2022

Telecoms Annual Report

Bundesnetzagentur

Foreword

Dear Reader,

I would love to look back on a year that was remarkable for once only for its calm and peaceful routine. Yet 2022 was another year where the caption for the overall situation read "Crisis". But you already know that it was a tense year and that we managed it well.

I will therefore gladly draw your attention to a project of ours that merits your confidence in us: we have taken steps to prepare for crises so that we are not passively at their mercy. The pandemic, the question of energy security and the disastrous flooding in the Ahrtal have shown us how fragile our networks are. This is the case for not only the electricity and gas networks, but for the telecommunications networks as well. The protection and stability of these networks must be as great as possible; they must always be functioning, especially in times of crisis. That is why we have made this a high priority. Together with the Federal Office for Information Security (BSI) and representatives of the telecommunications sector we formulated a strategy and in September 2022 drew up the "Strategy Paper on the Resilience of the Telecommunications Networks". The paper outlines our plans to increase the resilience of our public networks and publicly available services. Naturally our work does not end at the strategy paper: we are continuing the dialogue between the participating companies, associations and governmental bodies. Moreover, the four operators of public mobile networks in Germany have completed our detailed questionnaire on the resilience of their networks.

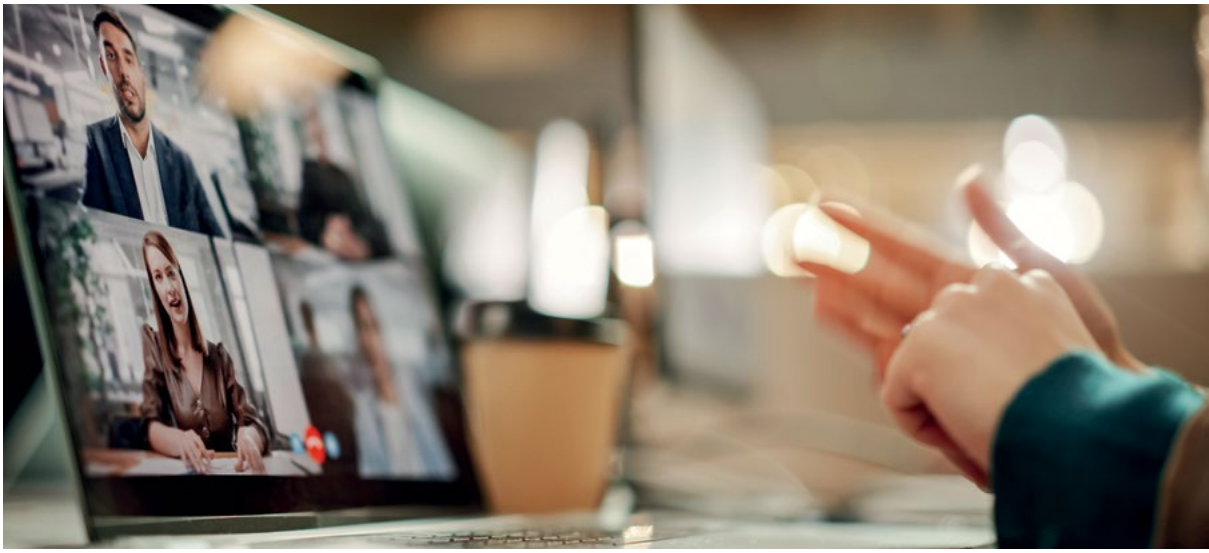
On an ongoing basis, we are in talks where we are able to develop concrete measures and make recommendations for action.

Even when there are no exceptional circumstances, information technology and telecommunications play a major role in everyday life. Our social lives, economic processes, healthcare and public safety are all largely dependent on telecommunications networks and services. Without resilient networks, we would undoubtedly encounter many more crises. That is why this project is so important.

While 2023 might be just as eventful, I am highly confident that 2022 has prepared us well. In a sense, we have become old hands at handling crises. Lets see to it that the networks follow suit.

Klaus Müller

President of the Bundesnetzagentur



Contents

The technical regulation strategic plan is available here (in German):

www.bundesnetzagentur.de/tk-technik

Market trends

The number of homes passed by fibre has nearly doubled in the last two years. Mobile data volumes continue to climb steeply and reached 6,714 million gigabytes at the end of 2022, up 23% on the year before.

Telecommunications markets as a whole

External revenue

According to the Bundesnetzagentur's preliminary calculations, external revenue in the German telecommunications market was €59.1bn in 2022, corresponding to a year-on-year increase of over 1%.

Both Deutsche Telekom AG and its competitors saw their external revenue rise in 2022, with €33.8bn (+1.5%) for the competitors and €25.3bn (+0.8%) for Deutsche Telekom AG. The competitors' share was 57% and Deutsche Telekom AG's 43%, proportions that were the same as in the previous year.

A breakdown of external revenue by market segment shows that the largest share is still attributable to mobile services. Accounting for a projected €27.51bn (47%), the market share of mobile services in 2022 was more than that of digital subscriber/fibre (xDSL/FTTx) networks at €24.98bn (42%) and of hybrid fibre coaxial (HFC) networks at €5.82bn (10%).

xDSL/FTTx networks

In the xDSL/FTTx networks segment, external revenue amounted to about €24.98bn in 2022, according to currently available data. This is a similar amount to the year before.

External revenue can be broken down into retail services, wholesale services and other external revenue. Revenue via retail is generated from services for private, commercial and public-sector final consumers. Its share gained one percentage point to 83% in 2022. Wholesale services for fixed-network and mobile operators and pure service providers outside of the Deutsche Telekom AG group took a share of 16% in 2022, the same as in the previous year. These

services include wholesale products for voice traffic and telephony, broadband and internet, and infrastructure services.

HFC networks

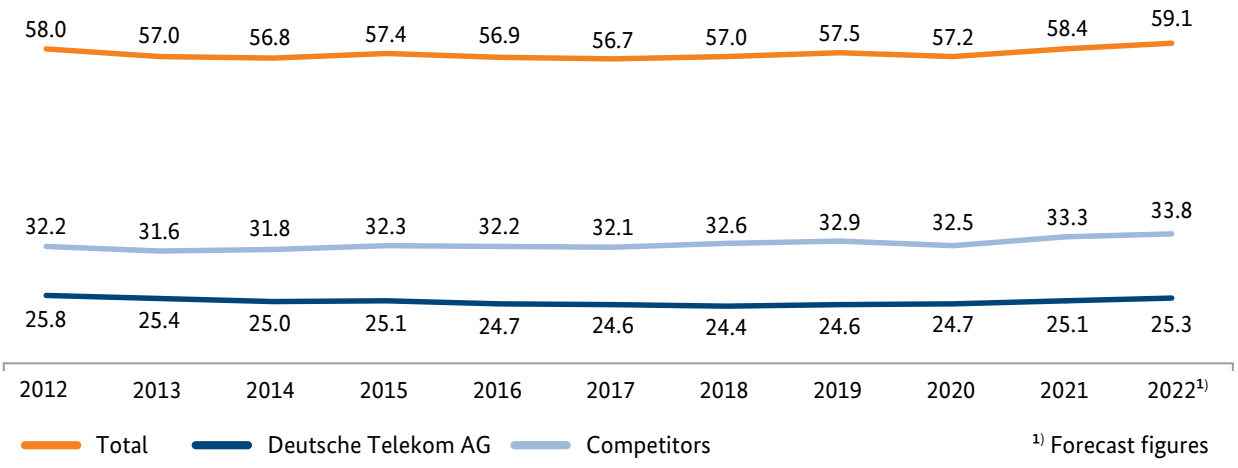
HFC network operators registered a decrease in revenue in 2022, with external revenue falling more than 3% on the previous year to a projected €5.82bn. By far the largest proportion of this, 96%, was for revenue via retail, while the share of external revenue for wholesale was 1%. The wholesale business is of very little significance compared with the xDSL/FTTx segment.

Mobile services

External revenue from mobile services amounted to around €27.51bn in 2022, just under 4% above the prior-year figure. This can be broken down into 68% via retail (excluding terminal equipment), 9% via wholesale and 21% via terminal equipment.

The distribution of revenue between network operators and service providers/mobile virtual network operators (MVNOs) shows that the lion's share of this external revenue (over 80%) was attributable to network operators and that the proportions have remained stable. From 2020 to 2022, the share of network operators was 82% and that of service providers/MVNOs 18%.

External revenue in the telecommunications market
(€bn)



External revenue by sector

	2020		2021		2022[1]	
	€bn	**%**	**€bn**	**%**	**€bn**	**%**
External revenue on the telecommunications market	**57.2**		**58.4**		**59.1**	
External revenue in xDSL/FTTx networks	**24.63**	100	**24.94**	100[2]	**24.98**	100
Via retail	20.04	81	20.51	82	20.62	83
Via wholesale	4.17	17	4.06	16	4.03	16
Other external revenue	0.42	2	0.37	1	0.33	1
External revenue in HFC networks	**5.94**	100	**6.02**	100[2]	**5.82**	100
Via retail	5.64	94	5.74	95	5.56	96
Via wholesale	0.08	1	0.09	1	0.07	1
Other external revenue	0.22	4	0.19	3	0.19	3
External revenue from mobile services	**25.65**	100	**26.50**	100[2]	**27.51**	100[2]
Via retail	17.47	68	17.87	67	18.61	68
Via wholesale	2.50	10	2.44	9	2.40	9
Via terminal equipment	5.00	19	5.28	20	5.66	21
Other external revenue	0.68	3	0.91	3	0.84	3
Other external revenue	**0.97**	100	**0.90**	100	**0.78**	100

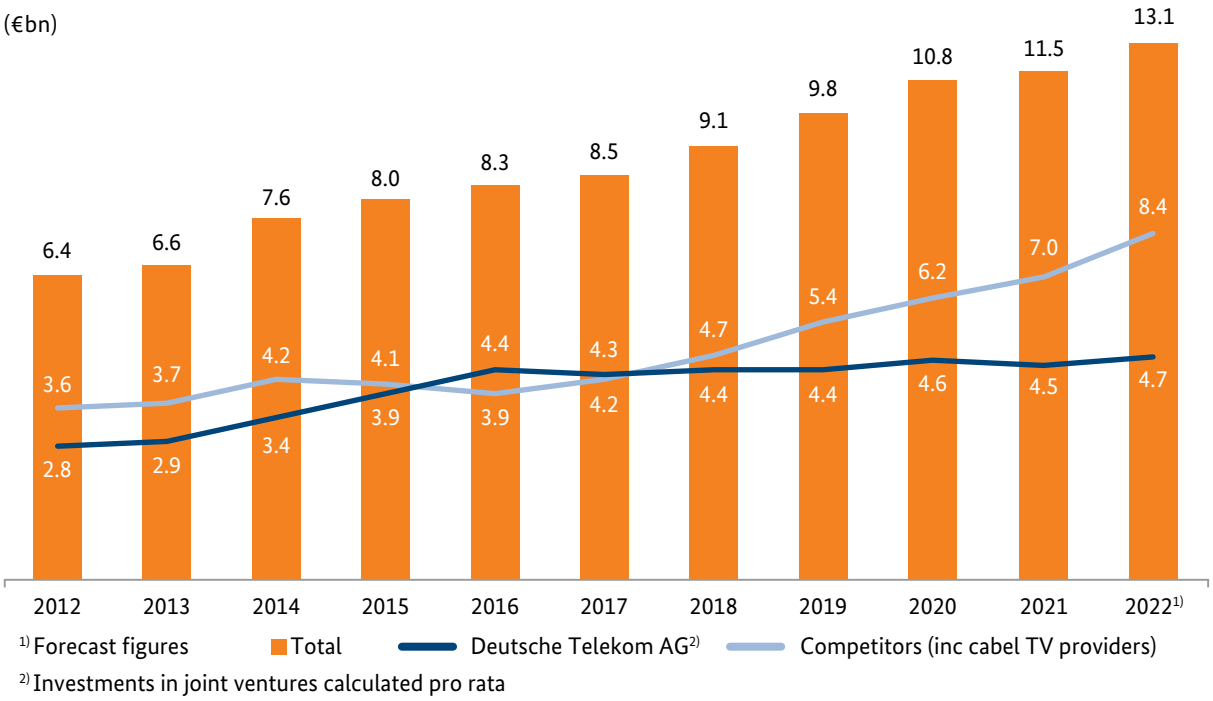
1) Forecast figures
2) Totals may deviate from rounded cumulative values.

External revenue from mobile services

	2020		2021		2022[1]	
	€bn	**%**	**€bn**	**%**	**€bn**	**%**
Total	**25.65**	**100**	**26.50**	**100**	**27.51**	**100**
Network operators	20.95	82	21.64	82	22.59	82
Service providers/MVNOs	4.70	18	4.86	18	4.92	18

1) Forecast figures

Investments in fixed assets in the telecommunications market
(€bn)



Investments in fixed assets

Investments in fixed assets in the telecommunications market were up again in 2022, according to currently available data. At €13.1bn, they were €1.6bn higher than the previous year. Competitors invested €8.4bn in 2022 compared with €7.0bn in 2021. The growth rate was 20%. Deutsche Telekom AG's investments increased by €0.2bn to €4.7bn in 2022.

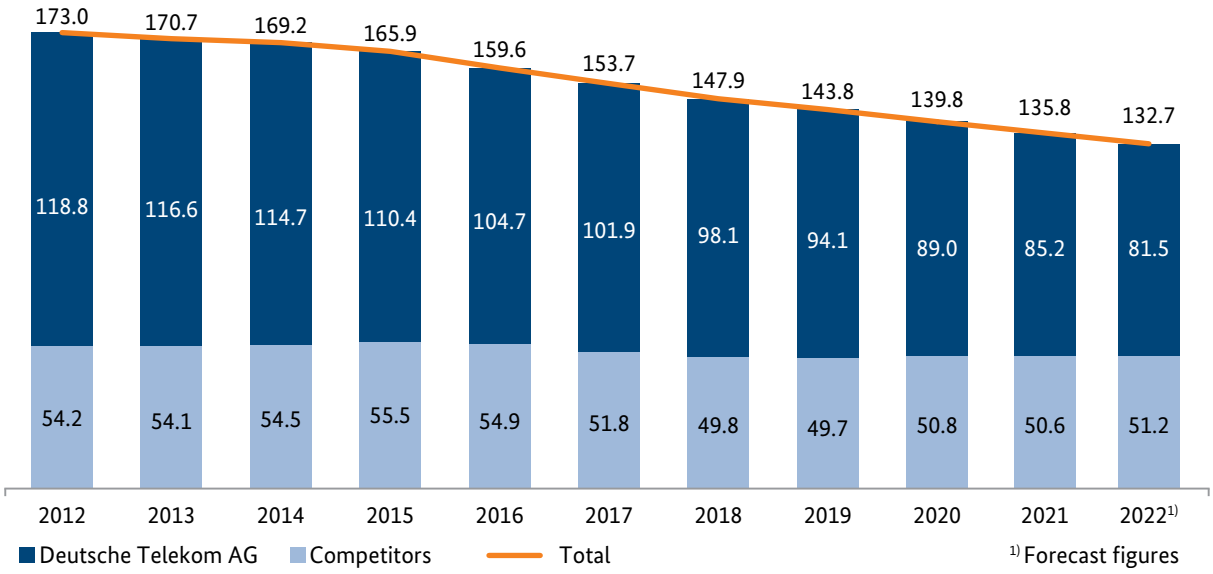
The companies were mostly investing in new broadband network infrastructure. This includes investments to expand coverage and/or upgrade connection performance. These investments accounted for about 78% of total investments in 2022. Approximately 9% went towards the maintenance of existing broadband network infrastructure and around 13% was used for other purposes, such as investments in subscriber terminal equipment, the expansion of data centres and investments in customer support.[1]

In the fixed-network segment, investments were devoted primarily to rolling out optical fibre networks. In mobile networks, the focus was on rolling out 5G networks.

From the time the market was opened up in 1998 through to the end of 2022, companies invested a total of just under €200bn in fixed assets in the telecommunications market. Of this amount, 54% (€107.2bn) is attributable to competitors and 46% (€92.1bn) to Deutsche Telekom AG.

[1] When interpreting the data, it should be noted that the assignment of investments to the categories "existing broadband network infrastructure", "new broadband network infrastructure" and "other" may have been subject to different interpretation by the companies surveyed in order to collect information for this report. In addition, not all companies were able to provide a breakdown of their data. These companies are not included in the calculation of shares.

Employees in the telecommunications market
(thousands)



Employees

According to preliminary calculations by the Bundesnetzagentur, 132,700 people were employed in Germany by companies in the telecommunications market at the end of 2022, which is 3,100 fewer (2.3%) than in the previous year. The decline is a result of ongoing workforce reduction activities at Deutsche Telekom AG, where the headcount fell by 3,700 to 81,500. By contrast, the number of people employed by the competitors rose by about 600 from the previous year to around 51,200 at the end of 2022.

Fixed network

Broadband connections

The number of contract-based broadband connections[2] increased to a total of about 37.5mn[3] by the end of 2022, bringing the proportion of private households in Germany with active broadband access to about 91%.

The majority of broadband connections, about 66% or 24.7mn, continue to be based on various DSL technologies[4]. Together, all other technologies accounted for approximately 12.8mn connections. Most of these were based on HFC networks (around 8.7mn). Approximately 3.4mn were based on fibre-to-the-home (FTTH)

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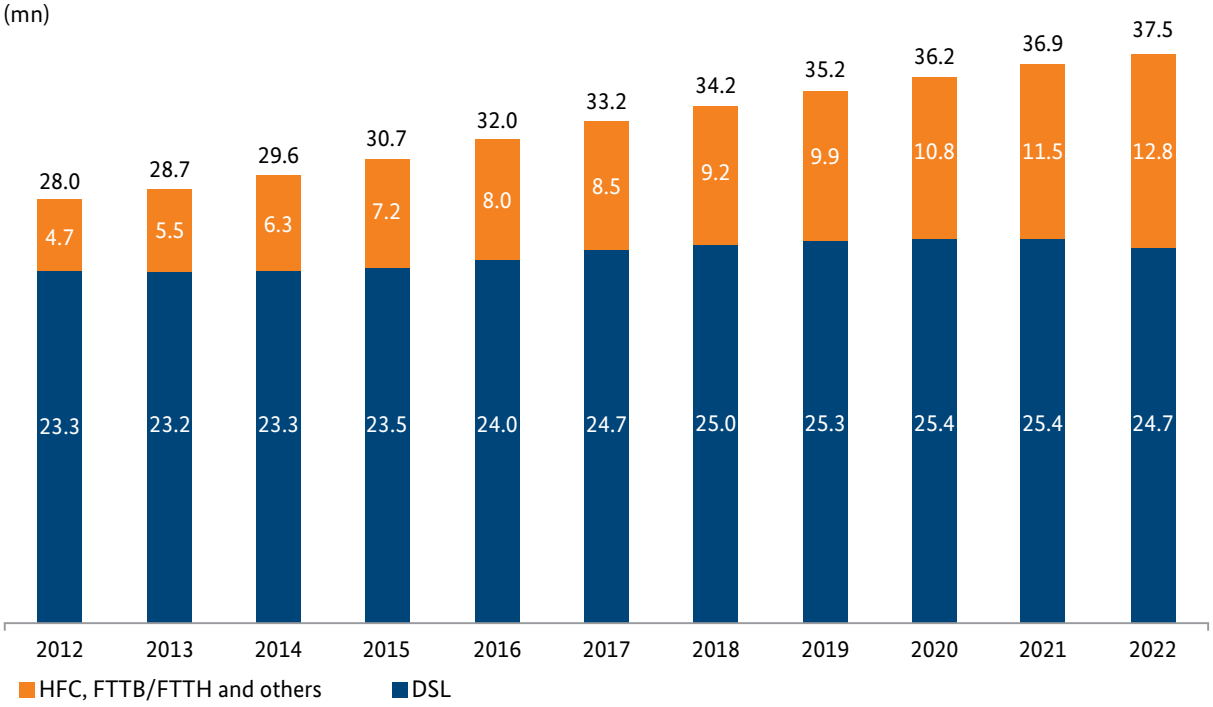
[2] Broadband connections include all connections with a bandwidth of at least 144 kilobits per second (Kbps). The Bundesnetzagentur bases this threshold on the requirements defined by the European Commission in its latest broadband report (COCOM).

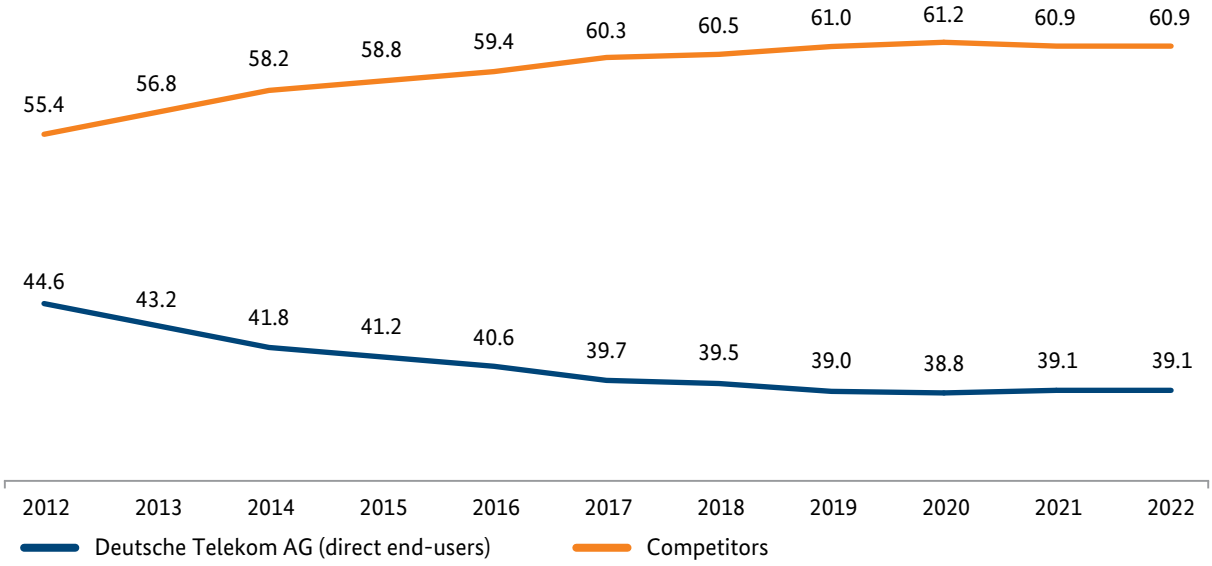
[3] Unlike in previous years, the figures for 2022 for the first time include fixed wireless broadband services.

[4] Hybrid connections are included in the DSL figures.

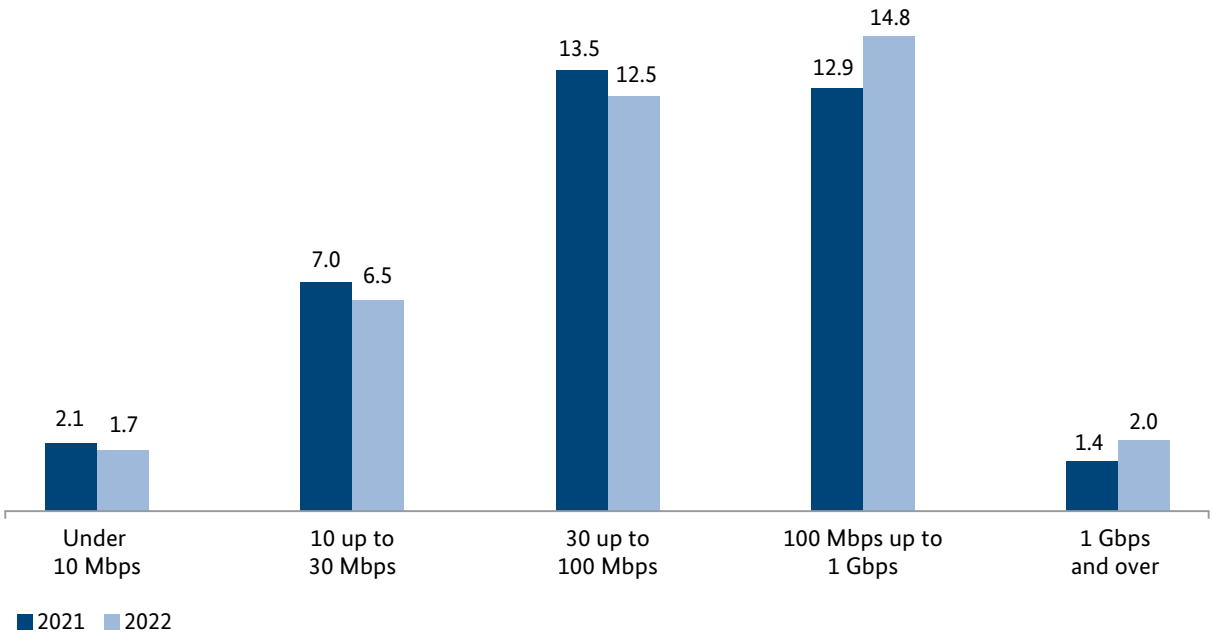
Active fixed broadband connections
(mn)



Share of fixed broadband
(%)



Advertised maximum download speeds of active fixed broadband connections
(mn)



or fibre-to-the-building (FTTB). Around 0.7mn connections were fixed wireless broadband, broadband wireless access (BWA), fixed or satellite connections.

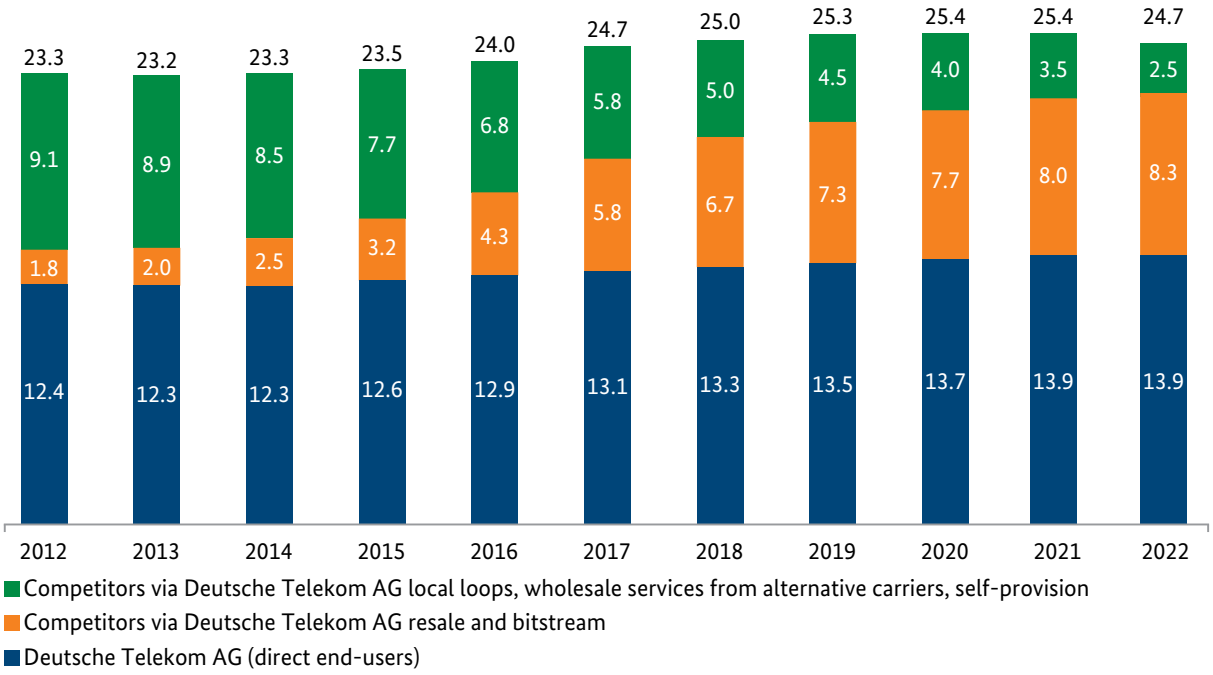
As far as marketing to end-users was concerned, Deutsche Telekom AG's competitors maintained their market share of all retail broadband connections of around 61% at the end of 2022.

Transmission rates

In the broadband market, there was again strong demand for connections with fast transmission speeds in 2022. Some 16.8mn broadband connections were available with an advertised transmission rate of at least 100 megabits per second (Mbps) at the end of 2022. This amounted to about 45% (2021: 39%) of all broadband connections sold in fixed networks (37.5mn).

Roughly 2.0mn connections had an advertised speed of at least 1 gigabit per second (Gbps), while some 1.7mn connections still had a maximum data rate of under 10 Mbps at the end of 2022.

Active DSL connections
(mn)



Digital subscriber line connections

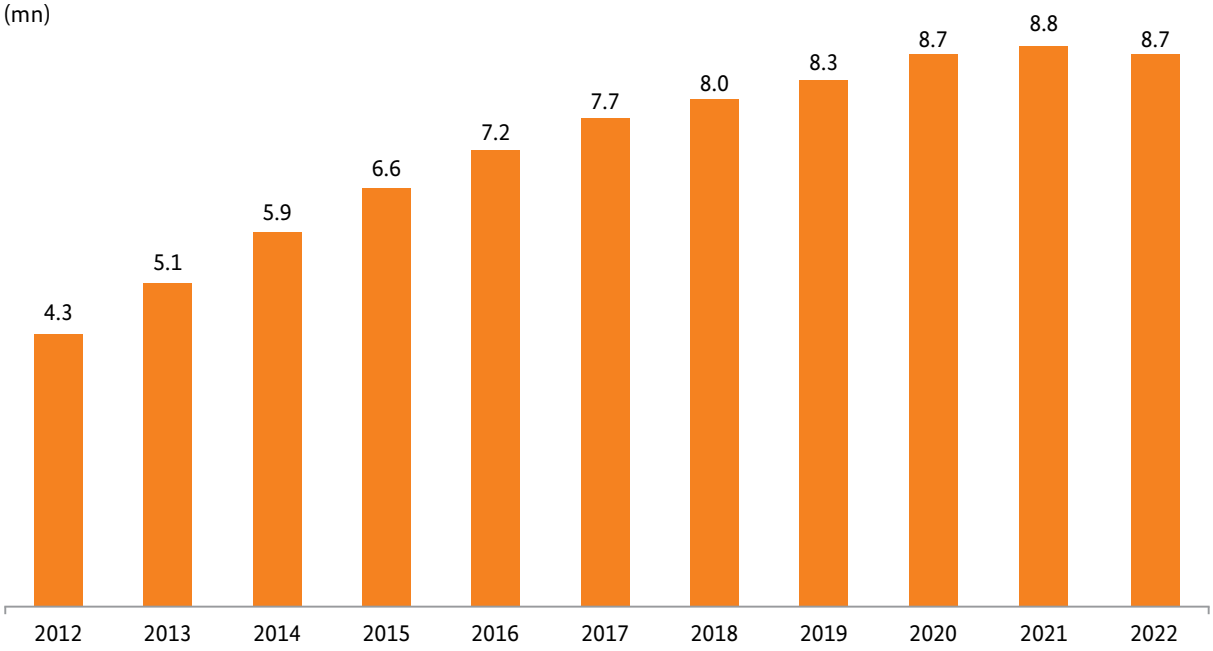
The number of active digital subscriber line (DSL) connections in 2022 was about 0.7mn lower than in the previous year. At the end of 2022, some 24.7mn DSL connections were operational. Around 13.9mn of these were attributable to direct end-users of Deutsche Telekom AG and around 10.8mn to competitors, which primarily marketed DSL connections to end-users on the basis of the specific wholesale products of Deutsche Telekom AG or alternative carriers. Based on these figures, Deutsche Telekom AG's competitors had achieved a DSL market share of around 44% by the end of 2022.

At around 19.5mn connections, very high data rate DSL (VDSL) technology accounted for approximately 79% of all active DSL connections at the end of 2022. About 8.1mn VDSL connections were provided by the competitors compared to Deutsche Telekom AG's total of around 11.4mn direct end-users.

Vectoring technology is the main reason for the wide spread of VDSL. It can be used to provide transmission rates of up to 250 Mbps.

The significance of VDSL was also reflected at the wholesale level. In the last few years it has led to a considerable rise in demand for specific VDSL wholesale products from Deutsche Telekom AG, with bitstream wholesale products seeing particularly strong growth. Deutsche Telekom AG's layer 2 bitstream product was the main cause of this increase. It has been offered by

Active broadband connections via HFC networks
(mn)



Deutsche Telekom AG alongside its established layer 3 bitstream product since the end of 2016 and is another alternative for providing end-user access.

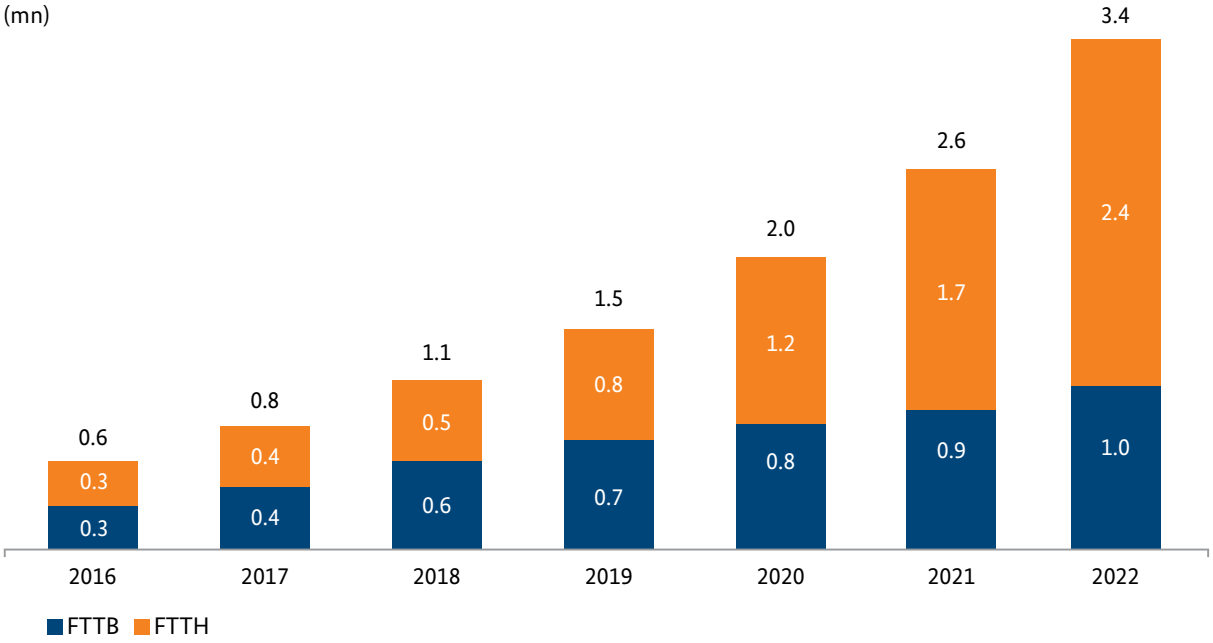
According to Deutsche Telekom AG, there were around 4mn connections based on layer 2 bitstream access at the end of 2022.

By contrast, there was a considerable decrease in the number of competitor-operated connections based on Deutsche Telekom AG's high-bit-rate, unbundled local loops, wholesale services provided by other carriers and self-provision (about 2.5mn), perhaps due to their limited usage possibilities amidst the ongoing rollout of vectoring technology.

Broadband connections via HFC networks

These hybrid networks comprising fibre and coaxial cables now frequently offer download speeds of up to 1 Gbps. At the end of 2022, there were around 8.7mn connections via HFC infrastructure. This reflects a slight fall in demand for the first time following a steady increase to a peak of 8.8mn connections at the end of 2021.

Active broadband connections via FTTH/FTTB
(mn)



Number of end-users covered or passed by FTTH/FTTB

	2020	2021	2022
Number of end-users covered or passed by FTTH/FTTB (homes passed)	6.7mn	8.9mn	13.1mn
Active and inactive FTTH/FTTB end-user connections (homes connected)	4.5mn	5.5mn	6.4mn
Active FTTH/FTTB end-user connections (homes activated)	2.0mn	2.6mn	3.4mn
Take-up rate	30%	29%	26%

Broadband connections via FTTH/FTTB

Thanks to their outstanding technical properties and almost unlimited transmission rates, optical fibres are considered to be the perfect medium for transporting data. The number of active fibre connections with FTTH or FTTB for private, commercial and public-sector end-users increased to 3.4mn at the end of 2022, around 800,000 more than at the end of the previous year. These were split between about 2.4mn FTTH connections (71%) and about 1.0mn FTTB connections (29%). The share of FTTH connections has been greater than that of FTTB connections since 2019.

According to the Bundesnetzagentur's calculations, the number of homes passed by FTTH/FTTB grew to around 13.1mn by the end of 2022, an increase of 4.2mn against 2021 (8.9mn).[5] As well as active connections, the figures for homes passed include inactive FTTH/FTTB end-user connections that are available but are not yet operational under a corresponding

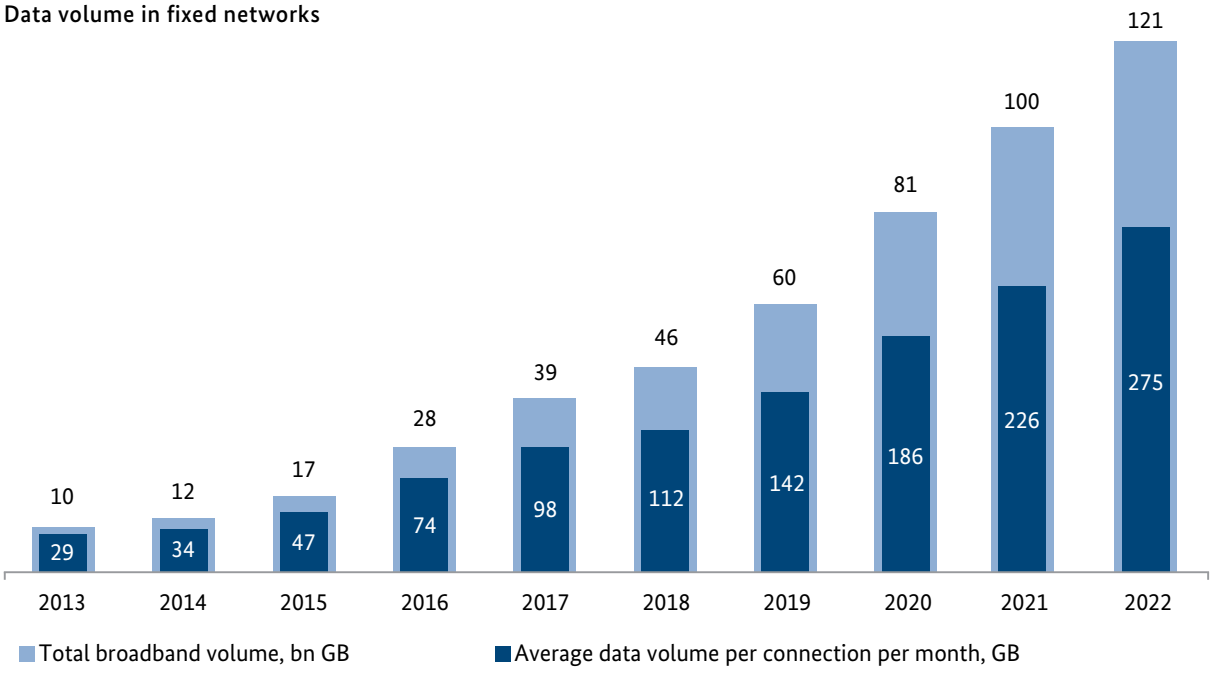
[5] These figures may include a small number of homes counted more than once where two or more providers have deployed fibre infrastructure.

contract, as well as end-users directly passed by FTTH/FTTB.[6] Fibre infrastructure already reaches these customers, ie an FTTH/FTTB-dedicated optical fibre cable or bundle directly passes their property (at a maximum distance of 20 metres). Further investment is required to complete the connection to these end-users.

The growth in demand drove up the share of homes activated among total active broadband connections from 7.1% in 2021 to 9.1% by the end of 2022. However, the prevalence of these connections is still low, largely due to the high level of existing coverage with high-speed infrastructure (VDSL vectoring and HFC networks). The FTTH/FTTB share of broadband connections is expected to grow sharply in the coming years. The take-up rate, which is the proportion of homes activated or passed, was about 26% at the end of 2022.

[6] The sum of active and inactive FTTH/FTTB end-user connections is referred to as "homes connected".

Data volume in fixed networks



Satellite broadband connections

Nearly 24,000 customers were using satellite internet access from virtually any location at the end of 2022. Demand remained low due to the availability of more cost-effective alternative access options, often with higher maximum transmission speeds. However, satellite internet connections can help to provide full broadband coverage in regions where other technologies are not, or not sufficiently, available.

Data volume

In 2022, a total of 121bn gigabytes (GB) of data was transmitted on the basis of broadband connections in fixed networks in Germany.[7] Since 2019 data volume has increased each year by around 20bn GB.

This corresponds to an average of approximately 275 GB per fixed-network customer per month in 2022.

Bundled products

Bundled products that, in addition to a broadband connection, include at least one other telecommunications service (fixed-network telephony, TV or mobile services) in a single contract are offered as standard by companies in their marketing to end-users. It is also usually more expensive to purchase these services separately.

In addition, consumers who have already entered into a fixed-network and mobile contract with a provider can increasingly take advantage of discounts and exclusive offers by bundling the two contracts in special advantage programmes. By offering such measures, providers seek primarily to increase customer loyalty to their products.

At the end of 2022, Deutsche Telekom AG and its competitors had around 35.1mn contracts with bundle tariffs and advantage programmes. Bundled products with two services were still the most common of these, accounting for approximately 20.4mn customers. The majority of these dual-play bundles consist of an IP-based telephone service in addition to a broadband connection.

Around 13.1mn customers had triple-play bundles at the end of 2022. Approximately 67% of these consisted of a broadband connection and telephone service and an additional TV service, whilst roughly 33% had a mobile component instead of the TV service.

At the same time, around 1.6mn customers were using quad-play bundles and advantage programmes consisting of four fixed-network and mobile services.

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[7] The traffic volumes shown do not include data volumes from Deutsche Telekom AG's IPTV (internet-based TV) service or data traffic via mobile networks with hybrid and fixed-location use.

Telephone connections

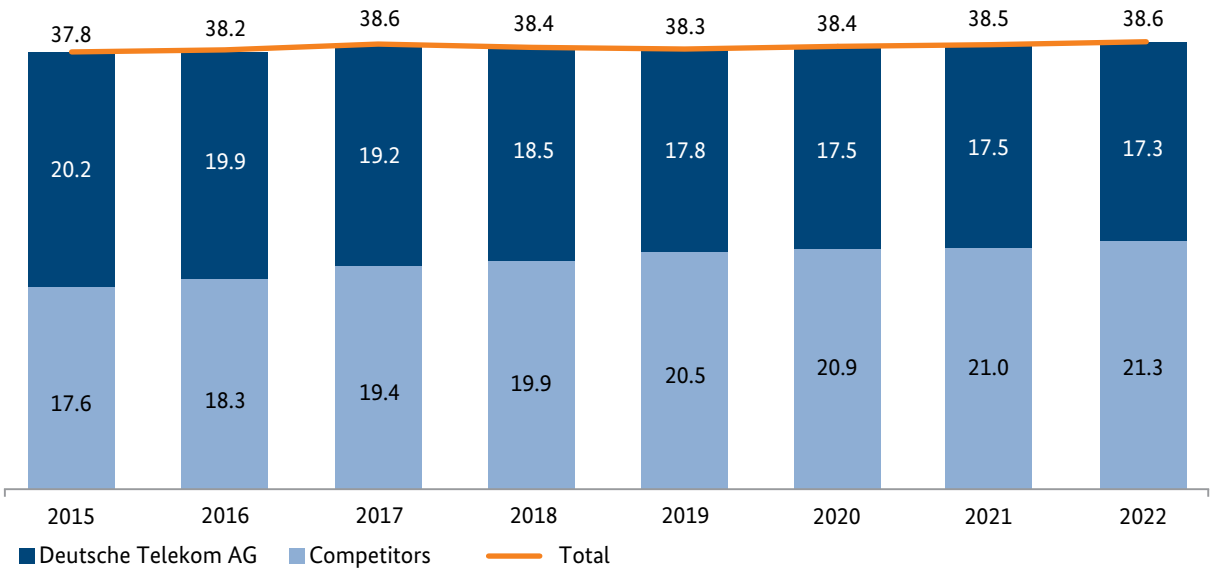
The number of voice communication connections in the fixed networks has been relatively stable in recent years. The total number of telephone connections in 2021 was 38.5mn, which rose slightly to about 38.6mn in 2022.

The competitors of Deutsche Telekom AG have increased their share every year. In 2022 they accounted for 21.3mn telephone connections, compared with 21.0mn in the previous year. The number of Deutsche Telekom AG telephone connections decreased by 0.2mn year-on-year to 17.3mn in 2022. This corresponds to a share of 45% of all telephone connections in 2022 for Deutsche Telekom AG and 55% for the competitors.

Conventional fixed-network telephony using analogue and ISDN[8] connections has now moved almost completely to Voice over Internet Protocol (VoIP). At the end of 2022, the number of analogue/ISDN connections in the fixed networks of Deutsche Telekom AG and its competitors was only around 0.1mn. The majority of telephone connections (38.5mn) were based on IP technology.

[8] Integrated Services Digital Network

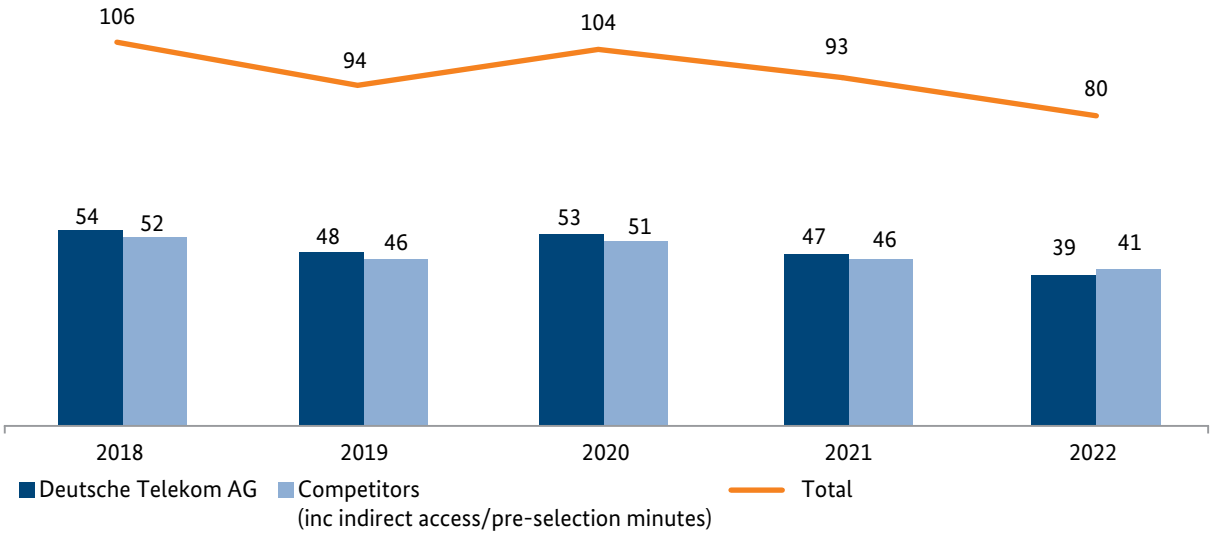
Telephone connections
(mn)



Telephone connections and competitors' shares

	2020		2021		2022	
	Total	Competi-tors' share	Total	Competi-tors' share	Total	Competitors' share
	mn	%	mn	%	mn	%
IP-based telephone connections (VoIP)	37.94	54	38.19	54	38.45	55
Analogue/ISDN connections	0.44	97	0.30	99	0.13	99.9
Total	**38.38**	**54**	**38.49**	**55**	**38.58**	**55**

Outgoing call minutes in fixed networks
(bn)



Call minutes in fixed networks

Up until 2019, the volume of call minutes from fixed networks to fixed networks within Germany, to German mobile networks and to international fixed and mobile networks was in decline.[9] In 2020, the first year affected by the coronavirus pandemic, call minutes rose to about 104bn, and in the second year of the pandemic (2021) they fell by 11% to around 93bn. Call minutes fell again in 2022 to about 80bn, continuing the steady decline that was interrupted by the pandemic.

Approximately 39bn (49%) of the total call minutes in 2022 can be attributed to Deutsche Telekom AG, which is a drop of 17% from the approximately 47bn minutes the year before.

The call volume handled by competitors decreased by 11%, from 46bn minutes in 2021 to about 41bn minutes in 2022. For the first time, the competitors' share (51%) was higher than Deutsche Telekom AG's. As in previous years, direct traffic accounted for the majority of these minutes, around 40bn (97%) in 2022. Indirect access and carrier pre-selection calls accounted for a total of more than 1bn minutes, or almost 3%, of all calls handled by competitors in 2022 (more than 1% of total calls). A decrease in pre-selection in the Deutsche Telekom AG network means that indirect access again exceeded pre-selection call volumes in 2022.

Of the total 80bn minutes of calls made in 2022, around 68bn were within the national fixed networks. About 10bn minutes were made to the national mobile networks and around 2bn to foreign fixed and mobile networks. The competitors had a share of about 51% of these national fixed-network minutes, 50% in national mobile networks and 53% of the international minutes.

[9] In general it should be noted when interpreting these call minutes that certain traffic volumes are not included in the database. These primarily include voice transmission by over-the-top (OTT) providers that do not operate their own fixed-network lines or telecommunications networks and that offer internet-based services.

Mobile services

Actively used SIM cards

Data collected by the Bundesnetzagentur suggests that there were 104.4mn active SIM cards at the end of 2022. This does not include cards for machine-to-machine (M2M) data communications. Statistically speaking, each resident has around 1.2 SIM cards. SIM cards are defined as active if they have been used for communication in the last three months or if an invoice has been generated for the SIM card in this period.

The shares of SIM cards attributable to network operators and to service providers and MVNOs was the same in 2022 as in the previous year. The network operators accounted for 77% (80.5mn) of SIM cards and the service providers and MVNOs for 23% (23.9mn). With contracts, by contrast, there was a small change of three percentage points from prepaid to postpaid cards. At the end of 2022, 69% (72.5mn) of SIM cards were on postpaid contracts and 31% (31.9mn) on prepaid contracts.

Some 58.3mn SIM cards were being used for M2M at the end of 2022 (2021: 45.6mn). This increase of nearly 28% is a result of sustained high growth in smart home and Internet of Things (IoT) applications.

The number of SIM cards in active use in long term evolution (LTE) networks was 74.5mn at the end of 2022, up almost 5% year-on-year.

Voice communication is increasingly being made using the internet-based service Voice over LTE (VoLTE), which in future will be joined by Voice over New Radio (VoNR). These are IP-based and offer much better call quality, faster connections and more efficient use of bandwidth. The number of active users with a VoLTE-capable device in combination with a suitable mobile contract rose from 56.4mn at the end of 2021 to 61.2mn at the end of 2022.

Use and distribution of active SIM cards

		2020		2021		2022	
		mn	%	mn	%	mn	%
Total excluding M2M cards[1)]		**107.4**		**106.4**		**104.4**	
Penetration (SIM cards/inhabitant)		**-**	**129**	**-**	**128**	**-**	**124**
Business:	Network operators (MNOs)	80.2	75	81.5	77	80.5	77
	Service providers/ MVNOs	27.2	25	24.9	23	23.9	23
Contract type:	Postpaid	72.4	67	70.7	66	72.5	69
	Prepaid	35.0	33	35.7	34	31.9	31
M2M cards		36.0	-	45.6	-	58.3	-
LTE subscribers (excluding M2M cards)		63.6	-	71.2	-	74.5	-
VoLTE users		45.7	-	56.4	-	61.2	-

1) The drop in active SIM cards in 2021 is due to an adjustment to exclude inactive cards.

Registered SIM cards

The total number of SIM cards registered in Germany is significantly higher than the total number of SIM cards in active use. One reason for this is that second and third devices or other spare SIM cards are not in constant use.

At the end of 2022 the mobile network operators reported a total of 169.0mn registered SIM cards.[10] This is an increase of around 7.7mn cards compared with 2021.

Mobile data volume

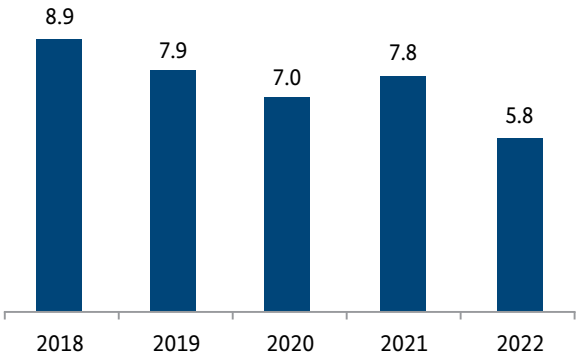
Mobile data volumes are continuing to increase steeply. Current data collected by the Bundesnetzagentur suggests that 6,714mn GB of data were transmitted in 2022, up from 5,457mn GB in 2021. This corresponds to an increase of 23%. The vast majority (94%) of data traffic took place via LTE.

The average data volume used per active SIM card, per month, rose by about 23% year-on-year in 2022 to 5.3 GB.

SMS messages

Use of the short message service (SMS) had been in decline since it peaked in 2012 at 59.8bn, as more and more people acquired internet-capable smartphones and instant messaging services were introduced. Following a short-term rise in 2021 to 7.8bn messages, there was a further decrease in 2022. The number of SMS messages sent fell to 5.8bn. Each active SIM card sent an average of about five messages a month, down from around six the previous year.

SMS messages sent
(bn)



[10] No standard definition applies to the total number of SIM cards specified in the publications of network operators. Each company decides for itself how to count SIM cards and when adjustments are required.

Call minutes

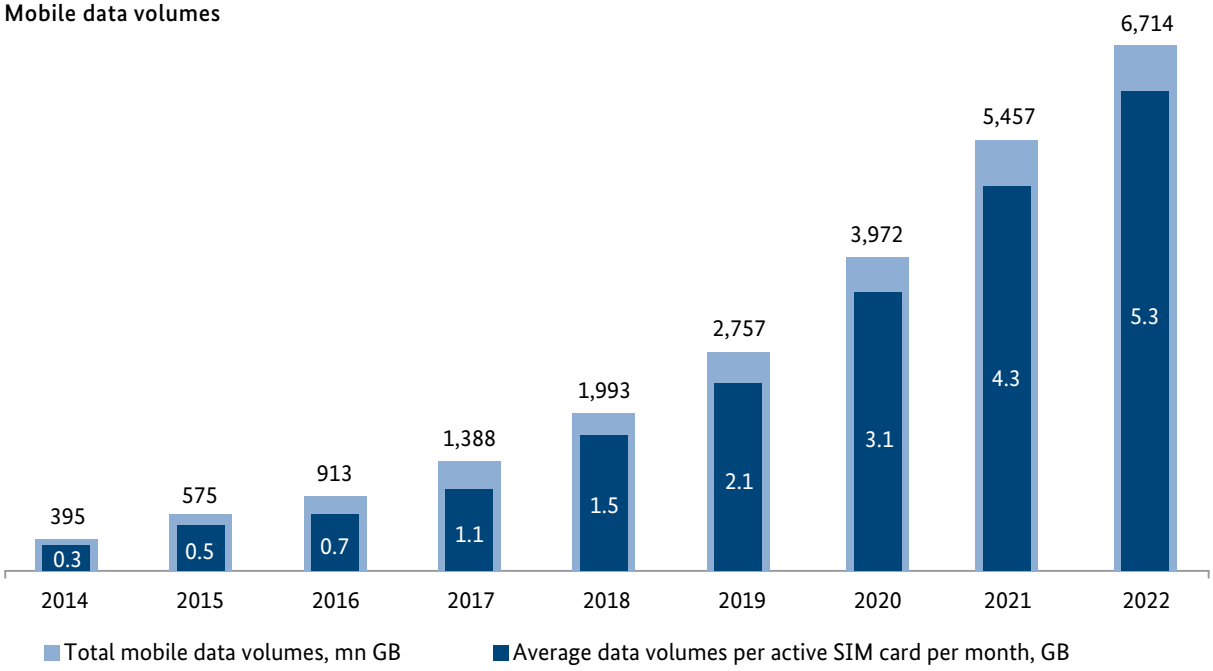
Around 159bn minutes of outgoing calls were made via mobile networks in Germany in 2022. In other words, about 126 minutes of calls a month were made with each active SIM card. Mobile call volumes significantly exceed the volume of calls in the fixed networks (around 80bn minutes). For the first time, nearly twice as many call minutes were generated through mobile terminal devices as were generated through landlines. This is due to a variety of factors. Improved voice quality and network coverage, flat rates and the fact that younger generations tend not to use landlines are reasons for this development.

Overall there was a slight year-on-year decline of 2% in mobile telephony in 2022, which may indicate a return to pre-pandemic usage patterns.

The breakdown of mobile call traffic has varied only slightly in recent years. Around 42% of call minutes in 2022 (2021: 41%) were within the same operator network (on-net) and approximately 34% were calls to other national mobile networks (off-net), the same as in the previous year.

The number of inbound call minutes terminated within mobile networks in 2022 decreased by 1% to around 139bn minutes. Roughly 47% of the call minutes were from the same operator network and 41% from other national mobile networks.

Mobile data volumes



Outbound and inbound mobile voice minutes				
	2019	2020	2021	2022
	Minutes (bn)	Minutes (bn).	Minutes (bn)	Minutes (bn)
Outgoing traffic from mobile networks	**126.88**	**155.28**	**162.58**	**159.27**
To German fixed networks	30.22	37.60	36.90	33.51
To the same mobile operator network	51.98	62.62	66.53	66.78
To other mobile operator networks	40.50	50.67	54.75	54.88
To foreign networks (fixed/mobile)	2.67	2.76	2.39	2.60
Other traffic	1.51	1.63	2.02	1.51
Incoming traffic to mobile networks	**104.36**	**130.92**	**139.80**	**138.49**
From German fixed networks	9.78	13.99	14.31	12.95
From the same mobile operator network	50.26	61.62	66.27	65.37
From other mobile operator networks	41.47	52.42	56.30	57.45
From foreign networks (fixed/mobile)	2.59	2.58	2.49	2.32
Other traffic	0.26	0.31	0.43	0.40

International roaming

Since the introduction of "roam like at home", which generally allows consumers to use their domestic mobile plan on comparable terms in other EU countries, the use of mobile data and voice services had been increasing. The Covid-19 pandemic led to a year-on-year decrease in 2020, followed by a considerable increase in the subsequent two years. The volume of data generated abroad rose by 75% from 149.3mn GB in 2021 to 261.7mn GB in 2022. This large increase is presumably due primarily to people travelling abroad again following the pandemic, together with the spread of online communications services and the increased use of over-the-top (OTT) content services, such as streaming services. The number of outgoing call minutes abroad increased by 18% from 3,183mn in 2021 to 3,746mn in 2022. The number of SMS messages sent abroad was up 18% from 152mn in 2021 to 179mn at the end of 2022.

International roaming				
	2019	2020	2021	2022
Volume of data generated abroad (mn GB)	98.7	88.3	149.3	261.7
Outgoing call minutes abroad (mn)	3,812	2,887	3,183	3,746
SMS sent abroad (mn)	223	110	152	179

Radio base stations	2020		2021		2022	
		%		%		%
Total	**224,554**	**100**	**187,443**	**100**	**203,241**	**100**
5G	19,510	9	29,959	16	41,945	21
LTE/4G	75,901	34	82,479	44	85,054	42
UMTS/3G	56,934	25	652	0	111	0
GSM/2G	72,209	32	74,353	40	76,131	37

Infrastructure

The expansion of the mobile communication networks relies heavily on the installation of additional radio base stations. The number of these interfaces between the wireless and wire-based network rose by 8% in 2022 to 203,241, mainly due to the expansion of the 5G networks. The number of LTE base stations in operation increased by 3% to 85,054. The number of 5G base stations grew sharply, by 40% from 29,959 at the end of 2021 to 41,945 at the end of 2022. In addition, small cells were also reported. These provide additional capacity at locations of high user concentration by densifying the network in city centres, affecting both the speed of data throughput and the data quality (such as high-resolution streaming).

Rollout of 5G networks is partly based on the existing 4G infrastructure. This is mainly done using Dynamic Spectrum Sharing (DSS). DSS allows bands to be used for both 4G and 5G at the same time. The bandwidth available in a particular band is shared between the active 4G and 5G users in a radio cell according to demand. Base stations with DSS were mostly counted as both 4G and 5G base stations. DSS technology enables 5G coverage to be achieved across the country relatively quickly. The full potential of 5G, including particularly high data speeds or low latency, is not always reached.

In practice, a physical antenna site usually contains radio base stations of different mobile communication standards. The number of antenna sites (88,820 at the end of 2022) is therefore lower than the number of radio base stations (203,241 at the end of 2022). Infrastructure operated jointly by more than one network operator, a practice known as site sharing, is counted multiple times in the physical site data.

Most of the antenna sites are connected via fibre or fixed links. At the end of 2022, about 50% of the sites were connected via fibre and about 48% via fixed links. The number of fibre-connected sites was up 11% year-on-year. A small number of sites are still connected via copper-based transmission paths.

Key figures and competitors' shares

The following table summarises selected key figures and competitors' shares in the telecommunications market for the period from 2020 to 2022.

Key figures and competitors' shares in the telecommunications market			
Key figures	**2020**	**2021**	**2022**
External revenue (€bn)	57.2	58.4	59.1 [1)]
Investments (€bn)	10.8	11.5	13.1 [1)]
Employees	139,800	135,800	132,700 [1)]
Total active fixed broadband connections (mn)	36.2	36.9	37.5
- DSL	25.4	25.4	24.7
- HFC	8.7	8.8	8.7
- FTTH/FTTB	2.0	2.6	3.4
- Other	< 0.1	< 0.1	0.7
Broadband penetration rate (active connections/household) (%) [2)]	88	90	91
Total telephone connections in fixed networks (mn)	38.4	38.5	38.6
- IP-based telephone connections (VoIP)	37.9	38.2	38.5
- Analogue/ISDN connections	0.4	0.3	0.1
Active SIM cards (mn)	107.4	106.4	104.4
Mobile penetration rate (active SIM cards/inhabitant) (%) [3)]	129.2	127.9	124.0

Competitors' shares (%)	**2020**	**2021**	**2022**
External revenue	57	57	57 [1)]
Investments in fixed assets	57	61	64 [1)]
Fixed broadband connections	61	61	61
DSL connections	46	45	44
Telephone connections in fixed networks	54	55	55

[1)] Forecast figures
[2)] Number of households according to Eurostat
[3)] Number of inhabitants according to Federal Statistical Office

NI-ICS market overview

Legal classification

The revised Telecommunications Act (TKG), which entered into force in December 2021, transposes the provisions of the European Electronic Communications Code (EECC) into national law. There are two categories of interpersonal communications services: number-based interpersonal communication services (NB-ICS) and number-independent interpersonal communication services (NI-ICS). The main difference is whether or not the services use publicly assigned numbering resources.

NI-ICS comprise messaging services (including internet and video telephony), video calling services and email services, provided the criteria set out in the TKG are met.[11] The most popular NI-ICS services in Germany include WhatsApp, Facebook Messenger, Skype and Zoom, together with Gmail, GMX and Web.de.[12]

Under the new TKG, NI-ICS are covered by some of the sector-specific regulations. Unlike providers of NB-ICS (such as fixed and mobile telephony), providers of NI-ICS are not subject to the requirement in section 5 TKG to notify their activities to the Bundesnetzagentur. In order to still be able to ensure reliable application of the regulatory provisions of the TKG, the Bundesnetzagentur assesses any NI-ICS intended for the German market and informs the providers how their services are categorised and which requirements are applicable. The regulatory requirements for NI-ICS relate above all to public safety, customer protection and market monitoring (such as requirements to provide certain user data, supply a contract summary and comply with information requests).

NI-ICS market data survey 2022

The results of a representative consumer survey carried out in 2021 show that nearly 90% of the population in Germany (at least 16 years of age) regularly use NI-ICS.[13] This means that the level of use of these services is now similar to that of traditional fixed and mobile telephony services. The majority of NI-ICS offer a bundle of different communication options, including text and voice messaging and voice and video telephony. Depending on the particular business model, other options may also be available, such as delivery and read receipts or status and story messages.

[11] See section 3 paras 24 and 40 TKG for the definition of (number-independent) interpersonal communications services. These services are now commonly referred to as over-the-top (OTT) communication services.

[12] See Bundesnetzagentur (2022): Use of online communications services in Germany – 2021 consumer survey results.

[13] See Bundesnetzagentur (2022): Ergebnis einer repräsentativen Verbraucherbefragung der Bundesnetzagentur.

In the past, information about the market conditions for NI-ICS was mainly based on data that was not supplied directly by the providers or could not be obtained directly from them (but was taken from surveys or estimates). The new TKG extended the Bundesnetzagentur's powers to obtain information to include providers of NI-ICS. The Bundesnetzagentur therefore carried out its first mandatory survey covering the providers of the NI-ICS services with the greatest market relevance in Germany at the beginning of 2023 (survey of market data for 2022).[14] The vast majority of the NI-ICS providers contacted responded to the market data survey and provided the information requested. The response rate of 83% is generally positive, in particular considering the fact that it was the first time a survey was conducted.[15] The Bundesnetzagentur is currently designing measures to make sure that those companies that did not provide any information in the first survey, for whatever reason, respond to future surveys.

The following figures relating to the use of NI-ICS in Germany are the first set of figures to be published based on a comprehensive direct survey of companies.[16]

User numbers and multi-homing

In 2022, the messaging and video calling service providers surveyed had an average of 186.07mn monthly active users, while the email service providers surveyed had an average of 148.91mn monthly active users. The idea behind "monthly active user" is to only cover users who have used an NI-ICS at least once in a month to make calls or send text messages, images or videos.[17]

The numbers for messaging and video calling services do not include the figures for five, presumably medium-sized, services. The user numbers given above are therefore to be seen as minimum figures. Based on an estimate of the missing figures, the Bundesnetzagentur assumes that the whole messaging and video calling services market comprises an additional approximately 39.11mn users.[18] The total number of users in 2022 is therefore estimated to be 225.18mn.

[14] The market relevance of the services was determined on the basis of user numbers estimated by the Bundesnetzagentur before the survey. The aim was to cover more than 90% of all the messaging and video calling service providers and email service providers relevant in Germany.

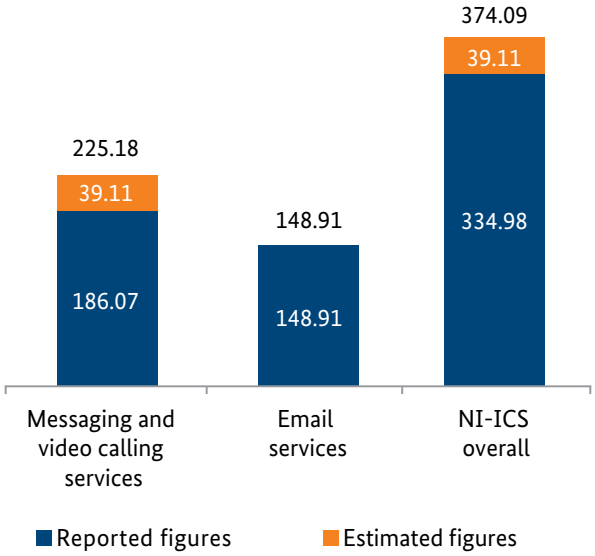
[15] Based on the number of services covered.

[16] Some of the figures included in the overall figures are estimates from the companies.

[17] See BEREC (2021): BEREC Report on harmonised definitions for indicators regarding over-the-top services, relevant to electronic communications markets, BoR (21) 127.

[18] The missing figures for the services were estimated using the user shares for each service based on a recent representative consumer survey made by the Bundesnetzagentur (in January 2023).

Monthly active users of NI-ICS in Germany in 2022
(mn)



A number of studies have shown that for various reasons users of messaging and video calling services, unlike NB-ICS users, typically use multiple services simultaneously (known as multi-homing).[19] The market data from the survey indicates a multi-homing rate of 2.95 services per user (3.57 services per user with the estimated figures.[20]

Usage figures

Instant messaging has become part of everyday life for most users of NI-ICS. However, this way of communicating is not directly comparable with other forms of text communication such as SMS messaging. Instant messaging enables users to send images, videos, documents, voice messages and emojis as well as text messages. In 2022, the monthly active users in Germany sent a total of 805.39bn instant messages[21] (892.30bn with estimated figures[22]). This corresponds to an average of around 361 instant messages per month per monthly active user or about 12 instant messages per day. It is important to remember that the average number of messages sent by multi-homing users is higher, depending on the number of different services they use.

The figures below relate to the volume of voice calls made via messaging and video calling services. In 2022, 13.28bn outgoing voice calls with a total duration of 120.97bn minutes (137.91bn with the estimated figures) were made via messaging and video calling services in Germany. This corresponds to about 71 voice calls per monthly active user per year and an average duration of 9 minutes per call. By contrast, 7.65bn outgoing video calls with a total duration of 143.24bn minutes (165.08bn with the estimated figures) were made in 2022. This corresponds to about 41 video calls per monthly active user per year and an average duration of 19 minutes per call.

According to the email service providers, the monthly active users in Germany sent a total of 56.74bn emails in 2022.

[19] See, for example, Bundesnetzagentur (2022): Use of online communications services in Germany – 2021 consumer survey results; RTR (2020): Monitoring Interpersonelle Kommunikationsdienste mit Fokus auf Instant Messaging, RTR Fachbereich Telekommunikation und Post (RTR FB TKP); WIK (2019): The Impact of OTT-1-Services on Communication Behaviour – a consumer perspective, WIK Discussion Paper No. 440.

[20] Assuming a user share of 90% of the total population in Germany (16 years and above), ie a total of approximately 63mn users. A minimum age of 16 years typically applies in Europe to the use of messaging services.

[21] The providers were asked to provide figures based on the point of origin of the communication. This also applies to the other usage indicators.

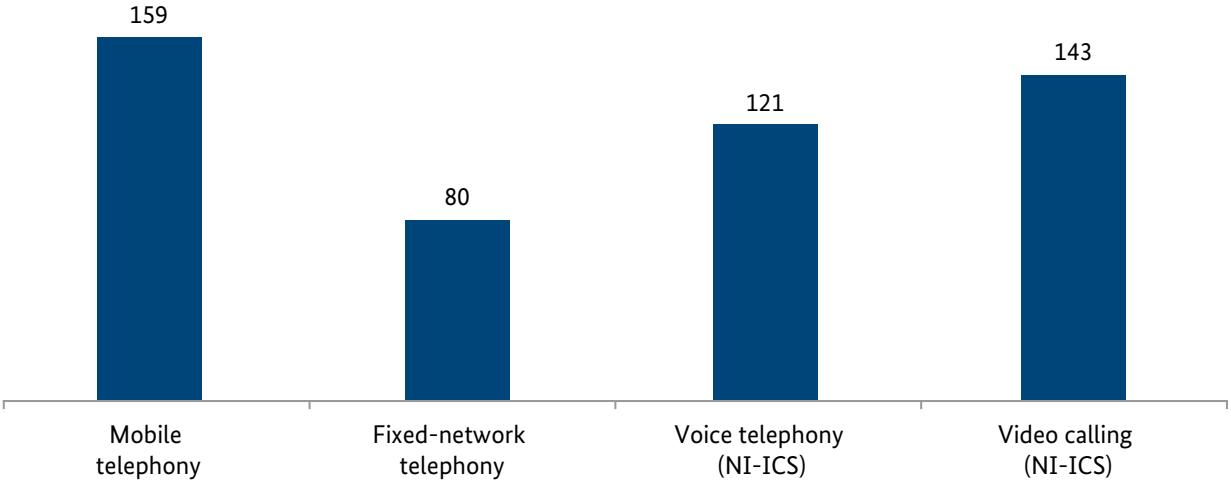
[22] The figures were estimated using the above-mentioned usage shares from the consumer survey and an "actual" market average based on available market data.

Comparison with traditional telecommunications service

It is possible for the first time to compare the volumes of calls made via messaging and video calling services and via fixed and mobile telephony services using market data provided by the companies. In 2022, 159bn outgoing call minutes were generated in the mobile networks and 80bn minutes in the fixed networks. By contrast, users in Germany generated at least 121bn voice telephony minutes and 143bn video telephony minutes via NI-ICS. This means that the volume of both voice and video calls via NI-ICS was larger than the call volume in the fixed networks. Traditional number-based mobile telephony is (still) the most popular telecommunications service with users in Germany.

NI-ICS have grown in popularity over the past few years, presumably driven even more by the changes in communication during the Covid-19 pandemic (such as the increasing relevance of video calling for home working). Overall it should be taken into account that the usage figures for NI-ICS also reflect the wide range of applications for which the services can be used, from personal contact with family and friends, for example, to work-related communication and special purposes such as voice and video telephony among gamers.

Outgoing call minutes
(bn)



Internet and digitalisation

The Bundesnetzagentur performs a number of tasks in the field of internet and digital transformation. It oversees the safeguarding of net neutrality in Germany and is also heavily involved in issues concerning the interoperability of digital services. Once the Bundesnetzagentur is entrusted with tasks related to the Digital Services Act, it will be able to apply its expertise in the nationwide implementation of the new regulations.

Net neutrality

Bundesnetzagentur prohibits zero-rating options "StreamOn" and "Vodafone Pass"

On 28 April 2022 the Bundesnetzagentur prohibited the marketing of the zero-rating options "StreamOn" and "Vodafone Pass" and ordered the termination of existing customer contracts. The European Court of Justice (ECJ) ruled on 2 September 2021 that the zero-rating options are not compatible with the principle of equal treatment of data traffic. The Court understands this principle as a general obligation to treat traffic equally, Zero-rating options treat data traffic unequally by not counting certain services and applications towards the data included in a tariff, as opposed to all other services and applications. New marketing of "StreamOn" and "Vodafone Pass" was ordered to cease by 1 July 2022 and existing customer contracts had to be terminated by the end of March 2023.

Mobile flat rates

Several providers offering mobile flat rates had been prohibiting the use of fixed LTE routers. The Bundesnetzagentur found in the reporting period that all the providers were infringing the end-users' right to use terminal equipment of their choice and prohibited the relevant contractual clauses. Telefónica has appealed a ruling in civil law proceedings brought by the Federation of German Consumer Organisations (Verbraucherzentrale Bundesverband e. V./vzbv) against Telefónica. The rulings received to date from civil courts handling parallel proceedings confirm the legal opinion of the vzbv and the Bundesnetzagentur.

DNS blocking

The Bundesnetzagentur does not itself order blocking but rather examines whether a blocking is in breach of net neutrality provisions. A

blocking imposed through statutory, regulatory or court order, for example, is compliant with net neutrality. In the reporting period, the state media authorities ordered DNS blockings on the basis of laws protecting juveniles, and the Common Gambling Authority of the Federal States (Gemeinsame Glückspielbehörde der Länder/GGL) ordered DNS blockings on the basis of the State Treaty on Gambling (Glücksspielstaatsvertrag/GlüStV) to protect against illegal gambling. Council Regulation (EU) 2022/350 and Council Regulation (EU) 2022/879, each of which expand Council Regulation (EU) 833/2014, also required internet access providers to implement DNS blockings to curb the dissemination of content from several Russian stations. Finally, three DNS blockings of websites that were infringing copyright by offering films and series for streaming were recommended by the Online Copyright Clearance System during the reporting period.

Annual report on net neutrality

As in previous years the Bundesnetzagentur published an annual report on net neutrality in Germany for the period from May 2021 to April 2022.

Digitalisation at small and medium-sized enterprises (SMEs)

The status of digitalisation in Germany's industry is a regular focus of studies and surveys, which frequently find that SMEs in particular have not yet adequately recognised and realised the potential associated with using digital technologies. As part of a representative survey conducted by the Bundesnetzagentur at the end of 2022, companies of various sizes from different branches of industry were asked about the status of their digitalisation efforts. One focus beyond topics related to digitalisation was on the role of the ecological sustainability of the company's activities. To gain initial insight into the general landscape of company support for digitalisation, selected business development agencies (often the first contact for SMEs) were asked in an extra ad hoc survey about what they offer and the extent of their advising activities on topics related to digital and ecologically sustainable transformation. Both surveys enable better understanding of the challenges facing SMEs in particular as well as making decisions and taking measures that are more evidence-based.

An important measure is to network with a large number of players actively supporting the digital transformation process among SMEs. Such players include the digital agencies of the federal states, Mittelstand-Digital Innovation Hubs, centres of excellence, digital hubs, SME and trade associations as well as higher education institutions. In addition to general fact-finding about the range of support measures offered and the challenges SMEs face in connection with the transformation process, the networking also serves to identify other possible accompanying measures to support SMEs in the process. With this in mind, the Bundesnetzagentur and the German Chamber of Industry and

Commerce (DIHK) jointly organised a network day in September 2022 for selected players that function as disseminators and points of contact for SMEs. Under the catchphrase "digitalisation meets sustainability" participants focused on how digital and ecological transformation in companies, particularly in SMEs, can be converged and incorporated and what they can contribute. The networking event aimed in particular to create new contacts and synergies and explore opportunities for cooperation.

Besides providing interesting information about digital technologies and facts about the current state of digitalisation, the Bundesnetzagentur's website also features an extensive database with points of contact for companies that are interested in digitalisation or are planning to digitalise. It provides an overview of numerous active points of contact, most of which are publicly funded. They offer advisory services, training, demonstrators, project support and financing opportunities, primarily for SMEs. The site includes a collection of digitalisation projects as further stimulation for SMEs interested in digitalisation.

Gaia-X

The funding competition "Innovative and practical applications and data spaces in the Gaia-X ecosystem" began on 15 March 2021 and runs alongside the French-German initiative creating the Gaia-X European data infrastructure project. Players from business, academia and the public sector are working together towards the common goal of developing a digital ecosystem based on European values (including European data protection, digital sovereignty and trust) with support from politics and in cooperation with other European partners.

The funding competition administered by the Bundesnetzagentur is now well underway and the first milestones of the 11 projects receiving funding have already been reached. In spite of the fact that many funding recipients were participating in such a competition for the first time, the projects are overall off to a solid start and are running on schedule.

The second tranche that was originally planned could not be launched due to a lack of budgetary resources. Many applicants were able to obtain assistance from other sources, which attests to the high quality of the project ideas.

For the remaining projects the federal government still aims to provide a total of around €117mn in funding at the user level over a period of three years and thus play a part in the practical implementation of key flagship projects from Germany in the Gaia-X ecosystem.

Artificial intelligence

The Bundesnetzagentur remains in constant dialogue about artificial intelligence (AI) with the market participants in Germany from the network sectors. In the reporting period the Bundesnetzagentur used findings obtained in 2021 to examine the use of AI in the telecommunications sector. Several network operators are already using AI in planning and rolling out their fibre networks. AI is already being used widely in the operation of high-bit-rate networks, especially for predictive maintenance.

From March to April 2022 the Bundesnetzagentur conducted interviews with relevant network operators to examine where AI is being used in the planning and rollout of gigabit networks and also to identify areas where the Bundesnetzagentur could provide active support.

The companies surveyed indicated that what is especially important for implementing AI is that the required data is as comprehensive as possible, current and valid because only then can one expect reliable predictions and resulting efficiency gains along with cost savings in network planning and rollout.

Building on the market participants' exchange, a virtual event series under the title "AI café" was initiated where AI topics were discussed among a wide range of people from business, academia, administration and politics. Topics of the discussions thus far have been AI for the planning and rollout of telecommunication networks, data acquisition and data pooling and data availability and data quality in telecommunications network rollout. Another event is devoted to the status of the Artificial Intelligence Act. All of the events in the series were recorded and are available on the Bundesnetzagentur's website at www.bundesnetzagentur.de/KI.

Interoperability

Digital markets are showing strong trends toward concentration and a development toward increasingly interlocked, closing ecosystems. For this reason, discussions are taking place about interoperability obligations that aim to break the market power of dominant providers and to reduce dependencies. Regulations in the area of number-independent interpersonal communications services (eg messaging services) are to stimulate competition by enabling users of different services to communicate across providers.

The Bundesnetzagentur commissioned a study that relates to the current debate on the issue of interoperability of digital services. The study examines a (lack of) interoperability as a possible cause or driver of such concentration tendencies and analyses the need for interoperability obligations. In addition to looking at the objectives and possible positive effects of such regulations, the study also considers a number of risks.

Under the Digital Markets Act (DMA), which was adopted at European level and entered into force on 1 November 2022, providers of messaging services that are classified as gatekeepers must meet interoperability obligations. The DMA requires gatekeepers to create a reference offer containing the exact technical interoperability conditions. The European Commission may consult the Body of European Regulators for Electronic Communications (BEREC) when it evaluates the reference offer. In this context the Bundesnetzagentur plays a part in BEREC's work, particularly with regard to the technical approaches and requirements for ensuring interoperability.

Digital Services Act

The Digital Services Act (DSA), which entered into force on 16 November 2022, sets rules for digital services and platforms. The DSA lays out EU-wide requirements for things such as ways to report illegal content, algorithm transparency and researchers' access to platform data. Its objective is the creation of a transparent and safe online environment. It applies to a wide array of providers from cloud providers to online marketplaces, social networks and video sharing services to search engines.

The draft legislation for implementation in Germany will focus primarily on designating the government authorities and determining sanctions. Legislators can delegate tasks from the DSA to one or more authorities. The Digital Services Coordinator (DSC) has a special role. The DSC will coordinate national and cross-border cooperation with competent authorities and other DSCs while also functioning as a point of contact for the European Commission. Special tasks are assigned specifically to the DSC, for example, to act as a grievance board for citizens and to classify "trusted flaggers". The DSC will also be responsible for the approval of out-of-court dispute resolution bodies.

The Bundesnetzagentur has devoted much time to adopted European legislation regulating digital platforms and has been actively involved in drafting BEREC's opinions on the legislation. For many years the authority has been dealing with the relevance of digital business models from a legal, technical and economic perspective. For example, it analyses the role of online platforms for business customers through continuous monitoring. If the Bundesnetzagentur is entrusted with similar tasks from the DSA, it can apply its previously acquired legal, economic and technical expertise in implementing the new regulations in Germany.

Terrorist Content Online Regulation

Regulation (EU) 2021/784 on addressing the dissemination of terrorist content online ("Terrorist Content Online Regulation") entered into force on 7 June 2021. The regulation requires hosting service providers to remove terrorist content within one hour of receiving a removal order and if their web space has been used repeatedly to distribute terrorist content they must take specific measures to prevent it in the future.

The Act addressing terrorist content online (TerrOIBG) assigns regulatory tasks to the Bundesnetzagentur and the Bundeskriminalamt. Under the TerrOIBG the Bundeskriminalamt issues orders to hosting service providers requiring them to remove terrorist content. The hosting service providers normally have to comply with the orders within one hour, and in a subsequent procedure the Bundesnetzagentur can impose fines on non-compliant hosting service providers.

To date the Bundeskriminalamt has not issued any orders for the removal of terrorist content to hosting service providers based in Germany. For this reason no further action by the Bundesnetzagentur regarding fines and/or administrative procedures has been necessary.

Data Act

The EU Commission presented the draft of a new Data Act on 23 February 2022. The Data Act aims to improve the exchange and use of data between businesses (B2B), between businesses and consumers (B2C) and between businesses and government (B2G). The Data Act also contains rules that make it easier to switch between data processing services (eg cloud services), including interoperability requirements.

Data as a factor of production is a topic the Bundesnetzagentur already focussed on in the past; it published a policy paper with the title "Data as a factor in competition and value creation in the network sectors". As legislative processes related to the Data Act are in progress, the Bundesnetzagentur is in contact with market participants and the ministries involved in the negotiation process, in particular with regard to the topic of cloud/interoperability of data processing services. In order to improve the potential of data, strengthen the data economy and simplify the switch between different services to the benefit of consumers and alternative providers, then what matters most is interoperability, ie that different digital products and data processing services such as cloud services are capable of interacting with each other.

In this context the Bundesnetzagentur has been proactively involved in the drafting of a BEREC opinion on the Data Act. There will be more ad hoc input on the Data Act's legislative process in the BEREC Work Programme 2023.

Data Usage Act

The German Data Usage Act (DNG), which regulates the use of public sector data, entered into force on 16 July 2021. It broadens the availability of the federal administration's open administrative data while simplifying and improving the options for the use of available publicly financed data. In accordance with section 10 DNG, the usage is normally free of charge.

Public sector bodies that have to earn sufficient revenue to cover a significant portion of the costs associated with fulfilling their public tasks can notify the Bundesnetzagentur that section 10(4) DNG allows them to charge for data usage. A list of the public sector bodies that have notified the Bundesnetzagentur of their exemption from free-of-charge data usage is available on the Bundesnetzagentur website at www.bundesnetzagentur.de/datennutzungsgesetz.

Data Governance Act

The Data Governance Act (DGA) is a key pillar of the European data strategy. It entered into force on 23 June 2022 as a European Regulation and goes into effect for all Member States on 24 September 2023. The DGA is a cross-sectoral regulatory tool with the aim that more data overall can be made available, shared with confidence and re-used without it being technically complex. The newly created provisions should reduce obstacles to data exchange so that the untapped potential of the data economy can be unleashed.

With this in mind, the DGA essentially regulates four areas. First, it provides rules for the re-use of protected data that is owned by public sector bodies. Second, it establishes a notification and supervisory procedure for the provision of services by data intermediaries. Third, it creates a framework for the voluntary registration of entities that collect and process data made available for altruistic purposes (data altruism organisations). Fourth, it calls for the creation of a European Data Innovation Board.

The DGA sets out that one or multiple competent authorities assume the tasks of monitoring and enforcing the DGA. Legislators will allocate the specific responsibilities as part of the national implementation. The Bundesnetzagentur has been focused on various issues associated with data regulation for several years and has been performing supervisory tasks from the Data Usage Act since 2022.

Sustainability and digitalisation

Given the rapidly growing importance of ecological sustainability in both national and international contexts, the Bundesnetzagentur is dealing increasingly with the question of what role the telecommunications sector can play in a sustainable digitalisation of industry and society.

The telecommunications sector has a key role as a digitalisation enabler and thus also as an important driver of digital, ecological sustainability solutions. Digitalisation shows promising potential, for example with respect to a more efficient and resource-friendly production and use of products.

At the same time, numerous ecological challenges (eg rebound effects) may be intensified if digitalisation moves forward without proper consideration of ecological sustainability factors. The availability of appropriate analysis tools is crucial for evaluating the ecological impacts made by entire sectors and individual business models. A research project commissioned in the second half of 2022 should generate initial ideas and starting points for further discussions. The focus of the research is the identification of appropriate indicators for measuring the ecological sustainability of electronic telecommunications infrastructure.

The report is available in German at:
www.bundesnetzagentur.de/indikatorenstudie

In addition, the topics of "sustainability of digitalisation" and "sustainability through digitalisation" are also examined explicitly from the perspective of companies. For example, this was done in the form of a representative survey and in various networking formats together with players that are actively supporting the digitalisation of SMEs (see Digitalisation at small and medium-sized enterprises (SMEs), page 34).

Overall the Bundesnetzagentur considers it necessary to converge the areas of digitalisation and sustainability as much as possible.

Consumer protection and advice

The Bundesnetzagentur can provide consumers with practical assistance in many cases. In 2022 the Bundesnetzagentur was again resolutely focused on tracking cold calling and combating number misuse. The Bundesnetzagentur's broadband speed checker helps consumers to prove reduced performance in their fixed network.

Broadband speed checker

For the seventh time the Bundesnetzagentur has published detailed findings from the broadband speed checker (https://breitbandmessung.de/ergebnisse). The tests were carried out in the period from 1 October 2021 to 30 September 2022 (the seventh year the broadband speed checker has been in operation). The report covers a total of 398,747 valid tests on fixed broadband connections and 623,581 valid tests on mobile broadband connections.

The proportion of users across all bandwidth categories and providers whose fixed broadband connection had a speed that was at least half their contractually agreed maximum speed was 84.4%; the proportion of users whose connection had a speed equivalent to or higher than their contractually agreed maximum speed was 42.3%. For the first time gigabit-speed connections were included, which is why no comparison can be made with the previous year, which only looked at connections up to 500 Mbps.

The ratio of actual to agreed estimated maximum data speed for mobile broadband connections was once again well below that for fixed broadband connections. The proportion of users across all bandwidth categories and providers whose connection had at least half their contractually agreed estimated maximum speed was 23.2% (2020/2021: 20.1%). The proportion of users whose connection had a speed equivalent to or higher than their contractually agreed estimated maximum speed

was 3.0% (2020/2021: 2.6%). The trend over the seven reporting periods since the first broadband speed tests shows that the results in percentage terms have improved on the previous year for the third time in a row. The test results depend on the tariffs agreed between the users and their providers. It is therefore not possible to draw conclusions from the results about broadband coverage or the availability of broadband internet access.

In autumn 2022 the Bundesnetzagentur consulted on key elements in order to define criteria that would also enable mobile communications end users to demonstrate entitlement to a reduction of their fee. Such arrangements have been in place for fixed-line networks since December 2021. The new consumer rights in the amended Telecommunications Act (TKG) make it possible to reduce the contractually agreed fee for internet access or to terminate the contract without notice.

Broadband Atlas

The Broadband Atlas is operated by the Bundesnetzagentur's single information point of the Federation (ZIS) and is Germany's main information tool for current fixed and mobile broadband coverage in Germany. The atlas is regularly updated and is available to all interested parties free of charge.

The interactive maps show which bandwidths and technologies are available for data transmission. The map can be navigated to display any location in Germany to the level of place name and address. Broadband availability is shown in different colours of the raster cells as a percentage of the households to be supplied. Unpopulated areas without households are only shown in the mobile communications view. As a supplement to the map, the left side of the page displays the settings and filters along with a bar chart that shows the percentage of broadband availability.

Information on the fixed network was gathered for the first time in 2022 by the

Bundesnetzagentur at the request of the Federal Ministry for Digital and Transport (BMDV). The Mobilfunkinfrastrukturgesellschaft mbH (MIG) validated, processed and made the information available. In the future the Bundesnetzagentur will perform the tasks of the single information point of the Federation.

The entry into force of the new TKG on 1 December 2021 created for the first time a legal basis for the delivery of information about broadband rollout. The Broadband Atlas now receives data on fixed networks from around 290 telecommunications companies. In addition, mobile coverage data that is collected by the mobile network operators is updated biannually and can be displayed under mobile network coverage (Anschlussart Mobil). The coverage data is gathered the same way as for mobile communications monitoring.

Data was provided earlier on a voluntary basis to the previous operators of the Broadband Atlas. Since 2022 the data survey has been address-specific and includes a larger number of telecommunications companies. The requirements for data deliveries have also been specified, with some deviation from the previous standards.

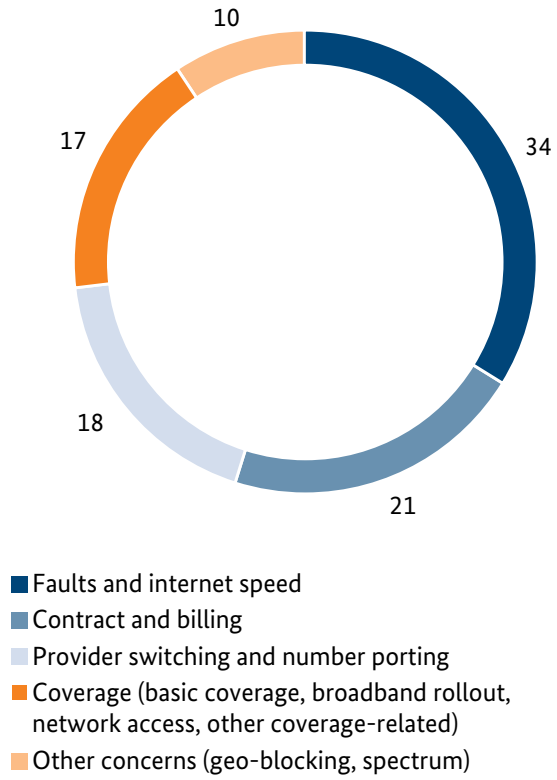
Broadband availability is not shown address-specific so that operational and commercial secrets are upheld. Instead the availability is shown in raster cells of 100x100 metres. The availability data for fixed network and mobile communications can be viewed separately and filters can be set for the different transmission technologies in each connection type.

Customer protection

Customers of telecommunications service providers tend to approach the Bundesnetzagentur for help when they have not managed to resolve their issue with their provider directly. Their messages are handled as enquiries or complaints. Dispute resolution requests are different; they are received by a special dispute resolution body of the Bundesnetzagentur.

The Bundesnetzagentur breaks down the enquiries and complaints into different topics. A total of about 25,700 concerns were raised in 2022, more than half of which had to do with service disruptions. Issues in 2022 fell into the following categories: around 34% were about fault repair and internet speed, around 18% were related to provider switching, number porting or moving home. Around 17% were other service questions, in particular questions about basic coverage or broadband rollout, around 4% concerned billing and 17% had to do with a wide variety of contract-related issues such as contract duration.

Breakdown of customer protection concerns in 2022 (%)



The Bundesnetzagentur can use the specific messages received to consider whether providers might be in breach of their obligations under telecommunications legislation, in particular of customer protection provisions in the TKG. If the concerns raised are well-founded, the Bundesnetzagentur asks the providers concerned to look at them again individually. Legal advice is not provided. The Bundesnetzagentur does not enforce any individual's special contract termination rights, rights to a fee reduction or monetary claims. It is possible to apply for dispute resolution at the Bundesnetzagentur with the aim of reaching an amicable agreement with the provider.

Service disruptions

One of the main activities of the Bundesnetzagentur is to ensure that providers resolve service disruptions as quickly as possible. The key topics here are provider switching, number porting, moving home, fault clearance and internet speeds.

Provider switching requires providers to promptly clear up complaints made to the Bundesnetzagentur about interruptions to service lasting more than a day; the aim is to ensure that an end-user has telecommunications services again as quickly as possible. There were 1,138 such cases in 2022, including number porting. Requests for remedy under the new TKG were necessary in only a few cases, particularly with the reversal of provider switches. The Bundesnetzagentur did not have to issue any orders or impose any penalties or fines in this regard in the reporting period.

The Bundesnetzagentur received around 170 enquiries and complaints per week about faults and internet speeds. The proven process structures of the complaint procedure for provider switching were applied in the areas of faults and speeds. Here the vast majority of the providers cooperated very well. The primary task is ensuring that providers remedy service disruptions such as blackouts or periodic interruptions without undue delay. In individual cases the providers also have technical measures at their disposal for remedying substantial discrepancies between the contractually agreed internet speeds and the speeds actually measured.

Customers do indeed show understanding for longer disruptions, especially when the provider communicates with them as openly and with as much detail as possible about what measures are

being taken (including finding out what caused the disruption) and how long the disruption is expected to last.

Whenever technical measures undertaken by a provider are not or are only partially successful within two calendar days after the fault report has been received, different providers proceed differently. Provision of adequate temporary services are allowed such as setting up mobile coverage with no volume limit as a substitute for a wired connection. Other providers, by contrast, choose to indemnify the customer. Sometimes the provider also executes an ordinary contract termination to avoid sustained financial losses.

The providers have developed different calculation methods for determining the fee reduction amount when there are significant deviations in internet speed. This is because with fixed-line products there are three different contractual performance indicators that can be key: the maximum, the normally available and the minimum internet speed available. The deviation from the advertised maximum speed may thus only provide an initial orientation for determining how much a fee may be reduced on an individual basis.

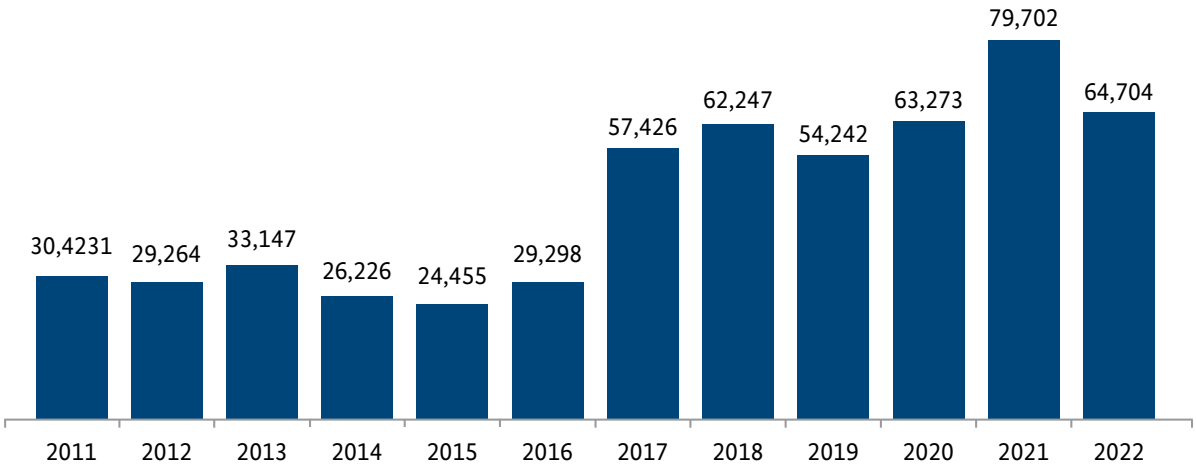
Tracking unsolicited marketing calls

In 2022 the Bundesnetzagentur was again resolutely focused on tracking cold calling and callers hiding their identity since thousands of consumers are still involuntarily victims of such harassment every year. Although cold calls that are made without the prior express consent from the consumers are prohibited by law, the Bundesnetzagentur received 64,704 such written complaints in 2022. This figure thus dropped by around 19% from the previous year but still represents the second highest yearly figure recorded by the Bundesnetzagentur.

The topics with the highest numbers of complaints received by the Bundesnetzagentur in the reporting period were unsolicited marketing calls for energy supply contracts and sweepstakes. Other frequent topics of complaint concerned financial and insurance products as well as construction products.

Those targeted especially run the risk of being caught out by pushy sales tactics or unfair and intentionally misleading tricks on the phone,

Written complaints about unsolicited marketing calls



like being outright manipulated into entering a contract. This year a particularly large number of consumers reported that cold callers presented them with false facts in an attempt to get them to enter into an energy supply contract. To gain the trust of the parties they called, the callers posed, for example, as energy consultants from independent comparison sites, representatives of the consumer's current electricity provider or as government authority representatives. In some cases the callers used this business model to pretend that they would like to provide information about an upcoming price increase. They put consumers under pressure with the claim that a particularly attractive offer would only be valid if they signed a contract that same day. In some instances the parties concerned were asked to provide personal data such as their meter number and meter reading so that the callers could arrange for a supplier switch against the will of the parties concerned.

The Bundesnetzagentur opened investigations into numerous companies and issued a total of nine fines that came to around €1.15mn collectively. However, as some of the fines were appealed, not all of the proceedings have been concluded.

Since 30 November 2022 consumers have been able to access the newly designed e-form on the Bundesnetzagentur's consumer portal to make submitting a complaint about receiving unsolicited marketing calls even easier. The new form guides consumers step-by-step through the process of submitting a complaint. By asking specific questions it ensures that all the data needed to track an unsolicited call is gathered. Consumers also receive up-to-date information about unsolicited marketing calls, securing evidence and defending themselves effectively against such calls, and information about administrative procedures.

In addition to its enforcement efforts, the Bundesnetzagentur published a guide to the interpretation of section 7a of the Act against Unfair Competition (UWG) on 7 July 2022. Section 7a UWG requires advertising companies to document and store written consent for telephone marketing calls in an appropriate form. Among other things the section should enable a more efficient tracking of cold calls. By publishing the guide, the Bundesnetzagentur is fulfilling its obligation under the Fair Consumer Contracts Act. The guide serves to inform advertising companies about how the authoritiy will act in future on the basis of the new legislation. It also provides those companies with a tool to meet their legal requirements in compliance with the law without undue complexity. Before publishing the guide, the Bundesnetzagentur provided a draft version of it for a public consultation so that the parties concerned and protected concerns of the market participants could be taken into account as much as possible.

In the guide, the Bundesnetzagentur first explains which type of companies are subject to documentation requirements and describes the scope of the documentation and storage

requirements. In particular the guide addresses contractual relationships that are standard for the market between entities that contract cold calls and call centre service providers. The latter part of the guide addresses the consequences of a violation of the documentation and storage requirements as well as the extent of the requirement to submit documentation to the Bundesnetzagentur. Breaches of the requirement to document may incur fines of up to €50,000.

As part of ongoing administrative fines proceedings, the Bundesnetzagentur requested companies to comply with the documentation requirement by submitting proof of consent documents.

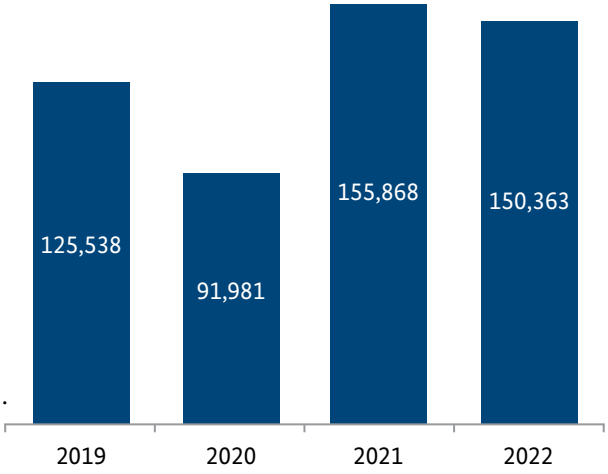
Combating number misuse

The Bundesnetzagentur is the supervisory authority responsible for combating number misuse. It follows up on any breach of number use. Cases pursued in this context frequently concern breaches of the consumer protection provisions of the TKG and the UWG. A variety of measures can be taken to protect affected parties from disturbances and financial losses.

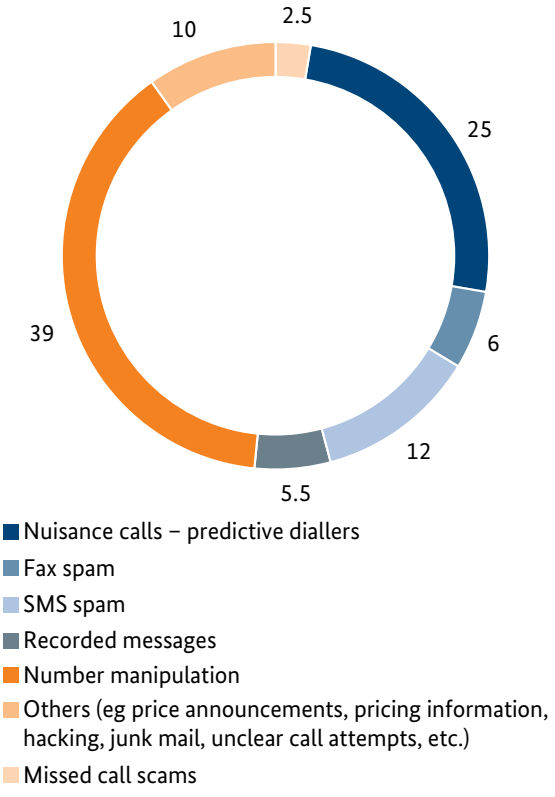
In total, the authority received 150,363 written complaints and enquiries about number misuse during 2022. The number of complaints received thus remains at a consistently high level. In addition to the written complaints, the Bundesnetzagentur received 18,561 telephone enquiries and complaints about number misuse and unsolicited marketing calls.

The Bundesnetzagentur works to protect consumers from unsolicited advertising and nuisance calls, charges for call queuing and the unauthorised billing of third-party services and subscriptions. It opened administrative proceedings to investigate the breaches in 1,150 cases, resulting in orders to disconnect 1,446 phone numbers. Bans on billing and collection were issued with regard to 3,697 numbers. All actions are published (in German) online in a continually updated list at www.bundesnetzagentur.de/Massnahmenliste.

Written complaints and enquiries



Written complaints about unsolicited marketing calls (%)



Nuisance calls

During the reporting period the Bundesnetzagentur received a total of 38,096 complaints concerning nuisance calls. Often the complaints are for call attempts where there is a connection but no one speaks on the other end or calls are attempted multiple times a day without leading to an actual telephone conversation. They are usually generated by the software used in call centres to manage telemarketing calls (diallers).

There are no specific legal provisions governing the use and configuration of such software or the calling behaviour of call centres itself. Depending on the software configuration, call recipients can be subjected to considerable harassment in violation of section 7(1) UWG. In such cases, the Bundesnetzagentur can take measures pursuant to section 123(1) and (4) TKG, including reprimands, warnings and orders to disconnect the call centre telephone numbers. Before it can do so, it is reliant on complaints containing descriptions of the nuisance call attempts that are as detailed as possible.

This type of calling behaviour is telemarketing that is subject to an administrative fine and as such cannot be prosecuted for being attempted. Therefore complaints concerning unreasonable calling behaviour are recorded separately from complaints about telemarketing and statistics on such complaints are reported separately.

In 2022, 40 reprimands were made. In the course of the reprimand process, companies are informed about complaints about their calling behaviour at an early stage, thus giving them the opportunity to make changes.

Router and telephone system hacking/malware

The Bundesnetzagentur continued to take strong action against cases of hacking, in which third parties unlawfully generate calls that incur charges via routers or telephone systems of consumers or other end-users. When such cases occur, bans on billing and collection are often issued to protect the affected end-users. These orders provide protection to end-users against financial damages. The ordering of payment bans is another tool that can be used to enable the involved national telecommunication service providers to avoid payments of call termination charges on a lasting basis. The Bundesnetzagentur's consistent intervention has led to a situation in which the majority of measures are taken in response to requests. Most cases continue to be reported to the Bundesnetzagentur by telecommunication service providers while some are reported by the affected end-users. The sector's work on halting payment flows and on improving early detection of such cases is ongoing. The overall objective is to permanently prevent cases of hacking. This can only be accomplished when hacking is no longer financially lucrative for the hackers.

Again in 2022 the Bundesnetzagentur received complaints about international calls on mobile phone bills, mainly to numbers in Madagascar, Morocco and to satellite telephone numbers. The Bundesnetzagentur's findings suggest that these connections were made with the help of malware and without the knowledge of the affected parties. Often the telecommunications service providers had already indemnified the affected end-users. In some cases the Bundesnetzagentur issued bans on billing and collection.

Third-party providers

As a result of procedures set out in 2019 by the Bundesnetzagentur to protect consumers, third-party services may only be billed via mobile phone bills under certain conditions. Either the customer has to be redirected during the process of paying for a third-party service from the third-party provider's website to a website of a mobile provider (redirect) or the mobile communications company has to implement various defined consumer protection measures (combination model). There was again a comparatively low total number of complaints (214) received on this issue, which marked another significant decrease compared with the previous year. The Bundesnetzagentur examines such complaints and contacts the respective mobile providers on these issues.

Number manipulation

A new provision has enabled the Bundesnetzagentur to investigate number manipulation cases since 1 December 2021. It is authorised to request information from providers about the telephone number from which a call originated and the personal data necessary for prosecution of the number holder such as the name and the address at which documents can be served.

Under the current rules, telecommunications providers are generally limited to storing call data for only a few days after the call and traffic data is normally deleted after seven days.

In 2022 the Bundesnetzagentur received around 58,000 complaints about calls originating from manipulated caller numbers. In appropriate cases it exercised its new authority by making around 3,100 call data requests to network operators within the storage period. Here the suspicion was confirmed that the vast majority of calls with manipulated caller numbers are routed through foreign networks to Germany. In these cases the German network operators are unable to verify the actual number using the traffic data because the caller information transmitted is already false. However, there were certain scenarios where it was possible to observe that the calls were routed from different networks to Germany. Calls routed through different networks are more difficult to trace because using different networks makes it impossible to directly identify the specific country from which a call is placed.

For example, in the reporting period the Bundesnetzagentur received a large number of complaints from consumers about receiving calls in the name of Europol or other supposed international police authorities such as Interpol, the Federal Police or the FBI. When taking the call, a recorded message told the called party to press the number one on their telephone. After pressing the button the called party was forwarded to a person who (in some cases in English) asked them to provide their personal data or to transfer money.

German telephone numbers (mobile numbers or geographic numbers) were transmitted as sender identifications. As far as the Bundesnetzagentur is aware, these telephone numbers were manipulated and routed through foreign networks, presumably to conceal the caller's identity.

Since 1 December 2022, no calls transferred from foreign networks to the German public telecommunications network can display a German telephone number as a sender identification. In such cases the caller's number must be hidden. A person receiving a call from a German number should again be able to feel confident that the call is from the authorised number holder.

SMS and messaging spam

The Bundesnetzagentur received 18,455 complaints from consumers about SMS and messaging spam in 2022. Compared with the previous year the Bundesnetzagentur received a significantly lower number of complaints about messages attempting to trick the recipient into downloading malware.

Particularly in the second half of the year the Bundesnetzagentur observed an increased number of complaints reporting that recipients were told per SMS that they may allegedly receive a tax refund from the tax office, a "tax authority" or the Federal Ministry of Finance. The parties concerned should click on the link in the SMS to receive the "refund". The links were to websites using logos of well-known banks and credit institutes where consumers were to enter their personal data. This data would allegedly be used for abusive purposes. In such cases the Bundesnetzagentur made extensive use of its powers to order network operators to disconnect the phone numbers.

In addition, the unauthorised sending of purely promotional SMS messages continues. As in the previous year there was again a large amount of SMS spam with ads for travel services.

The sending of unsolicited promotional SMS messages breaches provisions of the UWG. In some cases it also violates provisions of the TKG, such as the pricing information requirement of section 109. The Bundesnetzagentur regularly orders the sending numbers and, where necessary, the contact numbers advertised to be disconnected. This measure ensures that the unlawfully advertised service can no longer be reached and no more SMS messages can be sent using the sender number. In addition to disconnecting numerous mobile numbers in 2022, the Bundesnetzagentur also disconnected a large number of geographic numbers as well as freephone number..

Fax spam

The Bundesnetzagentur received 9,161 complaints about fax spam in 2022 (2021: 35,072). The significant decline was associated with fax advertising for Covid tests and masks, which had accounted for the majority of the complaints. The measures taken against fax spam in 2021 and again in 2022 (disconnecting telephone numbers and imposing prohibition orders with penalties) have had a lasting effect.

Pop-up error messages

The Bundesnetzagentur has consistently disconnected numbers displayed on the computer in fake Microsoft warnings called pop-ups. This scam warns of viruses and software problems that do not actually exist. The aim of the scam is to use remote diagnostics to pressure users into expensive, unnecessary repair contracts or gather personal details. The numbers shown on the PC are often registered using fake details. In some cases, the data of consumers that previously had contact with the supposed technical support staff are misused for this purpose. The Bundesnetzagentur regularly issues warnings to people not to call numbers on pop-ups. Official error messages from the Microsoft Corporation never contain telephone numbers.

Other issues

As in previous years the Bundesnetzagentur received a large number of complaints in this reporting period that do not fall under any of the above topics.

For example, many consumers reported receiving unsolicited text messages that give the impression that they come from a relative of the recipient (usually their children or grandchildren) who recently started using a new mobile number. In the text messages the recipient is asked to transfer money to help the supposed text message sender out of a dire emergency. The recipients of the text messages are usually given a time limit of only a few hours to send the money and prevent an unfavourable situation for their alleged family member.

Complaints also brought the operation of fake hotlines for various airlines to the attention of the Bundesnetzagentur. The telephone numbers were advertised on the fake websites of a number of airlines. The supposed airline employees used the fake hotlines to try to obtain identification data, bank account information and credit card data. The parties concerned were often asked to download software to enable remote access.

To the maximum extent possible the Bundesnetzagentur also imposes the consumer protection measures at its disposal such as disconnecting telephone numbers. As part of its public relations, the authority provides information as early as possible about fraudulent groups of cases and advises consumers where possible about what to do.

Dispute resolution

The telecommunications dispute resolution panel of the Bundesnetzagentur provides customers of telecommunications companies the opportunity to settle contract-related disputes over telecommunications services outside of court. The dispute resolution procedure is free of charge. The objective is to reach a speedy and satisfactory resolution for both sides.

The telecommunications consumer dispute resolution panel is an official consumer conciliation body under the Act on Alternative Dispute Resolution in Consumer Matters (VSBG). Dispute resolution is however generally open to all end-users. End-user means a user neither operating public telecommunications networks nor providing publicly available telecommunications services. However, restrictions may arise from some provisions of telecommunications legislation. Before end-users submit a request for dispute resolution they must have first made an attempt to settle the issue with the telecommunications company.

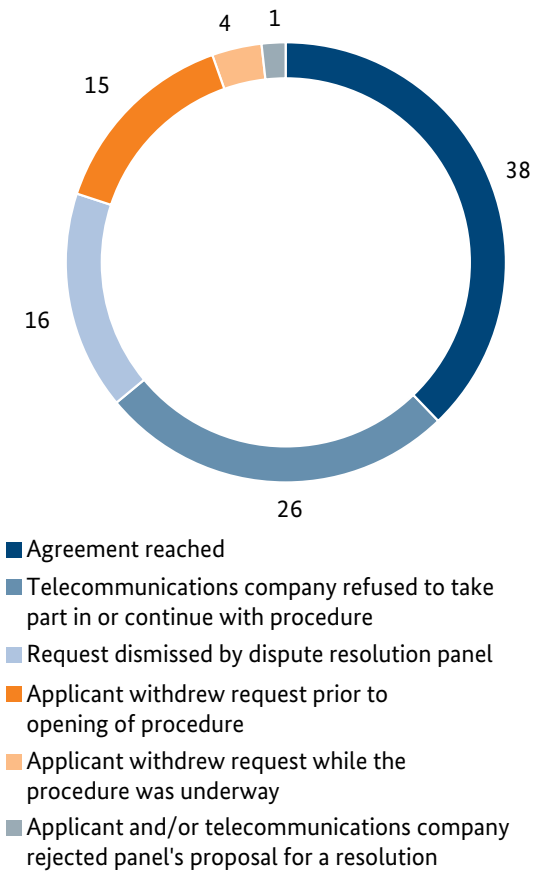
In 2022 the telecommunications dispute resolution panel received 2,389 requests for dispute resolution. This represents an increase of around 47% (2021: 1,622 requests). In addition, the panel received 765 enquiries and requests for assistance, mostly relating to whether the facts

presented in particular cases could be resolved through dispute resolution. The increase in the number of requests may well have to do with the fact that the new TKG, which entered into force on 1 December 2021, introduced new customer protection provisions and received a great deal of media attention.

Most dispute resolution requests related to the failure of companies to provide the contractually agreed services. Contract finalisations, disagreements on terminating contracts and contract duration were other common causes of dispute. Other causes were disturbances, reduced data transmission speeds and billing complaints. A number of dispute resolution requests had to do with contract disputes that were not related to the TKG.

The dispute resolution panel handled and closed 2,351 cases in 2022. In 38% of closed cases, the parties reached an agreement, usually before a resolution proposal was made. Frequently, companies will offer their customers a resolution once the procedure is underway. In 26% of cases, the telecommunications companies implicated in the dispute resolution procedure refused to take part in or to continue the procedures and offered no solution to the issue in hand. In 19% of cases, the applicants withdrew their requests, for example because the matter had suddenly been resolved.

Outcomes of dispute resolution procedures
(%)



In 16% of the cases closed in 2022, the panel dismissed the request for dispute resolution on the basis that the prerequisites for initiating a procedure were not met. That is an 11% drop from the previous year in the number of requests dismissed. One reason for this could be that the law was amended to expand the dispute resolution panel's area of responsibility as from 1 December 2021 to include new areas. Moreover, it is now possible to open a dispute resolution procedure over a dispute relating to the provisions set out in section 68 TKG. To open a procedure the complainant is no longer required to claim that the telecommunications company has breached any specific customer protection rights.

In accordance with the VSBG, additional information is published in the dispute resolution panel's annual activity report, which can be found on the Bundesnetzagentur's website.

Roaming

The Bundesnetzagentur is responsible for compliance with the Roaming Regulation in Germany and thus also enforcement of the "roam like at home" principle. In the interests of consumers, the Bundesnetzagentur continually monitors the market and tariff situation so that it can identify breaches and enforce the rules. The revised Roaming Regulation entered into force on 1 July 2022. The Bundesnetzagentur entered into dialogue early on with roaming providers in Germany to ensure that the new provisions were implemented in compliance with the Regulation. It also investigated cases of limits on fair use that were not in compliance with the Regulation and ensured that these were amended appropriately.

Intra-EU communications

Price caps for voice calls (€0.19/minute net) and SMS messages (€0.06/SMS net) from the home country (Germany) to another EU Member State and accompanying rules for regulated intra-EU communications were introduced by EU Regulation on 15 May 2019. Since then the Bundesnetzagentur has continually monitored the products offered on the market by mobile and fixed network providers offering intra-EU communications and taken action when it has encountered infringements. One violation was cited in 2022. A provider had not complied with price caps for Slovenia and Northern Ireland. The prices were adjusted following intervention by the Bundesnetzagentur.

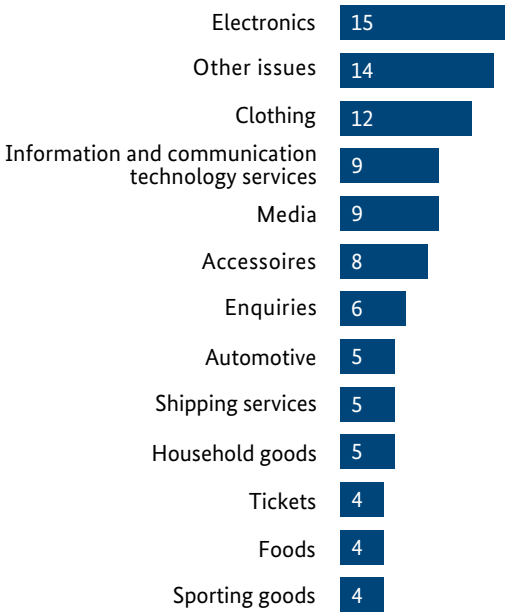
Geo-blocking

The Geo-blocking Regulation (EU 2018/302) is part of the European Union's strategy to create a digital single market. The Regulation addresses unjustified discrimination against customers in the EU based on their nationality, residence or place of establishment. It removes barriers to cross-border business between providers and customers for the sale of goods and provision of services. The Geo-blocking Regulation applies to both online and brick-and-mortar retailers. Its key provisions cover access to online interfaces, non-discriminatory treatment when purchasing or accessing goods and services, and non-discriminatory treatment in connection with payments. Some sectors are not covered by the scope of the Geo-blocking Regulation, including audiovisual, health, financial, telecommunications and transport services. Access to electronically supplied services, the main feature of which is the provision of access to or use of copyright-protected works or other protected subject matter, is not covered either.

The Regulation also specifies that a customer buying goods is not entitled to delivery to a location outside the provider's field of activity. Consumers can submit their complaints to the Bundesnetzagentur easily online using the Bundesnetzagentur consumer portal and the Federal Portal. In 2022 there were 130 cases reported. Most related to orders for electronic equipment, media content and clothing.

In 2022 the Bundesnetzagentur worked closely with the European Commission, the other EU countries' national authorities responsible for the enforcement of the geo-blocking Regulation as part of the consumer protection cooperation procedure and with the European Consumer Centre Germany (ECC).

Enquiries and complaints related to geo-blocking
(%)



Text and video relay service for people who are deaf or hard of hearing

The service provides an accessible way for people who are deaf or hard of hearing to make telephone calls with hearing persons. To do so, they set up a video or data link via a PC, tablet or smartphone to a sign language interpreter or speech-to-text reporter provided by the service. The interpreters then call the desired person and translate the message received into spoken language. Conversely, the recipient's message is translated into sign language or written language. The text and video relay service enables people who are deaf or hard of hearing to make phone calls.

In 2022 the Bundesnetzagentur examined the need for the text and video relay service for 2023 and defined the need in an administrative order. In this way the Bundesnetzagentur implemented the legal changes set out in the new TKG, which had entered into force on 1 December 2021. It set an initial limit of 30 minutes per month up to which the use of the relay service is free of charge for users. The order also set out the requirements the service must fulfil if it is to be used for emergency calls.

The Bundesnetzagentur awarded the relay service to Tess - Sign & Script – Relay Dienste für hörgeschädigte Menschen GmbH for the period from 1 January to 31 December 2023.

The Bundesnetzagentur also took appropriate measures to ensure that the text and video relay service would be financed in 2023. In particular, it determined the proportionate costs to be paid by providers of voice communications service.

Investigating interference – the radio monitoring and inspection service

The Bundesnetzagentur makes an important contribution to consumer protection by dealing with radio interference through its radio monitoring and inspection service. In 2022 the radio monitoring and inspection service resolved over 2,800 cases of radio and electromagnetic interference on site. More than 1,600 of those cases concerned people with direct consumer issues such as radio reception, WLAN networks and mobile service. In addition, cases were handled that had to do with everyday radio applications in households such as wireless headphones and wireless garage door openers as well as electromagnetic interference from DSL lines.

The above case volume arose from more than 55,000 calls received by and more than 15,000 consultations conducted by the radio monitoring and inspection service.

In addition to readiness to handle consumer-relevant interference, the fault reporting desk is open around the clock and the radio monitoring and inspection service is always on standby to ensure interference-free operation of safety-critical radio and telecommunications services such as aeronautical radio, radiocommunication for public protection and disaster relief and maritime and inland waterways services. Staff and measuring vehicles are based for this purpose at 19 locations throughout Germany.

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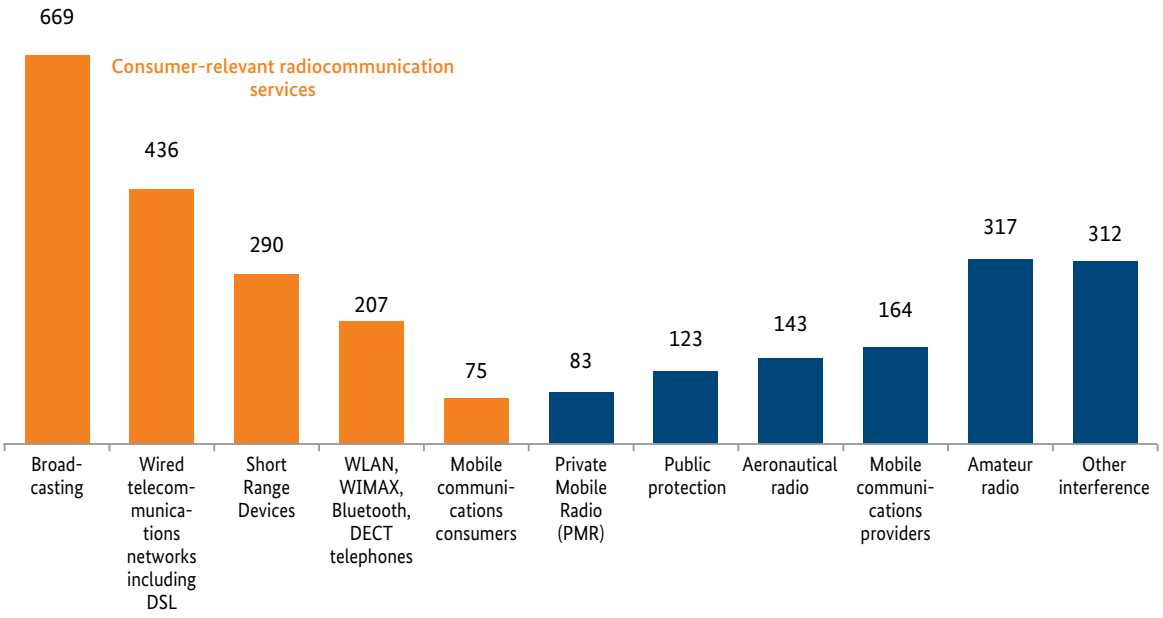
Interference volumes by type of service in 2022



The availability and structure of the radio monitoring and inspection service play an important role in the efficient, interference-free use of spectrum and the maintenance of critical infrastructure.

This service is available free of charge to institutions, business and consumers, including the parties that caused the interference, provided it was not their fault.

Introduction of the 116 016 "Violence against women" support hotline

In December 2022 the Bundesnetzagentur assigned the telephone number 116 016 to the Federal Office of Family Affairs and Civil Society Functions (BAFzA) as a "Violence against women" support hotline. The telephone number can be used as a subscriber number in all 5,400 geographic areas without the need to dial a prefix, as a national number that can also be reached from outside of Germany and as a mobile short code number in all German mobile networks.

The assignment became possible when the EU Commission registered 116 016 in the EU-wide list of reserved numbers for harmonised services of social value. The initiative to introduce a uniform Europe-wide telephone number for national support hotlines for violence against women began during Germany's presidency of the EU and was diligently supported by the Bundesnetzagentur in the relevant bodies.

Public tendering normally done for awarding a harmonised service of social value was waived in the case of 116 016 because the BAFzA, as the implementing entity, is required under the "Act to launch and operate a nationwide 'Violence against women' support hotline" to deliver this service in accordance with the requirements associated with the assignment of the number. The BAFzA has been using the telephone number (0)8000 116 016 for the support hotline since 2013. The hotline can now be switched to the single EU-wide (and easier to remember) 116 016 number.

Rulings, activities and proceedings

The Gigabit Register went online in December 2022. It is the data hub for information relating to infrastructure rollout planning and current and future coverage levels. The Gigabit Forum serves as a platform for discussing the framework for promoting investment and competition for a faster transition to gigabit infrastructure. The Bundesnetzagentur published a position paper setting out its initial assessment of the next steps in providing spectrum from expiring usage rights.

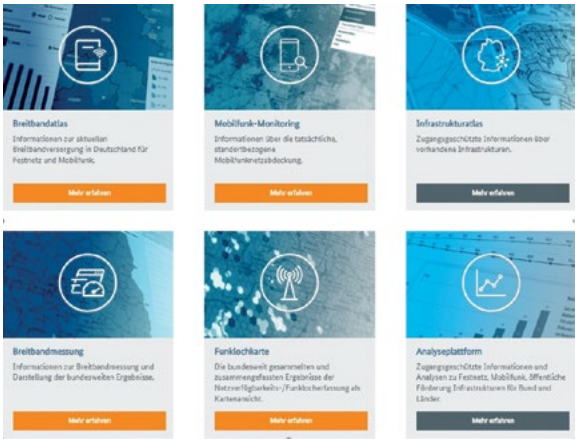
Gigabit Register

The Gigabit Register is the data hub for information relating to infrastructure rollout planning and current and future telecommunications network coverage levels. The portal provides central access to the relevant geographic information systems at gigabitgrundbuch.bund.de (in German). It gives users access to data, maps and additional information relating to digital infrastructure via a single platform.

The efficient rollout of digital infrastructure needs a sound basis of data that can be used to prepare investment decisions, identify sharing potential and plan effective national and regional support measures. Decision-makers at all levels, as well as the public, also benefit from the provision of transparent and tailored information on broadband coverage.

The current geographic information systems form the basis for the integration of further data and functionalities. The systems will be developed and adapted to future tasks, without going offline.

The Gigabit Register's core elements are the Broadband Atlas and the Infrastructure Atlas. These two established information systems have been supplemented by a new analysis platform.



The Broadband Atlas is the central information tool for current fixed and mobile broadband coverage in Germany. It is regularly updated and is accessible to everyone free of charge.

The Infrastructure Atlas is the central information and planning tool for the gigabit rollout in Germany; details are set out in the Telecommunications Act (TKG). It contains data on the location of network operators' infrastructure. The data can be accessed upon request by companies and national, regional, district and local bodies in connection with the gigabit rollout. The data is only accessible to authorised users for a limited time and is not public. The Infrastructure Atlas helps to simplify and speed up gigabit rollout project planning. Sharing existing infrastructure also helps to save rollout costs. The infrastructure data is supplemented by information on planned civil works for public supply networks.

The Infrastructure Atlas now comprises data from more than 4,000 owners and operators of public supply networks. The conditions for providing and accessing the data and the obligations for data providers were revised in 2022 following the entry into force of the new TKG on 1 December 2021.

The analysis platform is an information and analysis tool for public administration with restricted access. Decision-makers from national and regional bodies can access detailed information on fixed and mobile coverage, public funding and infrastructure. The platform increases transparency for public administration and contributes to efficient (public) rollout planning. The analysis platform makes tailored information available while safeguarding the operating and business secrets of the telecommunications companies supplying the data.

The Gigabit Register currently provides access to three other information tools maintained by the Bundesnetzagentur: the maps for mobile communications monitoring, broadband speed checks and dead spots.

These components will be supplemented by a planning platform designed specifically for companies on the telecommunications market involved in rollout. The platform will hold information on existing and planned infrastructure and will enable companies to explore potential for infrastructure sharing and co-deployment. The platform will be based on the Bundesnetzagentur's existing Infrastructure Atlas. It is planned to include information on publicly owned property suitable for mobile rollout and other functions that can potentially speed up network rollout.

The aim is also to increase transparency further for those involved in broadband rollout, especially for political decision-makers at all levels. The Gigabit Register will be expanded gradually to include other databases and analysis tools.

Gigabit Forum

The Gigabit Forum, which the Bundesnetzagentur set up in March 2021, is a platform for market players, ministries and authorities to meet and discuss the framework for promoting investment and competition for a faster transition to gigabit infrastructure (further information is available (in German) at www.gigabitforum.de). The German government's Gigabit Strategy highlights the Gigabit Forum as the key platform for dialogue to agree on common principles, positions and standards for the rollout of high capacity networks and the migration from copper to fibre networks.

Copper to fibre migration

As the fibre rollout gathers pace, the subject of the copper to fibre migration is becoming increasingly important. The Gigabit Forum enables an early and ongoing discussion of general migration issues, while there are two project groups that deal with more specific aspects.

- One group has the task of raising early awareness of the migration among business customers. It will first identify questions and problems among these customers and plans workshops with the opportunity for in-depth discussion in the second half of 2023. Its aim is to provide business customers with answers to their key questions.

- The other group focuses on building owners. It has the task of designing measures so that as many buildings as possible are connected to a new fibre network when fibre is first rolled out in an area, which will speed up migration processes later. It plans to publish information answering all the main questions from building owners.

The WIK institute produced two discussion papers in 2022 as research contributions to the Gigabit Forum. One paper looks at the necessary steps in the migration process (https://www.wik.org/uploads/media/WIK_Diskussionsbeitrag_Nr_483.pdf) and the other at the migration from copper to fibre networks in France and the United Kingdom (https://www.wik.org/uploads/media/WIK_Diskussionsbeitrag_Nr_482_01.pdf) (both papers in German with an English summary).

Open Access

Another focus of the Gigabit Forum is on open access, when operators voluntarily open up their fibre networks to other providers of internet access services. The players represented at the Gigabit Forum have the common goal of achieving market-negotiated open access for all fibre networks.

A project group for open access was set up in 2022 and has the task of simplifying the process for open access agreements between companies. The group's work is divided into three steps based on its mandate (available (in German) at www.gigabitforum.de). The first step is to identify the various success factors and challenges of open access at present. This serves as the basis for the next steps, which involve drawing up information for all players as guidance to help them work out open access agreements and in turn lower transaction costs.

A working group for interfaces and processes has the task of developing a modern interface architecture for the exchange of access products that accommodates the requirements of fibre networks.

The Gigabit Forum will gradually and continually expand its focus to include other aspects, such as following pilot projects for the migration from copper to fibre networks. This will give the opportunity for consensus-based discussion of relevant issues to help speed up the rollout and use of viable digital infrastructure.

Spectrum management

Mobile communications monitoring

The interactive mobile communications monitoring map displays transparent data about each provider's actual mobile coverage across the country. Anyone interested can access tailor-made information on mobile availability at www.gigabitgrundbuch.bund.de/GIGA/DE/MobilfunkMonitoring/start (in German).

The Bundesnetzagentur collects the necessary data from the network operators based on uniform rules once a quarter. It validates the operators' data using data from the dead spot app and checks the quality of the operators' calculation models using the results of random measurements by its own radio monitoring and inspection service. The Bundesnetzagentur also uses information from consumers about inconsistencies in the data displayed on the map to improve the quality of the data bases. Work on expanding the online portal continued throughout 2022. The downloads section now includes a detailed report on mobile coverage on major and minor roads, rail lines and waterways, and maps displaying the percentage of dropped voice calls for each provider, in line with section 103(4) of the new TKG. In June 2022, the Bundesnetzagentur completed its first mobile communications report as required by section 103(5) TKG for submission to the Committee

on Transport and Digital Infrastructure of the German Bundestag. The report contains details of the mobile coverage levels identified in the mobile communications monitoring and the status of compliance with the secondary conditions (coverage obligations) attached to mobile spectrum assignments.

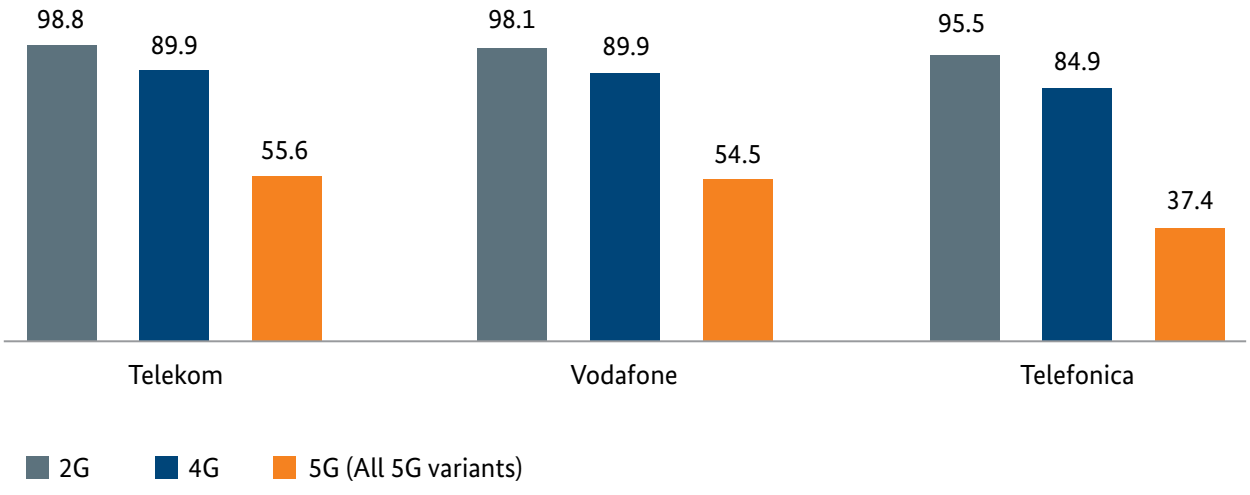
Mobile network coverage in October 2022

An analysis of the data collected in October 2022 shows that almost all the country (99.7%) has 2G coverage and nearly the same percentage (around 97%) has 4G coverage from at least one mobile network. The level of 2G and 4G coverage from each individual network operator is also very high.

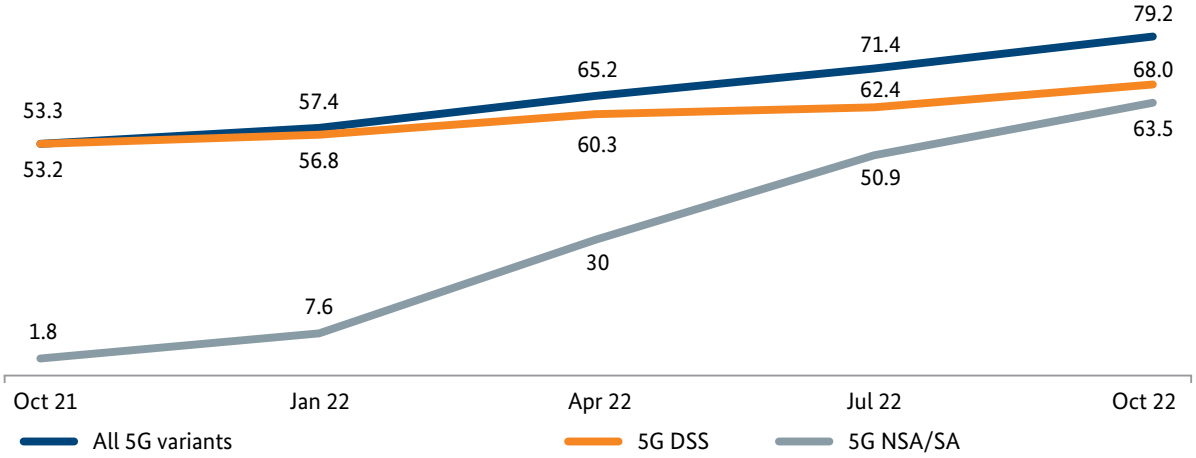
5G network coverage

An analysis of the data for 5G collected at the end of October 2022 shows that around 79% of the country has 5G coverage (all variants). It also shows a dynamic development in the level of coverage since data was first collected in October 2021 and the network operators' underlying rollout strategies. While 5G DSS (dynamic spectrum sharing) was mainly used initially, 5G NSA/SA (non-standalone/standalone) is now being rolled out more widely. 5G NSA/SA gives consumers more bandwidth than 5G DSS; this bandwidth is used exclusively for 5G and offers higher data rates. Coverage with 5G DSS had increased by only around 15 percentage points since October 2021, while coverage with 5G NSA/

Mobile coverage by operator and technology
(%)



5G coverage from at least one network operator in Germany
(%)



SA had increased by more than 61 percentage points. The data collected in October 2022 shows that about 68% of the country has 5G DSS coverage and about 63% 5G NSA/SA coverage.

White and grey spots

There has been a decrease since October 2021 in the percentage of the country affected by white[1] and grey[2] spots to 2.94% and 18.56% respectively. The percentage of the country without any mobile coverage at all (dead spots) has also fallen slightly to 0.32%. The network operators switched off their 3G networks completely at the end of 2021 as planned.

Coverage obligations for households and transport routes

The assignments for the mobile spectrum auctioned in 2019 require the established mobile operators to provide coverage with at least 100 Mbps for 98% of households in each of Germany's states by the end of 2022. They also require the operators to provide coverage with 100 Mbps for all motorways, trunk roads and busy rail lines. All other major roads must have coverage with at least 100 Mbps and minor roads, seaports, major waterways and all other rail lines coverage with at least 50 Mbps by the end of 2024.

The three established mobile operators have to put into operation 500 base stations with 100 Mbps in white spots by the end of 2022. Each of the mobile operators, including new entrant 1&1, has to put into operation 1,000 base stations for 5G applications.

The Bundesnetzagentur has been monitoring compliance with the coverage obligations from the start. The mobile operators are required to provide monthly reports and coverage data. The data is analysed and verified in measurements by the radio monitoring and inspection service. The operators were informed about any discrepancies found between their coverage data and the measurements to give them the opportunity to investigate and modify their forecasting tools.

The federal states and mobile operators held

1 No 4G or 5G coverage.
2 4G or 5G coverage from at least one but not every network operator.

regular meetings about coverage of white spots. The states offered their support to the operators, who took up the offer for a number of sites. The operators see a key factor in delays to be the time needed to look for suitable sites and get approval. Several states have already taken action to speed up approval procedures.

All three established mobile operators are actively driving forward network expansion and rollout. A final assessment of whether all the coverage obligations have been met will be made on the basis of the end reports.

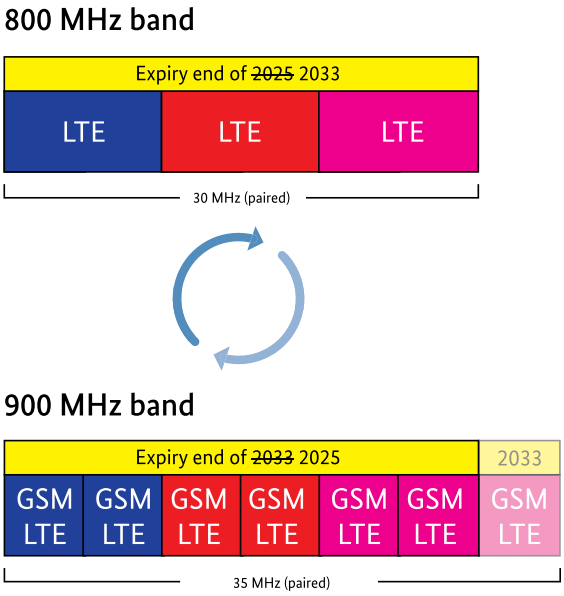
Provision of additional spectrum for mobile broadband

Spectrum usage rights in the bands relevant to mobile communications at 800 MHz, 1 800 MHz and 2 600 MHz will be expiring at the end of 2025. The Bundesnetzagentur's aim is to decide on the provision of available spectrum at an early stage. It published a spectrum compass in 2020 and a scenario paper in 2021 for public consultation. This gave all stakeholders the opportunity to be involved at an early stage in the discussion about the provision of the spectrum that will become available for mobile communications.

The Bundesnetzagentur subsequently published points of orientation and a demand survey on 24 January2022. The points of orientation outlined the facts relevant to the future provision of the spectrum. They also set out aspects to be clarified and considerations about the duration of the spectrum usage rights, the competitive independence of the fourth mobile network operator, competition-related and coverage obligations, and the promotion of cooperation. The aim of the initial demand survey was to examine signs of possible spectrum scarcity.

The Bundesnetzagentur evaluated the responses to the points of orientation and published a position paper on 22 September 2022. The position paper sets out its initial assessment of the next steps in the provision of spectrum at 800 MHz, 1 800 MHz and 2 600 MHz. The assessment is not binding and does not pre-empt the exercise of discretion by the President's Chamber. The starting point is the indication of a scarcity of spectrum. This is an argument in favour of award proceedings, rather than an extension of spectrum usage rights, which some market players called for. The assessment is that an

auction is the most suitable method. A spectrum swap with the 900 MHz band is proposed to relieve the demand situation in the 800 MHz band:



A spectrum swap would mean that the usage rights at 800 MHz would expire at the end of 2033 instead of the end of 2025, while the usage rights at 900 MHz would expire at the end of 2025 rather than the end of 2033. The 900 MHz spectrum would then be awarded instead of the 800 MHz spectrum. This swap would secure the current LTE coverage on the basis of the 800 MHz spectrum for the longer term and give new entrants an opportunity to receive spectrum below 1 GHz.

The Bundesnetzagentur will provide impetus for further improvements in broadband coverage. There will therefore be a greater focus on the perspective of users. The position paper also presented a series of proven and new measures that, alternatively or in combination, are designed to improve coverage. Various means of promoting competition at the service level were also weighed up.

The insight from the responses to the position paper will provide a basis for the next steps. Up-to-date information is available at https://www.bundesnetzagentur.de/EN/Areas/Telecommunications/Companies/FrequencyManagement/ElectronicCommunicationsServices/ElectronicCommunicationServices_node.html.

Cooperation in grey and white spots

The Bundesnetzagentur followed the negotiations between the mobile operators on cooperation in grey and white spots.

Telefónica, Telekom and Vodafone cooperate in providing coverage in grey spots, which helps to improve broadband coverage for rural areas and transport routes. Grey spots, in contrast to white spots, are areas where mobile broadband coverage is provided by only one operator.

The cooperation arrangements mean that the operator with coverage gives the other established mobile operators access to the network infrastructure on a bilateral basis. The operators can therefore provide coverage to their customers in areas previously unserved by them. This helps to achieve uninterrupted coverage by filling in gaps in coverage for rural areas and transport routes. The arrangements offer a cheaper and quicker alternative to setting up new sites.

Compliance with the obligations and full implementation of the operators' cooperation arrangements for grey spots is expected to lead to a considerable improvement in coverage on transport routes for all mobile users. According to the operators, they have already granted mutual access at a large number of sites and achieved coverage in a large number of grey spots.

The mobile operators also cooperate in providing coverage in white spots. White spots are areas without any mobile broadband voice or data services from any public mobile network operator. The cooperation arrangements involve setting up and sharing up to 6,000 new mobile sites. Each operator will set up the same number of sites, which the other participating operators can use under equal conditions and equip with their own base stations. This allows the operators to save costs and facilitates network rollout for the benefit of consumers.

Competitive independence

The Bundesnetzagentur's last auction of usage rights for spectrum at 2 GHz and 3.6 GHz in 2019 was also open to companies active as service providers and mobile virtual network operators (MVNOs). Its transitional arrangements allowed companies to have a dual role as a network operator and service provider/MVNO for a temporary period to give them time to change their business model (President's Chamber decision of 26 November 2018 (BK1-17/001), point III.1.2, margin no 19 et seq). The aim was to promote competition by giving new entrants the opportunity to acquire spectrum. 1&1 received spectrum in the auction in 2019 together with the requirement to ensure its competitive independence as a mobile operator.

Companies from the 1&1 group were and are still acting as service providers and MVNOs on the German mobile market for other network operators. The spectrum usage rights assigned to 1&1 gave the company the right and the obligation to roll out its own mobile network. The regulatory objective of efficient spectrum use requires networks to be rolled out swiftly.

The principle of competitive independence means that operators of mobile networks may not also act as service providers/MVNOs for another operator's network. This is because a network operator also acting as a service provider/MVNO for another operator could have an unfair competitive advantage. It could also be interested in the success of the other operator's network that provides coverage to its own customers. This would reduce or distort competition in the medium term.

The Bundesnetzagentur therefore took a decision on when 1&1 had to end its dual role to ensure its competitive independence as a mobile operator. 1&1 has to end its sales operations as a service provider/MVNO by the end of 2023 and all its business activities in this field by the end of 2025. The decision on competitive independence creates clarity by setting specific deadlines. It sets an end date for 1&1's dual role as a service provider/MVNO and network operator and implements the requirements from the last spectrum award decision.

Service-based competition

Service providers and MVNOs help to strengthen competition at the service level and thus to promote consumer interests with their mobile offers. One of the aims of spectrum provision is to promote competition at the service level.

The President's Chamber set the service provider regulation that currently applies in its last spectrum award decision in 2018. It includes a negotiation requirement (see President's Chamber decision of 26 November 2018 (BK1-17/001), point III.4.15).

The Bundesnetzagentur carried out a market survey about implementation of the service provider regulation in April 2022. The aim was to obtain a full overview of the situation and identify any need for action at an early stage. It looked at developments on the wholesale market and especially the provision of 5G products to service providers/MVNOs. It focused on whether negotiations were non-discriminatory and which 5G wholesale products were offered and requested and on which terms and conditions.

The findings from the market survey will be taken into account in the next steps in the proceedings for the provision of usage rights for spectrum at 800 MHz, 1 800 MHz and 2 600 MHz. The consultations for these proceedings also dealt with service-based competition. The service providers/MVNOs call for further obligations, which the network operators are opposed to. The Bundesnetzagentur will assess the current negotiation requirement and decide whether further action is needed.

Arbitration for service providers

The current service provider regulation requires mobile operators to enter into negotiations on sharing wireless capacity with suitable service providers/MVNOs. Negotiations should be non-discriminatory and the capacity to be provided should not be restricted to certain services, radio technologies or applications. The aim of the negotiation requirement is to encourage constructive negotiations between mobile operators and suitable service providers. There is no compulsion to enter into or conclude a contract or agreement.

The Bundesnetzagentur has acted as arbitrator in two cases. One case resulted in constructive negotiations between the parties. The Bundesnetzagentur is still acting as arbitrator in the other case to facilitate constructive negotiations between the parties concerned.

Actions for saving energy in mobile networks

The three national mobile operators took action in an effort to reduce energy consumption in their mobile networks in view of the tense situation on the energy market in 2022 and 2023. Each of the operators separately took measures, which they notified to the Bundesnetzagentur.

Their actions essentially involve switching off individual frequency bands at mobile sites at night when demand for data capacity is low. The bands are automatically switched on again if demand increases.

The Bundesnetzagentur welcomed these energy-saving measures, which can help to save a significant amount of energy. This is important, not only in light of the tense market situation. Saving energy is also a sustainable action and contributes to achieving the climate targets for 2030.

The measures are also compatible with the operators' coverage obligations. The operators said they would make the obligatory data transmission rates of 100 Mbps available at short notice if and when they were actually required. Basic coverage would always be available.

The Bundesnetzagentur found no indications that the operators' actions affected their customers' user experience. It is continuing to monitor the situation.

Short-term assignments

The Bundesnetzagentur issues short-term assignments for spectrum to be used at sporting, cultural and other media events and for state visits. The spectrum is usually only needed for a few hours or days at a time. Many of the spectrum users are from outside Germany and frequently apply to use spectrum designated in Germany for other purposes. In these cases, the Bundesnetzagentur checks whether the spectrum can be used for a short time without interfering with other, designated uses. This is a complex task if an event is held near the border to another country because the Bundesnetzagentur then needs to coordinate with the neighbouring country. The frequencies requested come from a wide range of bands from below 30 MHz up to 90 GHz.

In 2022, there were about 2,300 applications for short-term assignments for approximately 11,800 individual frequencies. This was around 20% higher than in 2019, before the coronavirus pandemic. The number of applications received during the pandemic was considerably lower, about 1,100 in 2020 and 1,400 in 2021.

Several major events of international importance took place in 2022 in which the Bundesnetzagentur's spectrum team was involved: the G7 Summit in Garmisch-Partenkirchen, the European Championships in Munich and a guest appearance of the American National Football League (NFL), also in Munich. The Bundesnetzagentur provided numerous frequencies for users from all over the world and its radio monitoring and inspection service was on site to ensure interference-free spectrum use.

Satellite communications

The advantage of today's satellite communications is that near-global coverage can be achieved using signals from non-geostationary and geostationary satellites. Not only do satellite communications support key social and governmental activities, they are also important in terms of the economy. Another advantage of satellite connectivity is its instant availability, which makes it suitable to supplement terrestrial multimedia, communications and internet technologies. Satellite communications play an increasingly important logistical role in peacekeeping missions, safeguarding domestic and international security and in crisis situations such as natural disasters. They also provide data and communication links in situations where terrestrial infrastructure either does not exist or has been destroyed.

In 2022 the Bundesnetzagentur submitted filings for 49 new satellite systems to the ITU. German satellite operators submitted a total of 3,100 coordination requests to the ITU for hundreds of frequencies used in orbit. The subsequent bilateral negotiations with other countries and their satellite operators guarantee that all satellite systems can use the spectrum without interference.

Complete revision and publication of the spectrum plan

The spectrum plan provides an overview of all spectrum allocations from 8.3 kHz to 3 000 GHz within Germany. The Bundesnetzagentur is responsible for drawing up the spectrum plan in accordance with section 89 TKG. Work on revising the whole spectrum plan was completed in 2022; the new plan was published for all those interested in the Official Gazette and on the Bundesnetzagentur's website, marking the successful end of the revision process.

The spectrum plan will next be updated in 2023 to accommodate regulatory measures resulting from work within international bodies (European Commission, CEPT, etc) and changes at national level. The work on updating the plan is due to be completed by the end of 2023.

Amateur radio/PMSE/PMR

The questions for amateur radio examinations were completely revised by a working group in collaboration with Germany's Amateur Radio Round Table (RTA). The Amateur Radio Ordinance 2005 was revised together with the Federal Ministry for Digital and Transport (BMDV) and is due to enter into force at the end of 2023. The new ordinance includes numerous improvements for radio amateurs, including the long-awaited introduction of a novice class (N).

A general assignment was issued enabling use of the 1 350-1 400 MHz band for programme making and special events (PMSE), and the ranges of other generally assigned bands were also extended slightly. This cuts out the usual red tape and costs for the culture and events industry, which had been hit particularly hard by the coronavirus pandemic.

Work on refarming the spectrum for professional mobile radio (PMR) continued, with the switch to 12.5 kHz channel spacing and digital modulation. Spectrum assignments for trunked radio were issued for beyond 2025, giving the industry legal certainty.

Provision of numbering resources for campus networks

Campus networks are local, non-public mobile networks that are assigned spectrum by the Bundesnetzagentur in accordance with the Administrative rules for spectrum assignments for local spectrum usages in the 3 700-3 800 MHz band.

The Bundesnetzagentur published rules enabling operators of campus networks to be assigned International Mobile Subscriber Identities (IMSIs) and other network codes in February 2022. IMSIs are needed to identify terminals in campus networks operated with today's mobile technology.

Holders of mobile spectrum assignments for campus networks can apply to the Bundesnetzagentur as of 24 February 2022 for the assignment of sub-blocks of 10,000 IMSIs from the "262 98" block and five other network codes. These network codes – Closed Subscriber Group Identities, Tracking Area Identities, E-UTRAN Cell Global Identifications, globally unique Mobility Management Entities and Network Identifiers – are to be used in combination with the IMSIs from the "262 98" block. The codes are standardised in 3GPP TS 23.003 version 16.8.0 (2021-12).

Companies are able to introduce new, digital business processes through operating their own campus networks. This benefits both large industrial enterprises as well as small and medium-sized enterprises wanting to operate private campus networks with their own broadband spectrum assignments and numbers.

Campus networks previously used mainly IMSIs provided by the International Telecommunication Union for general use. The individual assignment of IMSIs and special network codes for five different internationally standardised types of mobile network identification now makes it possible to reliably differentiate between networks. It can also help to prevent interference from unwanted login attempts.

First measures ensuring EU-wide access to numbers and services

The 2021 version of the TKG gives the Bundesnetzagentur the task of ensuring that end-users in Germany can access all numbers within the EU, including universal international freephone numbers and content services provided in EU Member States via numbers.

The Bundesnetzagentur's mandate implements a provision in EU legislation that aims to ensure cross-border access to numbers within the EU. Providers of telecommunications services are required to implement the provision at national level because it is the providers that enable customers and thus end-users to access numbers.

If the Bundesnetzagentur finds that a provider is not ensuring the required access, it will take appropriate action. In 2022 the Bundesnetzagentur opened administrative proceedings against two telecommunications service providers because their mobile contracts did not allow access to international numbers for freephone services ((00)800 numbers). These numbers are universal international freephone numbers within the meaning of the EU legislative provision. As a result of the two administrative proceedings, the providers revised their mobile contracts to allow access to (00)800 numbers.

Basic set of telecommunications services

The new TKG, which took effect on 1 December 2021, gives everyone in Germany the right to be supplied with telecommunications services, comprising voice communications services, internet access services and the necessary connection. The legislative provisions state that the services must be available at an affordable price to consumers. This ensures consumers' social and economic participation in society. Internet access services must enable the use of common online services and applications, working from home and the use of online content services as is usual on the market. Any company active on the relevant market for telecommunications services can be required to provide the set of basic services.

The Bundesnetzagentur defined the minimum requirements for the telecommunications services in the Telecommunications Minimum Supply Ordinance (TKMV), which entered into force on 1 June 2022, following stakeholder consultations. The Bundesnetzagentur had also commissioned reports in 2021 for the purpose of setting the minimum requirements. These reports are available on the Bundesnetzagentur's website. Based on the findings in the reports and the consultation, a minimum download speed of 10 Mbps, a minimum upload speed of 1.7 Mbps and a maximum latency of 150 ms were defined as the minimum requirements for internet access services.

The Bundesnetzagentur's principles for calculating affordable prices ensure that all consumers can pay for a basic set of services. The Bundesnetzagentur published its principles on 16 August 2022, having consulted with

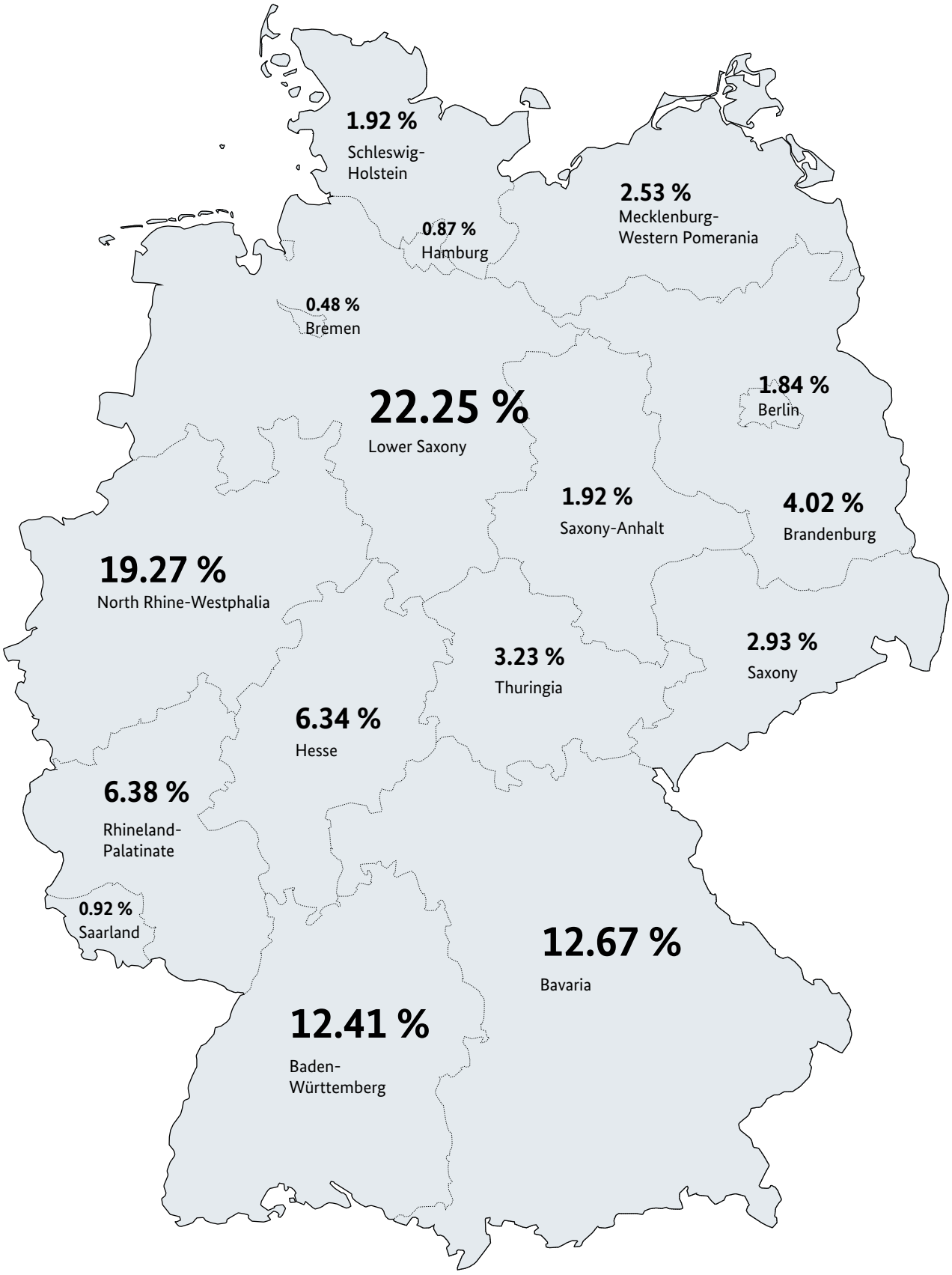
consumer and industry associations and other expert groups. A distinction is made between the one-off price for connection and the monthly rental price. The reference point used to calculate affordable prices is the national average of prices for products and connections comparable with the basic set of services. The average price for connections in the relevant district is seen as the affordable price for connection. This means that account is taken of particular regional factors that may influence the price for connection.

Consumers in areas where the Bundesnetzagentur has identified both an undersupply and a need for supply have a right to the provision of a set of basic services. Areas with an undersupply are mainly areas without access in the objectively foreseeable future to affordable telecommunications services that meet the TKMV's minimum requirements.

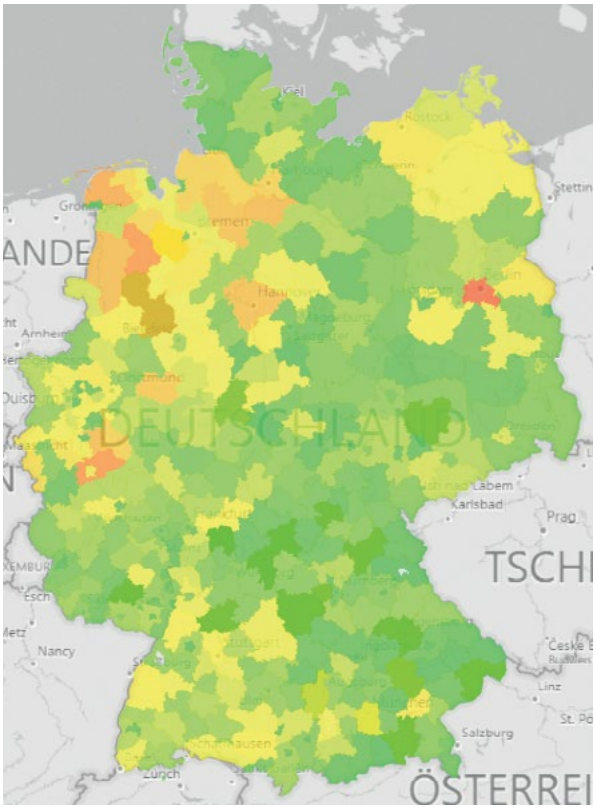
If the Bundesnetzagentur identifies an undersupply in an area, companies have one month to volunteer to provide the set of basic services. If no company volunteers, the Bundesnetzagentur will usually oblige one or more companies within three months to provide the services. These companies must then begin work on providing access to the services within three months and the services must generally be available within another three months.

The Bundesnetzagentur has received about 2,600 enquiries about the provision of basic services since the new TKG came into force in December 2021. It received 35% more enquiries between 1 June 2022 (when the TKMV took effect) and 30 November 2022 than in the period from 1 December 2021 to 31 May 2022. The following map shows the percentage of enquiries from each state:

Queries about basic telecommunications services by state since 1 December 2021



Map of enquiries about basic telecommunications services by district



The Bundesnetzagentur has identified the first cases of undersupply since the new TKG came into force in areas in Lower Saxony and North Rhine-Westphalia. The Bundesnetzagentur visited the areas on its own initiative to investigate the situation and met with residents, companies, public agencies and local political representatives. It also made visits to areas in Brandenburg and Thuringia. The map shows the spread of enquiries across the states and shows the number of enquiries in each district using different colours, from green (low) to red (high).

The Bundesnetzagentur is currently working on obligations for one or more telecommunications companies to provide the set of basic services in the undersupplied areas.

Market regulation

Regulatory orders for markets 1 and 3b

The Bundesnetzagentur finalised its order regulating Telekom Deutschland GmbH's fixed network (market 1) based on the President's Chamber determination of 11 October 2019 (BK1-19/001) and published it on 21 July 2022. The new regulatory order replaces that of 1 September 2016 (BK3g-15/004) and that for layer 2 bitstream access (broadband network gateway virtual unbundled local access – BNG VULA) of 28 October 2015 (BK3h-14/114). It sets out the new regulatory framework for wholesale access to Telekom's "last mile" of infrastructure, the company's copper and, importantly, new fibre lines.

The regulatory order's key points are outlined below.

In the ruling chamber's view, extending the scope of access to Telekom's civil engineering is essential in the context of duct access and access to documentation and planning systems despite the many associated issues.

The use of ducts by competitors, which can help to make fibre rollout quicker and simpler, largely depends on the competitors being able to access information about available duct capacity relatively easily. Information about free capacity in Telekom's network that is available for competitors to use must therefore be included in the Infrastructure Atlas and Gigabit Register and must be directly accessible to interested telecommunications companies.

Access to fibre local loops will not be guaranteed through a traditional access obligation but through the new instrument of equal access conditions for other telecommunications companies (equivalence of input).

There will be no additional approval requirements for virtual unbundled access to copper local loops (layer 2 bitstream access/BNG VULA) in view of the long-term price stability agreed on the market (commitment contracts up to the end of 2031). The Bundesnetzagentur must be notified of any changes in this price anchor for fibre rollout before they take effect and will examine the planned changes. The prices can also be examined in the procedure under section 46 TKG if necessary.

In the ruling chamber's view, it is important to acknowledge the market consensus and competitively negotiated prices as the primary pricing instrument, not least with respect to investment certainty for fibre rollout and progress in digitalisation. The aim is to give all companies involved in rollout a secure and stable basis for calculating their investments in fibre networks.

The regulatory order does not include a transparency obligation for the migration from copper to fibre networks. The procedure set out in section 34 TKG for planning migration is adequate.

It was possible and necessary to restrict the regulatory order to making a recommendation for Telekom to present its migration plans before notifying the Bundesnetzagentur in accordance with section 34 TKG, to seek a consensus with the market and to make any necessary changes to its reference offers for copper-based access products in good time.

The new framework conditions are currently expected to be in place for at least the next three years until they are replaced by new Bundesnetzagentur decisions. The Bundesnetzagentur is already preparing new data surveys, which will be used to review and redefine the current market conditions and adjust the regulatory framework if necessary.

Ruling Chamber 3 also issued a regulatory order for Telekom's layer 3 bitstream access (market 3b) on the basis of the President's Chamber determination of 16 December 2020 (BK1-20/004). The new regulatory order replaces that of 28 October 2015 (BK3h-14/114). It sets out that all towns with more than 60,000 inhabitants (a total of 141) no longer require sector-specific regulation, in addition to the 21 towns and cities that had already been deregulated because they had competitive layer 3 bitstream access. It therefore lifted the obligations imposed for these 141 towns.

The regulatory order for market 3b published on 22 December 2022 mainly follows the regulatory order for market 1 issued on 21 July 2022. It essentially imposes an access obligation on Telekom for copper-based layer 3 bitstream access.

It was not necessary to impose an access obligation for fibre-based layer 3 bitstream access because of a strict obligation of non-discrimination based on the equivalence of input principle.

A non-discrimination obligation in line with the equivalence of input principle was imposed on Telekom for fibre-based layer 3 bitstream access. This covers not only identical processes but also an economic replicability test in line with the methodology developed in the BK3i-19/020 proceedings.

The regulatory order did not introduce regulation for the prices for fibre-based layer 3 bitstream access, as permitted by section 38(2) TKG. The Bundesnetzagentur must still be notified of the prices for copper-based bitstream access before they take effect and will examine the prices under the procedure in section 45 TKG.

Following the regulatory orders imposing obligations on Telekom, other proceedings were opened with a view to imposing regulatory obligations for local loop access and layer 3 bitstream access on Glasfaser NordWest GmbH & Co. KG and GlasfaserPlus GmbH. These two companies are affiliated and merged with Telekom (section 3 para 69 TKG) and also have significant power on the relevant markets within the meaning of section 11 TKG.

Decisions on new prices for local loop access

Two decisions were issued in 2022 on the prices for accessing local loops. Local loop access is still very important because of the revenue it can generate and its function as an anchor product. Demand for access to the local loop at main distribution frames is falling, while demand for access at street cabinets is increasing because active components are being relocated to street cabinets. Both decisions cover the monthly prices for the basic copper pair access variant and other variants.

The first local loop access decision of 28 June 2022 set the prices applicable from 1 July 2022.

Telekom changed its planned monthly prices during the approval process from €12.15 for access at main distribution frames and €8.25 for access at street cabinets to €10.65 and €6.92 respectively. It also proposed an increase of 4% after five years (from 1 July 2027) to €11.08 and €7.20. The changes were due to negotiations

between Telekom and its access customers with the highest revenues before and while the prices were being approved. The negotiations led to a full agreement on the prices set in 2016 and 2019, which had been legally challenged, and the new prices for 2022, subject to approval by Ruling Chamber 3.

The ruling chamber's detailed examinations found that the new prices were eligible for approval. The prices were lower than the costs of efficient service provision as defined in section 42 TKG. The prices were capped at the levels proposed by Telekom because the calculated costs of efficient service provision were higher.

The approved prices applicable from 1 July 2022 are 4.8% and 1.8% lower than the previous prices (€11.19 for access at main distribution frames and €7.05 for access at street cabinets).

The ruling chamber's cost calculations involved very detailed calculation of the investment value, based on extensive considerations of the calculation basis, the WIK institute's next generation access cost model and the provisions of the Commission Recommendation on consistent non-discrimination obligations and costing methodologies to promote competition and enhance the broadband investment environment (2013/466/EU).

The components of the costs of efficient service provision other than the capital costs (rental, operating, fault repair, distribution and common costs for local loops) were determined as in the past using Telekom's cost documents and taking into account various efficiency-oriented changes.

The approval process also included an assessment in accordance with section 37 TKG to rule out anti-competitive pricing and, most importantly, margin squeezing. A new market survey was carried out before the approval process as input for the calculations. The calculations of the average revenues took into account not only losses in revenue with a direct effect on broadband bundles but also discounts given to customers buying bundled services (mobile and TV in addition to landline and internet), as called for by competitors. However, the average level of these discounts calculated by the Bundesnetzagentur was much lower than competitors' estimates.

The prices were approved for ten years, as requested by Telekom. The unusually long approval period accommodates the interests of all market players in long-term price stability and the accompanying legal and planning certainty, which is a key basis for the rollout of fibre to the home. At the same time, a line was drawn for the long term under the lengthy legal disputes about various individual elements in the calculations, which were costly for all involved.

The second local loop access decision of 19 December 2022 set the prices applicable from 1 July 2016 to 30 June 2019. The decision was necessary because the original decision of 29 June 2016 (BK3c-16/005) had been revoked with respect to the appealing companies by Cologne administrative court's final rulings of 11 December 2019.

As a result of the above-mentioned local loop agreement, Telekom changed its proposed monthly prices on 6 September 2022 from €11.20 for access at main distribution frames and €7.51 for access at street cabinets (in the original application for approval of 5 February 2016) to €10.02 and €6.77. The new prices were the same as those originally approved in the decision of 29 June 2016 and were eligible for approval as in the original process.

The new costs of efficient service provision differed from those calculated for the original decision. This was mainly because, in light of the Federal Administrative Court's rulings, the new calculations used up-to-date information about actual developments in the approval period and different parameters than those forecast for the original process. It was also necessary to make individual changes to the calculation method to guarantee that the calculations took account of any changes necessary because of pricing decisions made in the meantime and were therefore up-to-date.

The costs of efficient service provision calculated were slightly higher than those determined by the ruling chamber in the original process in 2016. The main reason for this was that information about the approval period showed that key input parameters for the investment calculation were higher than those originally forecast and the resulting increases overcompensated cost-reducing effects (such as a lower imputed rate of return). The proposed prices were therefore lower than the costs of efficient service provision calculated by the ruling chamber. These prices were also capped at the levels proposed by Telekom because the calculated costs of efficient service provision were higher.

The revised decision was the last building block in connection with the negotiated local loop agreement. The decision should therefore be the last relating to the prices for access to copper local loops, which has been the most important wholesale product for the past 25 years.

Approval of one-off charges for local loop provisioning

In addition to the monthly prices for local loop access, Ruling Chamber 3 issued a decision on 30 September 2022 on the one-off charges that Telekom had presented for approval on 20 April 2022. The decision covered the charges for provisioning and cancellation for the basic and several other access variants and prices for various additional services (around 130 prices in total).

The prices for provisioning and cancellation for basic access at main distribution frames are on average 4.1% lower than the previous prices. Those for basic access at street cabinets are on average 2.0% higher. The reduction in the level in prices for access at main distribution frames is due to lower prices for cancellation (see below).

As in previous decisions, the prices that were approved were all lower than those proposed; the decreases (well into the double-digit percentage range) were the result of nearly all the elements in the calculations being corrected.

It was necessary for the first time to re-set the imputed rate of return for the new cost release. Although it was not very relevant for the process-driven products covered by the decision, it was highly important for other decisions on investment-based services. The real rate fell from 3.12% to 2.16%. The nominal rate is 4.02%.

The rate is essentially based on the Commission Notice on the calculation of the cost of capital for legacy infrastructure in the context of the Commission's review of national notifications in the EU electronic communications sector (2019/C375/01) ("WACC Notice"). One change was made to the calculation methodology to provide more stability in several decisions based on the

previous cost release: the German risk-free rate was set as a 10-year average instead of a five-year average as in the WACC Notice. However, the decisions also stated that the 10-year average would gradually transition into a five-year average as in the WACC Notice, based on a three-year glide path. The calculation in this decision was therefore based two thirds on a 10-year average and one third on a five-year average for the risk-free rate.

Cancellation charges for access at main distribution frames currently generate the most revenue because of the increasing migration to higher data rate products. Telekom said it could not bundle cancellation orders and disconnect several lines at main distribution frames at the same time. However, the ruling chamber assumed that Telekom could collect cancellation orders over a short period and have one day a week when it disconnected all the lines together. The relevant costs of efficient service provision were therefore reduced.

The prices were approved for three years as requested instead of two years as in the past.

Telekom's reference offer for fibre broadband

One of the requirements in the regulatory order for market 1 of 21 July 2022 (BK3i-19/020) was for Telekom to publish a reference offer for virtual unbundled access to its fibre infrastructure. Telekom presented its reference offer within the statutory three-month period (section 29(2) TKG) on 21 October 2022.

The draft contract is based on the fibre broadband contract submitted in the regulatory order proceedings. The fibre broadband contract is in turn based on the regulated reference offer for layer 2 bitstream access (BK3d-15/003, BK3d-18/015).

Ruling Chamber 3's regulatory order required Telekom to make arrangements for monitoring. Telekom complied with the requirement and included monitoring arrangements in its reference offer.

A number of competitors had already signed fibre broadband contracts before the reference offer proceedings were opened, in light of the commitment contracts concluded with Telekom and with the aim of joining the fibre rollout as quickly as possible, but also called for an assessment. They and other competitors highlighted the importance of the conditions of the reference offer for the fibre rollout.

Unlike the fibre broadband contracts already concluded, the draft contract presented in the reference offer proceedings does not include an arrangement for "locked access". This is access to the fibre-to-the-home lines managed in the old information technology environment. The regulatory order requires Telekom to migrate these lines to the new environment by 15 December 2023 in order to enable competitors to access these lines on the same terms and

conditions as Telekom in accordance with the equivalence of input principle.

The ruling chamber opened assessment proceedings under section 29 TKG and published the draft reference offer for consultation. Eleven of the summoned third parties submitted detailed responses. A seven-hour public hearing was held on 19 January 2023. Telekom and the 22 parties summoned were then given until 10 March 2023 to comment. The ruling chamber will assess the reference offer in light of the responses received and will request Telekom to revise its offer if necessary.

Telekom's reference offers for NGN interconnection and mobile termination

Ruling Chamber 3 issued its second partial decision on next generation network interconnection (NGN IC) with Telekom's network on 10 October 2022. Telekom had submitted its 2021 reference offer on 9 July 2021. The new reference offer replaces the previous one (examined in the second partial decision of 17 December 2015 in the BK3d-13/033 proceedings).

Telekom's main aims behind the new reference offer were to reflect the deregulation of call origination services at European level, allow different pricing for calls originating within and outside the EU, remove 155 Mbps NGN interconnection accesses (NICAs) and the obligation for duplication for NICAs, and make a number of changes in light of the new TKG.

The case was technically very complex because of the billing arrangements for origin based rating (OBR). This mechanism allows operators to charge termination rates that are higher than the Union-wide maximum for calls originating outside the EU. The first step was to decide which technical information should be used to identify the origin of a call (the P-Asserted-Identity or the History-Info header field). The second step was to decide on the conditions under which the contents of the P-Asserted-Identity header field, which was decided to be the relevant field, were valid. Here it was necessary to define a "valid P-Asserted-Identity". According to the definition in the reference offer, the P-Asserted-Identity corresponds to the number of a calling line, which contains information identifying the origin of a call. The reference offer states that providing an "invalid P-Asserted-Identity" breaches the rules because it is then not possible to identify the origin of a call. If an operator provides an invalid P-Asserted-Identity, Telekom is entitled to add a surcharge to the termination rate. In the ruling chamber's view, Telekom's definition did not entirely meet the criterion of reasonableness and therefore had to be revised.

Telekom had also presented a reference offer for internet protocol (IP) interconnection for mobile termination on 23 August 2021. The new reference offer replaces the reference offer of 31 October 2007 examined in the BK3a-06/040 proceedings.

The new mobile reference offer approved by the ruling chamber in its second partial decision of 10 October 2022 accommodates technical developments as well as changes to the legal framework. Telekom had previously provided interconnection using circuit-switched technology and the public switched telephone network, but the technical components required were no longer being fully supported. Interconnection is now only provided using packet-switched technology and an IP interface.

The reference offer was based on Telefónica Germany GmbH & Co. OHG's reference offer already examined in the BK3g-17/068 proceedings, but with different pricing for origination within and outside the EU, as with the fixed network (NGN IC reference offer), because of origin based rating (OBR).

Telefónica Germany GmbH & Co. OHG also presented a reference offer for mobile voice termination via an IP interface on 7 July 2022. Telefónica's offer is based on Telekom's above-mentioned reference offer.

Monitoring maximum termination rates

Union-wide single maximum rates for terminating calls have been applicable since 1 July 2021 (fixed: 0.07 cent; mobile: 0.7 cent from 1 July 2021, 0.55 cent from 1 January 2022, 0.4 cent from 1 January 2023 and 0.2 cent from 1 January 2024).

The European Commission set the maximum rates in its Delegated Regulation (EU) 2021/654 of 18 December 2020. All Germany's network operators brought their prices into line with these rates. The Bundesnetzagentur monitors prices to ensure compliance with the Union-wide rates in accordance with section 38(6) TKG and has not identified any non-compliance to date.

Pricing complaints

Telefónica Germany GmbH & Co. OHG made a complaint to Ruling Chamber 3 in December 2021 calling for detailed analyses and calculations.

Telefónica suspected margin squeezing on the wholesale fixed network market (market 1) and barriers to competitors' potential for sales to their end-users because of unreasonable preferential treatment for Telekom's own sales (constituting anti-competitive conduct under section 37 TKG).

Telefónica said that the ruling chamber's margin squeeze test had to be updated. It stated that the percentage of provisioning charges paid by competitors, the percentage of sales via the internet and the percentage of young customers were all higher than those assumed in the ruling chamber's test and needed a higher weighting. Telefónica called for a separate test for sales via online comparison sites and offers for 18 to 28 year-olds. It suspected a significant margin squeeze particularly in these two segments. It said a number of changes were necessary, including taking account of costs for end-user hardware (routers).

Telefónica doubted Telekom gave equal treatment to its competitors because Telekom's margin was too high compared with its wholesale customers. It said Telekom's actual costs were far below the wholesale prices it charged.

The ruling chamber responded to these concerns and complaints by adding detailed questions to its market survey on local loop access prices (BK3c-22/002). It consequently updated some of the parameters in question and made the margin squeeze test much more stringent overall.

However, costs for end-user hardware are still not recognised. Telefónica had admitted that its own customers had to pay for any hardware it provided.

The ruling chamber had already rejected the call for a separate margin squeeze test for special customer segments (young customers) and sales channels (online portals) several times in the past. It still did not see any new facts that would lead to a different conclusion.

The ruling chamber did not agree that Telekom gave unreasonable preferential treatment to its own sales. It is natural and therefore not anti-competitive for Telekom to be able to generate a higher operating margin than its wholesale customers, given greater added value for its end-user services. This evaluation is in line with the price regulation system under the TKG. Defining cost benchmarks on the basis of the reasons for presuming anti-competitive conduct as set out in section 37 would not be compatible with the discretion for deciding on the criterion for approval under section 39.

The ruling chamber's examination in response to the complaint still indicated no margin squeeze with respect to wholesale IP bitstream access given even stricter parameters. There were no indications of a breach of the non-discrimination obligation. The complaint therefore did not lead to any facts that would have justified initiating a formal price assessment under section 46(1) TKG.

The ruling chamber received a further complaint from Telefónica on 2 December 2022 about Telekom charging excessive wholesale prices. Telefónica suspected a breach of section 46 in conjunction with section 37 TKG. The ruling chamber made another detailed examination and still concluded that there should be no ex post regulation of the current prices for layer 2 bitstream or IP bitstream access.

Reference offer for Ethernet 2.0 carrier leased lines

Telekom introduced its Ethernet 2.0 carrier leased line product in 2018 as a high-quality wholesale access service to replace its 1.0 carrier leased line product. Telekom was required to submit a reference offer for its new product. The reference offer was examined in a multi-stage process to see if it met the criteria of fairness, reasonableness and timeliness and was sufficiently comprehensive for access seekers to accept it without the need for further negotiations. Telekom was asked to change various aspects of the reference offer, most recently in the second partial decision of 25 November 2022. These included the time frames for ordering, providing and repairing the carrier leased lines, including escalation procedures, the introduction of contractual penalties for delays in provisioning, the deletion of planning agreements, the imposition of a rollout obligation, the identification of different quality parameters (in particular delay parameters) and various other technical performance indicators, including extending the range of protocols to be transmitted transparently. For the first time, the monitoring obligation from the regulatory order was laid down for all market 4 products.

Ex post checks on prices for high-quality wholesale Ethernet virtual private network 2.0 (VPN 2.0) access and subsequent pricing order

Ruling Chamber 2 set the fundamental course for pricing on the market for high-quality wholesale products in its decisions of 31 May 2022 and 17 August 2022. It stated that the prices Telekom charged for certain VPN 2.0 access services ("1 G UNI/NNI" upgradeable lines, "premium" connections, "10 G customer sited" NNI lines, "10 G collocation" NNI lines) did not meet the criteria of section 37 TKG. The prices Telekom charged for these services were deemed to be invalid and Telekom was prohibited from charging or agreeing these prices. Telekom did not use its right to propose compliant prices and so the ruling chamber laid down prices in subsequent own-initiative proceedings.

The proceedings were prompted by different prices being notified with effect from 1 April 2022. Before the prices were notified, Telekom had appealed to Cologne administrative court against the request from Ruling Chamber 2 for it to notify its VPN 2.0 access prices for the "standard" service, which is key to the wholesale market, and for the "10 G NNI" services. Telekom withdrew its appeal on 25 January 2022 following a hearing at the court and notified the relevant prices.

The ruling chamber's examination found that some of the VPN 2.0 access prices notified with effect from 1 April 2022 for 2 Mbps to 155 Mbps transmission paths were too high and anti-competitive within the meaning of section 37(1) sentence 2 para 1 TKG. The prices charged by Telekom for individual services were at least 15% higher than the costs of efficient service provision. The ruling chamber ruled that a markup of more than 5% on the costs of efficient service provision was anti-competitive. It also ruled that any markup on these costs was wholly impermissible if the prices Telekom charged its own end-users for services were lower than the prices it charged its competitors for the corresponding wholesale services.

In the subsequent proceedings, the ruling chamber laid down prices corresponding to the costs of efficient service provision plus a "relevancy markup" of 5%. The ruling chamber made an exception for prices for the "UNI/NNI 1 G customer sited" service; it did not allow a markup for these prices because the prices Telekom charges its own business customers with different discount levels are lower than the costs of efficient service provision.

Approval of one-off and monthly prices for provisioning and leasing Ethernet 2.0 carrier leased lines

Telekom is required to get approval for its prices for its Ethernet 2.0 carrier leased lines with bandwidths between 2 Mbps and 155 Mbps.

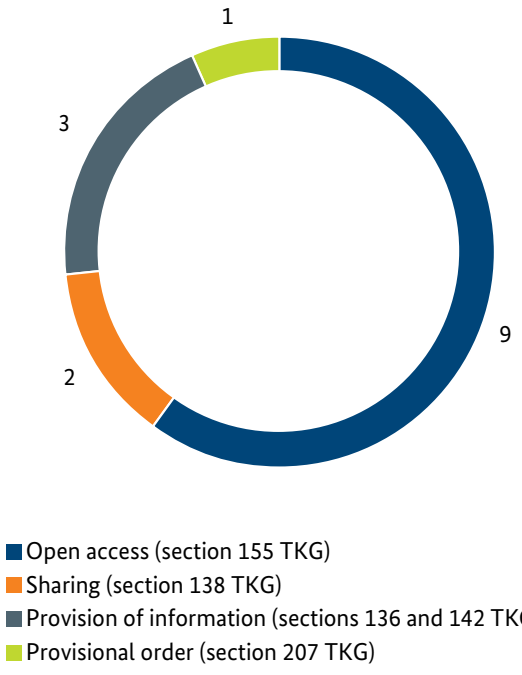
Approval was given on 5 April 2022 (BK2a-21/008) for the prices for leasing until 31 March 2024 and on 29 September 2022 (Bk2a-22/005) for the prices for provisioning until 30 November 2025. Different prices for leasing SDSL (up to 8 Mbps) and VDSL (up to 20 Mbps) copper lines were proposed and approved, instead of the same prices as in the past. The pricing system for pure fibre lines was not changed but the prices approved were noticeably lower than those proposed and previously approved. The connection prices for all bandwidths except 2 Mbps were also lower.

Different prices for provisioning SDSL (up to 8 Mbps) and VDSL (up to 20 Mbps) fibre lines were proposed and approved, as with copper lines. The prices approved for provisioning were all lower than those last approved, with a considerable decrease above all in the provisioning prices for collocation lines.

National dispute settlement body under the Digital Networks Act

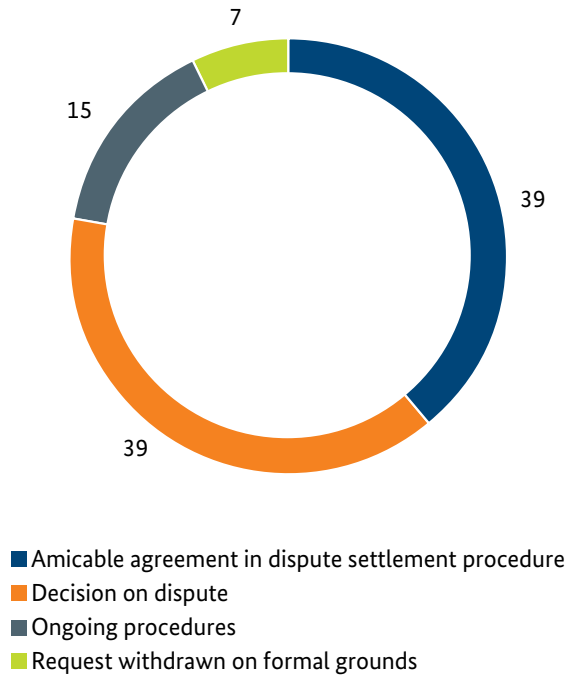
In 2022 the national dispute settlement body under the German Digital Networks Act (DigiNetzG) was again a frequent point of contact for market participants and was requested to act in 13 dispute settlement procedures. These procedures related to rights to sharing, information and open access to publicly funded infrastructure.

Breakdown of subjects of dispute settlement procedures
2022



Negotiations on requests for information, sharing and co-deployment and the associated conditions are primarily a matter for infrastructure owners and the requesting network owners or operators. However, if they cannot agree between themselves on whether a request can be met or on the specific conditions, either of the parties involved can request the national dispute settlement body of Ruling Chamber 11 to open a dispute settlement procedure. The national dispute settlement body examines the issue within statutory time frames, mediates between the parties and makes a decision on the basis of a public hearing. The ruling chamber can, for example, require an offer to be made or a contract to be amended under fair and reasonable terms and conditions, including the prices for sharing, co-deployment or open access.

Closed procedures 2022
(%)



Decision on in-building infrastructure

Ruling Chamber 11 made its first decision on a dispute about in-building infrastructure between Telekom as the applicant and a large property company, SAGA Siedlungs-Aktiengesellschaft Hamburg, as the respondent (BK11-21/002). Following the decision and successful bilateral negotiations with Telekom, SAGA AG withdrew its appeal in June 2022.

The dispute was about a request for the respondent to allow Telekom to share indoor copper cabling in its properties free of charge in the event that civil court cases concluded that Telekom did not own the cabling. The Bundesnetzagentur's decision balanced various conflicting interests. Telekom is essentially allowed to continue using the copper cabling in the properties in question. In return, it has to pay any additional costs incurred. Telekom may no longer share the copper cabling when it no longer supplies any end-users with it; this includes wholesale products for its competitors. There is no legal basis for the property company's right to limit shared use to fibre cabling, however.

Market overview

Information on the terms and conditions of contracts in place for sharing, co-deployment and open access to publicly funded infrastructure makes it possible for the ruling chamber to mirror market activities when settling contractual disputes. In light of this, more than 7,100 potential physical infrastructure owners were requested to notify sharing contracts to the Bundesnetzagentur in accordance with new obligations in the TKG.

Enforcing the obligation for open access to publicly funded infrastructure

General

For over ten years, granting state aid for broadband rollout has been linked to the obligation that competitors must be given access to the infrastructure for which aid is granted. This aims to close the digital gap, help create equal living conditions and provide comparable services in areas with and without the need for public funding. European and national State aid and subsidy rules require public authorities to attach an access obligation when granting aid. The rules make any aid granted to private companies subject to the specific obligation that competitors must also have access to the publicly funded infrastructure.

German lawmakers introduced accompanying provisions in the new TKG with effect from 1 December 2021 to better enforce the open access mandatory under State aid rules and to guarantee that the end-users' choice of products from different providers, quality and price is comparable to that for end-users in areas without the need for public funding. The provisions in section 155 TKG state that competitors may request owners or operators of publicly funded telecommunications lines or networks to give

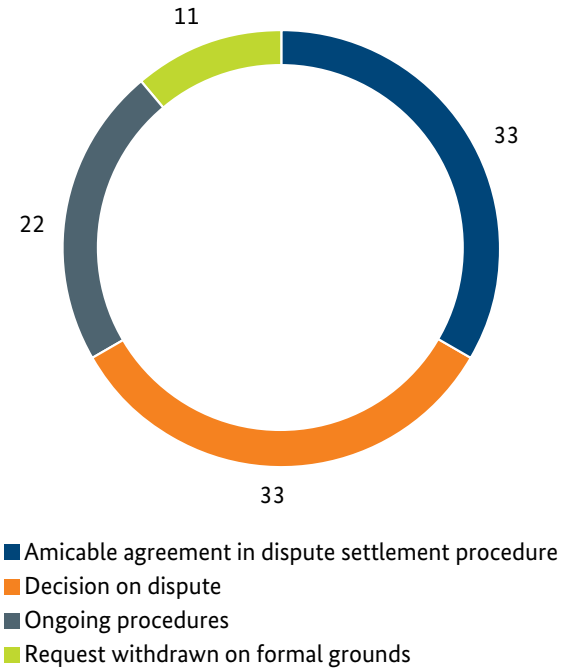
them access to the infrastructure. This includes access to the wholesale products to be provided in accordance with State aid rules, as before the introduction of the new provisions, including dark fibre, bitstream products and ducts.

If the parties do not reach an agreement in bilateral negotiations, either of them can request the Bundesnetzagentur to settle their dispute. A binding decision is then made on the basis of a public hearing similar to court proceedings.

First open access dispute settlement procedures

The new possibility for enforcing access rights by calling on the Bundesnetzagentur under section 155 TKG was taken up by market players. In 2022 the Bundesnetzagentur received nine requests just to settle disputes about open access. Four cases were closed because the requests for dispute settlement were withdrawn, mostly because the parties had reached an agreement. Decisions have already been made in three other cases. The first two substantive decisions on open access required a telecommunications company to grant open access to dark fibre in a publicly funded network in northern Hesse. Both decisions emphasised that the applicable legal framework requires the timely provision of access for competitors to all types of active and passive access products as mandatory under State aid rules, and the requesting company can choose freely from the products. A company can therefore also request access to dark fibre in the core or backbone network. The decisions have been published on the Bundesnetzagentur's website.

Open access procedures 2022
(%)



Benchmarks

It may be necessary in a decision to set or examine fair and non-discriminatory terms and conditions for open access to publicly funded telecommunications networks, including disputed prices. European and national rules state that prices should be based primarily on the average published wholesale prices that prevail in other comparable, more competitive areas of the State or the Union rather than regulated or cost-oriented prices. In 2022 operators of public telecommunications networks, providers of publicly available telecommunications services, and owners and operators of public supply networks were requested to provide information on these prices.

Consultation principles

Section 155(4) TKG provides for principles to be published in consensus with the Federal Ministry of Transport and Digital Infrastructure

and the Federal Ministry for Economic Affairs and Energy on the type, scope and conditions of open network access. The principles, together with the practice followed in the first decisions, aim to provide investment certainty and identify the scope and limits of open network access for companies requesting access. The principles take account of EU rules on State aid for fast broadband rollout as well as national subsidy rules. The principles provide an easy-to-read summary of the main points of open access. The aim is to give the market an overview of the type, scope and conditions of open access and to serve as a practical aid in future State aid procedures by providing references to applicable standard contracts.

The market consultation on the principles of open access to publicly funded infrastructure opened on 7 December 2022 following consensus at working level between the Bundesnetzagentur and the ministries.

Technical regulation

Market surveillance

Market surveillance activities in Germany are based on the EU Market Surveillance Regulation and the German Market Surveillance Act (MüG), Electromagnetic Compatibility of Equipment Act (EMVG) and Radio Equipment Act (FuAG).

Under the statutory rules, electrical and radio equipment must not only have CE marking but also clearly show an economic operator that is located in the EU.

The Bundesnetzagentur made checks on electrical and radio equipment from both online and brick-and-mortar retailers. It found that products manufactured outside the EU were more likely to be non-compliant than products from the EU. It took appropriate market-restricting measures to ensure both the safety of consumers and fair competition.

The Bundesnetzagentur also increased cooperation with the competent regional authorities, in particular in the field of product safety, and with the market surveillance authorities in Germany's neighbouring countries with the aim of removing non-compliant products from the EU single market.

A consumer-friendly web-based solution was developed on the basis of the German Online Access Act (OZG) to create an easier way for consumers to report non-compliant products.

German Market Surveillance Conference 2022

The German Market Surveillance Conference takes place in Berlin in the autumn of each year. This year's conference was held as a hybrid event at the Federal Institute for Materials Research and Testing (BAM) on 14-15 September 2022. The main responsibility for the conferences lies with the Federal Ministry for Economic Affairs and Climate Action (BMWK).

The Office of the German Market Surveillance Forum, which is part of the Bundesnetzagentur, helped to prepare and host the conference.

The conference was attended by about 100 participants at the BAM and 300 online. It gave an opportunity for discussion with representatives of the European Commission, the German Electro and Digital Industry Association (ZVEI), the German Institute for Standardization (DIN) and the Fraunhofer Institute for Production Systems and Design Technology (IPK) about current market surveillance issues in connection with introducing the digital product passport. There were also short presentations and discussions about ongoing IT projects for online market surveillance, preventive protection for e-commerce and current legal issues.

Promoting competition and protecting consumers – interoperability of audiovisual media

Television content is now consumed via traditional broadcasting as well as streaming on the internet. The Bundesnetzagentur's activities in this area included contributing to a digital video broadcasting (DVB) project to develop DVB-I, a technology that serves as a bridge for consumers between the two technologies. Consumers can access audiovisual media services, including broadcasting programmes delivered over different transmission media, using a common service list.

Activities continued in national working groups after the standardisation work had been completed, with a view to a possible market launch and with the focus again on competition, interoperability and consumer aspects.

Online form for reporting non-compliant radio and EMC products

IThe Bundesnetzagentur developed through to final acceptance an online form for reporting non-compliant radio and EMC products in conjunction with the implementation of the OZG, which aims to improve online access to administrative services. The online form was also designed in view of the requirement in the Market Surveillance Regulation ((EU) 2019/1020) to take into account "consumer complaints and other information received from other authorities, economic operators, media and other sources that might indicate non-compliance" for the products to be checked. The aim of the online form is to make it much easier to contact the Bundesnetzagentur and therefore accommodate consumer protection interests. The reports to the Bundesnetzagentur help to identify distortion of competition and remove non-compliant and unsafe equipment from the market.

Radio equipment/EMF protection

The Bundesnetzagentur's site certification procedure ensures that the electromagnetic field (EMF) exposure limits are met at sites where radio equipment is operated. In 2022 a total of 22,075 site certificates were issued, with 2,260 sites being assessed using the field theory-based WattWächter tool. In October 2022 a feature was added to the tool to take account of material attenuation. This enables cautious account to be taken in the interests of EMF protection of the physical fact that the level of electromagnetic radiation from radio equipment is reduced by concrete ceilings.

The EMF monitoring campaign for the long-term measurement and assessment of local emissions from radio equipment was re-launched in 2022. The Bundesnetzagentur acquired new measuring equipment with a larger range up to 6 GHz for this purpose. This equipment can be made available free of charge to regional authorities and municipalities on request. All the measurement results are published on the EMF map.

Further information about the site certification procedure and the Bundesnetzagentur's measurements can be found in the EMF section of the Bundesnetzagentur website at www.bundesnetzagentur.de/emf (in German).

Radio interface specifications

Radio interface specifications are technical descriptions or specifications for radio equipment operated in frequency bands that are not harmonised at European level. They contain all the information necessary for manufacturers to carry out the relevant tests of their choice for the essential requirements applicable to their radio equipment. Section 33(1) and section 23(2) para 6 FAG give the Bundesnetzagentur the task of providing the interface specifications. More than 90 specifications are currently available at www.bundesnetzagentur.de/schnittstellenbeschreibungen.

The Bundesnetzagentur continued its work in 2022 on developing and updating interface specifications. It completed nine new specifications, which took effect when they were published in the Official Gazette. Another nine draft specifications are at the approval stage and are expected to take effect in 2023.

Publication of the Technical Directive DE-Alert

In light of the disastrous flooding in summer 2021, a political decision was made to introduce an additional warning system in Germany too, using the Cell Broadcast short message service.

The primary legal basis was created in section 164a of the new TKG and the Mobile Telecommunications Warning Ordinance (MWV). The Bundesnetzagentur's technical directive specifies the technical details for the warning system. The regulations enable the relevant mobile operators to implement the legal requirements for public warnings via mobile communications in their networks.

The Bundesnetzagentur published the Technical Directive DE-Alert (version 1.1) in its Official Gazette on 23 November 2022. The requirements must be met from 23 February 2023.

Public safety/security

Technical safeguards

Protecting the privacy of telecommunications and personal data, protecting systems against faults or interference, and managing the risks to the security of telecommunications networks and services are the key objectives of section 165 TKG. Work began on developing and updating the catalogue of security requirements to accommodate the new TKG (which came into force on 1 December 2021), the continual changes due to new technologies and current threats.

A strategy paper on the resilience of telecommunications networks was developed in cooperation with the Federal Office for Information Security (BSI), telecommunications network operators and industry associations on the basis of the network resilience conference held on 29 March 2022 and the current geopolitical situation. The aim of the paper is to identify scenarios and areas for action as a basis for suitable measures and recommendations for making telecommunications networks in Germany more resilient, in particular in view of potential threats and disasters.

In 2022 the Bundesnetzagentur carried out random checks at 366 companies on the implementation of their security concept. Additionally, 85 new and 265 revised concepts were submitted to the Bundesnetzagentur for review to determine compliance with section 166(1) TKG. A total of eight companies fulfilled the obligation after being threatened with fines, while four companies met the requirement after a fine had been imposed.

The ongoing coronavirus pandemic meant that implementation checks were increasingly carried out on the basis of requests for documentary evidence and information proving compliance. On-site inspections were carried out in only a few cases. In 2022 the Bundesnetzagentur received 57 reports of security breaches within the meaning of section 168 TKG.

Data for information requests from security authorities

The automated information procedure enables statutorily authorised bodies (mainly the police, state police, federal and state protection authorities and emergency call centres) to request subscriber data including names, addresses and telephone numbers from telecommunications companies via the Bundesnetzagentur's automated and highly secure systems 24 hours a day. At present 117 systems as authorised bodies and 104 telecommunications companies as obligated companies take part in the scheme.

Information can now be provided extremely rapidly – if necessary, within a few seconds – thanks to technological improvements. In 2022 the Bundesnetzagentur's systems processed a total of 23 million requests.

A conformity assessment programme was launched in February 2022 to accompany the requirements introduced in December 2021 for identification procedures in the prepaid mobile sector. In future, telecommunications companies are to have their identification procedures verified by certification bodies accredited under this programme and will only be allowed to continue using their procedures for the registration of prepaid SIM cards if the procedures have passed verification. Following reports about security weaknesses in video identification procedures in general,

the regulatory requirements as a whole are being revised, which is affecting the delayed introduction of conformity assessments. The aim is for this work to be completed in the third quarter of 2023.

An evaluation report on Germany's Customer Data Information Ordinance (KDAV) was produced by the BMDV in cooperation with section ITS 14 at the Bundesnetzagentur. The revised version of the KDAV is due to be drawn up and come into force in 2023.

A new version of the Technical Directive TR-AAV is also due to be produced next year with participation from the parties involved; this will contain new requirements for search options, shorter response times and general improvements in performance.

In addition, a compliance summit on data quality in the automated information procedure is planned. The event will be the first step in a joint initiative to remedy shortcomings in the field of data quality and for an industry dialogue on suitable action.

Implementation of intercepts

Under the statutory provisions (for example of the Code of Criminal Procedure (StPO)), anyone providing or cooperating in providing telecommunications services must enable telecommunications to be intercepted and recorded and provide information about user, customer and traffic data. Sections 170 and 174 TKG set out whether and to what extent telecommunications companies must make relevant arrangements. Section 171 TKG requires mobile network operators to cooperate with investigations involving mobile terminal equipment, such as searches for missing persons.

One of the Bundesnetzagentur's tasks is to stipulate the technical details for these requirements in a technical directive (TR TKÜV). Any changes to the TR TKÜV are made in consultation with the authorised bodies and with the participation of industry associations and manufacturers. Over the past two years, new technical rules have been developed and existing technical requirements updated for the obligation under section 171, for instance for messaging services and other number-independent interpersonal telecommunications services. Version 8.1 entered into force on 8 February 2023.

Disaster preparedness

The Post and Telecommunications Service Provision Act (PTSG) ceased to have effect with the entry into force of the TKG on 1 December 2021; the provisions of the PTSG relating to telecommunications were incorporated into the TKG as regulations for disaster preparedness. The Bundesnetzagentur again worked closely with the telecommunications companies on measures to cope with future disasters and expanded on concepts already in place.

Electronic trust services as a lever for the digital transformation

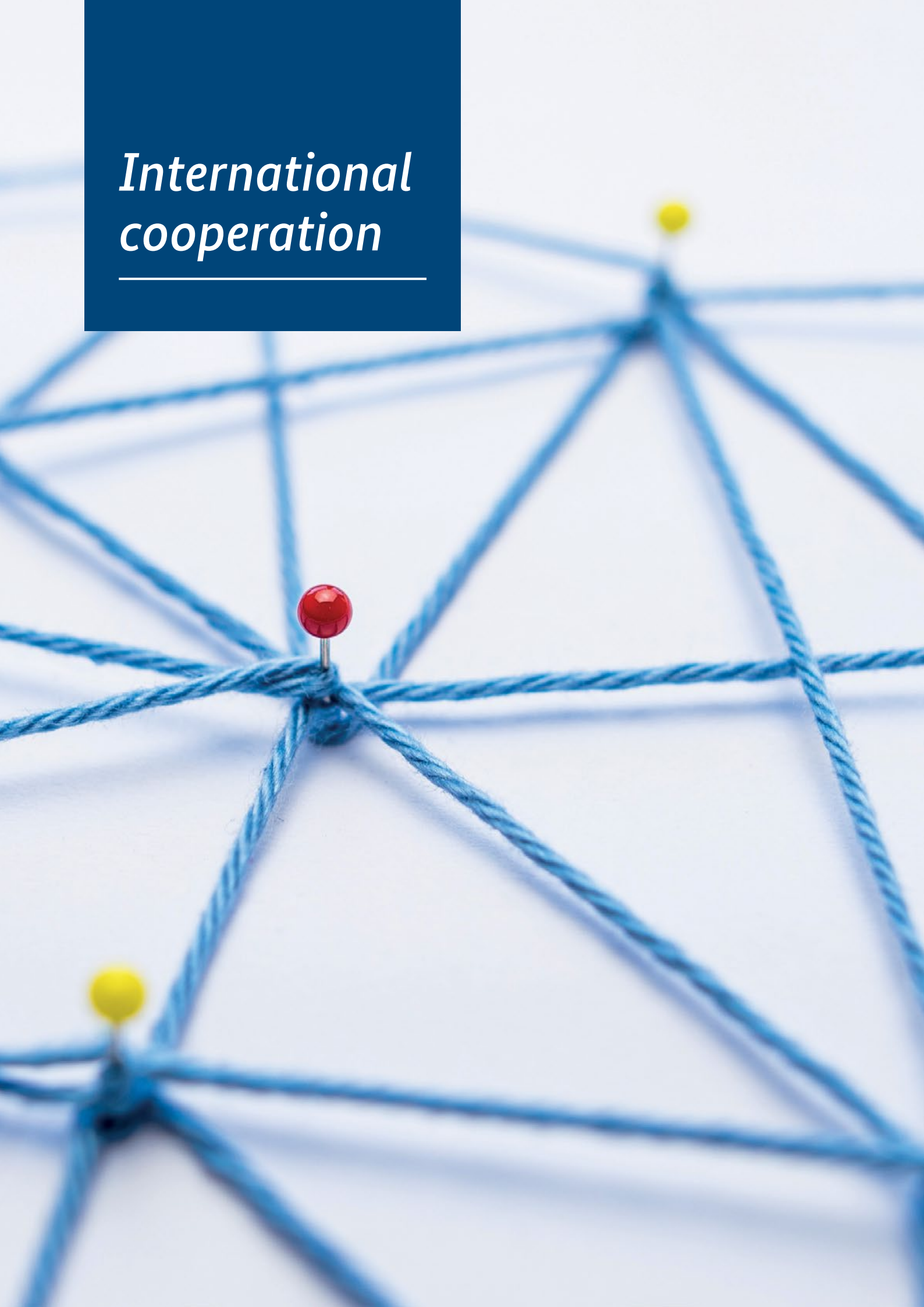
An eventful year once again put the spotlight on the significance of the digitalisation process. The German government's goal of placing Germany among the top ten in Europe can only be achieved with a networked and digitally sovereign society. The Regulation on electronic identification and trust services for electronic transactions in the internal market (eIDAS Regulation) establishes the necessary regulatory framework and strengthens trust in electronic transactions as one of the building blocks of the EU's Digital Agenda for Europe. The electronic trust services under the eIDAS Regulation enable the digitalisation of analogue processes.

The technical and legal framework is currently being revised on the basis of the experience made over the past years and will accommodate the digital transformation process as a guarantee for progress. Through its involvement in reworking the eIDAS Regulation, the Bundesnetzagentur has a significant influence on how electronic trust services are developed as a basis for the digitalisation process.

Alongside the development of digital services and digital identity solutions, infrastructure and secure transactions are basic elements in the successful transition to a digital state. The strong increase in enquiries from administration, civil society and industry about the use of electronic trust services clearly shows that digital market penetration not only drives innovation but also secures Germany's economic power in the long term. The Bundesnetzagentur supports the digital strategy by acting as the approval body and the central technical infrastructure for qualified and therefore quality-tested electronic trust services and creates a reliable framework for legally secure cross-border transactions based on the EU's common digital toolbox. The need among EU citizens for simple, digital access to public authorities – driven by the pandemic – is still developing strongly.

The revised eIDAS Regulation (eIDAS 2.0) together with digital identities, attributes such as occupations or training qualifications, and the use of electronic trust services, including an easy-to-use, legally secure electronic signature through an EU digital identity wallet, will pave the way for the digital, self-sovereign society. The Bundesnetzagentur is committed to creating secure, trustworthy digital consumer networks through its work on eIDAS 2.0 within the specialist bodies.

International cooperation



In 2022 the Bundesnetzagentur again played an active role within the EU's Body of European Regulators for Electronic Communications (BEREC) and contributed directly to its deliverables, such as the revision of BEREC's retail and wholesale roaming guidelines and the report on interoperability of number-independent interpersonal communications services (NI-ICS).

BEREC and BEREC Office

The focus of the Bundesnetzagentur's international activities is on participation within the EU's Body of European Regulators for Electronic Communications (BEREC) and its working groups, which deal with numerous issues relating to the EU's internal telecommunications market.[1] BEREC's work is based on its three strategic priorities for 2021 to 2025: connectivity, sustainable and open digital markets, and empowering end-users and their rights.

The BEREC Office, which has its seat in Riga, provides administrative support to BEREC. It is accountable to the Management Board, which is composed of representatives of all the national regulatory authorities and the European Commission. The Board of Regulators, which is composed of representatives of the national regulatory authorities, is BEREC's decision-making body and adopts the deliverables prepared by the working groups. Some of the points of focus of BEREC's activities in 2022 are described below.

[1] https://www.berec.europa.eu

International roaming

The new Roaming Regulation entered into force on 1 July 2022 following intensive preparatory work in 2021 involving BEREC and the Bundesnetzagentur.[2] The new Regulation retains the "roam like at home" principle, but one significant change is that operators are required to provide roaming services not only at the same price but also with a similar quality of service as at home, as long as this is technically possible. The new Regulation also introduced obligations for providing information about using value-added services when abroad and about accessing emergency services.

The recast of the Roaming Regulation meant that BEREC also needed to revise its retail and wholesale roaming guidelines to cover the requirements relating to the quality of roaming services and the new information obligations for roaming providers (databases for value-added services and emergency numbers). Both sets of guidelines explain the provisions of the Roaming Regulation and are designed to help roaming providers apply the provisions correctly. The guidelines are also an aid for national regulatory authorities when monitoring compliance with the roaming rules. The Retail Roaming Guidelines[3] focus on the provisions relating to retail customers and the Wholesale Roaming Guidelines[4] on the provisions relating to the contractual relationship between operators offering roaming services.

End-user rights

The European regulatory framework provides for ensuring equivalent access to communications services and choice of undertakings and services for end-users with disabilities. BEREC published a report on the formal implementation and planned monitoring of the relevant provisions[5] from the regulatory framework[6] and other regulations[7], the measures currently in place, the responsibilities of the national regulatory authorities, funding mechanisms for access, engagement with organisations for end-users with disabilities, and access to emergency services.

The regulatory framework also provides for end-users to have access to at least one independent comparison tool. In light of this, BEREC gathered information on the comparison tools available and planned and on access to these tools.[8] The comparison tools are designed to enable end-users to compare different internet access services, number-based services and, optionally, number-independent services with regard to prices and tariffs and, in some cases, quality of service. The tools must, among other things, set out clear and objective criteria and include a broad range of offers covering a significant part of the market. Tools fulfilling the requirements must be certified by competent authorities upon request by the providers of the tools.

[2] Regulation (EU) 2022/612
[3] BoR (22) 144
[4] BoR (22) 147

[5] BoR (22) 172
[6] Articles 111, 102, 85, 96, 103, 104, 109 and 114 of Directive (EU) 2018/1972
[7] For example Directive (EU) 2019/882, Regulation (EU) 2022/612, Directive 2010/13/EU
[8] BoR (22) 139

Helpline for victims of violence against women

In 2020, the German presidency of the Council of the EU launched an initiative to reserve a harmonised EU-wide helpline number (116 016) for victims of violence against women in the Member States. In line with EU legislation, the European Commission requested BEREC in August 2022 to provide an opinion on the planned introduction of the helpline number. The Bundesnetzagentur advocated a swift preparation and adoption of the opinion, in which BEREC concluded that the criteria for reserving the helpline number were met.[9] On 25 November 2022, the International Day for the Elimination of Violence against Women, the dedicated number 116 016 was established across the EU. Victims of violence against women are now able to call this freephone number to get advice and support.

Study on the independence of national regulatory authorities

One essential characteristic of national regulatory authorities is their independence. A study commissioned by BEREC looked at the independence of the national regulatory authorities beyond the requirements of the EU regulatory framework and concluded that their independence is not an end in itself but rather key to the authorities' ability to function effectively.[10] The report focuses on three dimensions of the authorities' independence (operational, personnel and financial); it concludes that all of these dimensions are important to independence and that the ability of the national regulatory authorities is likely to suffer if any one of them is seriously impaired.

[9] BoR (22) 141
[10] BoR (22) 189

Market regulation

BEREC produced a report providing a snapshot of the regulatory treatment of business services and an overview of the geographical scope of business markets[11] An external study on communication services for businesses, based on a comprehensive data survey covering the supply and demand sides in business services markets, provides a key basis for future market analyses and a better understanding of future developments.[12], die einen wichtigen Beitrag für zukünftige Marktanalysen und zum besseren Verständnis von künftigen Entwicklungen leisten wird.

A report looking into the regulatory treatment for fixed and mobile backhaul was also published.[13] The report focused on the legal provisions of the European Electronic Communications Code (EECC) and the EU Recommendation on relevant markets as well as on the current regulatory framework and the views of the market players on this framework.[14] Efficient backhaul connections are essential because the volumes of data to be managed will continue to increase considerably. The regulatory outcomes vary among Member States and mainly depend on the problems identified in the relevant retail markets. Options for accessing physical infrastructure are also of key importance. The report reveals that in the majority of Member States backhaul is subject to ex ante regulation, generally in market 2/2020 (or market 4/2014), but also that a quarter of the national regulatory authorities no longer see a need for regulating the market.

[11] BoR (22) 185
[12] BoR (22) 184
[13] BoR (22) 33
[14] Commission Recommendation (EU) 2020/2245

Competition amongst VHCN/NGA network operators

BEREC produced a report on competition amongst multiple operators of very high capacity/next generation access (VHCN/NGA) networks in the same geographical area.[15] In many Member States, 11-50% of homes have access to two VHCN/NGA networks within the same area although relatively few have access to three or more networks. Interestingly, only three countries found that this had an effect on retail prices. The EU Recommendation on relevant markets specifically requires a thorough analysis of any geographic differences in competition, which is why the availability of multiple networks is of considerable importance.

Digital Markets Act and Digital Services Act

In November 2022 a comprehensive body of legislation for digital markets and services entered into force in the EU with the aim of creating a level playing field for all market participants and protecting users from illegal content and products. The Digital Markets Act (DMA) provides for the ex ante regulation of all digital platforms classified as gatekeepers and establishes "dos" and "don'ts" obligations for gatekeepers. The Digital Services Act (DSA) regulates the obligations and responsibilities of online service providers, from small to very large, with respect to the removal of illegal content and products and the fundamental rights of all users. Implementation of the rules of the Digital Markets Act is the task of the European Commission, assisted by an advisory group of bodies and networks from the digital sector. BEREC is one of the members of the group together with data protection and competition authorities. It is developing a procedure for selecting its representatives for the advisory group. Implementation of the provisions of the Digital Services Act, by contrast, is the responsibility of the competent authorities. The European Commission has supervisory and enforcement powers for very large online platforms. It is supported by a European Board for Digital Services, which consists of Digital Services Coordinators entrusted with coordinating implementation at national level.

Data Act and Artificial Intelligence Act

Two further European legislative proposals relate to the regulation of artificial intelligence (Artificial Intelligence Act) and access to data (Data Act). BEREC published an opinion in which it welcomes the objectives of the Data Act and its basic principle that data sharing should benefit individual, business and public-sector users.[16] BEREC also produced a report on the challenges and advantages of artificial intelligence, looking at various applications and areas in which national regulatory authorities can use artificial intelligence. The draft report was published for public consultation at the end of 2022.[17]

[15] BoR (22) 188

[16] BoR (22) 118

[17] BoR (22) 191

NI-ICS and internet ecosystem

BEREC produced two reports on the interoperability of number-independent interpersonal communications services (NI-ICS) and their (revenue) indicators[18] and on the internet ecosystem and its whole range of added value[19] . The substitutability of traditional telephone services by number-independent services means that the monitoring of the electronic communications markets for the purposes of market regulation and consumer protection now also covers over-the-top (OTT) service providers, whose data most European regulators have not yet begun collecting. A list of relevant indicators can therefore help in collecting data in future.

The internet ecosystem is of huge importance to the activities of the European regulators in light of the ever-increasing relevance of digital services and markets. BEREC's report looked at how each element in the internet ecosystem impacts the ability of end-users to access and distribute information and content. The report identified the main players and analysed issues such as competition dynamics and potential market barriers.

[18] BoR (22) 183
[19] BoR (22) 167

Net neutrality

The national regulatory authorities have many years of practical experience applying the EU rules for ensuring net neutrality[20] and BEREC's net neutrality guidelines. BEREC published a revised version of its guidelines in June 2022 following a public consultation.[21] The revised guidelines took particular account of the judgments of the European Court of Justice (ECJ) of 2 September 2021, in which the ECJ ruled that the "StreamOn" and "Vodafone Pass" zero-rating options were not permissible because they were not compatible with the principle of equal treatment of data traffic.

The European Commission has to submit its second report to the European Parliament and the Council on the review of the Regulation by 30 April 2023. BEREC published an opinion as input for the report, concluding that the Regulation laying down measures concerning open internet access is fit for purpose and there is no need for any amendments.[22]

Fair Share

In 2022 the debate continued about content and application providers making a financial contribution to network costs ("fair share"), which the large European telecommunications network operators have been demanding for some time. BEREC published a preliminary assessment of the underlying assumptions of such contributions in October 2022.[23] In its preliminary assessment, BEREC emphasises that the data traffic is "caused" by the customers of the internet service providers (ISPs) and not by the content and application providers

[20] Verordnung (EU) 2015/2120
[21] BoR (22) 81
[22] BoR (22) 163
[23] BoR (22) 137

(CAPs). It also confirms that CAPs and ISPs are mutually dependent on each other. BEREC also finds no evidence of CAPs "free-riding" the ISPs' infrastructure (using the infrastructure free of charge), supplementing this with further calculations.

Cybersecurity

Cybersecurity was more topical than ever in 2022 and was a focus of the Bundesnetzagentur's activities. In this context, the Directive on measures for a high common level of cybersecurity (NIS 2 Directive) and the Directive on the resilience of critical entities (CER Directive) are particularly worth mentioning. The two Directives were published in the EU Official Journal on 27 December 2022 and must be transposed into national law by October 2024. To accompany this process, BEREC conducted a survey on the extent to which national regulatory authorities in the EU are responsible for cybersecurity and how and where telecommunications network operators' critical network components are operated.[24]

Environmental sustainability

BEREC has included environmental sustainability in its work programme in light of the increasing importance of the topic at political level and on the European Commission's agenda. BEREC's first aim was to collect information and generate knowledge on the environmental impact of telecommunications and digitalisation.

In its report on environmental sustainability, BEREC provides an overview of its activities over the past years, such as workshops and bilateral meetings with various organisations and stakeholders, and of national regulatory authorities' individual initiatives in this area and presents its findings and conclusions.[25] BEREC's outline of potential future work includes plans to identify indicators to determine the digital sector's environmental footprint. In view of the positive enabling effects of digitalisation on decarbonisation and climate neutrality, BEREC intends to extend its knowledge building to include this field and an investigation of the digital sector's enabling and net effects on the environment.

An external study commissioned by BEREC and published in March 2022 provided an overview of the greenhouse gas emissions from the electronic communications sector and possible measurement methodologies.[26] The focus of the study is on greenhouse emissions as this is the field where the most data and knowledge is available, but impacts on natural resources are also discussed.

[24] BoR (22) 175

[25] BoR (22) 93

[26] BoR (22) 34

The study also analyses initiatives that have been taken by electronic communications network operators and national regulatory authorities to measure and/or limit emissions and other environmental impacts linked to electronic communications.

It concludes by examining the potential role that national regulatory authorities could play in supporting sustainability goals, the limitations they may face in this context, and trade-offs that may arise in conjunction with objectives and commitments that national regulatory authorities need to meet in the context of EU and national legislation applicable to electronic communications.

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Broadband Cost Reduction Directive

The Broadband Cost Reduction Directive is a key instrument in incentivising and accelerating the rollout of fibre networks by significantly lowering the costs of deployment.[27] The provisions of the current Directive focus on easier access to existing physical infrastructure across utilities, coordination of civil works between project developers, simpler and faster administrative procedures, and requirements for new buildings and major renovations. The European Commission began a review of the Directive in 2022 with the aim of presenting a proposal for a revision in early 2023. BEREC submitted an opinion in response to a questionnaire from the Commission.[28]

Guidelines on State aid for broadband networks

BEREC also drew up a response to the draft revised Guidelines on State aid for broadband networks.[29] The Guidelines aim to simplify the procedures for granting State aid for very high capacity networks (VHCNs) and provide guidance on the conditions under which the European Commission presumes that State aid is lawful. In light of the consultation and not least BEREC's response, the Commission revised its draft and published the final version of the Guidelines with a number of amendments at the end of the year.[30]

Satellite connectivity for universal service

BEREC investigated the extent to which satellite systems can be used to provide universal services.[31] This solution is of particular interest for rural areas and other hard-to-reach locations

[27] Richtlinie 2014/61/EU
[28] BoR (21) 30
[29] BoR (22) 16
[30] Communication C(2022)9343
[31] BoR (22) 169

that are not served by fixed or mobile broadband networks. Satellite systems are not currently capable of serving the mass market because of the technical bandwidth limitations and restricted capacity, but they can offer a solution for a small part of the market to enable the provision of universal services on the basis of case-by-case decisions.

Independent Regulators Group

The Independent Regulators Group (IRG) was established in 1997 by independent regulatory authorities and celebrated its 25th anniversary in 2022.[32] IRG is open to a larger group of members than is possible for BEREC (such as the national regulatory authorities from Switzerland and the United Kingdom) and provides a forum for topics relevant to regulation but outside BEREC's mandate.

IRG is supported by its secretariat in Brussels, which provides a direct link and information flow between the national regulatory authorities and the relevant EU institutions and other stakeholders based there. IRG held a number of events in 2022 to facilitate an intensive dialogue between the various market players, including a webinar on the EU Global Gateway, the first IRG Ted Talks on cloud computing and the EU Data Act, and the first Info-Shot on the Digital Markets Act. IRG also organises regular workshops on current topics for members of the national regulatory authorities.

International spectrum policy

ITU Radiocommunication Sector

Work within the ITU Radiocommunication Sector (ITU-R) in 2022 was again shaped by the Covid-19 pandemic, with most meetings being held online in a tight time frame. The meetings were divided between preparations for the World Radiocommunication Conference (WRC) and ITU-R's normal tasks.

Different positions emerged across the issues on the agenda for WRC-23. These differences are mainly due to the wide range of user interests represented by the administrations and industry (for example in the 7 GHz and UHF bands). The use of compatible technologies (as in the fixed service international mobile telecommunications (IMT) studies) could be binding in the future. Clear rules are also needed on a global level, including for satellite communications to unmanned aerial vehicles (UAVs) or for the protection of fixed-satellite services (FSS) in the C-band. During the preparations at European level, it was possible to agree on many common approaches or even common positions.

One of the many topics ITU-R is looking at is technological trends for the next decade's generation of mobile communications under the working title of "IMT for 2030 and beyond".

[32] https://www.irg.eu

CEPT's Electronic Communications Committee

The Bundesnetzagentur cooperated with other European spectrum management authorities to offer support with numerous technical and regulatory studies and help finalise European spectrum rules (www.ecodocdb.dk/home).

The European regulatory framework is developed by the Electronic Communications Committee (ECC) within the European Conference of Postal and Telecommunications Administrations (CEPT). The ECC's tasks include producing ECC Decisions and ECC Recommendations, studies on radio spectrum issues (ECC Reports) and reports from CEPT in response to mandates issued by the European Commission.

The focus of the work in 2022, alongside the response to the Commission's mandate to develop harmonised technical conditions for 5G in the 40.5-43.5 GHz band and the corresponding ECC Decision, included the technical characteristics for specific radiodetermination applications in the 116-260 GHz frequency range, which enables numerous innovative high-resolution sensor applications, for instance in the field of industrial production.

Radio Spectrum Committee

The European Commission's Radio Spectrum Committee (RSC) draws up implementing decisions binding on all Member States with the aim of harmonising conditions for the use of radio spectrum.

In 2022 the RSC's work based on the deliverables provided by the ECC in response to mandates included the following.

The rules for mobile/fixed communications networks (MFCN) were supplemented with technology-neutral usage conditions in the 900 MHz and 1800 MHz bands to enable the deployment of 5G technology (including the use of active antenna systems (AAS)), with the Bundesnetzagentur making a key contribution.

The Commission Implementing Decision amending the harmonised technical conditions for the use of spectrum in the 5150-5250 MHz, 5250-5350 MHz and 5470-5725 MHz bands for wireless access systems (WAS) including radio local area networks (RLANs) includes rules for the use of WAS/RLANs in different types of vehicles (road vehicles, trains and aircraft).

The Commission Implementing Decision to include additional access technologies and measures for the operation of mobile communications services on aircraft (MCA services) enables 5G connectivity on aircraft. It also takes account of the current pace in upgrading networks to 4G and 5G technology and the gradual decommissioning of 3G networks in Europe by no longer requiring the operation of a network control unit (NCU) as part of MCA equipment on board aircraft in the 900 MHz band and in the paired terrestrial 2 GHz band as from 1 January 2026.

The RSC also completed the eighth update of the EU-wide rules for short range devices (SRDs). This update includes harmonised technical conditions for the use of spectrum for enclosed nuclear magnetic resonance (NMR) applications. These applications can be used among other things for food testing, the pharmaceutical sector, building materials testing and fluid studies (see also https://ec.europa.eu/digital-single-market/en/radio-spectrum-committee-rsc).

Radio Spectrum Policy Group

The Bundesnetzagentur's activities for the Radio Spectrum Policy Group (RSPG), the high-level advisory group that assists the European Commission with spectrum policy issues, involved supporting the Federal Ministry for Digital and Transport (BMDV) and providing input for various opinions and reports. The RSPG Peer Review Report was adopted (https://radio-spectrum-policy-group.ec.europa.eu/opinions-and-reports_en).

Standardisation activities

Radiocommunications

The Bundesnetzagentur continued to contribute in 2022 to activities within the European Telecommunications Standards Institute (ETSI) and played an active part in numerous working group meetings (mostly held online because of the pandemic) to develop modern and open high-quality standards for radio equipment for a wide range of radiocommunication services (including fixed links, aeronautical, maritime and inland waterways, radiodetermination and radionavigation). The focus was on incorporating the regulatory objectives as far as possible in the standardisation process.

Artificial intelligence

The European Commission announced its intention to adopt the Regulation on artificial intelligence (AI) for it to come into force in 2023 on the assumption that harmonised European standards will be developed to ensure the trustworthiness of artificial intelligence in science, industry and civil society. The overarching aim of the European regulatory framework is to put in place requirements for conformity assessment and market surveillance in order to ensure trust in the creation and marketing of innovative AI products and services. To this end, the Bundesnetzagentur played an active part in standardisation activities at European level for electrotechnical, telecommunications and other technical fields within ETSI, the European Committee for Standardization (CEN) and the European Committee for Electrotechnical Standardization (CENELEC). The activities included designing requirements for AI-based autonomous

networks to secure a high quality of service, resource-efficient network orchestration, robustness, traceability and data security. The Bundesnetzagentur also led activities on the European standardisation of a classification scheme for AI systems. The goal is to create uniform risk and conformity assessment procedures for AI systems for consistent application throughout the EU, based on the proposed legal framework. Quality criteria aimed at promoting the trustworthiness of AI from a technical perspective were elaborated, including criteria for protection and security, explicability, transparency, reliability and accuracy. At national level, the Bundesnetzagentur participated in work within the German Institute for Standardization (DIN) and the German Commission for Electrical, Electronic & Information Technologies of DIN and VDE (DKE) on developing the German Standardization Roadmap on Artificial Intelligence (2nd Edition) and within the federal government's expert group. The focus of the work was on identifying the measures needed to implement the upcoming European regulatory framework for AI and drawing up a digital glossary on AI with more than 500 defined terms from a range of specialist areas.

ITU's World Telecommunication Standardization Assembly and Plenipotentiary Conference

The Bundesnetzagentur represents Germany's interests in meetings at the International Telecommunications Union (ITU) on behalf of the Federal Ministry for Digital and Transport (BMDV) in accordance with section 221 of the German Telecommunications Act (TKG).

The Bundesnetzagentur coordinated the contributions and negotiations for the European region (CEPT) at the World Telecommunication Standardization Assembly (WTSA) in March 2022 and a representative of the Bundesnetzagentur was elected Vice-Chair of the Assembly. Another of the Bundesnetzagentur's representatives was elected Vice-Chair of the Telecommunication Standardization Advisory Group (TSAG) for the new ITU study period (2022-2024).

At the Plenipotentiary Conference 2022 (PP-22), ITU's highest policy-making body, the Bundesnetzagentur and the BMDV jointly presented contributions coordinated at national and European level that led to the adoption of resolutions on the strategic focus of ITU's activities.

Standardisation in the field of electromagnetic compatibility

The Bundesnetzagentur initiated a second study on fundamental issues in the 6-40 GHz band. The aim was to establish a firm data basis for a qualified recommendation on incorporating appropriate measurement methods into generic electromagnetic compatibility (EMC) standards for radiated emissions, taking into account economic efficiency in the band. These standards play a pilot role and contribute to achieving comprehensive radio protection for 5G applications with product and product family standards.

A study was carried out to analyse the EMC characteristics of electric vehicle charging in view of the rapid growth in not only public but also private charging infrastructure. Ensuring the smooth functioning of all components in conjunction with each other is also a challenge in the context of EMC.

5G/6G standardisation

The 3rd Generation Partnership Project (3GPP) is the major driver behind 5G standardisation. 3GPP completed its work on Release 17 under pandemic restrictions in mid-2022.

A very comprehensive content package for Release 18 (5G-Advanced), for which work is currently in progress, was adopted at the end of 2021; the package includes the use of artificial intelligence and machine learning (AI/ML) in 5G networks, satellite access in mobile networks and enhancements for non-public 5G networks. Progress was made in various areas in 2022. A number of new activities for Release 19, among other things relating to sensing, the metaverse and AI/ML enhancements, were also initiated.

The Bundesnetzagentur is an active partner of 3GPP.

In light of the start of activities for 6G, for instance within ITU, the Bundesnetzagentur organised a 6G workshop in June 2022. The workshop was attended by about 125 participants, including experts and decision-makers from businesses and associations, the research community and public authorities and ministries. The presentations covered issues such as the current status of standardisation, visions and requirements, energy efficiency and 6G security.

Impact of EU standardisation strategy on ETSI

The European Commission's new standardisation strategy and proposal for an amendment of Regulation (EU) No 1025/2012 presented on 2 February 2022 introduced new requirements for European standardisation organisations' processes for developing and adopting mandated harmonised European standards. These requirements mean that in particular ETSI, as one of the recognised European standardisation organisations, needs to reform its internal processes, coordination procedures and weightings for the votes of its members involved in the standardisation process. The Bundesnetzagentur is participating in the work on these reforms in consultation with the Federal Ministry for Economic Affairs and Climate Action (BMWK).

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