



## Dutch Digital Infrastructure 2016

Enabling the digital economy and society

Deloitte Consulting, November 2016



Platform voor de  
InformatieSamenleving



# Preface

Dear reader,

The digital economy is growing fast and is - when seen as a separate sector – already larger than many of the traditional sectors in our economy. Recent research by CBS found that this digital economy provides 345.000 jobs with an estimated annual growth of 7-9%. The digital infrastructure is one of the key enablers of the digital economy and allows Dutch companies to grow both nationally and on an international scale. In addition, the digital infrastructure is one of the main reasons for international digital companies to locate in the Netherlands and these companies bring substantial activities and jobs to our country.



In its 2013 and 2014 reports, Deloitte found a significant correlation between the strength of a digital infrastructure, a country's digital economy as a whole and its international position in the online world. The Netherlands appeared to have it all. In just 20 years the Netherlands has become one of the largest global hubs for the exchange and delivery of data and digital services. The economic impact of the digital infrastructure turned out to be our third mainport, next to the Rotterdam harbor and Schiphol airport.

We now proudly present the third edition of our research report as commissioned by 11 organizations active in digital infrastructure. It shows how the Dutch digital infrastructure and the digital ecosystem as a whole are rapidly evolving and expanding. With internet traffic growing 22% annually, the Amsterdam Internet Exchange (AMS-IX) still being one of the largest internet exchanges in the world, and a colocation market that grows almost 15% annually, the Dutch digital infrastructure is the foundation of a strong national and international internet economy.

Although well positioned as a first mover and differentiator internationally, this does not mean the current growth and high desirability of the Dutch digital infrastructure sector will continue unabated. A combination of factors need to be aligned in order to sustain and expand our leading position. As the recommendations of this report show, there is still a lot that can and must be done to maintain and safeguard our position.

Most importantly, however, all parties involved need to recognize that the Dutch digital infrastructure provides an unprecedented opportunity for the Netherlands to become the data hub for the 21<sup>st</sup> century needs. If we don't make it so for the Netherlands, another country certainly will do so for themselves.

**Michiel Steltman**

Director DINL

Dutch Digital Infrastructure Association

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6. Attracting international digital companies
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**Part I**

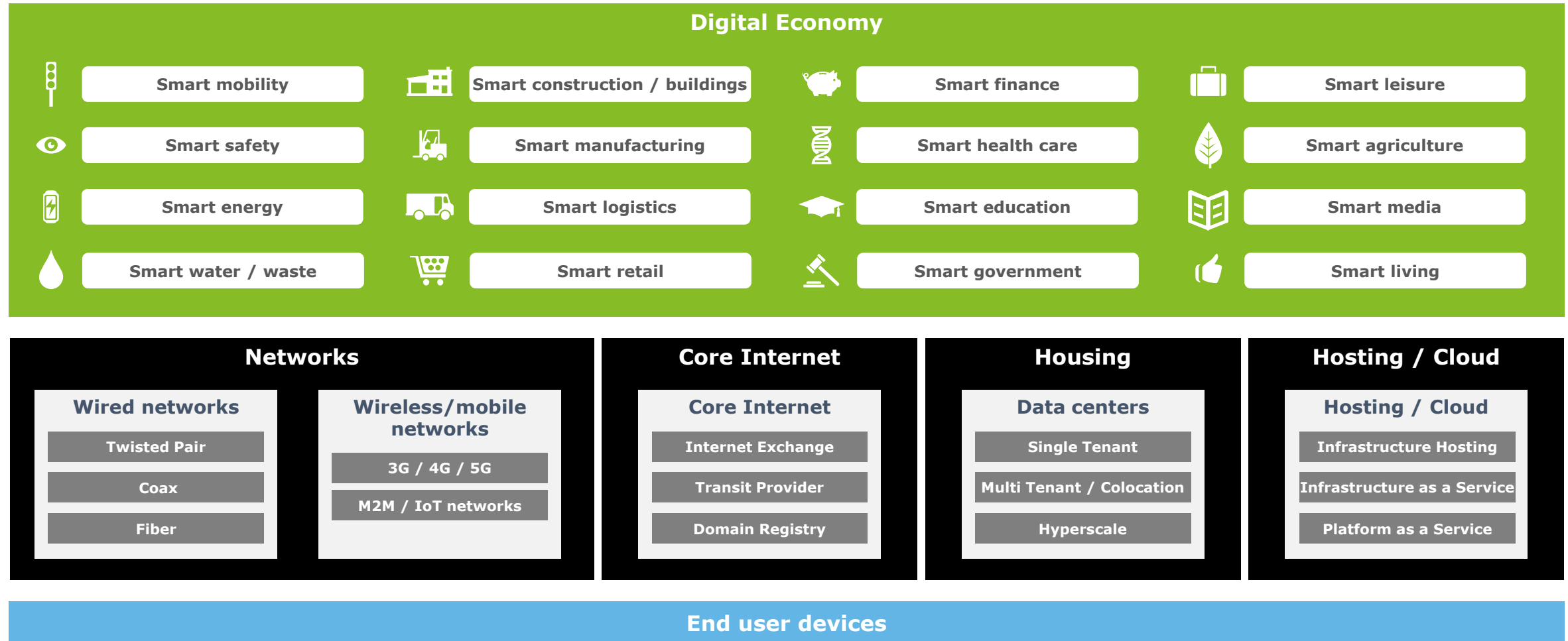
**The Dutch digital  
infrastructure  
sector**

# 1. Introduction and scope



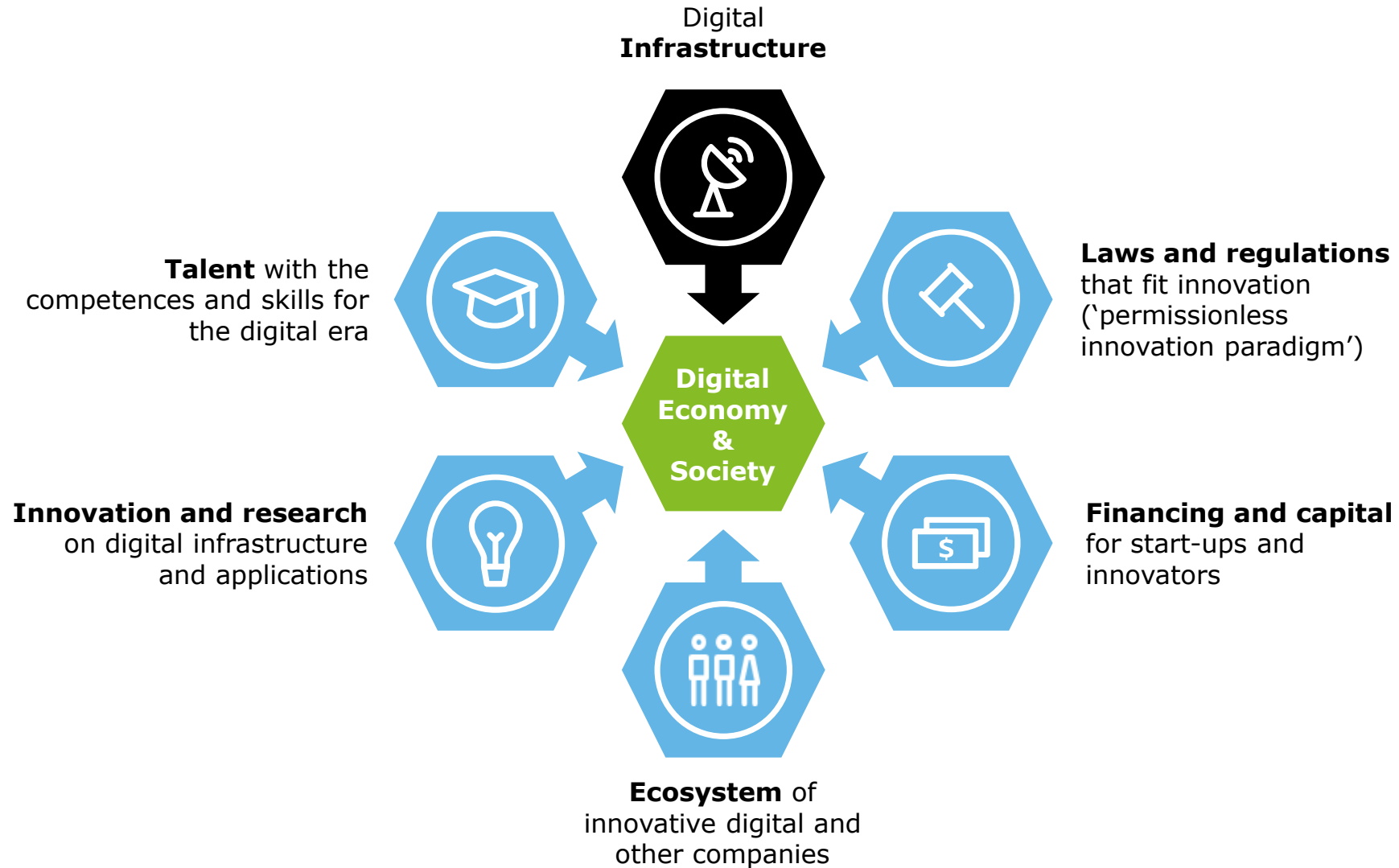
# The digital infrastructure is the foundation for the digital economy and society ...

The digital economy and society are built on a digital infrastructure consisting of networks, core internet, housing and hosting /cloud



## ... together with other 'enablers' of the digital economy and society

The digital infrastructure is a vital enabler of the digital economy. You simply can not create a digital economy without it. There are however more enablers of the digital economy and success follows from each of these enablers being present with the right level of maturity



# The importance of digital infrastructure is in its role as enabler of economic growth

As digital technology permeates all economic sectors and is a source of innovation everywhere, its importance is not in the sector itself but in the innovation and growth it enables in other sectors ('digital economy')

- The position of the Netherlands as international 'data hub' – with the presence of the internet exchanges, a large number of data centers, networks and submarine fiber optic cables and combined with the direct and indirect economic effects - leads to the use of the metaphor 'third mainport'. In 2015, this term has officially been adopted by the Dutch government with the objective to develop a vision and policies to strengthen this third mainport.
- The essence of this metaphor is in the role of the digital infrastructure sector as the foundation, enabler and 'engine' of innovations in every sector of the emerging digital economy.



Publishing and Media



Manufacturing



Logistics



Health



Financial services



Retail



Construction



Mobility



Education



Professional services



Banking



Agriculture



Government



Entertainment

Digital Economy

Digital Infra

## MOTIE VAN HET LID VERHOEVEN

Voorgesteld 15 oktober 2015

De Kamer,

gehoord de beraadslaging,

overwegende dat Nederland een uitstekende uitgangspositie heeft op het gebied van ICT dankzij AMS-IX, de snelle internetverbindingen en de snelle uptake van nieuwe internetdiensten;

overwegende dat Nederland moet blijven investeren in de digitale infrastructuur om deze uitgangspositie te behouden;

constaterende dat de rijksoverheid investeert in de economische positie van mainport Rotterdam en in het vinden van innovatieve oplossingen voor de duurzame ontwikkeling van mainport Schiphol;

verzoekt de regering:

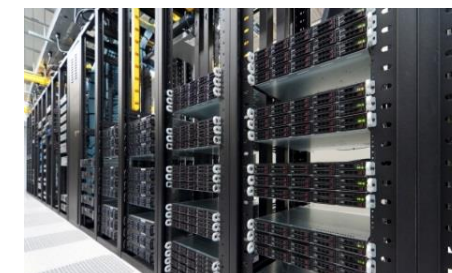
- de digitale infrastructuur (AMS-IX, hosters en housing) te erkennen als derde mainport;
- samen met relevante belanghebbenden een economische visie te ontwikkelen om de positie van de digitale mainport te versterken;
- en te investeren in de uitvoering van die visie,

en gaat over tot de orde van de dag.

Verhoeven



- Mainport is a Dutch term for the economic ecosystem which exists around large transport hubs such as airports and harbors.
- For this reason the data hub is referred to as the 'Digital Main port'.
- This mainport acts as a digital gateway to Europe.





## 2. Status and growth of the digital infrastructure sector

# Definitions (1/2)

## Wired networks

**Twisted Pair**

**Coax**

**Fiber**

Wired broadband networks range from access ('last mile') to core and international networks. In general three types of fixed networks are available:

- **Twisted pair** network is an access network with copper (twisted pair) in the 'last mile'. It has its origin in the traditional telephony network, but has changed into a data network (suitable for triple play). Twisted pair is available at 98% of all houses in the Netherlands. It typically provides up to 100 Mbps and can be upgraded to several hundreds Mbps.
- **Coax** is part of the Hybrid-Fiber-Coax (HFC) access network with a combination of fiber and copper (coax) in the 'last mile'. It was traditionally used as a cable television network, but has changed into a data network (suitable for triple play). Coax is available to 97% of all houses in the Netherlands. It typically provides up to 300 Mbps and can be upgraded to 1 Gbps and above.
- **Fiber networks** are consisting of full fiber networks in the core and the 'last mile' (both to enterprises and consumers). Currently, fiber to the home (consumer market) is available at c. 35% of all houses. It typically provides up to 500 Mbps and allows Gigabit bandwidths.

## Wireless/mobile networks

**3G / 4G / 5G**

**M2M / IoT**

- **3G / 4G / 5G** networks are generations of mobile networks that originated from mobile telephony (voice) but evolved to networks that also provide broadband internet data connectivity.
- **M2M / IoT** networks specifically designed for the requirements of Machine-to-Machine (M2M) communication (M2M) and the Internet of Things (IoT). The key characteristics of these networks are:
  - Long range – Typically several kilometers and providing coverage in locations like basements etc. where 3G/4G coverage is lost.
  - Low energy – IoT devices are often battery operated and require communication with very low energy use.
  - Low bitrate – IoT devices transmit small amounts of data and do not need broadband networks but only kbps bandwidth.

## Definitions (2/2)

### Core Internet

Internet Exchange

Transit Provider

Domain Registry

- **Internet exchange:** An internet exchange Point (IXP) is a network facility that enables the interconnection of more than two independent autonomous systems (AS), primarily for the purpose of facilitating the exchange of internet traffic.
- **Transit provider:** Parties that provide network traffic in the 'core' internet and connect smaller internet service providers (ISPs) to the larger Internet.
- **Domain Registry:** A domain (name) registry is a database of all domain names and the associated registrant information in the top level domains of the domain name system (DNS) of the internet that allow third party entities to request administrative control of a domain name. A registry operator, maintains all administrative data of the domain and generates a zone file which contains the addresses of the nameservers for each domain.

### Data centers

Single Tenant

Multi Tenant / Colocation

Hyperscale

- **Single tenant data center:** delivering facilities (floor space, power, cooling, network connectivity) for a single client often customized to the specific requirements of the client.
- **Multi tenant data center / colocation:** Delivering facilities (floor space, power, cooling, network connectivity) to enterprises and service providers for housing servers, storage and other computer equipment as an alternative for an in-company data center. Colocation providers serve a multitude of customers in the same facility in a standardized way.
- **Hyperscale data center:** large scale data center owned and run by a single organization and specifically build for this purpose.

### Hosting / Cloud

Infrastructure Hosting

Infrastructure as a Service

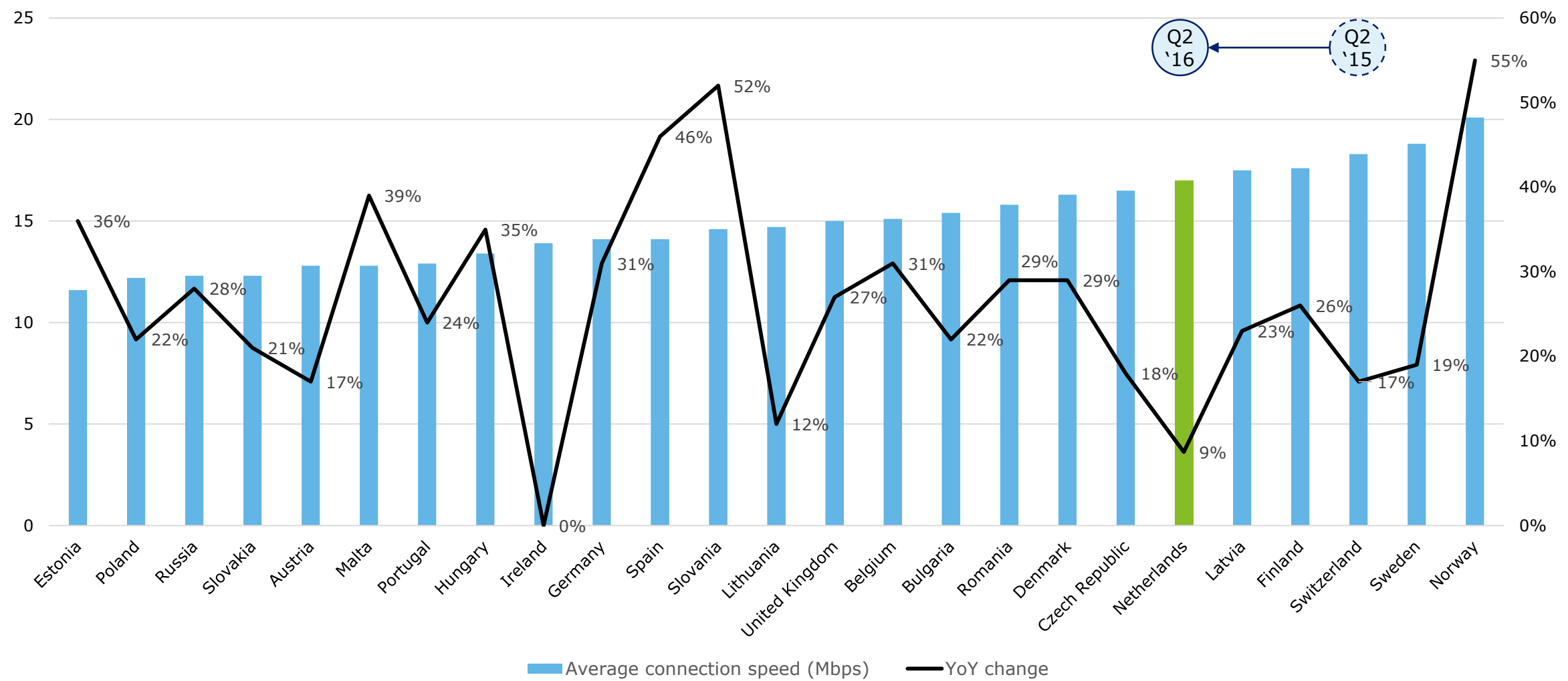
Platform as a Service

- **Infrastructure Hosting:** Delivering computing power and storage either via equipment dedicated to a specific client but managed by the hosting provider, or by sharing the resources of physical equipment among multiple customers.
- **Infrastructure as a Service:** Delivering computing resources (e.g. servers, storage) according to a model that meets the essential characteristics of cloud computing: on-demand self-service by the customer, measured service (pay-per-use), rapid elasticity (any quantity at any time), resource pooling (multi-tenant model) and broad network access (infrastructure is available over the network via standardized mechanisms).
- **Platform as a Service:** Platform as a Service, providing a platform allowing customers to develop, run, and manage applications without the complexity of building and maintaining the infrastructure typically associated with developing and launching an app,



# Fixed networks ('last mile') – Average wired connection speeds

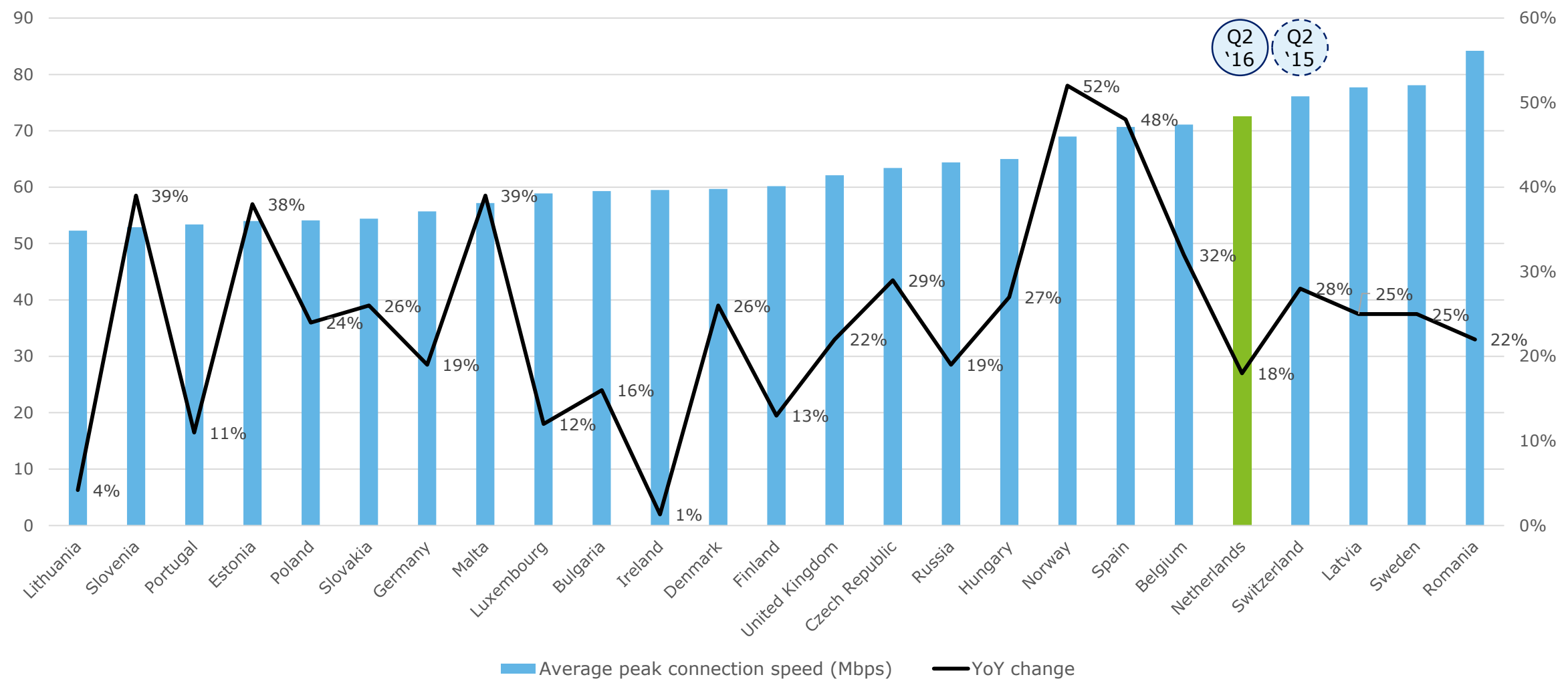
The Dutch wired broadband infrastructure (DSL, Coax, Fiber) has an average connection speed which scores 6<sup>th</sup> place in EMEA. However, the YoY growth rate is the second lowest in EMEA, and Netherlands dropped from the 3<sup>rd</sup> position in Q2 2015 to the 6<sup>th</sup> position in Q2 2016



Source: Akamai – State of the internet Q2-2016

# Fixed networks ('last mile') – Average wired peak connection speeds

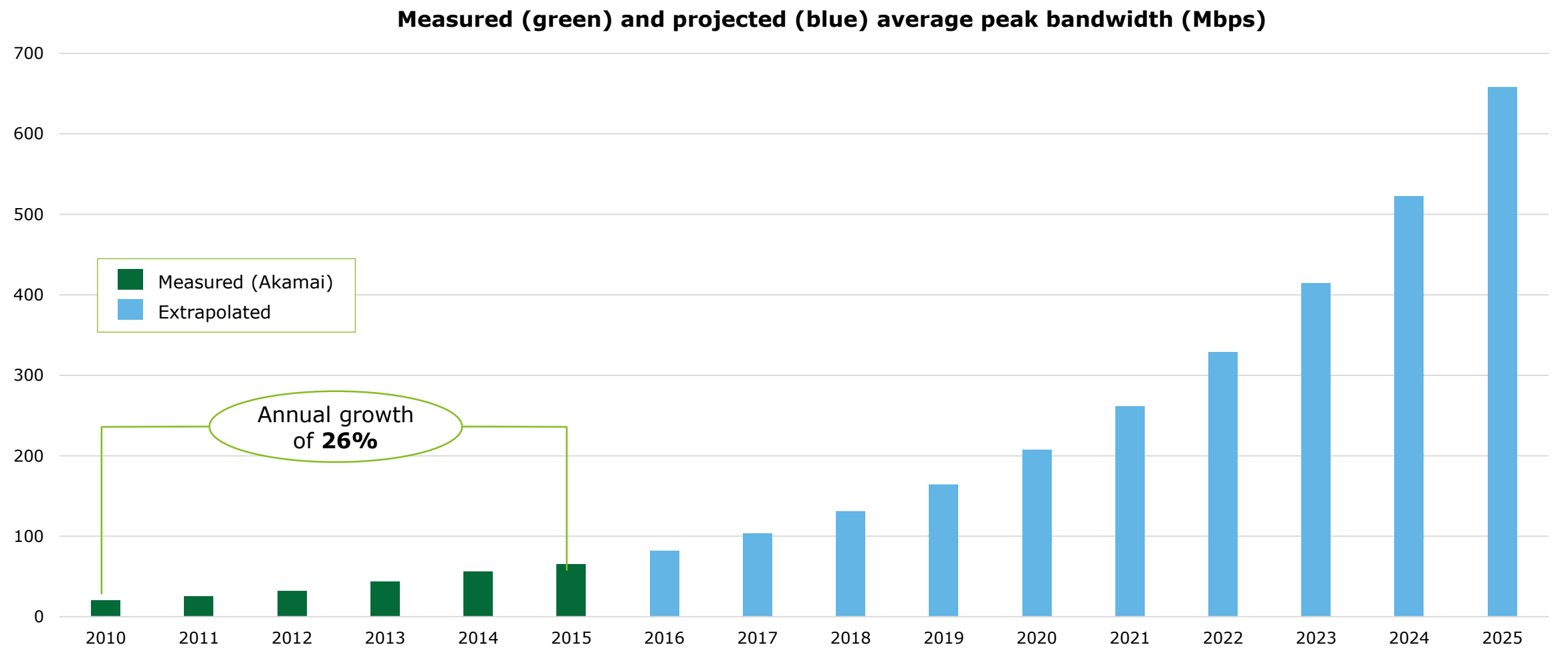
The Dutch wired broadband infrastructure (DSL, Coax, Fiber) has an average peak connection speed which scores 5th place in EMEA. However, the YoY growth rate is below average, and Netherlands dropped from the 4rd position in Q2 2015 to the 5th position in Q2 2016



Source: Akamai – State of the internet Q2-2016

# Fixed networks ('last mile') – Historic and projected average peak connection speed

Between 2010 and 2015, the average measured peak connection speed increased with 26% per year. If this continues, the average peak connection speed in 2025 will be close to 700 Mbps

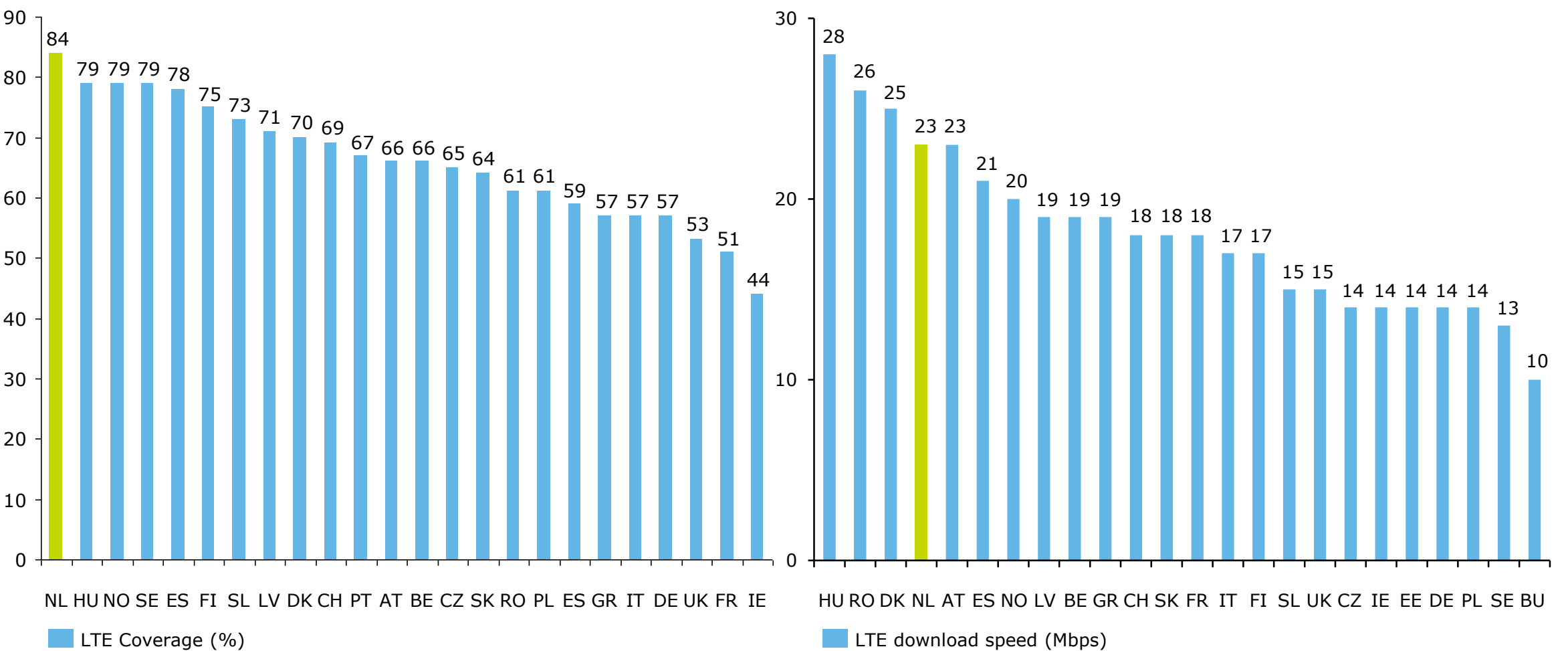


Source: Akamai – The State of the Internet, Deloitte analyse



# Mobile networks – Availability: coverage and speed of LTE networks

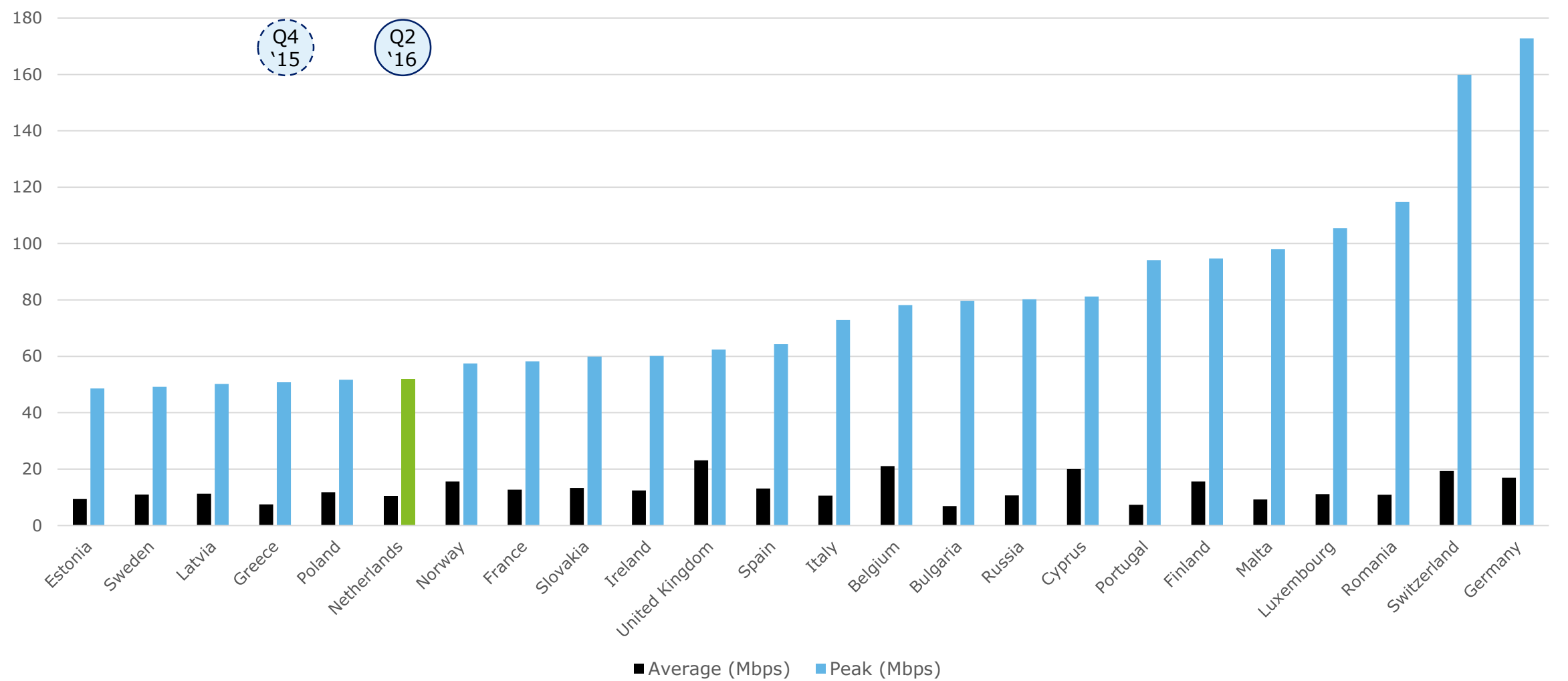
The Netherlands scores high on LTE coverage and download speed on a global scale. Within EMEA, The Netherlands holds a 1<sup>st</sup> position on LTE coverage (84%) and a 4<sup>th</sup> position on LTE download speed (after Hungary, Romania and Denmark)



Source: OpenSignal – The state of LTE (January 2016)

# Mobile networks – Actual use: average and peak connection speeds

Although LTE infrastructure is available, it is not used to its full potential. The actually realized connection speeds on Dutch mobile broadband infrastructure (3G, 4G) has an average peak connection speed which scores 19<sup>th</sup> place in EMEA

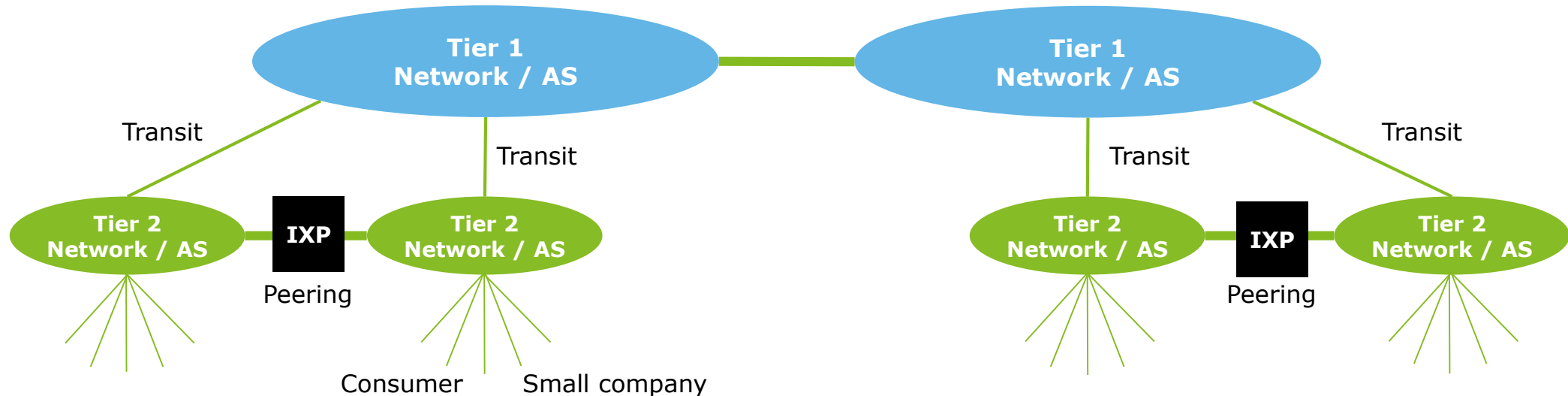


Source: Akamai – State of the internet Q2-2016

# Internet exchanges (1/4)

The Internet is a network of circa 54,500 networks called 'autonomous systems' who connect to each other to exchange traffic

- Each autonomous system (AS) is uniquely identified by an autonomous system number (ASN), maintained by IANA, and is owned by a single party. These parties can be of different types, for example:
  - Internet service providers (ISP)
  - Hosting providers
  - Telecommunication providers
  - Large multinationals
  - Large content and service providers (e.g. Facebook, Google)
- Technically, autonomous systems exchange traffic via the Border Gateway Protocol. Economically, there are two types of arrangements for these interconnections: "*peering*" and "*transit*". These are explained on the next page.
- Of the c. 54,500 AS, there are about 15-20 tier-1 networks that together form the backbone of the internet. A tier-1 network peers with all other tier-1 networks and together, the tier-1 networks connect to every AS there is.
- Tier-2 networks connect consumers and (smaller) companies to the Internet. They peer with other tier-2 networks and use tier-1 networks as transit providers additionally.



Source: [www.cidr-report.org/as2.0/](http://www.cidr-report.org/as2.0/)



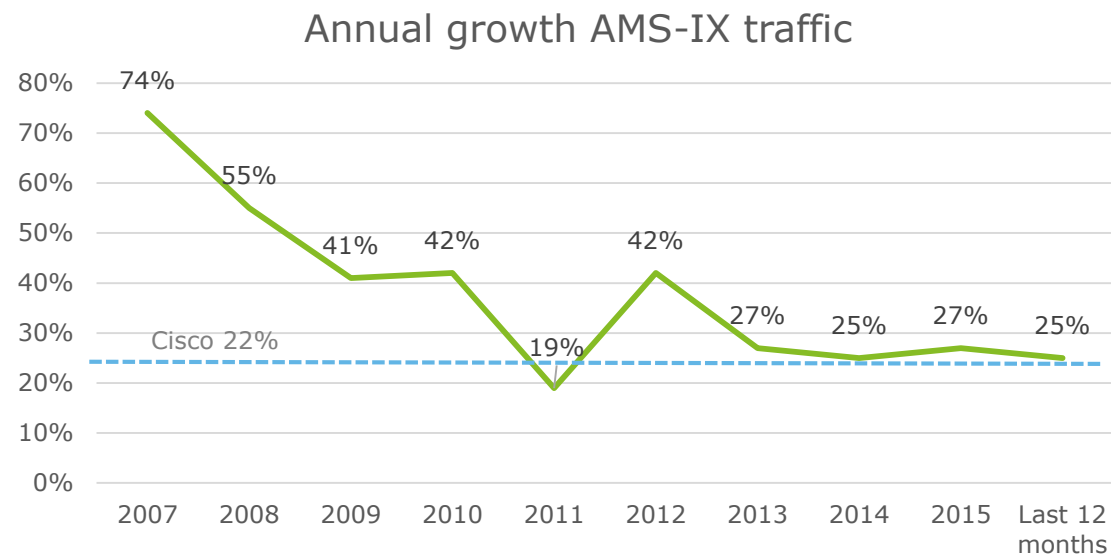
# Internet exchanges (2/4)

AMS-IX has shown year on year double-digit annual growth of internet traffic. In the past years, annual growth rates have been stable a couple of percentage points above the 22% CAGR estimated by Cisco for Global IP traffic.

## Historic growth (last 10 years)

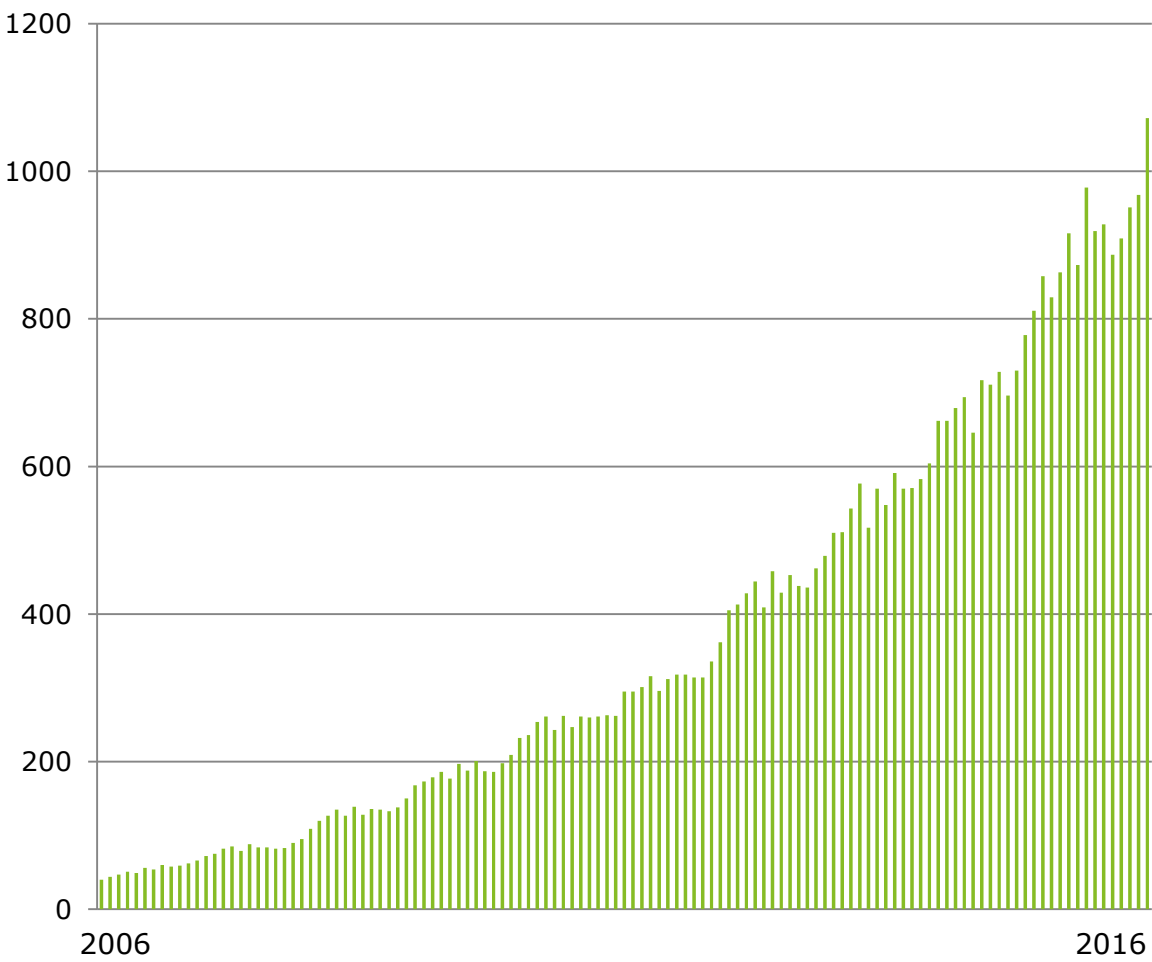
The Amsterdam internet exchange (AMS-IX) is the second largest Internet Exchange in the world, measured both in number of peering networks (AS's) and in peak traffic exchanged. Over the last 10 years, the size of AMS-IX has grown significantly, both in terms of peering networks and in terms of traffic.

- Over the last 10 years (October 2006 – October 2016), AMS-IX Internet traffic increased more than **29-fold** with an average annual growth rate of **40%**.
- In the last 12 months (October 2015 – October 2016), AMS-IX Internet traffic has grown **25%**.
- Cisco estimates that Global IP traffic will increase nearly threefold over the next 5 years, and will have increased nearly a hundredfold from 2005 to 2020. Overall, IP traffic will grow at a compound annual growth rate (CAGR) of **22%** from 2015 to 2020.



Source: [www.ams-ix.nl](http://www.ams-ix.nl) , Cisco Virtual Networking Index, 2015-2020

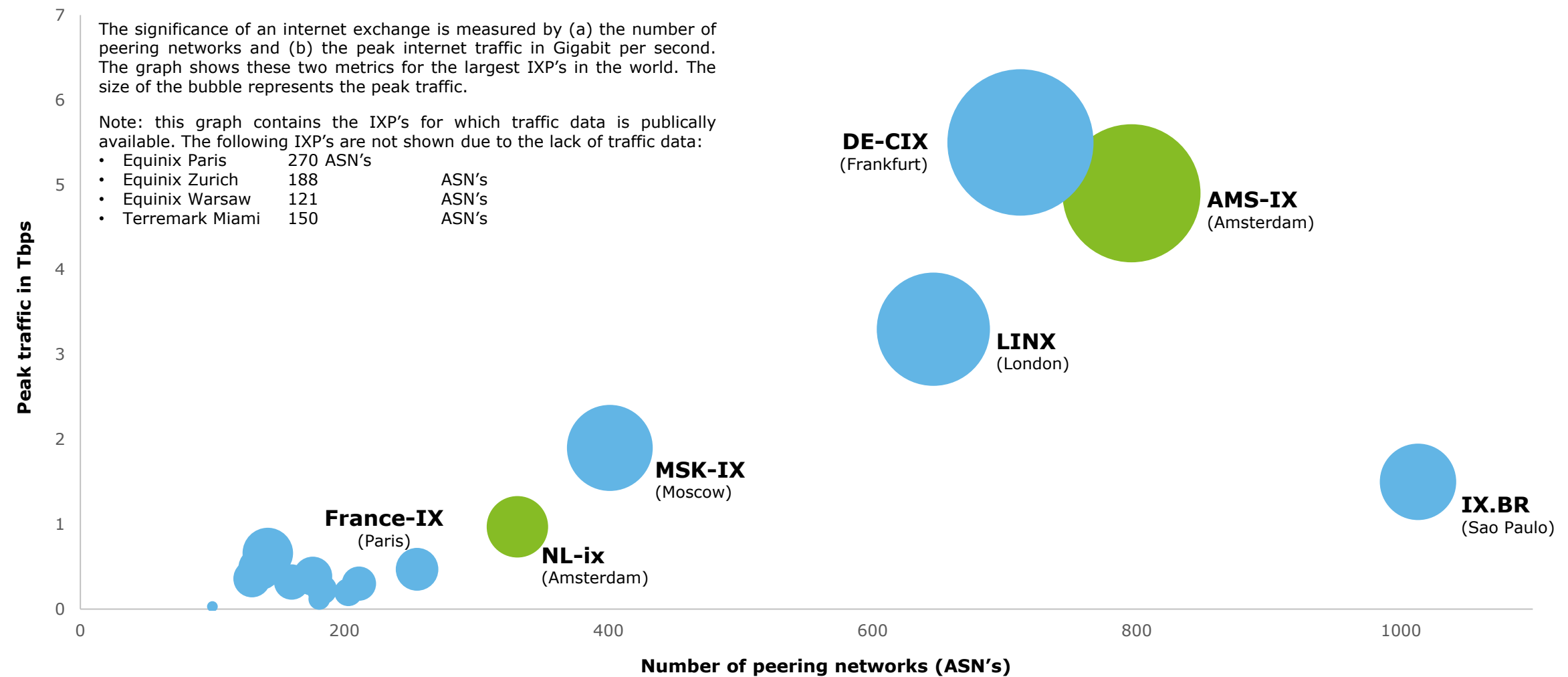
## Monthly AMS-IX internet traffic (last 10 years)



Source: <https://ams-ix.net/technical/statistics/historical-traffic-data>

# Internet exchanges (3/4)

AMS-IX is one of the leading internet exchanges in the world, measured in number of peering networks (ASN's) and in terms of peak traffic



Sources: [www.euro-ix.net](http://www.euro-ix.net) (peering matrix) for number of ASN's, IXP websites for peak traffic

# Internet exchanges (4/4)

AMS-IX and NL-IX are a mainport for internet traffic more than Rotterdam and Schiphol are for containers and passengers respectively

Rank	Top internet exchanges (by number of ASN's)
1	PTT, Sao Paulo, BR
2	<b>AMS-IX, Amsterdam, NL</b>
3	DE-CIX, Frankfurt, DE
4	LINX, London, UK
5	MSK-IX, Moscow, RU
6	<b>NL-IX, Amsterdam, NL</b>
7	Equinix Paris, FR
8	France-IX, Paris, FR
9	Equinix Warsaw, PL
10	TorIX, Toronto, CA
11	TPIX, Warsaw, PL
12	Equinix, Zurich, CH
13	LONAP, London, UK
14	SwissIX, Zurich, CH
15	MIX-IT, Milan, IT
16	Thinx, Warsaw, PL
17	Terremark, Miami, US
18	Netnod, Stockholm, NO
19	JPIX, Tokyo, JP
20	VIX, CZ

Rank	Top container ports (by volume, 2013)
1	Shanghai, China
2	Singapore
3	Shenzhen, China
4	Hong Kong, S.A.R., China
5	Ningbo-Zhoushan, China
6	Busan, South Korea
7	Qingdao, China
8	Guangzhou Harbor, China
9	Jebel Ali, Dubai, United Arab Emirates
10	Tianjin, China
11	<b>Rotterdam, Netherlands</b>
12	Port Klang, Malaysia
13	Kaohsiung, Taiwan, China
14	Dalian, China
15	Hamburg, Germany
16	Antwerp, Belgium
17	Xiamen, China
18	Tanjung Pelepas, Malaysia
19	Los Angeles, U.S.A.
20	Keihin Ports, Japan

Rank	Top airports (by passengers, Q4 2015)
1	ATLANTA GA, US (ATL)
2	BEIJING, CN (PEK)
3	DUBAI, AE (DXB)
4	CHICAGO IL, US (ORD)
5	TOKYO, JP (HND)
6	LONDON, GB (LHR)
7	LOS ANGELES CA, US (LAX)
8	HONG KONG, HK (HKG)
9	PARIS, FR (CDG)
10	DALLAS/FORT WORTH TX, US (DFW)
11	ISTANBUL, TR (IST)
12	FRANKFURT, DE (FRA)
13	SHANGHAI, CN (PVG)
14	<b>AMSTERDAM, NL (AMS)</b>
15	NEW YORK NY, US (JFK)
16	SINGAPORE, SG (SIN)
17	GUANGZHOU, CN (CAN)
18	JAKARTA, ID (CGK)
19	DENVER CO, US (DEN)
20	BANGKOK, TH (BKK)



Sources: Euro-IX ([www.euro-ix.net](http://www.euro-ix.net)); World Shipping Council ([www.worldshipping.org](http://www.worldshipping.org)); Airports Council International ([www.aci.aero](http://www.aci.aero))



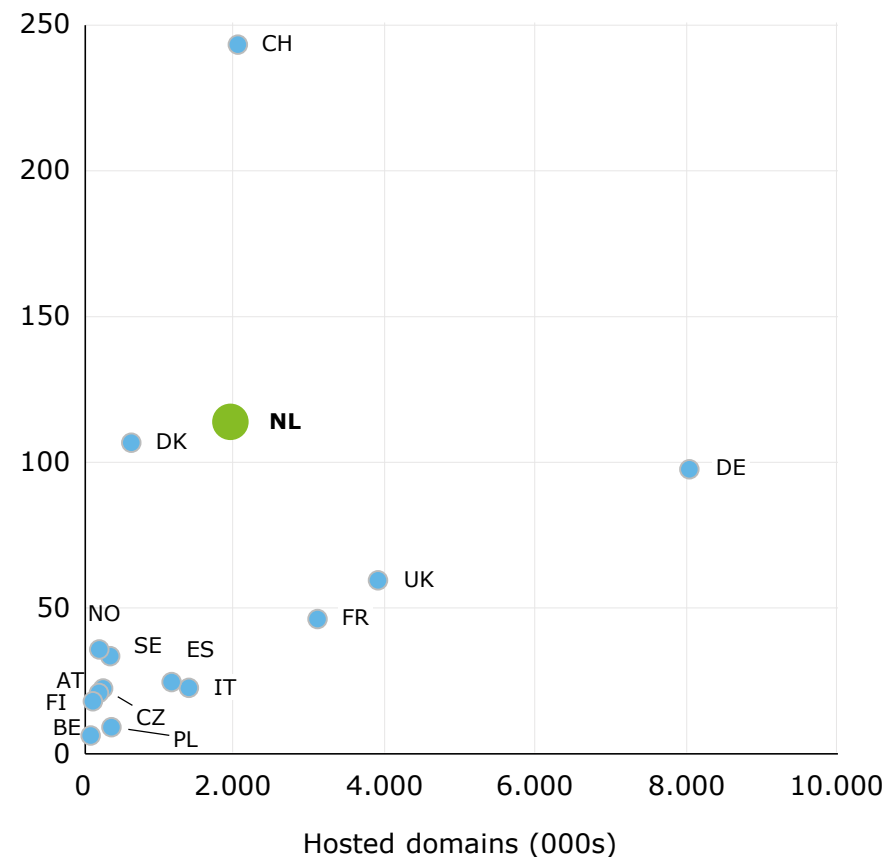
# The Netherlands has a strong internet presence in terms of domains and domain hosting

Within Europe our country is leading in domains per capita and we are the 2<sup>nd</sup> largest country for hosted domains per capita

Number of domains  
per capita



Hosted domains  
per capita



Source: CENTR , <http://webhosting.info/web-hosting-statistics>

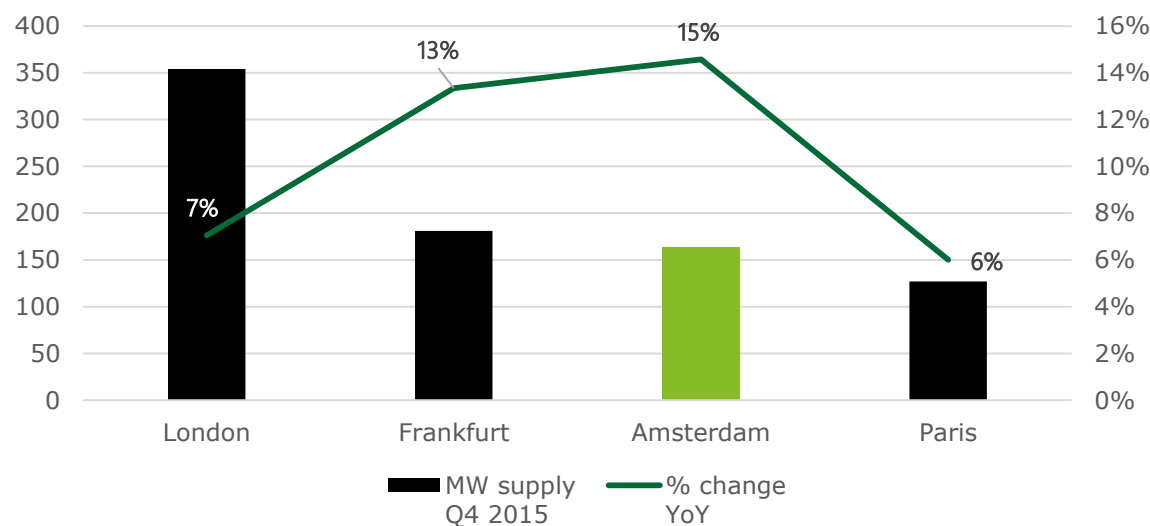
# European colocation data center market

The Amsterdam region is the third key market for data centers in Europe in terms of total capacity (MW). Compared to the size of our economy, the Amsterdam data center hot spot is much larger than what would be a 'fair share'

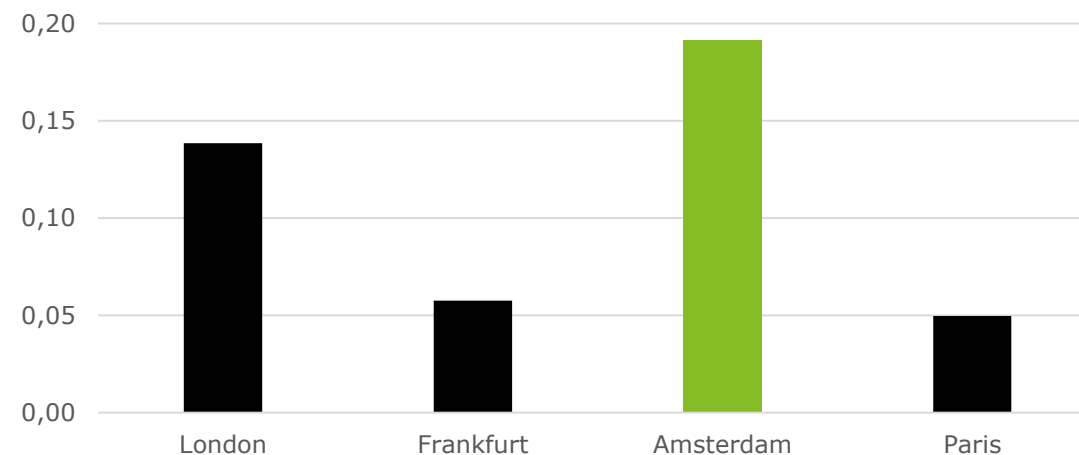
Region	MW supply Q4 2013	MW supply Q4 2014	MW supply Q4 2015	% change YoY <sup>1</sup>	MW / b€ GDP
London	309	337	<b>354</b>	7%	0,13
Frankfurt	141	164	<b>181</b>	13%	0,05
Amsterdam	125	146	<b>164</b>	15%	0,19
Paris	113	120	<b>127</b>	6%	0,05

- London, Frankfurt, Amsterdam and Paris form the leading group of colocation data centers hot spots in Europe.
- These four key data center hotspots are identical to the top-4 European regions with highest global internet traffic (largest internet exchanges).
- Measured in colocation supply (MW) per € billion GDP, Amsterdam exceeds all other regions. This means Amsterdam has a relatively high supply of tier-1 data center colocation compared to the size of the economy.

**Colocation capacity (MW) and annual growth rate**



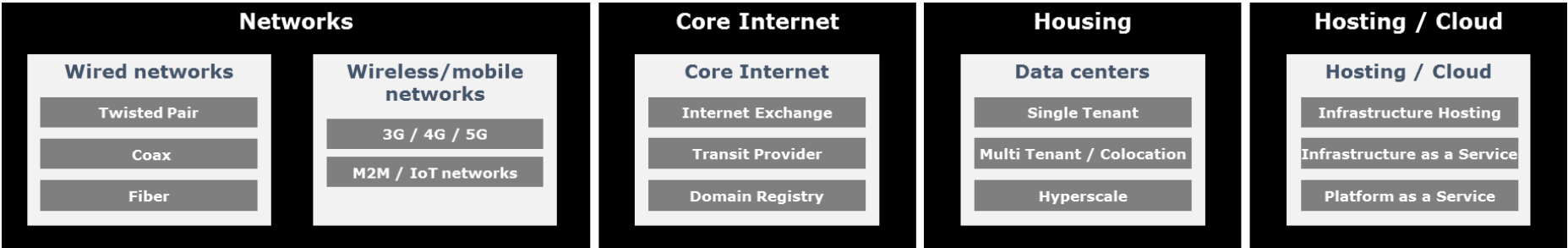
**Colocation capacity (MW) per billion GDP**



<sup>1</sup> YoY growth between Q4 2013 and Q4 2015  
Sources: CBRE, Marketview European Data centers

# Conclusion: our country has a leading position on infrastructure in Europe

We have the second largest internet exchange worldwide, we are one of four key data center hot spots in Europe. Our wired internet broadband scores 5<sup>th</sup> place among 25 European countries. LTE mobile Internet broadband scores 1<sup>st</sup> place on coverage and 4<sup>th</sup> place on speed



*Fixed Networks*  
Average wired peak connection speed



*In Europe*

*Mobile Networks*  
LTE coverage



*In Europe*

*Mobile Networks*  
LTE download speed



*In Europe*

*Internet exchanges*  
Peering networks



*Worldwide*

*Internet exchanges*  
Peak Traffic



*Worldwide*

*Domains*  
per capita

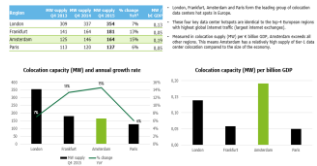
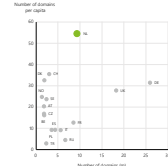
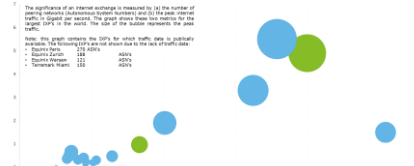
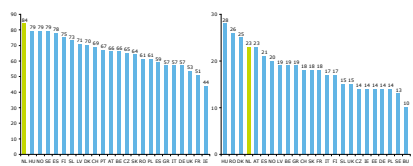
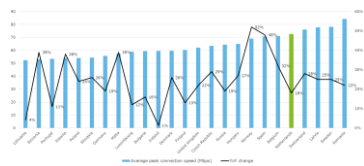


*In Europe*

*Colocation capacity*  
per GDP



*In Europe*



# 3. Contribution to digital innovation

# Digitization of media and entertainment

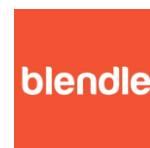
Media and entertainment have become digital and on-demand, with an abundance of choice for consumers, which has made possible by massive digital infrastructure

## Life in 1995

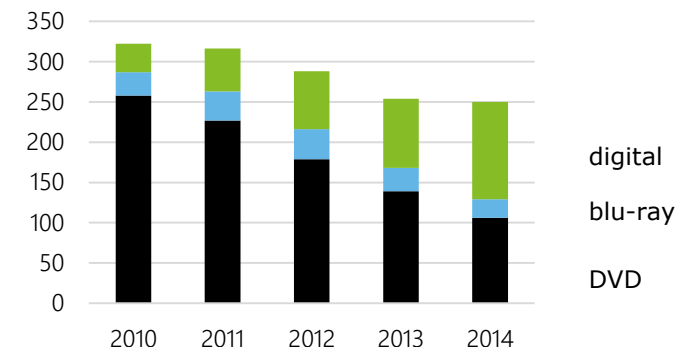
- Music was distributed on CD's. Almost everyone owned a CD-player. In cars, the traditional cassette tape was still in use.
- Video was still distributed on VHS videotape, the DVD was introduced only two years later in 1997.
- Newspapers were 100% paper.
- Television was consumed in a linear model (no on-demand in any form)

## Life in 2016

- Digital has become the new normal for media consumption. The smartphone and smart TV became the platforms through which media is consumed. CD-players and DVD players ceased to exist.
- Global players like Spotify and Netflix provide 'all you can eat' business models, with abundance in choice for consumers as a consequence.



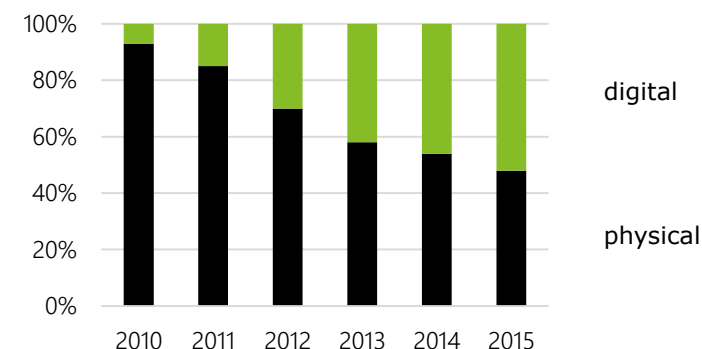
Video



Source: [www.nvpi.nl](http://www.nvpi.nl) JAARCIJFERS VIDEO/FILM



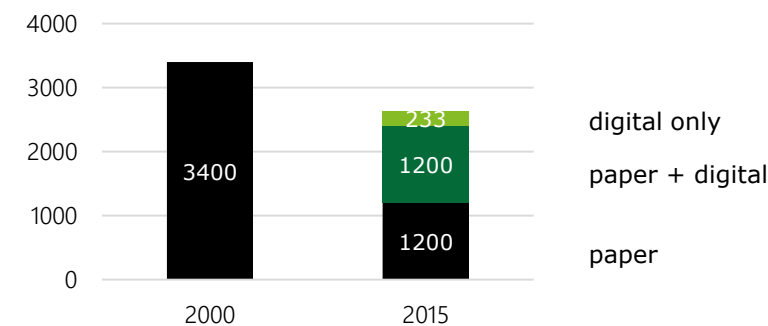
Music



Source: [www.nvpi.nl](http://www.nvpi.nl) NVPI Marktinformatie Audio



News-papers



# Digitization of shopping (e-commerce)

Digital technology disrupted the retail sector as online shopping has become part of every day life. Ubiquitous high speed internet connectivity (also on mobile) has made this possible

## Life in 1995

- In 1995, online shopping (e-commerce) was almost non-existent in NL. All products and services were bought in physical stores.



## Life in 2016

- Online shopping has become part of everyday life, with Bol.com, Wehkamp.nl, Zalando, Coolblue and Thuisbezorgd.nl as top-5.
- Market share of online in product retail has increased to **10%**.
- Total online sales (including services like travel) amount c. 20 b€ in 2016 (forecast), which is **23%** of total retail spend.
- Online shopping continues showing double digit growth, currently of **22%**

**1994** – Pizza Hut sells its first pizza online. The SSL protocol – for secure transactions - is defined

**1995** – Launch of Amazon.com

**1997** – Dell is the first company to reach the magical number of 1 million dollar online sales

**1999** – Bol.com starts in NL, Wehkamp.nl offers all products in its catalogue also online

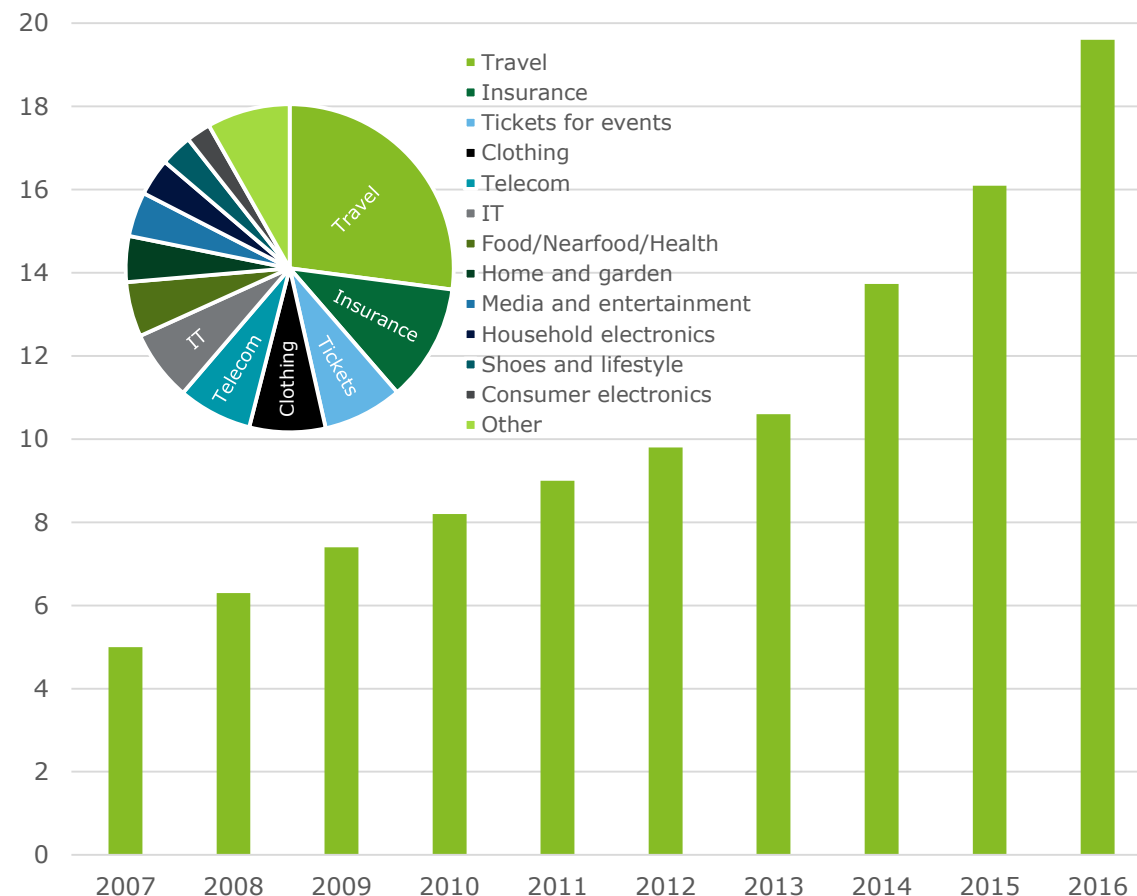
**2010** – Zalando enters the Dutch market with a large marketing campaign

**2012** – Coolblue offers a “same day delivery” service, following the example of Amazon.com that started this in 2009

**2016** – Digital disruption has become clearly visible in main streets as well known Dutch retailers that failed to embrace the digital channel have closed their doors



## Total online sales per year (billion euro)



Source: [www.thuiswinkel.org](http://www.thuiswinkel.org) Thuiswinkel Markt Monitor



# Digitization of currency and payments

Increasingly, digital currency and digital payments are replacing physical money. The smartphone is becoming our digital wallet. Our advanced Dutch payment infrastructure is build on our digital infrastructure

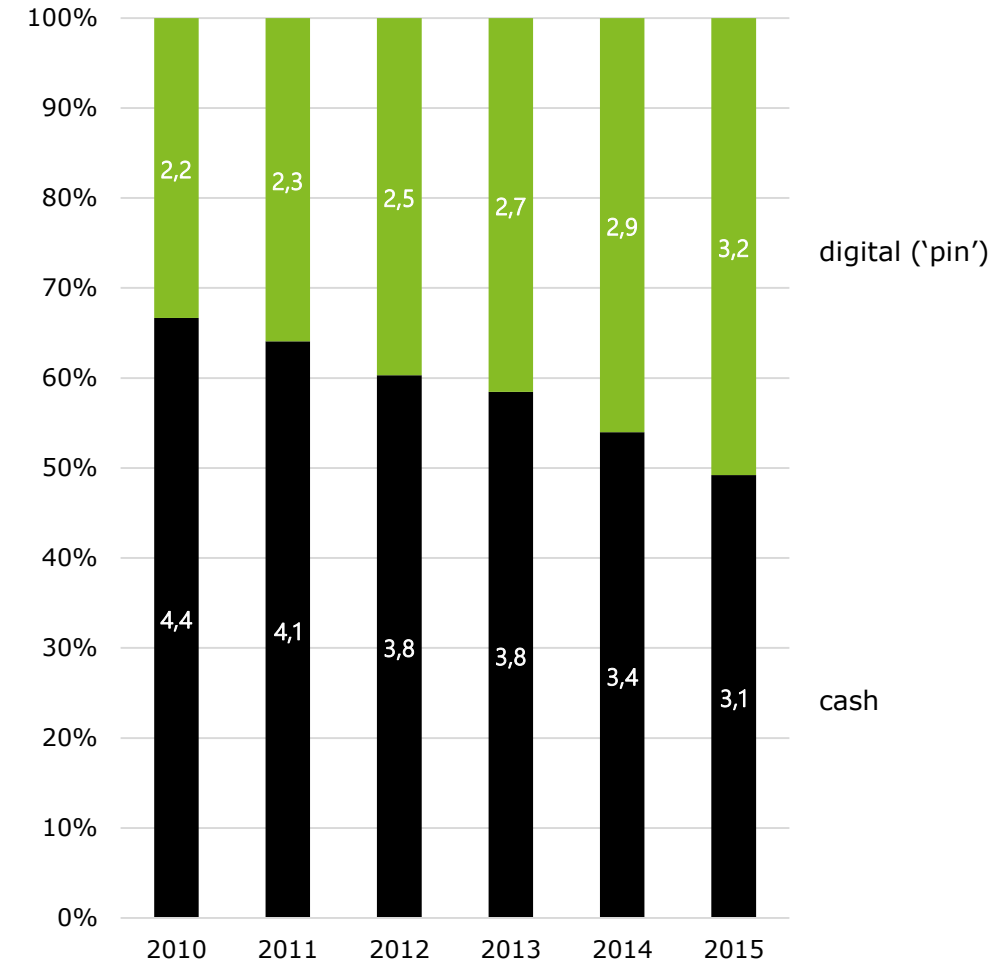
## Life in 1995

- In 1995, payments were done either by cash, by debit card in stores ('pin'), or through 'acceptgiro'; a paper payment instruction that was filled in and send to the bank for processing. Internet banking did not exist.



## Life in 2016

- In 2016, the majority of payments is done digitally ('pin'). The use of cash is steadily decreasing. Within the class of digital payments, the share of contactless payments is growing fast.
- Mobile apps have become the primary medium for electronic banking. People have real time insight in their financial situation and can make instant payments any time any place.



Source: [www.betaalvereniging.nl](http://www.betaalvereniging.nl) Verder dalend gebruik contant geld

# Digitization of communication

Digital technology has disrupted the way people communicate. This has been made possible by an exponential growth of bandwidth in the mobile networks

## Life in 1995

- In 1995, telephony was almost entirely done through fixed line telephones. People called each other at home or at work. When they were at some other place, they could not be reached. There was a special car phone network, but this was very expensive and only used by a small group.
- In 1995, the use of mobile phones was just emerging. In the Netherlands, it started in 1992 with provider PTT offering the Greenpoint network; about 5,000 base stations at gas stations and other public places. If you wanted to make a mobile phone call, you would drive to the nearest base station from where you could make the call. It was not possible to receive a call through Greenpoint. The peak use of Greenpoint was in 1996 with 60,000 users.
- The first GSM network in the Netherlands was launched in 1994 by PTT, but only at the end of the nineties it became attractive for consumers due to decreasing prices. In 2000, there were already nine million mobile phone users.



**1995** – The Nokia 2110 was the latest Nokia model at that moment. It had SMS capabilities, a 4 x 13 characters display and a memory for the 30 last calls (10 in, 30 out, 10 missed).

**2000** – The Nokia 3310 was one of the most popular mobile phones and provided telephony and SMS. At this moment, camera's and mobile internet did not yet exist.

**2007** – The first Apple iPhone marked a new era where telephony and computing (email, calendar, apps) converge. The smartphone takes of. "There's an app for that" becomes the new paradigm. 3G networks with 1 Mbps are the norm.

**2016** – The Apple iPhone 7 has a range of advanced sensors and **70 times** the processing power of the 3G version in 2008. This enables the use of features like natural language question answering (Siri) and augmented reality.

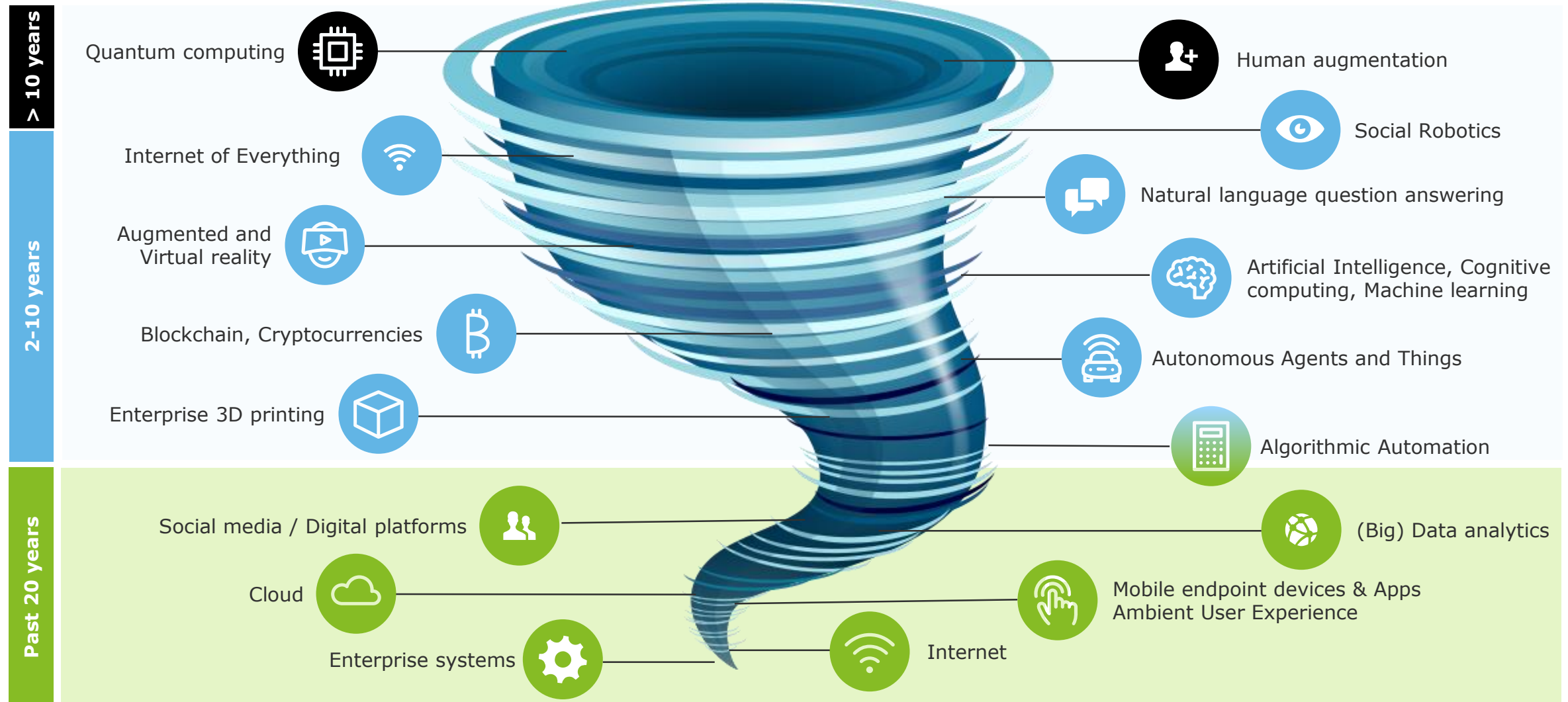
## Life in 2016

- Almost everyone (86% in general and 97% of all aged 20-29<sup>(1)</sup>) has a smartphone and is connected everywhere and anytime. The smartphone has become the most personal device people have.
- Communication encompasses a range of options: next to traditional Voice: WhatsApp, Facebook, Twitter, Skype, Facetime. The mobile network is almost entirely used for data (instead of voice).

(1) Smartphone penetration Netherlands 2016 Q1 - Telecompaper

# 4. Drivers for future innovation

A perfect storm - digital technology encompasses different technologies, of which the most disruptive ones have only just emerged and will take at least a decade to develop into mainstream



# Emerging technologies that will shape the next phase of the digital economy

Each of these technologies requires the presence of modern digital infrastructure to deliver on the promise of its innovative potential

## The Internet of Things

Billions of physical objects that surround us in our daily lives become equipped with advanced sensors and connectivity, generating a plethora of data. These objects transform into smart objects, that become responsive to our behavior and needs.



## Artificial Intelligence

Cognitive computing systems interact with humans via natural language. They are learning systems that understand questions from humans and can ask for additional information by asking questions themselves. This allows a whole new type of engagement between man and machine.



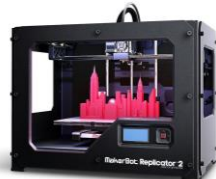
## Social Robotics

A new class of social / service robots emerges. These robots are designed to operate in the same environment as we live in and to assist humans performing all kind of tasks that increase quality of life.



## 3D Printing

A 3D printer uses a digital model to create a physical product through additive manufacturing techniques. This allows rapid prototyping and the option to create personalized products that are highly tailored to the needs and preferences of customers. 3D printing can be used to create spare parts when and where they are needed.



## Augmented / Virtual Reality

Augmented reality allows a computer overlay to be superimposed on images of the real world. Virtual reality allows people to experience a world that is fully digital and simulates the physical presence of that person in that environment. This technology creates a whole new market for experiences.



## Blockchain

The blockchain technology is based on a distributed system in which transactions are logged in an indisputable way. It allows to organize trust without a central authority that controls everything.









# We have evolved in a culture of innovation to build tomorrow's technology

Our country has many organizations and initiatives focused on digital technology and we have always been an active contributor to research and standardization of digital and internet technologies



**Cluster**



**Research**



**Research**



**Research**



**Support Organization**



**Security cluster**



**Gateway initiative**



**Startup Initiative**



**Research**



## Part II

# Opportunity analysis

# The Dutch digital position in an international context

The Dutch Digital infrastructure provides future growth for our economy, attracts international companies and allows Dutch companies to grow across the world

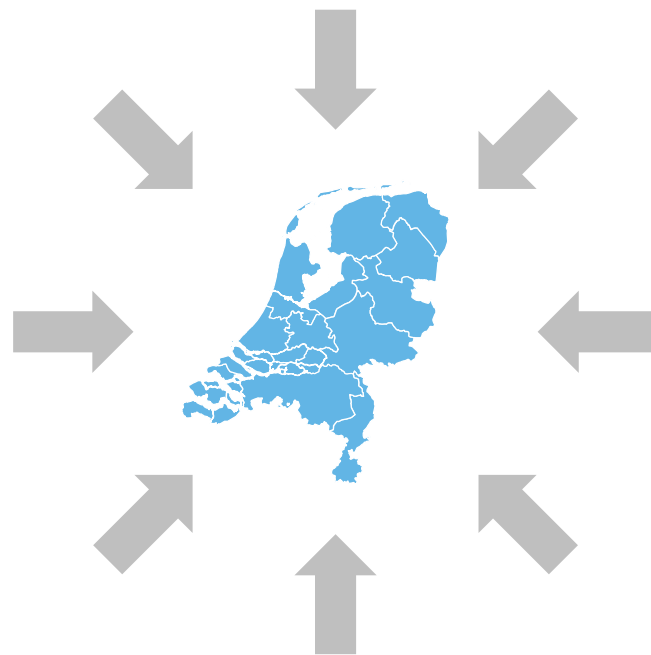
Ch. 5

## Opportunities for NL to strengthen our economy



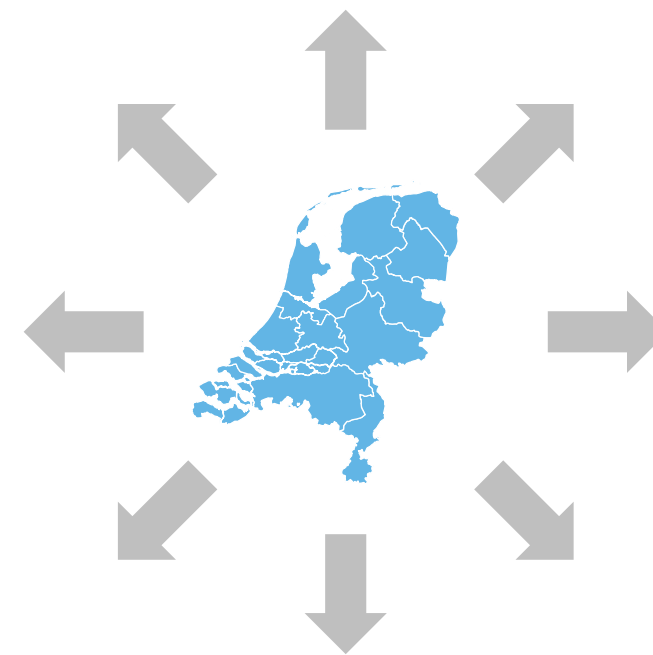
Ch. 6

## Attracting international digital companies



Ch. 7

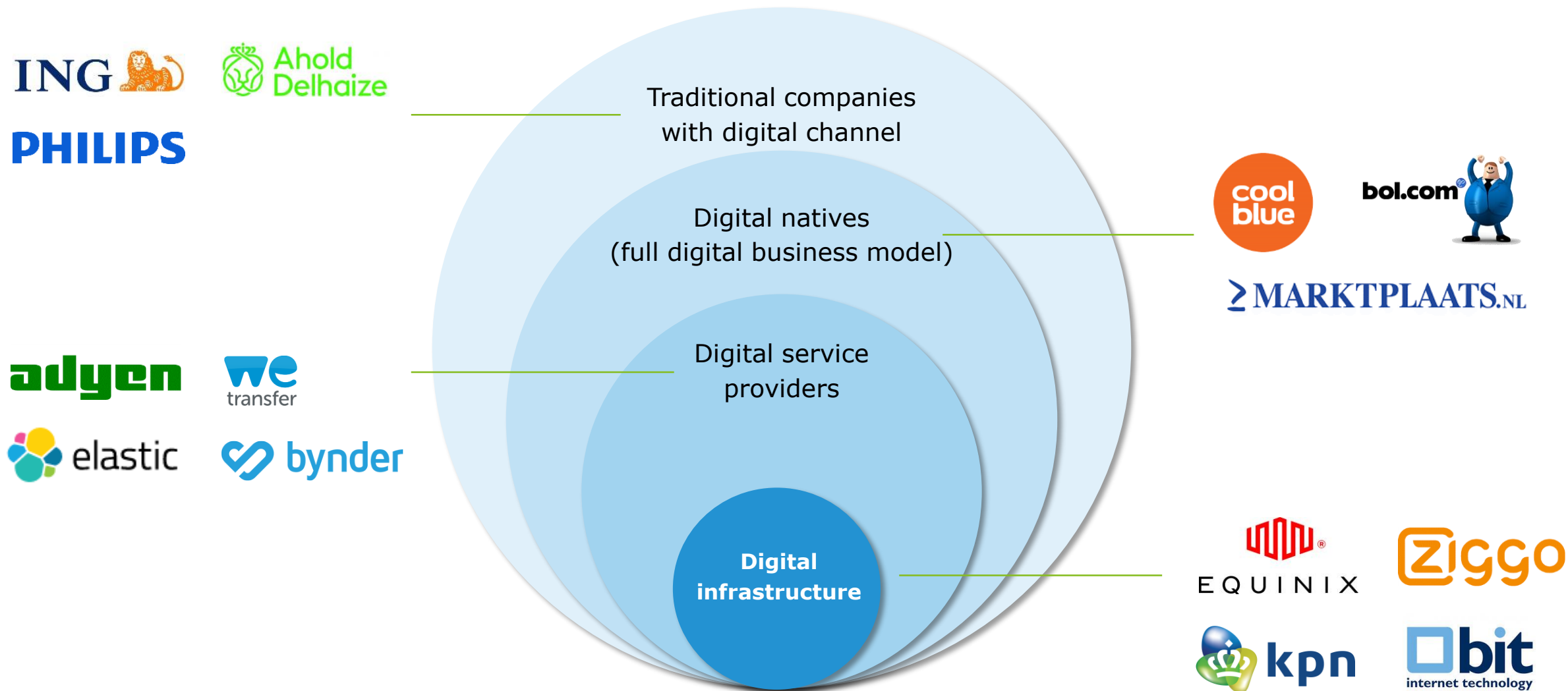
## Dutch digital companies expanding globally



# 5. Opportunities for NL to strengthen our economy

# Digital infrastructure ecosystem

The ecosystem of digital infrastructure extends beyond the digital infrastructure and digital service providers



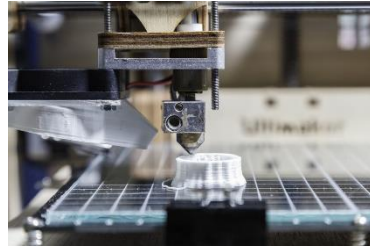


# Our entire economy is already dependent on digital infrastructure ....

Digital technology encompasses different technologies, of which the most disruptive ones have only just emerged and will take at least a decade to develop into mainstream. It will then take even more decades to realize their full potential



Publishing and Media



Manufacturing



Logistics



Health



Financial services



Retail



Construction



Mobility



Education



Professional services



Banking



Agriculture



Energy



Government



Entertainment



## ... with entire industries being disrupted

The pace at which digital technology transforms industries varies. Typical examples of industries that experienced and are experiencing disruption are publishing and media, retail and banking



The **Publishing and Media industry** experienced the following major disruptions:

- Digital is the norm for music and video, allowing business models that exploit the zero marginal costs of extra copies
- Shift from possession (CD's and DVD's) to use (streaming audio/video on subscription base). CD and DVD shops disappear from shopping streets.
- As a consequence, consumers have abundance in choice (millions of songs with Spotify for example)
- Free content competes with paid-for content (especially in the newspaper and magazine business)
- A flood of user generated content (blogs, vlogs, social media) with real-time information



The **Retail industry** experienced the following major disruptions:

- In many markets full transparency for product information (prices, characteristics, reviews, ratings)
- Online has become the primary source of product information, even for purchases done in physical stores
- The combination of transparency and online business caused disintermediation for categories like travel and insurance
- Omni channel has become the norm, shops that fail in their digital presence disappear
- For some product categories online is already the preferred channel
- The digital experience has become a make or break factor, customers expect no less than a seamless and intuitive customer journey



The **Banking industry** experienced the following major disruptions:

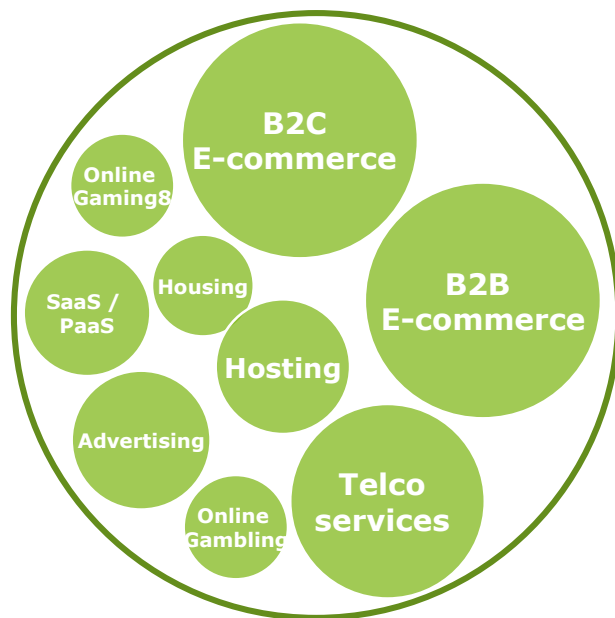
- Online banking is the norm for nearly 100% of day-to-day consumer interactions (payments, savings)
- ATM's fully automated cash withdrawals
- Mobile banking apps and contactless payments have been adopted by the masses in only a few years
- The distribution strategy of banks shifted from local branches (personal contact) to online, banks have closed most of their local branches
- Internal processes have become automated, banks have become large information processing organizations
- Digital payments already outnumber cash payments, cash will eventually phase out

# The size of the digital economy and the 'core' of the internet economy

Although using a different segmentation, new estimates confirm that our digital economy is substantial and growing

In 2014 we made a conservative estimate for the size of the **online ecosystem**

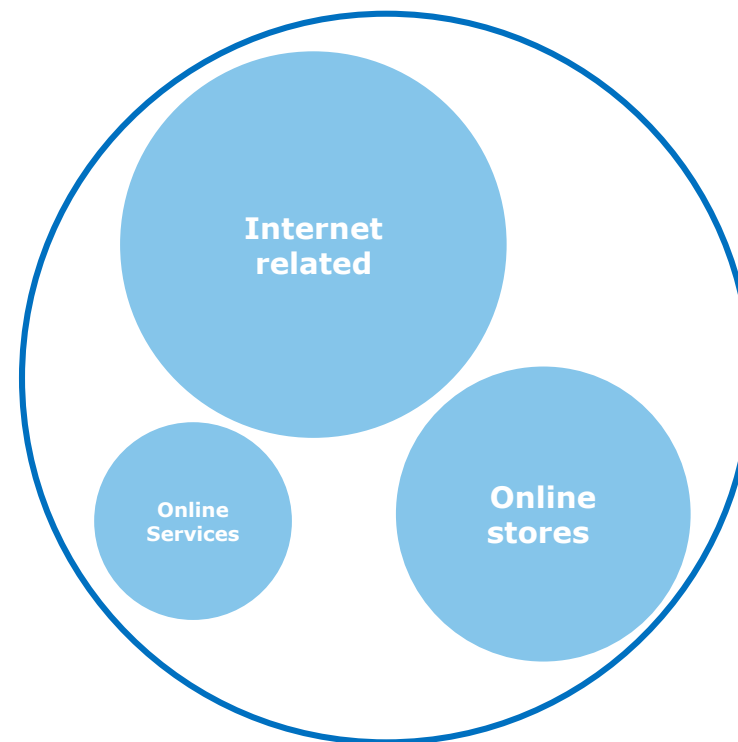
**2013**



**~€39 bn in revenues**  
**> 100.000 jobs**

For a different segmentation CBS has recently estimated the **'core' of the internet economy** to be substantially larger in 2015

**2015**



**~€110 bn in revenues**  
**~345.000 jobs**

# The 'core' of the internet economy is 4.4% (jobs) – 7.6% (turnover) of the NL economy

A recent study in a partnership of CBS, Google and Dataprovider estimates the core of the internet economy based on a big data analysis

Although the term 'internet economy' is widely used, there is no broadly accepted definition for it. Recently, a partnership of Statistics Netherlands (CBS) Google and Dataprovider published a discussion paper on the size of the internet economy.

The authors see the total economy as composed of six categories:

- A No income generated through Internet – no online presence
- B1 Income generated indirectly through the internet – passive online presence (e.g. Shell, DSM, hairdresser with a website)
- B2 Income generated indirectly through the internet – active online presence (e.g. Car rental company, Hotels, High street stores with supplementary websites)
- C Income generated directly through the internet – online stores (e.g. Bol.com, Wehkamp, Coolblue)
- D Income generated directly through the internet – online services (e.g. Relatieplanet, Airbnb, Marktplaats)
- E Income generated with the internet – Internet related ICT (Hosting and Cloud, Websites & Apps, Software, Marketing & Consultancy, Infrastructure & Security, Datamining & Big data)

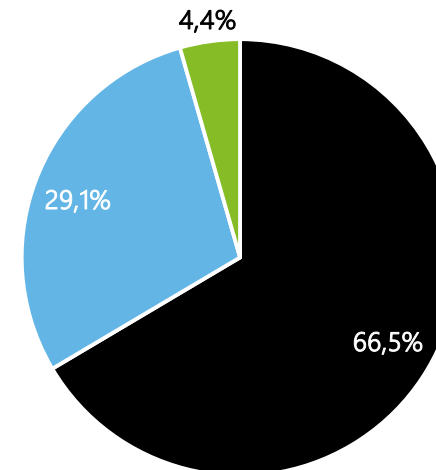


**The 'core' of the internet economy**

## Research results on 'core' of the internet economy:

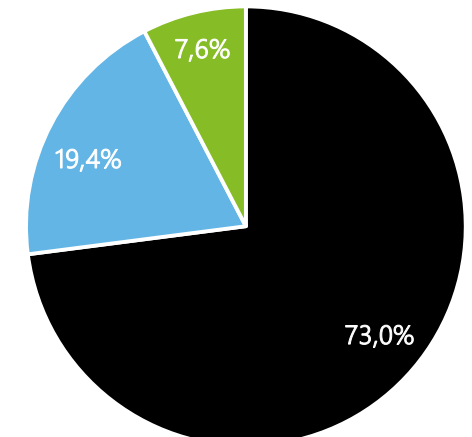
- The 'core' of the internet economy (online stores, online services and internet related ICT) consists of 50,000 businesses and provides **345,000 jobs** (333,000 FTE's) to employees (**4.4% of total**).
- The 'core' of the internet economy has a turnover of 104 b€ (**7,6% of total**).

**Jobs of employees**



- No/Passive online presence (A, B1)
- Active online presence (B2)
- Core Internet economy (C, D, E)

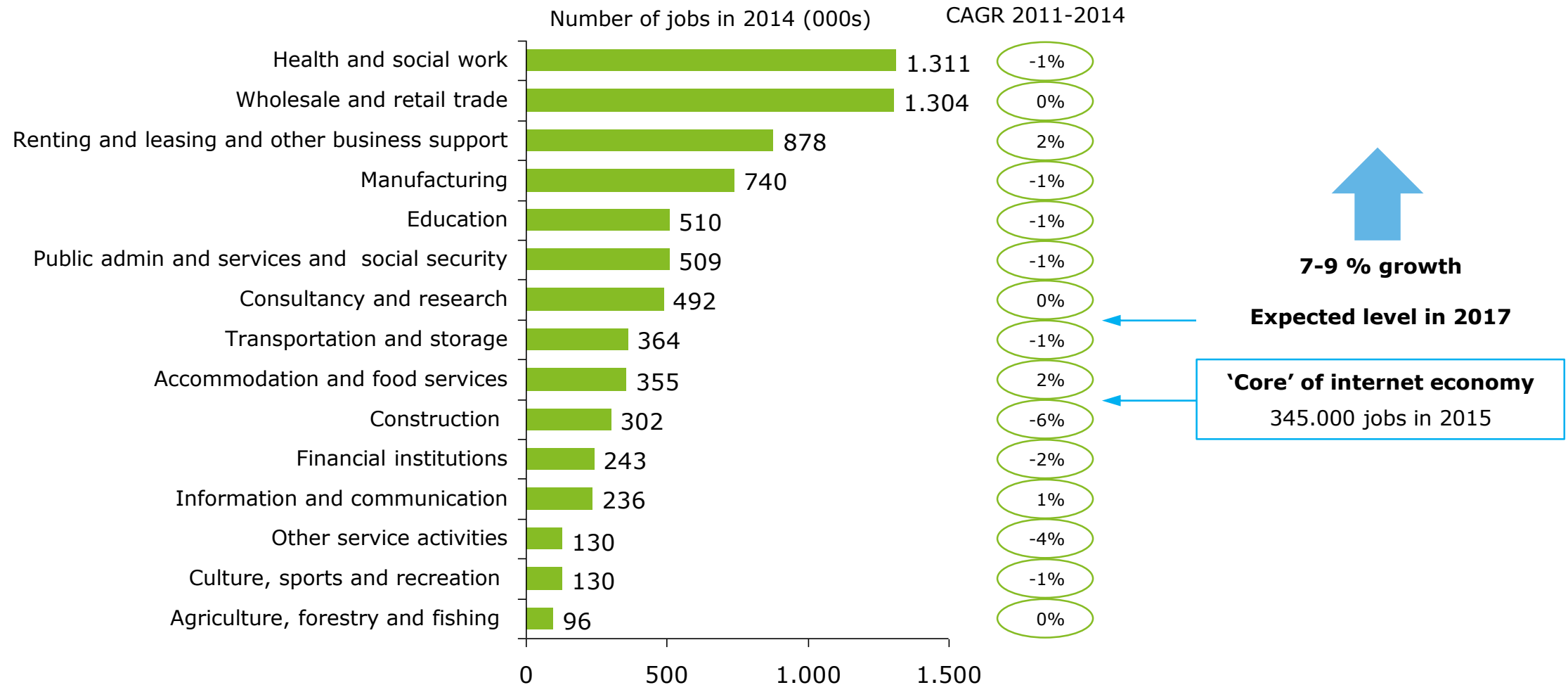
**Turnover (billion euro)**



- No/Passive online presence (A, B1)
- Active online presence (B2)
- Core Internet economy (C, D, E)

# The 'core' of the internet economy is already larger than many sectors and will continue to grow

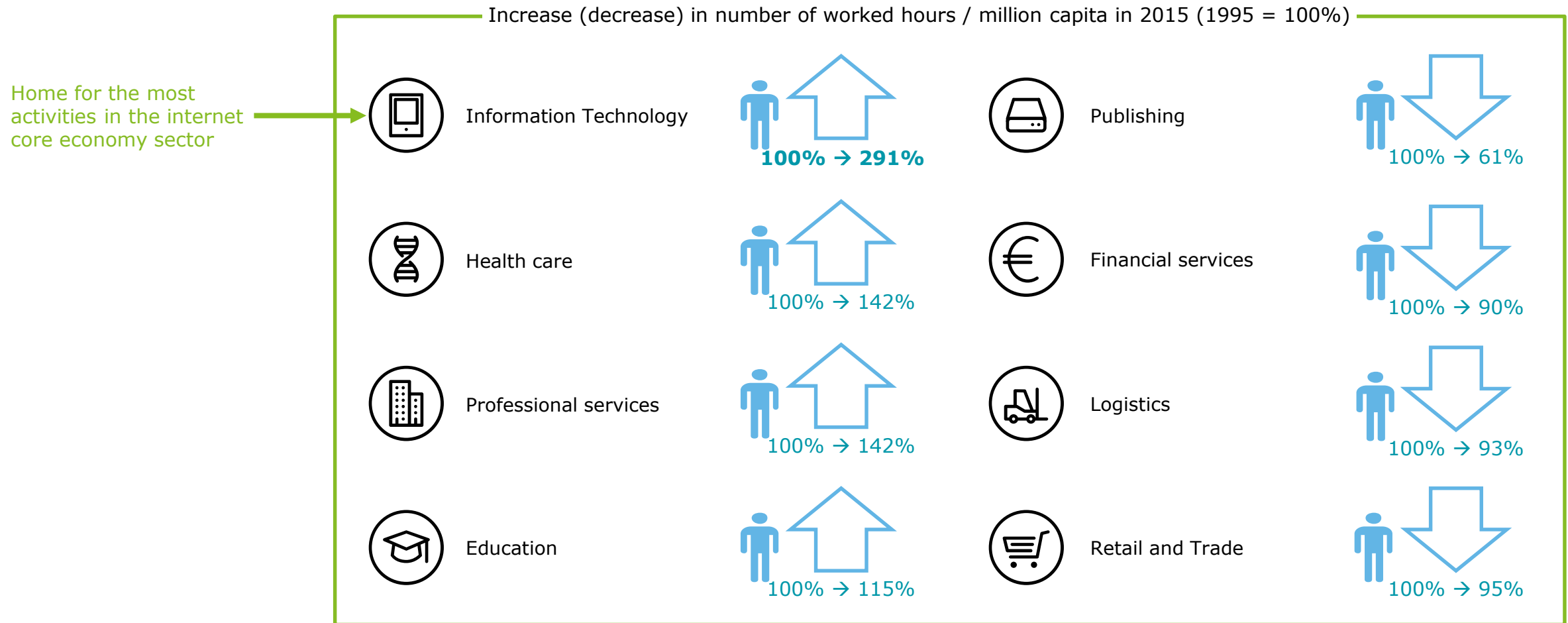
If the 'core' of the internet would be a separate business it would be comparable in size to other sectors such as construction, accommodation and food services or transport and storage.



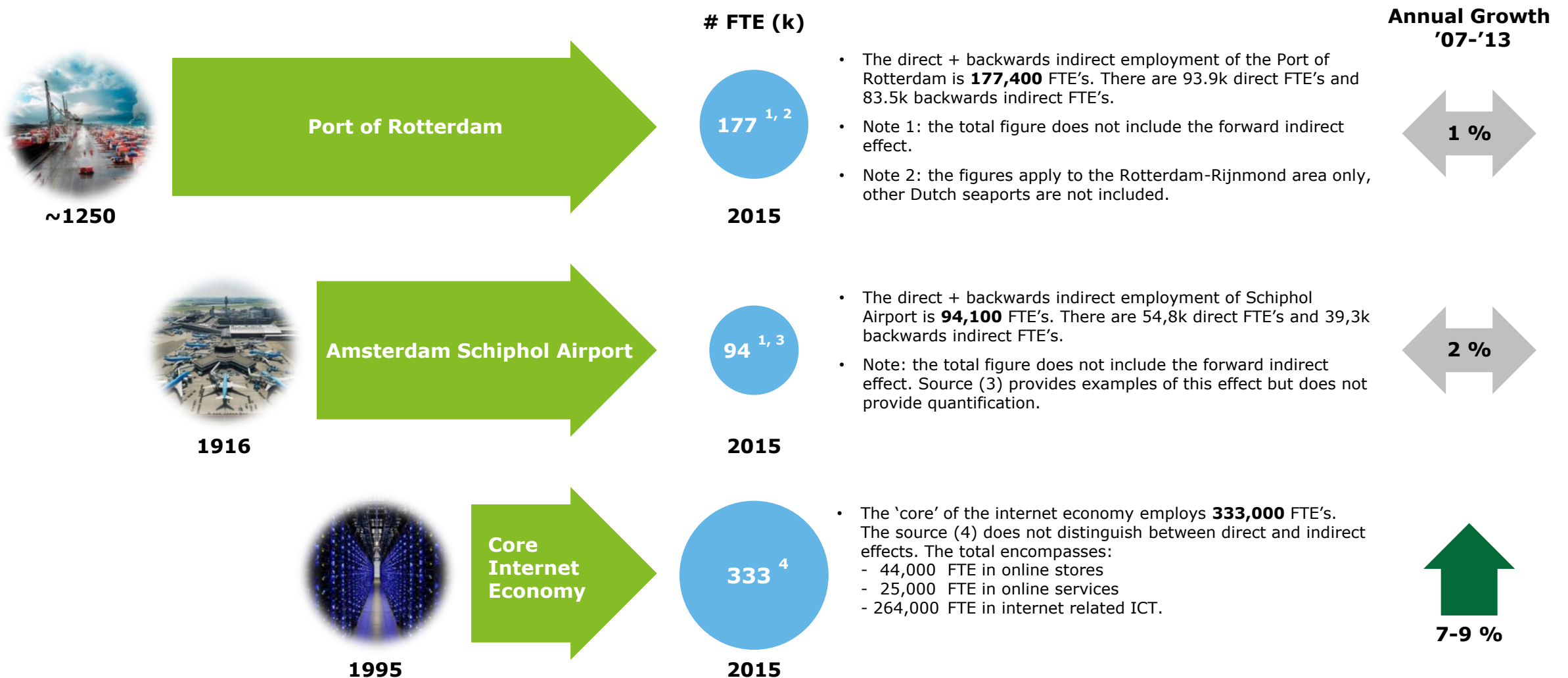
Source: CBS Discussion Paper, Measuring the internet economy in The Netherlands: a big data analysis, 2016, CBS Statline

# This is in line with the growth in employment compared with other sectors

IT stands out with an increase of total worked hours of 291% compared to the 1995 level. There is no other industry that has shown a similar growth. Industries that have been disrupted by digital technology decreased in worked hours



Given its age, the Internet economy has already a large impact on the Dutch economy and is growing at a rapid pace relative to other growth enablers



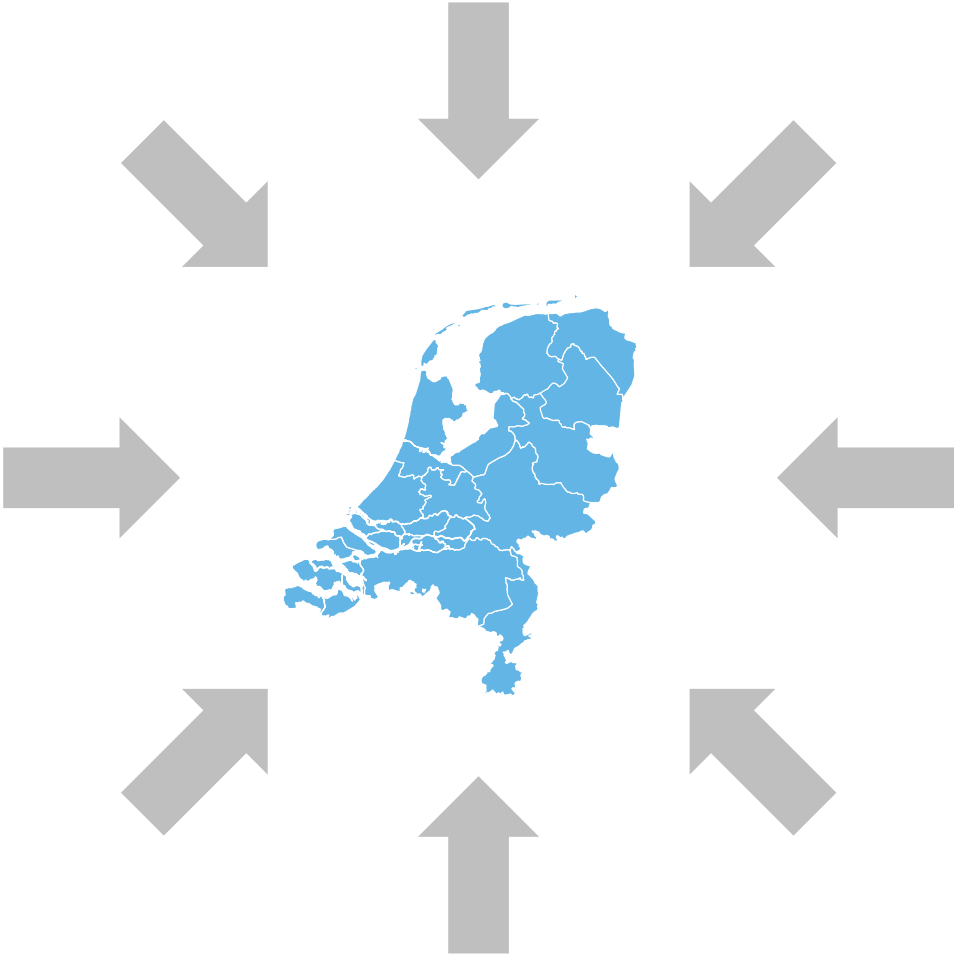
Sources: (1) Raad voor de Leefomgeving en Infrastructuur, Mainports voorbij, Juli 2016  
 (3) Decisio, Economisch belang van de mainport Schiphol, 1 September 2015

(2) RHV Urban Port and Transport Economics, Havenmonitor, December 2015  
 (4) CBS Discussion Paper, Measuring the internet economy in The Netherlands: a big data analysis, 2016

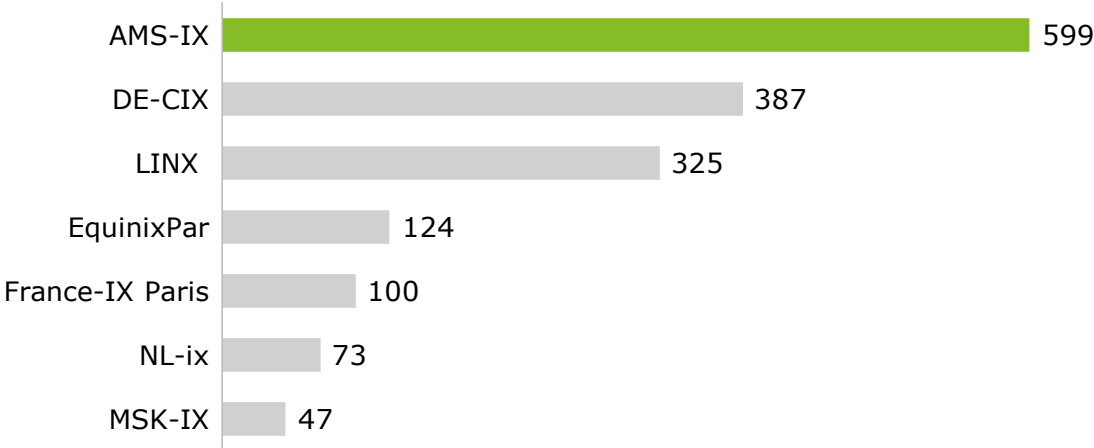


# 6. Attracting international digital companies

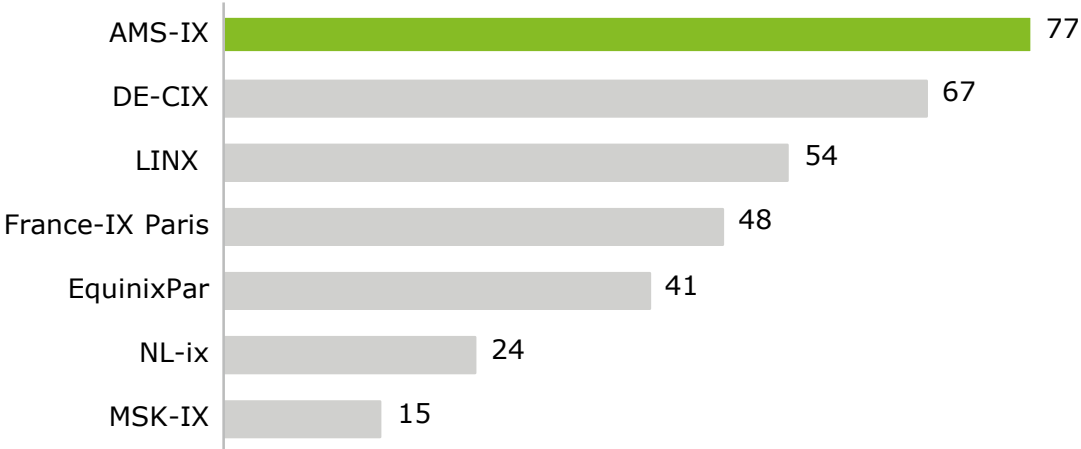
# The AMS-IX has been very successful in attracting companies from abroad



**Number of ASNs from foreign companies**



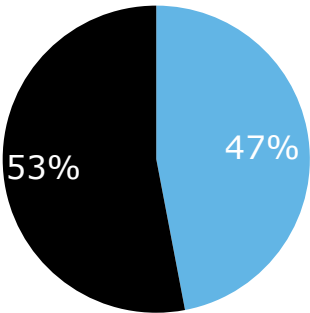
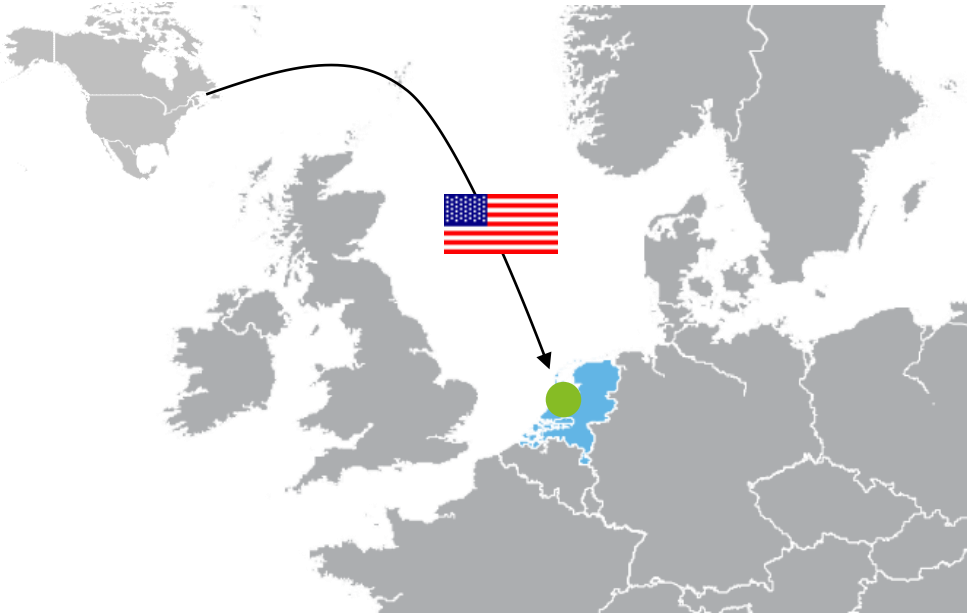
**Percentage of ASNs from foreign companies**



Source: PeeringdB, EuroIX, Deloitte analysis

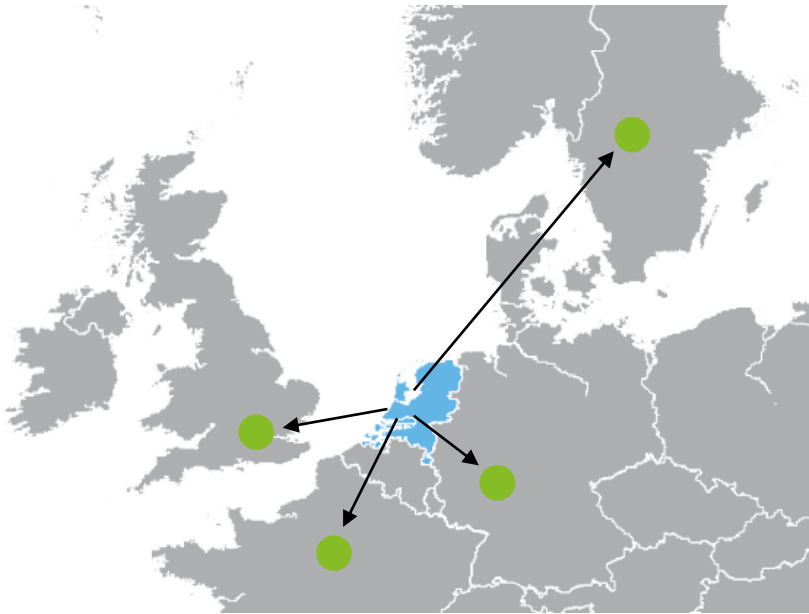
# For US companies the AMS-IX seems to be the preferred first entry in Europe

When focusing on US companies on a single exchange, the AMS-IX is most preferred as first entry

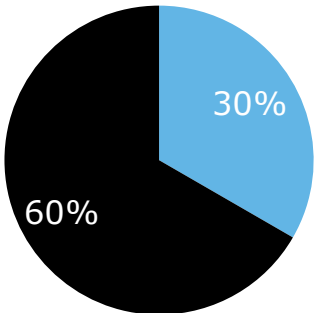


US companies (ASNs) on a single IX in Europe

US companies then spread throughout Europe with presence on many exchanges



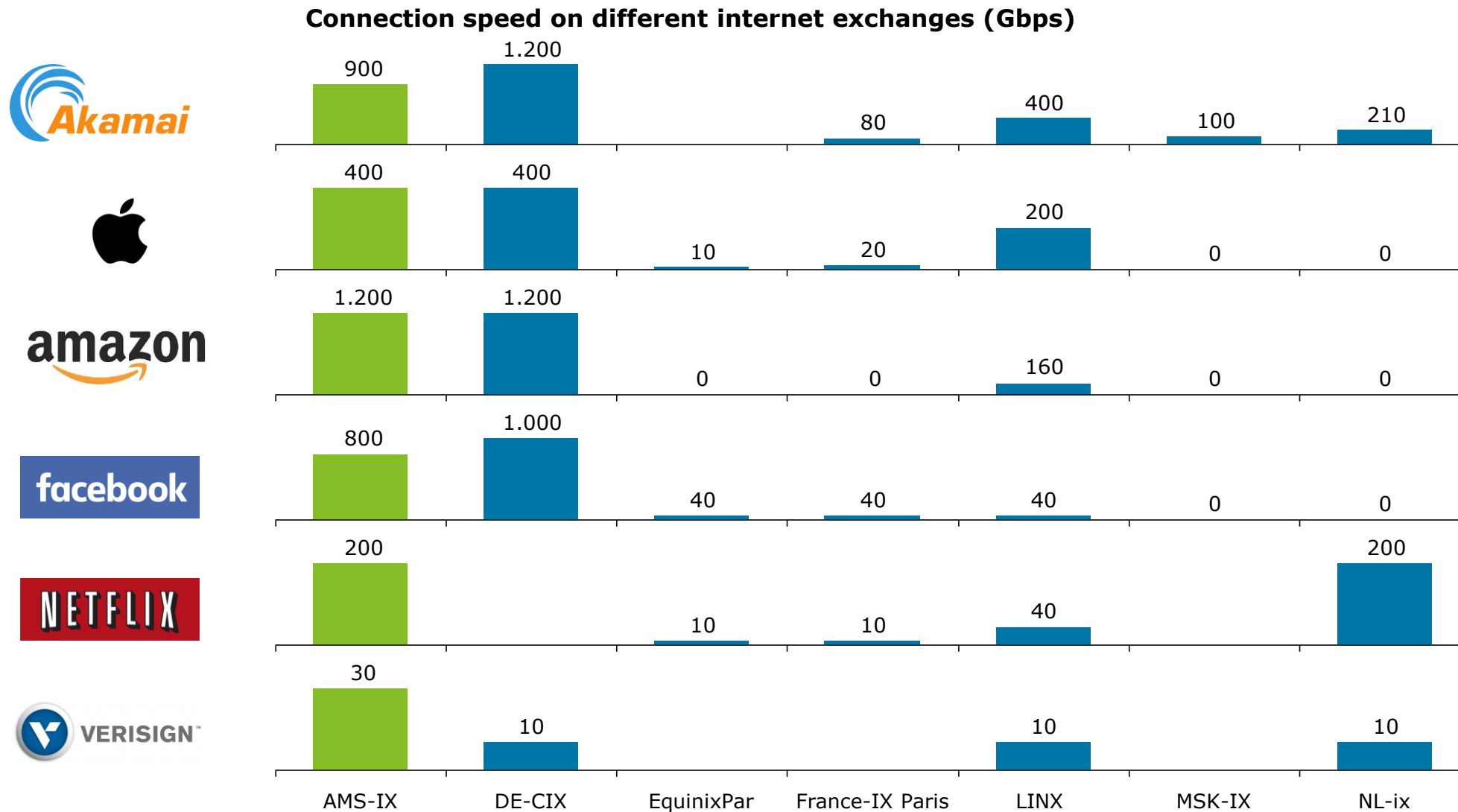
AMS-IX  
Other



US companies (ASNs) on one of more IXs

Source: PeeringdB, EuroIX, Deloitte analysis

The AMS-IX has attracted many internet giants directly competing only with the DE-CIX



Source: PeeringdB, EuroIX, Deloitte analysis

# How large internationals view the Dutch digital infrastructure and ecosystem: Google

## Infrastructure



*"In terms of digital infrastructure the Netherlands still has a **first-mover advantage** in terms of costs, low latency and availability of digital infrastructure. **Competition is on the rise** though. As digital infrastructure is a global marketplace, Asia should not be overlooked as a competitor."*

## Infrastructure



*"The Netherlands has **more to gain from sustainable energy**, as it is of growing importance for the digital ecosystem. Germany and the Nordics lead the pack in continental Europe."*

## Ecosystem



*"In the Netherlands there is a clear support and favorable attitude towards the digital economy, paired with good marketing of that interest. An example is the **flourishing start-up scene** and support by the government."*

## Financing



*"The Netherlands needs better **access to capital for startups**. Most of the capital is caught up in pensions funds and the regulatory framework hampers capital injection by crowdsourcing / angel investors. Consequence is that many scale-ups move to America."*

## Rules and legislation



*"Two things are important in policy; the current rules and the predictability for the future. We see two surveillance bills in the Netherlands coming up that are **out of balance with the current policy**, and may limit the digital economy from growing to its full potential."*

Source: Deloitte interview, 2016



### Company activities

Internet-related services and products that include online advertising technologies, search, cloud computing, and software

### Company history

Founded in 1998

### Revenue

\$74,9bn in 2015

### Employees

Over 66.000 worldwide  
200 in Amsterdam and rapidly growing

### Locations

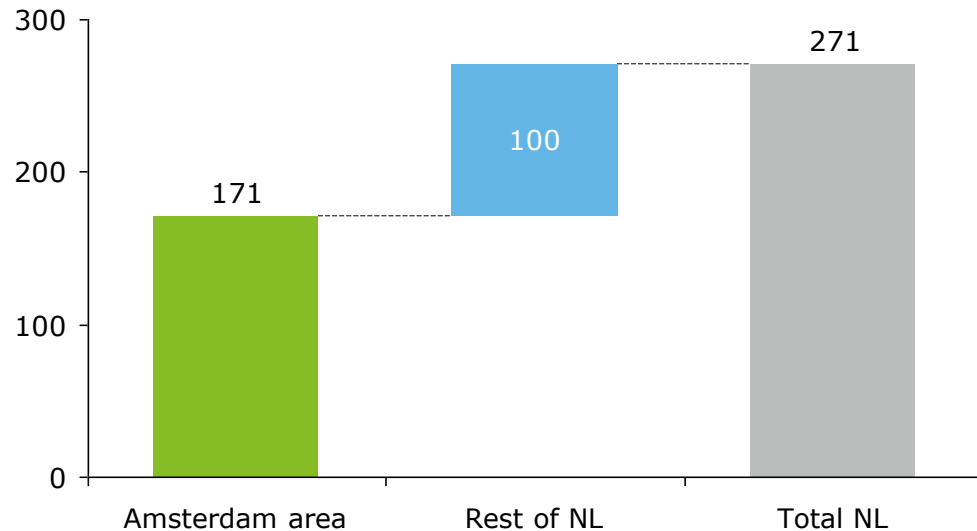
- Amsterdam office important particularly in innovation
- EMEA data centers in the Netherlands

# Amsterdam is the data center capital of The Netherlands and continues to show strong growth



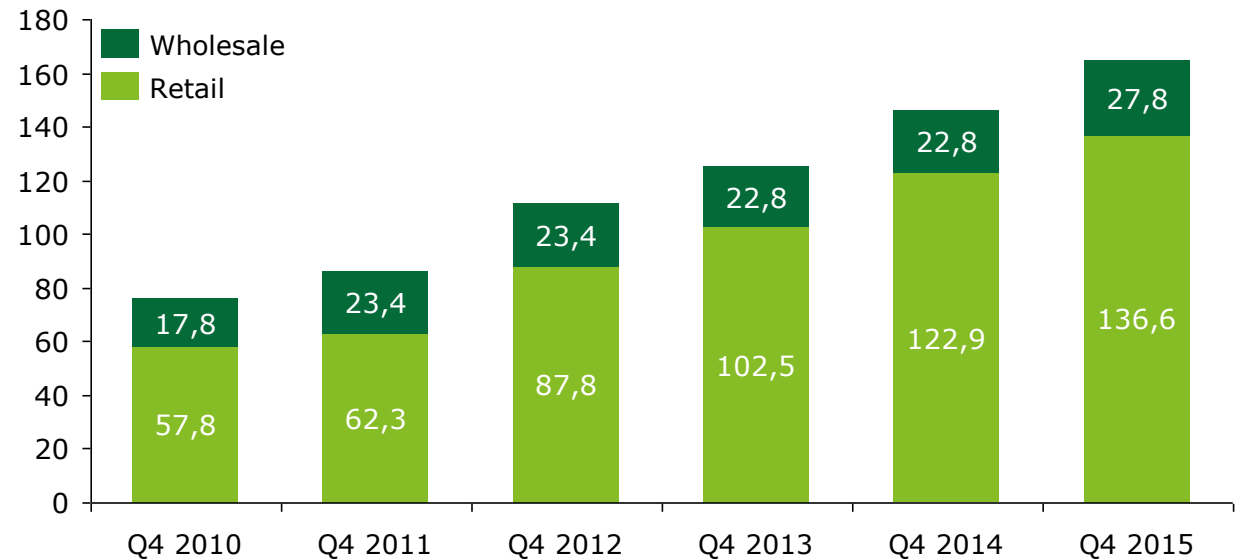
- The Netherlands has data centers in all regions of the country. Regional players are spread throughout the country while Amsterdam is dominated by large international providers.
- With 171 MW in supply the Amsterdam area represents more than 60% of all data center capacity in the country.
- The supply in Amsterdam continues to show a strong growth performance, showing a larger relative growth compared with its international competition in London, Paris and Frankfurt.

**Colocation data center supply in the Netherlands (MW)**



Source: Dutch Datacenter Association, Pb7 Research, 2016

**Data center supply in the Amsterdam area (MW)**



# The Amsterdam metropolitan area is dominated by international data center providers as part of their global play



Company	Global reach	Number of DCs worldwide
 EQUINIX	Active in 40 countries	145+
 interxion™	Active in 11 countries	42
 DIGITAL REALTY	Active in 11 countries*	155*
 GLOBAL SWITCH	Active in 8 countries	9
 Level(3) COMMUNICATIONS	Active in 22 countries	> 350
 kpn	Active in 1 country	10 (in NL)
 verizon✓	Active in 18 countries	43
 colt	Active in 15 countries	29
 evo <b>switch</b> NEXT GENERATION DATACENTERS	Active in 2 countries	2

Source: company information

\* Data generally based on 2015 situation and not necessarily reflects the current situation



# How large internationals view the Dutch digital infrastructure and ecosystem: Akamai

## Infrastructure



*"We are cloud-based thus stability and consistency are important. The Netherlands has a **stable infrastructure**, consistent internet connectivity and good quality data centers."*

## Ecosystem



*"The quality and reliable infrastructure in the Netherlands **attracts a lot of digital companies** and major providers which allows us to be close to our customers."*

## Talent



*"The NL attracts many talented people but mainly with trade and financial profiles. There is a **shortage of technicians** and more should be invested in technological education."*

## Rules and legislation



*"The Dutch government is very willing to engage with firms to **open the black-box of regulation** which makes life easier for tech-companies. Quality standards are very high as well, creating reliable infrastructure."*

Source: Deloitte interview, 2016



### Company activities

Akamai provides content delivery network services and solutions for web performance, mobile performance, cloud security and media delivery

### Company history

Founded in 1998

### Revenue

\$2.2bn in 2015

### Markets

All markets, globally. From automotive to financial services and from online gaming to the public sector

### Employees

6,100+

### Locations

Headquarters in Cambridge, MA (USA) with offices around the world

# The providers of data center services in Amsterdam are serving an international market

The majority of clients in the Amsterdam data centers is from abroad and often outside Europe. Many combine their data centers with significant business activities and the attractiveness is seen to be improving compared with other cities.

## Survey questions:

"Which % of clients in your Dutch data centers are international companies with the headquarters **outside Netherlands**?"



"Which % of clients in your Dutch data centers are international companies with the headquarters **outside Europe**?"



"Do your international clients combine their data center presence with **significant business activities** in the Netherlands (offices, personnel, investments)?"



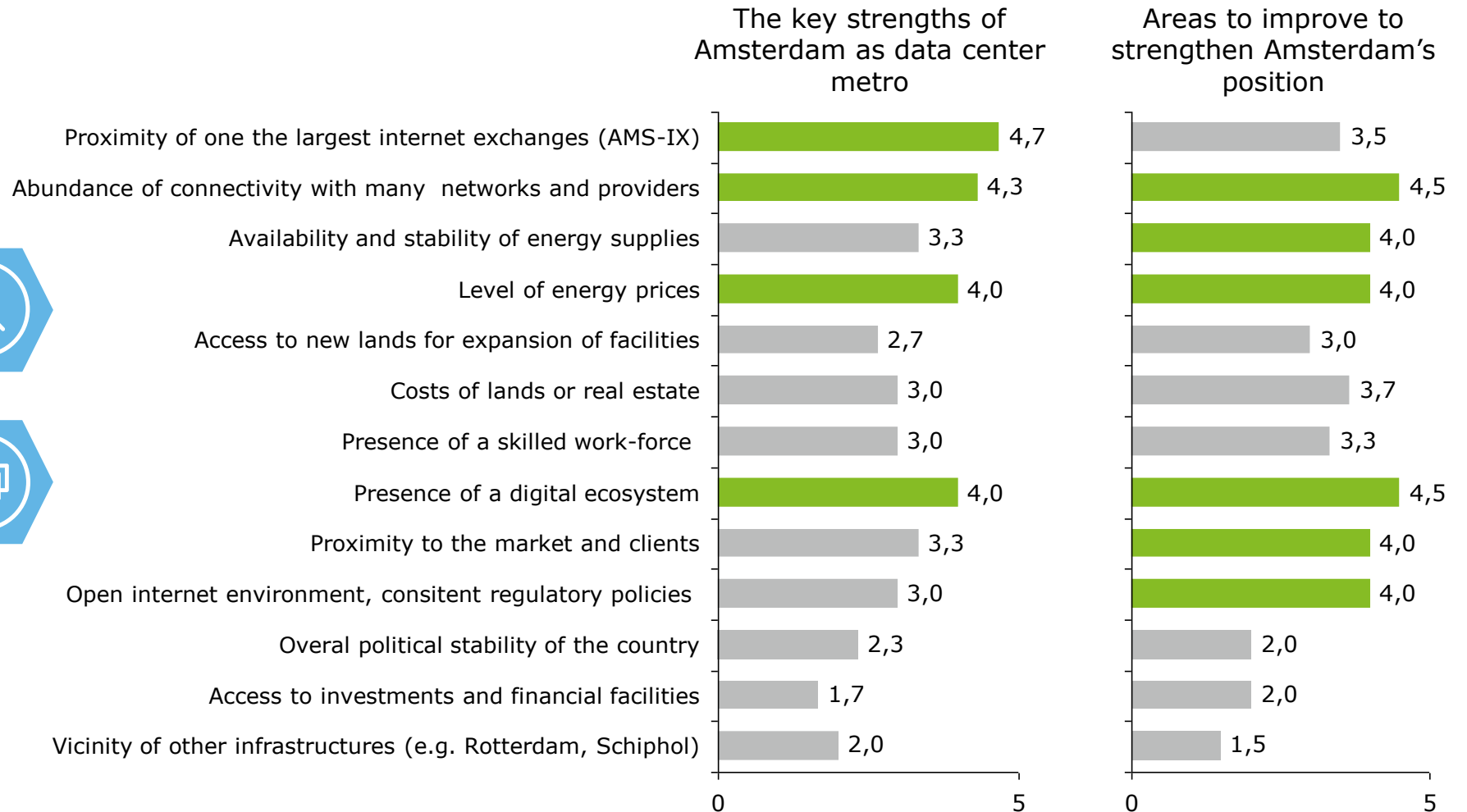
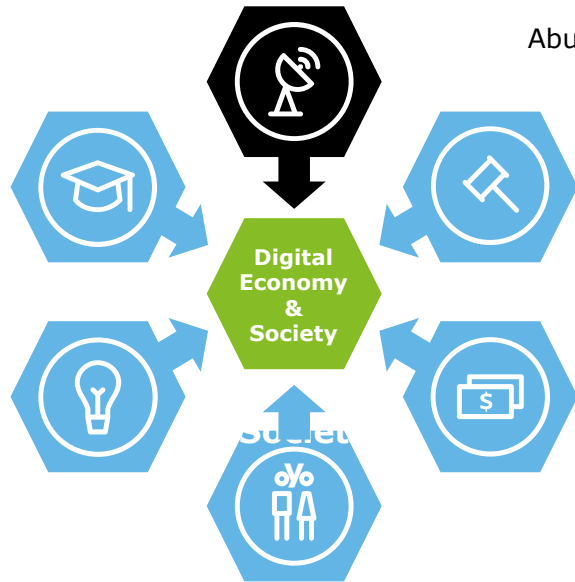
"Is the **attractiveness of Amsterdam as data center metro region** improving or decreasing compared with other European cities?"



Source: Deloitte survey among international data center providers in Amsterdam, 2016

# Amsterdam is an attractive data center city but some areas require further attention

DC providers and their clients rate Amsterdam high on infrastructure, energy prices and ecosystem but these factors require on-going attention to keep our leading role. Energy availability and regulatory are areas that need increased attention to improve.



Source: Deloitte survey among international data center providers in Amsterdam, 2016

# How large internationals view the Dutch digital infrastructure and ecosystem: Uber

## General



"Uber has chosen Amsterdam **for three reasons**: infrastructure, attractiveness of talent and the ecosystem

## Rules and legislation



"Innovation changes technologies rapidly. It is **impossible to capture every new technology in rules and regulations** without slowing down the pace of innovation.."

## Talent



"There is still a **limited supply of academics in The Netherlands** with a science or technology degree. Our search for international talent encompasses the whole world."

## Talent



"We have more than 40 nationalities in our office. It should be easier to **obtain work permits from outside the EU** as we continue to grow and look for the best talent.."

UBER

### Company activities

Uber develops and operates a digital platform for mobility services, packet and food delivery

### Growth

Reached 1bn of rides in 2015  
Reached 2bn in June 2016

### Company history

Founded in 2009

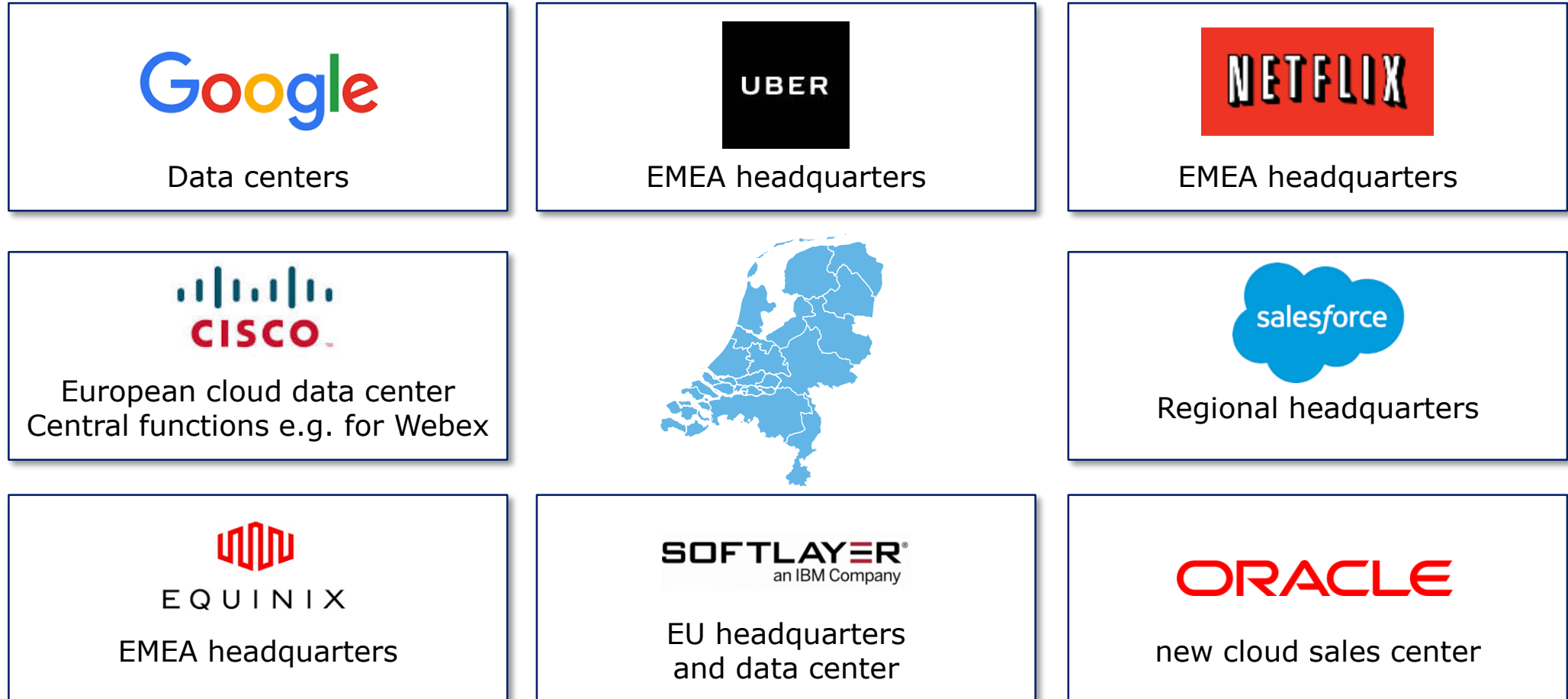
### Employees

~9000 globally  
Currently 300 in Amsterdam and rapidly growing

### Locations

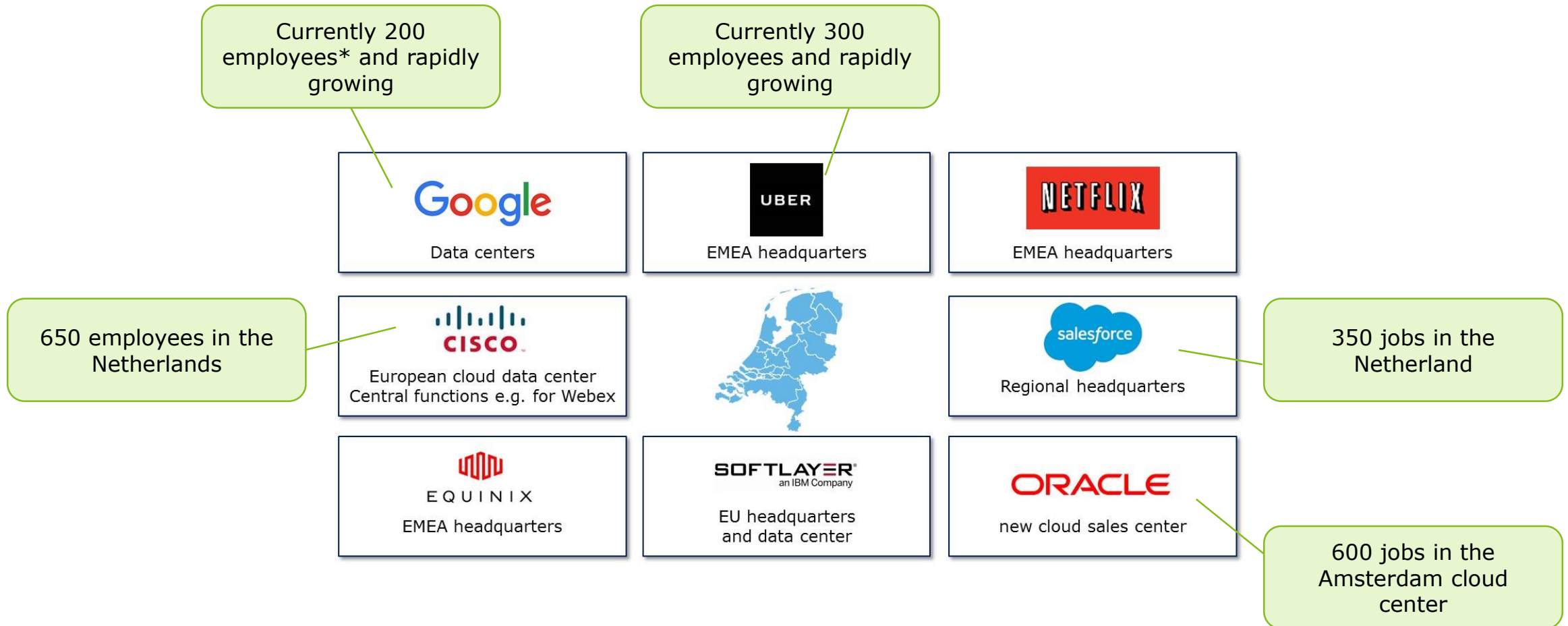
Amsterdam is the EMEA headquarter and the largest office out US

These companies bring significant activities like headquarters and data centers to our country



Source: Company information and press releases

Many of these centers have pan-European roles, employ a significant workforce and are rapidly growing



\*All Google employees in NL

Source: FD, company information and press releases

# How large internationals view the Dutch digital infrastructure and ecosystem: Cisco

## Infrastructure



*"The fact that the Netherlands has **an advanced infrastructure** combined with the common practice of thinking in **open frameworks**, makes the country very suitable for Cisco to develop innovation and test it in the market."*

## Innovation



*"The Netherlands has a leading position with major airports, ports, extensive waterways and a heavily used road infrastructure. **Continuing digital innovation** in all these areas is essential to keep our position as a country."*

## Ecosystem



*"Our technology is developed abroad but we **develop our services with local partners** and have a specific investment program for this. A **strong innovative ecosystem** is crucial for Cisco and one of the reasons for locating in the Netherlands."*

## Talent



*"**Attracting local talent** remains a challenge. Both for technical and commercial functions we see a significant gap between supply and demand. As Cisco we organize international training courses to fill this gap."*



### Company activities

Networking equipment and ICT solutions worldwide

### Company history

Founded in 1984

### Revenues

€49,2bn in 2015

### Employees

71.883 worldwide  
650 in the Netherlands

### Located in the Netherlands

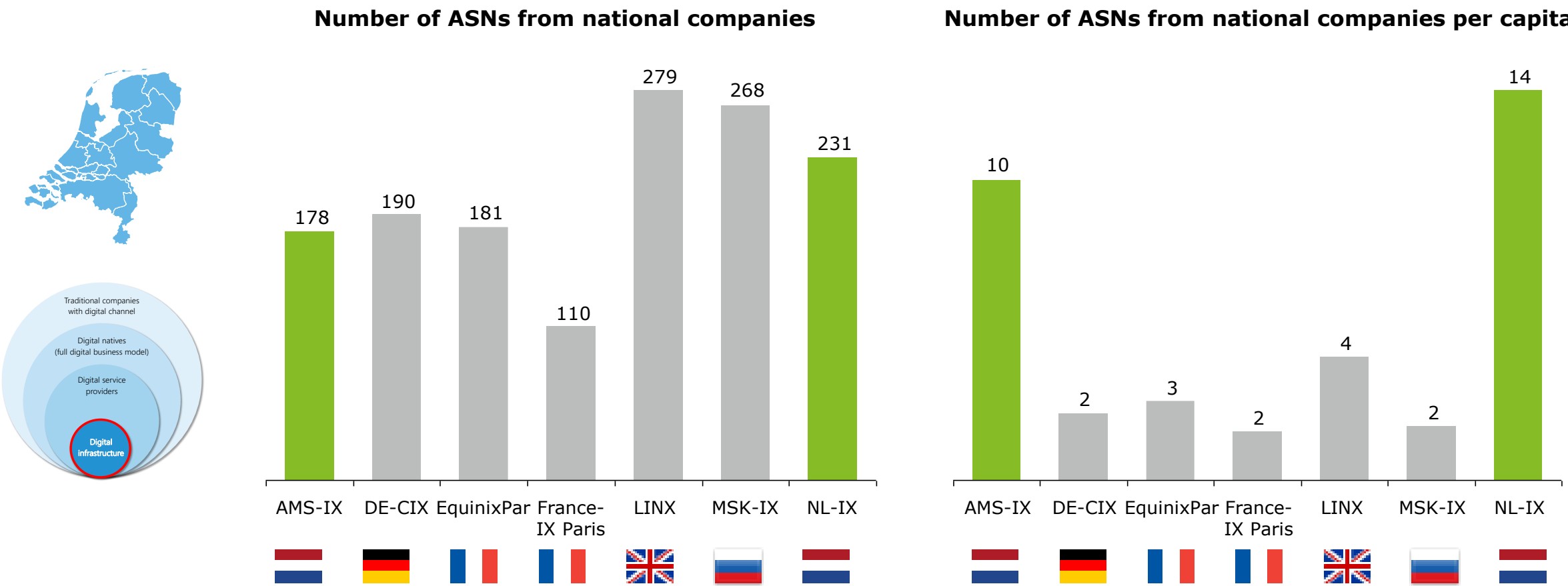
- European cloud data center
- Sales office for Netherlands
- European functions for e.g. Webex



# 7. Dutch digital companies expanding globally

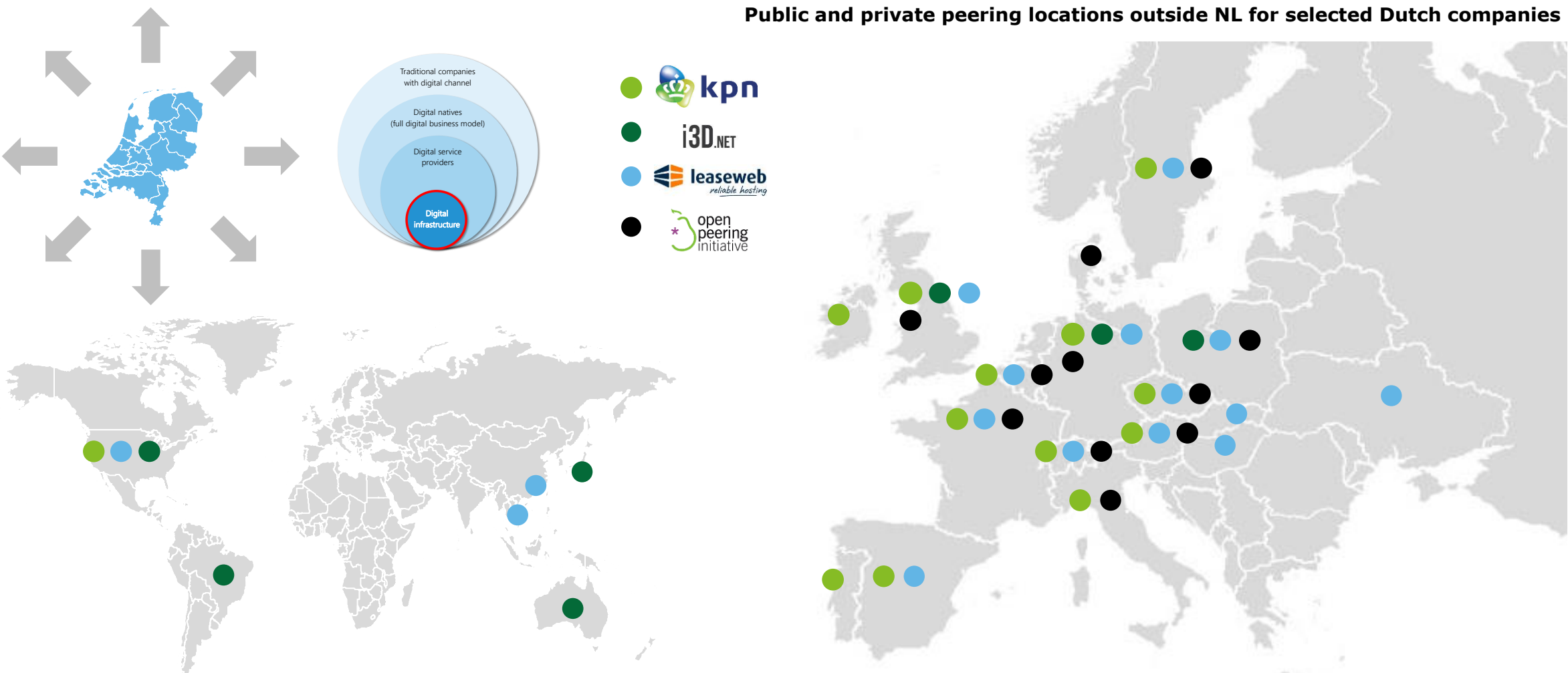
In addition to attracting international companies, our exchanges also host many NL companies

The AMS-IX and NL-IX have a large amount of local ASNs compared with the size of our country pointing a strong local internet sector



Source: PeeringdB, EuroIX, Deloitte analysis

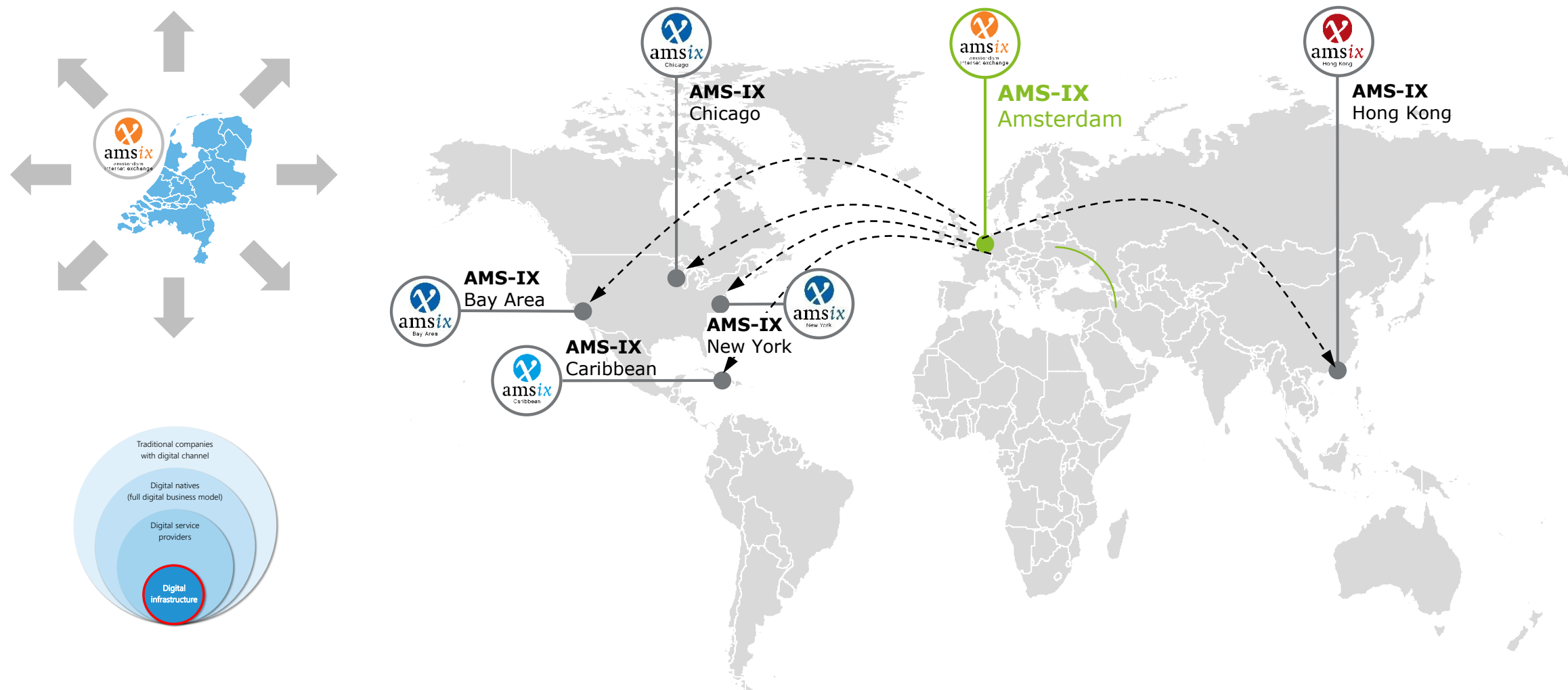
Dutch hosting and infrastructure companies are connecting to internet exchanges across the world to build their global business



Source: PeeringdB, Deloitte analysis

# The AMS-IX has been an example of expanding to new locations across the globe

The AMS-IX has expanded its business to other territories by opening subsidiaries



# How Dutch internet companies view our digital infrastructure and ecosystem: Openprovider

## General



"The Third [Digital] Mainport is much more important for our country than Schiphol and Rotterdam which are merely transit ports. It is **the place where we will develop the services for the next 50 years** so we can distinguish ourselves as a knowledge-based economy and provide **sustainable growth for the future.**"

## Innovation



"Innovation is **going much faster in other places** in the world. In India for example they are experimenting with different offerings that are going to have an impact on the market."

## Talent



"The **current labor market policies** in the Netherlands are a serious problem for companies in this sector. They are active in a dynamic international market where the Dutch legislation forms a substantial risk for entrepreneurs."

## Rules and legislation



"There is **much legislation** around the internet that is designed **without attention to the practical feasibility.** This leads to much additional effort and risk especially for smaller providers."



### Company activities

Wholesale provider of domain registration and SSL certificates. Operating under multiple brands

### Company history

Founded in 1997

### Reach

800% growth between 2010 and 2016. Current revenue mostly from the NL but international revenue is expected to take over in a few years

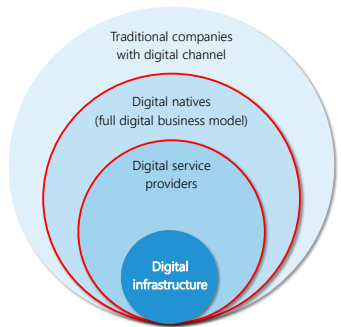
### Employees

35, mostly outside the NL

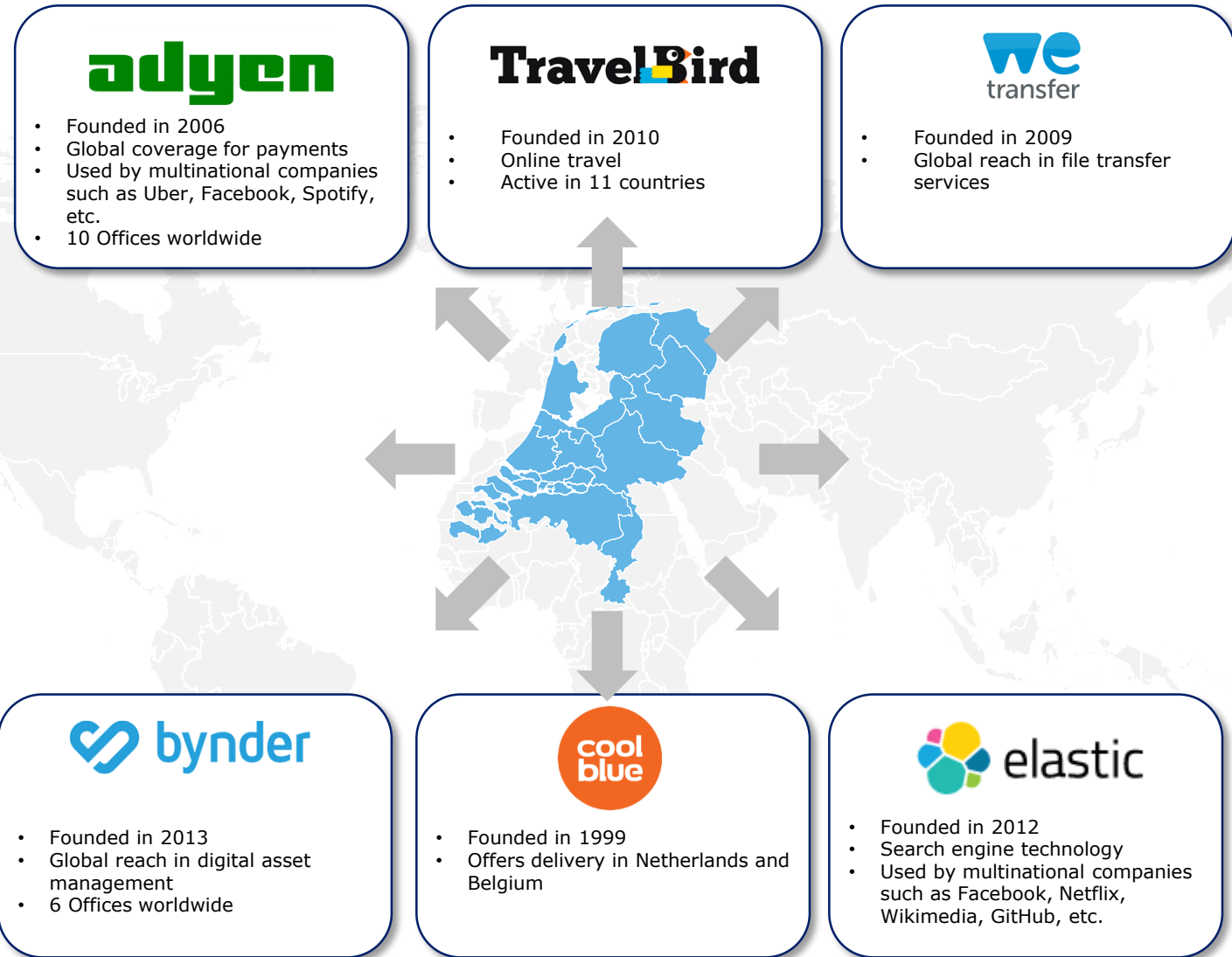
### Locations

Offices in the NL, Spain, Russia and India

On top of our digital infrastructure these Dutch digital service providers and digital native companies have grown to be global players and contribute considerably to the real economy

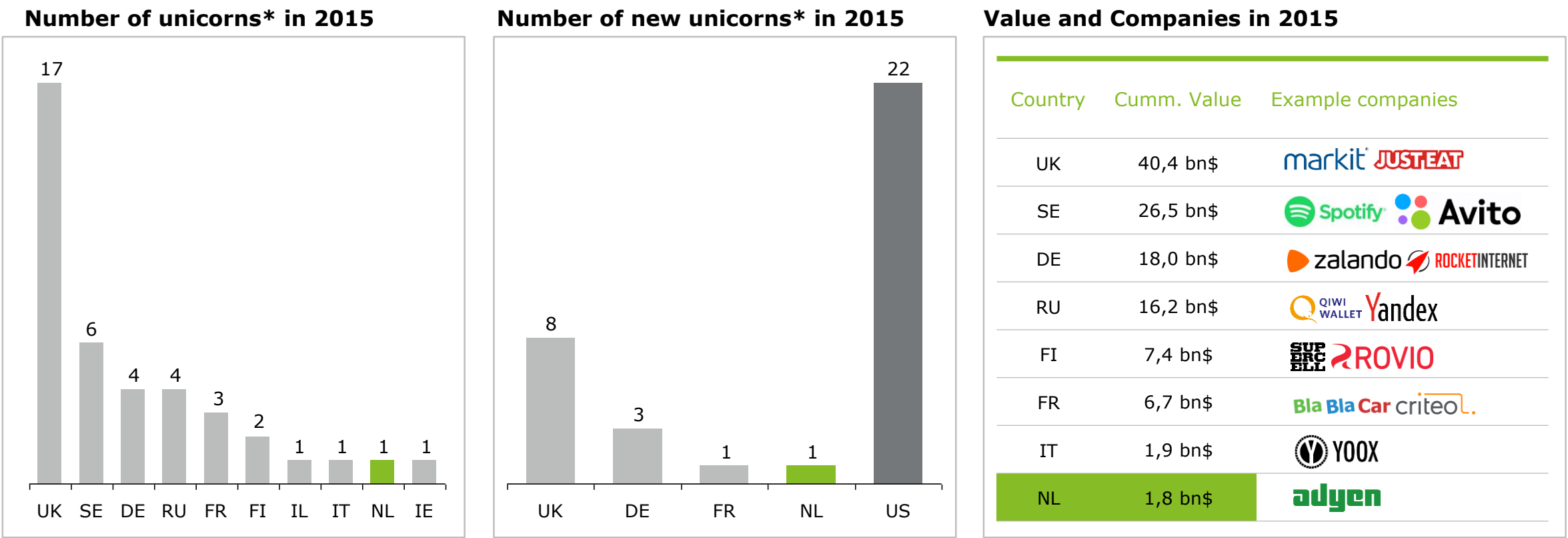


Digital natives  
Digital service providers





However – when looking at technology unicorns we are not leading in Europe and the US is even further ahead

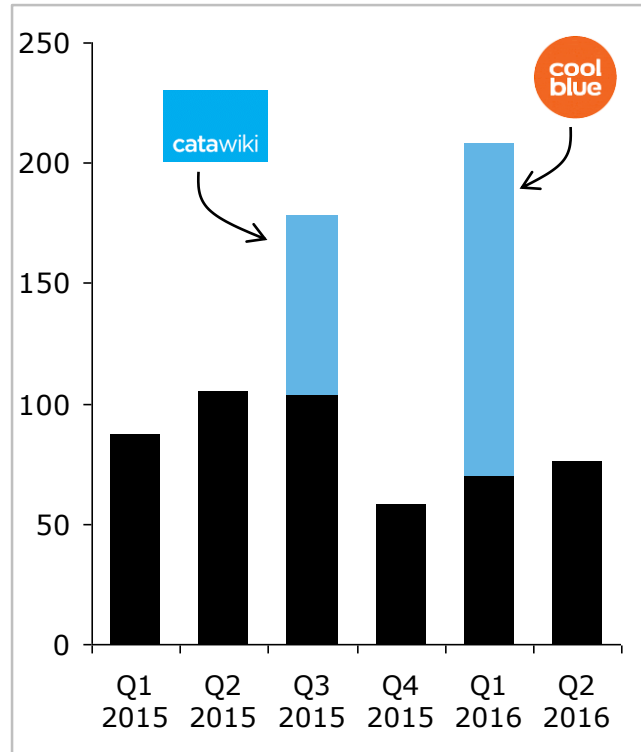


Source: GP. Bullhound Research

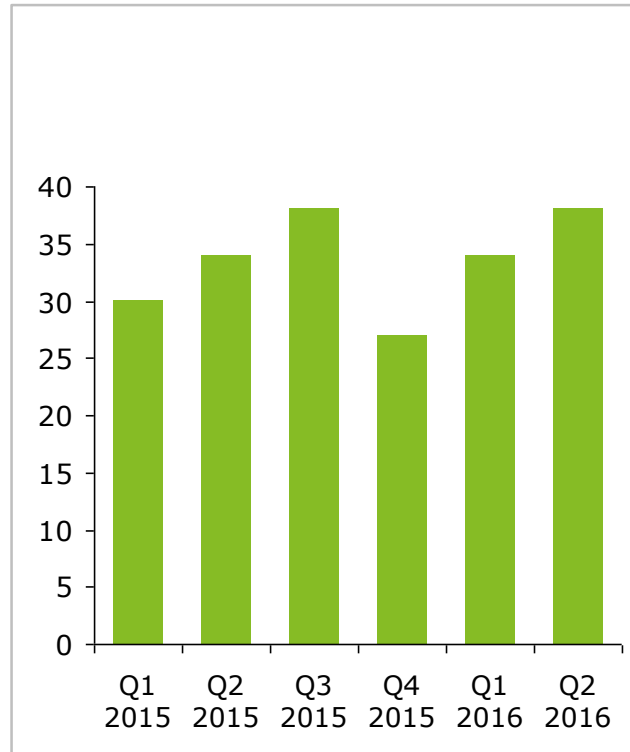
\* Unicorns: software/tech companies started since 2003 and valued at over \$1 billion by public or private market investors (Lee, 2013)

# Investments in start-up companies in the Netherlands are not structurally growing and lagging behind compared with other European countries

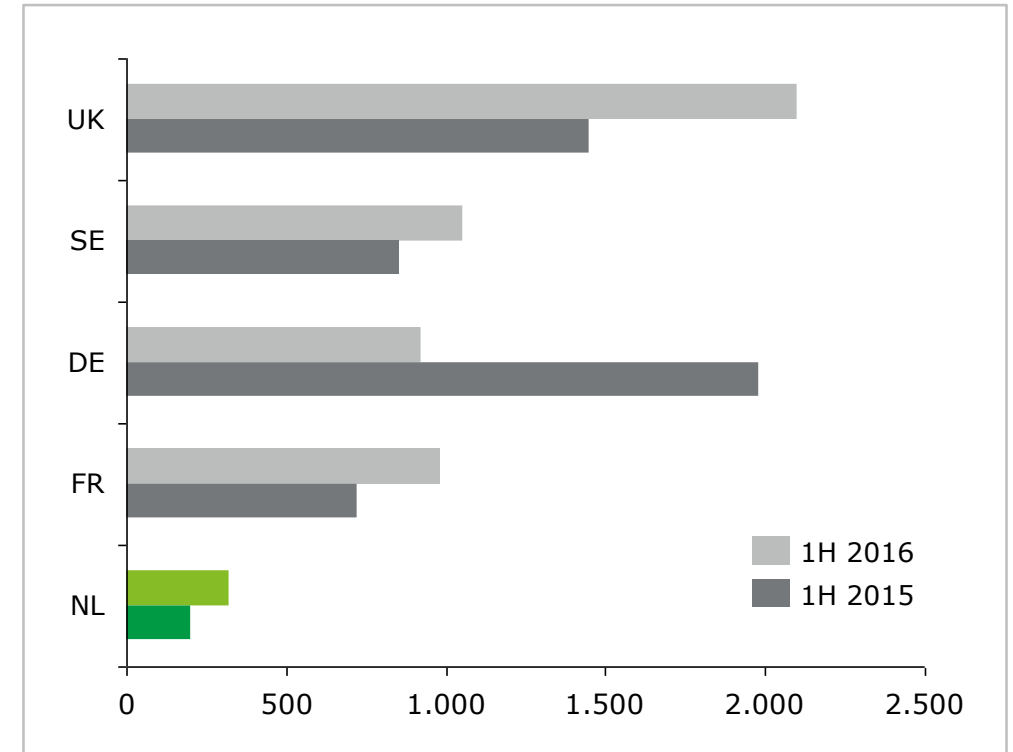
**Total investments\* in NL (m€)**



**Number of deals\* in NL**



**Total startup investments (m€)**



Large deals  
Structural investments

Number of deals

Source: River Venture Partners

\* Investments in Dutch Tech startups/scaleups

# How Dutch internet companies view our digital infrastructure and ecosystem: Teleena

## Infrastructure



*"We are providing many critical mobile services. People and enterprises depend on it. A solid digital infrastructure is essential to deliver our services and **the Netherlands has a very advanced infrastructure.**"*

## Infrastructure



*"Majority of Teleena's mobile and IoT business activities is **delivered from two data centers in the Netherlands.** If requested by the customer local infrastructure is built to serve their needs and support roll-out of Mobile and IoT services."*

## Innovation



*"Teleena's entrepreneurial DNA has a good fit with **the innovative mind-set of the many start-ups** you can find in **the Netherlands** especially in the IoT area."*

## Talent



*"It is **not easy to attract the right talent** in the Netherlands. More than half of our employees are from outside our country and often the EU."*

# Teleena

### Company activities

Teleena offers managed mobile and IoT service solutions to operators, retail brands and other enterprises, globally

### Company history

Founded in 2007

### Revenues

30 Mio (2015)

>20% growth from 2013 to 2015

### Markets

Around the world incl. Taiwan, UK, Japan, Australia and Canada

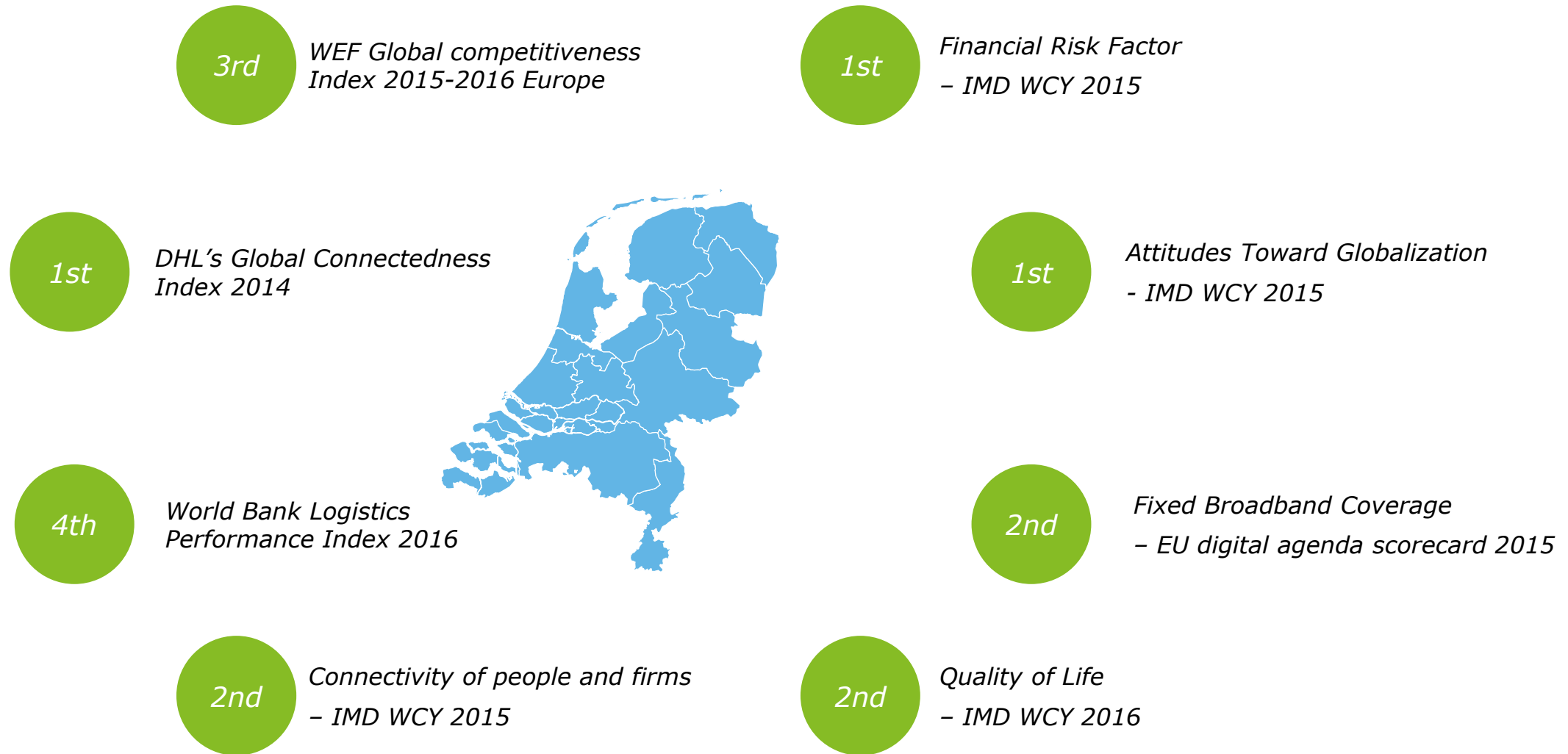
### Employees

80

### Locations

Headquarters in NL with offices in the UK and Dubai

# The Netherlands is very well positioned as a business location for global businesses



Source: NFIA, invest in Holland



Part III

Next steps

# 8. Conclusions and recommendations



# Conclusions (1/2)

Our Dutch digital infrastructure is a foundation for the emerging digital economy and society. It contributes to economic growth and quality of life. On an international level, the Dutch digital infrastructure sector stands out as a differentiator.

## Developments in digital infrastructure are going fast and our country has a leading position in Europe

- Internet traffic continues to grow at approximately 22% annually
- The AMS-IX is one of the world's leading internet exchanges and the largest in Europe in terms of number of peering networks (ASN's)
- The Dutch colocation market is showing ongoing growth at 15% annually and our market is significantly larger than other European countries compared to our GDP
- The Netherlands has a strong presence in terms of domains and domain hosting

## Digital infrastructure is the foundation for the digital economy which is already larger than many other sectors

- According to CBS, the 'core' of the internet economy provides 345,000 jobs - more than sectors like construction or transportation – and shows significant higher growth than other sectors
- Although existing only for 20 years, the core of the internet already employs more people than the Port of Rotterdam or Schiphol Airport

✓ *Leading position in Europe*

✓ *Foundation for the digital economy*

## Conclusions (2/2)

Our Dutch digital Infrastructure is attracting international digital companies and is a basis for Dutch digital companies to be successful across the world. We need to continue working on a combination of conditions to further strengthen our position.

### **The Dutch digital infrastructure is a strong asset in attracting foreign digital companies ...**

- The digital infrastructure, with a leading position in networks, data centers and internet exchanges, is one of the key reasons for foreign digital companies to locate here
- These companies bring substantial activities such as data centers, headquarters and other central functions with a significant amount of jobs

### **... and is a foundation for Dutch companies being successful abroad**

- The digital infrastructure provides a clear opportunity for Dutch companies to deliver services internationally
- Our country has been the breeding ground for successful digital companies such but our role in the international digital economy can be further strengthened

### **The Netherlands has a first-mover position in digital infrastructure but there is a combination of conditions that needs ongoing attention to sustain this growth**

- All companies emphasize the importance of a combination of factors that enable them to be successful in the digital world. Next to infrastructure, important factors are talent, regulation, innovation and ecosystems
- The digital economy is a global and rapidly evolving environment where the right combination of favorable conditions is essential to strengthen our competitive position

✓ *Attract foreign companies*

✓ *Foundation for international expansion*

✓ *First mover position*

# Recommendations

We can strengthen our competitive position in the international digital ecosystem by improving on a combination of conditions and firmly embedding the digital agenda in future public policies

## Infrastructure



- Ensure **sufficient availability of space and energy** for current and future data centers. Coordinate the effort to streamline issues on locations for data centers and fibers.
- **Accelerate sustainable energy** production and maintain a stable and reliable energy supply at competitive prices by smart grids.
- Define a clear public **strategy for 5G** to boost the Dutch economy and build a 'gigabit society'.

## Innovation and research



- Define **digital agendas** focusing on the opportunities arising from upcoming digital technologies such as IoT, Big Data and Artificial Intelligence.
- Stimulate **research, sector initiatives and pilot projects** such as next generation internet, to maintain the leading position of the Netherlands as internet innovator and safe place to do business.

## Ecosystem



- Drive **continuous collaboration** between public and private organizations to fuel the ecosystem and **build trust**.
- Make an agenda for **an integrated mainport policy** and promote initiatives such as Digital Gateway to Europe, with specific focus on growing it to the next level.

## Talent



- Establish a **closer link between our education system and the new digital economy** to ensure that we have the right talent to further grow our digital economy and society.
- Facilitate **access to foreign digital talent** by making our country the easiest and best place to work. This allows our country to attract foreign companies and our own digital leaders to grow further.

## Rules and legislation



- Provide a **balanced framework for legislation** taking into account the economic value and other drivers such as national security.
- Collaborate within Europe to **harmonize the national rules** and legislation around digital to ensure a borderless way of doing business in the digital economy.

## Financing



- Create the right structure and conditions in the Netherlands to make **financing for digital start-ups and scale-ups** more attractive.

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