boundaries and supported by the competent federal authorities – launch a communications initiative designed as a multiannual campaign. The objective is to provide transparent and neutral information about the developments in mobile communications in Germany and engage in an in-depth dialogue with the general public. In particular, the campaign is to prioritize regions in which discussions on the ground reveal a great need for information. The focus is to be on the technological properties, the fields of application and the possibilities of new technology as well as societal impacts and possible health-related aspects.

In addition, speedy delivery of the rollout of mobile communications on the ground requires the integration of the relevant stakeholders at an early stage. One thing that can help here is a guide showing how it was possible to speedily overcome comparable problems in other municipalities. In complex individual cases, it may be advisable to include a neutral mediator on a case-by-case basis. Here, consideration is to be given as to what functions can be performed centrally and where more responsibility should be assumed at local authority level in order to progress the implementation of projects.

# Ensuring a responsible technological impact assessment

It goes without saying that the Federal Government will continue to ensure, through the site certification procedure (see above), that the protection of the population with regard to electromagnetic fields is guaranteed. The Federal Government will thus ensure the established level of protection (thresholds for electromagnetic fields) for small cells as well. In addition, it will expedite research into 5G technologies, including concomitant research into the impact on humans and the environment, and the trialling of 5G applications.

Measure	Schedule
Cross-departmental round table on issues relating to the acceptance of the rollout of mobile communications and radiological protection (Federal Ministry of the Environment)	1Q 2020
Communication campaign on the rollout of mobile communications and to provide public information on health implications of mobile communications radiation	Starting in 2020
Develop a guide for the resolution of conflict situations in approval procedures on the ground	4Q 2019
Establish a neutral clearing house for local authorities on all issues relating to the feasibility of the rollout of mobile communications on the ground	Starting in 2020
Provide information on electromagnetic fields in connection with the deployment of 5G networks.	1Q 2020
Ensure the established level of protection (thresholds) of base stations with a higher EIRP on small cells by amending the 26th Immission Control Regulation if an extension of the existing voluntary commitment given by the mobile network operators with the same level of protection cannot be achieved by 29 February 2020.	2Q 2020
Establish and develop a centre of excellence for electromagnetic fields at the Federal Office for Radiation Protection	2Q 2020
Develop an EMF monitoring system to continuously record the exposure of the population and complex exposure scenarios	Starting in 2Q 2020
Establish continuous research funding in the field of concomitant research (especially issues relating to mobile communications electromagnetic fields).	3Q 2020

Better incorporate EMF issues in line with the international	Ongoing
guidelines into the standardization of mobile communications and	
related standardization	
Incorporate small cells into a public EMF database managed by the	Starting in 1Q 2020
Federal Network Agency	

## B. Implementation of rollout obligations and rollout pledges

To ensure that mobile communications networks are available not only in conurbations but also beyond, specific rollout obligations were imposed on the network operators in the 2015 and 2019 spectrum auctions. These have since been augmented, on the basis of the outcome of the 2018 Mobile Communications Summit, by the rollout pledges contractually agreed with the mobile network operators (implementation of the 2018 Mobile Communications Summit). With these rollout measures, the objective of nationwide availability of mobile voice and data services will have been largely achieved.

# B.1 Contractual stipulation of the rollout pledges given at the Mobile Communications Summit

On 5 September 2019, the Federal Government concluded agreements on binding rollout pledges with all four mobile network operators. The basis for this was the rollout pledges given by the network operators at the 2018 Mobile Communications Summit. As agreed at the Mobile Communications Summit, the Federal Government will, in return, grant the operators advantages in the terms of payment conditions in connection with the proceeds from the 2019 5G spectrum auction.

Measure	Schedule
Conclude an agreement to implement the outcome of the first Mobile Communications Summit	Completed
Monitor implementation of the agreement	Ongoing

# **B.2** Monitoring of the rollout commitments

It is crucial that the actual delivery of the rollout commitments be effectively monitored.

To this end, the Federal Network Agency requires the network operators to submit regular reports on the progress made in rollout even before the deadline by which the obligations must have been met. To check compliance with the rollout commitments, the Federal Network Agency selects, on the basis of the forecast coverage maps submitted by the network operators, suitable reference regions in each federal state which the radio inspection

and monitoring service checks by taking closely meshed measurements to determine the accuracy of the forecasts. Coverage is recorded separately per network operator and per frequency range. The mobile network operators have to furnish proof to the Federal Network Agency by 1 January 2020 that they have met the coverage obligations imposed on them at the 2015 spectrum auction.

Measure	Schedule
Review the progress made in rollout and compliance with the coverage obligations via the Federal Network Agency's radio inspection and monitoring service.	Ongoing

## **B.3** Enforcement of existing coverage obligations and rollout pledges

To be able to ensure that the coverage obligations and rollout pledges are actually met, the Federal Government will monitor the corresponding rollout.

It must be possible to impose effective penalties in the event of failure to meet coverage obligations. The Federal Network Agency must be in a position to enforce compliance with rollout obligations by means of sufficiently high penalty payments. With the previous ceilings for penalty payments and fines, this was no longer ensured. For this reason, the Federal Government has this year significantly raised the ceilings within the scope of the 5th Telecommunications (Amendment) Act. In this way, the Federal Network Agency has been empowered to impose stiff penalty payments and fines in individual cases if coverage obligations are not properly met.

The Federal Government likewise monitors compliance with the rollout commitments made by the mobile network operators in the agreements on implementation of the outcome of the 2018 Mobile Communications Summit. Provision is made for effective penalties in the event of infringements.

Measures	Schedule
Possibility of imposing higher penalty payments to ensure compliance with coverage obligations	Implemented
Noticeably widen the framework of fines for failure to meet coverage obligations	Implemented

# C. Measures to remove white spots

It will not be possible, in the foreseeable future, to provide a certain proportion of households and especially of the country's territory, with a range of mobile communications services that makes convenient data use and voice telephony possible, either through private sector deployment or through delivery of the rollout obligations from the coverage obligations or from the Mobile Communications Summit. Here, the Federal Government's objective is to achieve a rapid and noticeable improvement in coverage.

#### C.1 Identifying the need for state action

To be able to identify the need for state action, the target areas of state action have to be identified as precisely as possible.

## C.1.1 Actual status of coverage

The first step involves establishing clarity about the actual state of network coverage. The providers are therefore to be required in the future to provide the public sector with the data on the status of their networks. These data will be additionally validated by the data from the dead spot app (Funkloch-App). This will not only make it transparent where there may be a need for state action. Customers, too, will be able to see the network coverage of the individual providers before they conclude a contract. At the end of 2018, the Federal Network Agency already tightened the network operators' reporting obligations, which means that they have to report not only on the coverage obligation but also on the overall deployment status of 2G, 3G, 4G and 5G. To this end, they have to submit information on geographical and household coverage plus transport routes and up-to-date digital network coverage maps. The Federal Network Agency conducts systematic and ongoing provider-specific monitoring and proactively provides information and appropriate map materials on provider-specific network coverage. The 5th Telecommunications (Amendment) Act had already created the conditions for more transparency for consumers. In the future, the Federal Network Agency will make updated network coverage maps for the individual network operators publicly available. This will enable consumers to obtain sound information on the network coverage of the providers before they conclude a contract and to consider this information when deciding which provider to conclude a contract with.

Measures	Schedule
Validate the information provided by the network operators on the status of coverage with the help of the dead spot app (Funkloch-App).	Ongoing
Legal obligation to supply coverage and infrastructure data to a newly created consolidated transparency tool.	Implemented
Provider-specific monitoring of the status of rollout by the Federal Network Agency	Ongoing

## C.1.2 Forecast of network deployment: Coverage study and look ahead

It is not yet possible to conclude from the actual status where a need for state action exists. The implementation of network operators' rollout obligations will also have a positive impact on the coverage of households and territory. In places where the private sector network operators have to undertake deployment in any case (especially because of coverage obligations or other legally binding obligations) or the gap in coverage will be closed by, for instance, other funding measures, state-backed network delivery by the Federal Government is ruled out. The challenge is identifying today where state-backed deployment measures are likely to be necessary. The Federal Government commissioned a study to identify what the coverage in terms of households and territory is likely to be by the end of 2024, including the possible costs of such development. The study found that the mobile communications coverage likely at the end of 2024 is as follows: After delivery of the rollout obligations, the combined coverage of households is likely to be around 99.7 percent. The geographical coverage will then be more than 95 percent.

For the development of up to 5,000 sites in connection with the deployment of the gigabit network in all parts of Germany that will probably still not be covered at the end of 2024 without state-backed measures, the Federal Government will provide money from the special fund Digital Infrastructure. When fleshing out the funding, we will avoid deadweight effects by using the coverage study to delimit the permanently white spots from the areas in which coverage is to be provided by the network operators. Further clarity will be provided by the data from the private sector network operators on their rollout activities in the next twelve months ("preview"). A requirement for owners or operators of public sector telecommunications networks or telecommunications lines to make corresponding public sector data available – for instance to the mobile communications infrastructure company (MIG) and the Federal Network Agency – has been enshrined in the 5th Telecommunications (Amendment) Act.

Measures	Schedule
Forecast of the need for state action with the help of the Coverage Study	Ongoing
Statutory requirement to supply rollout plans to be provided on a GIS platform of the Federal Government	Implemented

#### C.1.3 A comprehensive electronic GIS portal

As already described, various measures are to be taken to establish transparency on the current and forecast status of deployment, on the shared use of existing infrastructures, properties, land and support structures and on the existing white spots. The need for state action and the most efficient option for deployment can be depicted most precisely in a GIS-based information and planning portal in which all these information layers are "matched", i.e.

superimposed on one another. The various items of information from the Broadband Atlas, the Infrastructure Atlas and recently created new data sources are thus to be merged to form a comprehensive GIS portal. It will create transparency not only for funding programmes with which the network deployment will receive state support if necessary but also for the private sector network deployment, while simultaneously informing the end-users. Graduated access rights will mean that it is still possible to preserve commercial and industrial confidentiality.

Measure	Schedule
Establishment of a uniform GIS-based information and planning portal that enables easy access to information on usable public and private sector infrastructures, property, land, support structures, trench sharing possibilities and – publicly accessible – availabilities of fixed network and mobile communications coverage.	Starting in 1Q 2021

## C.2 Mobile communications funding

For areas in which mobile voice and data services are not available and for which it is not foreseeable that the network operators will provide private sector coverage, the Federal Government will provide its own mobile communications funding programme. To ensure that coverage is provided rapidly, the funding is to be addressed to both local authorities and directly to deploying providers, for instance network operators or companies that provide communications masts and base stations to the network operators. To ensure an efficient procedure and the provision of optimum coverage in the areas, the shape of the funding is to be such that the burden on the local authorities is reduced as far as possible. In all cases, competitive tendering is to ensure effective and at the same time low-cost deployment by awarding the contract to the tenderer with the economically most advantageous tender. The objective is for the public to be provided with mobile communications in the very places where they often stay and where they rely on mobile communications - in other words, including at their place of work or on an excursion to tourist attractions. To identify the relevant areas for funding, we will focus on where people typically stay and will benefit from an improvement in network coverage. This is primarily the case in populated areas. In addition, the district and municipal roads and business parks not covered by the coverage obligations are to be provided with coverage within the scope of the funding programme. The subject of a funding project should ideally be several white spots that are interlinked in a manner that is appropriate from a network topology perspective and that cover both populated areas and connecting roads at district and municipal level.

The Federal Government will fund the provision of coverage only in those areas in which there are no private sector deployment plans and in which no deployment is planned on the basis of coverage obligations or on the basis of the contractual rollout commitments given by the network operators (agreement with the Federal Government of 5 September 2019). Areas in which coverage is provided with Federal Government funding may not be offset against compliance with the aforementioned commitments. We will ensure the delimitation

described above by means of appropriate coordination with the network operators. This is the only way to ensure that the funding can actually bring about the desired additional improvement in coverage.

With the provision of 5G frequencies for the deployment of local 5G networks (so-called campus networks), we have already created the conditions that enable companies to establish tailor-made 5G networks for their individual needs. With moderate charges, we make it easier for these companies to actively avail themselves of this opportunity. This applies especially to agriculture and forestry. For these undertakings, one of the main challenges is that they sometimes have to cover areas in remote regions with their own networks. To make the deployment of local networks tailored to the specific needs of agriculture possible and thus leverage the potential for innovation inherent in digital agriculture, we will support the establishment of such networks with a funding programme.

Before fleshing out the funding framework, we will talk to the federal states and local authority associations about this framework and define a procedure.

If existing funding programmes (including those for the gigabit rollout) are used, there will be close coordination with the Federal Government and the funding initiatives of the local authorities concerning white spots. These include, in particular, existing funding frameworks such as the Joint Federal Government/Federal State Scheme for the Improvement of Agricultural Structures and Coastal Protection (GAK) which, for the purpose of funding the deployment of local 5G networks for agricultural holdings' own use, will also receive an additional injection of funds totalling 60 million euros from the special fund Digital Infrastructure.

The Federal Government will draft as quickly as possible a state-aid basis for a federal mobile communications funding programme and consult with the network operators, the federal states and the local authority associations. Subsequently, it will obtain the necessary state aid approval from the European Commission and as quickly as possible start the provision of funding. The funds required for this purpose will be provided from the special fund Digital Infrastructure.

Measures	Schedule
Draft, coordinate and notify a funding framework.	Immediately

# C.3 Establishment of a mobile communications infrastructure company to support and accelerate deployment

Numerous measures of the mobile communications strategy will be implemented by a (yet to be established) subsidiary of Toll Collect (company), thereby facilitating a coherent approach by a one-stop shop. The mobile communications infrastructure company will be established before the end of 2020 provided that the conditions set out in section 65 of the Federal Budget Code have been met and the qualified spending freeze on the funds has been lifted

by the Bundestag. The aim is to relieve the pressure on the local authorities to a great extent. This is designed to ensure efficient and at the same time effective deployment. Because for sparsely populated white spots, in particular, overarching planning makes it possible to achieve optimum coverage and conserve resources. This support will also contribute towards achieving an appropriate network topology and thus optimum coverage in areas, away from major settlements.

The mobile communications infrastructure company is thus to perform the following functions:

- Collect data on public sector properties, plots and land, conduits, shareable infrastructures and the current coverage situation. The data will be made available transparently in a tool based on GIS data with graduated access authorization.
- Determine search radii in funding projects for possible sites of mobile communications masts/transmitter site on the basis of the planning tool. Fine-tuning of the right location will be done in a dialogue with the network operators so that the new sites complement the existing networks in an optimum manner. In an ideal case, the cross-check will show that public sector properties/transmitter sites are available that are suitable for the erection of a mast.
- Negotiate and establish conditions of use and model agreements for the use of public sector properties, plots and land and of infrastructures of larger infrastructure providers operating nationwide.
- Create incentives to ensure that funded and otherwise shareable infrastructures, open-access products and public sector properties, plots and land can be incorporated at best into the private sector or funded deployment of mobile communications and fixed-line networks.
- Use Federal Government funding to support local authorities in removing white spots. The funding procedures should be standardized to the greatest extent possible, thereby relieving the pressure on the local authorities to a high degree.
- The delivery of coverage to white spots in isolation by individual local authorities will
  not result in an appropriate network topology and optimum coverage of the white
  spots. The mobile communications infrastructure company is thus to engage in an
  institutionalized exchange of ideas and experience with the network operators as well
  as with the federal states and local authorities to support the coordination and
  planning of private sector or funded deployment activities.
- Coordinate dialogue formats. This will involve, among other things, institutionalized cooperation with the federal states and local authorities, for instance at an independent clearing house within the mobile communications company (or federal state clearing houses), if there is resistance to construction projects or awareness campaigns are to be conducted.

• Provide expert support to the proper implementation of the construction work delivered carried out with Federal Government funding.

The capacities of the mobile communications infrastructure company are to be established progressively. First of all, this will involve expediting the activities that significantly benefit private sector deployment as well. The mobile communications infrastructure company is to be established as a subsidiary of Toll Collect GmbH with its own supervisory board and is to be supported by an advisory council composed of representatives from the Federal Government, federal states and local authorities. In this way, it will be possible to link the company up to an existing institution that is 100 percent government-owned and possesses expertise in the deployment of decentralized infrastructures.

Measures	Schedule
Establish a project group to prepare for and establish a mobile communications infrastructure company	Completed
Create the legal, budgetary, financial, organizational and personnel- wise requirements for the establishment of a mobile communications infrastructure company with the legal form of a private limited company.	4Q 2019
Operational launch of the mobile communications infrastructure company	3Q 2020

# D. Funding programme to improve the network quality on trains

The improvement of network quality is also to be supported by a state-backed funding programme, namely in the field of mobile communications coverage on the railways.

The coverage obligations from the 2019 spectrum auction focus heavily on the transport routes. There will be a significant improvement in the availability of mobile communications coverage along the roads and railways as well as the waterways in the years ahead.

To avoid cross-interference between the radio systems used on trains, the Federal Ministry of Transport and Digital Infrastructure has issued a funding guideline on the replacement of existing GSM-R communications modules by interference-immune GSM-R communications modules or on the installation of appropriate filters. The call for applications for funding was launched on 1 October 2019.

Measure	Schedule
The Federal Government will support the installation of new GSM-R communications modules that will permit more tightly meshed mobile communications coverage along railway tracks (volume of funding: 50 million euros)	Call for applications for funding launched

# E. Improving emergency call availability

Nationwide mobile communications coverage is also important to ensure that, in emergencies, members of the public can obtain help rapidly – including in undeveloped areas. Regardless of their network operator, they will thus be able to make an emergency call anywhere where mobile communications coverage (2G, 3G, 4G or 5G) is provided by any network operator. Today, 98.5 per cent of the territory is already covered by the necessary networks. The measures contained in this strategy will increase the area covered.

To enable members of the public to make emergency calls anywhere in the country even before these measures take effect, we will examine the technological and legal conditions for the use of alternative solutions. Other countries already have experience of, for instance, special emergency alert transmitters which, via the international distress frequency (406 MHz) via satellite, make it possible to make emergency calls and at the same time for the persons in distress to be located.

Measure	Schedule
Examine the conditions for the deployment of alternative emergency call solutions that can be used nationwide.	1Q 2020

# F. Road map for the rollout of 5G

The aforementioned measures support not only the nationwide deployment of LTE but also of 5G. Some measures, on the other hand, specifically target the rollout of 5G.

# F.1 Rapid rollout of fibre optic networks

One indispensable prerequisite for the deployment of a comprehensive 5G network is the availability of fibre optic. Every metre of fibre optic cable that is installed for a fixed line also helps to improve the mobile communications network. The Federal Government's Broadband Funding Programme will ensure that there is a broad-based rollout and corresponding densification of fibre optic infrastructures, especially in rural areas. In the last parliamentary term alone, projects were launched that involved the installation of 320,000 km of fibre optic cable.

Translation

In addition, the Federal Ministry of Transport and Digital Infrastructure is planning to introduce a KfW (reconstruction loan corporation) programme designed to additionally speed up the rollout of fibre optic. With the funds to finance the low-interest loans (60 million euros of Federal Government funds), the aim is to have a total level of loans of 1 billion euros. In addition, the Landwirtschaftliche Rentenbank (agriculture annuity bank) has, since 2012, been granting loans from its own resources for the deployment of mobile communications and broadband in rural areas. The KfW programme represents an alternative to the Federal Government's Broadband Funding Programme for Fixed Broadband and is addressed to almost profitable projects which, with the help of this support measure, are to be delivered on an almost economically self-sufficient basis. The programme nor the GAK (Joint Federal Government's Broadband Funding Programme nor the GAK (Joint Federal Government's Broadband Funding Programme nor the GAK (Joint Federal Government's Broadband Funding Programme nor the GAK (Joint Federal Government's Broadband Funding Programme, thus ruling out double funding.

The objective of the programme is the deployment of public FTTH/FTTB networks and their connectivity with other telecommunications infrastructures (for instance connection of mobile communications masts) in Germany. As an alternative to the Federal Government's Broadband Funding Programme, the programme represents a low-threshold scheme that will make it possible, by means of low-interest loans and without much bureaucracy, to lift projects above the threshold of economic viability, thereby enabling telecommunications companies to deliver them on an economically self-sufficient basis. This will open up a further tailor-made funding opportunity that is designed to speed up the rollout of broadband and its connectivity with other telecommunications structures.

In the case of funded and private sector implemented deployment activities, it is apparent that the limited construction capacity is a "bottleneck" causing significant delays. In addition, excavation and trenching is a cost driver – a problem that is becoming increasingly serious given the currently very high level of construction activity. And conventional excavation and trenching requires a lot of time. An at least partial remedy to all these constraining factors is by making greater use than in the past of alternative installation methods. Thus, the Federal Ministry of Transport and Digital Infrastructure's Digital Networks Working Group will join forces with the telecommunications and construction industries and establish a Construction Steering Committee, whose remit will be to take measures to consolidate and strengthen excavation and trenching capacities and to standardize alternative construction methods. The greater use of trenching and the installation of overhead fibre optic cables would make a significant contribution towards speeding up the rollout of fibre optic. The former has so far encountered reservations from both excavation and trenching companies and local authorities, because standardized procedures are not yet available and they are afraid there may be liability problems in the event of damage. For this reason, a DIN standard is to be established describing the customary procedures and their implementation and setting a manageable framework for tenders and the resolution of possible liability issues. This will also make it possible to adapt the legal framework to make it mandatory for the contractors to use established trenching methods and to abolish derogations under building law. Given the importance of a rapid fibre optic and mobile communications rollout for future-proofing a region, consideration is also to be given as to whether, especially with regard to the

peripheral areas, the legal options for the installation of overhead fibre optic cables are to be widened, giving priority to the use of existing structures.

Measure	Schedule
Continue the Federal Government Funding Programme for Fibre Optic Rollout	Ongoing
KfW programme	Estimated starting in 1Q 2020
Set up a Construction Steering Committee for network deployment	Starting in 4Q 2019
Establish a DIN standard for trenching	Process already started at DIN
Widen the statutory options for the use of trenching	4Q 2020 (major recast of the Telecommunications Act)
Consider widening the statutory options for the installation of overhead fibre optic cables	As part of the major recast of the Telecommunications Act

# F.2 Funding of innovative ecosystems for 5G and corresponding clusters

5G will make a major contribution to the digital transformation of business processes and enable new innovative applications and business models. The mobile communications networks of the future will thus no longer be able to be based exclusively on wishes from the mass market. The quality of the services will improve in that, because of the 5G features, the specific requirements of the user industries – for instance in the fields of mobility and logistics, telecommunications, heavy engineering – and of the health care sector or agriculture are better met. 5G will not be able to fully exploit its potential unless there is a greater differentiation of the range of services. A major step for a 5G ecosystem are the frequencies in the 3.7 to 3.8 GHz range that have been provided and, which the Federal Network Agency earmarked for local 5G applications. The dynamism in the development of tailor-made applications in the field of campus networks, for instance in Industry 4.0 or agricultural holdings, will expedite the rollout of 5G.

In addition, the Federal Government is promoting research and development of 5G technology in Germany. By doing so, it is enabling many players to contribute to and shape 5G technology and the related standards and is making a major contribution towards developing Germany into a lead market for 5G. Local and private 5G networks, so-called 5G

campus networks, have emerged as a particular opportunity for the German industry. The idea and foundation for these networks were developed in the "Industrial Communication of the Future" research initiative.

The development of 5G ecosystems is also to be expedited with the 5G Innovation Programme. This is to involve trialling innovative 5G applications in a wide range of sectors – for instance mobility, agriculture, energy, health, security organizations, municipal services and many more – on urban and rural test beds.

Funding will be provided to the best concepts as of 2020/2021. A corresponding call for applications for funding was launched on 1 August 2019. But we also expect a widespread knock-on effect in the other regions in which consortia have been formed and clusters have emerged in the development of the concepts.

Six 5G research projects supported by universities or research institutions, which are suitable for short-term implementation, have already received a grant in 2019.

Measure	Schedule
Fund the "Industrial Communication of the Future" research initiative	Until 2020
Fund research into 5G campus networks and the deployment of laboratories for Industrial Communication	Until 2024
Fund innovative mobile communications technologies	2020 to 2023
Provide spectrum in the 3.7 to 3.8 GHz and 26 GHz ranges	Starting in 4Q 2019
Award grants to six 5G projects supported by universities or research establishments	4Q 2019
Use 5G Innovation Programme to provide 100,000 euros of funding to x regions to connect potential consumers and launch 5G pilot projects	Call for applications for funding for concepts completed
Funding of 5G implementation projects on the basis of the concepts submitted	2020/2021
Mobile network operators to achieve 5G coverage in at least 20 cities	End of 2020

## F.3 The next spectrum auction: densification of the 5G network also in rural areas

The coverage obligations from the 2019 auction already contain 5G rollout commitments The next spectrum award (probably in 2022/2023) will present an opportunity to establish more far-reaching coverage obligations and thus 5G-specific requirements to be met by the network quality over larger areas. This will happen in the light of the development of 5G deployment as well as 5G applications that has taken place by then. The rollout commitments to be established then will be an important building block for implementing a comprehensive 5G infrastructure in Germany and achieving further densification also in rural areas. Ahead of this, consideration is to be given as to whether, and if so how, the rules governing the spectrum award can be adapted in such a way that mobile communications coverage in rural areas is the crucial benchmark in the award and the latter is not based primarily on highest financial bids.

This will also include the options of extending spectrum use rights from the 700, 800 and 900 MHz ranges, which will expire in 2025 respectively 2033. It should also be taken into account that in the years ahead, a discussion will start on how other frequencies below 1 GHz can be used permanently. The Federal Government will request the Federal Network Agency at short notice to thoroughly examine the potential implications of a frequency extension for mobile communications coverage and to present the outcome of this examination by the end of 2020.

Consideration is also to be given as to whether, and if so to what extent, amendments to the Telecommunications Act might be appropriate in order to achieve an efficient use of spectrum.

Measures	Schedule
Review the rules governing the spectrum award before the start of the next procedure of spectrum allocation	2020
Federal Network Agency to comprehensively examine the implications of a spectrum extension for mobile communications coverage	2020
Establish further 5G rollout commitments	Next spectrum award estimated in 2022/2023

# F.4 Cooperation with the federal states and local authorities

If the further rollout of the mobile communications network is to be successful, all tiers of government – the Federal Government, federal states and local authorities – have to cooperate effectively and coordinate their measures appropriately. Here, the local authorities play a key role. Because in practice, the challenges become apparent in the actual delivery

of base stations on the ground. In turn, the federal states have a crucial role to play when it comes to issues relating to the necessary approvals. The "Convergence of Living Conditions" Commission has already succeeded in developing a common understanding of the objectives and individual problem-solving approaches for an improvement in mobile communications coverage. At a second Mobile Communications Summit, the activities of all three tiers are to be bolstered by specific next steps – including in cooperation with the network operators.

Measures	Schedule
Hold the second Mobile Communications Summit	1Q 2020
Involvement of the federal states and local authority associations into the activities of the deployment task force and the mobile communications infrastructure company.	Starting in 4Q 2019