Authority for Consumers & Markets

Public

Paper

5G and the Netherlands Authority for Consumers and Markets

December 12, 2018

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ACM/UIT/502033

Executive Summary

By publishing this paper, the Netherlands Authority for Consumers and Markets (ACM) seeks to explain its position on several subjects where 5G overlaps with the duties of ACM. Clarifying the rules will help boost innovation so that consumers and the market are better able to benefit from 5G. The development of 5G is still in its early stages, which means that market participants will need to make design choices regarding their 5G-networks in the development process. That may lead to situations where market participants will face dilemmas concerning the 5G-network design, and regulatory rules and boundaries. That is why ACM invites relevant market participants to engage in a dialog with ACM about their concerns with 5G and its implications for the market, consumers, and regulators.

This paper discusses the following subjects:

- Competition: 5G could lead to new forms of connectivity, which will have consequences for the division of roles among market participants. In addition, new competitors and markets may arise. Through its enforcement of competition law, ACM safeguards fair competition. Several factors have been formulated in competition law, which can have as effect that R&D agreements do not restrict competition or only do so to a limited degree.
- Mobile infrastructure sharing: Mobile infrastructure sharing can be a way for mobile operators to save costs or to accelerate the network rollout. These benefits of mobile infrastructure sharing are also mentioned in the European Electronic Communications Code. One drawback is that innovation and competition between mobile operators may be restricted. Parties that wish to enter into an infrastructure-sharing agreement must carry out a self-assessment to evaluate whether the agreement is in line with competition law.
- Net neutrality: 5G encompasses different technologies that enhance the possibilities for service differentiation on the network, such as network slicing, 5QI and Mobile Edge Computing. In the telecom sector, this has led to questions about how these technologies relate to the European Open Internet Regulation. According to this Regulation, all traffic within the network, in principle, must be treated equally in technical terms. At this point, ACM believes that the Open Internet Regulation leaves much room for the implementation of 5G-technologies such as network slicing, 5QI and Mobile Edge Computing.
- Spectrum: One important factor in the development of 5G in the Netherlands is making available the frequency bands that, within Europe, are used for 5G for the first time ever. ACM sees the allocation of the spectrum bands as an important policy instrument, with which influence can be exerted over the competitive process in the market. In its role as telecom regulator, ACM will, over the next few years, continue to play an advisory role in the allocation of new and existing frequency bands. In that context, ACM believes it is important that effective competition in the market is safeguarded.
- Number issuance: In accordance with the numbering plans of the Netherlands Ministry of Economic Affairs and Climate Policy, ACM issues numbers, and has oversight of the use of those numbers. The advent of 5G could lead to an increase in the demand of mobile numbers (06-series), numbers for automated applications (097-series) and mobile network codes (MNCs). ACM tests each application against the purpose in the numbering plan, and assists the legislature in the assessment of the desirability and possibility of adjustments to the numbering plans.
- Consumers: 5G can also have consequences for consumers. The selection of available mobile subscriptions may become more complicated if 5G-services become part of subscriptions. ACM finds it important to facilitate a smooth transition to 5G, and will do so through the usual channels such as ACM's consumer information portal ConsuWijzer.

5G and the Netherlands Authority for Consumers and Markets

5G is the new generation of mobile technology, succeeding the previous generation of 4G. 5G is currently still in the developmental phase, and may become operational in 2020. With 5G, mobile-network capacity is increased even further in order to continue to be able to meet the ever growing demand for mobile data. In addition, 5G offers support for the Internet-of-Things and for new applications in, for example, the car industry, health care, and media and entertainment.

The Netherlands Authority for Consumers and Markets (ACM) makes sure that companies compete fairly, and protects consumer interests. 5G can affect these duties. That is why ACM studies what technical innovations 5G will bring, what new business models may arise, and what 5G will mean for consumers.

Over the past year, ACM has held several discussions about 5G with market participants such as mobile operators and telecom hardware suppliers. Furthermore, ACM was involved in several recent studies into 5G. The Body of European Regulators for Electronic Communications (BEREC) had a study carried out into the implications of 5G on future business models.[1] Independent research firm TNO studied the relationship between 5G and net neutrality.[2] Commissioned by the Netherlands Ministry of Economic Affairs and Climate Policy (the Ministry), research firm Stratix carried out a study into the roll-out costs of 5G.[3] Using the results of the discussions and the studies, ACM can determine how 5G will affect its duties.

With this paper, ACM wishes to explain its opinion of several topics where 5G overlaps with ACM's regulatory duties. As such, ACM follows the Connectivity Action Plan, which was published in July 2018 by the Ministry.[4] First, the development of 5G is briefly explained, followed by a discussion of several topics where 5G overlaps with ACM's duties.

For ACM, it is important that 5G-related innovations are supported, and that consumers are able to benefit from 5G. That is why ACM would like to start a dialog with all parties involved about the implications of 5G for the market, consumers, and regulators. We therefore welcome all comments to this paper.

1 The development of 5G

5G is aimed at further enhancing the capabilities of mobile networks. Three priorities can be distinguished[5]:

- Enhanced Mobile Broadband: increasing the user data rate and the capacity of mobile networks in order to be able to accommodate future growth in data traffic;
- Massive Machine Type Communications: increasing the number of devices that can be connected in a given area in order to make the growth of the Internet-of-Things possible;

[1] DotEcon Ltd and Axon Partners Group, 'Study on Implications of 5G Deployment on Future Business Models', No BEREC/2017/02/NP3, 8 March 2018.

[2] TNO, '5G and Net Neutrality – a functional analysis to feed the policy discussion', April 2018.

[3] Stratix, 'Cost elements in the roll-out of 5G networks in the Netherlands', April 2018.

[4] Ministry of Economic Affairs and Climate Policy (EZK), *Connectivity Action Plan*, July 2018. This Action Plan outlines the Dutch 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 anywhere.

[5] ITU Recommendation ITU-R M.2083-0, "IMT Vision – Framework and overall objectives of the future development of IMT for 2020 and beyond", September 2015.

- Ultra-reliable and low-latency communications: improving reliability and reducing latency in order to make new services possible, for example in the car industry, energy sector, and public safety.

These three priorities have been represented in Figure 1, which also includes several applications. Depending on the nature of the application, each of these application areas is closely related or less closely related to one of said priorities.

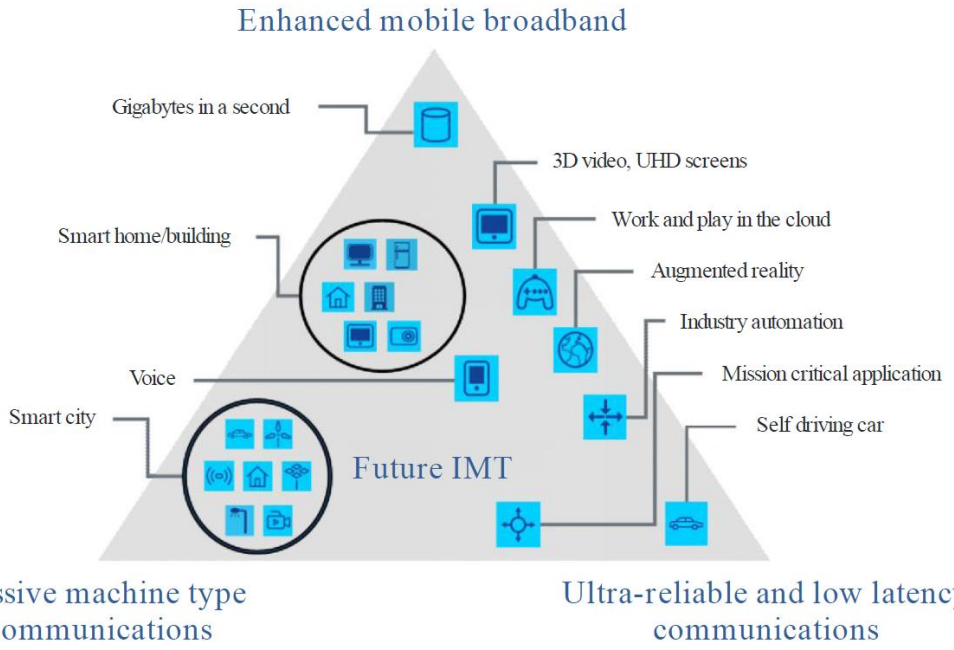

Figure 1: Priorities in 5G. (IMT stands for International Mobile Telecommunications)[5].

The International Telecommunications Union (ITU) has defined several criteria that 5G must meet so that the envisaged 5G-based applications can be realized. For example, the user-experienced data rate must be at least 100 Mb/s, and latency must be reduced to 1 ms. In addition, up to 1 million connected devices per km^2 must be supported. These criteria form the basis for 5G standardization that the international collaborative forum Third-Generation Partnership Project (3GPP) is working on.

In order to meet the criteria for 5G, different technologies are used that further enhance mobile-network capacity and quality. Some of these technologies are:

- Network slicing: this is the software-based partitioning of the network into virtual subnetworks. Each subnetwork (called "slice") can be tailored to the specific requirements of the application that is served by the slice. Mobile operators see network slicing as a way to serve so-called "verticals": application areas with specific requirements such as health care, self-driving cars or the energy sector.
- Massive MIMO: this is a development in antenna technology. MIMO stands for Multiple Input Multiple Output, which is a reference to the fact that, with a MIMO antenna, traffic can be delivered using multiple parallel data streams on the same antenna. MIMO technology is already used in 3G and 4G networks, but *Massive* MIMO is a new technology, which can significantly increase the number of parallel data streams. Using Massive MIMO antennas leads to a substantial increase in the amount of data traffic that a tower can handle.

- SDN/NFV: the terms Software-Defined Networking (SDN) and Network Function Virtualization (NFV) are often used together. The combination refers to technologies that, when designing a network, allow the use of multi-functional hardware that can be deployed and adjusted in a flexible manner. The combination SDN/NFV is considered a key building block for 5G, because it offers the opportunity to adjust the network's functionality in a very flexible manner, and to deploy capacity where needed. The abovementioned technology of network slicing can be seen as an application of SDN/NFV.
- Mobile Edge Computing: The term Mobile Edge Computing (MEC) refers to a network architecture where computing capabilities and/or data storage are set up at the 'edge' of the mobile network. The idea behind MEC is that, by running certain applications closer to the end-user, the user experience of those applications will improve, and network congestion is reduced. This principle is comparable to that of Content Delivery Networks (CDNs), which are used, for example, by Netflix to store 'content' (films and series) worldwide on many servers close to the end-user.
- New Radio: this is the new "radio interface" in 5G, which describes the way in which information over the wireless connection is transmitted. Apart from the Massive MIMO antenna technology, New Radio (NR) should be considered an evolution of the 4G radio interface, rather than a revolution with entirely new concepts. One key aspect of NR is its flexibility, which, on the one hand, makes it possible to deliver high data rates and low latency, but, on the other hand, also offers coverage in an energy-saving manner for sensors with limited battery life.

In addition to the use of new technologies, 5G will also be characterized by the use of additional frequency spectrum and by network densification, particularly in densely-populated areas. The additional frequency spectrum can primarily be found in the higher frequencies where more bandwidth is available. In Europe, 5G will be introduced first in the 700 MHz, 3.5 GHz and 26 GHz frequency bands. In the Netherlands, the Ministry is responsible for issuing the frequency bands. This is extensively discussed in the "Connectivity Action Plan".[4] Network densification can occur as a result of using "small cells": small antenna sites, for example, bus stops or lampposts in downtown areas or near shopping areas. Fiber-optic or a fixed radio connection is used for connecting these antenna sites to the rest of the network.

At this point, a first version of the 5G standard has become available. A final version is expected to be released in 2019. 5G devices are likely to follow soon after that. The exact timing of the introduction of 5G will primarily be determined by the availability of spectrum and the willingness of operators to invest in 5G. In the Netherlands, 5G could become available in 2020. T-Mobile, for example, has promised to offer nationwide 5G-coverage in 2020.[6]

The roll-out of 5G fits with the ambition expressed in the Connectivity Action Plan to realize diverse and high-quality mobile connectivity. The EU has also called for a smooth roll-out of 5G. In the EU 5G Action Plan[7], various objectives with regard to this point have been formulated. For example, each EU Member State would have to have at least one city in 2020 where 5G would be available, and all urban and major transport routes would have to have 5G by 2025.

[6] https://www.t-mobile.nl/beloftes.

[7] European Commission, "5G for Europe, An Action Plan", September 2016.

2 5G and ACM

This section covers a number of topics where 5G overlaps with ACM's duties.

2.1 Competition

The advent of 5G has consequences for the division of roles among market participants. In addition, new competitors and markets may arise. This can have implications for competition. Below, we will discuss the relationship between several 5G developments and competition law.

2.1.1 5G and competition in the mobile market

After the merger of T-Mobile and Tele2[8], there will be three operators each with their own mobile networks (MNOs[9]) in the Dutch market: KPN, VodafoneZiggo, and T-Mobile. 5G requires substantial investments in, for example, new antenna technology, network visualization, data storage capacity, and further converting the network to fiber-optic. In addition, 5G provides the opportunity to offer new forms of connectivity. Operators could specialize in offering a specific form of connectivity, for example, connectivity for self-driving cars. It is thus conceivable that, for example in the early stages of the roll-out, specific types of connectivity are only supported by a limited number of 5G-networks.

For ACM, it is important to keep track of the implications 5G has on competition in the mobile market. ACM acknowledges the importance of innovation. If an operator develops an innovative connectivity service, it may gain a stronger market position. When enforcing competition law, ACM's aim is that such market dynamics are not distorted. That is why innovation is taken into consideration as factor when conducting competition-law assessments.

If ACM sees the need to analyze the effects of 5G on competition, such an analysis will then be based on a definition of the relevant market. 5G can have implications for such a market definition. So far, the European Commission has considered the national market for offering retail mobile-telecommunications services to end-users (hereafter: the mobile market) as the relevant market, regardless of network technology (2G, 3G or 4G).[10]

Considering the technical specifications of 5G, ACM currently does not expect the differences between 5G and 4G to be so large that 5G mobile internet access services will belong to a different relevant market than that for 4G mobile internet access services. As described in Section 1, however, 5G could also lead to new forms of connectivity. Think of specific connectivity for "verticals", such as the car industry, the energy sector, and public safety. Whether the new forms of connectivity belong to a different relevant market depends on: 1) the extent to which end-users perceive a difference between the new forms of connectivity and the mobile internet access services, and 2) the ease with which a provider is also able to offer new forms of connectivity next to mobile internet access services.

5G can have effects on the value chain of mobile services. First, the division of roles among mobile market participants may change. Operators could, for example, 'outsource' the programming of a slice to a third party. One way of doing so is granting that third party access to an open programming interface (Open API, Application Programming Interface).[11] Second, new competitors and markets could arise. It is, for example, conceivable that market participants in the verticals will acquire

[8] http://europa.eu/rapid/press-release_IP-18-6588_en.htm.

[9] MNO stands for Mobile Network Operator, a service provider that has its own mobile network.

[10] See, for example, decision of the Commission of 2 July 2014 in Case No COMP/M.7018 – Telefonica Deutschland/E-Plus, paragraphs 45-50.

[11] Wolter Lemstra, "Leadership with 5G in Europe: Two contrasting images of the future, with policy and regulatory implications", Telecommunications Policy 42 (2018) 587-611.

spectrum. This could lead to additional competitive pressure on MNOs. Furthermore, new third parties could start acting as intermediaries in the value chain in order to facilitate the integration of mobile services between, for example, the operators and the verticals. There are also specialized third parties that acquire spectrum themselves in order to offer specific connectivity services to verticals. ACM will make sure that the incumbents and the possible new entrants compete fairly with each other. That is why ACM will keep a close watch on these developments and their potential anticompetitive risks.

2.1.2 5G and cooperation in the mobile market

The necessary investments in 5G also increasingly lead to the public desire to share among competitors, for example, locations, towers, antennas, or cabinets for equipment. In the discussions with market participants, it turned out that operators are more and more exploring the possibilities of sharing infrastructure.

Infrastructure-sharing agreements can lead to cost savings. At the same time, sharing infrastructure may have anticompetitive effects as competition between operators on the mobile market is restricted. The section below further explores the sharing of infrastructure.

In the build-up to the commercial roll-out of 5G, various innovation projects have been launched. One such example in the Netherlands is the 5G field trial *5Groningen* in the northern Dutch province of Groningen.[12] In this 5G field trial, 5G technologies are applied in agriculture, health care, energy, transport & logistics, and the environment. Market participants may have the desire to collaborate with other partners in the consortium within the context of *5Groningen*, for example when developing 'use cases'. ACM acknowledges the importance of cooperation within R&D for promoting innovation in the mobile market. That is why the innovation-stimulating effects of R&D collaborations are taken into account in competition-law assessments. In addition, group exemptions for R&D cooperation also exist. Considering the current market shares of MNOs, however, an R&D collaboration between MNOs will not meet the criteria for group exemptions anytime soon.[13] However, that does not mean R&D collaborations are prohibited.

Under competition law, agreements that restrict competition can be exempted if they meet certain cumulative criteria.[14] The following, among other factors, may be contributing factors to R&D agreements not restricting competition or restricting competition to a lesser extent[15], for example within the context of *5Groningen*:

- The R&D collaboration does not include the joint commercial exploitation of the potential results of R&D, for example, in the shape of joint production, marketing, or the granting of technology licenses.
- In the R&D project, the operators bring together complementary skills, technologies, and other resources.
- Other operators have sufficient and 'credible' R&D activities.

[12] http://www.5groningen.nl.

[13] The group exemption for certain R&D arrangements applies to undertakings with a combined market share of less than 25%. See Regulation (EU) No. 1217/2010.

[14] See Section 6, paragraph 3, of the Dutch Competition Act. These cumulative criteria are: 1) the restrictions lead to the improvement of production or distribution, or to the promotion of technical or economic progress, 2) users get a fair share of the resulting benefits, 3) the restrictions must be indispensable in the attainment of these objectives, and 4) the restrictions cannot eliminate competition in respect of a substantial part of the products and services in question.

[15] See Guidelines on the applicability of Article 101 of the Treaty on the Functioning of the European Union to horizontal co-operation agreements.

- The R&D collaboration does not result in the exchange of strategic information such as investment plans of operators.

The mobile market is a market that is characterized by a relatively limited number of competitors, and relatively high barriers to entry. These are factors that are critical in competition-law assessments of R&D agreements.[15]

5G could lead to new forms of connectivity, which will have consequences for the division of roles among market participants. In addition, new competitors and markets may arise. Through its enforcement of competition law, ACM safeguards fair competition. Several factors have been formulated in competition law, which can have as effect that R&D agreements do not restrict competition or only do so to a limited degree. Market participants have their own responsibility when it comes to assessing whether or not their collaborations comply with competition law. ACM would like to engage in a dialog with market participants if, after their self-assessments, they still have questions about their concrete plans for collaboration.

2.2 Mobile infrastructure sharing

For mobile operators, mobile infrastructure sharing can be a way to save costs or to accelerate the network rollout. One such example is the agreement between T-Mobile and Tele2, which grants Tele2 access to sites and antenna locations of T-Mobile.[16] In tunnels and at train stations, antennas are often shared in order to be able to provide coverage efficiently.[17, 18] Furthermore, in the Netherlands, sites such as towers and roof locations are shared among operators on the basis of an obligation in the Dutch Telecommunications Act.[19] Mobile infrastructure sharing helps operators continue improving coverage and network capacity, and it prevents visual pollution that may be caused by the massive growth in antennas.

In the context of mobile infrastructure sharing, a distinction is often made between *passive* and *active* sharing. In passive sharing, the shared elements are unable to process or convert telecommunication signals. One such example is sharing sites or passive antennas. Active sharing involves the joint use of active elements of the network, which are the elements that are able to generate, amplify and control signals. Examples of active sharing are the sharing of the radio network, the core network, and spectrum. Using the network of another operator (roaming) can also be seen as a form of active sharing.

The sharing of mobile infrastructure is observed in many European mobile markets. Many of the sharing agreements are the result of commercial negotiations between the participating operators. Additionally, the sharing agreements can also be the result of regulatory interventions by the National Regulatory Authorities (NRAs) or other competent authorities. The potential benefits of infrastructure sharing were already pointed out in 2001 in the 'Memo of the Netherlands Competition Authority (NMa), the Netherlands Independent Post and Telecommunications Authority (OPTA), and the Ministry of Transport and Water Management (V&W) on joint construction and use of UMTS network

[16] https://www.tele2.nl/newsroom/2013/t-mobile-en-tele2-gaan-antennes-delen-in-nederland/.

[17] https://property-telecom.com/2018-07-25/nederlandse-telecomproviders-voorzien-noord-zuidlijn-van-netwerk/.

[18] https://www.spoorpro.nl/spoorbouw/2016/07/15/dijksma-mobiele-dekking-in-spoortunnel-voortaan-meteen-goed-regelen/.

[19] These arrangements have been laid down in the Antenna Covenant, https://www.antennebureau.nl/plaatsing-antennes/documenten/convenanten/2018/januari/26/antenneconvenant-2010.

components'. [20] According to the 2011 BEREC-RSPG report[21], the most important benefits are cost reductions (for example, sharing rental costs among the participating operators) and the efficient use of spectrum. These findings have been confirmed in the 2018 BEREC report.[22] Moreover, more and more value is attached to the public benefits of sharing. Consider, for instance, the improved network quality in underserved areas and less visual pollution in nature reserves and historic city centers.

The importance of infrastructure sharing is increasingly acknowledged in the European telecommunications regulatory framework. The European Electronic Communications Code (EECC) will supersede the current European telecommunications regulatory framework. The EECC aims to stimulate infrastructure sharing. For example, the EECC describes the advantages of infrastructure sharing in the efficient use of spectrum and the rapid roll-out of networks, especially in underserved areas.

One drawback of sharing is that competition between mobile operators may be restricted. Cooperation between the sharing operators may lead to less or no competition at the network level. Cooperation can also have a negative effect on innovation, because operators are less able to distinguish themselves through innovations at the infrastructure level, and network innovations are more complex to implement if the network is shared with another operator. Market participants that wish to enter into a sharing agreement must assess by themselves whether the agreement complies with competition law. Collaborations aimed at infrastructure sharing is exempted under competition law if they meet certain cumulative criteria.[14] In the assessment whether the collaboration meets these criteria, the following aspects are important, among other aspects: 1) the nature of the infrastructure that is shared (active or passive), 2) whether strategic information is exchanged, 3) the geographical scale of the sharing and 4) whether the sharing is objectively necessary for the roll-out of infrastructure, for example in underserved areas.[23]

It is possible that 5G increases the necessity for infrastructure sharing. In order to reach the required coverage in a certain area, the 5G network, in many cases, needs more sites and antennas. That is why the costs for the roll-out of a 5G network are probably higher. As a result, network sharing becomes more attractive for 5G. ACM would like to engage in a dialog with market participants if they still have questions about their concrete plans for network sharing after self-assessment.

As BEREC member, ACM is actively involved in both the creation of the 2018 BEREC report as well as the preparation of the common position of BEREC on mobile infrastructure sharing. This common position is published on 12 December 2018, and seeks to offer more clarity regarding the infrastructure sharing in the context of 5G.

Mobile infrastructure sharing can be a way for mobile operators to save costs or to accelerate the network roll-out, for example in underserved areas. These benefits of mobile infrastructure sharing are also mentioned in the European Electronic Communications Code. It is expected that 5G will enhance these benefits. One drawback is that innovation and competition between mobile operators may be

[20] Consideration 6 of the Memo Joint construction and use of UMTS network components (in Dutch: Notitie Gezamenlijke aanleg en gebruik van UMTS-netwerkonderdelen): https://wetten.overheid.nl/BWBR0033162/2001-10-01#voetnoot_tekst6.

[21] BoR (11) 26: https://berec.europa.eu/eng/document_register/subject_matter/berec/reports/224-berec-rspg-report-on-infrastructure-and-spectrum-sharing-in-mobilewireless-networks.

[22] BoR (18) 116: https://berec.europa.eu/eng/document_register/subject_matter/berec/reports/8164-berec-report-on-infrastructure-sharing.

[23] See for example Telekom-Control-Kommission (TKK), "Position Paper on Infrastructure Sharing in Mobile Networks", May 2018.

restricted. Parties that wish to enter into an agreement involving infrastructure sharing must assess by themselves whether the agreement complies with competition law. ACM would like to engage in a dialog with market participants if, after their self-assessments, they still have questions about their concrete plans for network sharing.

2.3 Net neutrality

5G encompasses several technologies that create more possibilities for differentiation on service, such as network slicing, 5G Quality-of-Service Class Identifier (5QI) and Mobile Edge Computing (MEC). In the section below, ACM will address the discussion about 5G and net neutrality. ACM will subsequently explain its conclusions about the relationship between several 5G technologies and the Open Internet Regulation.

2.3.1 The discussion about 5G and net neutrality

On April 30, 2016, the Open Internet Regulation came into force, in which net neutrality rules have been laid down.[24] This Regulation contains, among other rules, the rule that, in principle, operators must treat all traffic on the network equally in technical terms. With that rule, the Open Internet Regulation seeks to protect end-users of internet access services and to guarantee "the continued functioning of the internet ecosystem as an engine of innovation."[25]

Service differentiation may result in traffic being treated *unequally* in technical terms within an operator's network. In the telecom sector, this leads to questions about how 5G technologies that enable service differentiation relate to the Open Internet Regulation. This is also an important topic within BEREC's net neutrality expert working group. As input to the evaluation of the Open Internet Regulation by the European Commission, BEREC published the BEREC Opinion on 12 December 2018.[26] Among other topics, BEREC discusses how 5G technologies relate to the Open Internet Regulation and the BEREC Guidelines. In 2019, the BEREC Guidelines will be clarified. ACM is closely involved in this process. In addition, ACM was also involved in a recent study conducted by TNO into 5G and net neutrality.[2] The aim of this study is to create a model for businesses and policymakers for analyzing the relationship between 5G and the Open Internet Regulation.

At this point, ACM is of the opinion that the Open Internet Regulation leaves much room for service differentiation within the context of 5G. However, the Open Internet Regulation does set out criteria for service differentiation. These criteria are meant to protect the quality of internet access services, and to prevent the disruption of the level playing field for competitors on the internet. With these criteria, the Open Internet Regulation seeks to do justice to the balance between 1) offering room to innovations within the context of 5G, and 2) protecting the open internet.

2.3.2 The relationship between 5G technologies and the NN regulation

At this point, ACM is of the opinion that the Open Internet Regulation leaves much room for the implementation of 5G technologies, such as network slicing, 5QI and MEC. To this day, ACM is not aware of any specific example of an implementation of a 5G technology given by an operator that

[24] Regulation (EU) 2015/2120 of the European Parliament and of the Council of 25 November 2015 laying down measures concerning open internet access and amending Directive 2002/22/EC on universal service and users' rights relating to electronic communications networks and services and Regulation (EU) No 531/2012 on roaming on public mobile communications networks within the Union (Regulation 2015/2120).

[25] Regulation (EU) 2015/2120, consideration 1, preamble.

[26] BEREC, 'BEREC Opinion for the evaluation of the application of Regulation (EU) 2015/2120 and the BEREC Net Neutrality Guidelines', 12 December 2018.

would be impeded by the Open Internet Regulation. ACM welcomes market participants to engage in a dialog with ACM if they have concrete examples of 5G use cases that would not be allowed under the Open Internet Regulation. In the paragraphs below, ACM will further discuss the relationship between several 5G technologies and the Open Internet Regulation.

Network slicing

Network slicing refers to the software-based partitioning of the network into several virtual subnetworks, called *slices*. Each slice can be tailored to the specific quality requirements of individual services. For example, think of specific connectivity for "verticals", such as the car industry, energy sector, public order and security (See Section 1).

Network slicing allows for providing customized connectivity. The Open Internet Regulation leaves much room for this. The Open Internet Regulation allows operators to offer so-called "specialized services." These are connectivity services that are optimized to the specific quality requirements of individual applications, for example in the verticals. Specialized services must be distinguished from the regular internet access services.

Criteria in the Open Internet Regulation for providing specialized services are, among other criteria: 1) the specialized services offer levels of quality that the regular internet access services cannot offer and 2) the specialized services do have a negative impact on the availability or general quality of internet access services for end-users.

Operators can use network slicing to offer both specialized services and regular internet access services simultaneously over 5G networks. Capacity allocation among the slices is dynamic, and a minimum capacity can be set for the slice used for providing internet access services.[2] As a result, network slicing can support that the provision of specialized services does not have a negative impact on the availability or general quality of internet access services for end-users.

5G QoS Class Identifier (5QI)

Just like with 4G, a mechanism of QoS Class Identifiers can be used in 5G (which is called 5QI). With 5QI, different traffic categories can be grouped into different quality classes. As a result, a higher quality can be assigned to one traffic category (for example: a voice service that needs low latency) than to another traffic category (for example: email traffic that is less time-critical).

In order to enable efficient utilization of network capacity, the Open Internet Regulation allows operators to take so-called "reasonable traffic management measures." The term "traffic management measures" refers to the way that internet traffic is handled on the operator's network. Traffic management ranges from traffic-handling on a first-come-first-serve basis to the more advanced forms where certain internet traffic, for example, is prioritized over other internet traffic on the operator's network. ACM is currently studying the traffic management measures of operators, and is assessing whether they are in line with the Open Internet Regulation.[27]

Traffic management measures can be regarded as reasonable if they are transparent, non-discriminatory and proportional. In addition, the traffic management measures cannot be based on commercial considerations, but need to be based on objectively different technical quality requirements for specific categories of traffic. Also, operators cannot monitor specific content of traffic when implementing these measures.

[27] ACM, 'Jaarverslag netneutraliteit 2017-2018', July 2018.

Under the abovementioned criteria, 5QI can be used for the implementation of a reasonable traffic management measure, which enables differentiation *within* an internet access service between traffic categories with objectively different technical quality requirements.

Furthermore, 5QI can conditionally be used for implementing different non-discriminatory quality classes for *different* internet access services. For example, think of an internet access service of a business subscriber whose traffic is temporarily prioritized over the traffic of a consumer's internet access service in a congestion situation. However, this cannot result in the internet access service of the business subscriber reducing the quality of other internet access services to levels below the contractual conditions that have been agreed upon under Article 4(1).[28] In addition, operators must be transparent about the traffic management measures, and the implementation of different quality classes cannot restrict the end-user right of open internet access. That means, among other things, that the consumer's freedom of choice between different applications on the Internet is not restricted by an operator.

Mobile Edge Computing (MEC)

Mobile Edge Computing (MEC) refers to a network architecture where computing capabilities and/or data storage are set up at the operator's base station. Using MEC, the operator is able to give specific services lower latency than other services. This could mean that traffic within the operator's network is treated unequally in technical terms.

ACM makes sure that the conditions and practices of operators with regard to MEC do not restrict the exercise of the end-user's right to open internet access. If MEC is offered in conjunction with internet access services, the criteria for reasonable traffic management measures laid down in the Open Internet Regulation must be met. If MEC is used for the implementation of specialized services, the criteria for specialized services laid down in the Open Internet Regulation will have to be met.

5G encompasses different technologies that enhance the possibilities for service differentiation on the network such as network slicing, 5QI and Mobile Edge Computing. In the telecom sector, this has led to questions about how these technologies relate to the European Open Internet Regulation. According to this Regulation, all traffic within the network, in principle, must be treated equally in technical terms. At this point, ACM believes that the Open Internet Regulation leaves much room for the implementation of 5G-technologies such as network slicing, 5QI and Mobile Edge Computing. ACM welcomes market participants to engage in a dialog with ACM if they are unsure whether a specific use of a 5G technology is allowed under the Open Internet Regulation.

2.4 Spectrum

One important factor in the development of 5G in the Netherlands is the availability of the frequency bands that, within Europe, are the first to be used for 5G. These are the 700 MHz, 3.5 GHz and 26 GHz bands.

- The 700 MHz band covers a relatively limited amount of spectrum (2×30 MHz[29]) in a low frequency band. This spectrum can be used to provide coverage for larger areas, indoors, and for services that do not require a high data rate, for example Internet-of-Things applications.

[28] For a further explanation of the criteria that apply to the implementation of different non-discriminatory quality classes for different internet access services, see BEREC, 'BEREC Opinion for the evaluation of the application of Regulation (EU) 2015/2120 and the BEREC Net Neutrality Guidelines', 12 December 2018.

[29] The spectrum in the 700 MHz band is "paired", which means there are separate frequency bands for the uplink and the downlink. In both of these, 30 MHz is available.

The spectrum in the 700 MHz band will be auctioned at the next mobile-spectrum auction, which is expected to be held in late-2019 or early-2020.

- In the 3.5 GHz band, more spectrum is available, almost 400 MHz[30] in total. Internationally, this band is seen as the most important band for large-scale application of 5G. In the Netherlands, licenses have already been issued for this band, mostly for local networks, with expiration dates in 2022 or 2026. In addition, this frequency band is also used by the national intelligence and security agencies for the sake of national security. The Ministry is currently assessing whether and in what way the 3.5 GHz band (or a part thereof) can be made available for mobile communication. At the end of this year, the Dutch House of Representatives will be informed.
- The 26 GHz band is also seen as an important frequency band, as a considerable amount of frequency spectrum is available in this band. These high frequencies have a limited range, which makes it possible to make them available for multiple market participants in areas that are geographically separated from each other. A large share of the 26 GHz band is expected to be awarded locally or regionally.

In the Connectivity Action Plan[4], the Dutch policy on 5G spectrum awarding is discussed in greater detail. It also addresses the need for frequency spectrum for business-specific applications that should enable specialized service operators or users to provide connectivity themselves. For example, think of local business networks in the ports and at airports, or of networks that provide connectivity in hospitals.

The new EECC acknowledges the importance of having more flexible access to and a more flexible use of spectrum in the context of the development of the 5G-network.[31] That is why the EECC provides more room for granting general authorizations for license-free use instead of individual licenses for using spectrum. An additional objective of the EECC is the promotion of shared use of spectrum (Licensed Shared Access, LSA). These developments aim to realize a more efficient utilization of spectrum, and are aimed at enabling more market participants to use the spectrum.

In the Netherlands, the Ministry is responsible for the allocation of frequencies. The Radiocommunications Agency Netherlands (AT) carries out this allocation, and has oversight of the use of frequencies. Through the choices that are made in the spectrum allocation, the government is able to influence competition in the mobile market. In that process, ACM plays an advisory role. For example, in the past, it was decided to reserve frequency space for new entrants so that sufficient operators would be active in the market. In late-2017, ACM offered its provisional recommendations to the Ministry regarding the design of the upcoming auction of the 700, 1400 and 2100 MHz bands. The final recommendations will be given in early-2019.

ACM considers the allocation of the frequency spectrum as an important policy instrument, and will thus continue to play its advisory role vis-à-vis the Ministry and AT over the next few years. That is why regular discussions will continue to take place between the Ministry, AT and ACM. In those discussions, it is important for ACM that effective competition in the market is safeguarded.

One important factor in the development of 5G in the Netherlands is making available the frequency bands that are the first to be used for 5G. ACM sees the allocation of the spectrum bands as an important policy instrument, with which influence can be exerted over the competitive process in the

[30] The spectrum in the 3.5 GHz band is “unpaired”, which means the same frequency band is used for the uplink and the downlink. Both directions are time-separated.

[31] Proposal Electronic Communications Code, Explanatory Memorandum.

market. In its role as telecom regulator, ACM will, over the next few years, continue to play an advisory role in the allocation of new and existing frequency bands. In that context, ACM believes it is important that effective competition in the market is safeguarded.

2.5 Number issuance

In accordance with the numbering plans of the Ministry, ACM issues numbers, and has oversight of the use of those numbers. These include the area codes for fixed telephony, and the 06-series for mobile telephony, but also 'special' numbers such as the 066-series for pagers, and the 0800/0900-series for directory assistance and premium-rate services. ACM also issues the Mobile Network Codes (MNCs), which are used for identification purposes of public electronic communication networks. Each year, ACM reports about the number issuance trends.[32]

Numbers from the 097-series

As already noted in section 1, 5G will significantly contribute to the further growth in the Internet of Things. As a result thereof, the number of devices connected to the network, and therefore the demand for numbers, are expected to increase dramatically. That projected growth in demand was already offset in 2011 by the creation of the 097 number series, consisting of 12 digits, the first three digits of which were set. At this point, only numbers starting with 0970 have been cleared for issuance, which means the total number of available numbers is 100 million. If necessary, that number can be expanded in the future by clearing other subseries such as 0971, 0972 etc. In 2014, the use of the 097 series was mandated for automatic applications. This has led to a strong growth in the number of issued numbers from the 097 series.[32] By late-2017, approximately 20 million 097 numbers had been issued. Even though 5G is expected to fuel this growth even further, sufficient numbers in the 097-series will be available for the foreseeable future. ACM will continue to keep a close watch on the growth of the issuance of numbers from the 097-series.

Numbers from the 06-series

In the 06-series (used for mobile telephony in the Netherlands), the issuance rate is quite high: in late-2017, it was over 90%.[33] Yet, ACM does not expect the numbers in the 06-series to run out in the short term, because, among other reasons, the major operators still have many numbers in stock, and the number of issued numbers hardly grows anymore. What is conceivable though is that, in time, demand will rise again, for example as a result of new, innovative communication services, which increasingly compete with traditional telephony. Demand for numbers in the 06-series calls for a technologically neutral framework for the issuance of numbers using transparent, objective, and non-discriminatory criteria that promote competition and innovation for the benefit of end-users. ACM supports the Ministry in any study into the needs and options regarding changes to the purpose of the 06-series. Furthermore, ACM also helped the Ministry find opportunities for expanding the number of available numbers from the 06-series.

Mobile Network Codes

MNCs are registered on the SIM card, and are needed to gain access to a mobile network. The Dutch MNOs each have one or multiple unique MNCs. It may also be desirable for MVNOs to have their own MNCs, allowing them to issue their own SIM-cards, and avoiding them being bound to the network of a particular MNO because of the SIM-card. As MNCs currently consist of just two digits[34], and some

[32] https://www.acm.nl/nl/publicaties/monitor-nummeruitgifte-2017 (in Dutch).

[33] https://www.acm.nl/en/publications/acm-continues-monitor-mobile-phone-and-premium-rate-numbers-closely.

[34] The ITU standard for MNCs also allows for three-digit MNCs, but this is not widely used yet by market participants.

MNCs have their own special purposes or are saved for other purposes, only 90 combinations are available for public operators. At this point, more than half of the MNC numbers can still be issued. In late-2017, a total of 41 MNCs had already been issued. In principle, the numbering plan[35] allows for the issuance of three-digit MNCs, but this could lead to compatibility issues on the network.[36]

The advent of 5G could result in more market participants needing an MNC. For example, think of market participants that provide connectivity to verticals over their own networks. In order to prevent possible future scarcity of available MNCs, ACM enforces a strict issuance policy. Each application is thoroughly tested against the purpose in the numbering plan. It has been laid down in the numbering plan that an MNC can be used for identifying 6 types of networks. One key element in the assessment is usually the question of whether the MNC is used for identifying a public electronic communications network.

For many applications in the Internet of Things, such as those used in cars and energy meters, it is impractical to change SIM cards. Market participants that provide such applications are therefore unable to switch mobile operators easily, and could thus benefit from having their own MNCs. The numbering plan has met this need since 2014 by including in this plan the sixth type of networks that qualifies for an MNC.[37] In these types of networks, the mobile network code is not transmitted using radio signals, and the mobile network code is only used for the selection of *another* electronic communications network for the use of electronic communications services. This purpose allows the sharing of MNCs among multiple users so that operators of large-scale business applications are able to have their "own" MNCs without creating scarcity of the available numbers. In the numbering plan, MNCs 90 and 91 have been reserved for these types of networks.

The option of a shared MNC is one of the measures that can prevent scarcity of MNCs from arising. Moreover, MNCs 95 through 97 are not included in the numbering plan, which means they cannot be issued. These MNCs can be used for network-internal purposes for the identification of a particular closed electronic communication network. One possible application is the use in private business networks and local wireless networks.

Market participants that provide Internet-of-Things (IoT) applications may, in the future, use embedded SIMs (eSIMs). It will then no longer be necessary to switch SIM cards when switching carriers, because the operator details can be changed remotely (called "Over-The-Air Provisioning"). For operators without networks of their own, the need to have their own MNC will then be less. Manufacturers of electronic communication devices have their own solutions for the eSIM. The GSMA, which is the international body of mobile spectrum holders, has developed a specification for the so-called embedded Universal Integrated Circuit Card (eUICC). This specification describes a safe and simple method for installing the operator details on the eUICC, which grant access to the network. Under the EECC, Member States must promote Over-The-Air provisioning of SIM-cards to make it easier for users to switch electronic-communication providers. ACM will follow the current implementation processes.

In accordance with the numbering plans of the Netherlands Ministry of Economic Affairs and Climate Policy, ACM issues numbers, and has oversight of the use of those numbers. The advent of 5G could lead to an increase in the demand of mobile numbers (06-series), numbers for automated applications (097-series) and mobile network codes (MNCs). ACM tests each application against the purpose in the

[35] https://wetten.overheid.nl/BWBR0010199/2014-03-13 (in Dutch).

[36] Report of Dialogic, "Feasibility study to assign 3-digit MNC codes to mobile network operators in the Netherlands", October 2013.

[37] Decision number ETM/TM/14024019, Dutch Government Gazette 2014 no 6781.

numbering plan, and assists the legislature in the assessment of the desirability and possibility of adjustments to the numbering plans.

2.6 Consumers

5G applications can also have consequences for consumers. That is why ACM finds it important that consumers understand what 5G is, and how they can benefit from it. With the introduction of 5G, consumers may not experience a similar speed improvement as the one with the introduction of 4G. Instead, consumers may be offered new services that are, for example, only possible with 5G technologies. One such example is a self-driving car that takes advantage of the low latency of 5G. It is also expected that the number of Internet-of-Things applications will further increase with 5G. ACM considers it essential that telecom operators and 5G service providers sufficiently explain to consumers what 5G entails, and what they need in order to benefit 5G-based services. Furthermore, consumers need to be properly informed about the security and privacy risks that are associated with these services and devices. In the paragraphs below, ACM will briefly touch on the potential consequences for using mobile services and the related consumer subscriptions.

Types of subscriptions and contractual conditions

The selection of mobile subscriptions may become more complicated if 5G services become part of the offer. Services such as connected fridges, self-driving cars and virtual reality could also be provided by telecom operators as part of their mobile services next to the traditional subscription of SMS, voice and data. Will these services be offered by all operators? Do consumers want to take out all of their 5G-based services from the same operator? Do consumers need different subscriptions for different services? What about switching operators, and what if consumers wish to change something in their subscribed services? And should consumers pay their invoices based on the services they subscribed to or based on the number of connected devices? These questions indicate that operators have a role in thinking about future subscriptions and what these subscriptions mean for consumers. Any changes to the form of subscriptions need to be communicated clearly and in a timely manner to consumers so that consumers are able to make the right choice for their mobile data subscriptions.

Consumers may be able to use different 5G-services simultaneously on a single device. With the current 5G standard, this is only possible if all services on the same device are offered by the same operator. ACM expects that the contractual conditions provided by the operators for the offered service can differ. One conceivable scenario is that a consumer has one connected device at home that takes care of all in-house 5G-based services such as a connected fridge, smart energy meter, and home entertainment. This consumer might need different quality-level guarantees for these services. These differences could lead to different contracts, and thus also different contractual conditions. ACM finds it is important that the contractual conditions are transparent for consumers.

Older devices

Another possible consequence of 5G is that operators will gradually phase out their services that are based on older technologies such as 2G and 3G. Vodafone has announced it will switch off its 3G-network in January 2020.[38] In January 2022, KPN will stop its 3G network.[39] After the switch-off, consumers will not or barely be able to use mobile data if their devices do not support 4G and 5G. T-Mobile has decided to switch off its 2G network by the end of 2020.[40] This means that handsets that are compatible with only 2G can no longer access the network. Consumers should be informed well by

[38] https://www.vodafone.nl/van3gnaar4g/.

[39] https://www.kpn.com/beleef/mobiel/de-toekomst-van-4g.htm.

[40] https://www.t-mobile.nl/2g.

operators about such changes and should be provided in time with the opportunity to cancel their contract free of charge.[41] ACM considers important to support consumers with a smooth transition from older technologies to 5G. ACM will do so via the usual channels such as ACM's consumer information portal ConsuWijzer.[42]

5G can have consequences for consumers. The range of mobile subscriptions as such may become more complicated if 5G-services become part of the subscriptions. ACM wants to support a smooth transition to 5G, and will do so via the usual channels such as ACM's consumer information portal ConsuWijzer.

[41] Section 7.2. of the Dutch Telecommunications Act.

[42] http://www.consuwijzer.nl.