



Federal Ministry
of Research, Technology
and Space

Our path to 6G

6G Research Road Map
2026 to 2030



Foreword

Dear readers,

Today's research creates tomorrow's value. This premise guided the launch of our High-Tech Agenda Germany. And now it also underlies one of our most important ventures under the Agenda: our 6G Research Roadmap 2025-2030 for the development and implementation of the new mobile communications standard.

Mobile communication is already an omnipresent, integral part of everyday life, be it in how we obtain our information, communicate or pay for the things we buy. In Germany, some 70 million people use a smartphone every day and worldwide that figure is almost five billion and rising. Artificial intelligence is rapidly adding to the possibilities, opening up completely new markets in the process. The Federal Government's position in this context is clear: we want to be not just consumers, but shapers – we want to stand our ground in the face of competition and ensure prosperity for Germany. We have made 6G an absolute priority as a result.

Today's research also creates tomorrow's standards. 6G has the potential to redefine our technological ecosystem, enabling huge leaps in both parameters and performance. With its international rollout expected at the end of this decade, it makes sense to plot our strategic course sooner rather than later. And that means now. Germany and Europe must play a prominent role in helping to shape the 6G standard. We aim to rank among the world's technology leaders.

As with value and standards, the today's research also secures tomorrow's sovereignty. Since its launch in 2021, the BMFTR 6G Research Initiative has achieved many successes, with a vast range of expertise gained along the way. We aim to utilise and develop this knowledge further. In a hyperconnected world, we want to ensure Germany remains autonomous and secure.



The 6G Research Roadmap sets out goals and objectives, action areas and measures to achieve a future-proof national innovation ecosystem and better transfer of research results to practical application. It is built around both our needs and our values. Successfully satisfying these two demands can only be ensured through close collaboration with national, European and international partners.

This is why the 6G Research Roadmap must be more than just a document. It must be used to promote intensive dialogue on our economic, security and social policy objectives. I therefore invite you to take part in this inclusive process, for I am confident that by working together we can successfully navigate our journey along the path to creating mobile communications we all want to use and trust – in other words, to 6G 'Made in Germany'.

A handwritten signature in white ink that reads "Dorothee Bär". The signature is fluid and cursive.

Dorothee Bär MdB
Federal Minister of Research, Technology and Space

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The BMFTR 6G Research Roadmap

Digital Competitiveness via Technological Sovereignty in 6G

Guiding principles and strategic objectives

Maintain and enhance competitiveness and global relevance in 6G

Avoid unilateral dependencies and create resilient supply chains with added value, also in Europe

Co-create 6G key technologies and critical applications as equal partners and players

Embed liberal democratic values and socially relevant paradigms such as sustainability, resilience, security and trustworthiness in 6G

Action Areas

I. Scientific and technological foundations, future technologies

- Core 6G technologies
- Technology and innovation pipelines
- Cross-cutting issues
- Explorative research

II. Application-based technology development

- 6G technologies in practical application
- Pre-commercial network components
- Contributions to technology specifications and pre-standardisation
- User needs and commercial implementation scenarios

III. National transfer and innovation ecosystem

- Cooperation between science, industry and existing networks
- Research transfer structures
- Test fields and laboratories
- Skilled labour

IV. National and international connectivity

- Dialogue and exchange between science, industry, public authorities and civil society
- Bilateral and multilateral collaborations
- Transdisciplinary and interdisciplinary exchange

Implementation and measures

6G transfer hubs: Creating transfer-oriented ecosystems

Application and mission-driven projects: Science-industry collaboration

Strategic alliances with like-minded partners: A global 6G vision

Connected and learning roadmap: Science-industry-civil society dialogue and exchange



1 Starting point, guiding principles and strategic objectives

6G as the nerve centre of digital society

Communications and connectivity technologies form the central nervous system of a society that is both digitalised and hyperconnected. Once a pure support service, mobile communications have since transformed into a connectivity infrastructure that plays a key role in our social coexistence and economic competitiveness. As early as 2023, the leading telecommunications companies operating in Germany accrued mobile communications sales of more than €27 billion.¹ The vast number of mobile devices in use coupled with short innovation cycles sends important signals to the microelectronics and chip sectors. Under the 'Important Project of Common European Interest (IPCEI) in Microelectronics and Communications Technology' (ME/CT) alone, seven German companies

are working on the development of 6G technologies and nine others on the development of the materials, components and production technologies required.

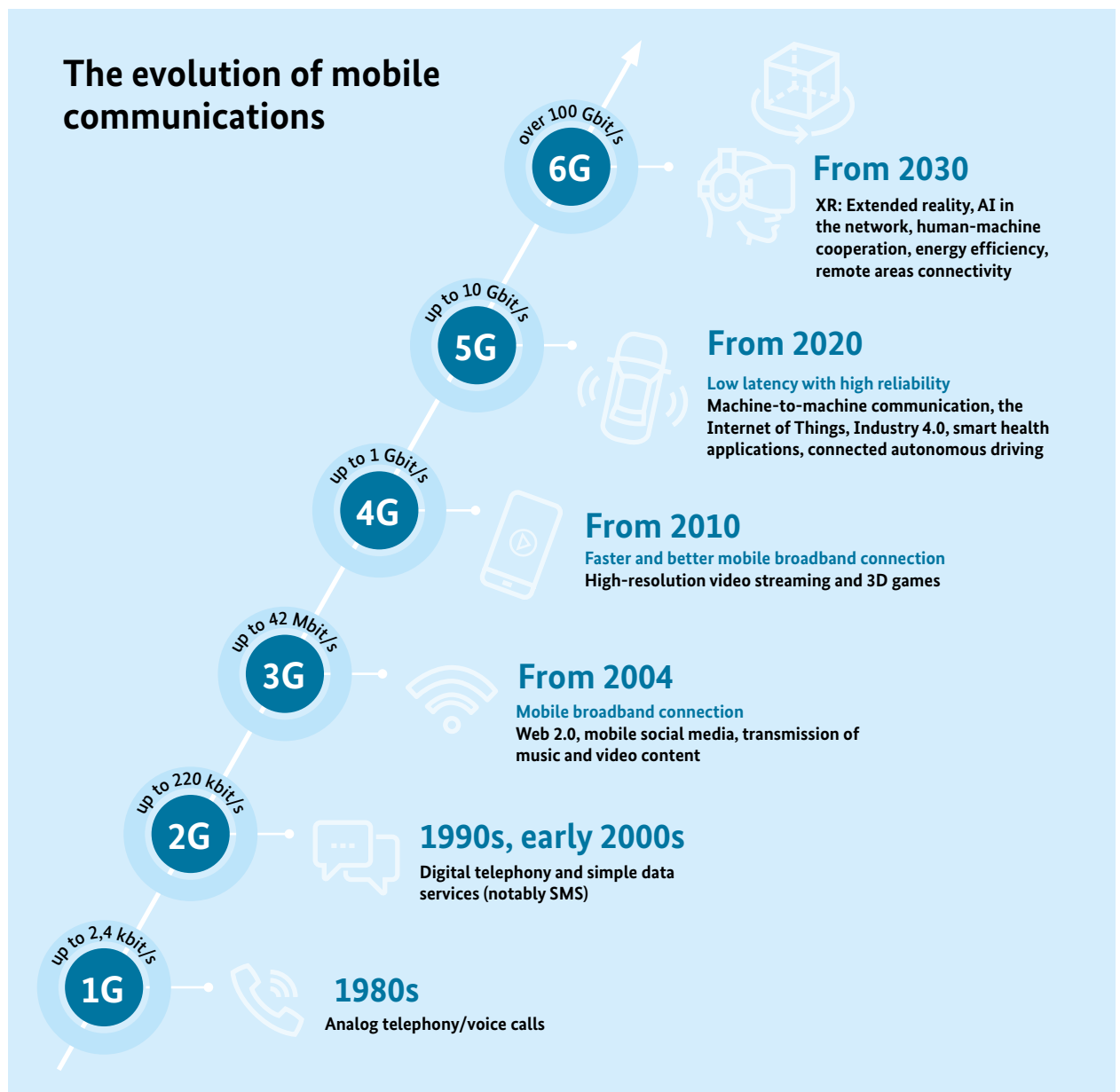
Mobile communications have also become a key driver of innovation in many leading applications. It was high-performance mobile data connections that paved the way for smart devices and applications. These hold prospects of societal progress and vast added value in areas such as the entertainment industry, mobility, health, industry and agriculture. In addition to the exchange of large volumes of data,² many of the use case scenarios identified call for rapid response times, fail-safe networks and a high degree of data security. The interplay between modern technologies such as those used in virtual and augmented reality (VR and XR) and the ever-growing use of artificial intelligence (AI) are drivers of increasingly data-heavy mobile applications.

1 data.bundesnetzagentur.de/Bundesnetzagentur/SharedDocs/Mediathek/Taetigkeitsberichte/2023/taetigkeitsberichttk20222023.pdf (Federal Network Agency Activity Report 2023).

2 de.statista.com/statistik/daten/studie/3506/umfrage/monatliches-datenvolumen-pro-mobilfunknutzer-in-deutschland (Data study on mobile data volumes per mobile communications users in Germany)

Research, development and design of the future 6G mobile communications standard are vital in ensuring that we can live and work with confidence and autonomy in the future. 6G will be based on the high-performance 5G core technologies, augmenting them with new features in a modular approach. 6G will thus be much more than a pure communications platform – it will evolve into a robust and easily accessible platform for innovative services (see infobox).

In the future, more efficient microelectronic components and digital methods will reduce demand for energy and resources. Smart control and (self) optimisation of network management will significantly improve resilience and responsiveness to disruptive influences, both internal and external. Seamless integration of satellites and mobile platforms, such as drones to provide access to mobile communications, will enhance network coverage, thereby enabling digital participation for all.



How will 6G technologies affect specific fields of application?

Real time control of robotic systems in operating theatres:

Cooperative robots and human-machine interaction through augmented and virtual reality call for communication and control with the least-possible delays. Only with 6G will the practicable latency times of a few milliseconds or less than a millisecond needed for data exchange be achieved for special applications. Collaboration between autonomous systems will be possible, as will remote control of medical robots in near-real time.

Digital twins for process automation in industry:

The interaction with digital models of complex real systems and processes calls for connectivity of innumerable data sources and high transmission rates. In future, 6G and the associated high-performance core networks will enable the achievement of high-speed transmission of several hundred gigabytes per second, thereby bringing real time-capable digital twins to application with their full potential.

Integrated sensor technology for healthcare provision and autonomous mobility:

In many sensitive areas of application, accurate localisation and detection of the surrounding environment is needed without restricting protection for people and data. Using high-frequency technology, future 6G communications systems will be equipped with integrated sensor technology so that, for example, biosignals from patients can be recorded directly and securely, and vehicles and drones are able to move around collision-free.

Flexible campus networks for the digital economy:

In many cases, digitalisation and automation of the economy calls for local networks that can be adapted to specific needs. 6G will contain smart solutions for use in network management and enable automated intra-network resource allocation. This should make campus networks much more accessible in the future, even for users with only basic mobile communications expertise.

Success factors in international competition

The vast importance of 6G and the associated standardisation leads to fierce international competition in the technological leadership race.³ Since 2020, many major economies have launched dedicated 6G programmes, with initial results and 6G network trials already implemented in some countries.⁴ The development cycle for a new generation of mobile communications usually spans about 10 years. 6G rollout is expected to begin from 2028 onwards, although 2030 is a more realistic start date for Europe (see infobox).

Developing a new generation of mobile communications

(a mobile communications standard) involves an ongoing process chain comprising research, study phases and the development of specifications. The full innovation cycle for a new standard is usually about 10 years. The study phase is the dominant link at the time this Roadmap is published. This is where the requirements for the first 6G applications are collected and ultimately flow into an initial commercial 6G release. The widespread, global rollout of the first 6G release is expected from 2030. This will be followed by further releases at approximately two-year intervals to successively expand the 6G standard and capabilities. Standardisation planning occurs largely as part of the 3rd Generation Partnership Project (3GPP). Under the 3GPP, key standardisation bodies, such as the European Telecommunications Standards Institute (ETSI), collaborate internationally on the standardisation of mobile communications. In parallel, closely interlinked processes are set in motion and talks are held concerning European and international regulation of the available wireless spectrum. And at every stage, committees in the European Union, the European Conference of Postal and Telecommunications Administrations (CEPT) and the International Telecommunication Union (ITU) take account of all frequency uses. These provisions stipulate which frequencies can

3 golem.de/news/mobilfunkstandard-usa-und-schweden-setzen-auf-eigenen-weg-bei-6g-2408-187829.html

4 rcrwireless.com/20240715/6g/china-claims-world-first-field-test-network-6g-communications

be used in mobile communications networks at national, regional and global level. In doing so, they create the conditions needed to ensure that the technologies researched can also be put to large-scale commercial use.

With the industry-led ‘Next G Alliance’ in the US, the ‘Bharat 6G Alliance’ in India and other initiatives in China, Japan and South Korea, major economies are striving to achieve a leadership position in mobile communications. In the EU, diverse cross-border and national initiatives are underway – among them the ‘Smart Networks and Services Joint Undertaking’ (SNS JU). In Germany and beyond, this large-scale 6G research initiative is making a major contribution to ongoing research and study phases at national, European and international level.

To successfully compete at international level and assert both German and European interests, the BMFTR sees the following factors as crucial:

- Early promotion and funding of research, development and innovation in the field of future 6G key technologies and application scenarios.
- Structured initial and continuing training of skilled workers and support for research transfer.
- Harmonisation of a global 6G vision in collaboration with like-minded partners within the EU and internationally.

- Preparation and coordination of contributions to 6G standardisation in collaboration with industry and selected national regulatory authorities.
- Patenting and licencing of innovative solutions in relevant technologies and areas of application.
- Strengthening the position of relevant German and European technology providers; developing new provider competencies for critical components.
- Support for innovation and market-promoting regulation, particularly concerning the wireless spectrum, for rapid availability of necessary wireless resources and suitable technological conditions for use.

Research and science must be enabled to fill the technology and innovation pipelines effectively and sustainably. Added to this come the effective influence and necessary expertise in the relevant technology and application companies, enabling impactful contributions to be made to international processes. Close collaboration between science and industry is essential in order to consider both the needs of society and the requirements of relevant leading and key industries in developing the technologies needed. Early, structured transfer of future-focused concepts and solutions enable specification, standardisation and regulation to be influenced in line with liberal democratic values and legitimate regulatory demands.

Key technologies for 6G development should continue to be developed in a targeted way via intra-European cooperation and with like-minded international partners, and should be produced in Germany and Europe. In the creation of sovereign value chains, geopolitical conditions, such as the availability of the necessary resources and supply chains, must be considered from the outset. Target markets must remain global to offset the high costs of research and development. When looked at from a European perspective, alongside network infrastructure, greater focus must be placed on the development of end devices and digital services to enable better participation in the benefits to be had from the vast added value in this field.

Technology and application-oriented companies must protect their intellectual property from an early stage and play a pioneering role in patents relevant to 6G standardisation. This is where innovative large enterprises, SMEs and start-ups play an important role



in technology transfer and in strengthening location advantages and technological sovereignty. Their involvement and their specifications will be of major importance in the development and performance of 6G. The future distribution and use of the available wireless spectrum play a decisive role in national and international regulation. The allocation of further frequency ranges for a new generation of mobile communications can be a key factor for success.

Looking ahead to the commercial expansion of 6G from 2030 onwards, international competitiveness and having a hand in shaping 6G must be considered from a longer-term perspective. Successfully contributing to an international 6G vision calls for good, trust-based collaboration within the EU and with like-minded international partners, and with the involvement of major private industry players. This is the only way to ensure the use of cross-cutting synergies, avoid negative developments and give

individual stakeholders more impact. To prevent an unwanted flow of knowledge and expertise to countries that do not share our liberal values, research security must likewise be enhanced.

The BMFTR 6G Research Roadmap: Strategic integration and objectives

For the Federal Government, Germany's security as well as its technological and digital sovereignty in the field of mobile communications (currently 5G) are of utmost priority. With its National Security Strategy adopted on 14 June 2023, the Federal Government took measures to better protect the country's public 5G mobile communications networks and prevent dependencies on individual suppliers. The telecommunications networks are to be protected against hybrid and cyberattacks that can quickly pose

6G Research Initiative 2021 – 2026

At the start of the research and study phase on 6G, the Federal Research Ministry launched the national 6G initiative as part of the 'Sovereign. Digital. Connected.' research programme. This laid the foundation for targeted 6G research and development in Germany at an early stage, creating a national ecosystem in the process.

The 6G Research Initiative is based on four national 6G research hubs (6G-RIC, 6G-life, Open6GHub and 6GEM). As science and excellence-driven innovation networks, these bring together the expertise of 42 universities and research institutes Germany-wide. They work in close collaboration with 18 industry-led projects that focus on system architectures and network components, as well as initial application scenarios for 6G technologies for key sectors.

Another focus area lies in the cross-cutting issue of the resilience of future digital systems. In seven different projects, research is underway to find

new solutions for resilient communications in the healthcare sector, the mobility sector and Industry 4.0. The initiative is accompanied by research on complementary communications technologies, including in the field of high-speed optical networks.

The StartUpConnect funding programme enables start-up teams and young businesses to develop their innovative ideas from the research stage to commercial application. Four start-up incubators with direct links to the 6G research hubs support pre- and post-launch start-ups.

As the umbrella project of the 6G Initiative, the 6G Platform is the technological link between national 6G projects and those at European and international level. In cross-sectoral working groups and international workshops, overarching topics are discussed and a joint 6G vision created.

an existential threat. The security and resilience of the 5G mobile communications networks are also a key priority within the NATO Alliance and for the European Union (notably the '5G Toolbox').

The same security policy challenges apply with the 6G technologies. This is why the principles currently applicable to 5G should be upheld for the future 6G sector, expanded where necessary and used as the basis for specific planning and funding possibilities.

With a view to the upcoming pre-competition specification and standardisation of 6G in the period 2025 to 2030, this 6G Research Roadmap will guide both the strategic alignment and the focus of further BMFTR activities. As a research and development roadmap, it sets out objectives and measures for the transfer of research results to socially relevant applications and commercial use. For the value-based development of a global 6G vision, close collaboration will be sought with national, European and international partners.

When developing technologies for trustworthy 6G networks, the ongoing aim is to consider the aspects of resilience, cyber security, sustainability, and technological sovereignty from the start and include them in future regulatory proposals.

The national ecosystem created under the 6G Research Initiative 2021-2025 has value propositions of international importance. With our targeted funding in recent years, we have been able to bring together key stakeholders from the research, industry and user communities, achieving considerable impact in the process. A future-focused strategy has also been developed in close exchange with the relevant stakeholders and the 6G Platform strategic steering group.

This is the basis on which we will continue to promote excellent researchers in Germany, further intensify transfer and exchange with industry, and further develop researched innovations towards standardisation and application. We will also strive to achieve high visibility of the results within the specialist community and in society overall.

The 6G Research Roadmap is a specially selected, technology-driven 'High-Tech Agenda Germany' project in the strategic research field of security and defence research. With its clear focus on placing Germany at the forefront of 6G key technology, strengthening the skilled workforce and boosting research transfer via intensified collaboration between science and industry, the Roadmap addresses key strategic objectives. And with its overarching theme of strengthening technological sovereignty in 6G, the Roadmap also directly implements and constitutes a measure under the BMFTR Framework Programme on 'Research and Innovation for Technological Sovereignty 2030' (FITS 2030).



The 6G Research Roadmap strategic goals

- **We want to maintain and expand Germany's competitiveness and global relevance in 6G.** The results of our research projects should thus flow into sustainable pathways for use. In conjunction with spin-offs from science, we speed up innovation processes and strengthen commercial use.
- **We want to prevent unilateral dependencies in the strategic research field of 6G and create the conditions needed for resilient supply chains.** In future, technology providers and licencing authorities in Germany, Europe and like-minded international partners should play a leading role and not be dependent on third-party expertise. 6G network expansion should rely solely on trustworthy components. Innovative companies should be enabled to develop 6G components in Germany irrespective of their size.

- We aim to continue promoting research that has an impact and is effective. Our aim is to **co-create 6G key technologies and highly relevant applications as equal partners and players.** We thus aim to focus our efforts clearly on key sectors and applications that are important to us. And we are already keeping an eye on exploratory research in future technologies – even beyond the innovation cycles that prevail in the telecommunications sector.
- Our aim is to collaborate with our partners to ensure that **liberal democratic values and socially relevant paradigms** such as sustainability, resilience, security and trustworthiness **are embedded in 6G.** We want to increase social acceptance of and participation in 6G and create visible added value for society using 6G. Our ultimate aim is to develop a uniform, global 6G standard that meets our requirements and values.



2 Action Areas

The role of the BMFTR

The success of 6G will be ensured through effective collaboration with a wide range of players. The BMFTR acts as an enabler and provider of opportunities for the research and development of 6G in Germany.

- We create the research-policy and structural conditions for successful research, development and innovation in the technology field of 6G.
- Within the scope of our remit, we promote research and development projects with a link to relevant innovative application scenarios and create the basis for a national innovation ecosystem.
- We promote young scientists and the expansion of the skilled workforce and create structures to aid the science-to-industry transfer of research results.
- We initiate and shape dialogue and exchange with the EU member states and international partners and work to ensure early coordination and harmonisation of national 6G research strategies and visions.

- We uphold liberal democratic values and enshrine key paradigms such as the resilience of communication networks, security of transmitted data and implementation of the UN Sustainable Development Goals in 6G research funding.

Action Area 1: Scientific and technological foundations, future technologies

When embarking on the development of future 6G technologies, we address lower Technology Readiness Levels (TRLs) of a fundamental, in some cases disruptive nature. Focus is placed on research topics concerning the fundamental further development of existing technologies such as 5G as well as the development and testing of new future technologies to maintain long-term global relevance.



Objectives

- Fill the technological innovation pipelines
- Ensure that technologies reflect fundamental paradigms such as sustainability, trustworthiness and liberal democratic values
- Create the conditions for successful validation and specification of technologies and methods

In the period 2025 to 2028, we will pursue open research topics on evolutionary (5G) technologies and promising use case scenarios, the aim being to transfer these to the first 6G specification.

This includes topics surrounding fundamental technology development for:

- Next generation campus networks
- Connected and distributed server architectures and cloudification (including the associated requirements for resilience and cyber security)
- Time synchronisation in converged networks
- Cyber security, resilience and trustworthiness
- Improved resource and energy efficiency

- Interfaces that provide scope for subsequent integration of innovative technologies such as sensory detection of the environment
- Merging of terrestrial and non-terrestrial networks (network of networks)
- The integration of highly reliable, interacting and real time-capable digital twins
- The applicability, security and sustainability of future AI integrations and AI services

Research into these technologies forms the basis for the further development of our communications networks.

For the subsequent development phase from 2028 to 2030, focus is placed on research topics surrounding innovative 6G basic technologies and their requirements for implementation. Of particular relevance are the expanded use and integration of AI, non-terrestrial networks (NTNs), sensing features, (sub)-terahertz communication and intelligent reflecting surfaces in 6G. We also support explorative





research on relevant future topics with an uncertain time horizon, but a potentially disruptive nature and with strong links with the objectives and topics mentioned earlier. These are notably future-focused concepts in fields such as quantum communication, molecular communication, communication models and information theory.

This enables us to identify new future technologies at an early stage and position topics in the research landscape.

Action Area 2:

Application-based technology development

We will create the conditions needed to ensure the availability of 6G technologies for future applications of particular social relevance that will strongly influence a future integrated 6G system and the technological sovereignty of Germany. The definition and harmonisation of users' needs and application requirements are key aspects of this approach. This will be augmented by an application-based specification and validation of the relevant technological solutions and system models.



Objectives

- Secure competitiveness while taking into account specific sectors, areas of application, societal goals, needs and interests
- Embedding cyber security and resilience in system design
- Provision of compatible solutions in the lead up to standardisation of 6G basic technologies and 6G application technologies

For the period 2025 to 2028, we see the following areas of application as especially important:

- Automated production (Industry 4.0)
- Intelligent robotics
- Connected mobility
- Resilient energy supply
- Network management
- Sensor and localisation processes
- Digital healthcare
- Telemedicine
- Automated agriculture (smart farming)

For the period 2028 to 2030, we will focus on solving still unresolved practice-related research topics with pre-commercial network components in specific application scenarios. Solutions must be found which allow widespread implementation and use scaling.

Action Area 3: National transfer and innovation ecosystem

We will build a connected 6G innovation ecosystem and further develop existing test laboratories.

Primary focus

- Identifying regional and transregional networks for collaboration on 6G
- Integrating relevant (also public) players into the innovation system
- Creating transfer-oriented and innovation-promoting structures
- Promoting digital sovereignty through the development of open standards for a competitive national supplier industry

Our goal is to build a sustainable and future-proof innovation ecosystem – one that combines innovation networks, science and industry, creates the conditions needed for efficient and effective research transfer and strengthens both training for young scientists and skilled labour recruitment. We support the development of open source technologies and network components with open interfaces as a key strategic component in strengthening the digital sovereignty of German and European industry and infrastructure. As part of an integrated approach, large enterprises, SMEs and start-ups will be involved to provide optimal conditions for efficient further development of research results towards mature, market-ready products.

In the coming years, the focus will largely be placed on supporting and involving start-ups, continuing to provide test fields, laboratories and research infrastructures for business and industry, and improving opportunities and training programmes for young entrepreneurs and young scientists.



Action Area 4: National and international connectivity

We promote national and international connectivity of the participating stakeholders and structures at all levels and beyond existing boundaries and borders.



Primary focus

- Dialogue and exchange between all science, industry, public authority and civil society players
- Strategic alliances with like-minded liberal democratic partners
- Visibility of the 6G projects and the 6G initiative itself
- Social acceptance

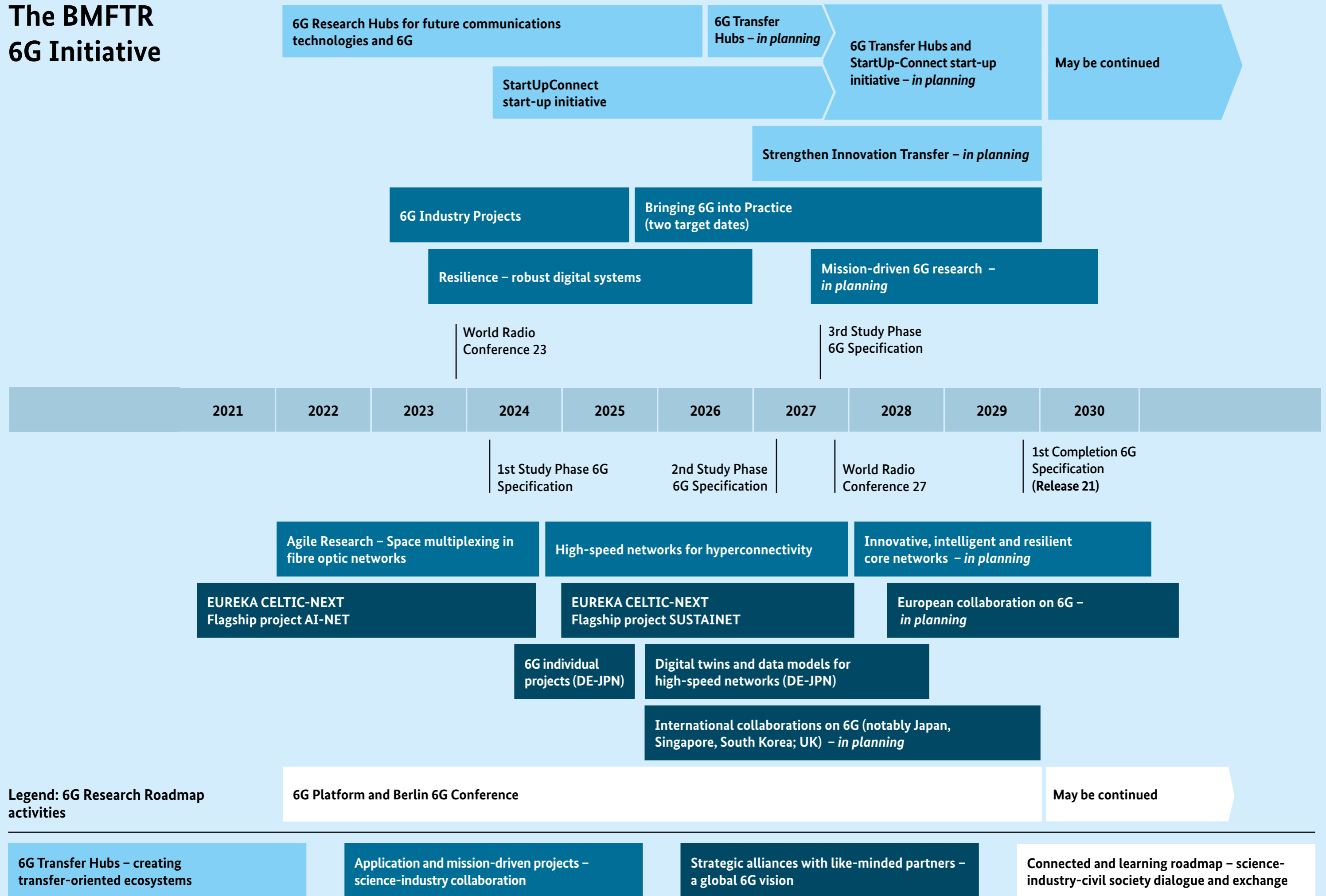
We aim to provide suitable platforms, dialogues and formats for national and international exchange, and for harmonisation towards a global 6G standard.

For the long-term success of our 6G Initiative, further development of national and international collaboration is vital. In the coming years, a strategic alliance with like-minded liberal democratic partners will come to the forefront, one that sees us working together to find solutions to cross-border challenges, such as the creation and integration of satellite networks into the 6G architecture and the further development of wide area networks. Also, the relevance of transdisciplinary and interdisciplinary collaboration at national level is increasing – for example, with scientific communities and companies in key neighbouring disciplines such as microelectronics, IT security, AI and quantum technologies, as well as relevant areas of application for 6G robotics, medicine, mobility, production and agriculture.

Overview

The BMFTR

6G Initiative





3 Implementation and Measures

6G Transfer Hubs: Creating transfer-oriented ecosystems

The four 6G research hubs are the foundation for scientific excellence in 6G research in Germany and have already significantly shaped research at international level. Our aspiration is to further develop the established research ecosystems for the longer term. Focus is placed on the transfer of research results along the innovation pipeline, development of the skilled workforce and promotion of structures for industry collaborations and start-ups.

From 2026, we will promote new regional and trans-regional 6G transfer hubs and expand existing laboratories. These will build on the successes achieved in the 6G research hubs and continue to drive key basic innovations and future technologies for 6G. And they will continue to play a central role in attracting, educating and training skilled workers and young researchers. Through closer links with the structures for technology validation, industry collaboration and start-up promotion, research transfer

will be significantly intensified in collaboration with industry. The test fields and testbeds established in the 6G research hubs will be more closely aligned with the needs of industry as a networked and distributed infrastructure, and expertise will be made available to users. From 2027, the successful start-up incubators created under the StartUpConnect Initiative are to be continued as part of a coherent overall concept in the 6G transfer hubs. An open-topic transfer measure is also to be designed, which will support companies in the further development of technological innovations from science. As part of that work, it will be ensured that the activities of the transfer hubs interact effectively with the 'Smarte Konnektivität für die Wirtschaft' (Smart Connectivity for Industry) initiative planned by the Federal Ministry for Digital Transformation and Government Modernisation (BMDS). The aim of the funding guideline is to strengthen German industry in the field of communications technology for the longer term, expand ecosystems and make the necessary transfer of innovation sustainable.

The integration of neighbouring disciplines such as AI, edge computing and cloud computing, microelectronics, IT security, robotics and quantum technologies via the 6G transfer hubs will align with ever-increasing technology convergence. Applicability, performance, security, resilience, data access and sustainability of future communications technologies will be further enhanced through relevant transdisciplinary and interdisciplinary collaboration. When looked as a whole, thematic focusing and complementary orientation of the 6G transfer hubs form the basis for an effective German 6G transfer and innovation ecosystem.

In the coming funding phase, and in conjunction with the BMDS, a long-term, sustainable perspective will be developed for the 6G transfer hubs in their respective host regions. In this way, the expertise gained and the research infrastructures put in place are to continue to be effective beyond 2030, supporting the national research ecosystem and strengthening Germany's standing as a science and business location.

Application and mission-driven projects: Science-industry collaboration

The existing funding of industry-led collaboration projects in cooperation with the scientific community has significantly advanced the development of cross-sectoral architecture and system approaches and the specification of socially relevant applications. Powerful consortia have made initial contributions to the pre-competitive standardisation of 6G technologies and 6G applications. Collaborative projects of this type create the conditions needed to bring competitors together in joint endeavours and enable interdisciplinary and transdisciplinary collaboration between universities, research institutions, industry and business.

With the new funding guideline, '6G in die Anwendung bringen' (Bringing 6G into Practice), we are supporting application-driven collaborative projects on further development of 6G technologies up to technology validation in relevant environments and testing in the pre-competition phase. This enables participating companies and SMEs to validate 6G solutions at an early stage and profitably integrate them into future

applications. The focus is placed on covering, to the extent possible, the full range of technologies and application scenarios of key importance for 6G, particularly with regard to leading national industries and social and regulatory priorities. Under the funding guideline, we also support contributions towards pre-competition standardisation of 6G so that existing barriers can be overcome and research results can flow into a global 6G vision.

We want to shape 6G beyond the first release and be agile in our response to developments at international level. This is why, from 2027 onwards, additional mission-driven funding programmes will be launched in the pre-competition environment for emerging priorities and dynamic cross-cutting topics. We will respond flexibly and fund projects of differing sizes and composition.

The success of 6G will also largely depend on complementary optical communications technologies, especially in the field of the underlying transport and core networks. Thus, in the period up to 2028, the funding guideline 'Hochgeschwindigkeitsnetze für die Hyperkonnektivität' (High-speed Networks for Hyperconnectivity) will be used to promote research on promising technologies conducted with greater involvement of industry and for practical application via technology demonstrators in transport and core networks. In addition, complementary technologies are to be promoted that take account of ongoing developments and future needs, for example in the field of edge and cloud solutions and distributed server infrastructures. The solutions to be developed should enhance the technological sovereignty of both Germany and Europe.

Strategic alliances with like-minded partners: A global 6G vision

We continue to actively engage in efforts to achieve a global 6G standard that is aligned with liberal democratic values. In doing so, we coordinate with our like-minded partners and engage in collaborative activities to develop a shared, harmonised 6G vision.

At European level, those partners are the member states which actively participate in European Commission programmes, such as the SNS JU and the Digital Partnerships. Taking this approach, we achieve joint strategic alignment of the working programmes and leverage synergies with the national initiatives of the member states.

At international level, coordination with partner countries such as Japan, the UK, Singapore, India and South Korea will be intensified in efforts to identify common exchange formats and compatible research priorities. In a first bilateral collaboration project, since 2025 we have been using the funding guideline 'Digital Twins and Data Models for fully optical high-speed networks' to promote German-Japanese research and development projects which are closely linked with the 6G Initiative.

We also rely on established research networks, such as the EUREKA Cluster CELTIC-NEXT, to advance the key topics of information and communications technology. Within that cluster, since 2025, we have funded the flagship project SUSTAINET in which more than 80 partners from various nations conduct research on new solutions for the creation of sustainable communications networks.

Connected and learning roadmap: Science-industry-civil society dialogue and exchange

The German 6G Platform connects the current 6G Initiative and plays a key role in creating a national 6G ecosystem. For the period 2026 to 2030, we will build on the platform's success, continuing with the format and addressing the needs of a changing ecosystem. The main functions of an enhanced 6G platform are to:

- Intensify exchange and networking within the 6G Initiative and beyond, for example with industry associations such as the GSM Association, the VDMA, the 6G-IA and the 5G-ACIA, with international partners and selected public authorities

- Continue technology road-mapping
- Connect structures for research transfer
- Manage participation in 6G Initiative trade fairs and conferences
- Intensify public relations work
- Provide important impetus via a strategic steering group

The continuation and further development of the annual Berlin 6G Conference also serves as a central and visible policy tool. In the coming years, we will use the conference to strengthen interdisciplinary and transdisciplinary dialogue and exchange. Researchers from neighbouring disciplines such as quantum communications, cyber security research, microelectronics and robotics will be better integrated into the conference formats. The umbrella project on quantum communication (SQuaD) and the Robotics Institute Germany (RIG) represent valuable interfaces through which we can achieve optimal effectiveness of our connectivity and research funding.

The 6G Research Roadmap is purposely designed as a learning roadmap. The ongoing development of the 6G standard, new developments and changing societal and industry needs will require measures which are suitably aligned. This is especially the case with regard to both current and future crisis situations. In addition, using appropriate instruments for technological impact assessment, the social implications of future innovations must also be considered at an early stage. The 6G Research Roadmap will thus live up to its ambition, with science-industry-civil society dialogue ensuring it remains current and reliable from 2025 to 2030. This includes ongoing exchange with all key target groups and players, and with the 6G Platform's strategic steering group. First and foremost, those target groups and players include the public, as well as industry, science, government and administration, industry federations and associations. Through the involvement of civil society, reservations are to be addressed at an early stage and social participation strengthened in line with the potential that lies in 6G. Use of suitable formats ensures that dialogue and exchange are promoted, and that the Roadmap is continually adapted and aligned with prevailing needs.

A strongly positioned Germany in the key technology of 6G can only be ensured in close collaboration with the departments responsible for 6G and the subordinate authorities within their remits. We use and create exchange formats and transfer points to ensure that the results achieved, and the structures created, are secured for the longer term as part of uniform digital policy underpinned by the ministries responsible for 6G. This paves the way for subsequently successful implementation in industry and society and ensures that research is linked with standardisation and technical regulation. Issues concerning security, trustworthiness of network components, data integrity of 6G systems and electromagnetic compatibility are also of crucial importance. Dialogue and exchange with like-minded partners in Europe and beyond on ensuring security in 6G and preventing unilateral dependencies on countries that do not share our values also plays a vital role.

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