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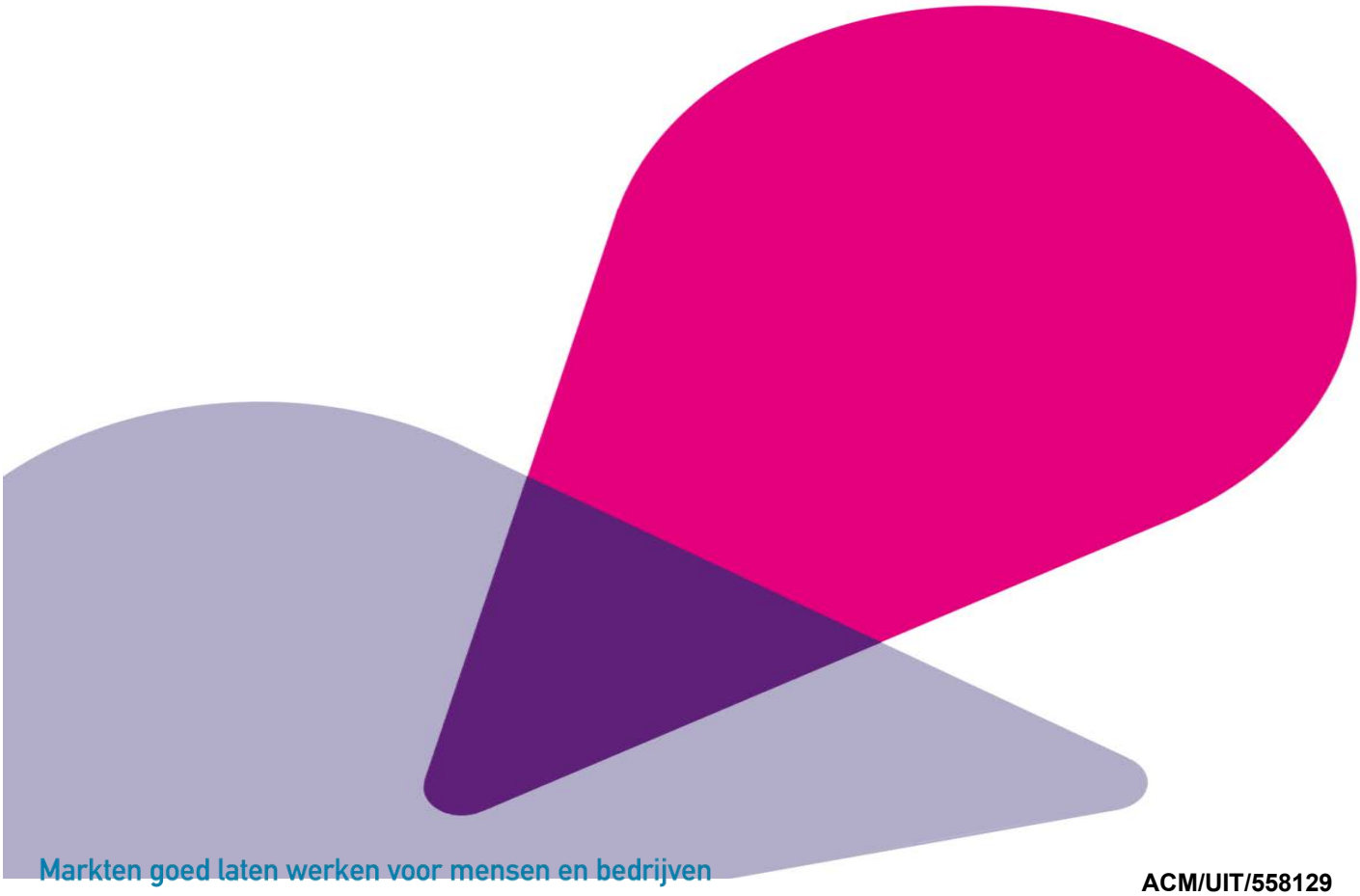
Study

Study into the Market for IP interconnections 2021



Markten goed laten werken voor mensen en bedrijven

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Summary

What is IP interconnection and why is this an important market?
IP interconnection ensures that different networks are able to exchange data. With the help of primarily the Internet Protocol (IP), providers of internet access, content, and services are connected to each other so that, at the end of the day, end-users are properly served. This market is therefore essential for high-quality internet access: if something goes wrong, it will have implications for streaming, video conferencing and online games, for example. Such services would then function slowly, falteringly, or not at all.

IP interconnection can be arranged in two ways: through agreements on peering, i.e. direct exchanges of information between parties, and via *transit*, this being the delivery of data by a third party. The major market participants engage in peering relationships among themselves. This can take place on an internet exchange, where many parties connect, or at a location of their own choosing such as a network node or a data center. Transit involves a third party that carries traffic to destinations. Peering and transit can substitute for each other fairly often, but each has its advantages and disadvantages and they are therefore not readily interchangeable.

What trends do we see in the market?
The increase in volume of exchanged data continues to grow and has made a great leap as a result of the coronavirus crisis. The market is thus growing and especially the major market participants are growing with it. Over the past five years, there has been a relatively large amount of consolidation among internet providers and data centers. The number of internet providers has decreased. T-Mobile Nederland and Tele2 Nederland have merged, Delta Fiber Nederland was created by a merger of Delta/Zeelandnet and CAIW by the private equity company EQT. Liberty Global and Vodafone have transferred their Dutch networks, i.e. Ziggo and Vodafone Nederland, into the joined venture VodafoneZiggo. Only Freedom Internet is a new entrant to the market.

In recent years, many data centers have been acquired and owned by other companies, predominantly American companies. Digital Realty took over Interxion, Equinix purchased a data center from Switch and Evoswitch came into the hands of Iron Mountain. The Datacentergroup and NLDC were purchased by a German asset manager. The American-based Equinix and Digital Realty are now the main providers in the Metropolitan Region Amsterdam.

Data are increasingly being delivered to end-users through CDNs, which is short for content delivery networks; market participants that use geographically dispersed servers, often in the network of the internet providers themselves, to host and deliver content close to the end-users. The content may, for example, consist of videos or software updates that consumers are downloading. Delivery is faster and cheaper because the content has to travel less distance. The growing market for CDNs has become a global market, though it has a high level of concentration among originally American providers.

A more balanced relationship seems to have emerged between content providers with sufficient scale on the one hand and internet providers with many connections on the other. Whereas back in around 2015, content providers and internet providers openly questioned who should pay for the content providers' traffic costs, this now no longer seems to be an issue. Both sides have an interest in good connections between end-users and the content providers they want to engage.

The largest market participants peer at no cost and over-the-counter, and are also leaving the internet exchanges. These trends make it more difficult for smaller market participants: they often have to pay

to be able to engage in peering with large market participants, while the internet exchanges function less as one single location where they can directly reach everyone else. In this way, it thus becomes more expensive for them to get the content to the end-users. Transit, through which market participants deploy a third party to deliver data, can often serve as an alternative to peering. However, it has its limitations and is often more expensive than peering if it involves large amounts of traffic.

The Netherlands is well connected internationally, but it remains essential to facilitate new international connections, by sea or over land. In the Netherlands, Amsterdam is the main center for the exchange, which is why it continues to be a business location for providers of content and connectivity. This is a positive aspect, as it makes the Amsterdam region appealing to many participants in the digital ecosystem. On the other hand, over-centralization of infrastructure does pose a risk to resilience: many services may be affected in the event of an incident in that particular region. The Ministry of the Interior and Kingdom Relations is currently drawing up a National Environmental Vision to distribute the data centers across the Netherlands.[1]

How well does the market function?
Conversations with various market participants have revealed that, compared with the rest of the world, the market for IP interconnections in the Netherlands and the rest of Europe functions well. According to those market participants, contributing factors are the high-quality digital infrastructure in the Netherlands, effective oversight and a healthy competition. However, Dutch market participants do experience difficulties on the international market. Where there is less adequate oversight and/or less competition for internet access, it is more difficult to interconnect on reasonable terms.

Market participants, however, do feel that the open atmosphere that used to be characteristic of the internet and that supported a lot of innovation is starting to change. Peering at no cost with large market participants, for example, is now only available to other large market participants; smaller market participants have to pay for it. Market participants appear more aware of the value that they offer others, and want something in return. These dynamics are effective among the large market participants given their mutual dependency. However, smaller market participants wanting to expand their business, such as internet providers or CDNs, are experiencing difficulties on the Dutch market due to the difficulty in securing advantageous peering and transit agreements for relatively low volumes. For example, 100 Gbit/s in transit costs about 10 times as much as 1 Gbit/s.

On the market for IP interconnections, economies of scale play an important role in the competitive landscape, like in other digital and tech markets. That makes it more difficult for smaller competitors and new entrants to enter those markets and to grow. However, such smaller competitors and new entrants are important for competition and innovation in the long run on the market for IP interconnections. That is why this is a point for attention.

What instruments does ACM have at its disposal?
ACM has competences based on the Dutch Telecommunications Act, the Dutch Competition Act and the Open Internet Regulation. These powers give ACM options to act if the competition or the openness of the internet is at stake, and, for example, if market participants are being refused to interconnect.

1 https://www.denationaleomgevingsvisie.nl/samenwerking+en+uitvoering/programmas/ruimtelijke+strategie+datacenters/default.aspx

What's next?
In cases where market participants face difficulties in the area of IP interconnection, these market participants are invited to submit any tip-offs to ACM. ACM may be able to solve or help solve the issue. Part of the issues that have been described in this market study fall outside the scope of what ACM can do. Tip-offs also help ACM understand this market better, and help identify when ACM needs additional powers to resolve any issues. ACM therefore calls on market participants to contact ACM if they experience problems where ACM can play a role, for example if a market participant refuses to interconnect or to negotiate about it, if it is not prepared to interconnect at market prices or against fair conditions, or if the market participant appears to abuse its dominant position. Tip-offs can be submitted online https://www.acm.nl/nl/contact/tips-en-meldingen/tip-ons and also anonymously https://www.acm.nl/nl/contact/tips-en-meldingen/anoniem-melden.

Contents

1 Introduction

Background
The digital economy is high on ACM's agenda. Digitization leads to fundamental changes in Dutch society. Companies make increasingly more use of data and algorithms to offer innovative services and products that are here to stay, or that promise new opportunities. Consider the rise of online platforms, search engines, the Internet of Things and blockchain technology. With these innovations, the digital economy offers businesses and consumers valuable opportunities and choices, but this development also brings risks. Online platforms can grow rapidly and disrupt existing markets. It offers opportunities for renewal, but it also holds the risk of creating positions of power that result in a smaller selection of choice for consumers and less opportunities for competitors. ACM conducts market research on many aspects of the digital economy and takes the interests of people and businesses into account.

Well-functioning communications networks are essential for the development of online and digital services, which is why electronic communications networks are the lifelines for the digital economy. These networks transport traffic and need to be properly connected, via IP interconnection, for example. In turn, the digital economy is driving network growth: the demand for ever faster internet and higher capacity networks is increasing. Access to electronic communications networks and the internet is crucial.

ACM uses this market study to explore the IP interconnection. IP interconnection means interconnecting different networks for the purpose of data exchange using mainly the Internet Protocol (IP). If this runs smoothly, customers from one internet provider can simply make video calls to customers from another internet provider. In other studies, ACM focusses on the impact of internet access on the functioning of the digital economy. One example is the market study into Cloud Services that ACM initiated in May 2021. In this study, ACM examines which trends present potential problems in the Cloud Services market. The results of this market study into IP interconnections will be taken into account. Another example is BEREC's study of the internet value chain in order to map this chain. In this study, BEREC will explore how the different layers of the internet value chain interact and identify any potential bottlenecks.

Background
In 2015, ACM carried out a study into the market for IP interconnections.[2] At the time, ACM concluded in that study that there was little chance that the market for IP interconnections in the Netherlands would lead to competition issues that would then lead to consumer damage. In that same study, ACM looked into both ways of realizing interconnection: peering and transit. Peering means that market participants physically connect with each other to exchange data, either at an internet exchange or at a place of their choosing. Transit involves a third party that delivers the traffic. At the time, ACM concluded that the refusal of delivery of peering and deteriorated peering conditions did not occur, exploitation of a bottleneck was not a great risk and the risk of the use of bottlenecks in order to exclude the market for content, i.e. social media and video streaming, appeared to be small. The study focused on the relationship and risks between internet access providers and content and application providers.

[2] IP Interconnection, a regulatory assessment, October 6, 2015.

Many developments have since taken place on this market[3]. The market is growing due to the increasing amount of data traffic, and market participants are taking advantage of the opportunities offered by this: they are growing, organically, by offering new services and acquiring other market participants, and thus changing the balance of power. ACM considers it important to have an up-to-date overview of the situation.

Furthermore, in 2019, an incident took place with IP traffic routing, leaving T-Mobile's end-users deprived of high-quality internet access for some time.[4] Along with previously-received signs, this was reason for ACM to verify whether the conclusions from the previous study needed to be revised. In addition, the Ministry of Economic Affairs and Climate Policy also requested ACM to do so. The market study's key question is how the market for IP interconnections has developed since 2015, whether there are any market issues and/or whether any market issues could arise, and if so, what could be done to either solve or prevent them.

The study
This market study presents ACM's findings on the market exploration of the market for IP interconnections. ACM has reviewed literature for this market exploration, has studied both recent and past laws and regulations, has collected news on market developments on the internet and, above all, has had a large number of conversations with the sector's market participants and stakeholders.

ACM has held interviews with the following market participants:

Company	**Type of market participant**
KPN	IAP
Liberty Global	IAP, Tier 1
T-Mobile	IAP
DeltaFiber Nederland	IAP
Freedom Internet	IAP
Eurofiber	IAP / Data center
A2B Internet	IAP
BIT	IAP / Data center
NPO	CAP
RTL – Videoland	CAP
Microsoft	CAP – hosting
Netflix	CAP
i3D.net	CAP – hosting
Leaseweb	Hosting
AMS-ix	IX
NL-ix	IX
Asteroid	IX
Akamai	CDN
Jet-stream	CDN
Tinify	CDN
Equinix	Data center
Dutch Datacenter Association	Industry association
Stichting Digitale Infrastructuur Nederland	Industry association
Dutch Games Association	Industry associations

In Chapter 2, ACM provides a brief market description. Chapter 3 describes the main market developments in the last five years. Chapter 4 focuses on the legal framework for the market for IP

[3] ACM frequently makes use of the term market in this study. By market is not meant a market in the sense of a relevant market defined by competition law.
[4] Letter to Parliament answers on this subject: https://zoek.officielebekendmakingen.nl/ah-tk-20192020-1003.html

interconnections, setting out ACM's powers to oversee this market. Chapter 5 contains the findings and conclusions.

2 Market description

2.1 Introduction

ACM's study from 2015 presented a market description of IP interconnection: interconnecting different networks for the purpose of data exchange using mainly the internet protocol (IP).

ACM provides a brief description of the market in the following paragraphs, including the different market players and the interrelationships in the internet ecosystem related to IP interconnection. As in the previous study, the focus lies on the exchange of data via the internet protocol – IP traffic – as opposed to other traffic, such as speech or linear TV.

2.2 Interconnection

The internet is a network of networks capable of routing data from the sender to the receiver through nodes by means of interconnecting. Interconnection allows data to flow from one network to another, thereby enabling the mutual exchange of data. Without interconnection, consumers and businesses cannot gain access to the internet, or part thereof, or to the services and products available on the internet.

Networks are mostly owned and managed by internet access providers (IAPs). Data originating from an IAP user often passes the networks of other providers, so-called autonomous systems (AS), before reaching the other user. An AS network controls the data traffic independently from other networks and ensures the management and routing of data to and from the connected IP addresses. Currently, there are about 70,000 of these AS networks worldwide, responsible for a much larger number of routes, which together make up the worldwide internet.

Owners of these networks make agreements on the exchange of data between their networks. These agreements rely on physical and contractual interconnection to enable the exchange of data between these internet access providers. Physical interconnection is understood to mean the connection of each other's networks, either in a data center or in another location, such as in an IAP's network node. Protocols are used to route the traffic between the networks and a link of networks is made in colocation centers, which are buildings where the interconnection takes place. The capacity of interconnection through ports is expressed in terms of the amount of data per unit time, such as Mbps or Gbps. ACM refers to 'contractual' interconnection as the collection of agreements made between market participants to realize interconnection and the exchange of data traffic, varying between a written agreement, a handshake, and a verbal agreement.

Networks can interconnect in two different ways to enable the exchange of data between users that have an IP address, namely via transit and peering. Transit involves networks purchasing connectivity from a provider with all the networks that together make up the internet. By entering into a transit agreement, the seller accepts the obligation to deliver the purchaser's IP traffic to all the destinations to which the purchaser has access on the internet and, *vice versa,* delivers all the IP traffic that it receives from third parties and that are intended for the purchaser's network. Peering means that two network owners decide to make a connection between their networks. By entering into a peering agreement, these two market participants agree to exchange IP traffic connected to each other's

networks without an obligation to deliver the traffic further, as in the case of transit. Peering consists of two forms:

- Public peering: interconnection with another network takes place via an open platform, an internet exchange, this being a place where several networks come together, for a fee to such exchanges, and where the exchange of IP traffic takes place. The latter usually involves a carrier neutral data center.
- Private peering: a direct interconnection between two networks and the exchange of IP traffic without the involvement of a third party.

Market players (see also paragraph 4 of this Chapter) make individual trade-offs based on costs and benefits in determining how to organize interconnection, in terms of location, public or private, paid/unpaid. The economic rationale behind the choice between transit or peering is determined by the connection's revenue and costs. Transit services are provided on the basis of payment of capacity used, measured in Mbit/s, and the costs of sending and receiving are largely variable. Traditionally, peering is settlement-free, meaning that market participants do not charge each other for the receipt and distribution of the IP traffic on their networks. Market participants will have to establish a physical interconnection between each other's networks, and the costs for equipment (such as routers and fiber optic) and colocation (meaning the building where the interconnection takes place) are usually fixed. The owners of the networks have to decide whether they prefer to interconnect via transit or peering. The advantages of peering over transit increase as the traffic that is exchanged between two networks becomes larger in terms of volume and the cost price per data unit therefore drops for the market participants. Another advantage of peering is that the connection quality may be better because the traffic can take a short cut by means of direct interconnection as opposed to via a third network. For two market participants to peer, both must benefit for it to be realized. Whether settlement-free peering or paid peering applies, depends on the transaction costs and the bargaining power of the networks. A network's bargaining power is determined by the degree of direct connectivity with other networks, the volume and the available capacity, as well as by the volume ratios in the traffic between two networks.

Historically, most data traffic between the largest internet access providers was exchanged bilaterally under peering agreements at no cost. In addition, internet access providers make use of transit of large international network providers with which they interconnect, often using an internet exchange as a platform, and thus having access to the entire internet.

2.3 The importance of interconnection

The importance of the internet in the Dutch digital economy, and therefore also the importance of interconnection, has increased significantly in recent years. The strong growth in volume of data traffic is the result of:

- the explosive growth of online videos in HD quality;
- the rise of the Internet of Things and the growth of the number of devices connected to the internet and the associated transported data;
- the growth of businesses' data storage in the cloud (from private cloud to public and hybrid cloud) and the increase of the processing and analysis of data;
- the emergence of online and offline gaming;
- the upgrading of existing access networks through investments in the upgrading of fixed and mobile networks that accommodate these trends.

To illustrate the growth of internet traffic, consider the internet exchanges: via the AMS-IX, the peak volume of the delivered traffic increased from 3 terabytes per second (TBps) in 2015 to over 9 TBps in 2020 – roughly a threefold increase.[5] Other internet exchanges in the Netherlands also show a strong growth: the amount of traffic processed in NL-IX increased to 3.22 TBps in 2020 in the Amsterdam region and to 1.10 TBps in the Rotterdam region[6], while in 2015 the traffic only barely passed the limit of 1 TBps.[7] Similarly, regional internet hubs, such as NDIX, GN-ix, and the relatively new IX Asteroid are showing an increase in handled traffic in the Netherlands.[8] On a global scale, the amount of internet traffic per capita is expected to nearly triple between 2016 and 2021.[9]

These trends require the internet traffic to being delivered increasingly more dynamic (in real-time), with a higher bandwidth and a higher quality. This growth and required quality of connections also impacts the scope of transit and peering.

2.4 IP interconnection and market players

There are a number of types of market players in the internet ecosystem in relation to IP interconnection that play a role in enabling end-users to exchange data via the internet. ACM specifies these categories of market players below. It should be noted that many market players carry out different activities and that these activities are sometimes difficult to distinguish from each other.

End-users
The internet's end-users are private individuals / households and businesses and organizations that receive data through the internet via a connection from a provider of internet access services, i.e. internet access providers, IAPs. Households and businesses pay these providers of internet access services a fixed monthly amount on a subscription basis for the internet access. End-users pay Content and Application Providers that offer applications via the internet by means of a subscription or according to data usage. There is also a large number of free applications paid for by advertising money.

Content and Application Providers
Content and Application Providers (CAPs), otherwise known as Over-The-Top (OTT) providers (such as Netflix and Facebook), are providers of electronic services aimed at information, media, content and entertainment and/or applications. These providers offer a variety of applications that can be used by private individuals / households and businesses. They create and aggregate content, such as movies, or offer applications, such as messaging and search engines. In practice, this concerns both small businesses, consider small and medium-sized enterprises, and major providers, such as multinationals. In terms of content, there is a demand for international content and local content, i.e. Dutch/Dutch language, that both compete for end-user attention and usage.

Internet Access Providers

[5] https://tweakers.net/nieuws/174110/ams-ix-doorbreekt-grens-van-9 tbit-s-aan-internetverkeer.html
[6] NL-ix website traffic data: https://www.nl-ix.net/network/traffic-stats/
[7] https://tweakers.net/nieuws/103286/nl-ix-doorbreekt-grens-van-1tbit-s-aan-dataverkeer.html
[8] ACM notes that these numbers only provide an indication of the volume of the Dutch IP traffic. A lot of international traffic is routed on large IXs (i.e. AMS-ix and NL-ix) from one foreign user to another foreign user, which therefore should not count. A large part of the traffic routed on AMS-IX therefore does not originate from Dutch users. Also, part of the traffic runs over a single-party's network or this data flow runs outside of IXs. Finally, the large IAPs' choices to no longer make use of certain IXs distort the growth of the volume.
[9] Cisco, https://www.cisco.com/c/dam/m/en_us/solutions/service-provider/vni-forecast-highlights/pdf/Global_2021_Forecast_Highlights.pdf

Internet Access Providers (IAPs), such as KPN, VodafoneZiggo and T-Mobile, offer private individuals / households and businesses internet access via mobile (4G, 5G) or fixed networks, such as DSL, cable, optic fiber. Internet access providers also often offer additional services such as email and webhosting. Moreover, large internet access providers often also operate within a holding company alongside an internet transit provider or internet exchange (also see below), and have a wholesale business.

Internet Exchanges
An Internet Exchange (IX) is an independent platform – owned by an association of internet access providers – or a commercial platform – owned by an undertaking active in the field of connectivity – on which affiliated market participants can exchange IP traffic. These IXs use a number of colocation points where they provide an ethernet network to which internet access providers can then connect their routers. In the Netherlands, AMS-IX, which is independently owned, and NL-IX, which is a commercial internet exchange, owned by KPN, are the main internet exchanges in terms of volume handled, the number of participants and connected networks. In the Netherlands, an IX is typically spread across locations of several, often competing, data centers. National IXs are important for local traffic, but for European and global IP traffic, AMS-IX competes with IXs in London, Frankfurt and Paris as one of the world's leading IXs.

Internet Transit Providers / Internet Backbone Providers
An Internet Transit Provider or Internet Backbone Provider is an internet provider that allows another provider or user to gain access to the entire internet through its (IP) network via transit. A transit provider is an internet service provider that usually owns and operates a global network that can be used to reach other access networks. A distinction is made between tier 1 providers, which usually peer payment-free with other tier 1 providers, and, if applicable, offer transit against payment with other networks, and tier 2 and lower providers, which do not have any direct connections with other networks and in some cases have to pay for interconnection with other networks. Tier 1 providers distinguish themselves from other providers in the sense that they are able to reach any other network in the world. In practice, therefore, smaller internet access providers must become a customer (they need to purchase IP transit) in order to effect a direct link with those specific tier 1 providers. Important tier 1 transit providers include GTT Communications, Cogent and Telia.

Data centers
A data center is a building that has room for the conditioned and secure placement and technical support and monitoring of servers with storage of data and applications. There are different types of data centers: they vary from single-tenant data centers (which are data centers with one user, often in-company), and multi-tenant data centers (having different tenants/users), carrier-owned data centers and carrier-neutral data centers (which are data centers of a telecommunications provider, or another party), and from small-scale to hyperscale data centers. There are also data centers that focus on end customers, i.e. retail, and on activities for internet access providers, cloud and hosting providers, i.e. wholesale. Incidentally, these servers are owned and managed by the data centers' customers, as opposed to the service provision of cloud and hosting providers. See below.

Internet Access Providers connect with multi-tenant data centers, which house different customers from hosting services via colocation. A multi-tenant data center links the servers at its locations to that of an internet access provider. Single-tenant data centers only facilitate the hosting of the company that owns the data center.

The market for data center services is growing rapidly and more and more data centers are being built, the vast majority of these being built in the Metropolitan Region Amsterdam.[10] DDA's report shows that the number of square meters of data center increased by 10% between April 2019 and 2020, to 370,000 square meters. The number of multi-tenant data centers in the Netherlands has decreased in recent years from 206 (2016) to 191 (2019), but revenue has increased substantially from about 700 million euros to 1,000 million euros in this period.[11] Despite the tremendous growth of the market, the number of colocation providers is decreasing every year, to 102 colocation providers in 2020.[12] The largest providers of multi-tenant data centers are Equinix and Digital Realty. In addition, Google and Microsoft have hyperscale data centers in the Netherlands for their own use.

Large companies typically use several data centers. For example, in the case of hybrid cloud, a company will run part of its operations on its own servers in a carrier-neutral data center, and another part on cloud platforms such as Amazon AWS or Microsoft Azure, which may be hosted in the same wholesale data center or in a hyperscale data center owned by Amazon and Microsoft themselves.

Hosting providers and cloud providers
A hosting provider rents server rooms to a user and offers different varieties of management and maintenance for running websites or applications for a customer/user. These servers are usually in data centers. See below. A cloud provider is a hosting provider that offers hosting on a large scale and globally and usually accompanied by different computer services, such as storage and data processing, in addition to management and maintenance. Well-known hosting and cloud providers are Amazon Web Services, Google Cloud and Microsoft Azure.[13] Hosting providers generally also offer physical interconnection in data centers. Furthermore, internet access providers, data centers and transit providers to render hosting services.

Content Delivery Network providers
Content Delivery Network or Content Distribution Network (CDN) providers are providers that develop and manage a network of geographically spread network servers in data centers or at the edge of IAPs' networks. The availability of a network of connected servers that work together allows these providers to deliver content quickly, with high availability and without congestion to locations closest to the end-users or in the delivery network. This involves a great diversity in types of internet traffic, for example, movies prompted by an end-user, but also images prompted when opening a web page. These days, CDNs are responsible for delivering a large part of the internet content, such as video streaming, software downloads, social media websites, accelerating mobile content, and more. Providers of CDNs' networks that deliver a high volume of commercial content are Akamai, CenturyLink, Limelight and Cloudflare. There are also various CDNs operating locally/nationally that ensure a high-quality distribution of content. Large high-volume CAPs also often develop CDNs in-house which means they no longer use independent CDNs.

[10] The *State of the Dutch Data Centers 2020* of the Dutch Data Center Association shows that 74.1% of the 189 data center facilities are located in the Metropolitan Region Amsterdam.
[11] Pb7 Research
[12] The *State of the Dutch Data Centers 2020* of the Dutch Data Center Association shows that the number of colocation providers between 2016 and 2020 has dropped from 126 to 102.
[13] According to the estimates of market analyst Canalys, Microsoft, Amazon and Google control more than half of the worldwide cloud market, followed by the Chinese company Alibaba and other US tech giants such as Oracle and IBM.

2.5 Relationship between market players in the internet ecosystem in relation to interconnection

Figure 1 below shows schematically the relationships between the different types of market players and the way in which interconnection takes place between the different market players. End-users have access to the internet via internet access providers. There are several routes for access to content of the small content providers and the larger content and application providers. Internet access providers make use of a direct interconnection, including through the placement of CAPs' cache servers in the data centers / colocations or networks or through a direct interconnection in data centers of large CAPs, such as hyperscale data centers. Internet access providers also make use of interconnection with other networks of other internet access providers, CAPs and other market participants in the data centers of independent multi-tenant data centers. The internet access providers can then also make use of the services of internet exchanges by network linking, i.e. ports and routers. Finally, internet access providers can do business with internet backbone providers (or transit providers and major internet access providers) to interconnect with other access networks and CAPs situated further away.

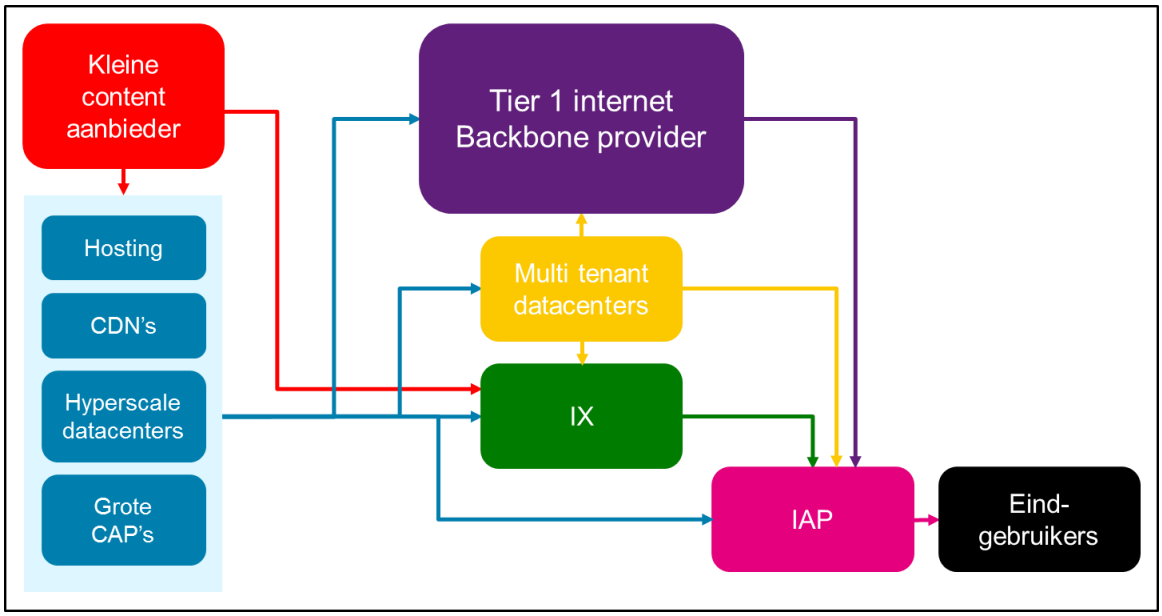

Figure 1: The internet ecosystem and the relationships between the different market players for IP interconnection

Figure 1 shows the main market participants for IP interconnection. The market participants that create content and/or distribute it are primarily shown on the left-hand side. These market participants ultimately aim to reach the end-users, which are shown on the right-hand side. There are several ways in which this is done. From the perspective of the other end-users – the content providers – the relationships are different and depend on the scale of the content providers. Small content providers usually make use of cloud and hosting providers for the storage and processing of data and for running applications. Larger content providers often do more by taking care of their own webhosting and purchasing transit from transit / backbone providers. However, due to cost and performance considerations, they outsource content distribution to CDNs that are often able to purchase transit much more economically.

For large content providers, it is profitable to make investments in international networks and peer with internet access providers. For the all-time major content providers, it is even attractive and cost-effective to develop their own CDNs instead of, or in addition to, third-party CDNs. For example, Google partly hosts its own content, purchases transit, invests in its own worldwide networks and peers with many IAPs and offers its own CDN for use in the networks of the major IAPs. Being a major content provider in video streaming, Netflix does not make use of CDNs, but rather three ways involving major investments in transmission and storage to deliver its content to the end-users as close as possible: (1) direct peering with IAPs, (2) the use of transit, and (3) the placement of cache servers in the IAPs' networks.

It is often difficult in practice to differentiate the activities of the market players described above, and there is an overlap of activities: many market players offer multiple types of services so that customers can purchase a larger part of their connectivity solution from just one single market participant.

2.6 IAPs' peering policy

The largest internet access providers and the backbone providers within the holding have a different peering policy and apply different conditions for interconnection. Tables 1 and 2 provide an overview of the main features.

Table 1: Peering of the largest internet access provider in the Netherlands[14]

Company	Network number	Number of peering locations in the Netherlands	Locations: locally, regionally, globally	Traffic level	Public peering, where?
KPN	AS1136	6 (public peering)	regionally	1-5 Tbps; mostly inbound	Peering via NL-IX and R-IX
GTT (previously KPN International)	AS286	3 (public peering) 10 (private peering)	globally	1-5 Tbps; mostly inbound	Peering via AMS-ix, NL-IX, R-IX,
VodafoneZiggo	AS33915 AS9143	2 (public peering) 9 (private peering)	Europe regionally	50-100 Gbps, mostly inbound 5 Tbps; mostly inbound	Peering via AMS-ix
Liberty Global[15]	AS6830	5 (public peering) 4 (private peering)	globally regionally	7 Gbps balanced (1:3) traffic	Peering via AMS-ix, NL-IX, Asteroid, Equinix
T-Mobile	AS31615 AS50266	0 (public peering) 1 (private peering) 4 (public peering) 2 (private peering)	Regionally regionally	-, mostly inbound -, mostly inbound	- Peering via AMS-ix, NL-ix
Deutsche Telekom	AS3320	1 (public peering) 3 (private peering)	globally	50-100 Tbps Usually inbound	Peering via AMS-ix
Delta Fiber Nederland	AS15542 (Zeelandnet)	0 (public peering) 6 (private peering)	regionally	100-200 Gbps, mostly	-

[14] peeringdb.com, consulted on December 18, 2020
[15] https://www.libertyglobal.com/operations/business-services/global-peering-principles/

				inbound	
Delta Fiber Nederland	AS15435 (CAIW)	4 (public peering) 2 (private peering)	Europe	300-500 Gbps, mostly inbound	Peering via AMS-ix, NL-ix

Table 2: The internet access provider's peering policy[16]

Company	Multiple locations	Ratio requirement	Contract requirement
KPN	Preferred	Yes	Yes
GTT (previously KPN International)	Required - internationally	Yes	No
VodafoneZiggo	Not required	No	No
VodafoneZiggo	Preferred	Yes	Yes
Liberty Global[17]	Required - internationally	Yes	Yes
T-Mobile	Required - EU	Yes	Yes
T-Mobile	Not required	Yes	No
Deutsche Telekom	Required - internationally	Yes	Yes
Delta Fiber Nederland (Zeelandnet)	Preferred	No	Only privately
Delta Fiber Nederland (CAIW)	Preferred	No	Only privately

Broadly speaking, the small IAPs have a more open peering policy than the large IAPs. The large market participants have also tightened their peering policy compared to 2015. It is noteworthy that for upstream, KPN (AS1136) makes use of the networks of Liberty Global (AS6830) and Deutsche Telekom (AS3320).[18]

2.7 Prices and costs of IP connectivity

The costs of IP connectivity (comprising equipment to interconnect, connecting to an IXP, and purchasing costs for transit and private peering) are relatively limited for IAPs compared to other costs for providing services to end-users, such as the construction and management of access and core networks. Below, ACM briefly discusses the prices and costs for IP interconnection.

Transit
The previous study indicated that the prices for transit have dropped considerably. In recent years, there has been no public, reliable information available on transit prices. However, the conversations have created the image that the transit prices have dropped even further over the past few years. This appears to be the result of economies of scale (high fixed costs with low marginal costs), falling prices of equipment (larger ports with lower costs per data unit), and a substantial increase in data volume.[19] Smaller market participants profit less from the transit price decrease: they pay a relatively high price for their lower bandwidths. For instance, 100 Gbit/s costs about ten times as much as 1 Gbit/s.

Public peering

[16] peeringdb.com, consulted on December 18, 2020
[17] https://www.libertyglobal.com/operations/business-services/ip-interconnection-portfolio/
[18] https://bgp.tools/
[19] https://blog.telegeography.com/global-ip-transit-prices-decline-pandemic-covid19

The prices for joining an IX to be able to peer publicly are known to some extent. AMS-IX publishes the tariffs[20], NL-ix provides them upon request. Asteroid also publishes the prices. The costs are a one-off access to the IX and a monthly amount to use a port (with a maximum data traffic capacity per time unit).

Table 3: tariffs IV in the Netherlands

Tariffs	**AMS-IX**	**NL-ix**	**Asteroid Amsterdam**
Entrance fee **(in euros)**	0		
Set-up fee			200 (port 10 GE / Gbit/s) 1,000 (port 100 GE / Gbit/s)
Internet peering (**in euros per month**)			
Port 1GE / Gbit/s	250	Upon request	75
Port 10 GE / Gbit/s	720	Upon request	225
Port 100 GE / Gbit/s	3,600	Upon request	1,125
Discount for additional port 100 GE	3%	Upon request	-
Cross-connect	Depending on the location	-	-

The costs of the use of AMS-IX are average in comparison with the main IXs in the surrounding countries. Table 4 presents a comparison of the tariffs under different usage. It should be noted that in many cases, the greater the range, the higher the tariff.

Table 4: costs of IXs in surrounding countries[21]

	100 GE / Gbit/s **price**	**10 GE** / Gbit/s **price**	**Cents/month/ Mbps 85% use 100 GE** / Gbit/s	**Cents/month/ Mbps 40% use 100 GE** / Gbit/s	**Cents/month/ Mbps 85% use 10 GE** / Gbit/s	**Cents/month/ Mbps 40% use 10 GE** / Gbit/s
AMS-IX	3,600	720	5.00	4.20	9.00	8.50
LONAP (London)	1,940	285	6.81	2.30	4.90	3.40
LINX LON1	3,253	676	4.81	3.80	8.10	8.00
LINX LON2 (London)	2,105	434	4.85	2.50	5.30	5.10
SwissIX (Zürich)	2,309	416	5.55	2.70	5.80	4.90
BCIX (Berlin)	2,889	714	4.05	3.40	7.20	8.40
ECIX (Germany)	3,278	528	6.21	3.90	8.20	6.20
BNIX (Brussels)	4,264	717	5.95	5.00	10.70	8.40
FranceIX (Paris)	4,300	850	5.06	5.10	10.80	10.00
Equinix (Paris)	3,861	792	4.88	4.50	9.70	9.30
NetNod (Copenhagen, Stockholm)	3,337	741	4.50	3.90	8.30	8.70

Private peering

As the name suggests: the prices for private peering are private. ACM does not have any concrete tariffs for the payment for IP interconnections. ACM concludes from the conversations with the market participants that the costs for private peering differ substantially and can vary between a few cents and several tens of cents per Mbps per month for IAPs. These costs are influenced by the expected added value of the connection for both parties and the extent of the negotiating power.

[20] https://www.ams-ix.net/ams/pricing

[21] https://peering.exposed, consulted in January 2021

Large data centers in the Netherlands, such as Equinix, also offer cross-connects, which have attractive port prices, mostly enabling the larger IAPs and CAPs present in their data centers to now interconnect at a relatively inexpensive rate.

The costs for private peering are relatively limited for IAPs. Public peering is more expensive per data unit for the larger IAPs. Much larger cost items include the maintenance of the access and core networks. The purchase of content in terms of the costs for end-users is also relatively more expensive for IAPs than the costs made for IP connectivity with third parties.

CAPs and CDNs
In the context of this market study, ACM has not extensively explored the purchasing costs of IP interconnection for CAPs and CDNs. The tariffs for transit and peering for small market participants (CAP) are not known and the relative interest of distribution costs vary between CAPs. Small CAPs presumably pay more or even a lot more for transit per data unit compared to large CAPs that engage in peering. For CDNs, the cost of operation – in addition to interconnection – lies in hardware and colocation, with the first cost being the biggest.

3 Market developments

ACM dedicates this chapter to describing the main developments that have emerged from its study and the conversations with market participants. ACM also looks back at the developments over the last few years and the main developments that will occur in the foreseeable future. In terms of these developments, ACM continuously refers to Figure 1 and the relationships between the various players involved in the market developments.

3.1 Consolidation, vertical integration and expansion

Over the past few years, since 2015, we have seen further consolidation in the Netherlands.

- The number of internet access providers has further decreased compared to 2015 and the concentration ratio has increased. T-Mobile and Tele2 Nederland have merged, Delta Fiber Nederland has been created through a merger of some regional market players (Delta/Zeelandnet, CAIW) by EQT, Liberty Global and Vodafone have placed their Dutch networks (Ziggo and Vodafone Nederland) with the joined venture VodafoneZiggo. Only Freedom Internet is a new entrant to the market.
- In recent years, many data centers have been acquired and owned by other companies, predominantly American companies. In 2019, Digital Realty took over Interxion. Before that, Equinix purchased a data center from Switch and Evoswitch came into the hands of Iron Mountain. The Datacentergroup and NLDC came into German hands. Equinix and Digital Realty are now the main providers in the Metropolitan Region Amsterdam. The market share of these market participants, measured in terms of supply based on revenue, available floor area, available capacity, peering partners and internet traffic is about 25% for both of them collectively.[22] These two companies service a particularly unique number of peering networks in their data centers.[23] Particularly because of Equinix's data centers, a large part of the internet data traffic runs through the Metropolitan Region Amsterdam.
- For cloud and hosting providers, consolidation is noticeable due to a migration from private cloud to public and hybrid cloud, whereby Amazon, Google and Microsoft show strong growth. All major clouds and CDNs are US operators, which have taken over the market in terms of the distribution of audiovisual content over the past decade.
- The growth of content has increased the importance of content distribution of video and other data. The main CDN providers (Akamai, Limelight and Cloudflare, amongst others) have expanded further. For end-user IAPs, the vast majority of traffic today comes from a limited number of market participants such as Facebook, Google, Netflix, Akamai and Cloudflare, with the big players appearing to be getting bigger. Local content distributors have nearly all been taken over by large and mainly US market participants.

The largest market players in IP interconnection in the Netherlands also show a trend of further integration of different activities, also known as forward and backward integration, on the one hand and further focus and specialization on the other hand. On the one hand, the traditional IAPs focus on their nationwide activities and access networks (KPN, for instance), while large international market players, on the other hand, are expanding their scale of activities. Table 5 provides an overview of the main

[22] ACM, Assessment concentration Digital Realty – Interxion, ACM/UIT/527319.
[23] Source: Peeringdb.com

internet access providers' activities; table 6 shows the large international market players in the Netherlands.

Table 5: internet access providers and the sale of activities in the chain in the Netherlands

Company	IAP	Transit / backbone	IX(P)	Hosting / cloud	Data center	CDN	CAP
KPN	KPN	- (international network sold to GTT)	NL-IX (100%)	KPN Cloud (business services and applications)	Yes, colocation services NLDC have been sold	-	KPN Ventures may have[24] interests
VodafoneZiggo (Liberty Global)	Ziggo Vodafone	Liberty Global	-	-	Nee, only its own	Yes	Pay TV (HBO, Ziggo Sport, Movies & Series (X)L)
T-Mobile (Deutsche Telekom)	T-Mobile	Deutsche Telekom	-	-			
DeltaFiber Nederland	Zeelandnet CAIW	-	-	-	For personal use only	-	-

Table 6: a few major international market players and activities

Company (apart from IAPs)	CAP	IX(P)	Transit / backbone	Hosting / cloud	Data center in NL	CDN
Google	x (YouTube, Maps, etc.)	-	x	X (Cloud)	x	X
Microsoft	x (Office, Teams)	-	x	X (Azure)	x	X (Azure)
Amazon	x (Prime)	-	x	X (AWS)		X (Cloudfront)
Netflix	x (Netflix)	-	-	-	-	x
Facebook	x (Facebook, Instagram, WhatsApp)	-	-			x

Market participants indicate that economies of scale and consolidation can cause problems. Fewer active market participants mean that the consequences of technical failures are always greater. The world now only depends on less than 10 market participants for a large part of the connectivity and access to content. If there is a technical breakdown at such a large market participant, the whole world would be affected by it today. Some businesses would completely shut down. Competition and the freedom of choice are therefore not optimal. Also see 3.2 and 3.3 for the effects.

[24] See: https://kpnventures.com/#portfolio

3.2 Private peering continues to increase, relative importance of IXs is decreasing

As previously mentioned, in peering, market participants establish direct connections with each other. It requires both a physical and a contractual interconnection to exchange data. Private peering is different from public peering by the point of physical interconnection. Public peering takes place at an internet exchange (IX), while private peering can take place anywhere, for example in a data center or at a location in an IAP's issuing network. Figure 2 shows this schematically.

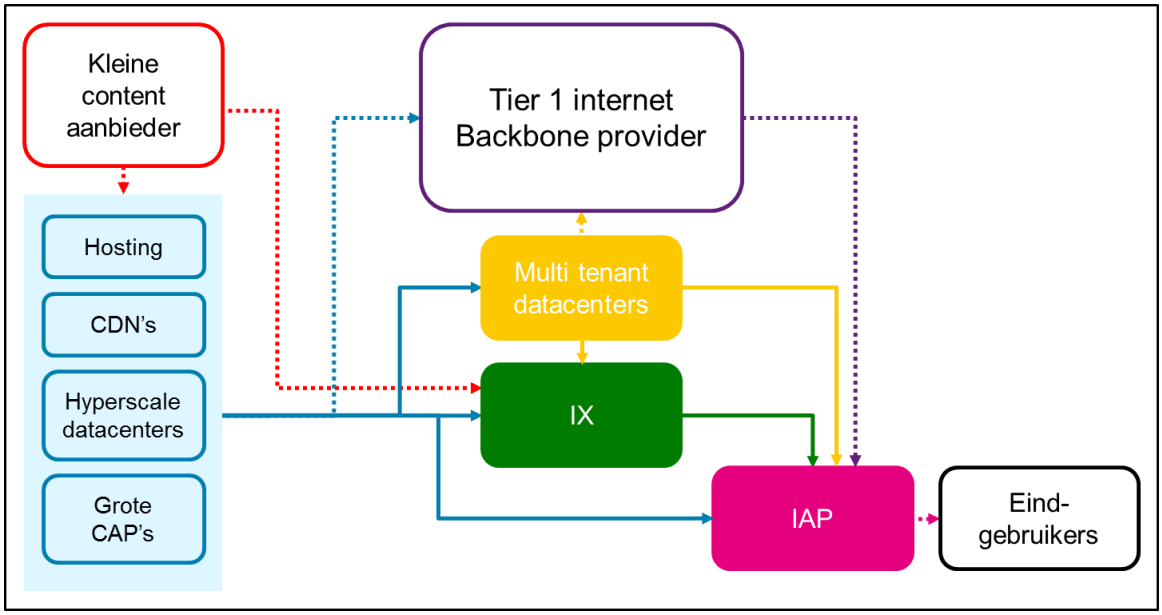

Figure 2: main market participants in shift from public to private peering

A larger part of the traffic is now being sent by a smaller number of market participants. These market participants are increasingly choosing to peer with each other directly, as opposed to via an IX. Before, much of the connectivity ran via independent IXs: they offered and continue to offer the opportunity to reach many market participants through one single port. See the dotted lines in Figure 2. Ports used to be relatively expensive, so it provided significant cost savings when multiple market participants could be reached through one port. IXs thus became a popular option for interconnection. On the one hand, this made it easy for market participants such as IAPs and CAPs to arrange proper connectivity: you connect with an IX and that takes care of the physical aspect. These market participants then connect with other market participants with an open peering policy; the contractual part must then be concluded with those market participants that do not have an open peering policy. On the other hand, this resulted in a strong position for IXs: these exchanges were the place to be for a connection. IXs further strengthened this position by, for example, implementing hardware redundant, so that the reserve set can instantly take over the traffic in case of a malfunction. This reduces the need for market participants to be connected at multiple points of presence (internet nodes), making the IX a one-stop shop for interconnection. IXs also offer additional products and services to support market participants in placing and monitoring connections. Duplicated hardware and additional services also increase costs, which also makes market participants less likely to choose to be connected on more than one IX.

IXs are therefore advantageous for market participants that exchange relatively few traffic with other participants as this traffic can all pass one single port. If the amount of traffic exchanged by two market participants grows, this traffic flow may 'outgrow' the IX. Purchasing an additional port or a larger port from an IX could then become relatively expensive. For these market participants, it would then be more advantageous to establish a direct mutual connection at another location (in a data center, for example): private peering. These two ways of interconnection may co-exist: one market participant can be both connected to an IX and exchange traffic with a number of market participants via private peering. This enables them to cost-effectively handle large traffic flows via private peering and the rest of the traffic via an IX, often through a smaller port (and therefore less expensive) than before they handled the larger flows via private peering. The rest may consist of many small-scale market participants and parties that are difficult to reach via other means. There are also market participants that leave the IXs altogether, and can only be reached via private peering or transit. For example, VodafoneZiggo left the AMS-IX in December 2020[25] [26]and KPN is only peering via the NL-ix, which it took over in 2011. The continued consolidation of the number of IAPs has contributed to this development of the shift to private peering.

The larger market participants, in particular, apply the above practice of private peering. This has an adverse effect on small market participants. They more frequently depend on IXs for their connectivity. Investing in private peering is a relatively costly operation for them, due to the high initial cost of it. It is therefore vital for them that the other market participants are easily accessible via an IX. If other market participants purchase a smaller port from an IX or leave the IX altogether, it will become more difficult to stay properly connected with all market participants. It then becomes more challenging for small market participants to enter the market and grow. This brings with it a risk of innovation and competition from small market participants being curbed.

In most cases, transit may be an alternative for peering. Transit providers bring traffic to destinations, and even global connectivity can be purchased that way. They bundle traffic by route or destination, allowing them to reach more favorable agreements than if each market participant had to enter into bilateral agreements. Transit traffic is usually invoiced on bandwidth. The clients' initial costs are relatively low, and the recurring costs are relatively high in comparison with private peering. This is why transit is often considered a good way for new entrants to start, and it may also be advantageous to deliver traffic to underserved destinations. A drawback of transit that some market participants mention is that they have less insight into and control over the traffic. Traffic is bundled through multiple links from multiple market participants to the final destination (extra hops) and if something goes wrong along the way, it can take a relatively long time to resolve. With peering, it is easier to find out where things are going wrong, and problems can thus be solved more quickly.

3.3 Peering policies raise entry barriers

A peering policy is a set of guidelines that market participants use to determine whether they want to enter into a peering relationship with another market participant, and subsequently how the amounts of traffic sent back and forth will be handled. Peering policies are regularly adjusted: the minimum amount of traffic that needs to be sent will go up, for example, because the amount of data traffic in the world is always increasing. The conditions are not fixed; the market participants can decide whether

[25] https://www.agconnect.nl/artikel/vodafoneziggo-verlaat-ams-ix
[26] https://www.telecompaper.com/nieuws/vodafoneziggo-is-weg-als-klant-van-ams-ix--1364289

they want to tightly apply their peering policies. It is mostly the larger IAPs that have peering policies set in place. See Figure 3. These policies often include the following subjects:

- Minimum amount of traffic: a market participant wants to peer only if a certain minimum amount of traffic is exchanged between the parties involved. This is because each peer requires a physical connection, contracts must be concluded and monitored to make sure this contract is being complied with, and if exceeded, offsets must be made. Large market participants do not want to do this with too many parties as it means too much work and thus excessive costs.
- The ratio between up and down traffic, in other words, inbound (or incoming) and outbound (or outgoing) traffic. A common ratio is 1:3. Both market participants may send up to three times as much traffic as they receive from the other party, otherwise setoffs must be made. This will ensure that the costs and benefits of transporting traffic are in balance. Otherwise, a market participant that primarily receives traffic and transports it further would assume a disproportionate share of the costs while the sending party benefits.
- Location of interconnection: agreements on the number of nodes on which the physical interconnection is realized, and at which locations. For example, parties may require the applicant to bring traffic to a location where the party already has infrastructure. To avoid peaks, parties may also require several locations for interconnection.

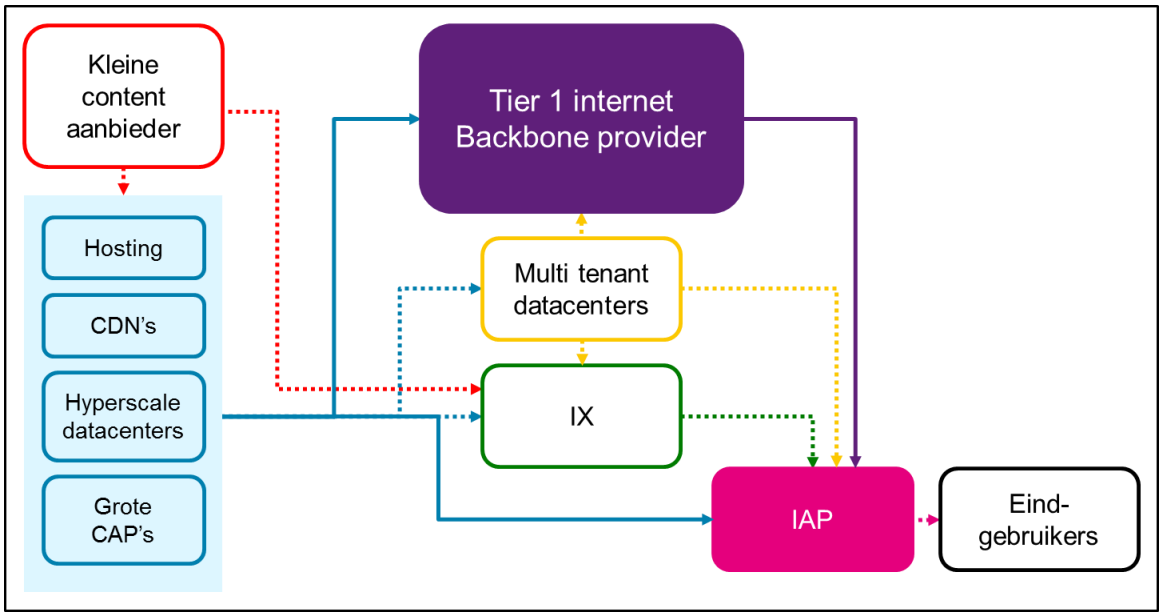

Figure 3: main market participants and relations in peering policies

For large peering contracts, some of the terms may also be waived: Liberty Global, for example, sets no requirements in terms of the in:out ratio if a party sends more than 100 Gbps in one country.[27]

From the perspective of large market participants, it does not seem unreasonable that they would only be willing to invest in direct connections with market participants with whom a lot of traffic is exchanged. However, peering policies with more favorable conditions for other large market participants do raise a barrier for entry for new CAPs, CDNs, small-scale business IAPs and hosting providers: until these market participants are large enough to supply sufficient traffic, delivery of traffic

[27] https://www.libertyglobal.com/operations/business-services/global-peering-principles/

is relatively costly, possibly making it difficult to grow. The relatively costly start is reflected, for example, in the mandatory purchase of a large port with relatively limited traffic that leads to higher costs per unit volume. Sending traffic is a relatively large expense for such market participants.

These disadvantages for smaller CAPs and CDNs vary depending on the type of content. Peering may be done much more easily for game hosting than for video streaming, for example, as it often meets the requirements of balanced traffic, i.e. the in-out ratio.

Less open peering may result in a scaling back of services. Smaller market participants that develop non-standard connectivity products for digital SMEs need good oversight of what is happening with their clients' data. If they operate by means of open peering, whereby everyone connects to each other to have everyone well connected, they will manage it well. If a smaller market participant wants to connect with a larger market participant that has a peering policy, this may be difficult. Peering policies often impose conditions on the minimum amount of data that need to be exchanged before a direct connection is established. Smaller market participants have more difficulty in achieving this amount of data, and thus will not be eligible to enter into a peering relationship. The only option left is transit, which has the downside of less control over the quality of the traffic, as explained in Chapter 3.2. It thus becomes more difficult for smaller companies to provide a good service to their customers for whom a standard internet product, as the only offering available with large IAPs, is not sufficient.

In addition to a possible deterioration of quality, peering policies also have an impact on costs. The earnings from traffic from both sides by IAPs is also referred to as double dipping. In other words, the earnings from the end-user subscriptions on the one side, and the earnings from incoming traffic from market participants on the other side. The method of tariff setting depends on the competitive situation on both sides of the market. If the competition on the internet access markets, i.e. the end-user subscriptions, are relatively strong, IAPs may choose to deploy peering revenue from inbound traffic to improve the quality or to reduce the subscription prices in order to strengthen their position. If, by contrast, IAPs want to strengthen their position on the side of the inbound traffic, they may choose to offer advantages to the parties on the side of the inbound traffic, such as lower tariffs or no tariffs for interconnection, or by offering free space for caches in its network. If an IAP has a certain power owing to a large customer base of end-users and limited competition on the end-user side, that IAP may also opt to not use this income to improve the quality of the service provision, but use this power to increase the tariffs. Risk factors for onerous conditions in peering policies mentioned by market participants include the lack of competition between IAPs and vertical integration between transit providers and IAPs. If both factors are present in an area, market participants (such as CAPs, CDNs, hosting companies, etc.) that want to deliver traffic to reach the end-users then depend on one single market participant that also has earning money from routing traffic as its business model.

3.4 Large CAPs continue to grow

As previously described, there is a large number of types of content and application providers (CAPs) that operate on the market for IP interconnection, consider video streaming services, social media platforms, game publishers and providers of programs and mobile apps.

In the area of video streaming, Netflix and Disney have seen a significant growth in recent years as CAPs and these companies are still growing, both nationally and internationally.[28] The Dutch market

[28] https://www.telecompaper.com/achtergrond/streaming-partijen-leveren-in-na-einde-lockdown--1359935

for video streaming is relatively concentrated. There are a number of major market participants, of which Netflix is by far the largest, with Videoland a fair distance behind.[29] Disney+ and Amazon Prime are on the rise, though. It is noteworthy that the percentage of households with a subscription to a streaming service that only has a Netflix subscription has dropped from two thirds to a half in a year's time, probably due to increased supply and competition.[30] Market participants are trying to grow quickly and gain a greater share of the market through price differentiation[31] and exclusive content, among other things.[32]

It does appear to be possible for relatively small and national video streaming services to differentiate in terms of content. In the Netherlands, market participants such as NPO, Videoland (RTL) and platforms to review TV shows generally offer a different content than international CAPs. Households also seem often to combine subscriptions to streaming services. The most popular combination appears to be Netflix + Videoland, which may suggest that Netflix and Videoland are complementary. However, it should be noted that it has been proposed that international streaming services also be required to invest a percentage of their Dutch turnover in the (co-)production of Dutch films and series.[33] This may reduce the 'uniqueness' of the national market participants' content.

In terms of social media, the market is dominated by large American platforms: Facebook & Instagram, Google & YouTube, Twitter, Snapchat, LinkedIn and Pinterest are all US social media companies. A striking newcomer is the Chinese company TikTok, which became popular in the Netherlands during the coronavirus crisis. These major market participants generate such a higher volume of traffic compared to local media operators that they can gain a much better position in terms of peering.

Different market participants operate in the gaming industry: game developers, publishers, digital distribution platforms (such as Steam), and hardware producers of consoles and PCs, for example. In terms of interconnection, there is also an additional distinction to be made between sending data traffic related to content, e.g. digital game releases and updates. This "periodic" large amount of data traffic is sent to end-users via CDNs. This large amount of data traffic is expected to continue to increase in the coming years. More and more games appear to be sold digitally, through digital distribution platforms.[34] [35] Online gaming requires hosting providers, which host the game servers. These providers ensure that gamers are connected to each other with the lowest possible latency.

Additionally, companies that develop and launch those programs and applications are also considered to be CAPs. The programs that are being used for video conferencing have shown an interesting development since the coronavirus outbreak. For example, the number of Microsoft Teams users increased by 70 percent in the first weeks after the coronavirus outbreak, as many people had to work from home.[36]

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[29] The Telecompaper report shows that there were 5,590,000 subscribers in July 2020. Netflix has 2,940,000 subscribers, Videoland 980,000 and Disney+ 430,000.
[30] https://www.telecompaper.com/pressrelease/netflix-disney-blijven-groeien-fox-sports-komt-weer-op-gang--1356342
[31] The price of the cheapest Netflix subscription is 7.99 euros per month, the price of the cheapest Disney+ subscription is 6.99 euros per month, and the price of an Amazon Prime subscription in 2020 is 2.99 euros.
[32] Telecompaper: Compared to January 2020, the number of subscribers to Netflix, Disney+ and Amazon Prime grew by 5.4%, 11.8% and 170.8%, respectively.
[33] https://www.rijksoverheid.nl/actueel/nieuws/2019/12/19/meer-geld-voor-nederlandse-films-en-series-door-investeringsverplichting
[34] The figures from Sony show that in 2019 more digital versions of PS4 were sold worldwide than physical copies. This is 55% in 2019 against 43% in 2018. https://www.sony.net/SonyInfo/IR/library/presen/er/pdf/20q2_supplement.pdf
[35] Sony responded by releasing for the first time in November 2020 a digital edition of their new console, the PlayStation 5. https://www.playstation.com/nl-nl/ps5/
[36] https://www.rtlnieuws.nl/tech/artikel/5107431/microsoft-teams-heeft-meer-dan-75-miljoen-dagelijkse-gebruikers

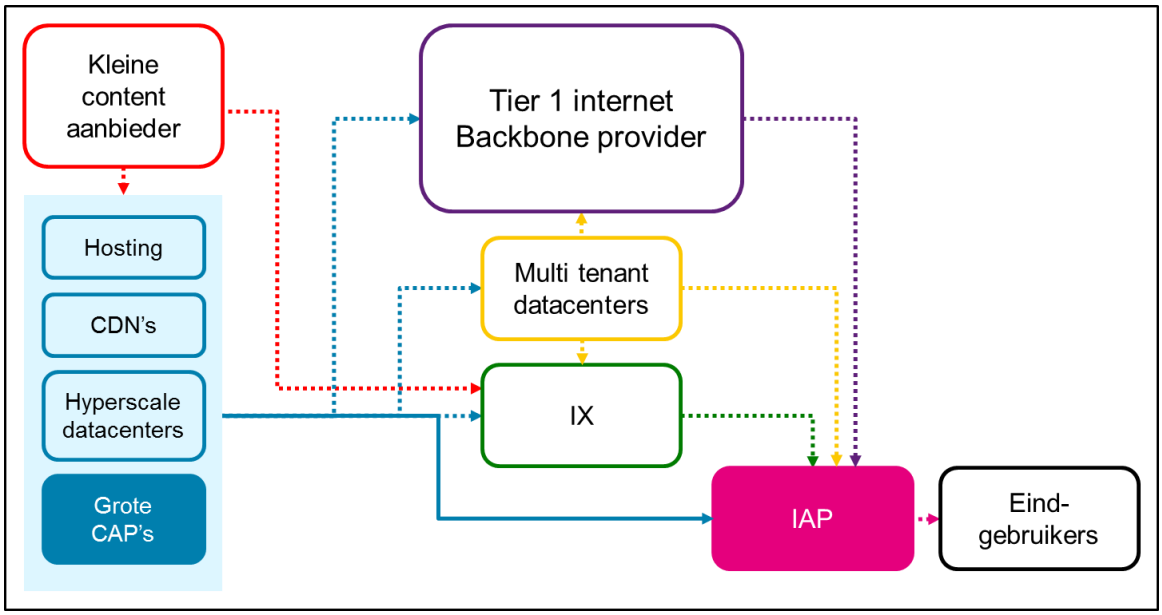

Figure 4: relationship between large CAPs and IAPs

The conversations with market participants reveal that the share of the amount of data sent by CAPs via IAPs to end-users continues to increase in comparison with the total amount of data. The conversations show that the majority of the IP traffic is caused by a limited number of about ten market participants, including Netflix and Google (YouTube).

Figure 4 schematically shows the ways in which CAPs can reach end-users. For relatively low amounts of data traffic, CAPs usually use the services of internet exchanges (IXs) or content delivery networks (CDNs). These services have benefits and drawbacks for CAPs. Many different parties can be reached via IXs and CDNs, against relatively low initial costs. The greater the amount of data traffic, the more appealing it becomes for a CAP to directly connect with an IAP, and thus engage in private peering, and perhaps install a cache to ensure that the most popular content is close to the user. Apart from an initial investment, this is a low-cost means of interconnection. In addition, it is easier for both CAPs and IAPs to monitor data traffic. Quality is better guaranteed, and it is possible to respond relatively quickly to the amount of data requested by end-users.

As a result of the growing demand for content of major CAPs and the increasing share of the amount of data traffic resulting from these market participants, the larger CAPs have obtained an increasingly better negotiation position relative to IAPs. Whereas in the past there had been rumors of heated competition between IAPs and major CAPs, with IAPs believing that major CAPs should pay for sending large amounts of data (double dipping), these major market participants now seem to be more balanced with each other. In the past, IAPs considered major CAPs to be competitors to IAPs' television programming, such as interactive TV. Nowadays, however, they recognize the added value of large video streaming services such as Netflix. Both CAPs and IAPs share a strong incentive to offer consumers the best possible experience, and this requires solid connectivity. End-users increasingly value a good internet connection, and in the event of problems with a service, the IAP is the first to be held accountable for this. For major CAPs, settlement-free peering now seems to be the standard.

To give end-users the best possible experience, CAPs with sufficient scale have the option of installing caches in the networks of IAPs. Installing caches offers different advantages. By storing the CAPs'

data on caches in the IAPs' networks, it reduces the amount of data traffic between CAPs and IAPs. In addition, the data are stored closer to the end-users, making it possible to load certain content even more quickly, such as the most popular videos, and it increases CAPs' quality of services. If CAPs of sufficient scale want to install caches in an IAP's network, it may be worthwhile for IAPs to do so. This involves relatively little cost for IAPs, and it is conducive to the customer experience. However, IAPs only have limited space within their own data centers and network locations to install caches of a large number of CAPs in networks, which is why they are not always inclined to install them. Moreover, disputes may arise over the maintenance and security of the servers.

Major CAPs also enjoy other advantages such as being allowed to program directly on the firmware of IAPs' set-top boxes. This gives them more options when programming, allowing them to offer end-users finer, better and faster apps. Smaller market participants do not have such options and have to make do with more limited options to program their apps.

For small CAPs, it is often more difficult to reach end-users with their content in the best possible way. IAPs have a strong bargaining position relative to small CAPs and often do not meet the eligibility requirements for favorable peering policies. IAPs are often reluctant to establish a direct connection (private peering) with many small CAPs due to cost considerations, which means that small CAPs often have to pay high tariffs to reach IAP end-users, or they have to use IXs, CDNs and transit providers to do so, resulting in possible inferior quality.

Also, from a CAP's point of view, it is not always advantageous to install a cache in a major IAP's network. Such investments create dependency, less freedom and a poorer bargaining position in future contract negotiations. Before making such investments, small CAPs must assess whether the benefits of an improved product outweigh the disadvantages of greater reliance on IAPs, with the associated risks.

As a result of the above developments, it is relatively difficult for small CAPs to compete with large national and international market participants in terms of connectivity and be able to grow to a size that would qualify them for more favorable peering with IAPs. The quality of a connection set up via a transit provider is often more difficult to guarantee for small CAPs as they have no control over the connections. There is less overview of the data traffic, and in case of any problems, it is more difficult to determine exactly where the problem is compared to any problems when connecting directly. Interviewees indicate that such entry barriers can act as a threshold for innovative start-ups to grow.

3.5 Data centers take over part of IXs' services with cross-connects

In addition to traditional data center services (selling racks), multi-tenant data center providers[37] are increasingly offering interconnection services in addition to colocation, thereby taking over some of the services provided by IXs. Two technologies are used to enable physical connections between networks in a data center – peering – without the data transferring via a third party: cross-connects (direct connections) and network switches. In cross-connects, a cable is pulled directly from one market participant's equipment to another market participant's equipment within the data center. A network switch allows customers to connect to an internet exchange and then (through the exchange) to other members of the IX, without having to install separate cables.

[37] Multi-tenant data centers, otherwise known as colocation data centers, manage servers for multiple customers.

If multiple market participants are customers of the same data center, it is relatively easy for a data center service provider to establish so-called cross-connects, or patches, between these customers. The more customers a data center has, the greater the benefit to the customer. This market is therefore characterized by network effects.

As previously mentioned, large market participants choose to connect directly to each other, rather than connecting through an IX. The one-to-many advantage of IXs thus seems to be diminishing, and as a result, IXs are becoming a less preferable option for broad connectivity.

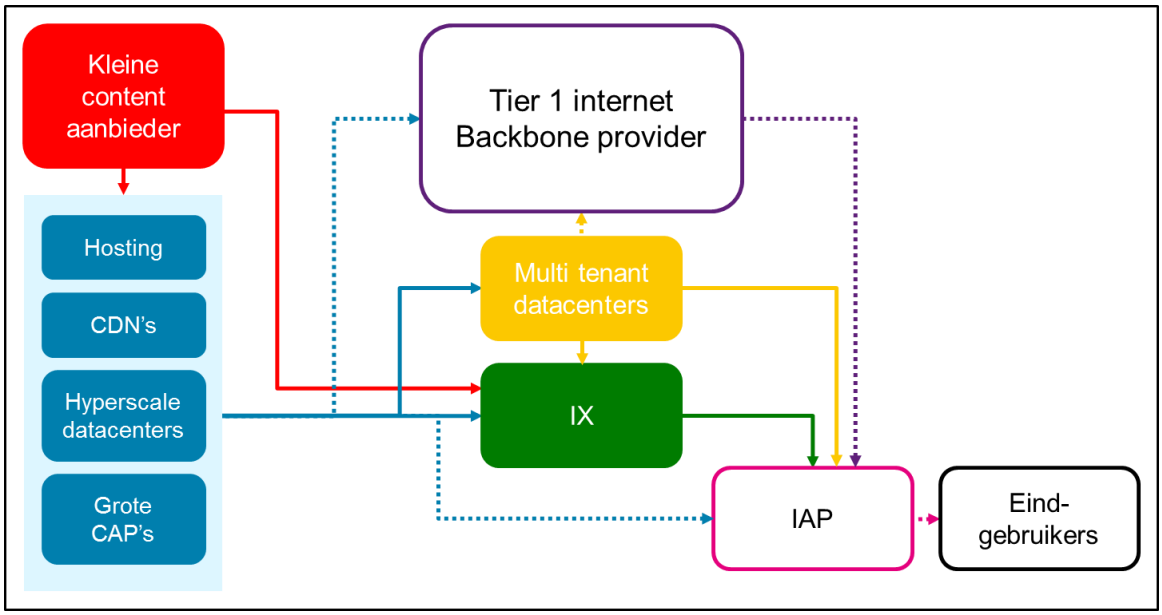

Figure 5: data centers in relation to IXs

Conversations between ACM and market participants have repeatedly revealed that data centers offer ports to certain existing or potential customers relatively cheaply. In the short term, this puts pressure on the IXs, which promotes competition and reduces the prices. However, several interviews have also shown that this erodes the position of IXs, such as the AMS-IX, and diminishes the diversity on these nodes. This could be detrimental to small market participants, which depend on IXs for their interconnectivity.

Different market participants also observe threats caused by these developments. Large data center service providers are increasingly becoming one-stop shops. This may lead to lock-in effects at large data center service providers. When more and more services are purchased from multi-tenant data centers, it will become more difficult to switch to another market participant. The transfer costs of switching data centers and data center service providers are high. In addition to "physical" transfer costs, market participants also instantly lose interconnectivity with a large number of other market participants upon leaving the data center. At the same time, the number of market participants connected to traditional IXs is decreasing, which also makes this alternative for interconnectivity via data centers less and less appealing. This may create a strong position for data centers in the longer term, which could drive up the prices of a combined offering of data center racks + interconnectivity.

3.6 Undersea cables: ongoing attention to international connections

As the name suggests, undersea cables are cables laid on the seabed that form an essential link in internet traffic between different continents, through intercontinental cables, and partly or wholly within Europe. Fiber optic connections over land and under the sea ensure that countries are interconnected. One single cable has tens of Tbps if not hundreds of Tbps of capacity.[38] At the endpoints of the undersea cables, internet nodes link routes with other national and international networks. Telecommunication links between countries and continents are therefore of great importance for connectivity to and around the world.

During the interviews, a number of market participants expressed concern that the international connectivity position of the Netherlands will be under pressure. The cables connecting the Netherlands are getting outdated[39] and new undersea cables underway are heading towards other countries. As a result, they fear that the Netherlands may not be as competitive in the future, as the Netherlands will then only be indirectly connected. According to a number of market participants, the Netherlands will then lose its competitive and digital main port position.

However, there is room for some nuance in this. According to some market participants, continental underground connections via dark fiber are a good alternative to undersea cables on certain routes. The shorter distance and fewer intermediate stops mean that the quality of the connection is better. Market participants do indicate that undersea cables to the United Kingdom and Scandinavia are important as well as the Cobra cable between the Netherlands and Denmark.

The question of whether or not to renew the undersea cables and the issues surrounding them are first and foremost choices to be made by market participants, in which the government can act as a facilitator. This issue has already been flagged by the Ministry of Economic Affairs and Climate Policy.[40] In the Letter to Parliament of October 23, 2020, the State Secretary indicates to have spoken with market participants and that different insights have emerged. A new undersea cable will be installed between England and the Netherlands, which will also be connected to Ireland. This cable can be used to transport traffic directly to the United States. The Letter to Parliament also mentions a diffuse picture of the added value of direct intercontinental connections compared to connections via other countries. For example, market participants that have large data centers in the Netherlands indicate that they do not foresee a future problem in this area. During the roundtable discussions organized by the State Secretary, it was also emphasized that the loss of cables would not impact Dutch users in general, but that for the economic position of the Netherlands it would be preferable to have easy accessibility and that direct cables could therefore be of added value. In the Letter to Parliament, the State Secretary emphasizes that she appreciates the added value of the undersea cables for the Dutch digital infrastructure, and that she is prepared to act as a facilitator, should market participants or consortiums of market participants consider bringing a new undersea cable to the Netherlands. ACM believes that international connections deserve continued attention from policymakers to ensure that they evolve with the needs of the market. The consideration of whether a connection should be by sea or land is not decisive. What is important, is that new connections are built regularly and that the routes are as short as possible.

[38] The Stratix Study, Quick scan - International data connectivity across the sea, March 14, 2019, Available (in Dutch only) at: https://www.rijksoverheid.nl/documenten/rapporten/2019/03/14/quick-scan-internationale-dataconnectiviteit-over-zee
[39] Market participants indicate that the main undersea cables to the Netherlands were laid in the nineties and are near the end of their technical lifespan.
[40] Keijzer, M.C.G. (October 23, 2020). Overview of the undersea cable issues, research and actions. Available at: https://www.tweedekamer.nl/kamerstukken/brieven_regering/detail?id=2020Z19570&did=2020D42150

3.7 Geographic diversity of increasing importance

In the Netherlands, large international content providers (CAPs) and providers of connectivity (IAPs) primarily connect in the Metropolitan Region Amsterdam. The growth of data traffic and the expansion of multi-tenant (colocation) data center operations, IXs, and tier 1 and tier 2 providers and large IAPs in this region, have made it more difficult to find locations with adequate electricity supply. If grid operators cannot deliver a connection in time, market participants sometimes choose to build the connection themselves, in consultation with Tennet. Grid operators also publish maps to show the available space in the power grid.

The limited distribution of these operations in the Netherlands poses a risk to the resilience of the Dutch digital ecosystem. However, a more geographical distribution of these operations and locations across the Netherlands will not automatically come about due to the so-called chicken-and-egg problem: investments in connectivity to other locations in other regions are more difficult to achieve if there are no major market participants in contents and – conversely – major content market participants will not invest in a new location if there is no connectivity.[41] Additionally, it is also important to have enough skilled workers available.

Figure 6: geographical distribution of data centers in the Netherlands[42]

Figure 6 shows that the number of data centers are indeed concentrated in the Metropolitan Region Amsterdam, which harbors 36 data centers, and that there are mostly smaller data centers spread across the Netherlands. Of all data centers in the Netherlands, 70% of them are located within

[41] Interview report NL-IX
[42] Source: https://www.datacentermap.com, consulted on February 2, 2021.

approximately 30 kilometers from Amsterdam. As a large independent IX, AMS-IX is also situated in the Metropolitan Region Amsterdam.

A greater distribution of data centers within the Netherlands and a decongestion of the Metropolitan Region Amsterdam creating several large centers could prevent any potential future problems. Key is attracting enough users without the risk of overloading space and power grids, while at the same time ensuring sufficient availability of skilled workers. The Ministry of the Interior and Kingdom Relations is currently drawing up a National Environmental Vision to distribute the data centers across the Netherlands.[43]

43
https://www.denationaleomgevingsvisie.nl/samenwerking+en+uitvoering/programmas/ruimtelijke+strategie+datacenters/default.aspx

4 Legal framework

4.1 Introduction

Previous chapters provided a description of the market for IP interconnections and the market developments. This chapter focuses on the appropriate legal instruments available to ACM pursuant to laws and regulations to address potential problems in the IP interconnection market. The market developments outlined in the previous chapter will be used in this chapter to provide insight into possible solutions from the power vested in ACM by virtue of the law.

With respect to IP interconnection, ACM has the power to act and/or to impose obligations under the Dutch Telecommunications Act and the Dutch Competition Act. ACM may furthermore also act under directly applicable European law.[44] Section 24 of the Dutch Competition Act and Article 102 of the Treaty on the Functioning of the European Union prohibit companies from abusing their dominant position on a particular market. Pursuant to Chapter 6a of the Dutch Telecommunications Act, ACM may determine a significant market power among companies in the electronic communications sector, and if necessary, impose obligations on them. Moreover, the Dutch Telecommunications Act stipulates the obligation to negotiate on interconnection (as well as on interoperability), and ACM's authority to impose interconnection obligations in the event of non-compliance with the obligation to negotiate.

This Chapter covers both national laws and regulations and European laws and regulations and will elaborate on the instruments referred to above.

4.2 IP interconnection in the Dutch Telecommunications Act

The Dutch Telecommunications Act defines interconnection as "*a specific type of access realized between public network operators, involving the physical and logical interconnection of public communication networks used by the same or another company to enable the users of one company to communicate with those of the same or of another company or to access services offered by another company*".[45] IP interconnection, or interconnection across the network layer, is a logical access link between two networks in this definition.

The Dutch Telecommunications Act refers to public electronic communications services or providers of public electronic communications services, publicly available access services provided via public electronic communications networks: electronic communications networks used wholly or mainly to provide public electronic communications services. The term electronic communications network includes *transmission systems, including switching or routing equipment, network elements that are not active and other means, which allow the transmission of signals by cables, radio waves, optical or other electromagnetic means, including satellite networks, fixed and mobile terrestrial networks, electricity networks, insofar as they are used to transmit signals and networks for radio and television broadcasting and cable television networks, regardless of the nature of the information transmitted.*

[44] Article 101 and Article 102 of the Treaty on the Functioning of the European Union.
[45] Following the implementation of the EECC, the new Dutch Telecommunications Act will add to this description [...] *if such services are offered by the relevant parties or other parties with access to the network*.

The Dutch Telecommunications Act also defines the associated facilities and services. These include ancillary services and infrastructure associated with electronic communications networks, which enable the provision of internet access. In other words, these are the building blocks that may form part of telecommunications networks and services.

IAPs are providers of publicly available internet access services, in other words, Internet Access Service (IAS), and therefore qualify as providers of public electronic communications services. Market participants that have their own network at their disposal that can offer public electronic communications services are covered by the definition of providers of public electronic communications networks. Consequently, CAPs, CDNs and data centers are not providers of public electronic communications services. However, they may choose to additionally offer connectivity for public electronic communications services and thus perform public electronic communications activities.

4.2.1 Significant market power

Pursuant to Chapter 6a of the Dutch Telecommunications Act, ACM may determine significant market power among companies in the electronic communications sector. One of the Act's principal objectives is to promote effective competition in the relevant markets in the electronic communications sector to ensure that there is sufficient freedom of choice for end-users, including in terms of price and quality.

Chapter 6a of the Dutch Telecommunications Act contains the principles for imposing obligations on IAPs with significant market power. ACM must assess the relevant markets in the electronic communications sector before imposing ex-ante regulations on a company with significant market power. ACM has three options to initiate an investigation into the relevant markets:

1. the market is designated by the European Commission as a relevant market according to the Recommendation on Relevant Markets;
2. the imposition or enforcement of previous or current obligations by ACM are the result of a significant market power on the relevant market; or
3. ACM has reasons for initiating an investigation (for example in the event of expected competition issues) and passes the three-criteria assessment.

The market for IP interconnections is currently not regulated in the Netherlands (item 2), nor has the European Commission included a market for access to trunk / backbone and terminating segments on the list of the Recommendation on Relevant Markets (item 1). The only possibility for ACM to initiate an investigation into the relevant market is if it has reasons to start an investigation and pass the three-criteria assessment.

The three-criteria assessment
In order to apply Chapter 6a of the Dutch Telecommunications Act on issues pertaining to IP interconnection, ACM would have to prove, if ACM has reasons thereto, that a possible market in the field of IP interconnection meets three cumulative criteria. According to these criteria, ACM can analyze a market that is not listed in the Recommendation on Relevant Markets, if:

1. there are high and non-temporary structural entry barriers;
2. the market structure does not tend towards effective competition within the relevant time horizon; and
3. regular competition law alone is inadequate in resolving the market disruption.

If these three criteria are cumulatively met in the relevant market under consideration, ACM's next step will be to carry out a market analysis. If the market analysis results in the establishment of significant

market power with regard to a provider of an electronic communications network, services or associated facilities, obligations may be imposed on that company in accordance with Section 6a.2 of the Dutch Telecommunications Act. The access obligations may concern, among other things, interconnection and the means of interconnecting to other market participants. See Section 6a.6(2)(i) of the Dutch Telecommunications Act.

4.2.2 Significant market power in practice

As stated above, ACM can pass the three-criteria assessment before performing a market analysis. If the market analysis results in the establishment of significant market power, ACM may impose obligations on the respective company in accordance with Section 6a.2 of the Dutch Telecommunications Act. The law stipulates that the obligations that can be imposed by ACM, **only apply** to providers of a public electronic communications network and/or service. This means that any anti-competitive conduct of other companies active in the field of IP interconnection, such as CDNs, CAPs and IXs, cannot be addressed by means of Section 6a.2 of the Dutch Telecommunications Act. In addition, this procedure requires a heavy burden of proof to determine significant market power in a relevant market. These are lengthy procedures, making it perhaps impossible to timely address the original problem in a rapidly-changing IP interconnection market.

4.2.3 Obligation to negotiate interconnection

On the basis of Section 6.1(1) of the Dutch Telecommunications Act, a provider of a public electronic communications network and/or service may request another provider of a public electronic communications network and/or service that controls the access to end-users, to negotiate in order to take the necessary steps to establish an end-to-end connection. The provider requested to negotiate is obligated to negotiate in order to establish a connection with the provider requesting that access. Either party may apply to ACM if the provider in question believes that the other provider is not fulfilling the obligation to negotiate. ACM may then give instructions regarding the way in which the negotiations must be conducted. The providers in question must comply with the instructions given by ACM. If the negotiations fail to result in an agreement, either party may request ACM to impose interoperability obligations in order to establish an end-to-end connection and to safeguard these under reasonable conditions. If providers fail to meet these interconnection obligations, a dispute may be filed in accordance with Section 12.2 of the Dutch Telecommunications Act.

In short, according to the Dutch Telecommunications Act, parties must enter into negotiations to reach an agreement on interconnection. Additionally, the Dutch Telecommunications Act offers ACM the opportunity to impose obligations with regard to the establishment and guarantee of end-to-end connections.[46] The prerequisite for this is that this is justified in light of the objective in the present case, as referred to in Section 1.3 of the Dutch Telecommunications Act. These provisions of the Dutch Telecommunications Act apply to providers of internet access services (IAPs).

4.2.4 IP interconnection in the Dutch Telecommunications Act following the implementation of the Telecommunications Code

A legislative proposal is currently being prepared to implement Directive 2018/1972 of December 11, 2018, establishing the European Electronic Communications Code (Telecommunications Code) into the Dutch Telecommunications Act. The legislative proposal will, *inter alia,* change Section 6.1 and Section 6.2 of the Dutch Telecommunications Act.

[46] Section 6.2(2) of the Dutch Telecommunications Act.

The proposed text for an amended Section 6.1(1) of the Dutch Telecommunications Act extends the target group of the existing obligation to negotiate to all providers of a public electronic communications network or service.[47] Furthermore, the objective of the negotiations is adjusted to the provision and interoperability of services and the provision of publicly available electronic communications services. As a consequence, the legislative proposal means that providers of transit networks, for example, can also no longer evade negotiations. Given the significance of the availability of publicly available electronic communications services, such parties may be demanded to also open up to requests to negotiate relevant measures in this.[48] If the negotiations do not result in an agreement, ACM may, if needed, impose obligations under Section 6.2 of the Act to providers of electronic communications networks and services to guarantee actual adequate interconnection and interoperability of services.

Guarantee provision

Section 6.2 of the Dutch Telecommunications Act will also be amended. In terms of Section 6.2(1) of the Dutch Telecommunications Act, the legislative proposal will determine that the regulatory authority is tasked with the promotion and guarantee, where necessary, of access, interconnection and interoperability in view of the objectives of the Telecommunications Code, i.e. the guarantee provision.[49] That guarantee provision from the Access Directive was not transposed into national legislation at the time, as it was assumed that this part has no independent value. There have since been rulings from the European Court of Justice in which the Court has ruled that the enumeration provided in Article 5 of the Access Directive[50] is not exhaustive and that the regulatory authority can therefore also take other measures to ensure access, interconnection and interoperability.[51] Based on case law, it can be concluded that the guarantee provision of Article 5 of the Access Directive, now Article 61 of the Telecommunications Code, may form an independent basis for the imposition of obligations. To give effect to the guarantee provision, the legislative proposal incorporates in Section 6.2(5) a power for ACM to impose obligations in the event of a situation that is not covered by the powers set out in Section 6.2(2,3,4) or Section 6.3 and 6.3a of the Dutch Telecommunications Act. It is essentially a catch-all provision for situations not covered by the specific powers referred to above. This could include cases where the party on whom the obligations would fall is not a provider of public electronic communications networks or services, or where it is not a matter of establishing an end-to-end connection.[52] In this context, ACM will also be able to impose obligations on providers of electronic communications networks that do not control access to end-users. Whereas now the regulation with respect to IP traffic applies only to IAPs, after the legislative amendment, CAPs, IXs and transit providers would also be covered by this interconnection regulation. Imposing obligations on the basis of this catch-all provision requires a careful consideration, taking into account the general principles of necessity and proportionality. Moreover, the imposition of the obligations must be justified in light of the objectives of Section 1.3 of the Act. These are therefore cases where the decision not to impose

[47] Section 6.1 will be amended as follows: (a) the following will lapse in the first subsection: “that controls the access to end-users” and “in order to establish end-to-end connections”, and (b) the term “interoperability agreements” stated in the second subsection will be replaced by “interoperability or access agreements”.
[48] Amendment of the Dutch Telecommunications Act, Explanatory Notes, Implementation of the Telecommunications Code, consultation version, paragraph 3.6.
[49] Section 6.2(1) of the Dutch Telecommunications Act will read: The Netherlands Authority for Consumers and Markets promotes and ensures access, interconnection and interoperability of services in pursuit of the objectives referred to in Section 1.3 and taking into account the results of negotiations referred to in Section 6.1.
[50] Directive 2002/19/EC of the European Parliament and of the Council of March 7, 2002 on access to, and interconnection of, electronic communications networks and associated facilities (Access Directive).
[51] See case C-85/14, OJ C 371, of November 9, 2015, consideration 36.
[52] Such as in the case of a market participant in content requesting a provider for interconnection but is refused.

obligations would be detrimental to, for example, competition, interoperability and the interests of end-users.

Section 6.2(2) of the Dutch Telecommunications Act will also be amended, which means that ACM will be empowered to impose ex officio obligations on providers of public electronic communications networks and services that control access to end-users, and in particular also with a view to ensuring end-to-end connectivity.[53] This power is to replace the power set out in Section 6.2(2) of the Dutch Telecommunications Act based on which ACM can only impose obligations in relation to end-to-end connections upon a market participant's request in the event that negotiations did not produce results.[54] This does not detract from the importance and the obligation of conducting negotiations, nor from ACM's authority to give instructions when requested about the manner in which the negotiations take place. See Section 6.1(3) of the Dutch Telecommunications Act. As long as negotiations are ongoing and may reasonably lead to an outcome, there will generally be no reason to impose any obligations under Section 6.2.

4.2.5 Dispute settlement by ACM

The law regulates the rights and obligations of market participants operating in the electronic communications sector. Disputes may arise over the duties that holders of a license for the use of frequency space, providers of public electronic communications networks, associated facilities, public electronic communications services or program services, or undertakings providing such networks, facilities or services, have towards another market participant.[55] Market participants involved in such a dispute may request ACM to settle the dispute in accordance with Section 12.2 of the Dutch Telecommunications Act.

Section 12.2 of the Dutch Telecommunications Act addresses all possible relationships between market participants in the telecom sector and the disputes that may arise from this within the context of the Dutch Telecommunications Act. All disputes based on this section always relate to the question as to whether either party to the dispute is in compliance with its obligations under or pursuant to the Dutch Telecommunications Act. In principle, each market participant involved in IP interconnection has the right to invoke this section, making this option preferential in the context of IP interconnection compared to the other instruments listed in the Dutch Telecommunications Act. The limitation regarding this option, however, is that the dispute must have a legal basis according to the Dutch Telecommunications Act, such as obligations imposed in relation to the duty to negotiate on interconnection based on Section 6.1 and Section 6.2 of the Dutch Telecommunications Act, or interconnection obligations imposed in a market analysis decision. See Section 6a.6(2)(i)).

4.2.6 Market developments and ACM's tools

The question arises whether the market developments detailed in Chapter 3 pose one or more problems and, consequently, create a situation in which ACM is empowered to act and deploy such instruments. This paragraph illustrates two market developments in more detail from the perspective of the Dutch Telecommunications Act.

[53] Section 6.2(2) of the Dutch Telecommunications Act will read: For the implementation of the first subsection, the Netherlands Authority for Consumers and Markets may impose obligations to ensure end-to-end connections to a provider of public electronic communications networks or public electronic communications services that control the access to end-users, with the exception of providers of number-independent interpersonal communications services.
[54] Paragraph 3.6.1.2. of the Explanatory Notes of the legislative proposal to amend the Dutch Telecommunications Act.
[55] T&C privacy and data protection law, commentary on Section 12.2 of the Dutch Telecommunications Act, Chapter 1, under a.

- *Peering policies raise entry barriers. See paragraph 3 of Chapter 3;*
  The trend related to peering policies can be considered a neutral development if the requirements and conditions set by the peering policies are fair and transparent. That also applies to the costs. If the requirements, conditions and/or any costs or tariffs prove not to be fair and/or transparent, ACM has the power to settle a dispute between market participants according to Section 12.2 of the Dutch Telecommunications Act.

- *Lock-in effects occur with large data centers taking over partial services of IXs. See paragraph 5 of Chapter 3:*
  Chapter 3, paragraph 5, shows that large data center service providers are increasingly becoming one-stop shops. The risk consists of lock-in effects at large data center service providers. When more and more services are purchased from multi-tenant data centers, it will become more difficult to switch to another market participant. While experiencing a switching barrier is and can be very inconvenient, this market development does not take away from the fact that a provider (a new and different provider is this case) being requested to negotiate is obligated to negotiate in order to establish a connection with the provider requesting that access.

4.3 Net neutrality

ACM also oversees net neutrality based on the Open Internet Regulation[56].[57] The Open Internet Regulation ensures the Internet Access Provider's (IAP) provision of internet access to end-users. Article 3(1) of the Open Internet Regulation stipulates that end-users have the right to open internet access, meaning that they are provided the ability to receive and send content and applications free from any interference or modification by providers and without providers being allowed to make any distinction in the internet traffic they transmit. Similarly, CAPs enjoy protection as end-users under the Regulation insofar as they use an internet access provider to reach other end-users. All content providers should be able to offer their services to end-users on equal terms and on a non-discriminatory basis over the access networks so that net neutrality remains guaranteed.

Article 3(3) of the Open Internet Regulation prohibits IAPs, when providing internet access, from exerting influence over internet traffic that makes any distinction in the type of traffic or content, subject to exceptional situations. All disputes relating to IP interconnection are expressly excluded from this provision.[58] Indeed, whereas the Regulation oversees the provision of internet access to end-users, IP interconnection is about mutual traffic in the form of wholesale peering and transit services.

However, IAPs' IP interconnection policies could be taken into account when assessing internet access insofar as they may affect net neutrality.[59] Consider the interconnection policies of access providers that are effectively designed to impede the degree of openness of internet access for end-users.[60]

[56] Regulation (EU) 2015/2120.
[57] Section 15.1(3) of the Dutch Telecommunications Act.
[58] The BEREC Guidelines on the Implementation of the Open Internet Regulation, Marginal 50.
[59] Consideration 7 of Regulation (EU) 2015/2120.
[60] The BEREC Guidelines on the Implementation of the Open Internet Regulation, Marginal 6.

4.4 Competition law

4.4.1 Merger control

Concentrations between companies of a certain size are reviewed by ACM or the European Commission (EC)[61]. It may in certain cases be necessary and preferable to attach conditions to an intended takeover to mitigate a risk of significant restriction of competition resulting from the concentration. Of course, this also applies to providers and customers of IP interconnection, such as CAPs, ISPs and IXPs. If these market participants were to merge, it may be necessary to impose IP interconnection obligations on the newly merged party, for example to ensure that sufficient opportunities are maintained for third parties to interconnect on reasonable terms.

To illustrate, Liberty Global's acquisition of IAP Ziggo, an ISP that has both backbone infrastructure and national IAPs is an example of forward integration by Liberty Global. The European Commission initially approved this acquisition.[62] After the European General Court[63] had annulled the EC's decision to approve the acquisition for failing to assess possible exclusivity of television content, the EC then re-examined the notification of the concentration when it was re-notified in 2017, accepting remedies from Liberty Global.[64] In making this assessment, the EC concluded, among other things, that Liberty Global has the ability to impede the distribution of competing OTT providers' content through its position in IP interconnection. The EC took Liberty Global's policy into consideration on the basis of internal documentation. It noted that high-quality peering connections were being offered subject to content exclusivity, and that peering would be refused if these conditions are not met.[65] The EC found that Liberty Global's interconnection policy could, at least in theory, cause competing OTT providers (CAPs) to be unable to reach Ziggo's end-users, or able only with poor connections due to congestion.[66] To avoid the identified potential problems, Liberty Global offered as a commitment that it will keep available at least three uncongested routes towards VodafoneZiggo's IP network, amongst other things, specifically by maintaining 20% additional capacity at three interconnection points.[67]

Therefore, in the case of concentrations that are notified to the EC or ACM, where there is a significant restriction of competition in IP interconnections, there is a possibility to impose remedies with respect to peering and transit, for instance, that will reduce the risk of competition issues.

4.4.2 Prohibition of abuse of dominant position

Section 24 of the Dutch Competition Act and Article 102 of the Treaty on the Functioning of the European Union prohibit market participants that have a dominant position from abusing that market power. ACM and the EC ensure enforcement of this prohibition through ex post oversight.

In theory, certain practices of market participants that have a dominant position on the market for IP interconnections may be detrimental to competition on the internet. The market for interconnections has certain structural features that create an increased risk of misuse of powers. Examples of

[61] Article 6 of Regulation (EC) 139/2004
[62] European Commission October 10, 2014, decision C(2014) 7241.
[63] The General Court of Justice of the European Union, the Court of First Instance of October 26, 2017, Case T−394/15, ECLI:EU:T:2017:756.
[64] European Commission May 30, 2018, Decision M.7000.
[65] European Commission May 30, 2018, Decision M.7000, Marginal 554 et seq.
[66] *"Given that any OTT audio visual service would thus only qualify for paid direct private peering, if at all, the Notifying Party could refuse or severely restrict those services from having access to its internet network, either by charging excessive fees for paid direct private peering or by altogether refusing to engage in private direct peering."* European Commission May 30, 2018, Decision M.7000, Marginal 571 et seq.
[67] European Commission May 30, 2018, Decision M.7000, Commitments, Section C.

practices of market participants with a dominant position that could be detrimental to competition on the IP interconnection market include unfair peering or transit conditions, quality discrimination, cross-selling practices and excessive tariffs.

In the IP interconnection market, IAPs with a network of end-user connections take on a gatekeeper role. Third parties, including other IAPs and CAPs depend on the interconnection of this first mentioned IAP in order to reach the end-users connected to these networks. The IAP in fact controls 100% of traffic termination towards its connected end-users. It should be noted that there is a mutual dependency between the different interconnecting market participants. Therefore, in the case of symmetry between different network parties, the phenomenon of settlement free peering is standard practice.

With respect to interconnection with vertically integrated parties, where providers of internet access services, content, IXs, and/or transit are all members of the same group, potential asymmetry is more apparent and thus creates a higher risk of potential anti-competitive misuse of a dominant position, which is detrimental to competition. A vertically integrated company, may, for instance, set requirements for the interconnection with end-users that involve the purchase of transit or paid peering at tariffs or terms that are not market-based, which may indicate unfair peering terms. An IAP that offers content itself may have an interest in CAPs having a poorer connection to end-users. This type of quality discrimination potentially has the effect of making it difficult or more difficult for parties (including content parties) with little scale and those seeking to enter the market to obtain interconnection and establish high-quality connections with end-users. Such distinction in interconnection capacity depending on the origin of IP traffic may be indicative of quality discrimination.

In theory, the bundling of different services may be used to create a lock-in effect. Paragraph 3.5 outlines a scenario whereby data centers will eventually come to have such market power that they can transfer that power to the peering market by combining hosting services with free peering. If such cross-selling services have the practical effect of preventing providers of the cross-selling services, such as open peering providers in this example, from competing with data centers, this may then be indicative of an abuse of the dominant position that providers of data centers might hold.

4.4.3 Prohibition on competition agreements

ACM and the EC oversee the prohibition of cartels, as listed in Section 6 of the Dutch Competition Act and Article 101 of the Treaty on the Functioning of the European Union (TFEU). Agreements or concerted practices between companies that restrict, distort or prevent competition are prohibited therein. The TFEU gives as examples of such agreements (a) directly or indirectly fixing purchase or selling prices or any other trading conditions; (b) limiting or controlling production, markets, technical development, or investment; (c) sharing markets or sources of supply; (d) the application of unequal conditions to trading partners with equal performance, thereby harming their competitive position; and (e) making the conclusion of agreements contingent on acceptance by the trading partners of additional performance which, by its nature or commercial custom, is not connected with the subject of these agreements.

In the context of IP interconnection, this may include agreements between different transit providers. Between them, they can agree on kickbacks or fees for delivering and taking over IP traffic. A vertically-integrated transit provider that also controls an access network also in theory has the possibility to make a distinction between the available quality of connections between transit providers that may or may not pay such kickbacks for terminating traffic, for example by not making sufficient capacity available for the first category. As a consequence for the market, CAPs are forced to pay

excessively high private peering or transit tariffs in order to reach the end-users of the vertically-integrated ISP without being faced with any difficulties. In doing so, the vertical in this scenario is guilty of quality discrimination against transit providers with which no agreements have been reached on kickbacks in exchange for sufficient quality.

5 Findings and conclusions

Overview
When the market participants were interviewed about the market situation in the Netherlands in comparison with the rest of Europe and the rest of the world, they were mostly positive about the functioning of IP interconnection. According to those market participants, contributing factors are the high-quality digital infrastructure in the Netherlands, effective oversight and a healthy competition. However, Dutch market participants do experience difficulties on the international market. In those areas where there is less adequate oversight and/or less competition, it is more difficult to interconnect on reasonable terms. In such areas, market participants must, for example, incur more costs for quality connections, or must settle for lower quality connections causing their service to perform less well.

On the one hand, competition in the Dutch market is a positive trend: there are several providers from which services can be purchased. On the other hand, the market participants interviewed also observe that the open atmosphere that used to be characteristic of the internet and that supported a lot of innovation is starting to change. Peering at no cost with large market participants, for example, is now only available to other large market participants; smaller market participants have to pay for it. Market participants appear to be more aware of the value that they offer others, and want something in return. These dynamics are effective among the large market participants given their mutual dependency. Smaller market participants experience the abovementioned issues as obstacles in their growth. Market participants that are considered large in the Netherlands, but small internationally, sometimes also experience difficulties. For example, they may be unexpectedly confronted with unilateral adjustments to agreements.

On the market for IP interconnections, economies of scale play an important role in the competitive landscape, like in other digital and tech markets. That makes it more difficult for smaller competitors and new entrants to enter those markets and to grow. However, such smaller competitors and new entrants are important for competition and innovation in the long run on the market for IP interconnections. That is why this is a point for attention.

Explanatory notes
Larger market participants are increasingly moving away from the independent internet exchanges (IXs) and thus switching from public peering to private peering, which is a direct physical connection at a location other than an IX. This reduces the IX's importance as an entry point for interconnection. Other, new and/or smaller, market participants must arrange more and incur more costs in private peering and transit (thereby making use of a third party to deliver traffic) to achieve the same interconnection position and thus level of service. Their product then becomes more expensive, and/or requires more investments, and/or it does not perform as well as it should.

Market participants providing content want this content to reach the end-users and need to do this via the Internet Access Providers (IAPs). It is especially those larger IAPs that often draw up peering policies setting conditions on the amount of traffic exchanged, the ratio of inbound to outbound traffic, and the locations where the physical connection takes place. These conditions can often only be met by very large parties. In principle, if a market participant cannot meet the conditions, there will be no peering, meaning the traffic must be delivered via transit, for example. The transit market appears competitive, however, one drawback of transit is that there is less visibility and control over data traffic, making it more difficult to ensure the quality.

Peering policies can also describe the conditions that must be met in order to exchange traffic via closed exchange, e.g., the delivery of high volumes of traffic. Larger market participants can therefore bring their traffic to end-users on better terms, as private peering allows them to send high volumes of traffic at low cost and with a high-quality connection.

Furthermore, larger content and application providers (CAPs) enjoy benefits such as 1) being able to install caches (servers with popular content such as movies) in the internet access providers' networks, making their content more readily available to the users and saving costs of delivering the traffic, and 2) being allowed to program at deeper layers of the firmware (software built into hardware) of set-top-boxes, for example, giving them more freedom in creating their apps and making them run more smoothly.

In addition to servers in their data centers, data centers also offer interconnection services. This allows customers present in a data center to connect with each other, as well as with cloud vendors connected to that data center, for example, which is how data centers compete with internet exchanges. This combination of services makes it more difficult for customers to switch than if these services had been purchased separately. This is especially the case if the customer cannot afford any downtime, which is an interruption of the service provision. Relocating both server capacity and interconnection to another data center will then be a complicated operation. This does not seem to cause any problems at the moment, though a number of market participants do foresee this vendor lock-in as a risk in the future.

The interconnection in the Netherlands functions well. However, it is vital for international connections to grow in line with the market's needs. Both subsea cables and landline connections contribute to this. The consideration of whether an international connection should be by sea or land is not decisive. What is important, is that new connections are built regularly and that the routes are as short as possible.

In the Netherlands, interconnection and content are particularly concentrated in the Amsterdam region. More geographic diversity would better distribute both the benefits and burdens, and ensure greater resilience in the Dutch digital infrastructure. The Ministry of the Interior and Kingdom Relations is currently drawing up a National Environmental Vision to distribute the data centers across the Netherlands.[68]

What can ACM do?
ACM has powers that can be used to address some of the problems that market participants may experience, and some that cannot be addressed or are very difficult to address. The laws that provide ACM with oversight powers:

- The Dutch Telecommunications Act:
    - ACM has the authority to prescribe to market participants how negotiations on interconnection need to be conducted and to impose interoperability obligations to enable end-to-end connections.
    - Significant market power: ACM can impose obligations on providers of public electronic communications networks or services having a significant market power.

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https://www.denationaleomgevingsvisie.nl/samenwerking+en+uitvoering/programmas/ruimtelijke+strategie+datacenters/default.aspx

This means that under this power, ACM cannot impose obligations on CAPs, CDNs and IXs.

- The Dutch Competition Act:
  - Section 24 of the Dutch Competition Act and Article 102 of the Treaty on the Functioning of the European Union prohibit market participants that have a dominant position from abusing that market power. ACM ensures enforcement of this prohibition through ex-post oversight.
- Open Internet Regulation:
  - The Open Internet Regulation ensures the IAPs' supply of internet access to end-users and determines that end-users have the right to free access without providers being allowed to make any distinction in the internet traffic they transmit. IAPs' IP interconnection policies are also taken into account when assessing internet access insofar as they may affect net neutrality.

Some of the developments that a number of market participants experience as difficult fall outside the scope of what ACM can do. Strict peering policies, for example, pose a barrier to smaller market participants, but only if the terms and conditions and prices are unfair or non-transparent, does ACM have the power to settle a dispute between market participants. In the event that market participants leave internet exchanges, it may be troublesome for those staying behind to re-arrange connectivity with the departing market participants. However, only if they fail to comply with the obligation to negotiate on interconnection for the establishment of end-to-end connections, can ACM intervene. ACM's competences will be expanded once the new European Telecommunications Code has been implemented, though. A legislative proposal is currently being prepared to implement the Telecommunications Code in the Dutch Telecommunications Act. See 4.2.4. The proposed text extends the obligation to negotiate to all providers of public electronic communications networks and services, as opposed to only those networks and services that control the end-user access. A guarantee provision has also been added that allows ACM, in light of the objectives of Section 1.3 of the Act, to impose obligations on any party that is not a provider of public electronic communications networks or services or in which the establishment of an end-to-end connection is not involved. These could, for example, be content and application providers, internet exchanges, and transit providers, while the current law only allows for obligations to be imposed on internet providers.

ACM has powers in the Netherlands, and may, in some cases, independently investigate cases that have both a Dutch and international element. In international cases that ACM cannot handle itself, ACM can nevertheless help to initiate the appropriate procedure. This is why ACM is calling on market participants that are facing difficulties in interconnecting on reasonable terms to come forward. See the paragraph below for the options.

What's next?
In cases where market participants face difficulties in the area of IP interconnection, these market participants are invited to submit any tip-offs to ACM. ACM may be able to solve or help solve the issue. Tip-offs also help ACM understand this market even better, and to identify when ACM needs additional powers to solve any issues. ACM therefore calls on market participants to contact ACM if they experience problems where ACM can play a role, for example if a market participant refuses to negotiate about interconnection, if it is not prepared to interconnect at market prices or against fair conditions, or if the market participant appears to abuse a dominant position. Tip-offs can be submitted online https://www.acm.nl/nl/contact/tips-en-meldingen/tip-ons and also anonymously https://www.acm.nl/nl/contact/tips-en-meldingen/anoniem-melden.

6 Glossary

Autonomous System (AS)	An internet subnetwork.
Backbone (provider)	An internet connection interconnecting multiple continental networks.
Bandwidth	The amount of data transmitted by a connection within a given time.
Bottleneck	A problem in a market.
Cache, caching server	A temporary data storage location.
Carrier	Telecommunications or internet access provider.
Cloud or cloud provider	Cloud services or a provider of cloud services.
Congestion	Disruption of internet traffic due to excessive inflow.
Content	Content, e.g. video, images, social media content.
Content and application provider (CAP)	Providers of electronic services focusing on media, content, entertainment and/or applications.
Content delivery network (CDN)	Parties that ensure that content is delivered as close as possible to the end-user or in the delivery network.
Colocation	Joint use of real estate or physical locations for the installment of servers or active equipment by multiple parties.
Cross-connect / patch	Connection between different customers of a multi-tenant data center.
Dark fiber	Non-activated or unused optical fiber.
Double dipping	The practice of charging twice. In the case of IAPs, this is done with consumers and content providers.
Firmware	Software programmed into hardware.
Hops	IP interconnection locations.
Hosting or hosting provider	Web servers or web server spaces, provider of web servers or web server spaces.
Hyperscale data center	Large data centers of big tech companies like Google, Microsoft and Amazon.
IAP	Provider of publicly available internet access services.
Internet exchange (IX)	Platform on which IAPs and CAPs can exchange IP traffic through public peering.
Internet of Things (IoT)	The set of devices that interact with other devices or systems via internet connections and exchange data, for example smart meters.
IP interconnection	The practice of interconnecting different networks for the purpose of data exchange using mainly the internet protocol (IP).
IP	Internet Protocol. Together with TCP (TCP/IP), IP forms the global standard for exchanging data between networks and devices.
Latency	Also called: ping or lag (when latency is high). The amount of time from the beginning until the end of a data transmission over the internet from sender to receiver, expressed in milliseconds.
Lock-in effect	Being "locked in" to a company due to switching costs being (too) high.
Multi-tenant data center	Data centers that servers manage for multiple customers.
Network effects	The more customers a company has, the more favorable this is to the customer and the harder it is to leave or to not join.
One-to-many	Being able to reach many other parties with one connection/contract.

Peering	The exchange of data flow.
Peering policy	The peering policy of network operators.
Point of Presence (PoP)	The physical access point by which underground networks are served.
Prisoner's dilemma	Situation in which 'players' simultaneously make a choice, which is a rational choice from the players' own point of view, but which does not lead to an optimal outcome.
Private peering	Direct interconnection between two networks and the exchange of IP traffic without any third-party involvement. Third-party involvement is the case in transit, see below.
Public peering	Interconnection at a location where multiple networks meet and exchange IP traffic, for a fee.
Rack	Suspension option for servers and electronic equipment.
Retail	The provision of services to end-users.
Settlement-free peering	Peering policy based on reciprocity, where no fee is charged to and from each other.
Set-top box	Device that connects the TV to external sources and decodes the information so it can be seen on the TV.
Single-tenant data center	Data center with one single user, often in-company use.
Tier one / 1 (provider)	Tier 1 providers are large market participants capable of reaching every other network in the world.
Transit	The transmission of internet traffic.
Transit provider	An internet provider that allows another provider or user to gain access to the entire internet or a part thereof through its network/IP network via transit. A transit provider bundles traffic, allowing it to deliver it on more advantageous terms.
Video streaming	The ability to view online videos without downloading these videos in their entirety.
Wholesale	Supply of raw materials or semi-finished products with which to build retail services.