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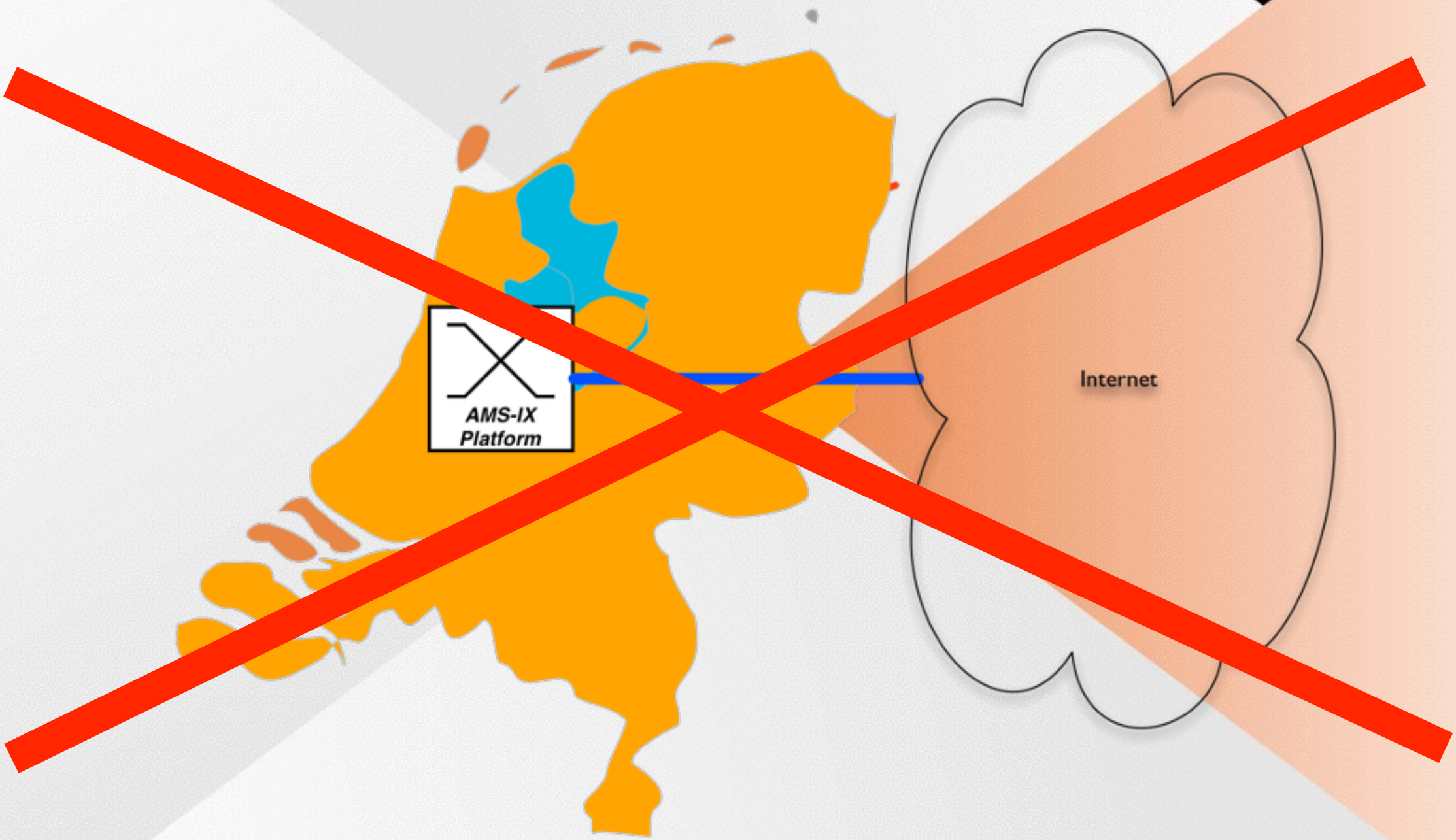
The AMS-IX model

Bastiaan Goslings, AMS-IX Regulatory Affairs
CRC IXP Workshop, Bogotá 19 March 2015

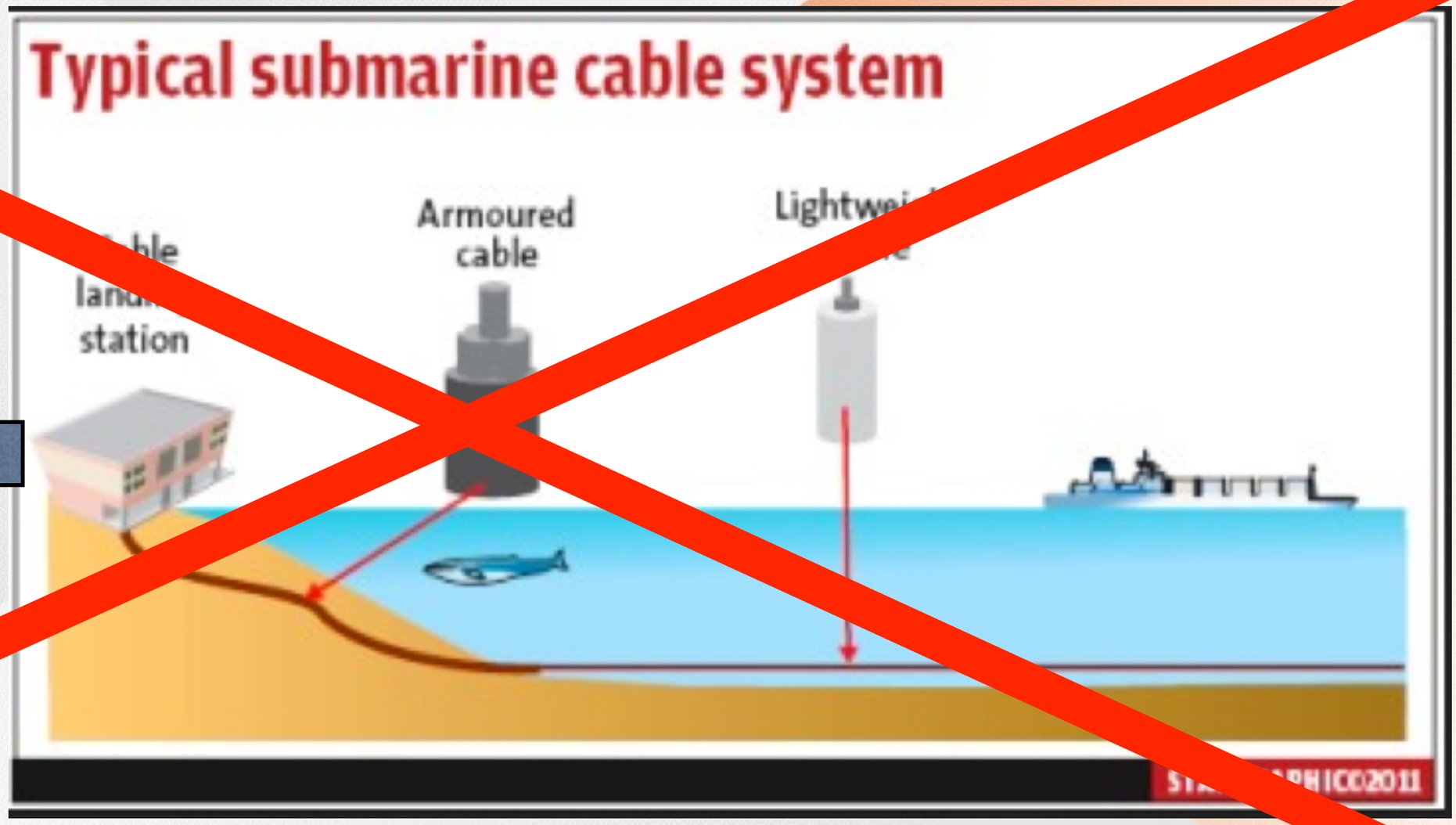
Agenda

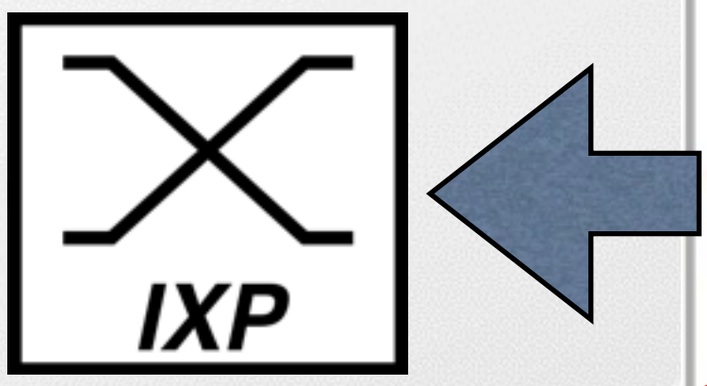
- First: what is not an IXP…
- 'It’s all about interconnection'
  - A bit more about ‘peering’ and IXPs
- AMS-IX
  - Philosophy and organisation, platform and connected networks
- Regulatory developments that might affect future succes?
- 'Q&A'

What is not an IXP?



What is not an IXP?





What is not an IXP?

Telecity AMS5 Amsterdam ZO

Meet the IXP

It’s not about the technical challenges…

- BC(O)P’s available
  - e.g. https://www.euro-ix.net/euro-ix-bcp
  - excellent work done by PCH and ISOC
- It is about getting networks to voluntarily use the IXP and peer with each other
  - ‘Setting up and developing an IXP is only 20% technical work, the rest is social engineering’
  - Potential participants often competitors

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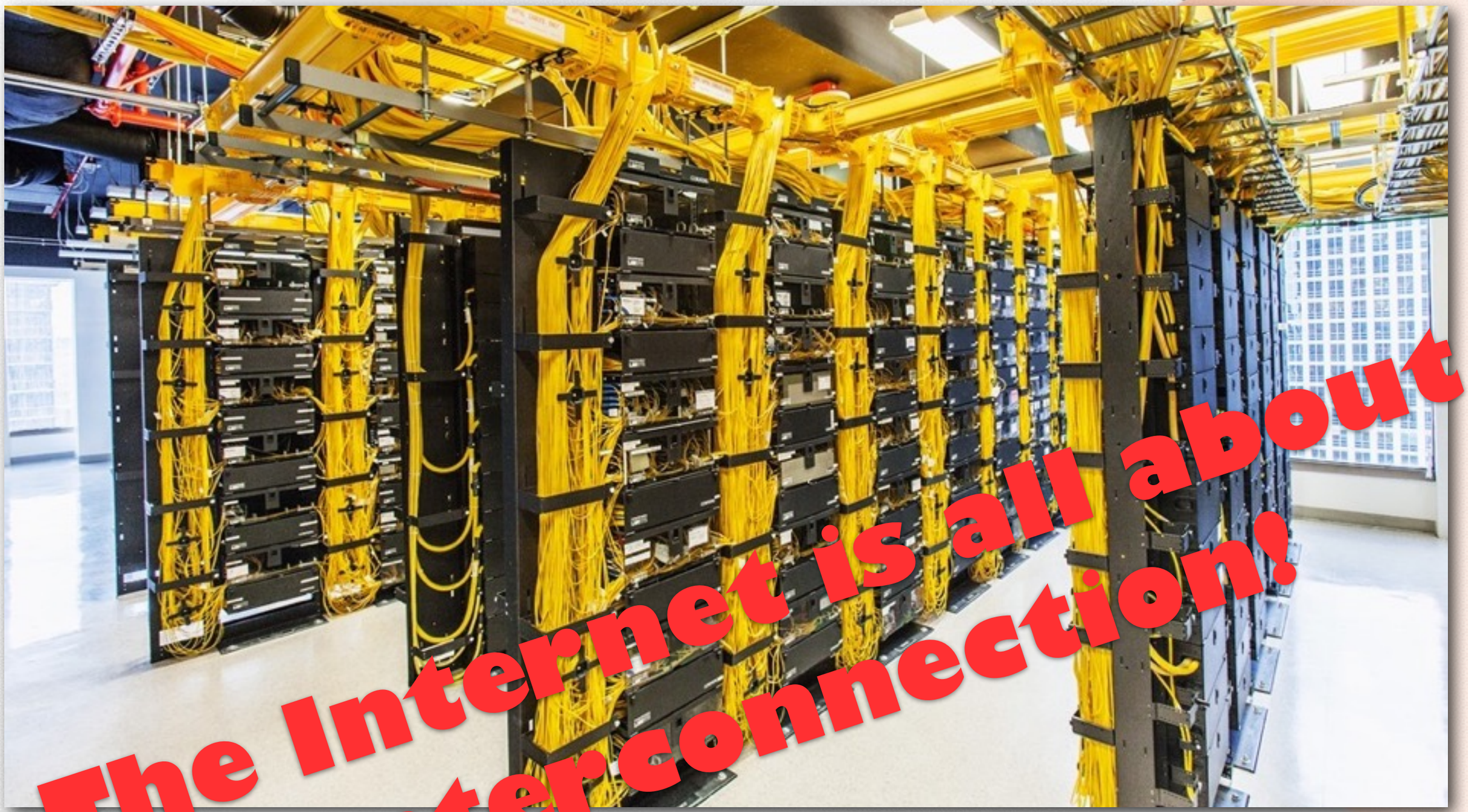
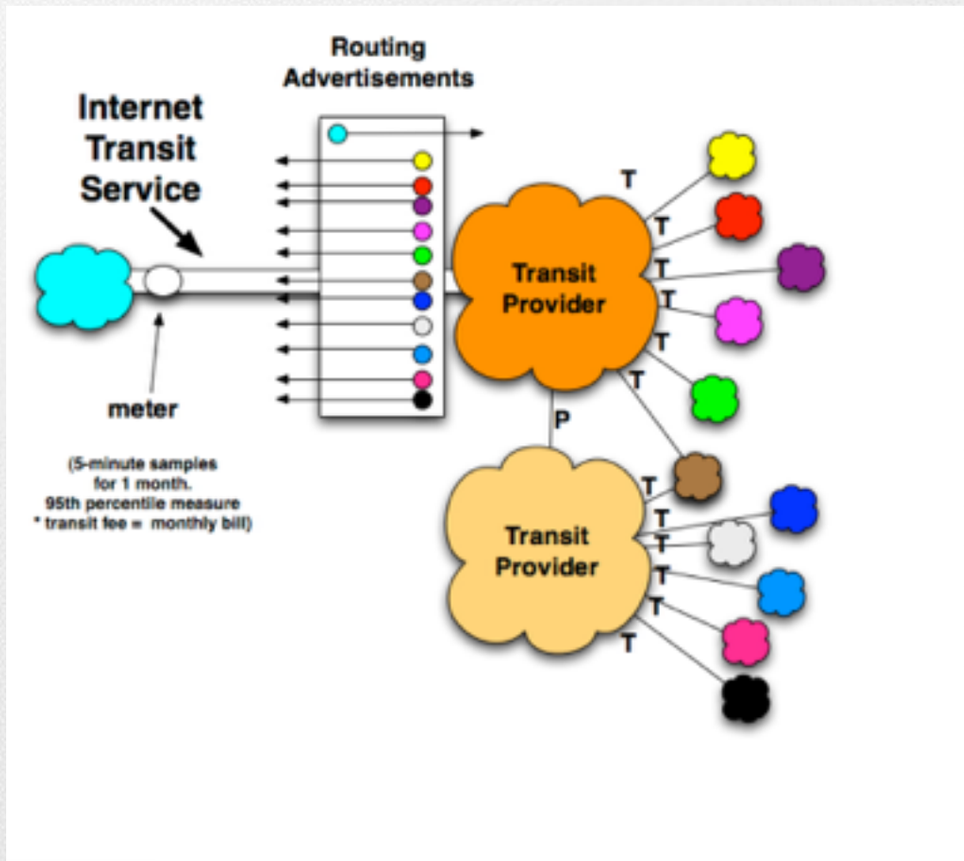


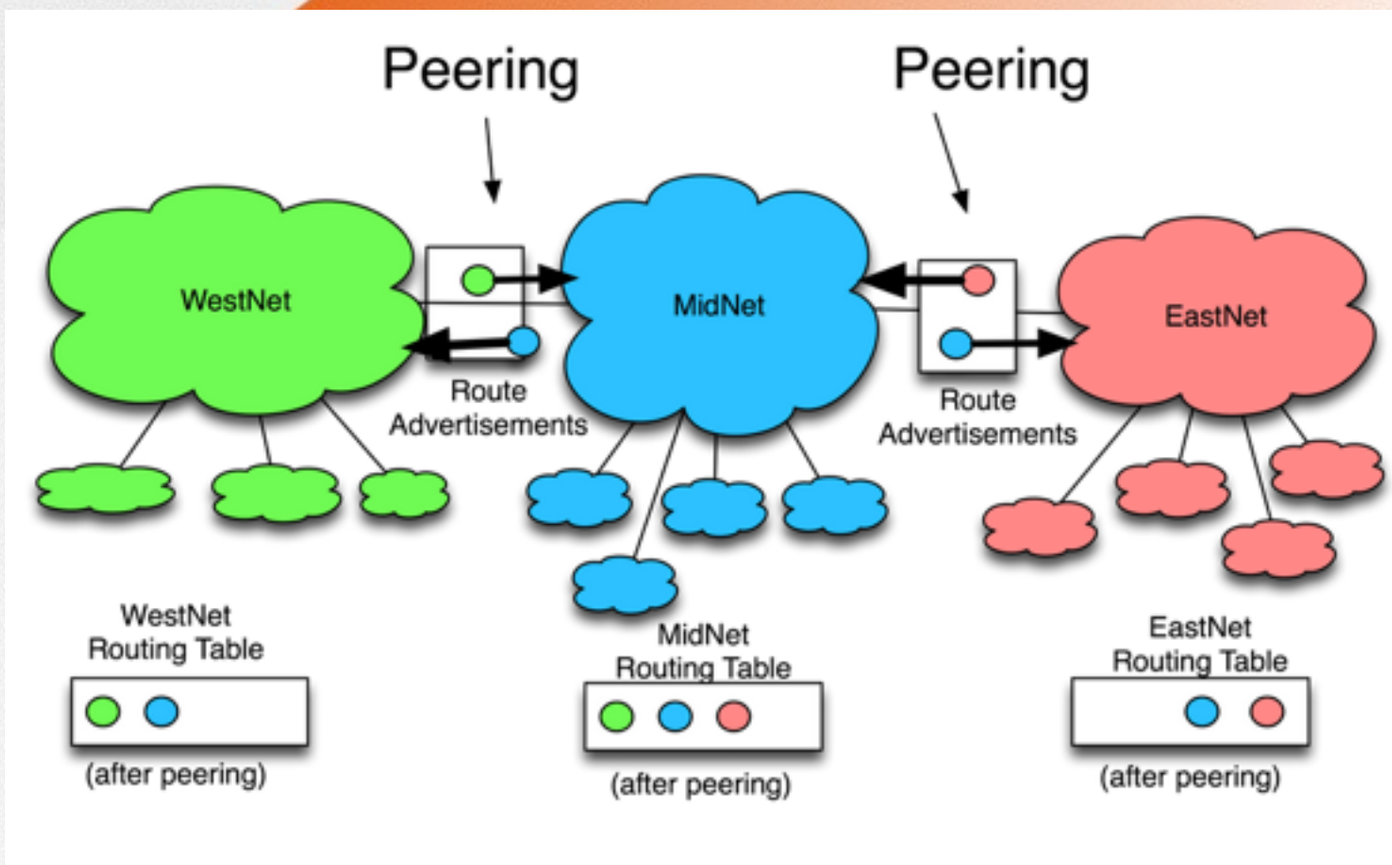
The Internet is all about interconnection!

More about ‘peering' and IXPs…

Peering and transit

- We all know the distinction…





http://drpeering.net/white-papers/Internet-Service-Providers-And-Peering.html

Peering, recap

- The Exchange of traffic between parties where only routes to each others customers are advertised is called peering
- Peer implies “equal party”
  - Large carriers traditionally peer with large carriers and small ISP’s with small ISP’s
  - But: in case of content providers where there is equal gain, traffic can be one directional!
- Peering typically happens without the exchange of money
- The benefit of peering is that it can significantly reduce costs of transferring IP traffic upstream and provides for faster data-flows (shorter paths, less router hops)

Peering, recap

- So basically to realise:
  - Saving money - 'it’s commercial'
  - Control over performance:
    - Less network hops, more direct routes, redundancy in routing
    - ‘Keep local traffic local'

Now put an IXP as a peering facilitator in the middle

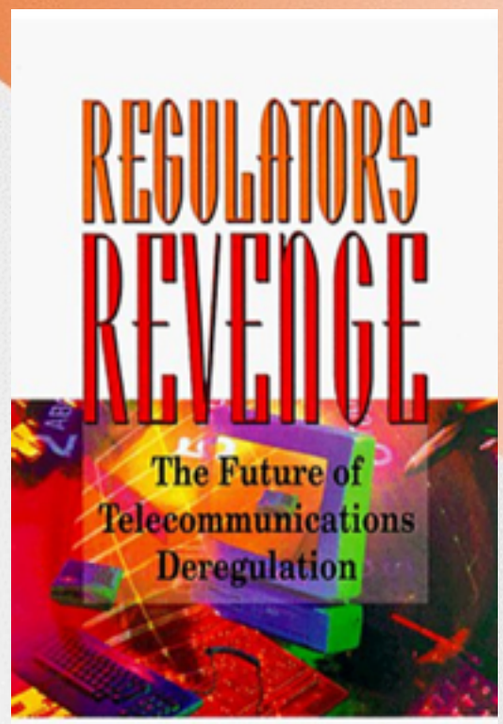
- With one physical interconnect, potentially peer with all others connected to the same switch
  - very efficient, in stead of endless array of private circuits
  - (you need to come to an agreement with others…)
- Optimisation peering via route server
  - When peering policy is open, a straight forward way to establish large number of peering sessions on day one when connected.

Elements for possible succes?

- Internal to the IXP:
  - Openness to parties who want to interconnect, no restrictions
    - Only simple (technical) criteria: legal entity with ASN, internet related business
  - Neutral: with regard members (content of traffic, commercial agreements, do-not-compete-with), carriers, datacenters, content related politics etc
  - Completely transparant: e.g. organisation, members-list on (English) website, set-up technical platform, traffic stats, performance indicators
  - Meet and talk to potential members/customers, educate and convince, also create circumstances where they can meet each other

Elements for possible succes?

- External factors:
  - Preferably a deregulated Market for Telecommunications, where transparant competition is stimulated, without unnecessary licensing scheme
  - 'Support' from incumbent
  - Carrier neutral datacenters
  - …



In a broader context it is important to create conditions where private sector is willing to invest

- In reliable supply of power;
- Roll out terrestrial fiber;
- Building datacenters.

- Stable political/tax climate, reliable independent legal system, ’trust' to do business
  - Foreign entrants need to be attracted!

The AMS-IX Philosophy and Organisation

‘The AMS-IX philosophy’

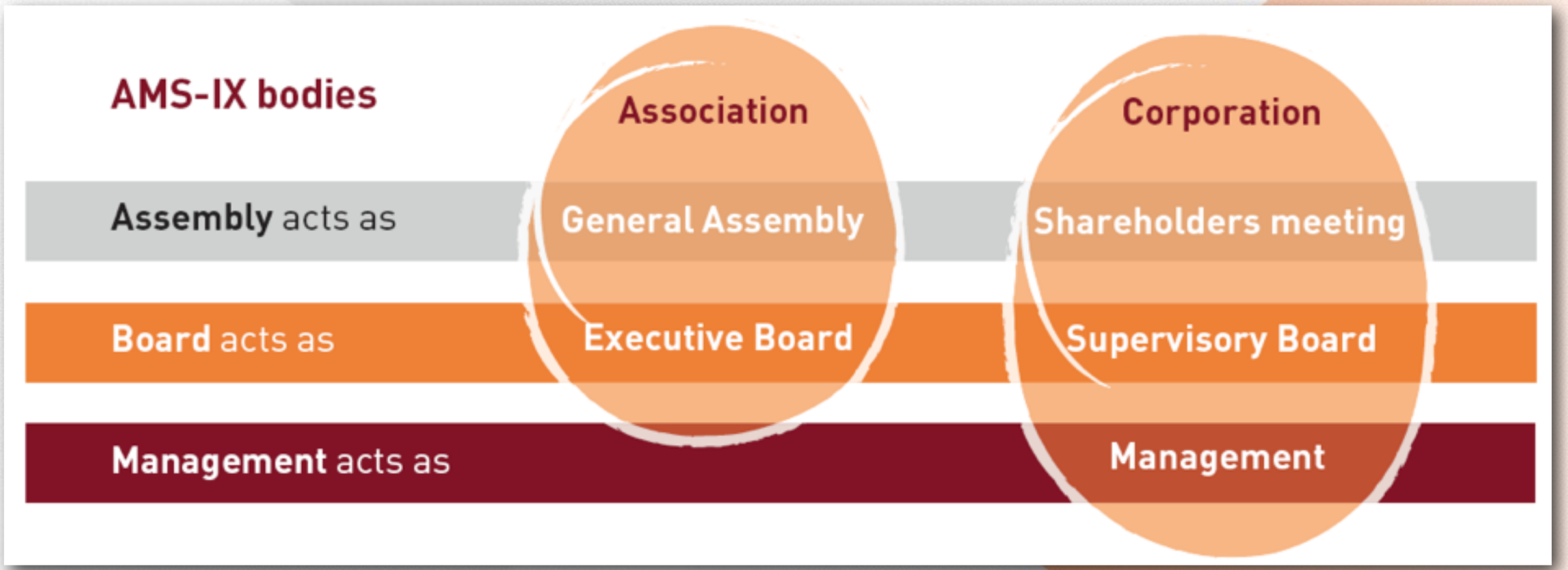
http://www.ams-ix.net/about/strategy/ams-ix-policy-statement/

- An association, governed by its members:
- on a ‘not for profit’ basis
- ‘for the mutual benefit for all connected’
  - which basically is ‘reliable, affordable and accessible interconnection’
- ‘neutral and independent’:
  - AMS-IX neutral towards the interests of its very diverse members and merely facilitates the stable, secure, continuously running and scalable infrastructure to which they can connect
  - connected parties establish bilateral agreements with each other (or not) on a voluntary basis
- ‘transparent’
- and importantly: the connected AS’s are multi-homed, which implies that they (can) use alternative routes and and are responsible for having associated capacity available

AMS-IX Organisation

- The beginnings of the exchange can be traced back to the early 1990's.
- On the 29th of December 1997 AMS-IX was established as an Association in the Netherlands, operating under Dutch Law.
  - Coincided with period of deregulation of Dutch telecommunications market, allowing foreign operators to enter the market
  - Avoid 'tromboning' effect of traffic going to US and back: 'keep traffic local'
  - International focus from the start - Netherlands as a neutral location
- Amsterdam Internet Exchange Ltd. company, founded in 2000, of which the Association is a 100% owner that acts as the operator and administrator of the exchange.

AMS-IX Governance Structure



The Board has 5 seats and is elected by the members, out of member representatives, in the General Meeting

- The Board is both Executive Board of the Association as well as Supervisory Board of the Corporation
- The General Meeting is both the General Assembly Meeting of the Association as well as the shareholders meeting of the Corporation

AMS-IX Organisation

- Originally AMS-IX, which was just the association, managed by the AMS-IX board
  - Operational management outsourced to academic network and university (SURFnet/SARA)
- From 2000 onward AMS-IX Ltd. company responsible for day to day management
  - From Jan 1 2002 also technical management platform
- AMS-IX Ltd. company staff:
  - 3 persons in 2000
  - 45 end of 2014 (18 nationalities)
    - Roughly half is technical (NOC, Engineering, Development)

By now, who is (not) connected?

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Google

kpn
international

Level(3)

upc

Deutsche
Telekom

@mail.ru
group

BBC

leaseweb
reliable hosting

amazon
web services™

Microsoft

etisalat

Akamai

By now, who is (not) connected?

Download this table as: Euro-IX JSON | TSV | perl source | ascii | PCH

Network (AS number) statistics:

Route server peers: 590 **Total connected: 708**
Total number of customer ports: 1402 **IPv6 peers: 568**

Search..

Organisation	URL	AS	Policy	Routeserver	Location	Vlan
1&1 Internet AG	http://www.1und1.de	8560	open	No	NIKHEF	ISP
2AT B.V.	http://www.2at.nl/	197219	case-by-case	Yes	Vancis, EvoSwitch	ISP
A2B Internet BV	http://www.a2b-internet.com	51088	open	Yes	NIKHEF	ISP
AC Webconnecting BV	http://acwebconnecting.com	47836	open	Yes	NIKHEF	ISP
Adamo Telecom Iberia S.A.	http://www.adamo.es/	35699	open	No	TeleCity 2, FiberRing B.V.	ISP
Adeli	http://www.adeli.fr/	43142	open	Yes	Liazo	ISP
Adobe Systems	http://www.adobe.com	15224	case-by-case	No	Equinix AM1/2	ISP
Advania hf.	http://www.advania.is/	30818	open	Yes	Telecity 5	ISP
Advo ICT Professionals	http://www.mijnasp.nl	51646	custom	Yes	BIT BV, TeleCity 2	ISP
Adylnet Telecom	http://www.adylnet.com.br	28283	open	Yes	Netrouting	ISP
Afilias Ltd.	http://afilias.info/	12041	open	Yes	Global Switch	ISP

Peering contact: pvlaar@afilias.info

IPv4: 80.249.208.190/21
IPv6: 2001:7f8:1::a501:2041:1
Speed: 10GE
Location: Global Switch
VLAN: ISP

https://ams-ix.net/connected/

Role AMS-IX as IXP changed over time

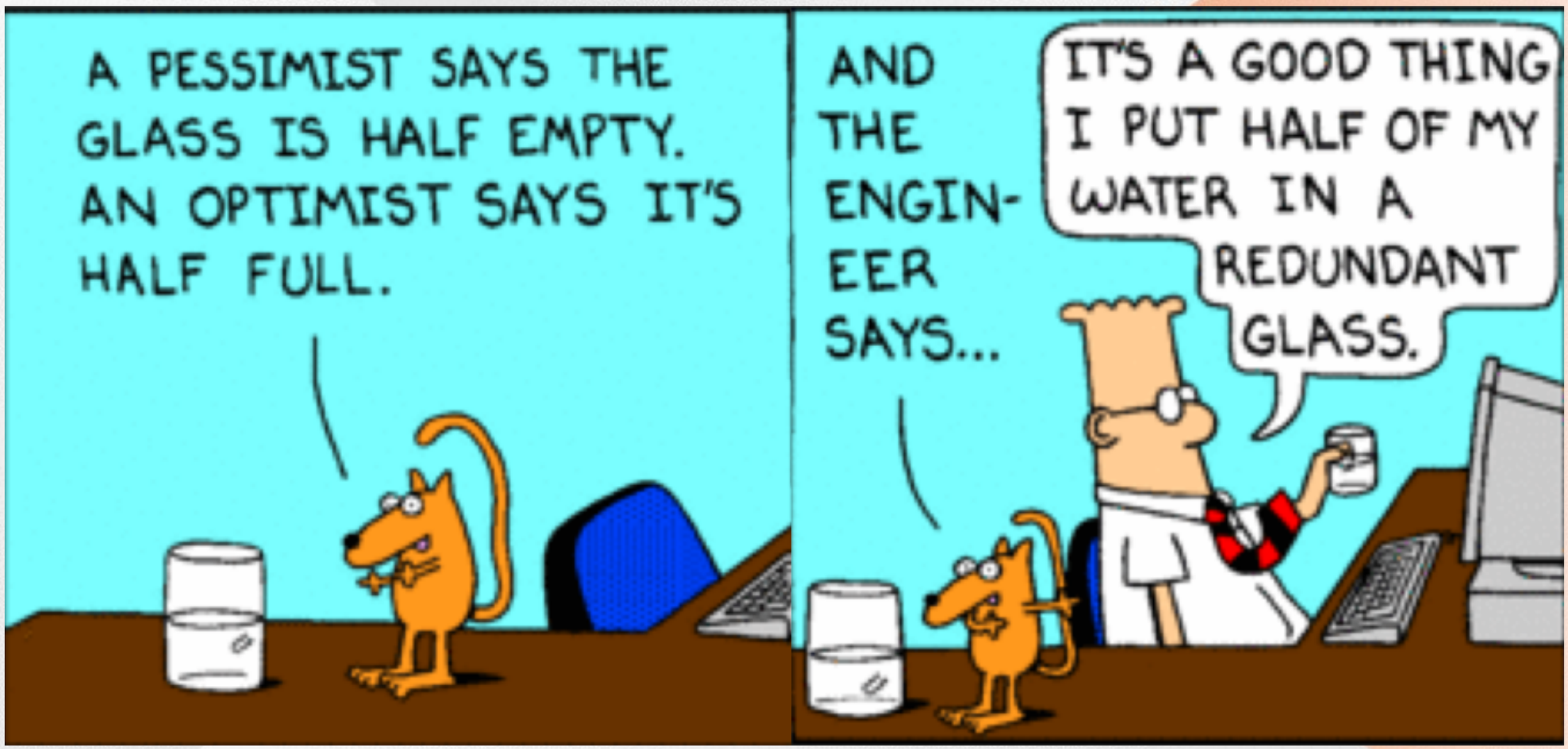
Role AMS-IX as IXP changed over time

- From interconnecting ISP's, and keeping local traffic local
- To 'content distribution platform'
  - Huge growth in traffic, from 'email' to video and cloud distribution
  - See IXPs in developing areas: numerous ISPs interconnected but limited growth in traffic levels
    - Value is not about traffic levels per se
    - However: once CDNs and other caches start to interconnect…

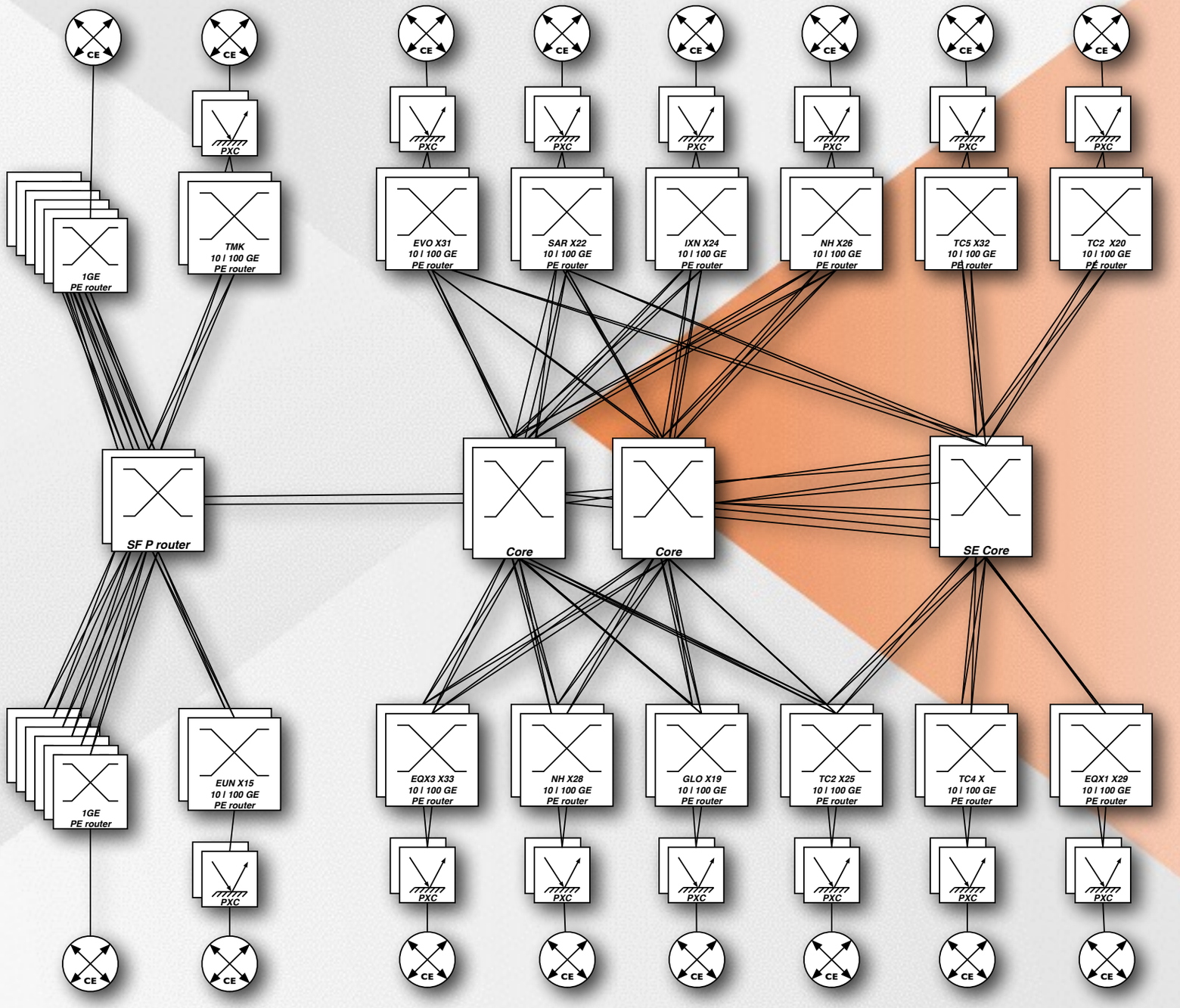
https://ams-ix.net

25% of capacity in use during peak

AMS-IX Amsterdam Platform

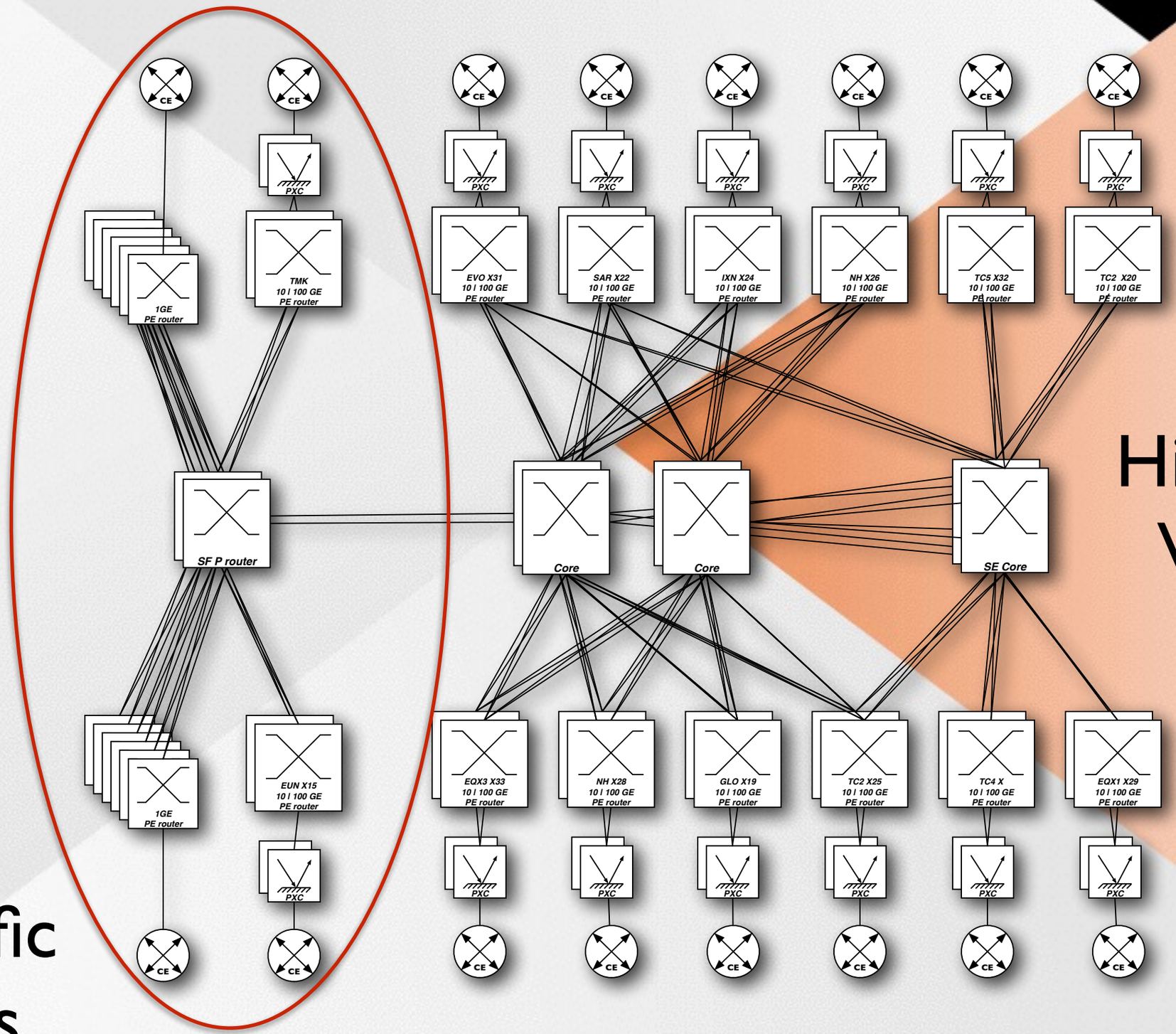


AMS-IX Amsterdam Platform



https://ams-ix.net/technical/ams-ix-infrastructure

AMS-IX Amsterdam Platform
Hub/Spoke MPLS/VPLS

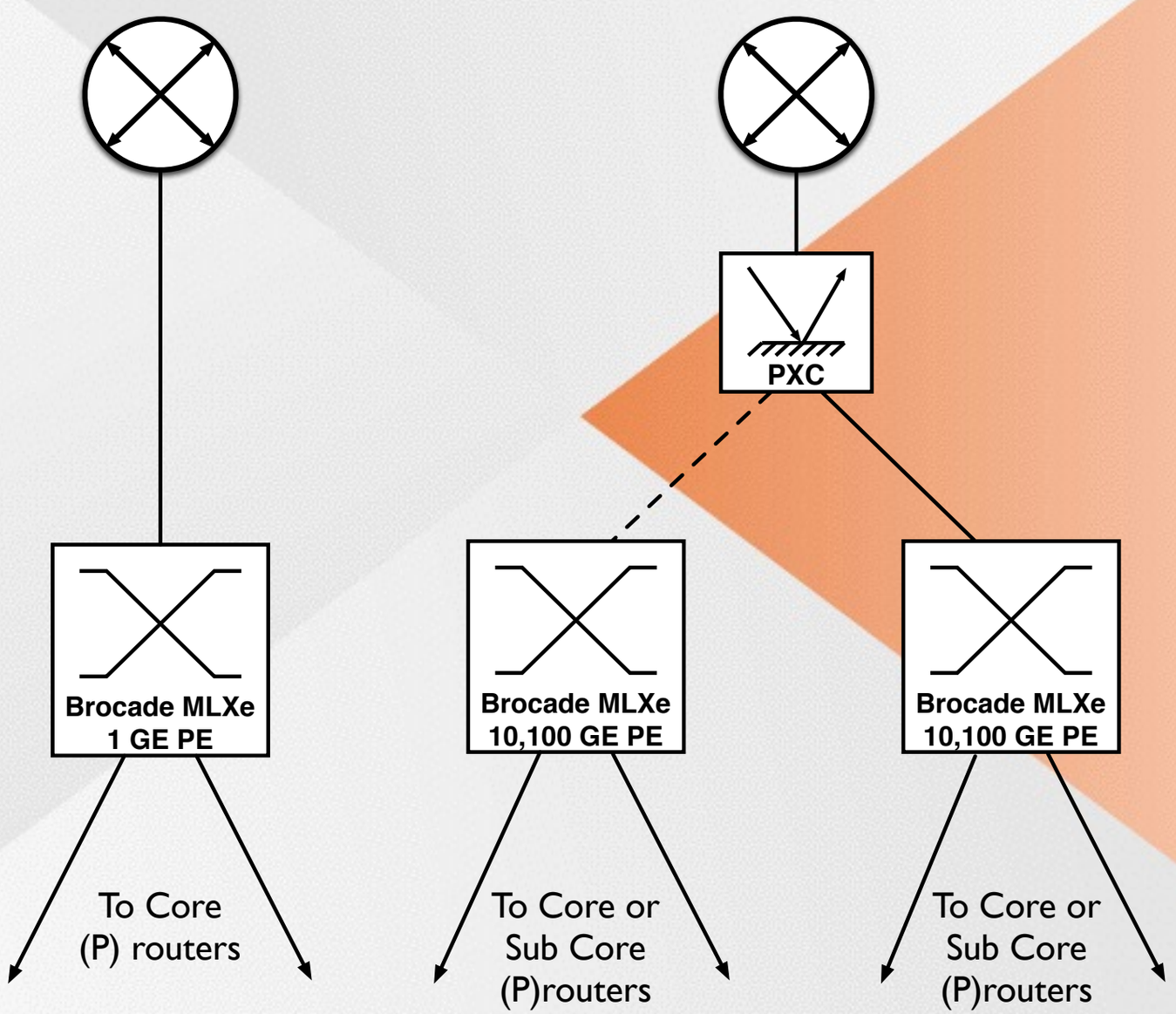


High Traffic Volumes

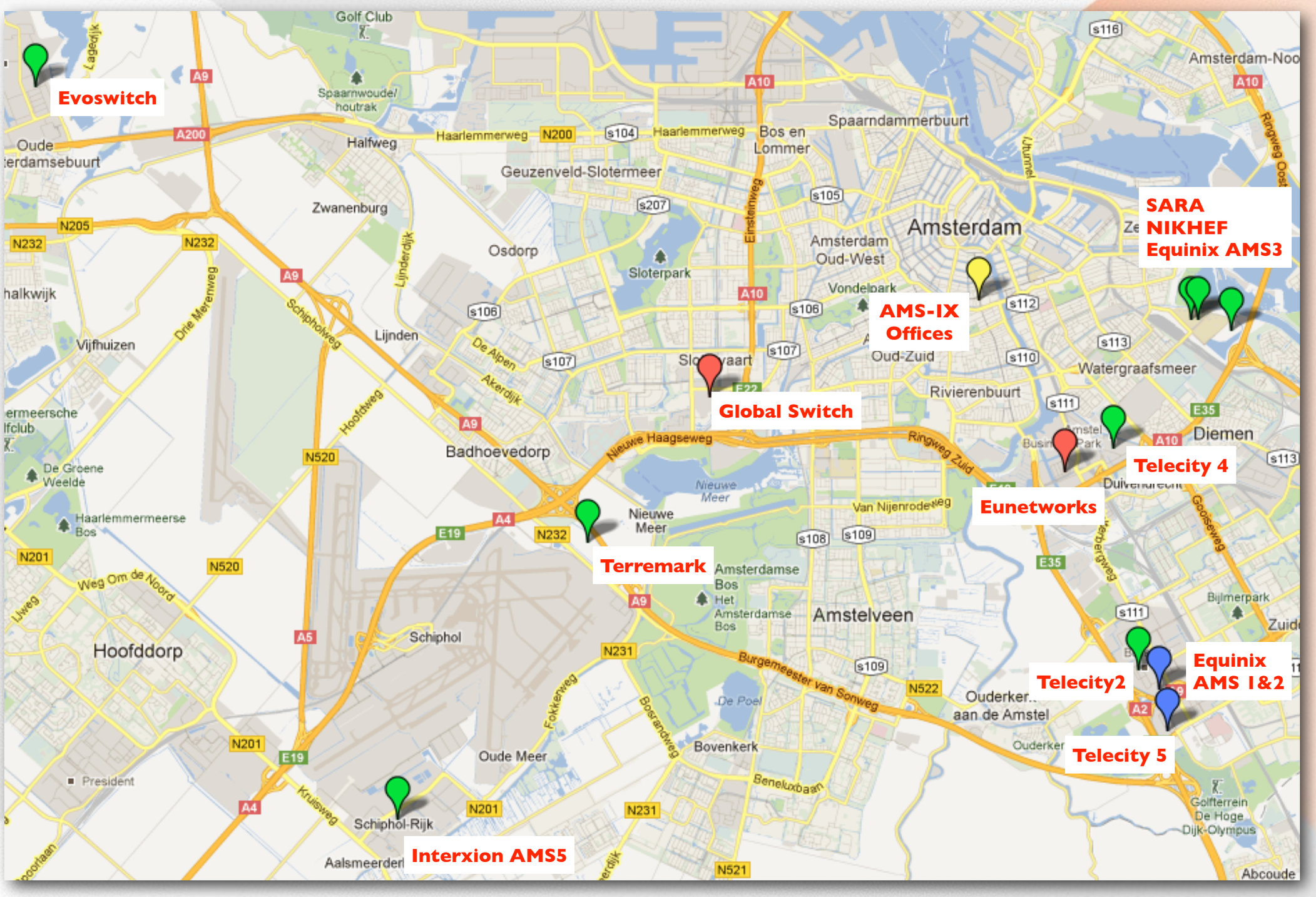
Low Traffic Volumes

Access Connections

High Speed Access connection protected



The Platform geographically



AMS-IX Backbone

- Connections between PE and P routers via dark fiber
  - Lighted up by predominantly 100GE interfaces in the switches
- Typical distances between PE and P routers in the Amsterdam metro area 10 to 35 km.
- Typical 100GE LR4 optics (most common) have a reach of 10km
  - Together with vendors we designed our own optical amplification solution

AMS-IX Amsterdam in numbers 2014

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Close to **700** connected IP networks

109

109 new members & customers

for the 3rd year in its existence the number exceeded the 100

Growth of Internet traffic at AMS-IX

30%

Total net customer capacity added:

close to

3.5 Tbps

Internet traffic:

Average monthly volume in 2014:

595000 Terabyte (TB)

595 Petabyte (PB)

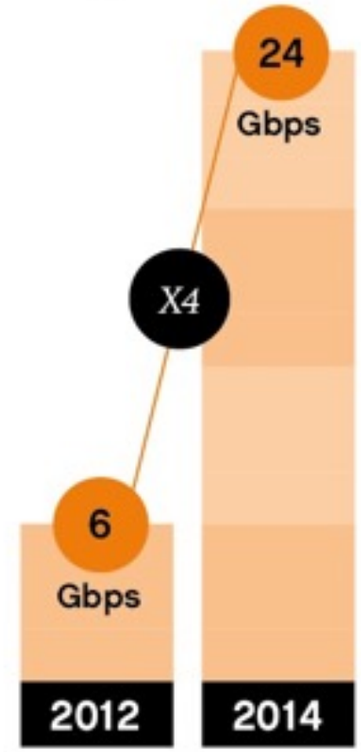
Total volume 2014

7142000 Terabyte (TB)

7142 Petabyte (PB)

7.1 Exabyte (EB)

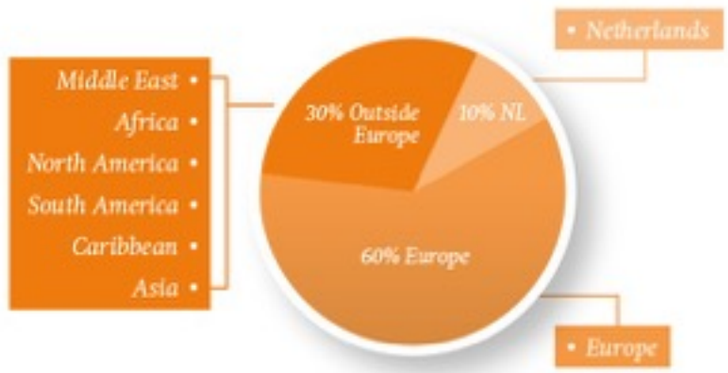
IPv6 traffic *quadrupled in 2 years:*



90%
of new members & customers originate outside the Netherlands

of which

30%
outside Europe



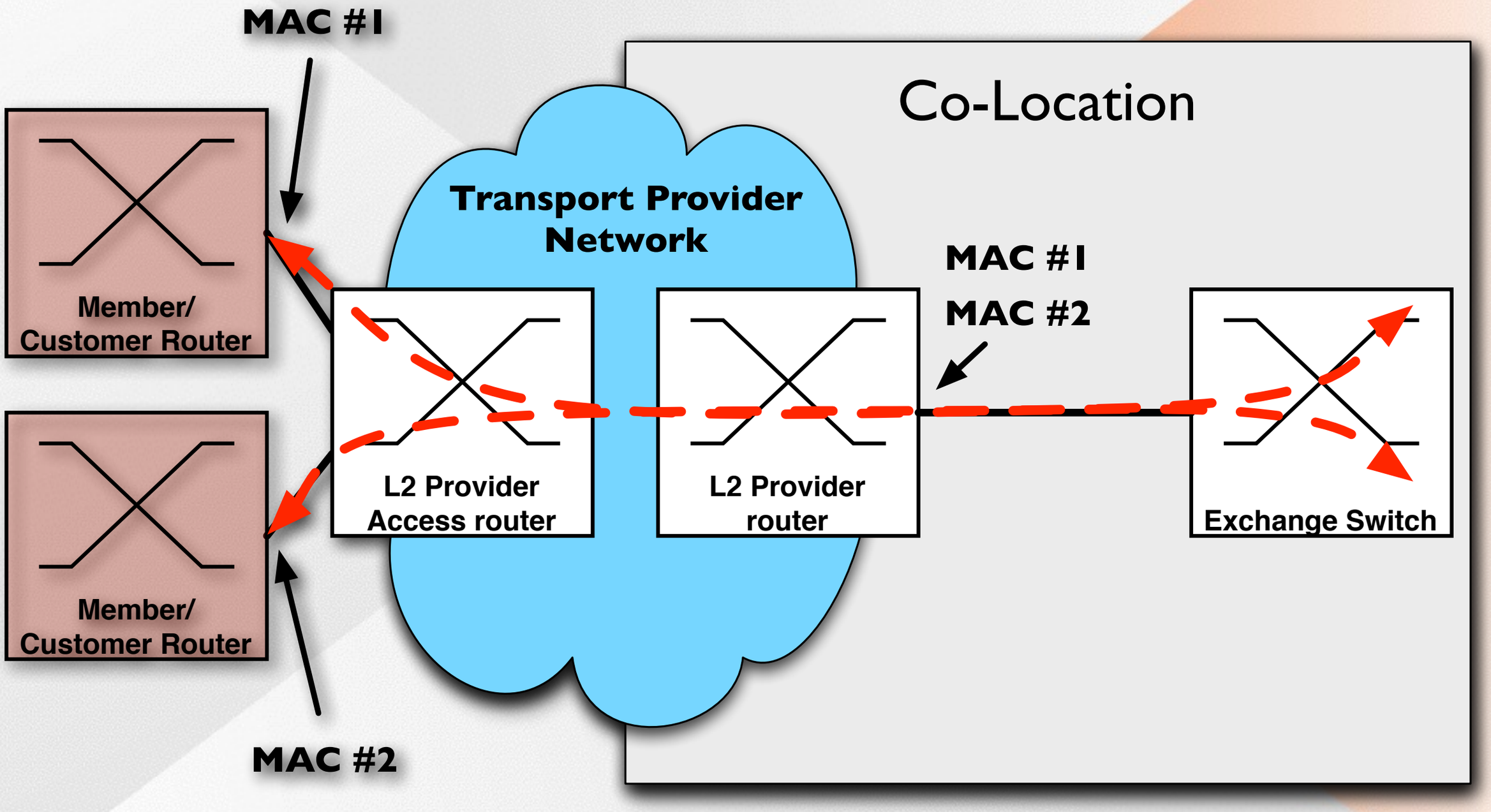
Attractiveness for foreign networks, mainly coming in remotely via resellers

Remote Connections have become very important

- Originally ISP router co-located with IXP switch
  - ISP network extended to Exchange co-location
- Sometimes ISP router in different close by location and connect “remote” over for example dark fiber, wavelength etc
- Router in remote location, connection over layer 2 transport provider
  - Can be any distance between ISP router and IXP
    - Most extreme: AMS-IX member with router in Los Angeles
  - Initially one router per connection, now multiple.

Remote Connection

2 logical connections over single physical connection



Multiple Connections, single Exchange connection:
Transport provider is AMS-IX reseller

AMS-IX Around the World

'Exporting the model'

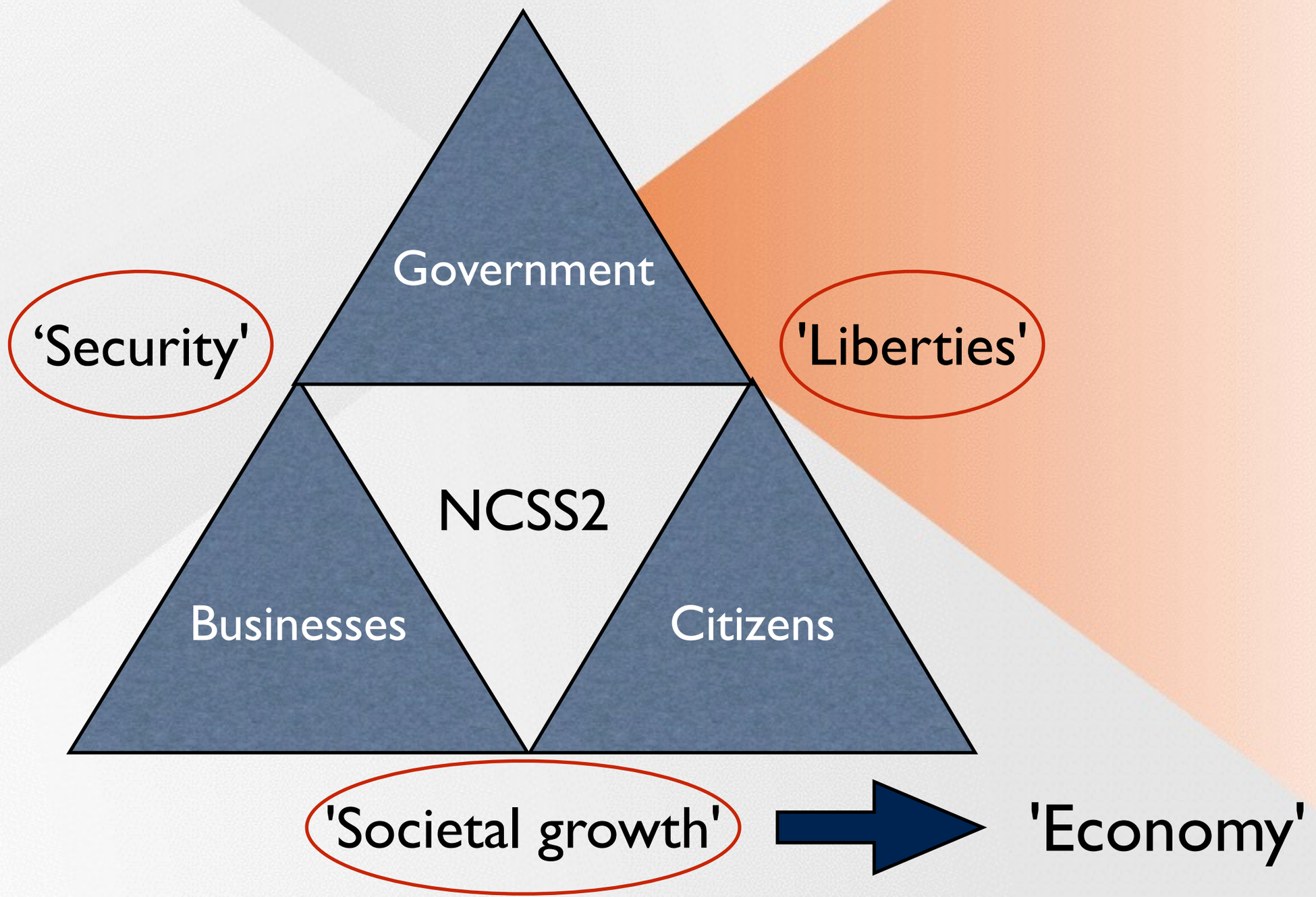
What regulatory developments might affect this succes in the future?

AMS-IX and Regulatory Development

- Still mainly from a Critical Information Infrastructure Protection angle: ‘what if functionality fails'
  - Traditional ‘Telco' approach by NRA
  - Focus on IXP as it is visible - lack of knowledge though of the entire ecosystem, ‘how it works’
    - Which parts of infrastructure do predetermined critical services depend upon, and who is responsible?
- Or fact that AMS-IX is deemed as a central place where it is more easy/efficient to implement and/or enforce measures
  - Security measures, BCP38/RPKI?
- Ongoing discussions: wiretapping in bulk by Dutch intelligence agencies, hacking capabilities for Law Enforcement Agencies

AMS-IX and Regulatory Development

- From Dutch National Cyber Security Strategy 2, October 2013: a continuous balance



AMS-IX and Regulatory Development

Available in English:
https://digitale-infrastructuur.nl/

AMS-IX and Regulatory Development

- It's about the ecosystem as a whole - with well functioning IXP(s) at the heart of it
- Innovation, openness, neutrality and competition are emphasised

- Some conclusions/quotes:
  - 'A superior Digital Infrastructure is pre-conditional for growth of our digital economy. The Digital Infrastructure hot spots (London, Frankfurt, Paris, Amsterdam) are magnets for high-tech web centric companies'
  - 'The Digital Infrastructure, despite its modest size, is a driver of the much larger and rapidly expanding Internet economy, impacting the fortunes of future economic growth in the Netherlands.'
  - 'The real value of the Digital Infrastructure sector, however, lies in its significant impact on the much larger Internet economy and broader digital society. The picture emerges that Digital Infrastructure cannot be separated from a successful digital society, placing the Dutch in a favourable position to profit from digital growth.'

Thank you for your attention!

bastiaan.goslings@ams-ix.net

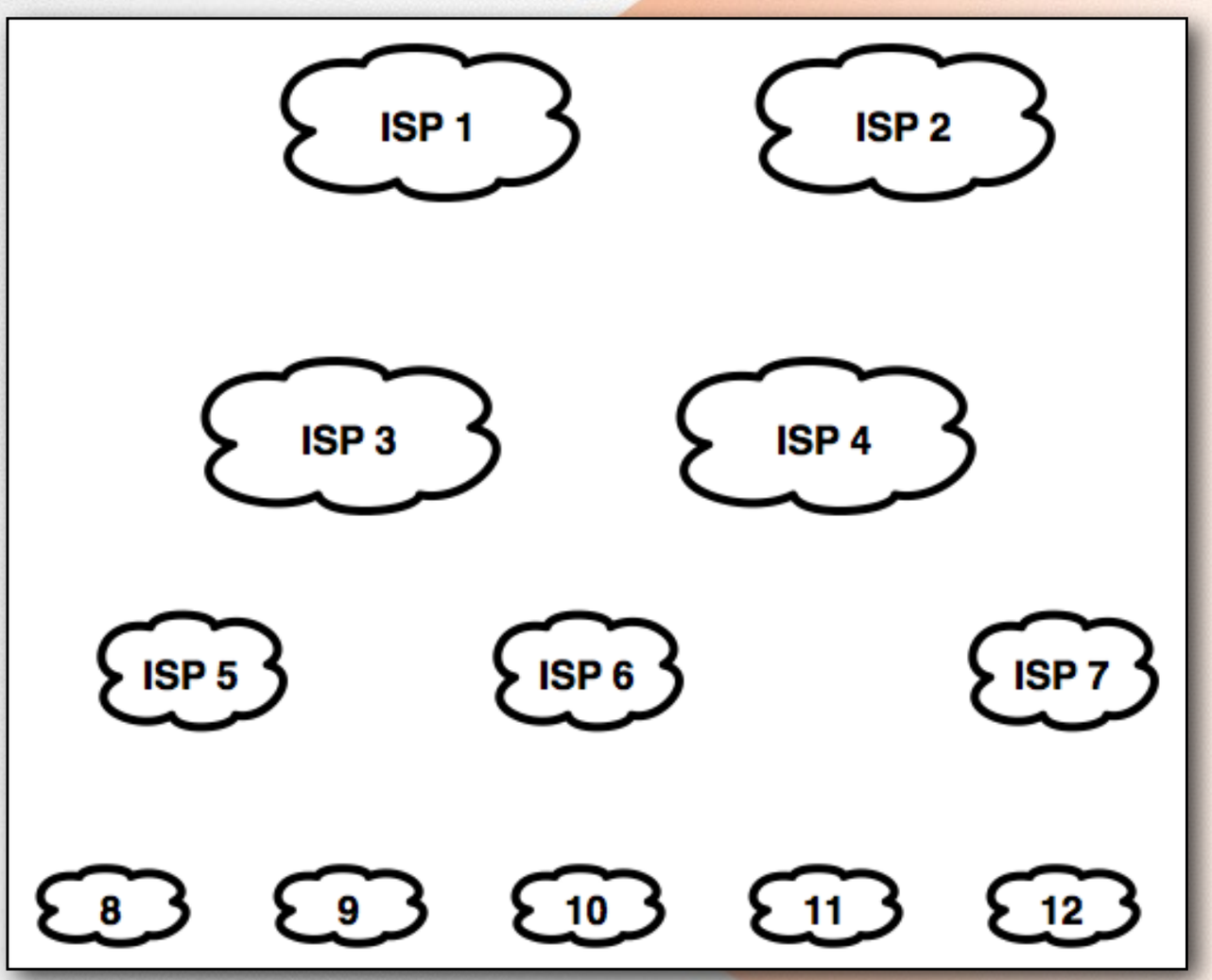
For reference…

A short video about IXPs…

https://www.euro-ix.net/

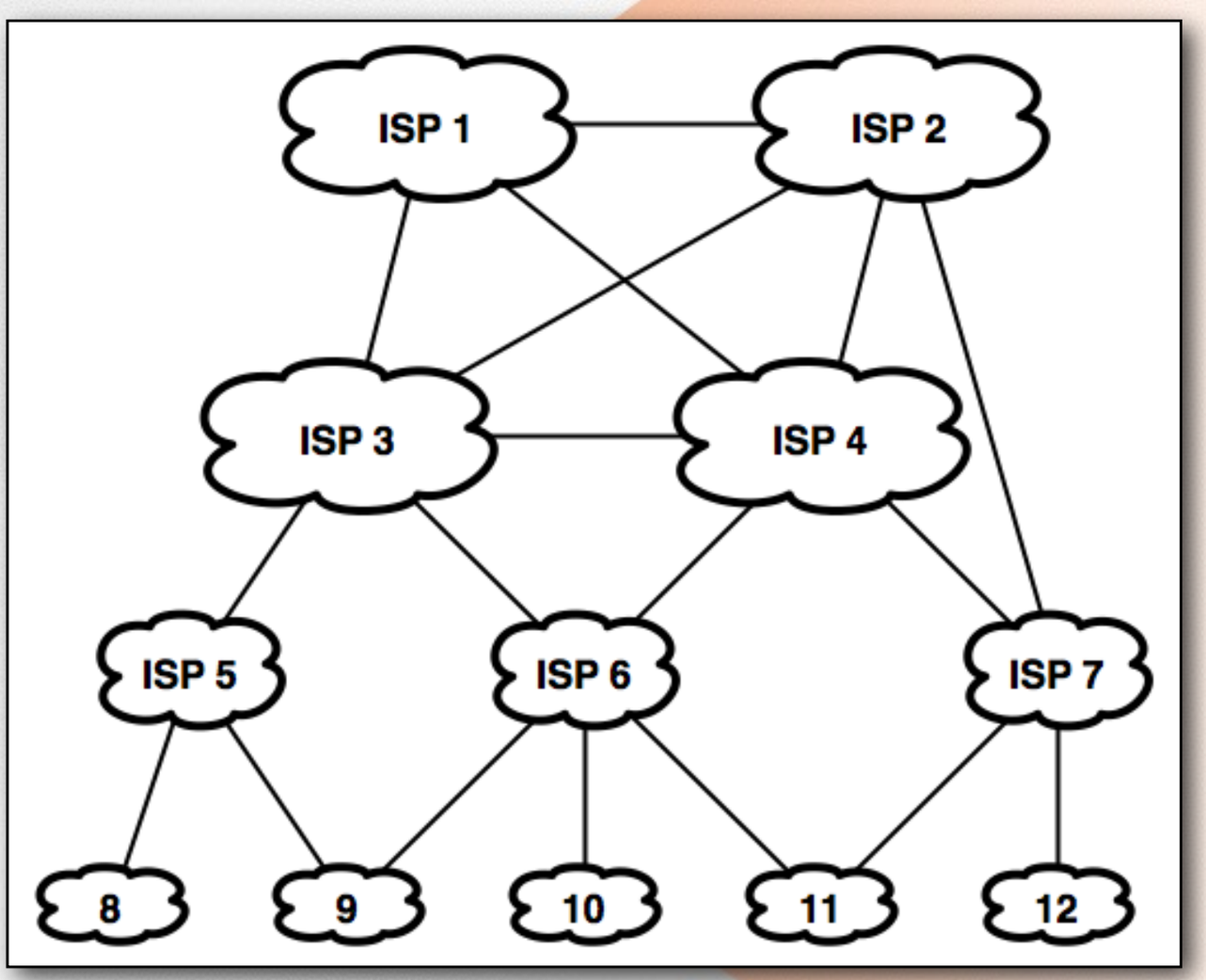
The place of an IXP in the Internet

- Autonomous Networks
  - Organisation
  - Purpose
  - Management
  - Infrastructure
- Symbol: cloud



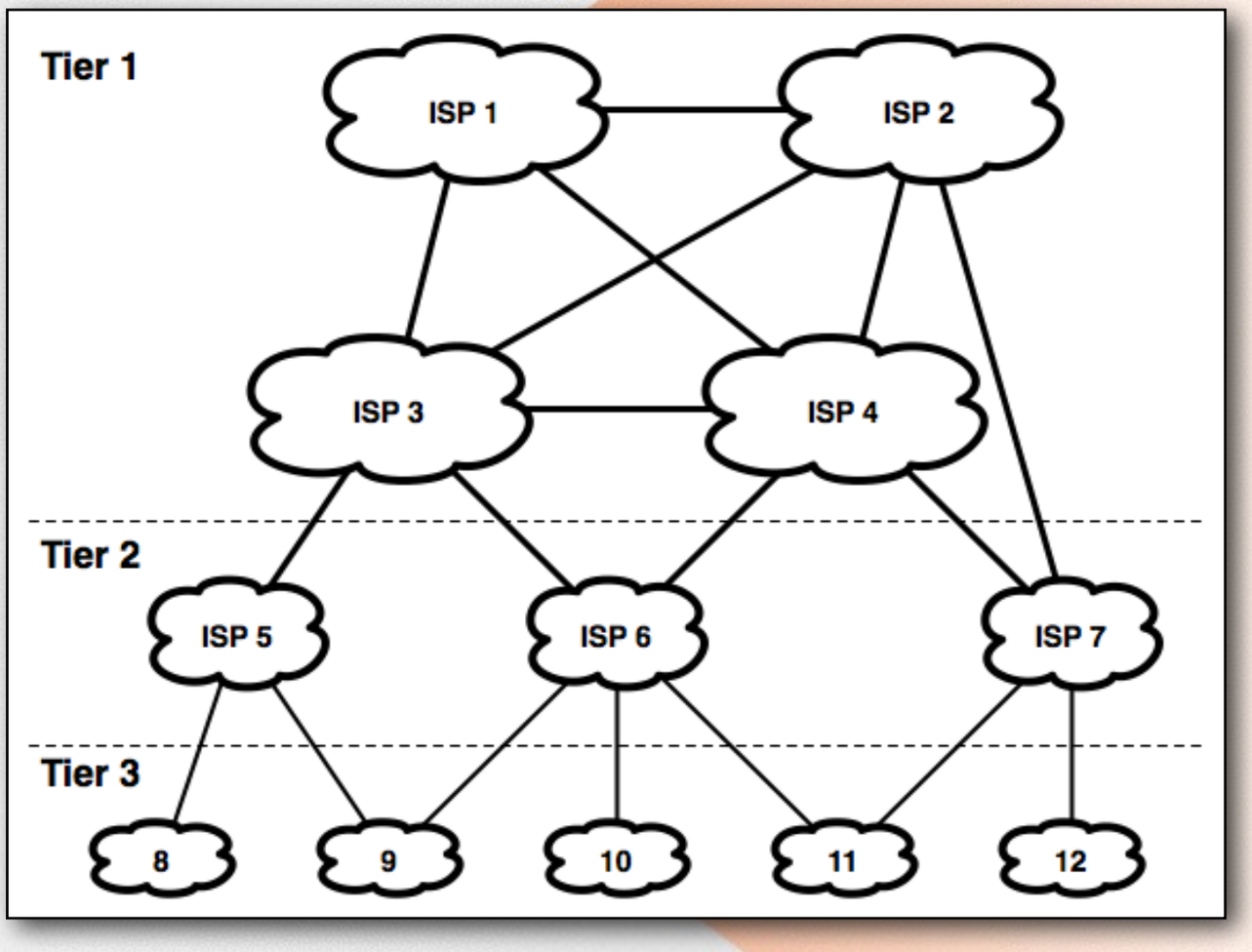
The place of an IXP in the Internet

- Not autonomous
  - Network Protocols
    - BGP OSPF
  - Addressing
    - IPv4, IPv6



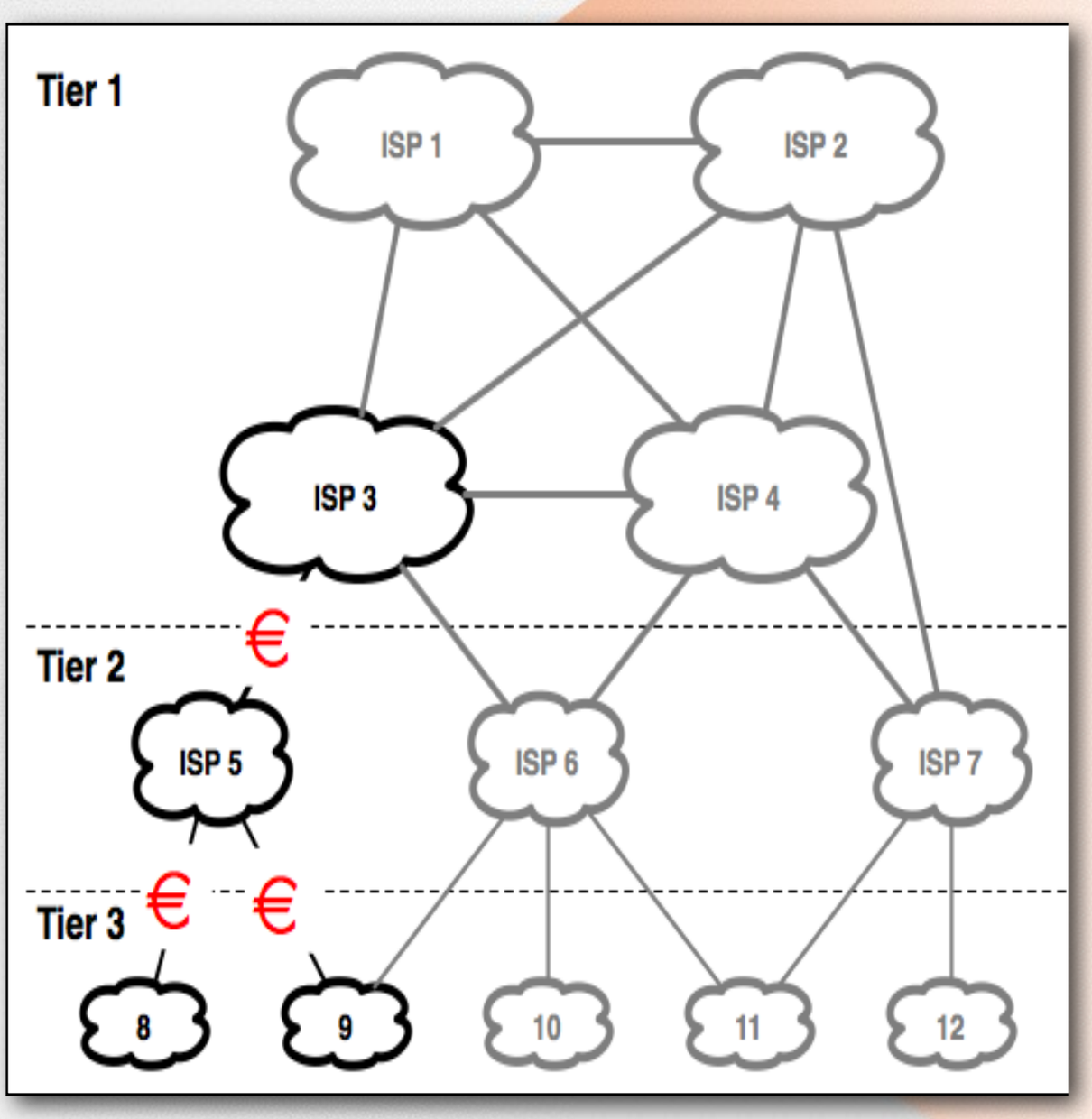
The place of an IXP in the Internet

- Impossible to interconnect each network with each other
- Transit providers can provide traffic between networks
- Larger networks (geographically) offer transit to smaller ones



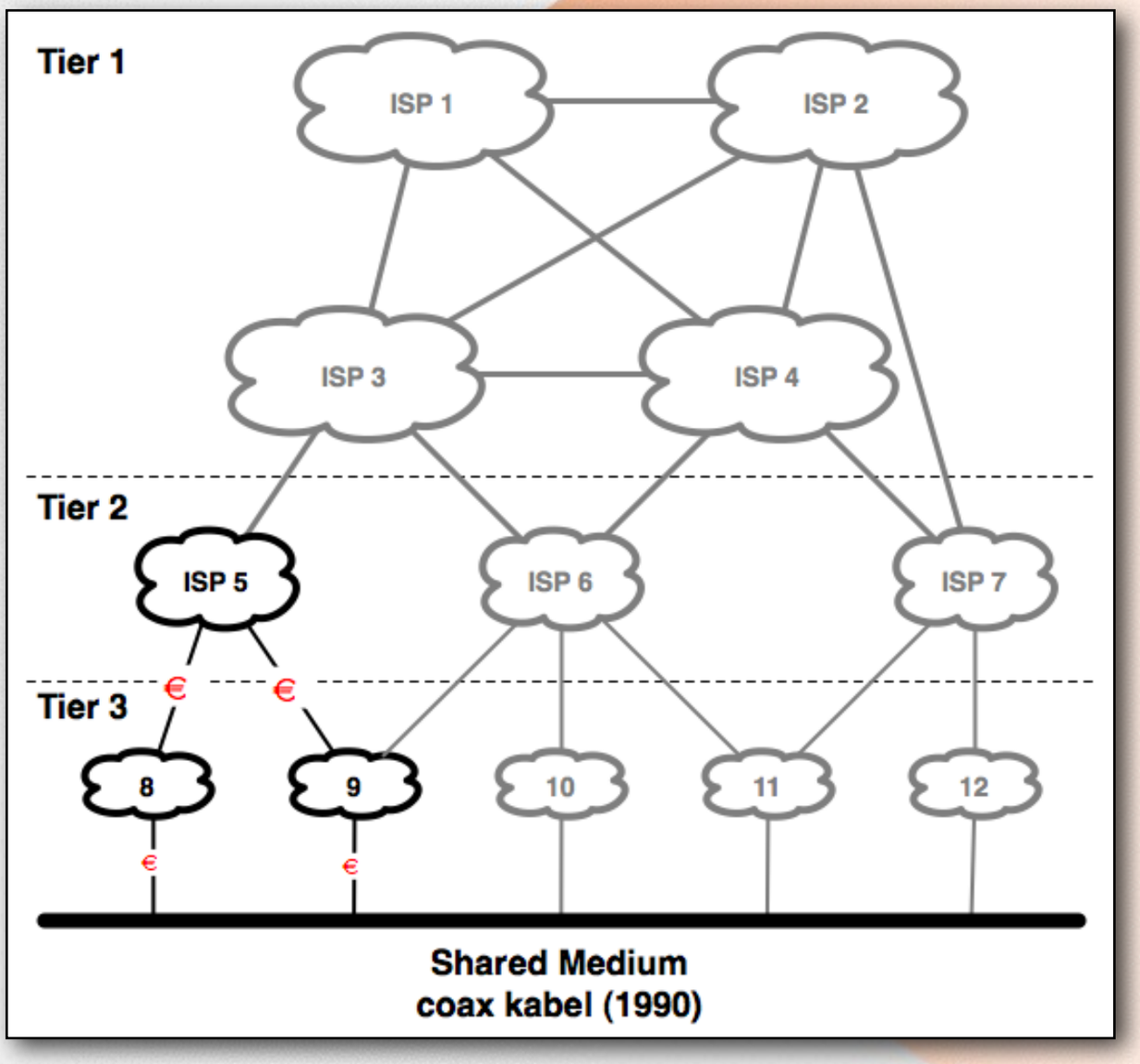
The place of an IXP in the Internet

- Transit (sometimes called upstream) costs money.
  - Typically as a price per Mbit/s available bandwidth
    - X€/Mbits
  - Lower price for higher volumes



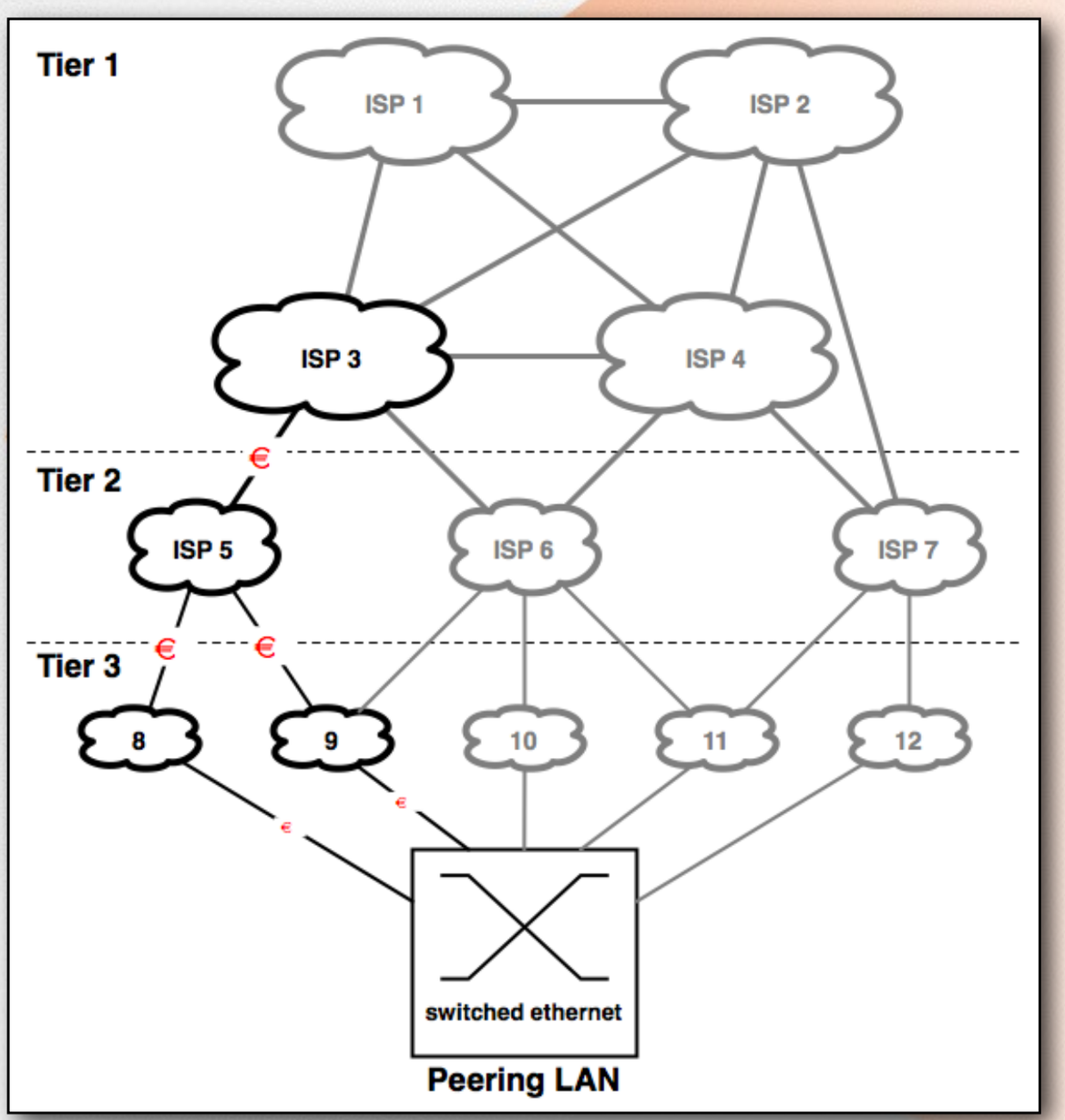
The place of an IXP in the Internet

- Instead of paying for transit for all traffic: keep local traffic local
- Peering: Exchange traffic between more or less equal parties locally
- Transit remains necessary for traffic which can not be handled locally



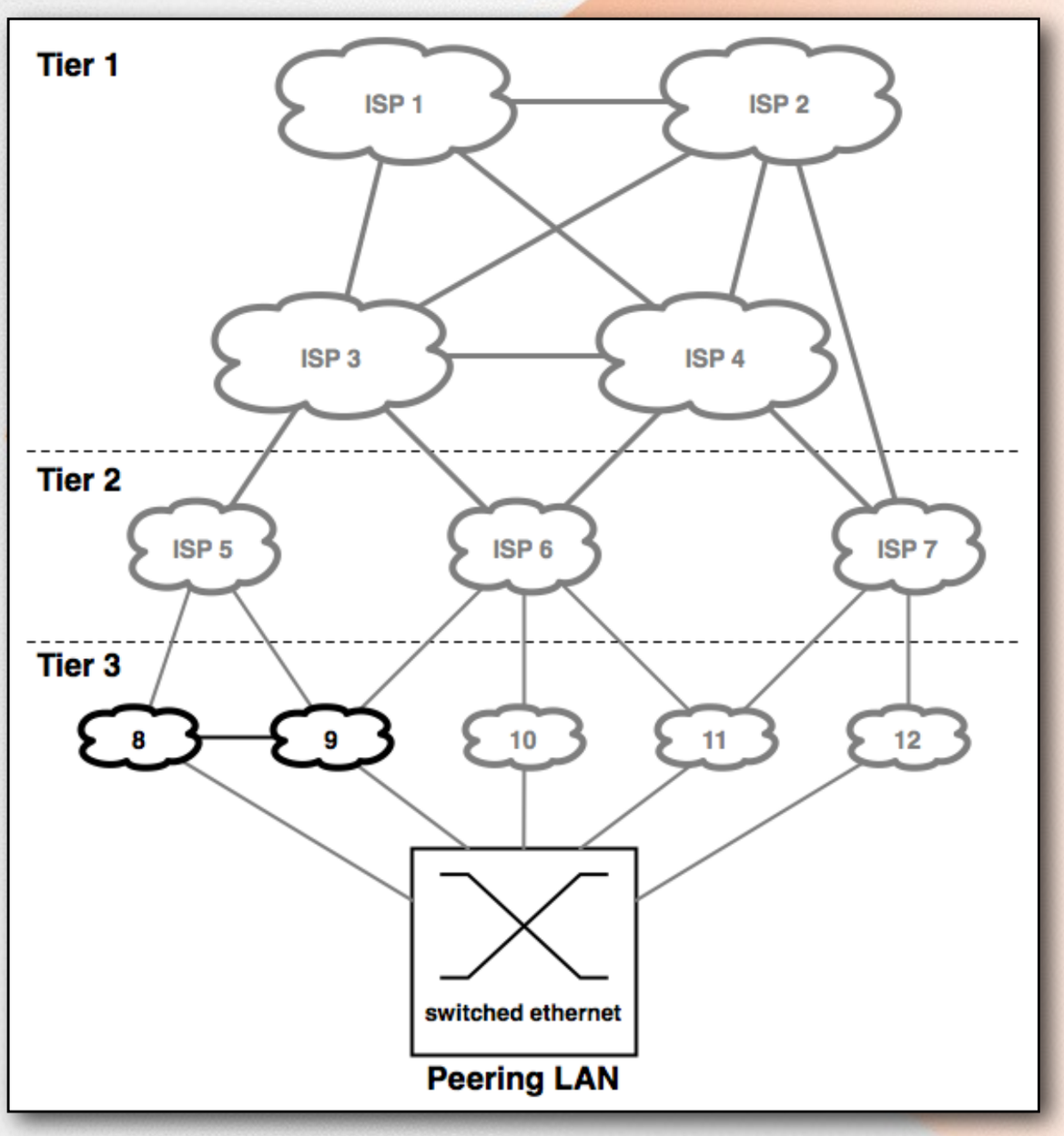
The place of an IXP in the Internet

- Facility where many (more than 2) parties can exchange traffic with each other
- Usually peering
- Typical technology
  - Ethernet



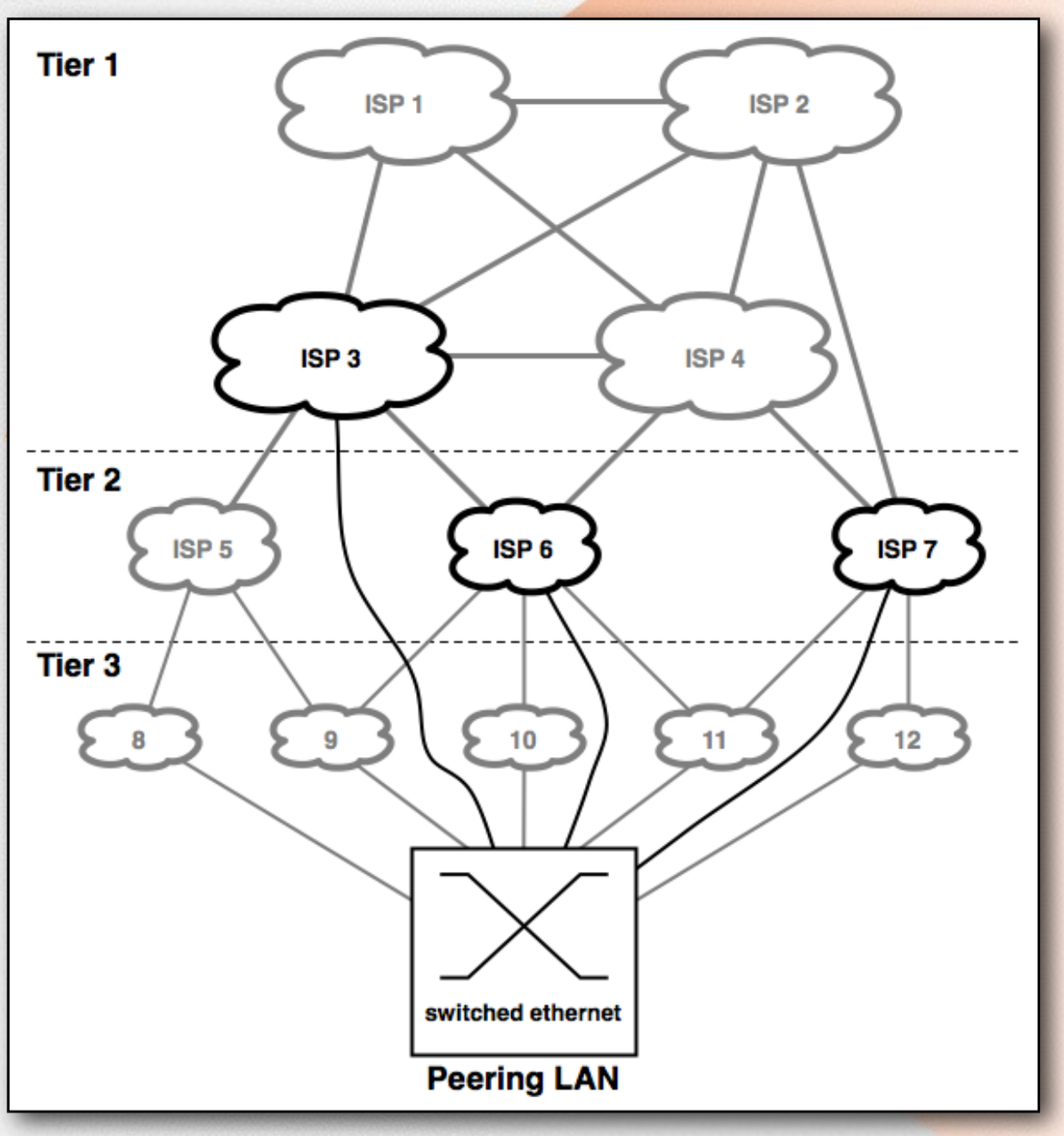
The place of an IXP in the Internet

- A lot of companies gather together in the data centers that co-locate an IXP
- Easy to make direct connections bypassing the IXP
  - Private Peering
    - More control over traffic exchange
    - Even cheaper



The place of an IXP in the Internet

- Larger IXPs also attract larger ISPs, CDNs etc
- Peering not obligatory
- Larger networks do not always want to peer
- Or not for free



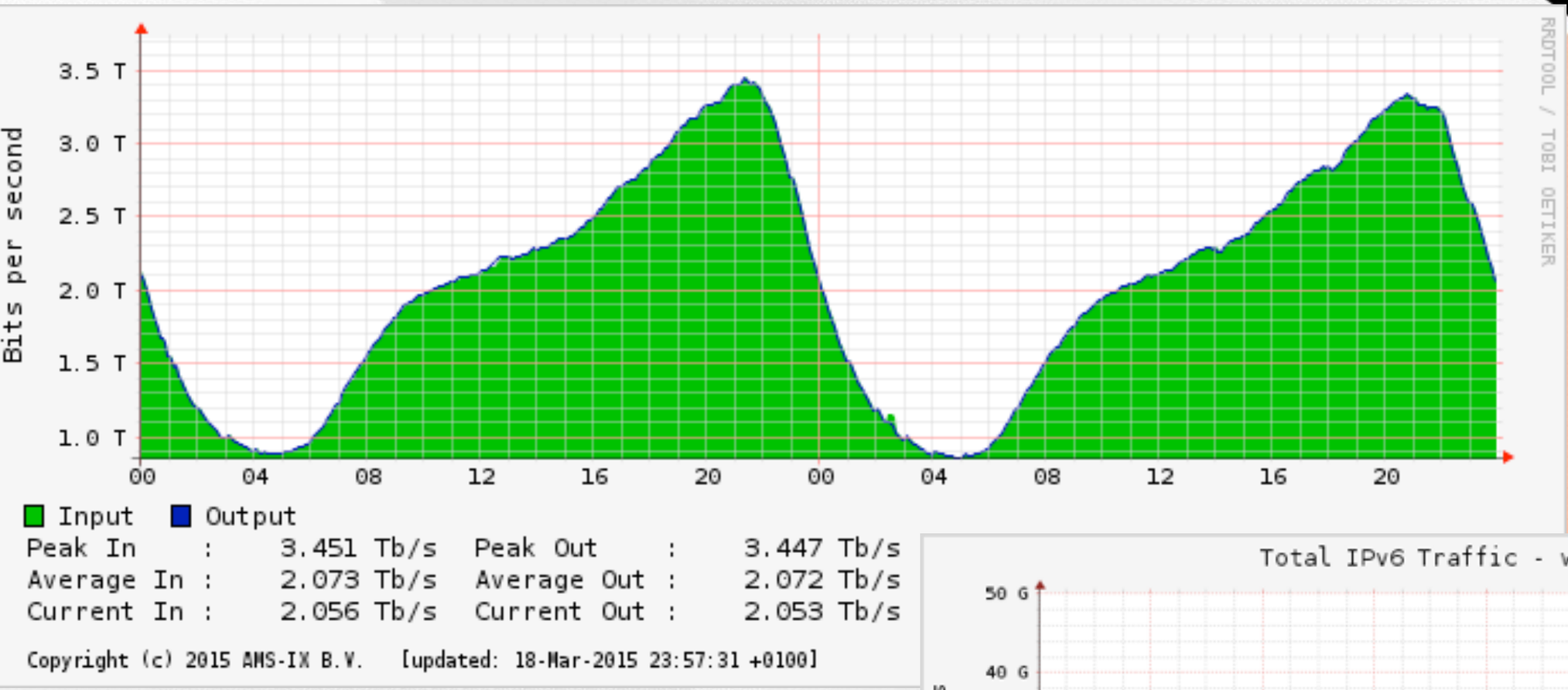
Different Business Models for IXPs: no perfect format

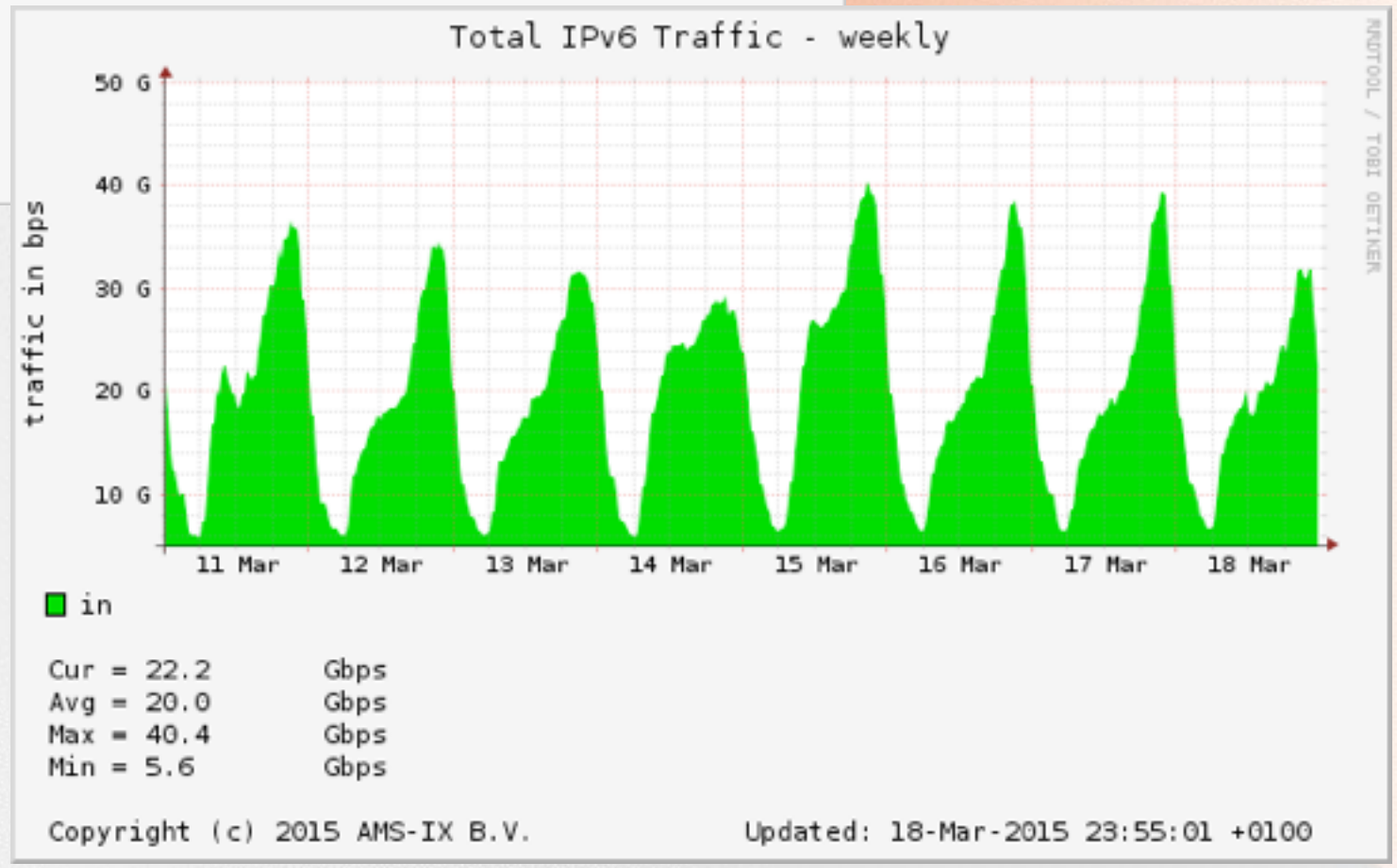
- Managed and operated by University or Government
- Association, as in the case of AMS-IX
- Not for profit company
- Neutral for-profit company
  - Typical as value added service by Data Centers
- Informal
  - Most basic form: aswitch is placed somewhere and anyone can connect
    - Usually unmanaged and unsupported

Additional Services

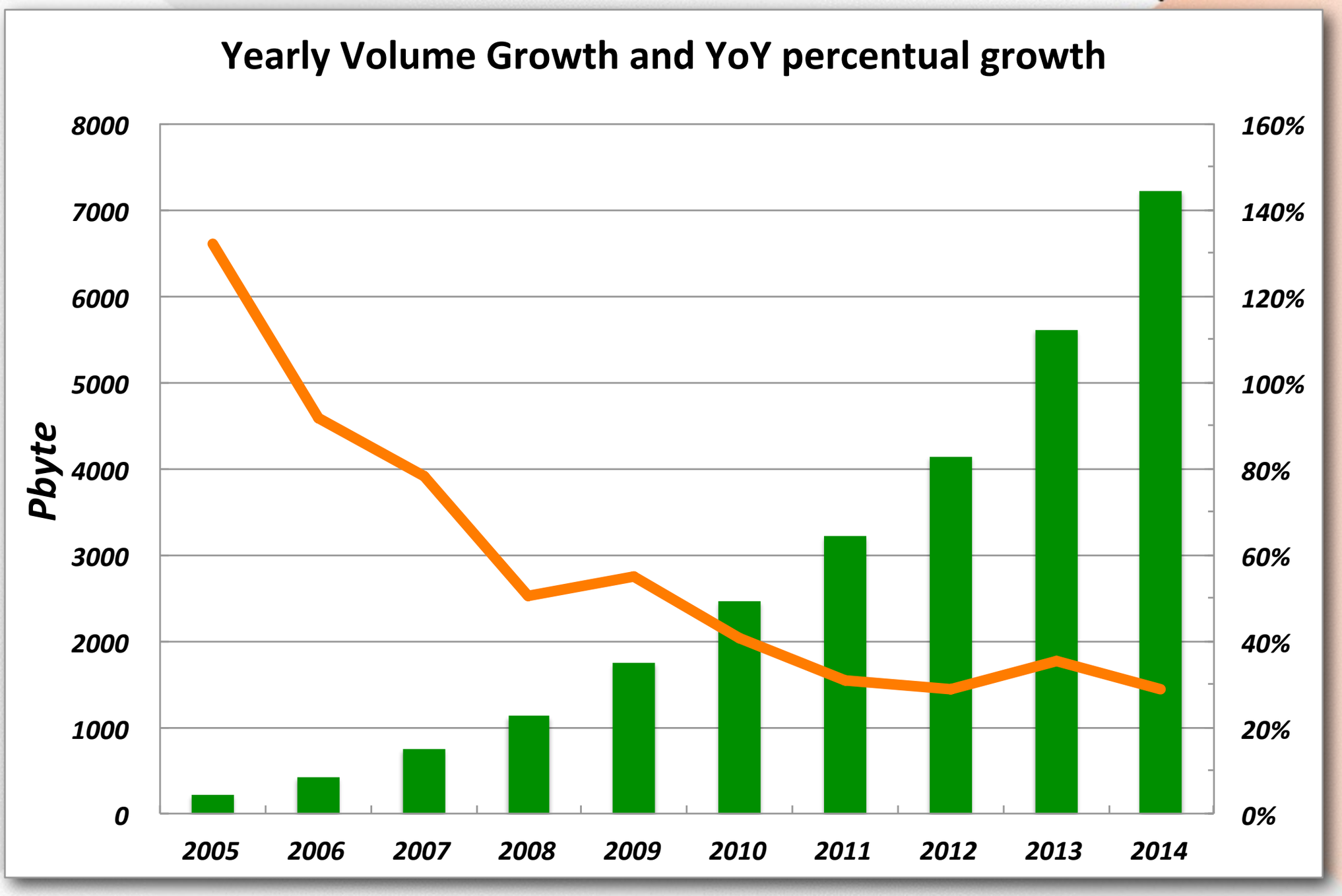
- Route-server
- Looking-glass
- Measurement and instrumentation
- Network Time Protocol
- Web cache parent
- News server
- Root server and ccTld instances

AMS-IX current Status





Historical Traffic Growth



AMS-IX Projections