Ministry of Economic Affairs
and Climate Policy

Connectivity Action Plan

Picture front page: GAPS Photography/Arjan de Jager

Connectivity Action Plan

This is a translation of the official Dutch publication

Overview of actions

	Ambition	Challenges	Actions
Radio spectrum	Divers and high-quality mobile connectivity	Sufficient spectrum Facilitating business-specific applications	Making spectrum available for mobile operators and suppliers of business-specific solutions
Local policy	Optimal cooperation between national and local governments te reach the connectivity goals	Difference between local policy and lack of transparency of this policy More communication between and with councils about how optimal local circumstances can be created	Transparency and best practices for local policy Communication with councils Legal standards for electromagnetic fields gal norms
Investments	Investment barriers as low as possible to achieve high-quality digital connectivity that is available anytime, anywhere and at competitive rates	Keeping competition Tackle rural areas	Review of the regulatory framework Toolkit for broadband Mobile coverage obligation
Continuity	Resilient networks and customers	Clear frameworks Good crisis response Resilience of customers	Further development of legal framework Improving crisis response structure Follow-up of Tele-vulnerability Programme
Innovation	Connectivity services develop to enable innovations	Innovation through cooperation and knowledge building Funding of experiments and pilot projects Availability of frequencies	5G innovation network Investigate a joint Digital Connectivity Research Agenda for 5G Provide support with EU-subsidies Experimentation licences

Contents

H1 Introduction

Citizens, businesses and governments use information technologies on a daily basis. They are used for online banking, the sale of tailor-made products, updating their accounts 'in the cloud' and for experiments with blockchain technologies, to name but a few. Digitisation is rapidly transforming our economy and society and is our main source of growth, innovation and new business activity. This transformation requires high-quality digital connectivity, which grows along with the needs of society and the economy.

The Netherlands has four fast mobile 4G networks and two high-quality nationwide fixed networks.[1] Both mobile and fixed networks are highly rated internationally.[2] These make an important contribution to the favourable business climate and conditions in the Netherlands, and to the fact that the Dutch are in the vanguard of introducing new digital applications. In order to maintain this position, the preconditions must be in place for market players to invest sufficiently in the further expansion of existing and new connectivity.

This Action Plan is a follow-up to the 'Exploration of digital connectivity' (*Verkenning digitale connectiviteit*),[3] which describes the expected developments in connectivity and the necessary steps to ensure good digital connectivity. The Exploration already indicated that this is being worked on and that the key prerequisites for good connectivity will be further discussed with stakeholders. This Exploration is thus an important starting point for further work on the government's ambition as formulated in the coalition agreement: to become the European leader in the social, economic and digital fields.[4]

This Action Plan was designed on the basis of meetings with stakeholders and various studies.[5] It is part of this government's[6] broader digitalisation strategy and is in line with the European call to develop new targets and plans for broadband and 5G.[7] An extensive public consultation was held concerning important elements of the Plan via Overheid.nl, which led to a large number of responses. The many responses have been gratefully used for this Action Plan. In addition, a short report was published containing the most important results and insights from the consultation.[8]

This Action Plan first outlines the main developments and sets out the objectives with regard to digital connectivity. Starting in Chapter 4, the preconditions for achieving these objectives are discussed, after which each chapter examines the ambitions, challenges and actions that the government has identified. First, radio spectrum provision will be discussed: making available and distributing (e.g. by auction) frequencies for wireless connectivity. The policy of local and regional authorities is then discussed with respect to promoting connectivity. This is followed by a discussion of the investments made by market parties and the often facilitating role played by the national government in this respect. Finally, the importance of continuity and innovation is discussed.

1 In addition to many other high-quality non-nationwide digital infrastructures.
2 European Commission (2018), The Digital Economy and Society Index (DESI).
3 Parliamentary Paper 26643, No. 432.
4 Coalition agreement 2017. *Vertrouwen in de toekomst* [Confidence in the Future], 11 October 2017.
5 These studies are on local policy (Kwink), network densification (Stratix), business-specific needs (Dialogic) and financing (KPMG).
6 Parliamentary Paper 26643, nr. 541.
7 Communication COM(2016)587, Connectivity for a Competitive Digital Single Market – Towards a European Gigabit Society, 14 September 2016.
8 See: https://www.internetconsultatie.nl/connectiviteitsplan.

H2 Key developments

This chapter outlines a number of developments that are important for the development of connectivity in the coming years. In doing so, we will look in more detail at connectivity demand, convergence, diversification, scale and investment. We will not deal with broadly shared notions of the digitisation's potential for the economy and society, nor with factors such as geopolitical tensions, social discontent and people's (legitimate) concerns about digital platforms, privacy, digital security and intellectual property. These are discussed in the Dutch digitisation strategy and underlying documents such as the Dutch Cybersecurity Agenda (NCSA: *Nederlandse Cybersecurity Agenda*).[9]

Increased digitisation and dependency on connectivity

As more services are delivered digitally and more devices are connected to the internet (the so-called Internet of Things, or IoT), our dependence on a well-functioning digital infrastructure grows. People want to have access anytime, anywhere, and connectivity is increasingly becoming a basic need. Connectivity is also crucial for businesses and public institutions. They are making increasing use of digital infrastructure for their services and internal business operations (such as cloud services and teleworking) and are attaching increasing importance to its quality. For example, it could be important not to have any problems with the connection (continuity) or delays in the transmission of data (latency). Certain sectors also have a growing need for connectivity for a wide range of new applications, such as e-health (remote monitoring), CCTV, data communication with and between drones (e.g. for precision agriculture) and self-driving cars. In addition, new applications are being developed for which it is not yet clear which connectivity will be needed. An example is 'virtual reality', a digital three-dimensional 'reality' in which you can walk around, or with which you can imitate or practise all kinds of situations realistically.[10] As soon as this development grows in scale, it will certainly lead to a broad need for connectivity.

Convergence

The increasing demand for connectivity is accompanied by the convergence and intertwining of different networks, sectors and services.[11] Telecommunications, media and the internet together form part of the digital infrastructure of the internet economy. The divide between fixed and mobile infrastructure is becoming increasingly blurred, partly because 4G and the emergence of 5G are leading to ever better mobile alternatives to fixed lines. Indeed, fixed and mobile services are increasingly being offered on a bundled basis: which is easy and beneficial for consumers, but also attractive to providers, as consumers are less likely to switch to a competitor. When it comes to the convergence between connectivity and content (the integrated offering of internet, telephony and broadcasting), a turning point seems to be in sight. Indeed, demand for internet-only subscriptions is growing, as is the supply of content independent of connectivity, including by parties offering music and video on demand. A similar shift has taken place in the market for electronic communication services. Such services used to be provided mainly by telecom companies, but for some time now have also been provided by companies that do not have their own electronic communications networks, such as WhatsApp, Facebook Messenger and Skype.
On the other hand, it is apparent that content ownership is increasingly becoming an important part of telecom companies' consumer proposition, for example with sports rights. Furthermore, the boundary between the telecom and other sectors is becoming blurred, because connectivity is increasingly an integrated part of products (think, for instance, of 'connected cars').

[9] Parliamentary Paper 26643 No. 536.

[10] An example is the black-suit that is used by both the Ministry of Defence and fire brigades during training for concrete operations. See: https://www.defensie.nl/actueel/nieuws/2017/05/15/suit-brengt-operaties-virtueel-tot-leven.

[11] This was already indicated in the *Visie op telecommunicatie, media en internet* [Vision on Telecommunications, Media and Internet] in 2013. See: Parliamentary Paper 26 643, No. 300.

Box: 5G – Towards a new generation of mobile communications networks

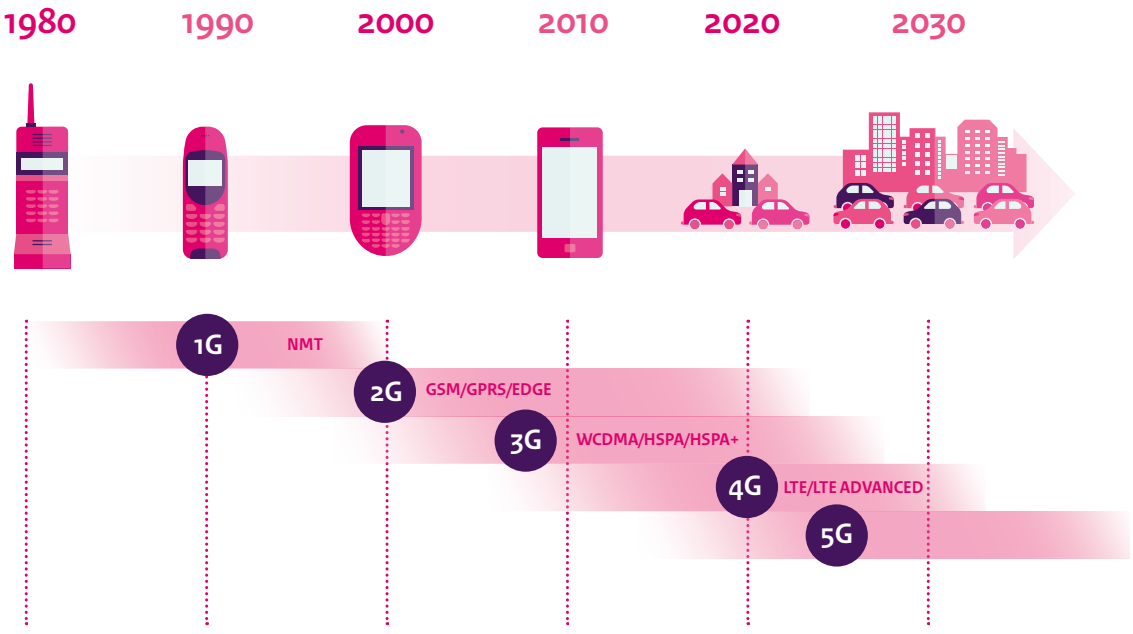
'5G' is the term for the next, fifth generation mobile communications technology. A lot is expected of 5G: it has the potential to strengthen mobile communication networks and to allow for more flexible use. As a result, it can make an important contribution to absorbing the growing data traffic and enabling all kinds of new applications. 4G is mainly a technology to provide smartphones and their apps with connectivity. 5G encompasses much more: from autonomous driving and smart cities, to remote care. 5G is therefore necessary for our digitising economy and society.

5G can be distinguished from 4G in a number of ways. 5G can deliver high-speed, reliable mobile connectivity, with peak speeds of up to 20 gigabits per second and response times (latency) of just a few milliseconds. This allows it to provide connectivity to millions of connected devices per square kilometre.

Perhaps even more importantly, with 5G the quality aspects of a connection can be varied, such as a high data transfer rate or a low latency. With technologies such as 'network slicing', it is possible to increase the flexibility of 5G communication networks. With network slicing, a physical network is divided into several virtual networks with their own specific performance in terms of speed, capacity, latency, etc. Thus, providers can provide customised services that meet the specific needs of sectors and users and adapt them if necessary.

5G is currently still under development. A final 5G standard is likely to be adopted in 2019 within 3GPP, the overarching standardisation platform. The roll-out of 5G networks is foreseen from 2020 onwards but is likely to take place in stages. Currently, experiments are already underway worldwide. In the Netherlands, for example, 5G is being experimented in Groningen.

For the roll-out of 5G in the Netherlands, new radio spectrum needs to be made available and the local policy for installing the many 5G antennas needs to be in place. In addition, it would be desirable for experiments to be carried out in pilots and testbeds in the Netherlands.[12]



[12] The figure above is an adaptation of a figure published in the British 5G strategy: Department for Digital, Culture, Media & Sports (2017), UK 5G testbeds & trials.

The need for bandwidth is increasing and changing

Current infrastructures offer more and more bandwidth.[13] The latest cable technology can provide citizens and businesses with speeds of over 1 gigabit per second. This allows, for example, multiple HD-quality films to be viewed simultaneously without any problems and allows realistic games to be played online. The need for bandwidth is also increasing. At the moment, current and future media services are to a large extent responsible for the growing demand for bandwidth. Already 70% of internet traffic is video traffic, separate from regular linear TV. Consumers want better image quality for their internet videos, because everyone is watching more and more of their own content. There is also a growing market for virtual reality and augmented reality, from video games to 'serious' applications such as 3D training programmes for trainee surgeons. The ongoing investments in the quality of experience (for example in hologram technology) and the massive collection of user data (Big Data) further increase bandwidth requirements.

In addition, end users are increasingly becoming producers of media themselves, either with their own films (live and on demand) or by contributing to media of third parties (such as live reporters for NU.nl). This is leading to a growing need for upstream bandwidth (where the customer 'sends' content), in addition to downstream bandwidth (where the customer 'receives' content). It is expected that over the period 2016–2026 the average required bandwidth will continue to increase exponentially, by about 40% per annum downstream, and slightly higher upstream.[14] These developments place high demands on the availability and speed of internet connection, as well as on the availability of backbones, nodes, data centres and infrastructural clouds.

Higher and more diverse demands on the digital infrastructure

Demand for connectivity is becoming more specific, with factors other than bandwidth becoming more important. For example, the connectivity in question is used for business-critical applications, for financial transactions, or for sharing and processing confidential data, and for real life applications that require extremely high capacity and extremely low latency (e.g. virtual reality). This leads to higher demands on continuity, reliability, latency and security. The use of current applications has already led to a growing need for capacity and continuity, because more and more work is being done 'in the cloud'. Consider, for example, the increasing use of cloud computing, teleworking and more frequent 'on demand' (streaming) TV viewing with increasingly higher image quality. Moreover, there is an increasing need to store information locally, so that latency decreases.

Investments

Considerable investments by telecom providers are needed to meet the growing need for digital connectivity. The capacity of fixed networks needs to be increased, including through more far-reaching replacement of parts of copper or cable networks by fibre optic ones, and network virtualisation needs to be possible so that tailor-made solutions can be delivered easily, quickly and cheaply. Investments are also needed in capacity for data storage and processing in the cloud, which will often take place ever closer to the user, for example in local exchanges or near antenna towers. Thanks to investments in the copper network, the majority of Dutch households can also opt for download speeds of more than 100 Mbps via the copper network, in addition to via cable networks. Also a lot of investment in mobile networks and technologies take place that can support new applications in the future. For example, more and more antennas will be installed for the roll-out of 5G.

Scale

Acquisitions and mergers are increasing the number of large players that can provide a total package in the connectivity market. There is a clear trend towards consolidation, especially for fixed and fixed/mobile products for consumers; takeovers and mergers are increasing the size of suppliers, while the number of parties in the market is decreasing. A few years ago, Ziggo and UPC merged to form a company that owns over 90% of Dutch cable connections. Subsequently, in 2016, Vodafone and Ziggo entered into a joint venture to be able to offer 'quad-play' (a combination of four services): fixed and mobile telephony, internet and TV. Furthermore, at the end of 2017 it was announced that Tele2 and T-Mobile intend to merge in order to compete with the two large fixed-mobile network operators KPN and VodafoneZiggo. There is also a clear trend towards consolidation at European level, both within countries and between countries. For example, there are a number of companies that provide connectivity services across Europe. This trend towards economies of scale and consolidation is producing benefits for companies. Their size and customer base make it easier to make the large investments required by new technologies and growing market demand. On the other hand, the number of suppliers is decreasing and therefore, possibly, competitive pressure as well. This may be to the detriment of consumers. Moreover, the past has shown that investments in the Netherlands were stimulated by competition. Outside the consumer market mentioned above, the number of new types of players and niche providers is sometimes actually increasing, for example with business-specific services.

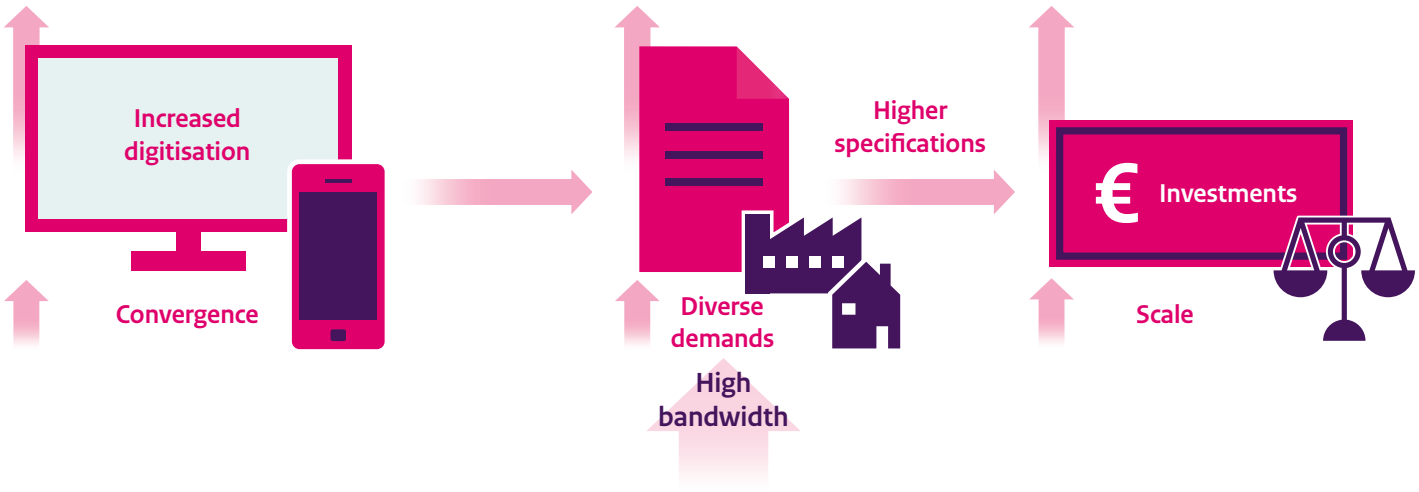
[13] Bandwidth is the capacity of a connection, expressed as the amount of data a connection sends per time unit.

[14] TNO and Dialogic (2016), *De toekomst van digitale connectiviteit in Nederland* [The future of digital connectivity in the Netherlands] (publication number 2016.076.1636), p.5.

Diverse range

As the demand for different forms of connectivity increases, the supply is also becoming increasingly diverse, with other parties providing telecom services. Much more so than in the past, fixed and mobile networks will converge through the use of smaller mobile cells (short-range antennas). It is also expected that 5G will have a considerable impact on developments in the digital domain from 2020 onwards. With the advent of the Internet of Things (IoT), many more devices will be interconnected: sensors with connectivity are everywhere, such as in smart electricity meters and in cars. Digital infrastructures are becoming increasingly virtual, which means that generic infrastructures will be able to respond to diverse needs more and more flexibly. Virtualisation[15] can lead to new revenue models for network owners, for example the provision of 'infrastructure as a service', in which a company, for example, has its own complete network, which is built and managed by a provider who thus provides much more than just communication services. On the supply side, the biggest change is that generic (i.e. not company-specific) connectivity products are increasingly able to meet a wide range of connectivity needs.

[15] Dialogic, Radicand, IMinds (2016), The impact of network virtualisation on the Dutch telecommunications ecosystem: An exploratory study.



H3 Objective

The Dutch Government considers it of great importance that the Dutch digital infrastructure is and remains of a high standard, so that digitisation can contribute to prosperity and well-being. For example, digital learning materials can better prepare our children for the future, connected cars can contribute to reducing traffic congestion and improving road safety, and e-health applications can improve our health care. In addition, digital innovations can lead to lower energy and raw material consumption and thus contribute to CO2 reduction. Sufficient, reliable and fast networks are a prerequisite for a multitude of important developments in the Netherlands.

In concrete terms, the government has set the following connectivity objective:

> *The Dutch Government is aiming for (a) high-quality connectivity (b) that can serve a wide variety of demand and (c) is available anytime and everywhere (d) at competitive rates.*

Before going into the four elements of the objective, it is important to note that this objective reflects the government's ambitions, where a weighing of the various interests may sometimes need to be made. For example, the government's ambition is to have one of the best fixed and mobile connections in Europe, but not at any price. There are physical and economic limitations to what is possible with the different forms of connectivity. For example, the costs of providing connectivity in rural areas are higher and a mobile connection may work less well in forests and indoors. However, this does not alter the fact that the government aims to increase the availability of connectivity throughout the Netherlands by means of a variety of policy instruments. The objectives are further elaborated below. In the following chapters, the ambition to contribute to the achievement of the objective is formulated for each subject. Based on this ambition and the trends in Chapter 2, the most important challenges and actions of this government will be described.

a. High-quality connectivity

High-quality connectivity means more bandwidth, but especially more products that meet specific quality parameters, such as the reliability of a network (sensitivity to interference, response speed (latency) and security).

b. Wide variety of demand

Demand for and supply of digital connectivity must be matched and sufficient investment in future-proof networks must be made. The connectivity study[16] shows that broadly speaking, digital connectivity meets the demand with the current state of technology. However, as more sectors digitise, demands on communication will become more diverse, and the demand for specific connectivity for company-specific applications will consequently grow. This often also applies to innovative services that contribute to the realisation of public interests, such as sustainability, mobility and public health. The objective in this respect is therefore to continue the growth in connectivity capacity, while increasing diversity of the supply.

c. Available anytime and everywhere

For many citizens and businesses, robust connectivity is a prerequisite for full participation in the Dutch economy and society. Future-proof networks will make it easier for businesses to innovate and citizens to develop digital skills and take advantage of the economic and social opportunities offered by digitisation. It is therefore important that citizens and businesses have access to some form of connectivity, anytime and everywhere. In the past, the government has embraced the European target[17] of having a 100 Mbps connection available to everyone by 2025. The government has chosen to move this goal forward such that already by 2023, 100 Mbps should be available everywhere in the Netherlands. This also fulfils the motion by Van den Berg[18] calling on the government to increase its ambition by applying the goal that by 2023 everyone should have access

[16] TNO and Dialogic (2016), *De toekomst van digitale connectiviteit in Nederland* [The future of digital connectivity in the Netherlands] (publication number 2016.076.1636)

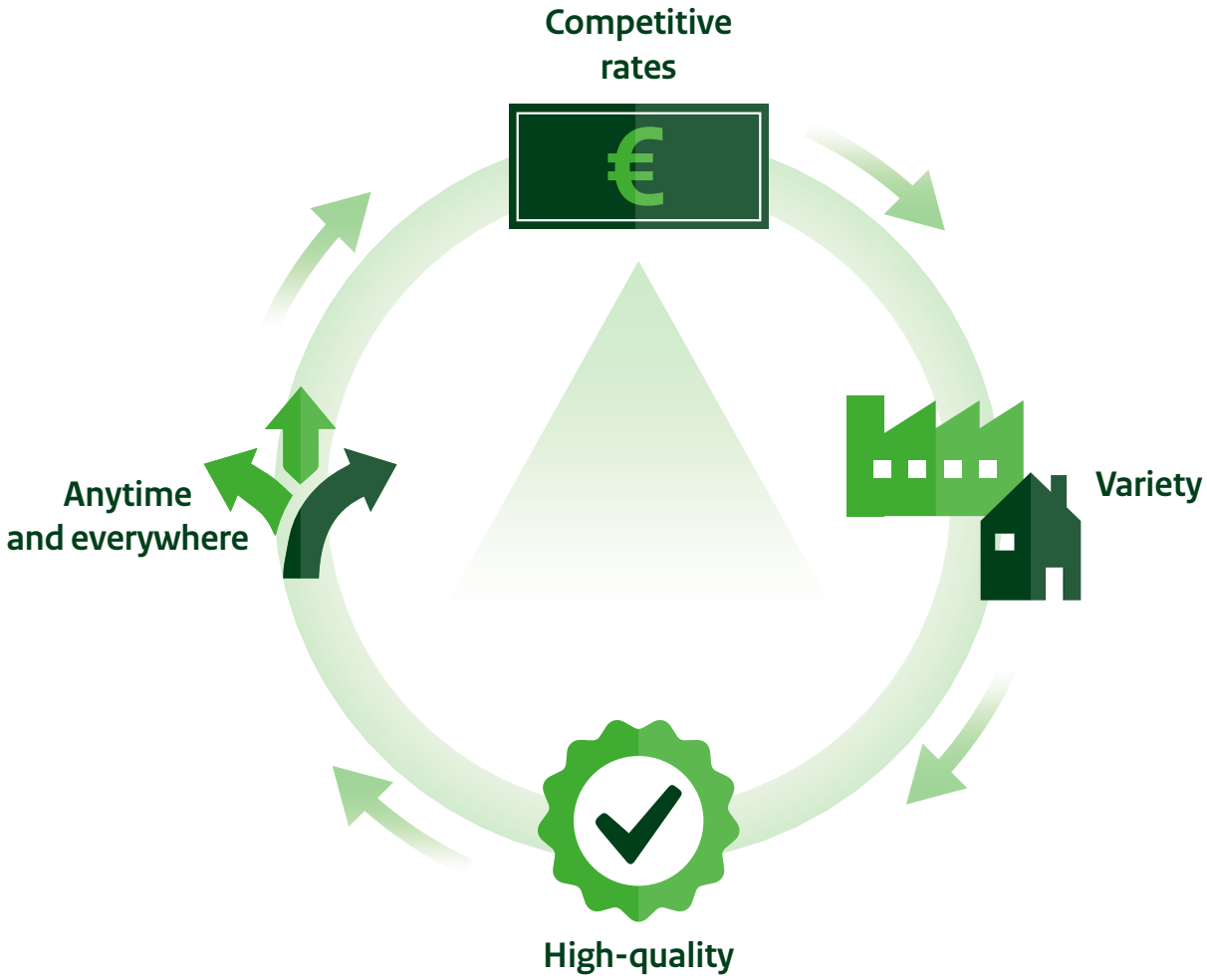
[17] Communication COM(2016)587, Connectivity for a Competitive Digital Single Market – Towards a European Gigabit Society, 14 September 2016.

[18] Parliamentary Paper 24095 No. 428.

to at least 100 Mbps. It should be noted that this is a lower limit. The government's aim is that by then a large majority of households will have access to a 1 Gbps connection. Mobile networks must also be able to access basic services at any time and from any location.

d. Competitive rates

Everyone must be able to benefit effectively from high-quality connectivity in social and economic life. In this respect, it is important that the rates are affordable. However, affordability cannot be quantified unequivocally. For a business user looking for support for mission-critical or business-critical applications, affordability has a different meaning than for a consumer. The basic principle is that affordability is best served by an efficiently functioning market with healthy competition. The government has the task of ensuring the preconditions for the efficient functioning of the market.



H4 Radio spectrum

Wireless connectivity has become an indispensable basic resource for Dutch society and an important condition for economic growth and social development.

The Netherlands already has four world-leading mobile networks at its disposal for the provision of fast mobile internet. This provides a good basis for serving the ever-widening demand from companies and sectors. Both nationally operating mobile operators and specialised providers are important to achieve this. This is why additional frequencies for national mobile communications will be auctioned in 2019, and frequencies will be made available that can also be used by specialised providers.

As a result of developments such as the Internet of Things (IoT), the demand for specific forms of mobile communication and related services is increasing and higher requirements are being made on, for example, the reliability, response time and speed of wireless communication infrastructures. The new 5th generation mobile technology (5G) is intended to meet this challenge. Whereas the previous generations of mobile communication technologies mainly had to provide for higher data speeds, 5G is mainly intended as a response to the widening of the demand for specific forms of service and customised solutions.

5G is particularly suitable for three types of connectivity, as illustrated in Figure 4–1 below: even faster internet (enhanced mobile broadband), connectivity for large amounts of IoT devices (massive machine-type communications), and ultra-reliable connections with a very fast response time for (business) critical applications (ultra-reliable low-latency communications). For a more detailed description of 5G, see the box in Chapter 2.

5G enables providers to offer a differentiated package of services with a single network that meets the needs of specific (individual) companies, business sectors and social sectors. At the moment, the focus is on industrial automation, smart cities, agriculture and care.

Ambition

The ambition is to expand the market for broadband mobile communications so that both mobile operators and specialised providers have the opportunity to meet the need for diversity in mobile connectivity of consumers and businesses through the provision of high-quality services.

Challenges

Need for company-specific radio spectrum

The Radio Spectrum Policy Memorandum 2016 states that the sector and company-specific telecom requirements will increase sharply in the coming years.[19] Research by Strict shows that mobile operators will be unable to provide for this adequately. It also appears that – for various other reasons too – companies want to purchase their connectivity services (PAMR[20]) from a specialist provider, or want a network under their own management (PMR[21]).[22] Research by Dialogic and Eindhoven University of Technology (TU/e) confirms that mobile operators with their generic mobile networks cannot meet these sector and company-specific telecom requirements.[23] Due to the limited frequency range available to specialist suppliers, their PAMR offerings are mainly limited to voice and data communications that do not require excessive data speeds. Due to the limited frequency range, the possibilities for the construction of privately managed mobile networks (PMR) are also limited, especially when it comes to broadband data communication.

[19] Radio Spectrum Policy Document (2016), Ministry of Economic Affairs.

[20] Public Access Mobile Radio. Providing mobile communications services to closed groups of business users. In other words, it is a public network.

[21] Private Mobile Radio. A network for the provision of services to a limited group of business users. In other words, it is not a public network.

[22] Strict (2017), *Onderzoek naar vergunningvrij gebruik in de 2100 MHz band* [Research into licence-free use in the 2100 MHz band].

[23] Dialogic and TU Eindhoven (2017), *Marktonderzoek professionele mobiele communicatie in de 450-470 MHz PAMR-band* [Market research into professional mobile communication in the 450-470 MHz PAMR band].

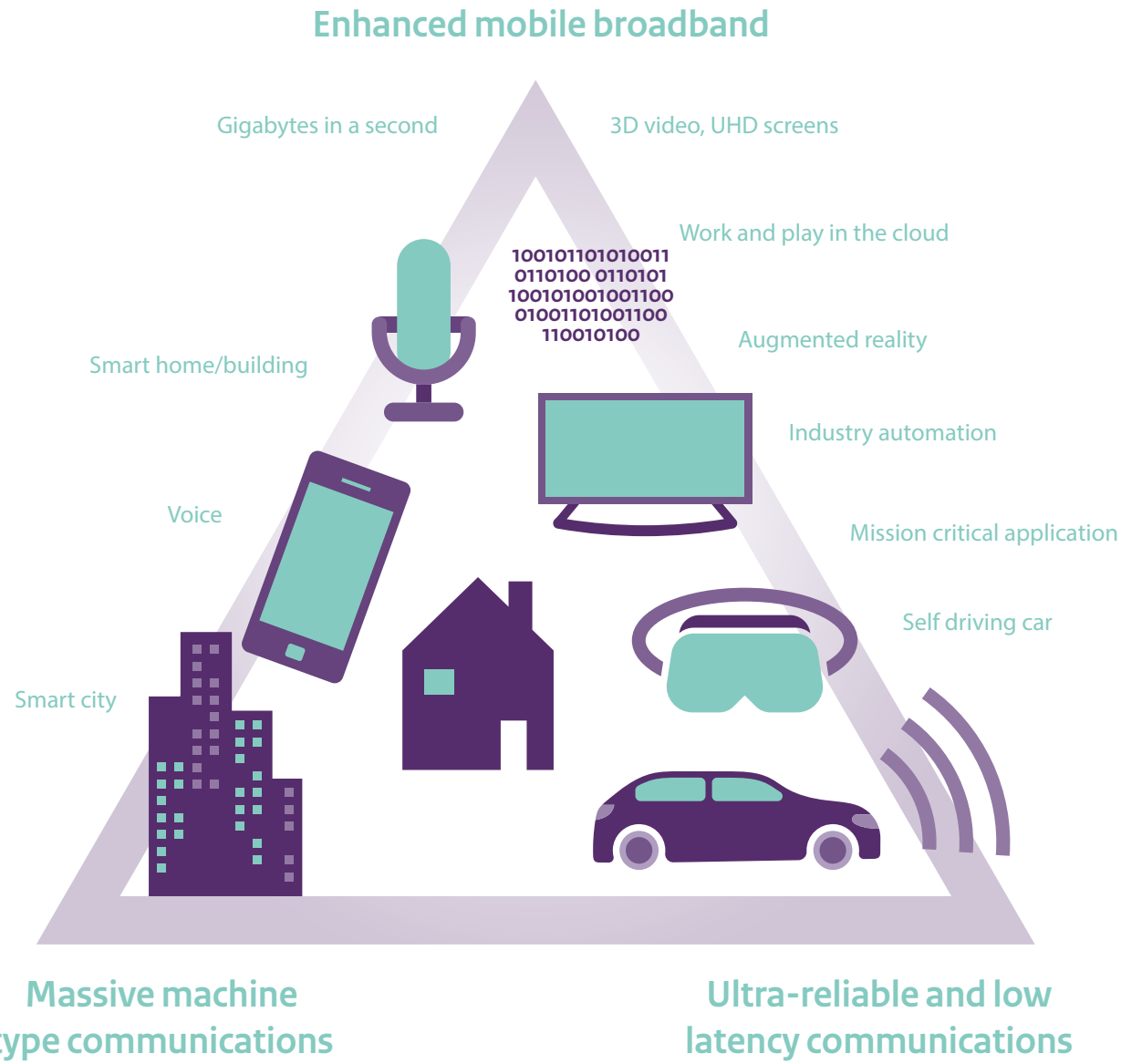


Figure 4-1. 5G usage scenarios.
Source: Recommendation ITU-R M.2083 IMT Vision. Framework and overall objectives of the future development of IMT for 2020 and beyond

Research by Strict has shown that there is a need for more spectrum for more broadband PAMR and PMR services. Strict estimates this would be 2×20 MHz or 2×40 MHz for FDD,[24] and 1×40 or 1×80 MHz when using TDD.[25] Follow-up research by Dialogic and TU/e confirms that at least 40 MHz (1×40 or 2×20) of spectrum is required for these forms of service.[26] It should be noted that TDD is the most obvious solution, as company-specific applications often require more upload capacity.

By making spectrum available, a choice will become possible for business-specific applications between mobile operators, more specialised providers or setting up a company network. All parties should be able to use frequencies that have been standardised by the industry organisation 3GPP in order to benefit from the economies of scale offered by the 3GPP ecosystem.[27]

Supply and demand

In practice, it is difficult for parties in need of connectivity in various sectors (so-called 'verticals') to translate their need for connectivity into concrete requirements on which mobile operators can base a commercial offer. Partly as a result of this, supply and demand do not always match up.

[24] Frequency Division Duplex. With this technology, download and upload traffic takes place via separate frequencies, allowing it to take place simultaneously.

[25] Time Division Duplex. This technology uses the same frequencies for download and upload traffic. Central control is then required to determine when the frequencies are to be used for downloading and when for uploading.

[26] Dialogic, TU Eindhoven (2018), *De behoefte aan spectrum voor specifieke, professionele breedbandige toepassingen* [The need for radio spectrum for specific, professional broadband applications].

[27] www.3gpp.org. The standardisation organisation for technologies such as GSM, 3G/UMTS, 4G/LTE.

The government can play a role here by bringing parties together and facilitating knowledge exchange, for example via the Dutch platform for Cognitive Radio (CRPlatform.NL).[28] In addition, the government supports the initiative of the Dutch Association of Large-scale Corporate Communications Users (BTG: *Nederlandse Vereniging van Bedrijfstelecommunicatie Grootgebruikers*) to bundle and articulate the demand for mobile broadband communication from various sectors in the expert group Critical Mobile Broadband Users (KBMG: *Kritische Mobiele Breedband Gebruikers*).

The government also facilitates the market by providing information. For example, the annual Wireless Technology Monitor (*Monitor Draadloze Technologie*),[29] provides a sound, up-to-date and accessible overview of the current state of affairs and expected developments in wireless technology. In this report, attention is also paid to the services that can be provided using wireless technology.[30] The government can also make spectrum available for experiments with potential application of new mobile and wireless networks and technologies. See Chapter 8 on innovation in this regard.

Making spectrum available can also contribute to improving indoor coverage, which is a major and growing part of connectivity demand. Technology already offers a solution here in part. For example, nowadays, Wi-Fi can be used not only for data communication, but also for speech. There are various solutions that can be used to bring indoor connectivity to a comparable level as outdoors.[31] Owners of buildings (belonging to businesses and otherwise) and their users are increasingly willing to invest in the necessary

[28] The CRPlatform.NL is an independent platform in which a diverse group of stakeholders (including the government) jointly discuss the use of new radio technology for wireless communication. Recently, attention has been paid to connectivity in various sectors, such as care and in the port of Rotterdam.

[29] Prepared by the Netherlands Organization for Applied Scientific Research (TNO) on behalf of the government. See https://www.tno.nl/monitordraadlozetechnologie/.

[30] In the autumn 2017 issue of *Monitor Draadloze Technologie* [Wireless Technology Monitor], extensive attention was paid to the standardisation of 5G and a number of promising application areas.

[31] This could include Distributed Antenna Systems (DAS) and Femtocells.

equipment for better indoor coverage. One problem is that the individual building owners have to conclude separate agreements with all the mobile operators in order to be able to offer the service. The four mobile network operators and the BTG are discussing a standard with which private parties can independently establish an indoor mobile network to which all mobile network parties can connect. It is important that such systems do not disrupt the outdoor network of mobile operators, while enabling users to achieve or improve the coverage of the mobile networks in their building(s) themselves. The licence-free spectrum in the 1800 MHz band can also be used for this but is insufficient to meet the growing need for indoor broadband communication.[32]

Provision of spectrum

In order to accommodate all developments, frequencies should be available to national mobile operators, specialised providers and parties wishing to set up a network for their own use. Various frequency bands will be made available for this purpose in the coming years, including frequencies for which 5G is currently being developed. This concerns in particular the 700 MHz, 3.5 GHz and 26 GHz bands. These are briefly discussed below.

700 MHz, 1400 MHz and 2100 MHz bands

Spectrum for mobile communications – in particular below 6 GHz – is generally scarce. In accordance with the guiding principle of Radio Spectrum Policy Memorandum 2016, auctioning is the main method of distributing this type of scarce frequencies. This applies, for example, to the 700 MHz, 1400 MHz (L-Band) and 2100 MHz bands. Preparations for the auction of these bands have been under way since 2016.

The 700 MHz band is ideally suited for 5G offerings that involve reliability and response time, as well as connecting extreme numbers of devices. In the 700 MHz band, 2×30 MHz of paired spectrum (703–733 MHz paired with 758–788 MHz) is authorised for mobile communications. The technical conditions for the use of the band have been harmonised at European level in Decision 2016/687(EU).[33] The frequency bands 698–703 MHz coupled with 753–758 MHz and the bands 733–736 MHz paired with 788–791 MHz have been assigned to the Ministry of Justice and Security (JenV) for broadband mobile communications for the purposes of Public Protection and Security. The remaining available frequency range in the 700 MHz band is for wireless audio connections (PMSE).[34]

For mobile broadband, the 800 MHz band has been previously freed from specific broadcasting uses and, from 1 January 2020, the same will be done for the 700 MHz band. This means that the current licensees for broadcasting (KPN/Digitenne and NPO) will have to start broadcasting with a different technology (DVB-T2) as of that date. It cannot be ruled out that 'broadcast bands' (bands reserved for broadcasting) will cease altogether after 2030.

The 1400 MHz band (also referred to as the 'L-Band'), between 1452 MHz and 1492 MHz, is harmonised at European level for so-called 'supplemental downlink' use. This means that this band can only be used for communication from the network to the user. The band can therefore only be used in addition to other frequencies.

The 2100 MHz band comprises the paired frequency bands between 1920 and 1980 MHz and 2110 and 2170 MHz. This band is currently already in use for mobile communications. The original licences were auctioned in 2000 (at the 'UMTS auction') and have recently been extended for the period from 1 January 2017 to 1 January 2021. As of the latter date, they will therefore be available again.

The 700 MHz, 1400 MHz and 2100 MHz licences to be auctioned shall be granted until 2040. This is in line with the principle that the duration of national exclusive licences should in principle be 20 years.[35] Such a licence period will allow both new entrants and existing parties to achieve a reasonable return on their investment. In view of the expiry date of licences already issued, this creates an allocation point every 10 years at which both low (below 1 GHz) and high (above 1 GHz) frequencies are offered.[36]

Due to the great importance of mobile connectivity for the economy and society, a coverage obligation will be imposed on the 700 MHz licences at the upcoming auction. This will ensure that mobile connectivity will also be realised in places where coverage is lacking or poor. The further details of this coverage obligation are detailed in Chapter 6.

To ensure that frequencies are actually used, all licences are subject to a so-called 'frequency usage requirement' (*ingebruiknameverplichting*). This means that the licensed

[32] In practice, this frequency range is mainly used for the construction of private mobile telephone networks based on 2G/GSM.

[33] Commission implementing decision (EU) 2016/687 of 28 April 2016 on the harmonisation of the 694-790 MHz frequency band for terrestrial systems capable of providing wireless broadband electronic communications services and for flexible national use in the Union.

[34] See: Parliamentary Paper 24095 No. 421.

[35] Exceptions may be made to this principle, for example where this is deemed necessary in order to ensure that the end date of the licences to be issued coincides with the end date of other licences for nationwide exclusive use. A shorter licence period of 15 to 20 years can then be chosen.

[36] See also the *Nota Mobiele Communicatie* [Consultation Document Memorandum on Mobile Communications], 2017.

spectrum must be used to offer a public electronic communications service – such as internet access, for example – in an area of a certain size. The more licences a party holds, the more onerous the obligation becomes and the greater the area in which it must use frequencies to provide services. For the 700, 1400 and 2100 MHz licences, the 'frequency usage requirement' will be as follows:

Band	2 years after granting of a licence per 2 MHz (in km²)	5 years after granting of a licence per 5 MHz (in km²)
2100 MHz	55	550
1400 MHz	74	734
700 MHz	751	7.512

Frequency usage requirement per 5MHz

This frequency usage requirement is in line with previous frequency usage requirements. Further details on the licensing conditions, the precise set-up of the auction, and any market regulating measures are addressed in the Memorandum on Mobile Communications (*Nota Mobiele Communicatie*). This will be finalised and published after the Netherlands Authority for Consumers & Markets (ACM: *Autoriteit Consument & Markt*) has given its opinion on possible market regulation measures.

3.5 GHz band

After the three aforementioned bands, spectrum will become available in the 3.5 GHz band. Licences have already been issued in this band with an end date of 2022 or 2026. It is also used by the intelligence and security services for national security purposes. In order to protect that use, restrictions have been imposed on other users of the band.[37]

A solution is being sought with the Ministry of the Interior and Kingdom Relations (BZK) and the Ministry of Economic Affairs and Climate Policy (EZK) for the 3.5 GHz band, which does justice to digital development opportunities on the one hand and the protection of national security on the other. In order to find a solution, research will be carried out in the coming months. This research has three components:

1. Investigation by the Netherlands Radiocommunications Agency (AT: *Agentschap Telecom*) into the current use in the 3.5 GHz band
2. External evaluation of the current issuance policy of the 3.5 GHz band including needs assessment of both current users and mobile operators
3. Research into concrete solutions for the use of the 3.5 GHz band by the intelligence and security services in Burum.

A decision on the future of the 3.5 GHz band will follow at the end of the year, on the basis of these studies. The new issuance policy for mobile communication licences in the 3.5 GHz band will be included in the Memorandum on Mobile Communications (*Nota Mobiele Communicatie*).

26 GHz band

The 26 GHz band[38] is seen in Europe as an important band for the further development of 5G, in addition to the 3.5 GHz band.[39] A characteristic of these high frequencies is that there is a lot of spectrum available.[40] Although a technology such as 5G requires many frequencies, it is conceivable that these frequencies are in fact only locally scarce, if at all, especially when the limited range of such high frequencies is taken into account.

The limited range of these frequencies also reduces the probability of interference. Due to the lower probability of interference and the limited scarcity, the main reasons for assigning licences for nationwide exclusive use for the 26 GHz band by auction are no longer valid. This opens up the possibility of making them available to a larger number of parties. This could take the form, for example, of (very) local or regional licences, issued in the order in which they are requested. Other options include first come first served or facilitating shared use or co-use.[41] This will make it possible for all kinds of companies to develop services for these high frequencies.

Spectrum for business-specific applications

In order to offer specialised service providers and users the opportunity to develop or realise business-specific connectivity themselves, there is a demand for spectrum that must be met. Currently, frequencies in the 3.5 GHz band are mainly used for this purpose. In a European context, this band is seen as the first band for the roll-out of 5G by the national mobile operators. This view was confirmed in the consultation. The external evaluation of the 3.5 GHz band will therefore include the future need of mobile operators for frequencies in that band and will examine the possibility of earmarking at least 1×40 MHz for business-specific (local) solutions.

[37] *Nationaal Frequentieplan 2014* [Amendment to the National Frequency Plan 2014], Government Gazette [*Staatscourant*] 2015 No. 37676, 2 November 2015.

[38] The 26 GHz band refers to the frequency range between 24.25 GHz and 27.5 GHz.

[39] RSPG Second Opinion on 5G networks (Strategic Spectrum Road Map Towards 5G for Europe).

[40] This concerns thousands of MHz, whereas in the 3.5 GHz band it concerns up to 400 MHz, and in the 700 MHz band: 60 MHz (2×30 MHz).

[41] For example, via a Licensed Shared Access solution.

Starting point for finding suitable frequencies is to connect to the existing broadband mobile communication ecosystems standardised by 3GPP (i.e. 4G/LTE and its successor 5G). In addition, it will also be examined whether and in which band technology can be used for the sharing of spectrum by different users. During the consultation, the 2300–2400 MHz band was mentioned, which has been or is being issued for mobile communications in some countries. In the Netherlands, this is currently an important band for shared use by wireless video cameras. Whether there are possibilities to use the band more efficiently will be investigated, wherebyfrequencies can also be offered for business-specific applications, in addition to PMSE.

Other bands

As a result of European decision-making and international agreements at the World Radio Conference 2019 (WRC-19), even more radio spectrum may be made available for mobile communications such as 5G. The position to be taken at the WRC-19 is being prepared in cooperation with other Member States of the European Union. It appears that the 66 GHz band will be proposed by Europe at WRC-19 as a candidate for 5G.[42] EU Member States are examining the possibility of making this band available licence-free.

Licence-free frequencies are an important breeding ground for innovation and contribute to dynamic market environment.[43] License-free spectrum access provides opportunities both for news users and for new applications. Any company, consumer and organisation can set up a wireless network or use wireless equipment without having to apply for a licence or having to purchase paid-for services. This contributes to broadening of the market.

Actions

In order to facilitate broadening of the market for various forms of wireless connectivity, the government is taking the following actions:

Making spectrum available

- Auctioning frequencies: At the end of 2019 or a few months later, the 700, 1400 and 2100 MHz bands will be auctioned by the Ministry of Economic Affairs and Climate Policy (EZK).
- 3.5 GHz band: In 2018, use of the 3.5 GHz band will be reviewed and potential solutions identified to do justice to the use of the band by the Ministry of Defence, the interests of national mobile operators in the 5G roll-out, and the interests of existing licensees.
- 26 GHz band: Following a European decision on the technical conditions of use for this band, expected in the second half of 2018, the policy for the authorization of the upper GHz range (26.5–27.5 GHz) will be finalised by the Ministry of Economic Affairs and Climate Policy (EZK) in order to allow for commercial use by 2020 at the latest.
- Spectrum for business-specific applications: The Ministry of Economic Affairs and Climate Policy (EZK) makes spectrum available so that specialised providers can also cater for the growing demand for various forms of wireless connectivity, or parties can set up a network for their own use.
  - 2300 MHz: The Ministry of Economic Affairs and Climate Policy (EZK) and the Netherlands Radiocommunications Agency is launching a study to determine whether the band can be used more efficiently to create possibilities in the 2300 MHz band for business-specific applications with the help of LSA.[44]
  - Additional spectrum: The Ministry of Economic Affairs and Climate Policy (EZK) and the Netherlands Radiocommunications Agency are examining in which 3GPP standardised frequency bands at least 2×20 MHz or 1×40 MHz can be made available for local use, taking into account the extent to which LSA in the 2300 MHz band can be used for this purpose.
- WRC-19: Together with other Member States and the European Union, the Ministry of Economic Affairs and Climate Policy (EZK) is working on the identification of additional spectrum for 5G at the World Radio Conference 2019.
- Currently there are frequency bands reserved for broadcasting. This use will be discussed in the Strategic Memorandum on Broadcasting Distribution (*Strategische Nota Omroepdistributie*)[45] drawn up by the Ministry of Economic Affairs and Climate Policy (EZK) and the Ministry for Education, Culture and Science (OCW).

Conditions for making harmonised frequencies for mobile applications available

When issuing frequencies for mobile communications on a national, exclusive basis, the Ministry of Economic Affairs and Climate Policy (EZK) will apply the following conditions in the next five to ten years.

- Licence period: In principle, a licence period of 20 years will be applied. In line with this principle, the end date of the 700, 1400 and 2100 MHz bands will be set at 2040.
- Frequency usage requirement (*ingebruiknameverplichting*): A frequency usage requirement will be used to oblige licensees to actually use the frequencies (see above for concrete figures).
- Technical conditions: In addition to European research into the technical conditions of use, research is always

[42] This concerns the 66–71 GHz band.
[43] Parliamentary Paper 24 095, No. 409, page 4.
[44] Licensed Shared Access.
[45] Parliamentary Paper 24095 No. 421.

carried out into the specific conditions in the Netherlands that future licensees must take into account in the case of upcoming frequency allocations for mobile communications. This will provide greater clarity about the expected forms of interference in the specific Dutch context and – where necessary – additional licensing conditions may be imposed.

Matching supply to demand

The Ministry of Economic Affairs and Climate Policy (EZK) participates in various forums and consultations to help to bring the supply and demand side of the market together. In 2018 and beyond, this concerns at least the ongoing initiative of the Critical Mobile Broadband Users expert group (KMBG) from the Dutch Association of Large-scale Corporate Communications Users (BTG) to articulate the demand from various sectors for mobile and wireless communication services, the Cognitive Radio Platform.nl, and facilitation of the exchange of knowledge in the National Frequency Policy Meeting (Nationaal Frequentiebeleidsoverleg: NFO) and 'specials' of that meeting.

Standardisation of solutions for improving indoor connectivity

- In order to contribute to improvement of indoor connectivity, the Ministry of Economic Affairs and Climate Policy (EZK) endorses the BTG initiative to reach a standard for indoor networks.
- The Ministry of Economic Affairs and Climate Policy (EZK) contributes in an EU context to harmonising the conditions for license-free use of the 66–71 GHz band.

H5 Local policy

The increasing demand for connectivity necessitates new investments in telecom infrastructure, both above and below ground. Consider, for example, the placement of small cells (antennas with a relatively short range) and new fibre optic lines to connect these antennas to the existing network. In making these investments, telecom parties have to deal with municipal and provincial policies and regulations. This chapter discusses how local policy influences new investments and what role the national government can play.

Responsibilities

Local government if possible, national government if necessary is the basic principle in dividing tasks and responsibilities in the field of spatial planning. This is a core value that also informs the new Environment and Planning Act (*Omgevingswet*) that is expected to enter into force in 2021. It is the national rules that define the framework, such as environmental law, within which municipalities can impose local requirements. The policy of the national government is shaped by the ministries of EZK, Infrastructure and Water Management (hereinafter: IenW), and the Ministry of the Interior and Kingdom Relations (BZK). Municipalities themselves are responsible for granting local permits for the installation of antennas and for excavation work. Provincial authorities play a role in this to ensure that there is coordination between municipalities on local policy. Within this context, central government has a limited role. Only in specific areas, such as energy and telecom, can central government steer decisions on spatial planning. There is a significant difference in how municipalities address their local connectivity challenges. For example, there are municipalities that are actively looking for ways to improve connectivity as part of their Smart City policy or to connect rural areas to fast internet. Other municipalities pay less attention to connectivity goals.

At a national level, the following telecom regulations now apply in broad outline. The current telecom regulations – including the Aboveground and Underground Network Information Exchange Act (WIBON: *Wet Informatie-uitwisseling boven- en ondergrondse netwerken*) – oblige landowners to allow telecom cables from public telecom providers to be located on their land, and users of designated frequency range for mobile communications are obliged to meet reasonable requests by either party for the sharing of antenna sites. In addition, (with the recent implementation of the WIBON) network operators[46] must provide access to their physical infrastructure for the construction of fixed and mobile electronic communications networks.

In a number of cases, the installation of antennas requires an integrated physical environment permit (*omgevingsvergunning*) from the municipality, such as for a free-standing transmission mast, antennas higher than 5 metres (including base), and in the case of monuments, listed buildings, or a village or urban conservation area.

For antennas lower than 5 metres, an *omgevingsvergunning* is usually not required, but the Antenna Agreement (*Antenneconvenant*)[47] does apply for an orderly installation, which encourages cooperation and information exchange between mobile operators and municipalities. The Agreement includes an Installation Planning Procedure. This provides municipalities with insight into the antennas to be installed by operators (as well as the installed antennas) in their municipalities. Operators should take the advice of municipalities into account as much as possible. In addition to the regulations referred to above and the Antenna Agreement, in the context of the antenna policy,[48] information is also provided by the Antenna Office (Antennebureau) of the Netherlands Radiocommunications Agency and the Electromagnetic Fields and Health Knowledge Platform (*Kennisplatform Elektromagnetische Velden en Gezondheid*).

[46] For example, for gas, sewage systems, electricity, roads, railways and ports.

[47] The signatories of the Agreement are the mobile operators, the Ministry of Infrastructure and Water Management (I&W), the Ministry of Economic Affairs and Climate Policy (EZK) and the Association of Netherlands Municipalities (VNG).

[48] The aim of the National Antenna Policy is to stimulate and facilitate sufficient space for antenna sites within clear frameworks for public health, the living environment and safety.

The revision of the European Telecom Rules also provides for operators to have access to infrastructure under the control of public authorities, including street furniture such as street lamps and traffic lights. The European Council and the European Parliament have reached a broad agreement on this matter, after which these provisions must be implemented in the Dutch Telecommunications Act (*Telecommunicatiewet*). This expansion of the possibilities regarding antenna sites will help operators facilitate the network densification they require. Another important development is the Environment and Planning Act (*Omgevingswet*) coming into effect. The firm Stratix expects that this Act can provide benefits[49] that are relevant to 5G network densification, including speeding up and simplifying the application procedure for a licence application at a one-stop shop of the province and municipality. Under the Environment and Planning Act, too, antenna installations below 5 metres will (as is currently the case) often remain exempt from Integrated Physical Environment Permits (*omgevingsvergunningen*) and will be subject to the provisions of the Antenna Agreement. This is important for the placement of small cell antennas, which will often fall into this category.

Ambition

The objective mentioned in Chapter 3 has a number of local consequences. Space is limited and must be used optimally. The ambition is for the various tiers of government, each with its own competence, to provide sufficient room for the necessary investments in high-quality connectivity, taking into account important preconditions. Local authorities are important in achieving connectivity goals. Preconditions include local support for telecommunications facilities, clarity about the local installation policy and the standards to be applied for electromagnetic fields (EMF) for antennas and limited nuisance caused by excavation work. These

[49] Stratix (2018), Cost elements in the rollout of 5G networks in the Netherlands, p. 15.

preconditions must be transparent, public and harmonised where appropriate, while municipalities must pay sufficient attention to the necessary investments in high-quality telecommunications infrastructure.

Challenges

Differences in local rules

Telecom providers indicate, for instance during the various round-table sessions, that municipal and provincial authorities implement antenna policy and policy on fees and licensing requirements for excavation work in different ways. According to telecom providers, differences in policy between municipalities is a major bottleneck when building new infrastructure. On the other hand, differences between municipalities may exist because of a different local political outlook. In order to further identify any differences, the Ministry of Economic Affairs and Climate Policy (EZK) commissioned the KWINK research agency to carry out an additional study[50] into the policy of local authorities with regard to the fees for granting licences for the laying of cables and pipelines, the fees for excavation work, and policy concerning antenna placement.

Excavation work

The research carried out by Kwink Group shows that municipal charges and fees for being allowed to carry out excavation work vary between municipalities. For example, the municipal charges for digging an average connection (125 m) can vary from €1,843.25 in Tilburg to €137.85 in Heemstede. In total, these can be significant costs for the roll-out of fast internet. The following figure shows the fees per municipality.

In addition to the difference in municipal charges, municipalities also apply different fees for carrying out excavation work. The level of these costs depends on the type of paving or the scope of the work. Soil quality also determines the level of regional costs charged by municipalities for excavation work. Poor soils mean higher costs. See on the next page an example chart showing a specific situation in case of poor soil >80% ('VNG Soil 5') and good soil 0<50% ('VNG Soil 1').[51]

In addition to differences in municipal charges and fees for excavation work between municipalities, municipalities have different procedures for granting licences. In addition, some municipalities have specific requirements, such as mandatory soil testing or waiting periods after previous excavation work. Kwink did not investigate these different conditions and differences in procedures. Market parties did, however, mention in the consultation that it is important.

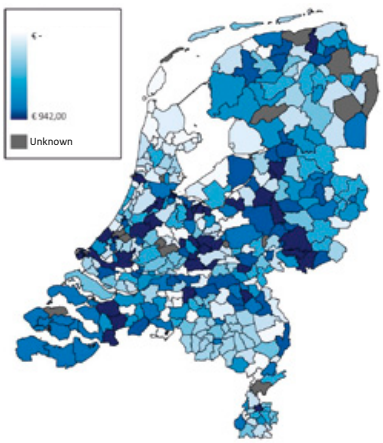
Municipal antenna policy

In its study, Stratix indicates that the majority of municipalities appear to be flexible with regard to Integrated Physical Environment Permits (*omgevingsvergunningen*) for towers, but that there are considerable differences between municipalities.[52] Kwink's research shows that only 25 of the 380 municipalities have a municipal antenna policy that can be found in the public domain via internet. Furthermore, approximately half of the 46 municipalities that Kwink subsequently approached do not have an established antenna policy. Kwink then found that municipalities with and municipalities without an antenna policy more or less follow the same principles for locations where the installation of antennas is preferred or discouraged. Finally, Kwink

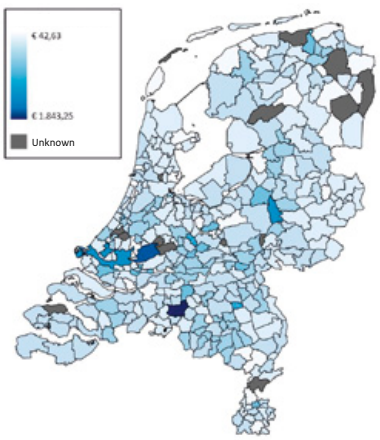
[50] Kwink (2018), *Inventarisatie gemeentelijk beleid telecomnetwerken* [Inventory of municipal policy on telecom networks].

[51] VNG guideline on rates for excavation work (telecom). See: https://vng.nl/onderwerpenindex/ruimte-en-wonen/kabels-en-leidingen/nieuws/herstraattarieven-2017-beschikbaar.

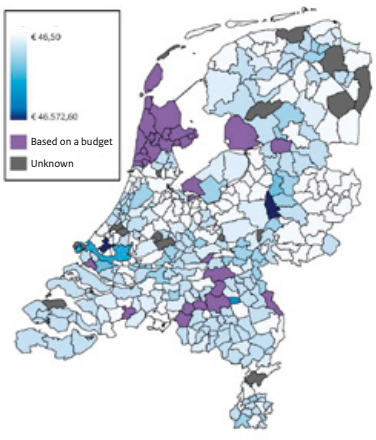
[52] Stratix (2018), Cost elements in the rollout of 5G networks in the Netherlands, p. 123.



Charges for 10 meter.



Charges for 125 meter.



Charges for 5,000 meter.

Fees for excavation work 3m², resurface by telecom provider

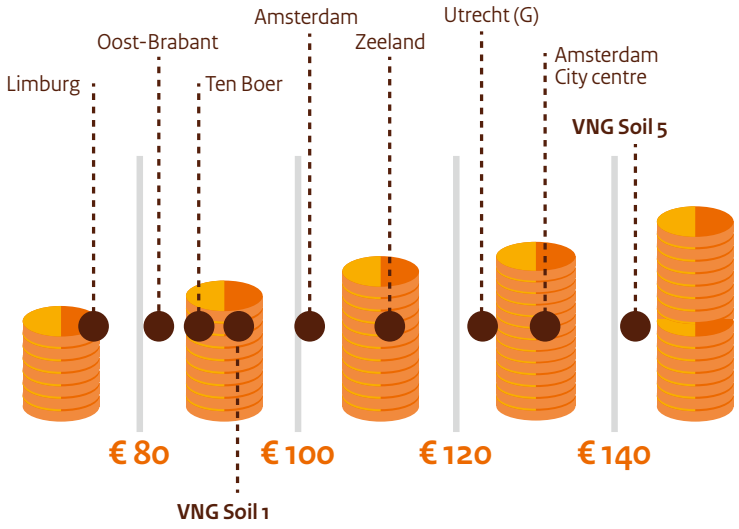


Figure 5: Report on council telecom policy (Kwink Group, 2018)

mentions that telecom providers indicate that specific principles apply in a number of municipalities that make the installation of antennas a complex matter. It was also indicated in the consultation that a trend is underway of ever higher land/rent prices for the use of land for antenna sites.

It is important for the roll-out of antennas (masts) by operators that all municipalities, in connection with the granting of an Integrated Physical Environment Permit (*omgevingsvergunning*) (e.g. for a free-standing transmitter mast), formulate an antenna policy in accordance with the Municipal Sample Memorandum on Antenna Policy (*Voorbeeldnota gemeentelijk antennebeleid*) of the Antenna Bureau[53] and make this policy publicly available. This will give providers clarity and is all the more important in view of the increasing density of mobile networks. Citizens can then also find out about the municipal antenna policy. The above sample memorandum provides municipalities with guidance on stimulating or restrictive policy for the installation of antennas and thus sufficient flexibility to be able to make choices relating to local conditions. The sample memorandum can also be used to arrive at a 'best practice' for municipalities. It is a specific power of municipalities to pass on costs for the use of land for antenna sites. However, municipalities are expected to set reasonable prices, because it is also in the interests of municipalities that connectivity can be achieved for its citizens. This aspect is also discussed in Chapter 6 on investments. The Antenna Agreement (*Antenneconvenant*) for the installation of antenna installations exempt from an Integrated Physical Environment Permit (*omgevingsvergunning*) expires at the end of 2019. In discussions about an extension, the various instruments, including the installation Planning Procedure, will be considered in the light of the introduction of 5G. The Installation Planning Procedure is expected to play an important role in the roll-out of 5G.

Cities with an old city centre face an additional challenge when rolling out antennas for 5G because of the many monuments, listed buildings and cityscapes which impose special requirements on installing antennas (small cell and otherwise). In other places in the Netherlands too, requirements regarding the external appearance of buildings (*welstandsregels*) can have a restrictive effect on the placement of antennas. In the past, the Department for the Preservation of Historic Buildings and Sites (RDMZ: *Rijksdienst voor de Monumentenzorg*) published a guide[54] for assessing plans for antenna installations in monuments. If the competent licensing authority has considered the factors mentioned in this guideline and does not see any objections, a licence can be granted. However, it is questionable whether the current guidance is still sufficient given the development of 5G networks and the increased installation of antennas. It is also being considered whether municipalities can be given more guidance on requirements regarding the external appearance of buildings (*welstandsregels*)

[53] The sample memorandum can be found at www.antennebureau.nl.

[54] Cultural Heritage Agency of the Netherlands (2003), *Plaatsing van telecommunicatieapparatuur op, in en aan monumentale gebouwen* [Placement of telecommunications equipment on and in listed buildings], Found at: https://cultureelerfgoed.nl/publicaties/plaatsing-van-telecommunicatieapparatuur-op-in-en-aan-monumentale-gebouwen.

when granting an Integrated Physical Environment Permit (*omgevingsvergunning*) for antennas. In addition, the municipality can investigate which infrastructure it manages (from buildings to street furniture) is eligible for the installation of antennas. To this end, the municipality can consult with telecom providers.

Standards for electromagnetic fields (EMF)

Further densification of mobile telecom networks is to be expected from 2020 onwards, given the increased data requirement. Additional antenna masts will be installed nationally (including in border areas), partly as a result of the obligation to cover the 700 MHz licences. And at the local level, the small cell antennas will be introduced in the streetscape. During the consultation, many citizens expressed their concerns about the radiation from antennas, also as a result of the introduction of 5G. Citizens must be given as much certainty as possible that the EMF of antennas does not pose a threat to their health in daily living environment, even if there are several antennas in the immediate vicinity (on lampposts, bus shelters, advertising objects, etc.). What's more, for operators it is important that the roll-out of 5G networks, including small cells, can take place under a nationally uniform EMF scheme. There is a recommendation of the European Council of 1999 on standards for EMF (Council Recommendation 1999/519/EC), but this is not enshrined in legislation in the Netherlands. In order to provide certainty to providers and citizens about the applicable rules, it is important to maintain uniformity and to lay down standards in law.

The challenges can be summarised as follows:

- There is a considerable difference between municipal charges for permission to carry out excavation work. In addition, many municipalities have not formulated a specific antenna policy. The challenge is to ensure transparency in regional policy with regard to the construction of new telecom infrastructure. The idea is that increasing transparency will contribute to the convergence and consistency of local policies.
- In addition to increasing transparency, a challenge is to ensure that the national ambition regarding digital connectivity is in line with municipal policy, in order to create optimal regional preconditions for further development of the telecom infrastructure. Central government can provide guidance in this respect, such as the Municipal Sample Memorandum on Antenna Policy (Voorbeeldnota gemeentelijk antennebeleid). Municipalities can also learn from each other and thus arrive at joint local policy.
- In specific areas, a clear framework of standards should be drawn up, in consultation with regional authorities and other ministries, clarifying who is responsible for what scope local authorities have for pursuing regional policy.

Actions

The actions are in line with the challenges, have been subject to public consultation, and have wide support.

- *Transparency*: KWINK's round-table discussion and research shows that municipal policy on the construction of fixed infrastructure and antennas varies and is not always publicly available. This results in uncertainty for parties who want to invest in new infrastructure. In order to ensure greater transparency in local policy, the Ministry of Economic Affairs and Climate Policy (EZK) publishes the local rates for the construction of new underground infrastructure and which municipalities have formulated and published an antenna policy on the website samen-snelinternet.nl. In addition, together with the Association of Netherlands Municipalities (VNG), central government will consult with municipalities on making local policy transparent. Furthermore, the government will work with the VNG to develop best practices for municipalities to facilitate the roll-out of infrastructure, including with regard to policy on the external appearance of buildings (*welstandsbeleid*). Together with Brainport Eindhoven, we will specifically examine whether steps can be taken to harmonise local policy within a region and use best practices to scale up these initiatives to other regions.
- *Communication with local authorities*: On the basis of the Dutch digitisation strategy and this Action Plan, the Ministry of Economic Affairs and Climate Policy (EZK) will be consulting municipalities together with VNG. In this dialogue with municipalities, the challenges and actions mentioned in this chapter and in the one on investment and innovation will also be discussed. In addition, stakeholders (including the VNG and operators) are being consulted on how the Antenna Agreement – and in particular the Installation Planning Procedure – can be extended beyond 2019 in order to be well prepared for the roll-out of 5G antennas. The VNG can play an important role in this on behalf of municipalities.
- *Harmonisation of specific frameworks*: To ensure that the maximum allowable exposure to EMF is applied uniformly throughout the Netherlands, the internationally used standards – which are now also used in practice – are laid down in the Dutch Telecommunications Act (*Telecommunicatiewet*).[55] In addition, the Ministry of the Interior and Kingdom Relations (BZK) – in cooperation with the Ministry of Infrastructure and Water Management (IenW) and the Ministry of Economic Affairs and Climate Policy (EZK) – what role the national government can play in the coordination of removing and investment in cables and other infrastructure in the subsoil.

[55] This is thus in line with EMF supervision already embedded in the Dutch Telecommunications Act (*Telecommunicatiewet*) regarding the trade in and commissioning of transmission equipment; the Netherlands Radiocommunications Agency will also become the competent supervisory authority in the use phase.

H6 Investments

As indicated earlier, both the fixed and mobile networks in the Netherlands are among the best in the world. In most places at least two fixed networks are available (copper and cable), sometimes even three (fibre optic), and, as yet, four mobile networks. Fixed networks allow speeds above 100 Mbps, and increasingly such speeds are also available via mobile networks. In addition, there are other wireless networks that contribute to the availability of connectivity in the Netherlands, such as KPN's LoRaWAN, the Things Network, Sigfox, and specialised fixed wireless networks that offer internet in the rural areas of the Netherlands.

Although large parts of the fixed networks were originally built by public authorities, their current capabilities are the result of private investment. This is particularly true of mobile networks. The competitive prices and many options for businesses and consumers are the direct result of the liberalisation of the telecom market. In the coming years, investments in networks will continue to be essential to cope with the developments described in Chapter 2. For example, higher and higher demands are being placed on connectivity to meet the variety of demand and offer sufficient guarantees for available and reliable connectivity at any time and in any place. The continued development of technologies and the ambitious roll-out to consumers and businesses will require significant investments.

Fixed networks – urban areas

In urban areas, fixed networks are likely to require investment mainly in upgrading and further extending existing local loops. VodafoneZiggo, for example, is preparing for the introduction of DOCSIS 3.1 and KPN for the roll-out and further development of VDSL technology.[56] The construction of a new infrastructure – Fibre-to-the-Cabinet (FTTC) – has been delayed due to the aforementioned further development of the KPN network and the takeover of Reggefiber by KPN. In the coming years in particular, investments are expected to be needed in other parts of the fixed networks (local loops and otherwise), such as the construction and upgrading of data centres, interconnection of networks, software for virtualising network infrastructure, and fibre-optic connections for connecting, among other things, new mobile antennas and data centres.[57]

Fixed networks – rural areas

As far as fixed networks in rural areas are concerned, major investments are needed to connect homes and industrial sites to future-proof infrastructure. Where this cannot be achieved through private investment – say if the business case cannot be made attractive enough to financiers –local authorities may have to consider providing assistance. Citizens and businesses cannot be left behind and deprived of what has become a basic need to participate in the economy and society.

Mobile networks

Investments in mobile and other wireless networks are also expected to be substantial. 5G, new frequencies becoming available (see the radio spectrum chapter), and increasing data traffic in combination with higher quality requirements all call for investments in both new equipment and the densification of the existing networks through the roll-out of extra antennas (see also the chapter on local policy). Because there are already many fibre-optic connections in the Netherlands, we are well positioned to realise this densification. With the advent of 5G and the need to further densify existing networks, there are opportunities for companies to enter the market and focus specifically on this.[58] Depending on the capacity the mobile network operators want to achieve, the cost of the necessary network densification will be at least a few hundred

[56] For example, with Bonded V Plus, a combination of copper technologies, maximum speeds of 400 Mbps can be achieved.

[57] International connections are also important, e.g. via sea cables. See e.g.: R. Kamerling (2018), Developing an explanatory model for the firm investments in submarine optic telecommunication cables.

[58] DotEcon Ltd, Study on implications of 5G deployment on future business models.

million euros, but could even increase to many billions.[59] In addition, these networks will also require investing in the construction of data centres – if possible located near antennas – and software for the virtualisation of network infrastructure.

Past experience has shown that investments will be largely market-driven, provided that the government creates the right framework conditions. This will no doubt also be the case for many of the future investments required, as shown by the TNO and Dialogic research into connectivity supply and demand in the Netherlands.[60] It is the role of central government, in particular the Netherlands Authority for Consumers & Markets (ACM) to remain vigilant to ensure that there still is sufficient competition in the market. It is also up to central government to ensure that sufficient radio spectrum becomes available for the mobile networks, as discussed in Chapter 4. The exception to the rule is if the market is unable to achieve the necessary connectivity, for example because the return on investment is too low or because of regulatory barriers.

Ambition

In order to maintain and expand the leading position of the Netherlands, we are working to make *investment barriers as low as possible* so that many different parties can contribute to achieving high-quality digital connectivity that is available anytime, anywhere and at competitive rates. It is vital that everyone is able to participate in the digital society, which is why it is important for every household to have a 100 Mbps connection by 2023. Where the necessary investments cannot be made commercially viable, the government may consider intervening. By then a large majority of Dutch households is already expected to have access to the higher speed of 1 Gbps.

Challenges

One of the original reasons for introducing market forces into the telecom market was that competition would encourage private parties to invest in networks. In view of the state of both fixed and mobile networks in the Netherlands, this has proved to be a successful strategy. Competition leads to investment. For example, competition between the four mobile parties has helped to increase investment, as have the various fixed infrastructures in the Netherlands. In addition, regulating access to KPN's network and the voluntary provision of access to mobile networks have led to the entry of various market parties, which has resulted in strong competition with positive consequences for customers (consumers and business).

Ensuring competition

However, competition is under pressure, primarily in the consumer market. The ability to make investments requires a certain scale, which in turn can affect the desired degree of competition. Achieving connectivity is often very capital-intensive, as described in Chapter 2. An important market development in this context is the development towards quad-play bundles. VodafoneZiggo and KPN in

[59] Stratix (2018), Cost elements in the rollout of 5G networks in the Netherlands.

[60] TNO and Dialogic (2016), *De toekomst van digitale connectiviteit in Nederland* [The future of digital connectivity in the Netherlands].

particular are able to offer these bundles at a good price because they have a fixed and mobile last-mile network. In order to be able to do the same, alternative operators must rely on access to the network of these two players. The financial figures of market parties show that consumers are increasingly opting for this type of bundle, and that they are less inclined to switch once they have purchased such a bundle (low 'churn' rate).[61] Lower numbers of switchers, along with the economies of scale and scope of these large parties, make it difficult for smaller competitors to attract switchers and to grow from there. Thus maintaining competition in both the fixed and the mobile market is a challenge. Another market development is the competition for TV content. With parties increasingly competing on exclusive content, there may be only one party broadcasting certain sporting events. Their popularity dictates whether this affects consumer choice.

It is important to ensure that there is sufficient competition regarding these developments. In principle, the Netherlands Authority for Consumers & Markets (ACM) decides on the competitive situation and the possible need for intervention, not the government. It is important that the ACM has the necessary instruments to carry out this task. The ACM is currently taking a market analysis decision in which both KPN and VodafoneZiggo are obliged to grant access to competitors.[62] The ACM will also advise on the possible need for market regulating measures in the next frequency auction for mobile communications.[63]

Matching supply and demand and other barriers to investment

Even when there is sufficient competition private investment is difficult to attain in some cases. Apart from geographical challenges, there may, for example, be uncertainty about demand. There is an increasing demand in the business community for connectivity in order to innovate, but what exactly is expected from that connectivity is not always clear. However, it is clear that demand is increasingly not only about bandwidth, but also about other things such as latency and reliability. In these cases, it is difficult for telecom providers to develop a product. Supply and demand are not in sync, meaning that the investments required to meet demand will not be made.

Geographically, the biggest challenges to the connectivity ambition lie in rural areas, but barriers to investment may also exist in other areas.[64] Although it is mainly the responsibility of local and regional authorities to remove these barriers, central government can play a facilitating role in this respect. In cities, compliance with local regulations and fees are important cost items that determine whether investments in the densification of mobile networks or the roll-out of fixed infrastructure will take place. This has already been discussed in Chapter 5. In rural areas, private investment is sometimes difficult to generate, particularly when it comes to rolling out fixed infrastructure. Sometimes investment is potentially profitable, but the scale of projects in an rural area is too small or there is no standardised business model, which means that transaction costs are too high for investors.[65] Moreover, smaller businesses and residents' initiatives do not always have the equity to raise financing.

Another aspect that can lower investment barriers is when companies invest in rolling out a network together, allowing costs to be shared across multiple end users making investments more profitable. Examples include sharing antenna masts, fibre-optic ducts, antennas, equipment, or frequencies. The possibilities for sharing networks or parts thereof within the applicable telecom and competition legislation are described in such places as the 2010 Strategic Memorandum on Mobile Communications (*Strategische Nota Mobiele Communicatie*) and a 2011 joint report[66] by the Body of European Regulators for Electronic Communications (BEREC) and the Radio Spectrum Policy Group (RSPG), a European policy advisory committee. In recent years, T-Mobile and Tele2 have also collaborated on the roll-out and operation of their mobile networks, while KPN and Vodafone have conducted a trial. It is up to private parties to decide whether to use existing possibilities.

Roll-out can also be promoted if non-telecom parties make their infrastructure or buildings available. At the end of April, for example, the bill implementing the EU Directive on reducing the cost of deploying high-speed broadband (WIBON) came into force. This Directive contains measures to reduce the costs of constructing broadband networks. The WIBON reduces costs by first of all requiring parties, such as railway or network operators, to agree to the shared use of their infrastructure if telecom parties submit a reasonable request to do so. In addition, network operators, which are (partly) financed with public funds, will be obliged to coordinate civil works (e.g. excavation work) if

[61] See for example KPN's Q4 2017 quarterly figures and VodafoneZiggo's provisional Q1 2018 quarterly figures.

[62] Netherlands Authority for Consumers & Markets (ACM) (2018), *Ontwerp marktanalysebesluit toegang tot vaste telecomnetwerken* [Draft market analysis decision on access to fixed telecom networks] (Wholesale Fixed Access).

[63] Parliamentary Papers 24 095, No. 437.

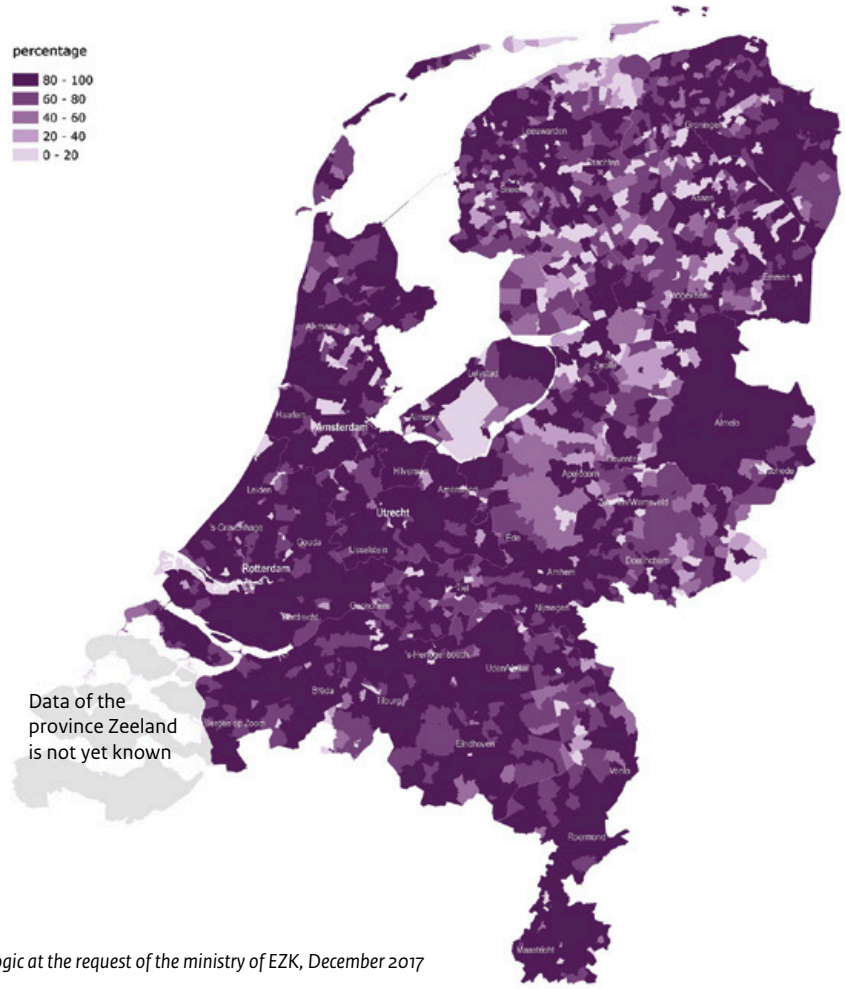
[64] See also recent research by Stratix in this context. This shows that, per capita, investment is highest in the rural areas. This makes it difficult to make economically profitable investments in these areas possible.

[65] KPMG (2018), *Beleidsonderzoek naar financieringsvormen voor snel internet* [Policy research into forms of funding for fast internet].

[66] Parliamentary Paper 24 095, No. 164 & BEREC/RSPG, report on infrastructure and spectrum sharing in mobile/wireless networks.

Available fixed internet speed

Percentage of households that have acces to broadband internet (100Mbit/s)



Source: Dialogic at the request of the ministry of EZK, December 2017

a telecom provider so requests. This makes it possible to efficiently carry out simultaneous work on telecommunications infrastructure when a street is already open, thus minimising the inconvenience to the surrounding area.

Non-profitable investments

Fixed networks

In some cases, investments remain unprofitable, often with good reason. For example, in areas where good fixed connectivity is already available, completely new infrastructure cannot be expected to be built profitably. KPMG describes this as one of the reasons why there is often no investment in a complete new fibre-optic connection in cities.[67] In some rural areas no new fixed connection is built simply because there are too few potential customers to justify the high investment costs for a company and investor. The lack of expected return was also indicated in the consultation as the most important obstacle to the roll-out of fast internet in rural areas.

Currently, 3% of households do not have a fixed connection of 30 Mbps, and 4% lack a connection of 100 Mbps or more.[68] These figures are an improvement on previous ones. Various investments have reduced the number of households without a 30 Mbps connection from 300,000 to 270,000. This is in part due to the Communication Infrastructure Fund (CIF), which in recent years has provided 50,000 households in rural areas with a reliable fixed connection. The map above shows the current

[67] KPMG (2018), *Beleidsonderzoek naar financieringsvormen voor snel internet* [Policy research into forms of funding for fast internet].

[68] These figures come from a study conducted by Dialogic on behalf of the Ministry of Economic Affairs and Climate Policy (EZK) of December 2017.

situation in the Netherlands.[69] It shows (at the postcode level) how particular parts are doing and where the greatest challenges are located (white areas). Connecting these households to a fast, fixed internet connection remains a challenge. Without good connectivity, however, citizens and businesses there will not be able to participate effectively in the digital society.

Local and regional authorities have an important role to play in tackling the remaining white spots. For example, they can facilitate the construction of networks through their local policy (see Chapter 5). Subject to certain conditions, they may also choose to provide financial support for the construction of new networks. Central government has also been forced to take a more active role, as a recent study by the University of Groningen (RUG) has shown.[70] For logical reasons, local and regional authorities often lack the necessary knowledge, for example about the applicable state aid rules or access regulation of the Netherlands Authority for Consumers & Markets (ACM). Residents who want to realise fast connectivity themselves often also lack such knowledge. Moreover, the European state aid rules sometimes offer too little room for achieving the necessary higher speeds in the rural areas. These rules and their lack of clarity were mentioned as important areas of concern in the consultation. Here, central government can play a stronger role.

Mobile networks

In addition to a connection to a fixed location, mobile connectivity can sometimes also be difficult to establish and may prove unprofitable in certain areas. In the Exploration of digital connectivity (*Verkenning digitale connectiviteit*) of December 2016,[71] the government acknowledged that more and more citizens and businesses see mobile communication as a basic need that must be available 'at all times and everywhere'. To achieve this, the draft Memorandum on Mobile Communications (*Nota Mobiele Communicatie*) describes the intention to include a coverage obligation in the 700 MHz licences to be auctioned.[72] Although mobile connectivity is not a full substitute for fixed or wireless[73] broadband connections, in some cases it does represent an improvement on the existing situation and may create new opportunities (economic and otherwise) for businesses and citizens in rural areas. For example, agricultural applications expected in the next five years may initially get off the ground via mobile networks. Further improvements in mobile coverage can also have a positive effect on the quality of life in these regions.[74] The government's ambition is therefore to have one of the best mobile connections in Europe, as mentioned above. During the consultation, the many different parties also responded positively to the intention of imposing a coverage obligation. Opinions were, however, very divided about the way to do so. Among other things, the parties asked for attention to be paid to the fact that the coverage obligation obliges them to invest in locations that are not profitable. In this context, it has been suggested that antenna sites should be made available and financed by the government ('social masts'). Since the parties can deduct such unprofitable investments from their bid for the licences to which the coverage obligation is attached, this is not logical. The government already bears the costs by means of reduced auction revenue. In order to reduce costs, the parties can of course choose to jointly finance and realise the construction of these masts and other necessary (passive) infrastructure at such locations. As regards complying with the coverage obligation, the parties further indicated that municipalities must also assist in the fulfilment of the obligation in other ways, for example, by making municipal buildings available. As indicated above, the policy is aimed at ensuring that, in the exercise of their powers, municipalities also expressly take into account the importance of good mobile coverage.

Actions

Creating the preconditions for the investments needed in the coming years is based on three pillars. First of all, wherever possible, an effectively functioning market in which there is genuine competition must be ensured. Secondly, it is important to lower barriers so that investments can be made that, in principle, can count on market demand. Finally, there will be places in the Netherlands where private investments will be difficult or impossible to facilitate independently and where active government action is needed to achieve high-quality connectivity. The actions arising from each of these pillars are set out below.

Three actions will be taken to ensure that the market functions efficiently and that effective competition is maintained.

1. Review of the regulatory framework: In the context of the negotiations in Brussels, the Netherlands has advocated rules that make it possible for the ACM to realise (permanent) access to local loops (fixed and otherwise),

[69] It is important to note that not all suppliers provided information, which means that the map of Zeeland, for example, is not coloured in.

[70] Salemink and Strijker (2018), *Digitaal Platteland* [Digital Countryside]: White paper on digital access in the Dutch countryside.

[71] Parliamentary Paper 26643, No. 432.

[72] Please refer to the consultation document which can be found at: https://www.internetconsultatie.nl/nota_mobiele_communicatie.

[73] The difference between a mobile and a wireless network as meant here is that wireless networks are dedicated to providing broadband connectivity at fixed locations (often at home or at the office), while mobile networks are intended to provide connectivity for users on the go. For the latter, less guaranteed capacity needs to be provided than for users at a fixed location.

[74] As described in Parliamentary Paper 26643, no. 432.

such as those of KPN and VodafoneZiggo. We have succeeded in including this possibility in the European framework[75] and this possibility will be implemented in Dutch legislation.

2. Memorandum on Mobile Communications:
   The allocation of frequencies for mobile communication to various parties is a task of central government.
   The policy to be pursued in this respect will be laid down in the Memorandum on Mobile Communications (*Nota Mobiele Communicatie*), in order to offer greater investment security in this way. An important precondition in this respect is ensuring sufficient competition.
3. Strategic Memorandum on Broadcasting Distribution:
   The possible risks of exclusive content and the significance of the roll-out of 5G for the distribution of media offerings will be addressed in the Strategic Memorandum on Broadcasting Distribution (*Strategische Nota Omroepdistributie*) to be published in 2018.

Discovering what the demand for connectivity is, is in principle the responsibility of private parties, but the government can, if necessary, act as a facilitator. Two actions are being taken to this end.

1. Digitisation summit: Organising a meeting for both connectivity providers and sectors that are actively integrating connectivity into their business operations or services, as part of the 'Digital Summit' that is being organised in accordance with the Veldman et al. motion.[76] If successful, this can be a recurring meeting within the Digital Summit.[77]
2. Matching supply and demand: At the request of market parties, acting as a facilitator in bringing parties together and, if desired, providing support in articulating the demand for forms of connectivity (see also chapters on radio spectrum and innovation), for example as a result of the aforementioned Digital Summit.

Where private investments are difficult to realise or non-existent, the following actions will be taken to improve connectivity.

- Mapping: This year, a map will be made available on samensnelinternet.nl showing the speed of fixed access networks in the Netherlands. This will be updated annually to allow regular reporting on the state of the Dutch infrastructure. In time, this periodic mapping system will be legally guaranteed once the new regulatory framework has been implemented, and a map of mobile networks will also be developed.
- Broadband Toolkit: Where private investment is not realised, it is important that public authorities have sufficient knowledge to address this issue. To this end, the Ministry of Economic Affairs and Climate Policy (EZK) will make a Broadband Toolkit available. The Toolkit contains the following tools.
  - Renewal of the broadband guide.[78]
  - A model business case for the construction and operation of a network. Incidentally, the problems and the solution chosen may differ from one area to another. A model business case is therefore not intended to standardise the approach, but rather to help (financiers) identify important elements in a plan.
  - A model regulation for support measures by public authorities.
  - A tool for easily mapping the number of addresses in each municipality without fixed, fast internet (based on the above-mentioned mapping).
- State aid umbrella scheme: Work is currently underway, in consultation with the European Commission, to enable aid to be granted in areas where speeds higher than 30 Mbps are available. This will provide local authorities with more tools to improve connectivity in rural areas.
- Joint action plan with municipalities: At the administrative level, the Ministry of Economic Affairs and Climate Policy (EZK), together with the VNG, will consult with the five municipalities[79] with the greatest challenges in terms of fixed connectivity. They will be supported in formulating a municipal action plan which can serve as an example for other municipalities.
- Continuation of the *Samen Snel Internet* (Fast internet together) knowledge platform for government agencies and the website samensnelinternet.nl: Facilitating knowledge exchange and making relevant information available via the platform and said website. The aim is to facilitate public and private initiatives. Good practical examples are exchanged.
- It is being investigated whether there are possibilities for Invest-NL to play a role making rural areas accessible, and if so what these are. As indicated in the Letter to Parliament regarding Invest-NL (Parliamentary Paper (*Kamerstuk*) 28165 No. 281), the conditions for the activities of Invest-NL are commercial principles and a return on equity. In unprofitable areas, the possibilities currently seem to be limited.

[75] Parliamentary Paper 21501-33, nr. 703.

[76] Parliamentary Paper 34775-XIII No. 67.

[77] This action has already been mentioned in the Dutch digitisation strategy, but has a positive effect on connectivity, which is why it has been mentioned here.

[78] Ministry of Economic Affairs, Agriculture and Innovation (2010), *Goed op weg met breedband, handreiking voor gemeentes en provincies* [Making good progress with broadband, a guide for municipalities and provinces].

[79] Initially, a meeting will be held with the municipalities of Staphorst, Baarle-Nassau, Bronckhorst, Alphen-Chaam and Dalfsen.

- To improve access to mobile connectivity, the 700 MHz licences to be auctioned will be subject to the following requirements for parties already holding 800 MHz and/or 900 MHz licences:
  a) Two years after the licence has been granted, they must achieve a geographical coverage of 98% in all municipalities in the Netherlands.[80]
  b) This coverage must guarantee a minimum speed. During the consultation, opinions on this level were so divergent that further research was deemed necessary. Ultimately, the minimum required speed must be ambitious but realistic and lead to a noticeable improvement in mobile network quality in places where it is still poor or absent.

[80] Nature conservation areas are excluded from this, although compliance with this standard will probably also lead to an improvement in coverage in these places.

H7 Continuity

Ensuring the continuity of telecom services is an important precondition for modern digital society. Reliable telecom services make services such as the 112 emergency number possible, but also innovative solutions such as smart grids and remote care. Everyone expects these services to work. In this context, processes are increasingly driven by data and becoming more dependent on complex data chains. New parties, besides the large telecom operators, are becoming increasingly important for continuity. Examples are internet exchanges, cloud service providers and trust services. As more and more devices become connected to the internet, the safety of these devices is playing an increasingly important role in ensuring the end-to-end continuity of data.
The Roadmap *digitaal veilige hard- en software*[81] (Roadmap for digitally secure hardware and software) addresses this. Because of the importance of the continuity of the entire data chain, more parties must be involved in the continuity policy. . Not only is it important to look at the resilience of telecom companies, it's also important to provide important telecom users with options to keep on functioning if a telecom service fails.

Besides the fact that the composition of the parties and the technology change, the risks of failure also change. A positive development is that telecom networks are so interconnected that there are many different ways for data to reach their destination. A new risk is that there are more and more ways to attack the integrity of data traffic by means of cyberattacks or to disrupt data flows digitally in a targeted manner. Another example of new risks that will come into play in the long term are the risks arising from climate change: flood risks are changing, and the risk of extreme weather is increasing.

Finally, on a technical level, partly as a result of the development towards 5G, new technical solutions are emerging that offer additional reliability. These developments create new opportunities for parties requiring specific telecom solutions, while creating chances for innovations such as remote care. As dependency increases, the role of the government is also changing.

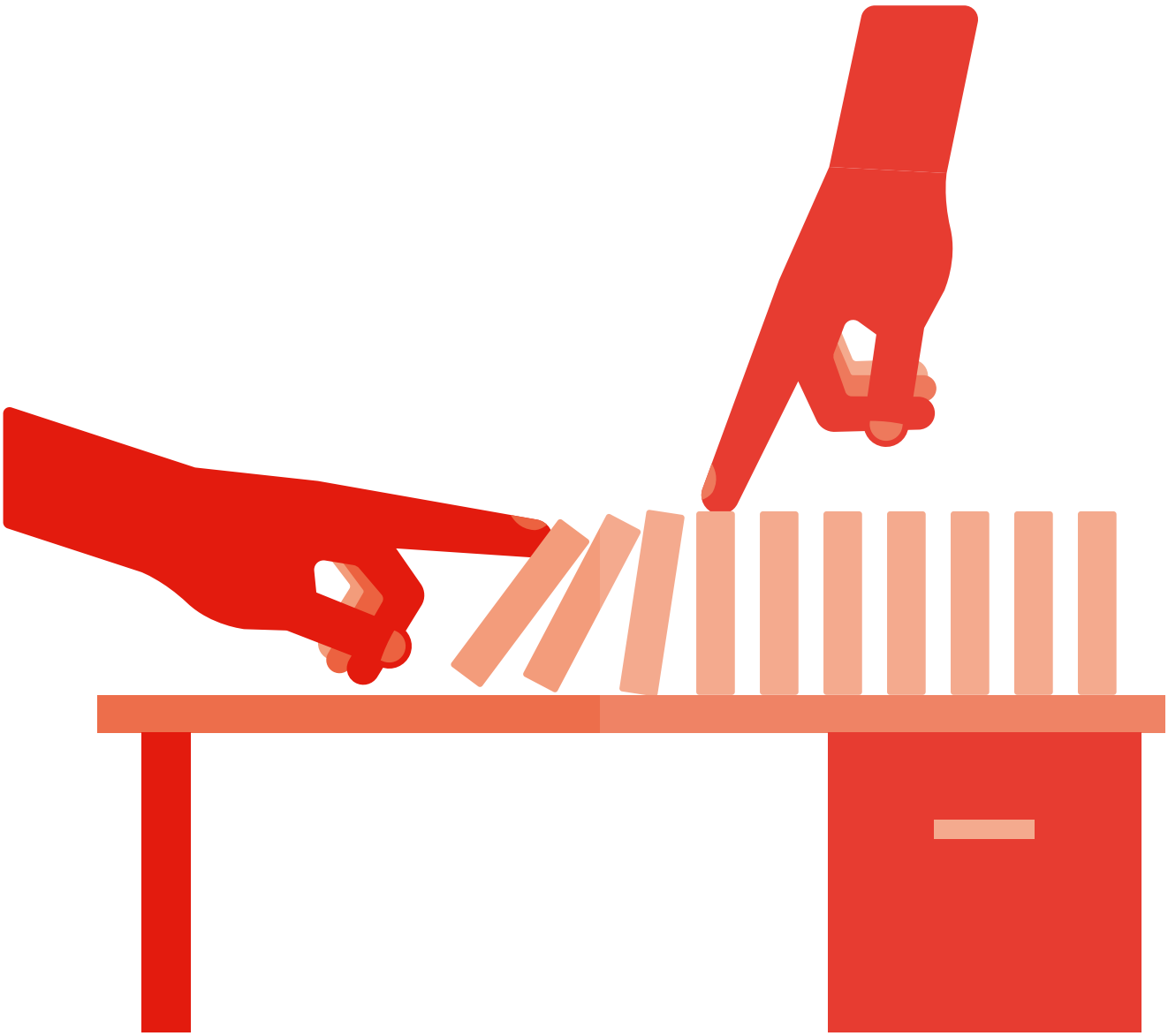
Government responsibilities

Ensuring optimal functioning of the market
Primary responsibility for ensuring continuity lies with the market parties and other parties offering the telecom solutions, and with customers by the particular telecom solution they choose. In making its investment decisions regarding reliability, suppliers will take into account the market advantage this gives them. Customers will weigh up the costs against the reliability of the service. Central government's role is to ensure that there is sufficient competition, that this interplay between supply and demand takes place properly and fairly, and that suppliers and customers are able to find each other in the best possible way.

Establishing frameworks
Society is heavily dependent on telecom services. In this context, the government has adopted a policy framework and standards, such as those in Chapter 11 of the Dutch Telecommunications Act (*Telecommunicatiewet*) for public telecom providers, which are intended to ensure that telecom parties ensure continuity. It is important for the government to continuously asses which standards apply for which parties.

Crisis response
Another role of central government – together with regional authorities and other public and private partners – is to ensure that the impact of major disruptive incidents on society is mitigated. Parts of the telecom sector have been identified as vital, as their failure can have a major impact on society. Society is highly dependent on telecom solutions for regular and emergency communication

[81] Parliamentary Paper 26 643, No. 535.



and process management, both of regular and critical processes. This is only increasing as part of the digitisation process. In this context, the Ministry of Economic Affairs and Climate Policy (EZK), together with the Ministry of Justice and Security (JenV), is in constant dialogue with vital telecom parties to see what can be done to mitigate the impact of major incidents. This can involve measures to prevent incidents (such as establishing frameworks), as well as measures to ensure a good crisis response or a rapid restoration of the telecom services.

User resilience: Customers are telecom dependent. In order to ensure that customers have a framework for action if telecom services fail, the government has set up the *Telekwetsbaarheid Programma* (Tele-vulnerability Programme). This programme aims to make parties aware of their dependence on telecom and to give them advice on how to organise their processes to be prepared for potential telecom failures, with the aim of minimising the social impact of telecom disruptions. Completely preventing failures is not possible, but it is possible to limit the consequences as much as possible in advance and to improve recovery times.

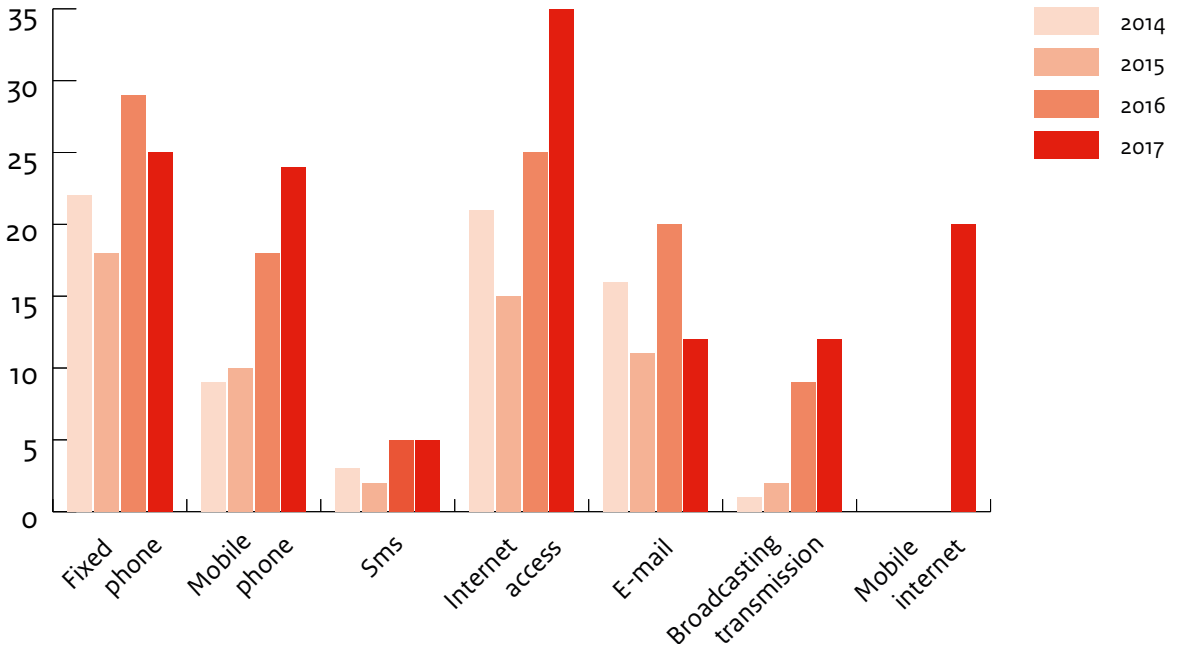
With each of these four roles, effective implementation is only possible in cooperation with market parties, since that is where the primary responsibility for providing reliable telecom solutions lies.

Finally, the government has a role to play in helping to ensure the right preconditions for the digitisation of Dutch society. Digitisation offers many opportunities for innovation and economic growth, but it is also important to safeguard preconditions such as cybersecurity, secure equipment, data integrity and privacy. This is addressed in the Dutch digitisation strategy.

Ambition

In line with the connectivity objective stated in Chapter 3, the ambition for continuity is to ensure high-quality connectivity and reliable connections that are available at all times and everywhere, through the following.

a) *Market forces*: A telecom market that offers sufficient affordable and reliable telecom solutions, now and in the future.
b) *Frameworks*: A clear and appropriate framework to ensure that telecom parties take appropriate measures to ensure the continuity of the telecommunications infrastructure and the integrity of data.
c) *Crisis response and resilience of customers*: Effective mitigation of the impact of disruptive incidents on the telecom sector and limiting the impact of telecom failures on society, partly by ensuring that customers are also prepared for telecom failures.



This graph shows incidents in which telecom providers declared that services where substantially interrupted or where there were large network failures. From 2017 onwards interruption of mobile internet is shown separately. Before 2017, this indicator was part of the group mobile telephone services and/or internet access.

This graph shows an increase in the number of interruptions caused by errors made by third parties (2016, 2017). It is mostly the smaller operators that indicate that the discontinuity of service of other providers is an important reason for failures.

Challenges

The challenges in achieving these objectives are divided into the points listed above.

Market forces

The Netherlands has one of the most reliable telecom systems in the world. There are also sufficient solutions available for parties who need additional reliability. This range of telecom solutions is constantly evolving, as well as new data and telecom solutions and devices that make use of them. The development of 5G is a good example of a telecom solution that can meet the need for additional reliability of certain parties. However, it is important that market forces also remain optimal, allowing customers to maintain reliable telecom services at an affordable price, and that various market solutions are available to parties who make additional demands on reliability. A properly functioning market is essential, and it is important that the demand side organises itself well and articulates the right demand. The government can also play an important role in this. This is discussed in detail in Chapter 6 Investments and Chapter 4 Radio Spectrum.

Establishing frameworks

It is important to have a clear set of standards to ensure that telecom parties take the right measures to ensure data continuity and integrity. A great deal of this has already been regulated. For example, the Dutch Telecommunications Act (*Telecommunicatiewet*) contains requirements (Chapter 11) to ensure that public telecom providers ensure the continuity of the telecom services they offer. This duty of care will be extended to other relevant telecom parties as a result of the EU Network and Information Security Directive (NIS Directive). There are also other instruments that contribute to the continuity of several sectors, including telecom services. A good example of this is the section of the Aboveground and Underground Network Information Exchange Act (WIBON: *Wet Informatie-uitwisseling boven- en ondergrondse netwerken*) that aims to ensure that excavation damage is prevented. Another example concerns the measures taken by the government to make the Netherlands cyber secure. In addition, the Roadmap digitaal veilige hard- en software (Roadmap for digitally secure hardware and software) was published in this context, which includes specific measures to ensure that this part of the broader data chain is also secure. Consider, for example, cyber-secure CE marking for devices.

The various frameworks can be fleshed out in consultation between supervisory authorities and the telecom parties. The challenge is to develop an effective framework that adapts to the rapid developments in the telecom market. This framework should provide the right incentives for different types of telecom parties.

Crisis response

Ensuring that the Netherlands is prepared for specific threats such as terrorist attacks, cyberattacks or power cuts is the responsibility of the interdepartmental National Security Programme (*Programma Nationale Veiligheid*).[82]

[82] https://www.nctv.nl/organisatie/nationale_veiligheid/strategie_nationale_veiligheid/index.aspx.

Under this programme, various sub-projects are being carried out in which, together with various departments, Safety and Security Regions (*Veiligheidsregio's*) and vital parties, it will be looked at what can be done to mitigate the impact of major risks. This involves measures to ensure that vital services are prepared for major disruptive incidents, but there is also an extensive interdepartmental and inter-regional crisis structure to ensure a good response to major incidents. It is important to continue to ensure, together with all crisis partners, an adequate response to disruptive incidents. This means maintaining an effective network of public and private crisis partners and having the right measures in place to mitigate risks. It must be clear who bears what responsibilities in the event of a crisis.

Resilience of customers

In recent years, the Netherlands Radiocommunications Agency has conducted a number of pilot projects with parties from various sectors through the Tele-vulnerability Programme (*Telekwetsbaarheid Programma*). These pilots have identified best practices and a model to help other parties with risks they may be subject to relating to the failure of communication technology (i.e. tele-vulnerabilities). As a follow-up to the current Tele-vulnerability Programme, it is important to develop an effective approach that supports sector associations and users in addressing their tele-vulnerabilities without the responsibility of users being taken over or that the government undertakes activities in this context that are also taken up by market parties.

Actions

In this chapter, the continuity policy is defined by looking at four roles that the government plays in this respect (market forces, establishing frameworks, crisis response and customer resilience). In addition, there are various strategic documents that include actions that each contribute to continuity, such as the recently published Dutch Cyber Security Agenda and the 'Roadmap for digitally secure hardware and software' (*Roadmap digitaal veilige hard- en software*). This was not discussed in detail because these points were described in other Parliamentary Papers. A Bill on the prevention of undesirable control over the telecom infrastructure (*Wetsvoorstel voorkoming ongewenste zeggenschap telecommunicatie*)[83] was also recently announced. The purpose of this Act is to mitigate the risks resulting from undesirable takeovers in the Dutch telecom sector. This bill gives the government the power to assess takeovers of important Dutch telecom companies in terms of national security and public order.

The following specific action points emerge from the points mentioned in this chapter. These are points that have been endorsed by the parties in the consultation round.

Legal framework and duty of care: The current frameworks for continuity will be further developed and expanded as a result of the implementation of the EU Network and Information Security Directive (NIS Directive). In this context, attention will also be paid to facilitating a constructive dialogue between regulators and the telecom parties. This dialogue will also look at how the Ministry of Economic Affairs and Climate Policy (EZK) can implement the current framework. One possibility is to define KPIs for specific services, parties or risks. An example of this is the Social Cost-Benefit Analysis (MKBA: *maatschappelijke kosten-batenanalyse*), which is now being carried out to see what can be asked of the large public telecom providers to keep the 112 emergency number active in the event of a power failure.

Crisis response: There is a good crisis structure, which is practised with on a regular basis. This structure will be further developed, and new threats will be taken into account. We will also be looking at new threats from the cyber domain and at whether new parties should join in.

Customer/user resilience: In recent years, the Netherlands Radiocommunications Agency has implemented the Tele-vulnerability Programme (*Telekwetsbaarheid Programma*). This has provided good insights and instruments. This programme is due to end this year. Based on an evaluation, we will look at how effectively and efficiently this programme can be followed up. Components that are likely to be part of this follow-up are the sharing of best practices by sector and umbrella organisations and the further application of the step-by-step plan developed by the Netherlands Radio-communications Agency by various sectors to map out vulnerabilities.

[83] Parliamentary Paper 32 637, No. 311.

H8 Innovation

This final chapter looks further into the future. Digitisation leads to new applications in all kinds of domains. For example, work is being done on connected and autonomous driving, e-health and augmented reality, whether or not in testbeds, living labs and smart cities. These require high-quality connectivity, which often has to meet specific conditions. For example, the connected car requires very reliable and fast-responding networks (with very low latency), while in virtual reality the bandwidth is very important.

Innovations in the various sectors and domains will only get take place if the market can also provide the required connectivity. Current networks have a lot to offer and, in addition, network technologies are developing rapidly. This was indicated in particular by various parties in the consultation. Many parties have high expectations of 5G and see a role for the government in this. For example, with regard to the distribution of frequencies and facilitating the roll-out (e.g. with regard to local policy). The European Commission has also proposed targets for the availability of 5G[84] and sees cities as pioneers in this. The Dutch House of Representatives has underlined this by means of the *5G steden* (5G cities) motion. It calls on the government to stimulate and support potential 5G cities so that by 2020 there will be one or more Dutch 5G cities.[85] To implement this motion, discussions have taken place between the Ministry of Economic Affairs and Climate Policy (EZK), municipalities and provinces about the need for 5G networks and applications, about experimentation that is already taking place or is planned, and what is needed for this. This showed that various initiatives and experiments with (5G) connectivity are ongoing or being considered, including the following:

- In the 5Groningen Living Lab, 5G applications are being tested to tackle region-specific societal challenges. These concern pilot projects with precision agriculture, remote care, autonomous transport, smart energy networks and smart industry.
- Amsterdam announced a 5G pilot project around the Johan Cruijff ArenA during the 2020 UEFA European Football Championships with applications in the areas of public order and safety, smart mobility, virtual and augmented reality, and 5G in the stadium.
- In Scheveningen,[86] Eindhoven[87] and Utrecht, there are public–private projects with smart streetlamps that can also provide 4G/5G connectivity and Rotterdam is looking at connectivity issues from the perspective of smart city policy.
- Amersfoort and Hilversum are developing a Smart City Platform to make the city more liveable, sustainable, safe, mobile and informative.[88] An example of this is the measurement of noise levels with sensors, which may also involve 5G in the future.
- Enschede wants to use 5G for innovative drone development (at Twente airport) and Venlo sees logistics as the main use case.

Innovation activities are being developed not only at local and regional level, but also at national (often sectoral or domain-specific) level around the arrival of 5G, such as the following.

- In the 'Talking Traffic' programme, the Ministry of Infrastructure and Water Management (IenW) is working together with regions and private parties on a better data chain (including better connectivity) for smart mobility.

[84] See Communication 'Towards a European Gigabit Society', COM(2016)587, and Communication '5G for Europe: an Action Plan', COM(2016)588.

[85] Motion by Paternotte et al., Dutch House of Representatives, Session year 2017–2018, 21 501-33, No. 676

[86] Living Lab Scheveningen: https://futureproofthehague.com/projects/living-lab-scheveningen.

[87] Roadmap *Stedelijke Verlichting* Eindhoven 2030 [Roadmap for Urban Lighting Eindhoven 2030].

[88] Market consultation document Smart City Platform, Municipality of Amersfoort and Hilversum, 2017.

- The Netherlands Organization for Applied Scientific Research (TNO) and the three technical universities are carrying out research into various technologies and sub-technologies, which are financed by STW (through the 'Advanced 5G solutions' Partnership programme).
- In 2018, KPN will start four 5G field labs for applications in urban areas, agriculture, transport & logistics and the automotive sector.
- At the European level, various tests are being prepared within the *5G Infrastructure Public Private Partnership*[89] *(5G-PPP)*.
- Various educational and research institutions (including the technical universities) in the Netherlands are working hard on the development of new 5G technologies, such as new antenna, chip and sensor technology.

In many cases, this involves public–private partnership aimed at applications. More than ever before, such close cooperation between companies (telecom and otherwise), end users and researchers is necessary for innovation. The role of central government is primarily to create the right preconditions for experiments and their upscaling. The preconditions for commercial roll-out of networks are also important (see the previous chapters for this). Local and regional authorities are playing an increasing role, because the actual roll-out and construction of digital infrastructure is being formed subject to local conditions and because various municipalities and regions are stimulating innovation and/or digitisation, for example in the area of smart cities.

Ambition

The range of connectivity services and products in the Netherlands must develop in such a way that it enables innovations in social domains and economic sectors, so that the Dutch economy and society can benefit fully from digitisation. Users are placing more and more specific and challenging demands on connectivity and the challenge for market parties is to respond with their products to the increasing diversification of connectivity demand. For this it is important that market parties and other parties from both the supply and demand sides collaborate and experiment with new forms of connectivity. It is up to central government to ensure that the preconditions for this are in order, so that 5G applications become available in the Netherlands.[90]

Challenges

Innovation through cooperation and knowledge building

Connectivity takes shape in an interplay between telecom companies, IT and internet companies and end users. Various initiatives are already emerging in the Netherlands. However, many market parties and other parties find innovation through cooperation new and challenging. On the one hand, telecom parties are looking for future revenue models that legitimise investments in 5G, for example, while on the other hand, sectors are struggling to identify the benefits of new network technologies and what demands their use cases make on the infrastructure. Stakeholders stress the importance of sectoral or regional partnerships that focus on socially relevant 5G applications, where experience is gained in concrete experiments and pilot projects and it becomes clear what works and what does not work in practice. The challenge is to scale it up to a size that results in an interesting revenue model. For the Netherlands, it is desirable to experiment with (5G) connectivity in both urban and rural areas and to carry out pilot projects in social sectors, in particular mobility, agriculture, care and public order and safety.

Experiences must also be exchanged between the various projects (see the introduction to this chapter). Stakeholders stress the importance of allowing different initiatives to learn from each other. The government can speed up this learning process by bringing together (regional and sectoral) initiatives. Various municipalities indicated the need to share knowledge among themselves so as not to reinvent the wheel. Knowledge and best practices must be shared, also with interested municipalities and sectors which are even less advanced. This could concern technical challenges, experiences with rolling out 5G, useful applications and new business models.

Funding of experiments and pilot projects

As indicated above, the many different new pilot projects and field labs should learn from each other. However, these initiatives also require significant investments which cannot always be fully borne by market parties and in particular by innovative small and medium-sized enterprises (SMEs). Therefore the government intervenes in various ways to ensure that initiatives that are socially desirable get off the ground. There are various sources of local, regional and national funding, for instance. There is, for example, generic innovation policy, including with regard to field labs.[91] In addition, various government authorities provide funding aimed at projects that address societal challenges.

[89] See https://5g-ppp.eu/projects and https://5g-ppp.eu/wp-content/uploads/2017/05/5GInfraPPP_TrialsWG_Roadmap_Version2.0.pdf.

[90] This gives substance to the motion by Paternotte et al.

[91] See e.g.: https://www.rvo.nl/subsidies-regelingen/smart-industry-fieldlabs.

Specific smart city pilots are being organised in a number of municipalities, for example, and there are also mobility and e-health tests. Furthermore, innovation competitions take place in a European context, for instance via the European Horizon 2020 innovation programme, in which subsidies are available for large-scale 5G pilots. However, parties indicate that this type of European project involves a complex application process, and central government can offer support in this respect, as well as, for example, the VNG.

Availability of frequencies

In anticipation of the issue of frequencies for mobile communications, the frequencies that will become nationally available at a later date should preferably be tested. To this end, the government is allowing parties to use frequencies temporarily for experiments. Interested parties can apply to the Netherlands Radiocommunications Agency for an experimentation licence if their experiment does not cause interference to other frequency users, or if the use or shared use can be coordinated. For example, experimentation frequency range can be requested in the 700 MHz, 3.5 GHz (under the Amsterdam-Zwolle line) and 26 GHz bands, which are important for 5G.

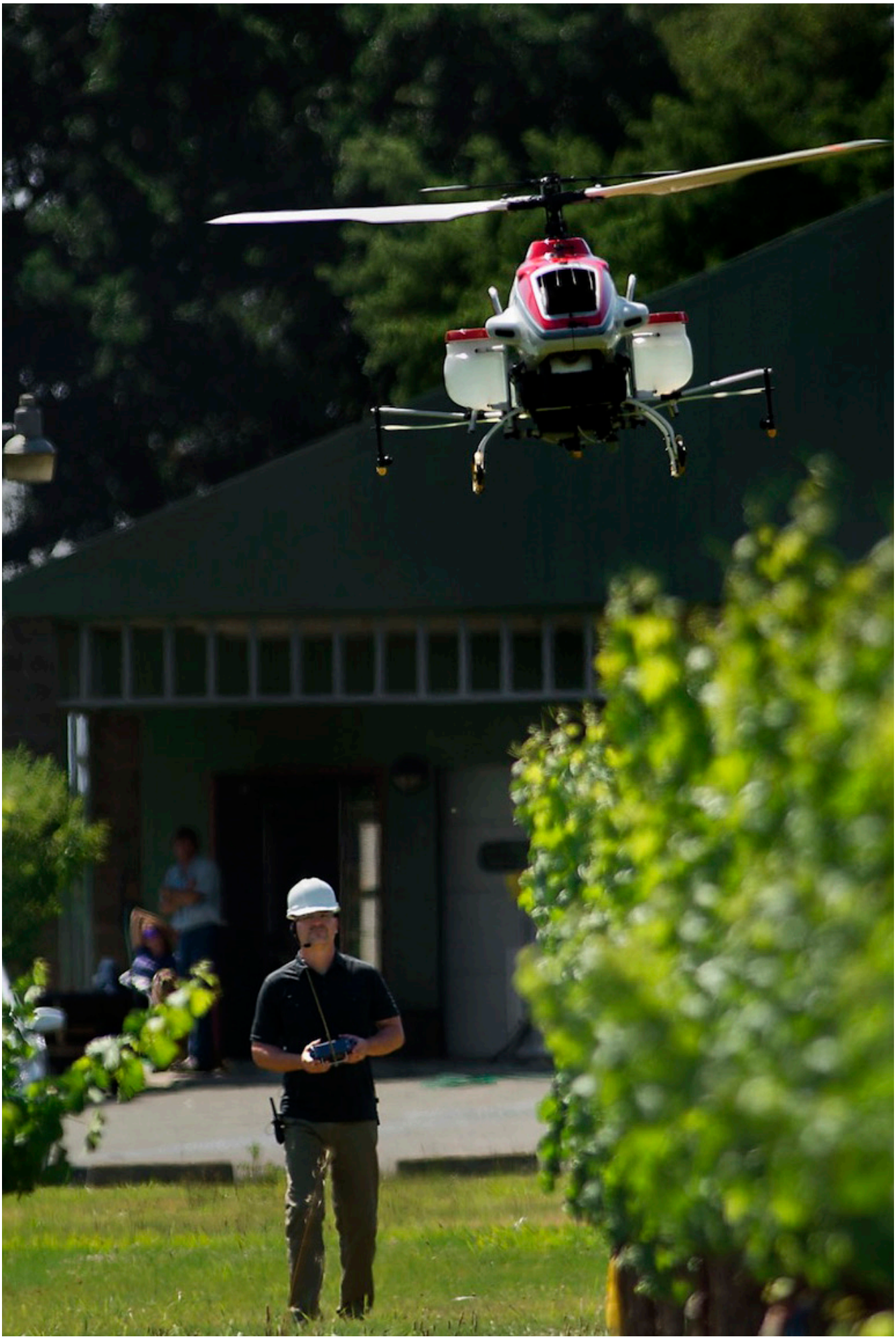
Other preconditions

In the consultation, stakeholders stressed that when developing new applications, they also encounter obstacles other than connectivity, such as data standards, the safeguarding of privacy, cybersecurity and uncertainty about net neutrality. As indicated in Chapter 1, these aspects will be addressed in other policy processes.

Actions

Central government facilitates innovation through cooperation through the following actions.

- The Ministry of Economic Affairs and Climate Policy EZK will establish a 5G innovation network, linking sectoral and local 5G initiatives, aiming to inspire and to facilitate knowledge exchange. To this end, the Ministry of Economic Affairs and Climate Policy (EZK) will organise a first meeting with the Association of Netherlands Municipalities (VNG) in the second half of 2018.
- Together with the ministries concerned, the Ministry of EZK will consider the future need for connectivity in social sectors such as mobility (Intelligent Transport Systems) and Public Order and Safety and consider whether and to what extent it can promote experiments and pilot projects. The Ministry of EZK will also remain in discussion with local authorities to facilitate initiatives where possible.
- Together with various Dutch knowledge institutes (including universities, the technical universities, the Netherlands Organization for Applied Scientific Research (TNO) and major research institutes), the Netherlands Radiocommunications Agency will investigate whether a joint Digital Connectivity Research Agenda for 5G can be established. The aim is to combine research efforts and knowledge in the Netherlands, and implement this with regard to existing and new social use cases.
- The Netherlands Enterprise Agency (RVO: *Rijksdienst voor Ondernemend Nederland*) and the Ministry of EZK will inform parties about how they can connect to future European pilot projects using the funding from the Horizon 2020 programme and will provide support where appropriate.
- The Netherlands Radiocommunications Agency and the Ministry of EZK are investigating the further application of dynamic issuing and allocation of frequencies. Where desired (and possible), the Ministry of EZK and the Netherlands Radiocommunications Agency will support specific experiments and pilot projects, for example with technical frequency-related knowledge or by making experimentation licences available.



H9 Conclusion

As mentioned above, digitisation requires excellent digital connectivity. The Netherlands is currently well equipped, but in order to maintain this position, sufficient investments must be made. To achieve this, the preconditions created by the government must be in place. This Action Plan outlines the government's efforts to remain the European digital leader with the aim of providing high-quality connectivity that can serve a wide range of demands and is available at competitive prices anytime and everywhere.

The various chapters indicate for each subject what the government's ambition is for each theme and how the government is committed to achieving this. However, central government cannot achieve this on its own, and we must work together with market parties and other government authorities to achieve this. Thankfully, therefore, the input from all parties was used to shape this plan. It will also be necessary and desirable to tackle this task together in the development of the actions referred to above.

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