ITU-D Regional Workshop for Arab LDCs on Interconnection Regulation in IP Based Environment

March 24 - 26, 2015, Khartoum, Sudan

Interconnection Models

Moez Chakchouk, CEO of ATI, Tunisia — @mchakchouk

Evolving environment

- From traditional circuit-switched networks to IP packet-switched networks: NGN Migration

- Convergence is fostering the change in all regulatory systems: historically, many networks delivered a single service, but today, any network can deliver any service — Internet development

- Impact of broadband data on ICT business models: OTT challenging situation for operators

- Interconnection is an issue among many others in the multi-stakeholder internet governance model

- New regulatory approaches to be adopted in order to promote the development of a non-fragmented internet

Interconnection

- **Access** enables an operator to utilise the facilities of another operator but **Interconnection** enables an operator to establish and maintain communications with the customers of another operator

- Interconnection of switched fixed and mobile networks is a regulated issue — The lack of interconnection implies a connectivity breakdown

- Regulators deal with the approval of Reference Interconnection Offers (RIOs) and need to address the market power

- Regulated arrangements for switched networks are mostly based on CPNP (Calling Party's Network Pays)

- Operators always try to set the termination fees at high levels in the absence of regulation (the termination monopoly) and encourage on-net vs off-net price discrimination

Interconnection — Towards IP

- In Conventional networks, interconnection costs are declining rapidly due to IP technology

- In Internet networks, interconnection prices are generally set by the market via commercial negotiations

- As NGN is developing and voice moves to IP

    - IP-based voice termination can’t have a substantially different cost from that of traditional voice

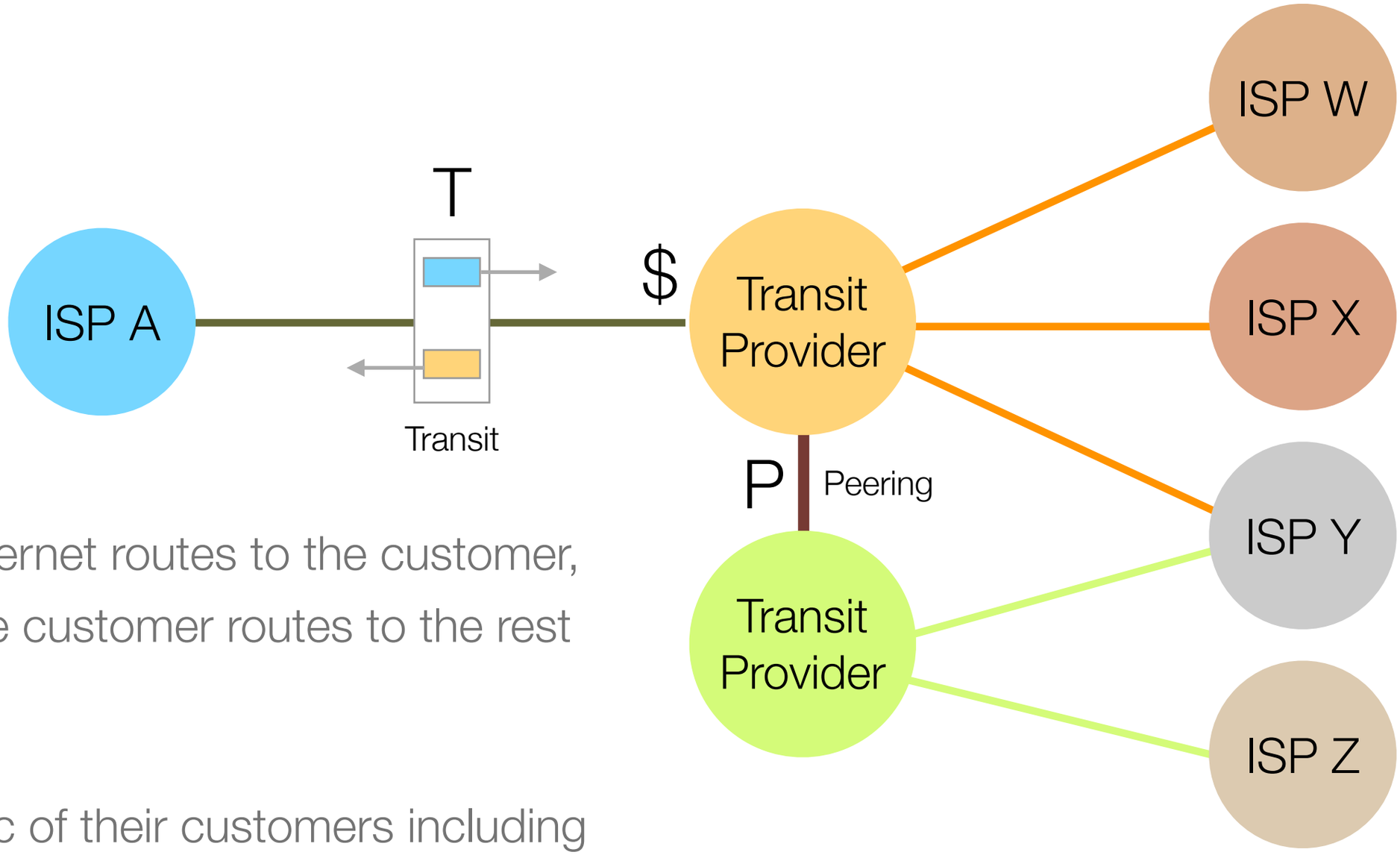
    - Basing the termination rates on the IP-based cost seems to make sense

    - Migration costs need to be involved in the long run incremental cost modelling

Internet Transit — Basics

- Internet is a network of networks
- To get connected to the internet, an entity must attach itself to an entity that is already connected to the internet
- Internet Transit is the business relationship whereby an Internet Service Provider (ISP) provides access to the global Internet
- ISP — “Transit Provider”: an entity providing (usually selling) access to the internet
- ISP needs to get connected to the internet in order to sell access to the internet, so they need to purchase Internet Transit from a Transit Provider

Interconnection — Transit vs Peering



Transit Service:

1. Announcing internet routes to the customer,
2. Announcing the customer routes to the rest of the internet.

Peering:

1. Exchange traffic of their customers including customers of their customers
2. Often, but not always done without charge.

Interconnection — Transit vs Peering

- General principle of interconnection arrangements: "*You carry traffic for me, in return for which I'll do something — either carry traffic for you, or pay you, or some combination of the two.*"

- Interconnection arrangements depend on the networks to interconnect: large/small, national/regional/global, public/private, connected/not to an Exchange, etc.

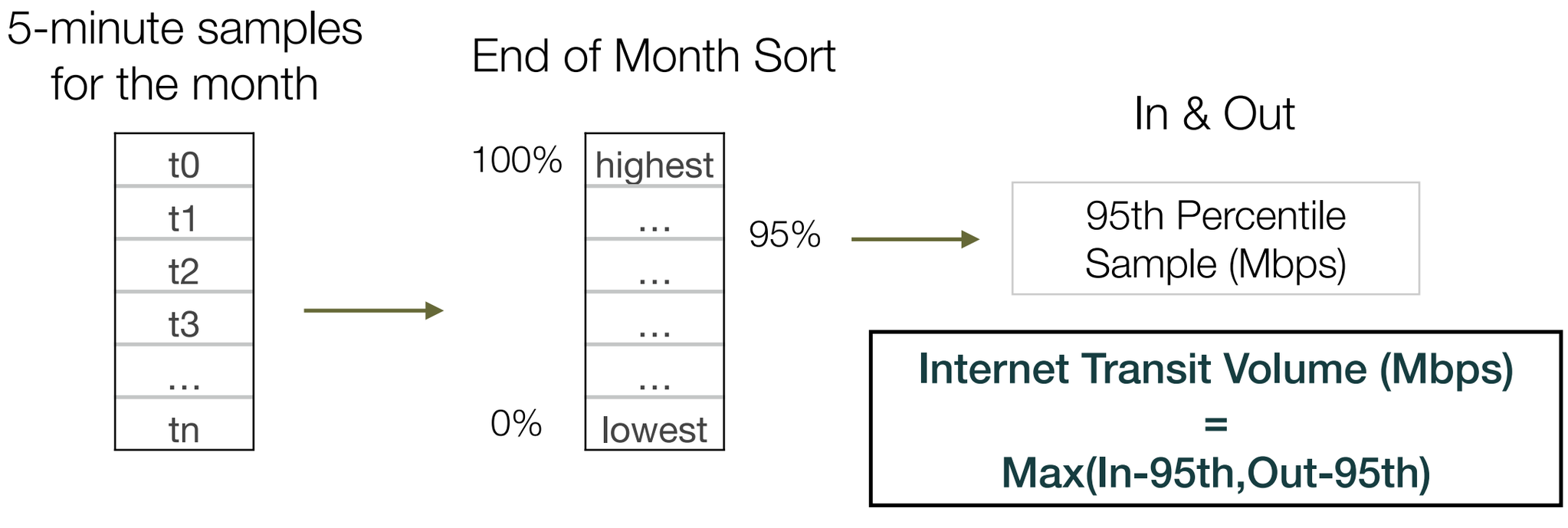
<table>
<tr><th>Network "A" accepts traffic for:</th><th>Network "B" accepts traffic for:</th><th>Financial Settlement</th><th>Networks connects</th><th>Nature of Agreement</th></tr>
<tr><td rowspan="2">Its own customers only</td><td rowspan="2">Its own customers only</td><td>No Charge</td><td rowspan="2">Directly</td><td rowspan="3">Bilateral</td></tr>
<tr><td rowspan="2">Volume based Charges</td></tr>
<tr><td rowspan="2">Other networks to home it connects</td><td rowspan="2">Other networks to home it connects</td><td rowspan="2">Via an Exchange</td></tr>
<tr><td>Mix</td><td>Multi-Party</td></tr>
</table>

Internet Transit — Pricing Model

- Internet transit is typically metered and priced in $/Mbps

Monthly Bill ($) = internet Transit Volume (Mbps) x internet Transit Unit Price ($/Mbps)

- The transit Volume is measured at 95th percentile traffic sampling technique



Internet Transit — Pricing Model

- Forget about the circuit-capacity basis: We can not purchase a transmission capacity (circuit) to the internet and pay as if you used the entire circuit capacity 24 hours a day

- Average use technique is inadequate compared to the 95th Percentile method because of the burst nature of internet traffic (occasional peaks)

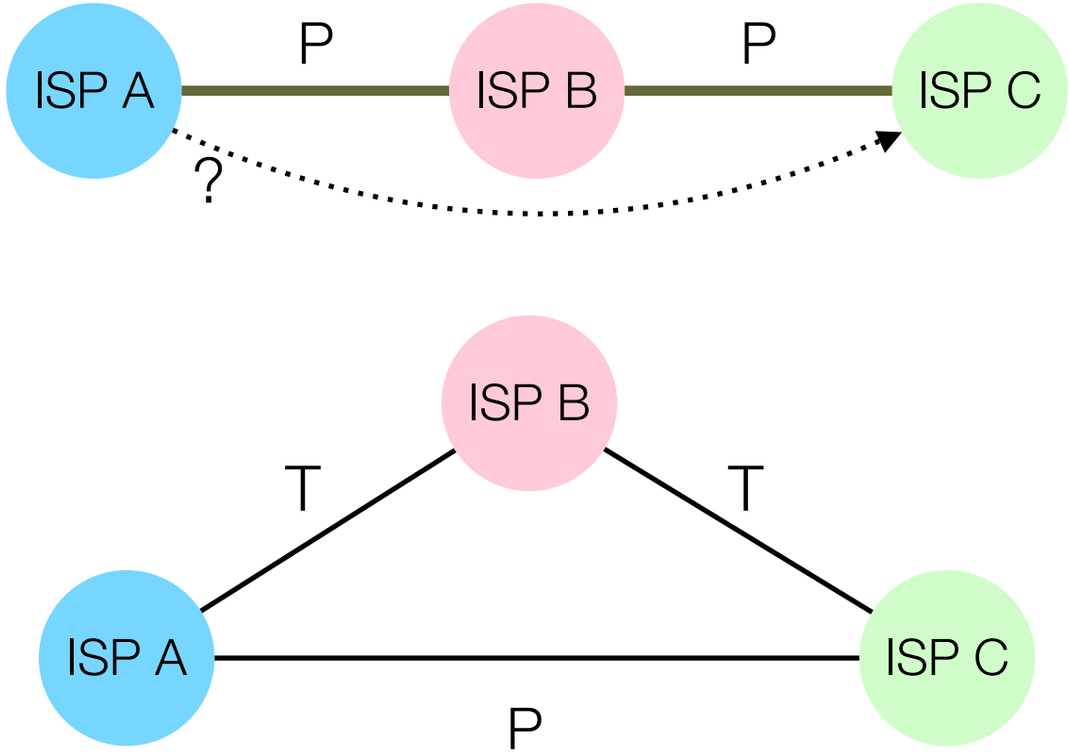
- Encourage the use of the internet transit service by providing pricing discounts for the pre-committing to certain volumes of traffic

Monthly Bill ($) = Max(Transit Volume x Unit Price , Commit Volume x Unit Price)

- Other variables could be considered in the determination of internet transit pricing, i.e. number of ports, capacity of ports, type of the customer traffic (inbound vs outbound), impacts of the traffic on the ISP, the region and the market conditions at the location of the interconnection.

Internet Peering

- Peering is not a transitive relationship
- Internet peering is not a substitute for internet transit
- Internet peering is typically settlement-free
- Motivations to peer:
  - Transit costs are reduced
  - End-user experience is better
  - Control over routing is strategic
  - Traffic billing is usage-based
  - Marketing benefits



Some well know best practices

- Competition is the Key for better IP connectivity: Open market for all actors —> Cost reduction and better resiliency

- Minimise the cost of internet transit by committing early to the next higher tier of commitment

- Connect to two or more upstream ISPs (Multi-Homing): spread the traffic across two or more ISPs in order to improve performance and resiliency

- Capture content and access customers: Build CDNs and keep the traffic on out networks

- Peer for free with similar networks and be member of IXPs

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Technical Challenges

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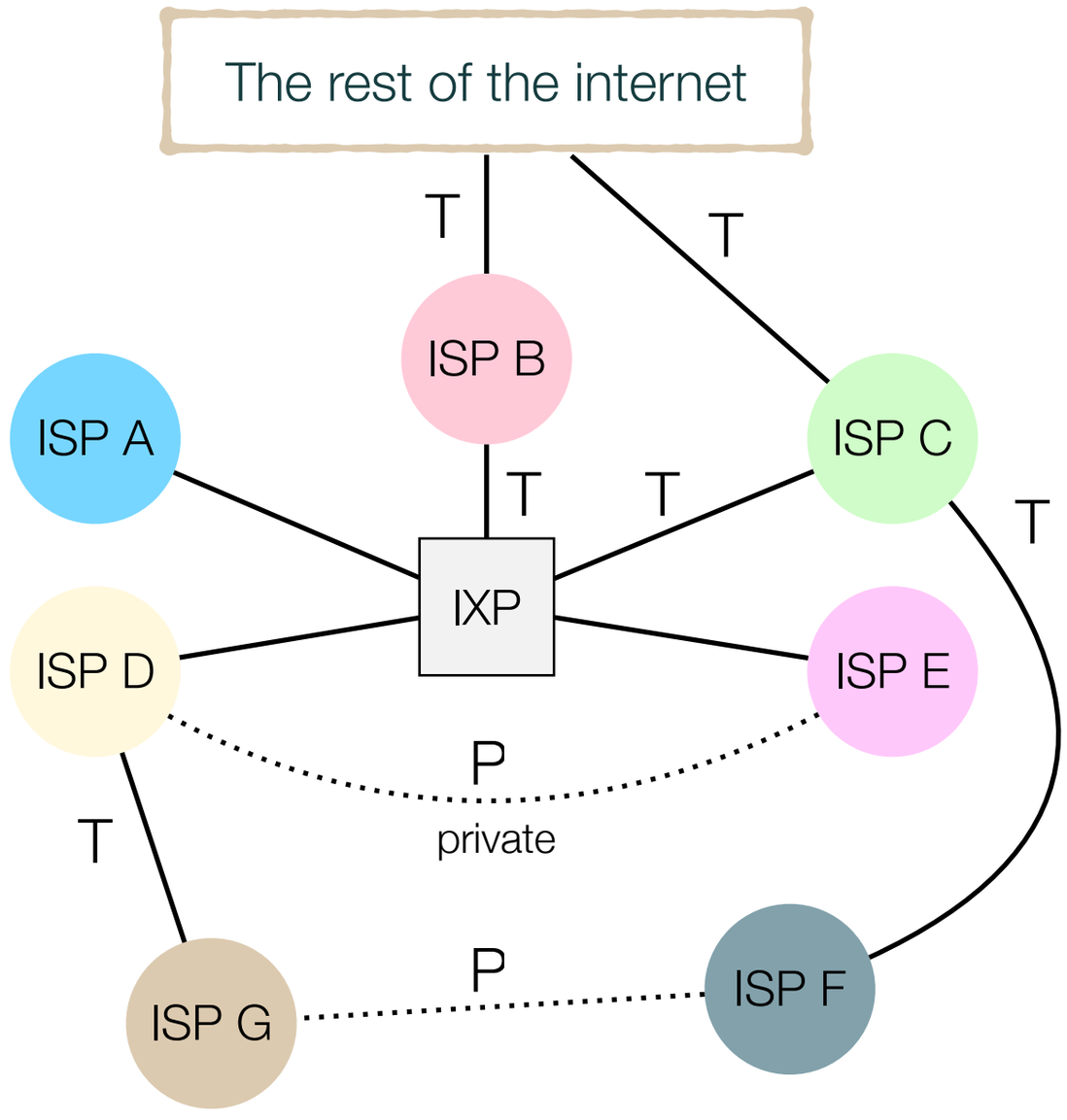
Context of IXPs

- Technically — BGP Routing and DNS are internet pillars
- RIRs deals with critical internet ressources: IPv4/IPv6 & ASN
- No network stands alone, broadband telecom infrastructure is essential but not everything
- A very large number of global transit networks are connected through submarine cables
- Domestic competitive providers generally appear immediately downstream of international providers
- Internet eXchange Points are the key of efficient interconnections

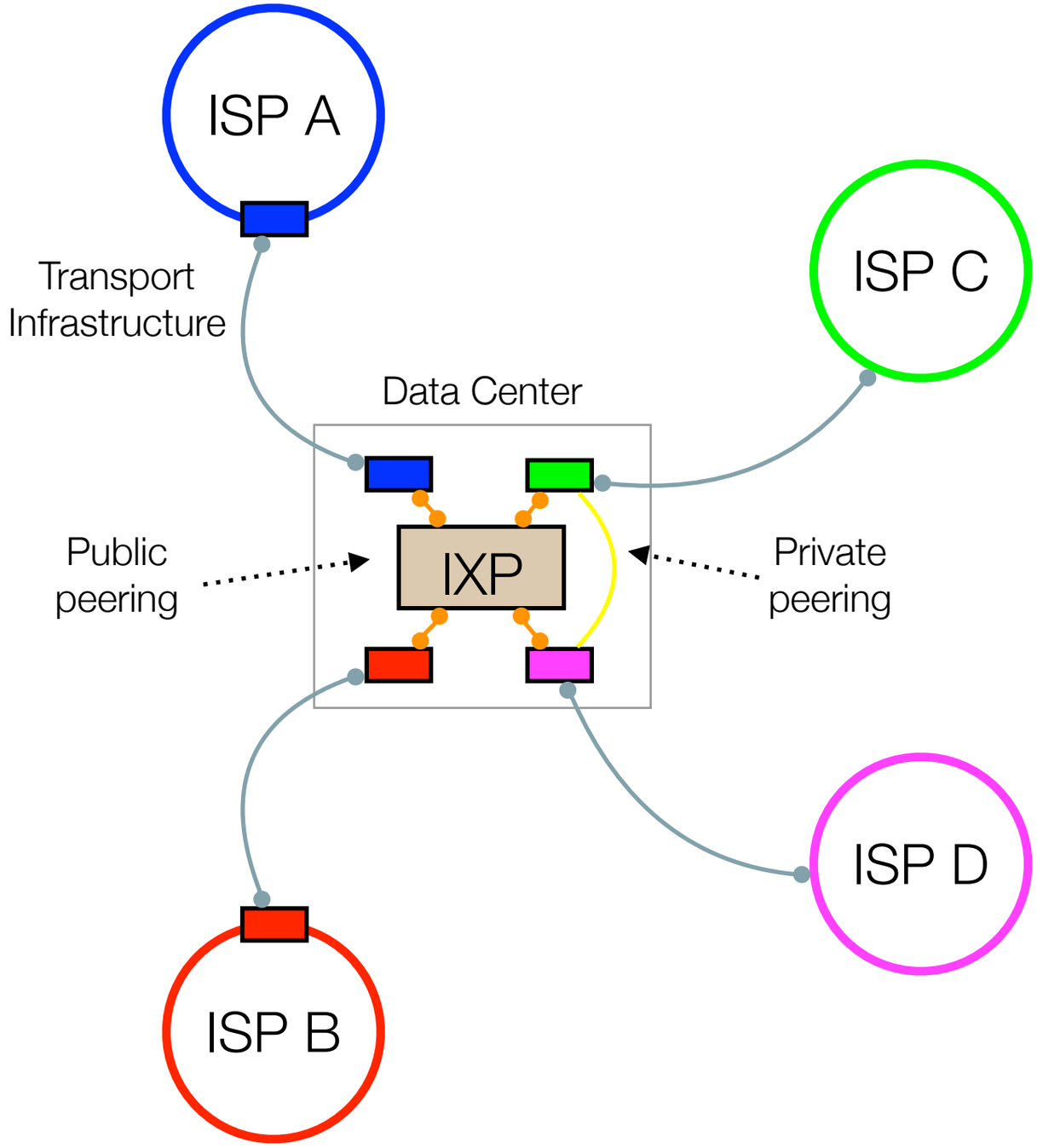
IXP: A Key Infrastructure

- IXP is crucial in an environment where nearly all domestic providers can have international transit
- Keep local internet traffic within local infrastructure and reduce interconnection costs
- Reduced latency increasing performance and driving demand — especially for data-heavy applications, including video
- Direct savings on international transit
- Convenient hub for attracting hosting key internet infrastructures within countries



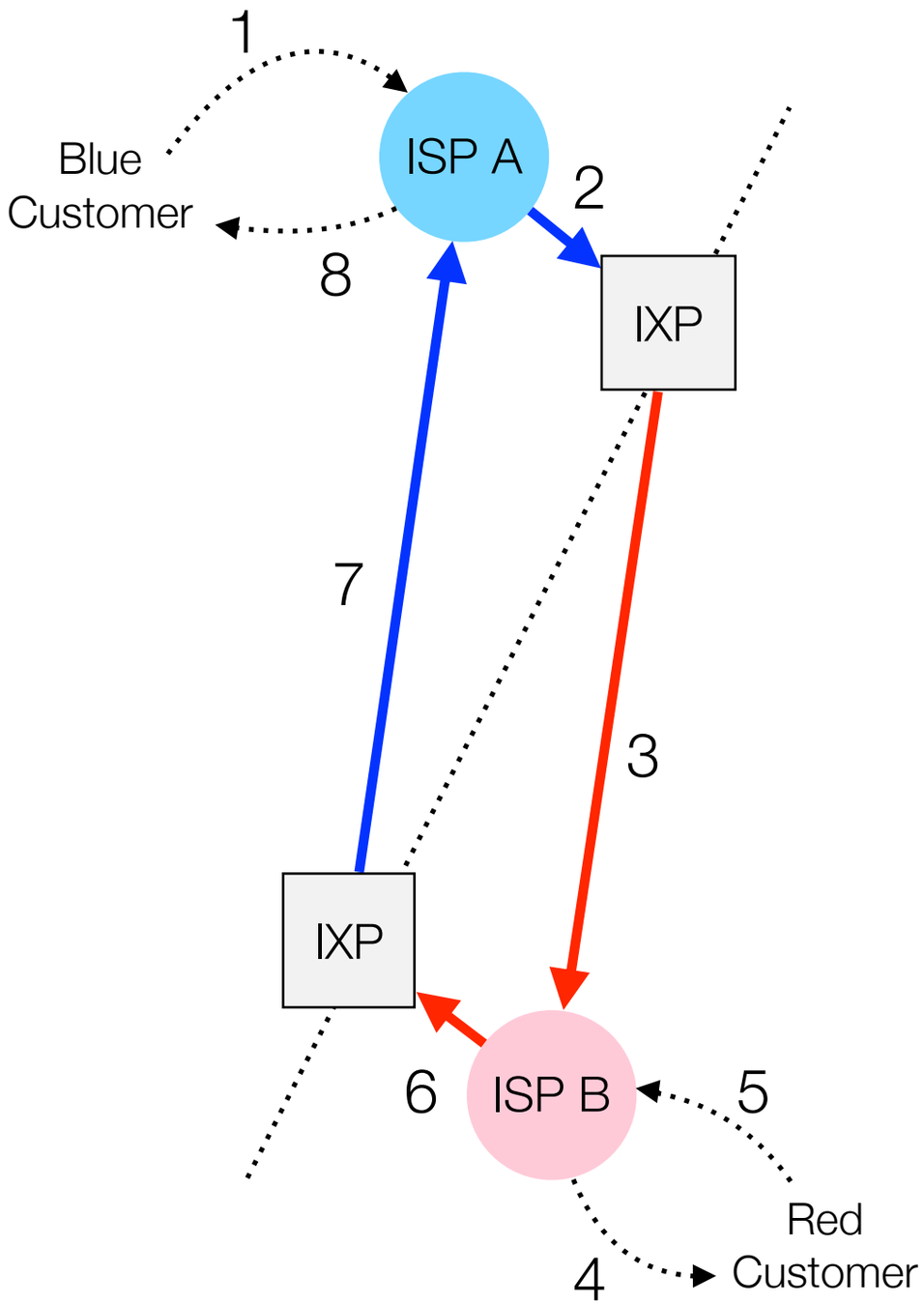
Peering via an IXP

- Transport for getting the traffic to the exchange point — fixed capacity circuit
- Housing the interconnection equipment — colocation
- Networking equipment used for internet peering
- Peering port on the IXP switch
- Encouraging public vs private peering



Peering & Shortest exit

1. Blue Customer sends to Red Customer via ISP-A network
2. ISP-A delivers at **nearest IXP**
3. ISP-B backhauls from **distant IXP**
4. ISP-B delivers to Red Customer
5. Red Customer replies to Blue Customer via ISP-B network
6. ISP-B delivers at **nearest IXP**
7. ISP-A backhauls from **distant IXP**
8. ISP-A delivers to Blue Customer



QoS in IP-Based Environment

- IP-based system under load, packets can be queued or dropped if the queue is too long
- Delays are not a failure mode but they are a normal aspect of IP operation
- QoS parameters and mechanisms are important to enable network operators to design, build and manage their networks, such as bandwidth, transmission delay, queuing delay, packet loss.
- Users are concerned by QoE which depends on the application (email, VoIP, videostreaming, etc.)
- Differentiated QoS is technically a common issue, but in practice enforcing QoS across IP-Based networks is a challenging issue: implementation of an inter-provider QoS, Net Neutrality, …

Network Neutrality

- Network neutrality has taken on various meaning:
    - The ability of all internet users to access the content or applications of their choice
    - Assurance that all trafic on the internet is treated equally, whatever its source, content or destination
    - Absence of unreasonable discrimination on the part of network operators in transmitting internet traffic.
- The use of various forms of quality differentiation for internet traffic within networks has been routine for decades
- Breaches of network neutrality have raised a range of different fears related to negative impacts on competition, innovation, freedom of expression, …

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Regulatory Hearing — Case Studies

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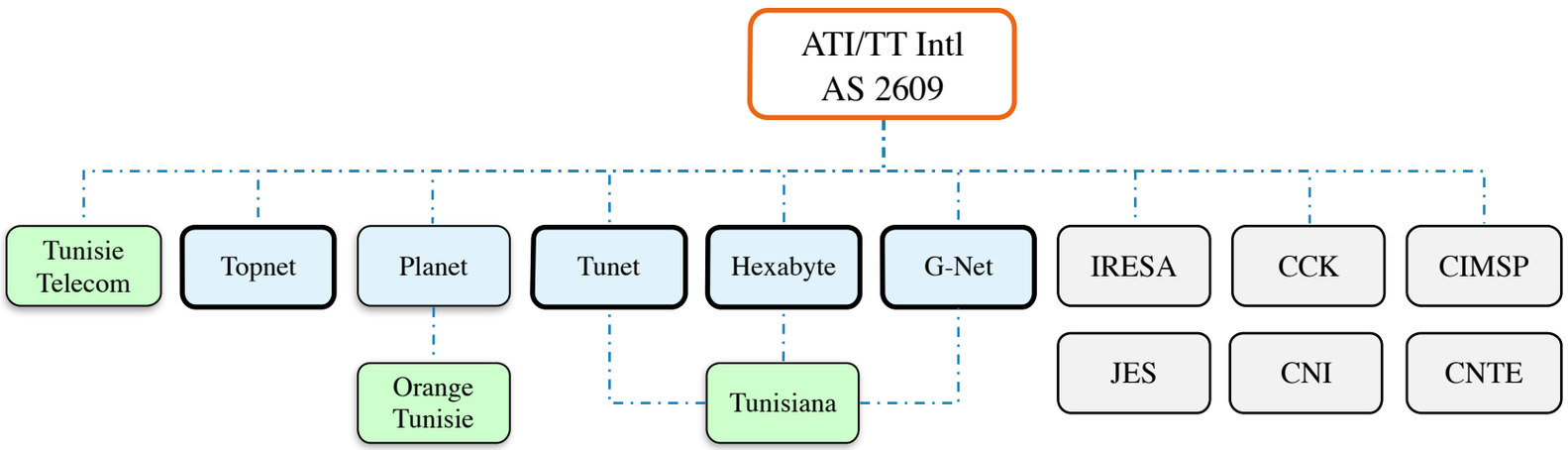
Case Study: ATI-Orange TN (Tunisia)

Situation until December 2012:

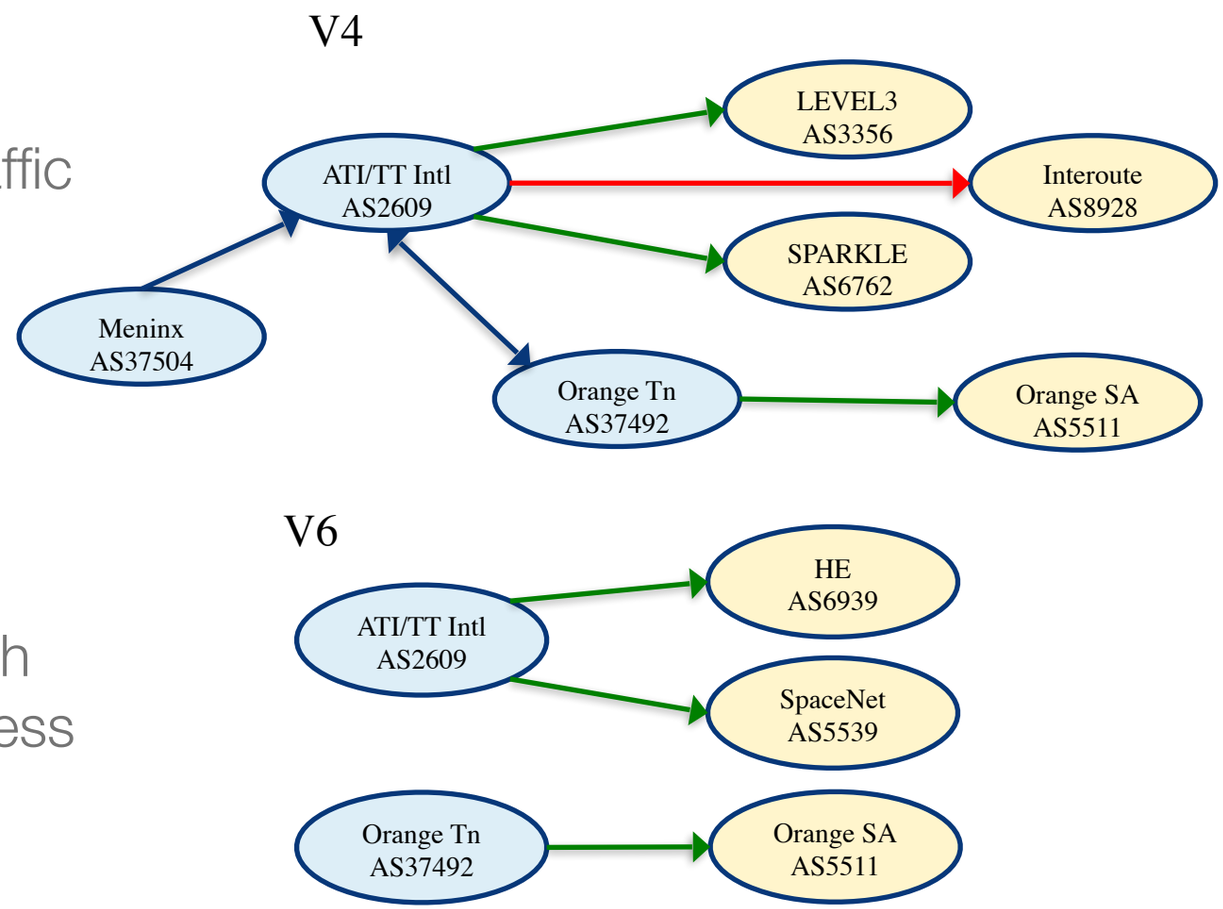
- Monopoly: 1 AS for the whole country operated by ATI / Tunisie Telecom (TT)
- Routing internet traffic via ATI is a regulatory obligation for all ISPs/Operators
- International IP transit service: Expensive tariffs (End of 2010: 60 TND/Mbps ($30/Mbps)
- Coarse economic model: Total revenue of IP Transit services in Tunisia was shared between ATI(30%) and TT (70%)
- National transit of domestic traffic is free.



Case Study: ATI-Orange TN (Tunisia)

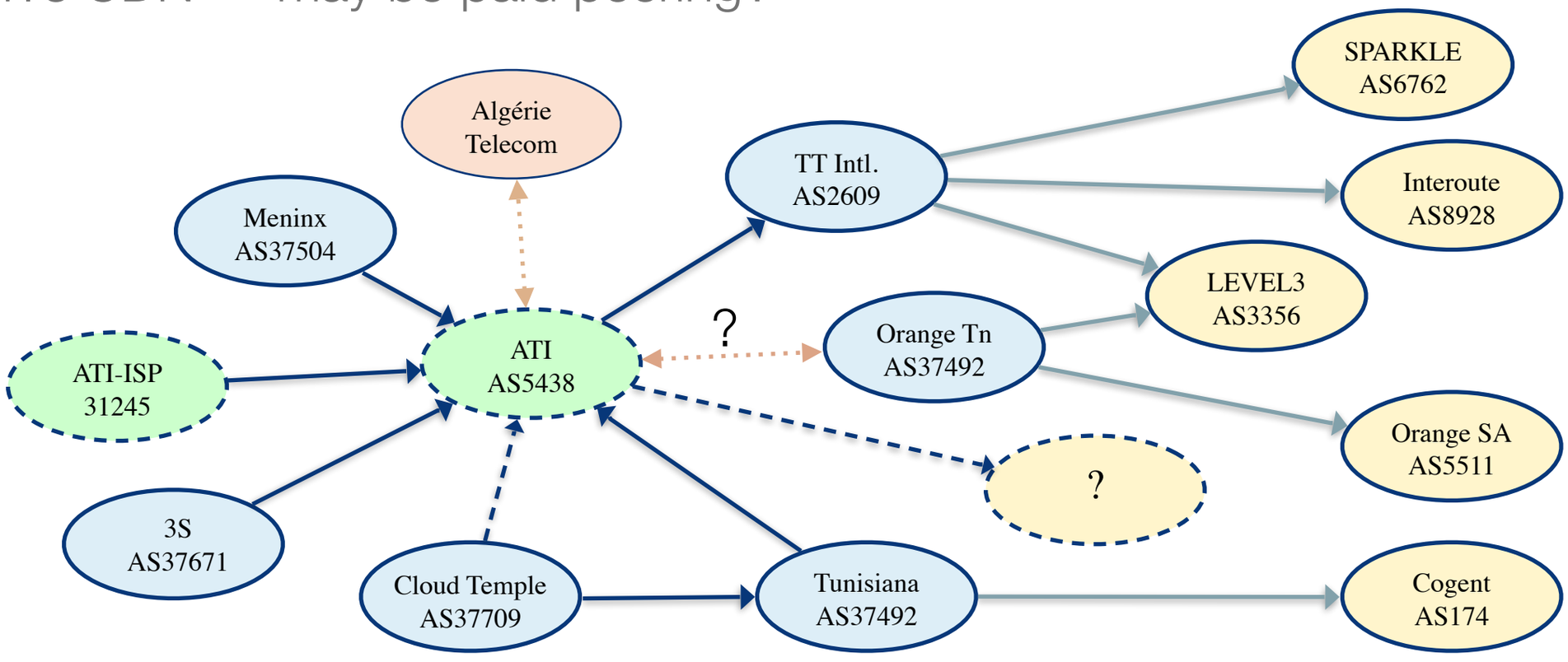
By January 2013:

- Orange TN purchased a 2x10GE international capacity from Tunisie Telecom and made its own peering with Orange OpenTransit (AS5511)
- Regulatory obligations to route the whole traffic via ATI did not drop and ATI kept providing national transit services via its backbone
- ATI launched a CDN and get 30% of the international transit trafic as a local trafic
- TT is not in favour of sharing the revenue with ATI and made pressure to change the business model
- A dispute between ATI and Orange TN regarding the tariffs for the national transit services



Case Study: ATI-Orange TN (Tunisia)

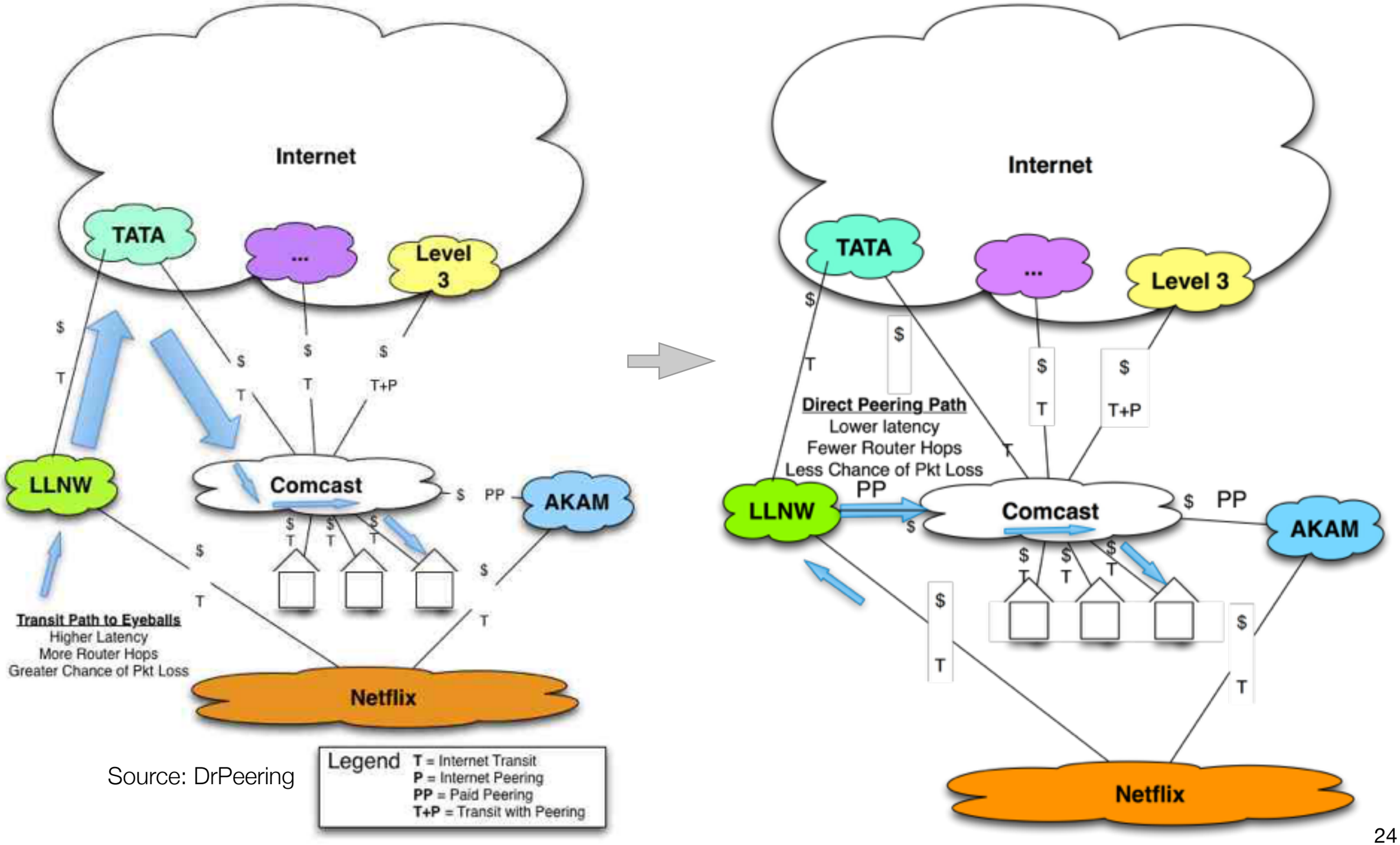
- Founding TunIXP clarified the role of ATI as an ISP (AS31245) and an IP Transit Service Provider (AS5438) operating independently from TT (AS2609)
- Tariffs of national IP Transit has been set by the regulator in 2013
- These tariffs wont be relevant when OrangeTN and TT will connect to TunIXP Layer 2 platform and support the TunIXP association and might be considered for the ATI's CDN — may be paid peering?



Traffic exchange and network neutrality

- Growth of Content Delivery Networks (CDNs): Video dominates the internet
- Internet videos tends to be massively asymmetric
- Access networks customers pulling down so much video content from the internet
- CDNs and content-heavy ISPs won't have balanced peering ratios with access networks
- Peering policy — prerequisites to peering could be:
  - Open: Willingness to peer with any other player in the ecosystem
  - Selective: few requirements needed (i.e. minimum traffic volume for peering)
  - Restrictive: not to peer with anyone other than their exiting peers
  - No peering. not to peer at all (i.e. transit is preferred)

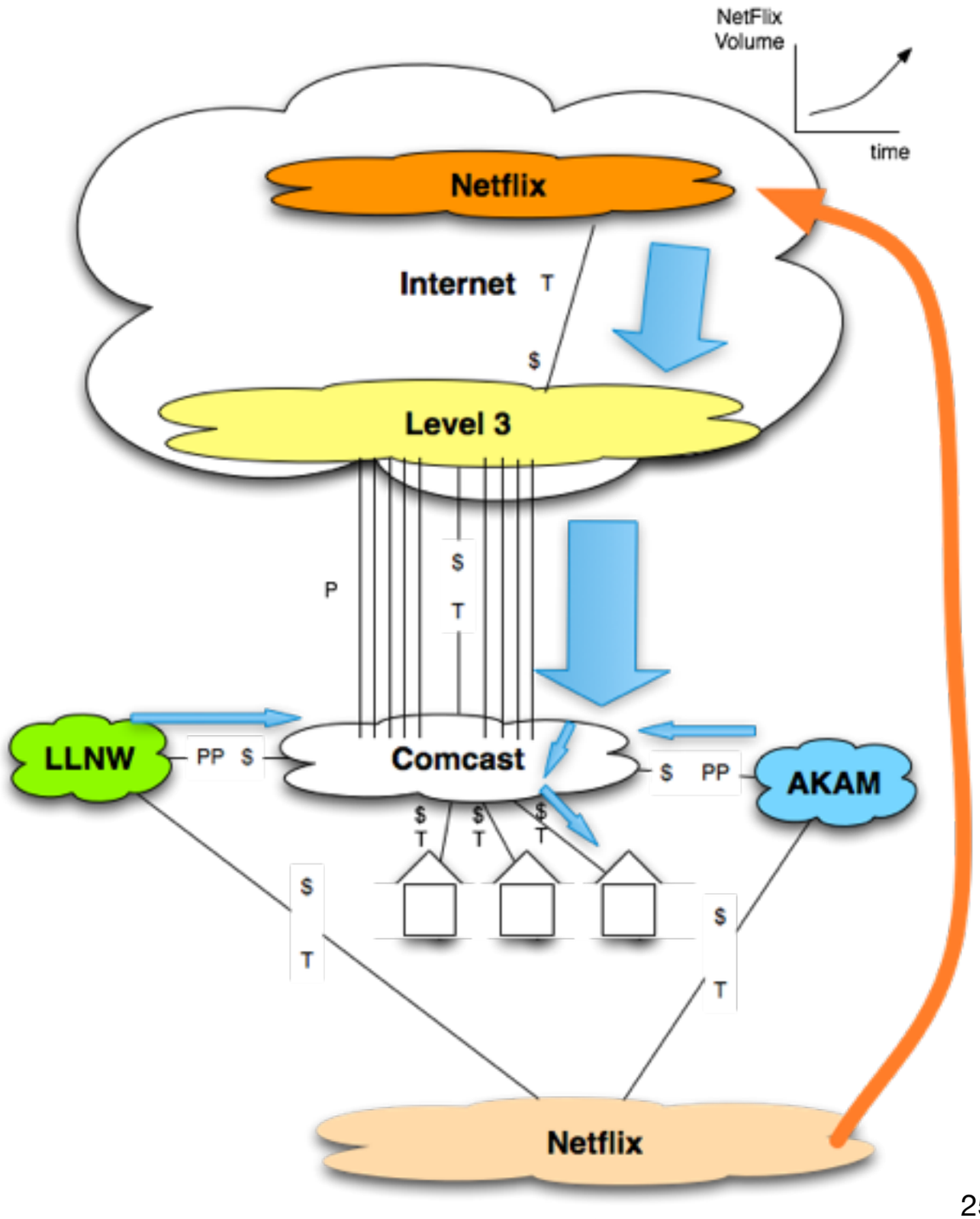
Case Study: Comcast-Akamai-Limelight



Source: DrPeering

Case Study: Netflix, Level3 and Comcast (1)

- The shift of video traffic from a paid peer to a settlement-free peer

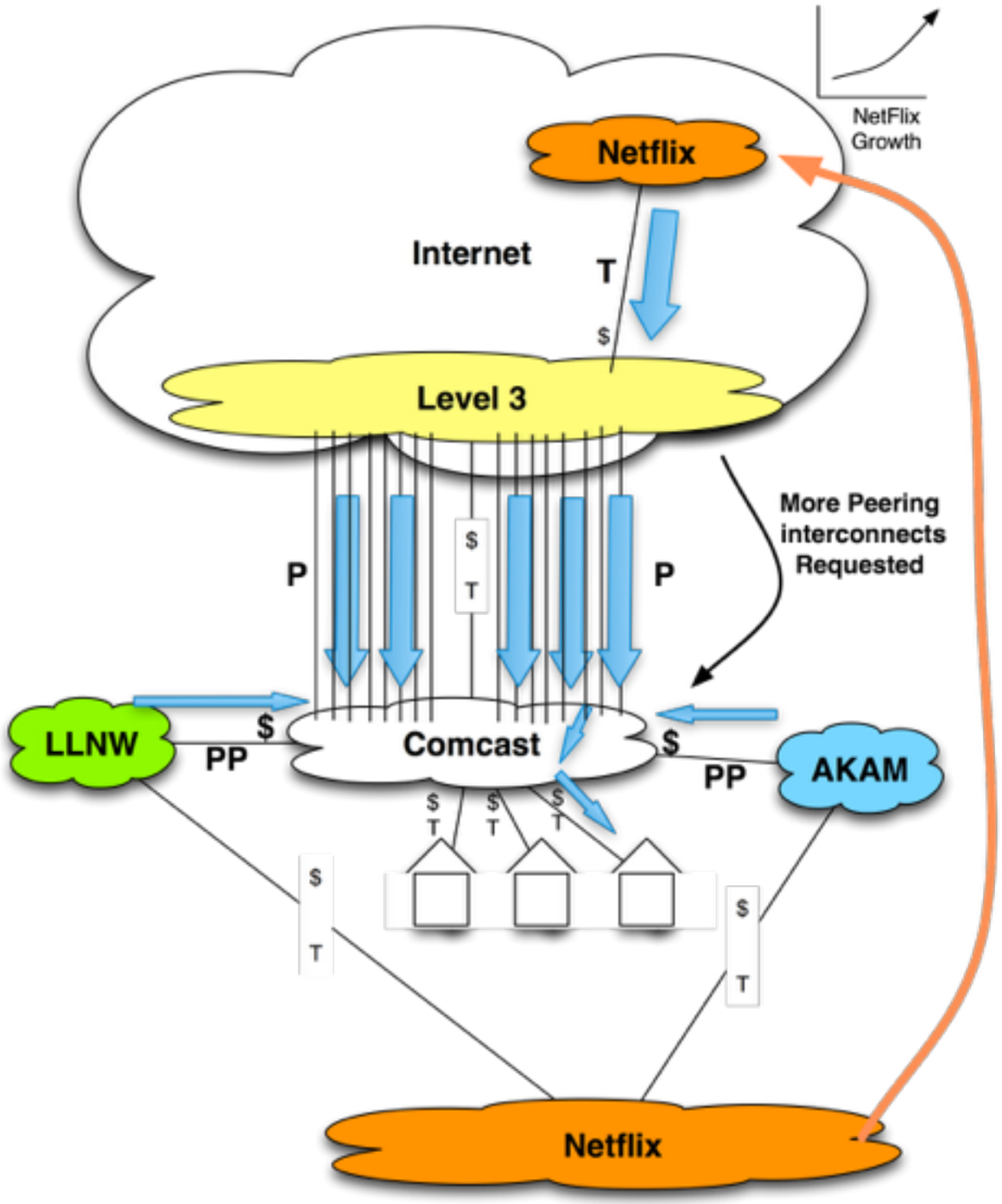


Source: DrPeering

Case Study: Netflix, Level3 and Comcast (2)

- The shift of video traffic from a paid peer to a settlement-free peer

- Additional ports requested from Access Network



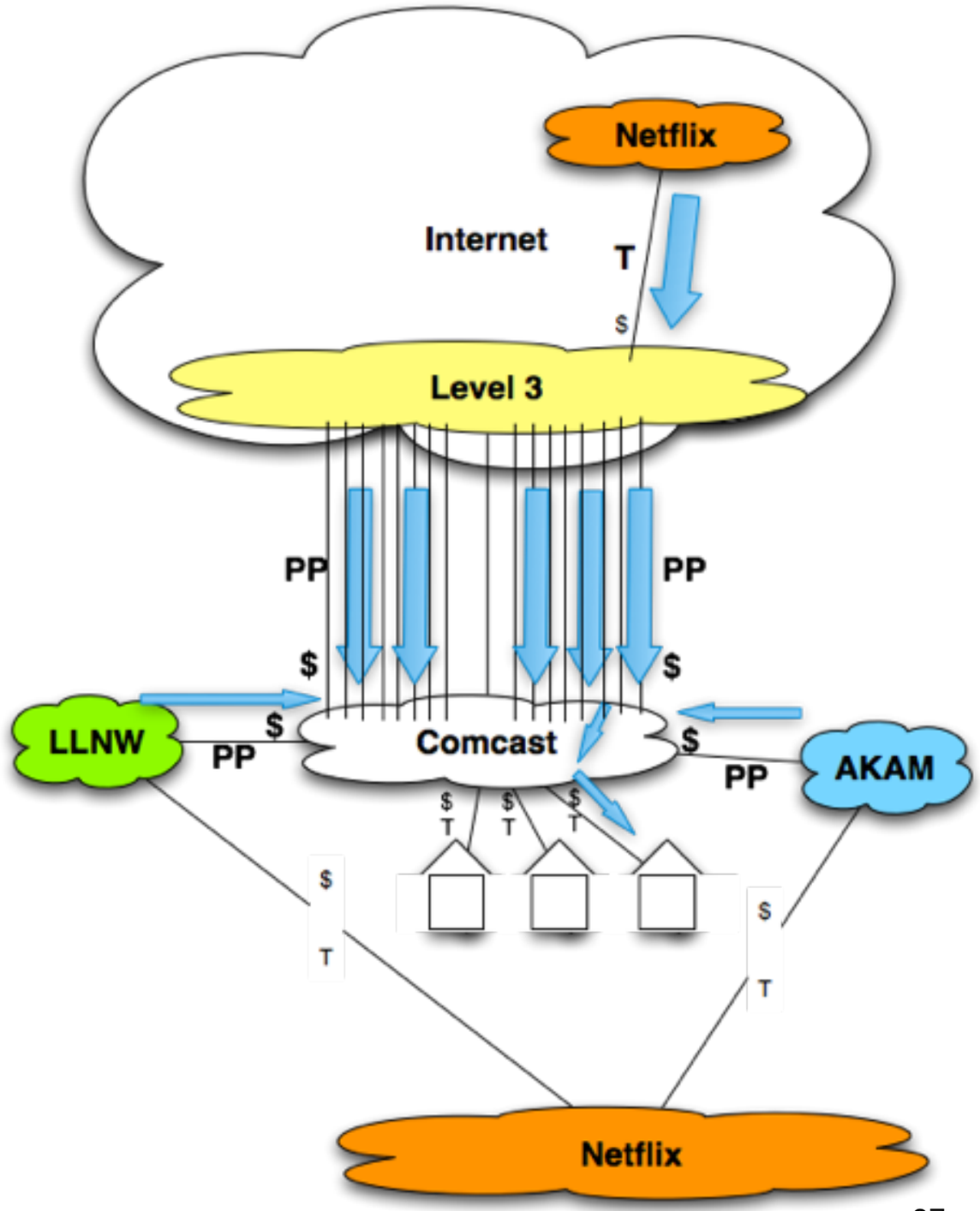
Source: DrPeering

Case Study: Netflix, Level3 and Comcast (3)

- The shift of video traffic from a paid peer to a settlement-free peer

- Additional ports requested from Access Network

- Level3 acquiesces and becomes a Paid Peering Customer like Akamai and LimeLight



Source: DrPeering

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International Trends

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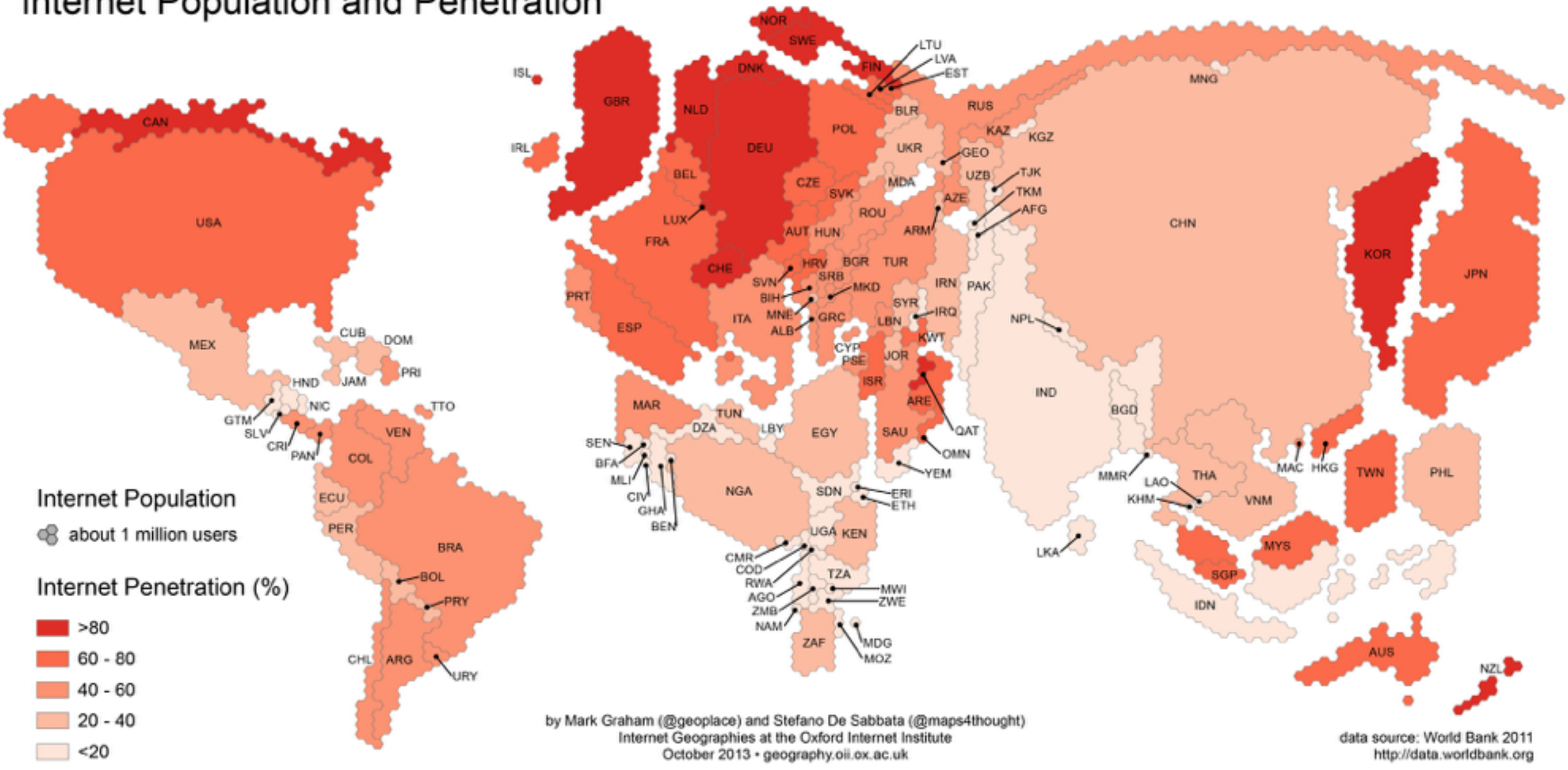
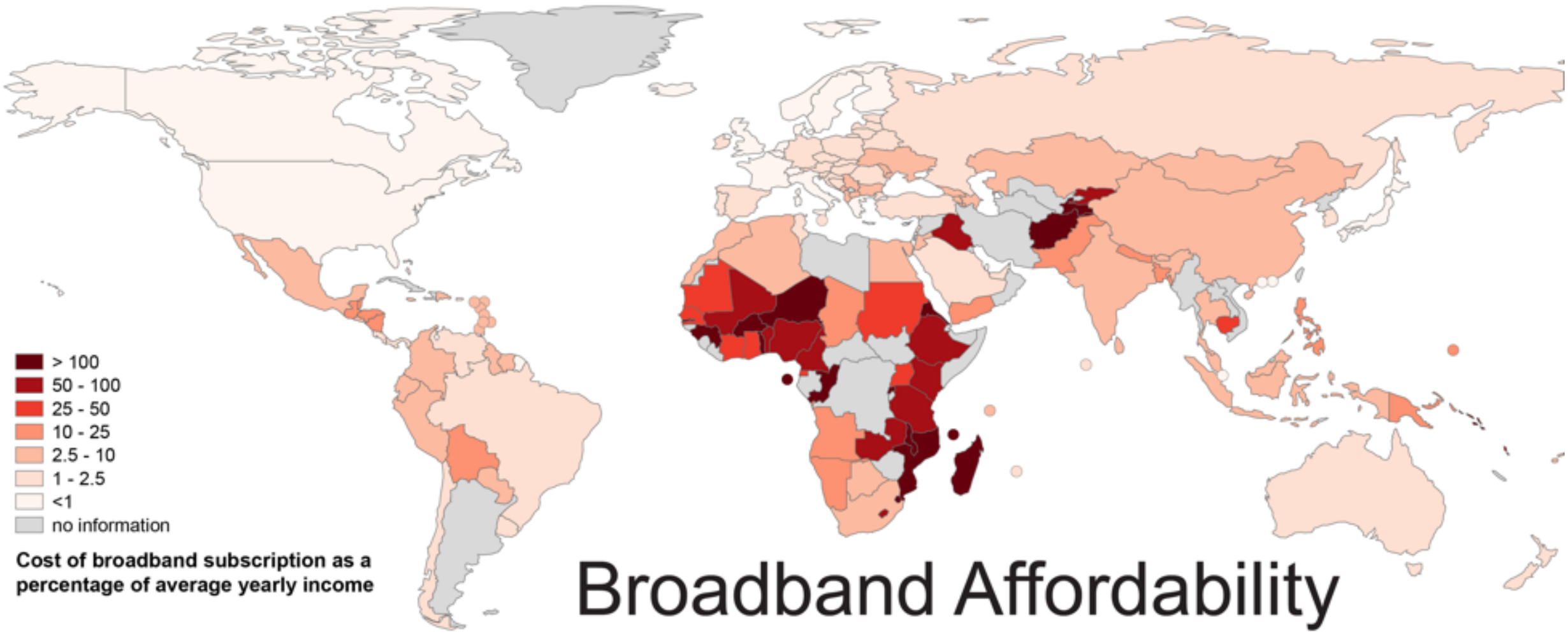
Internet Population and Penetration

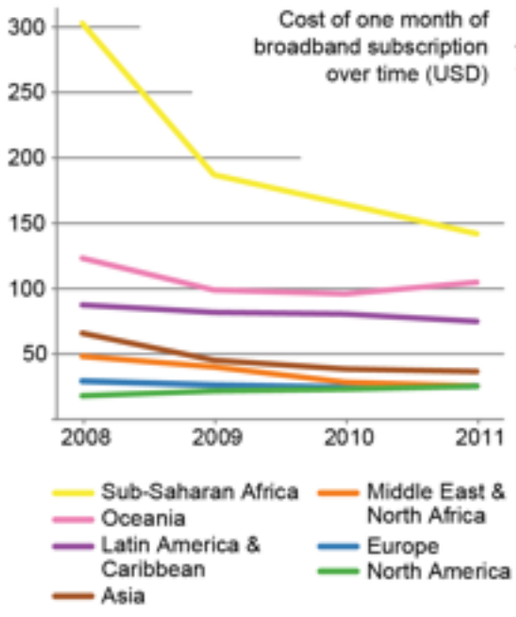


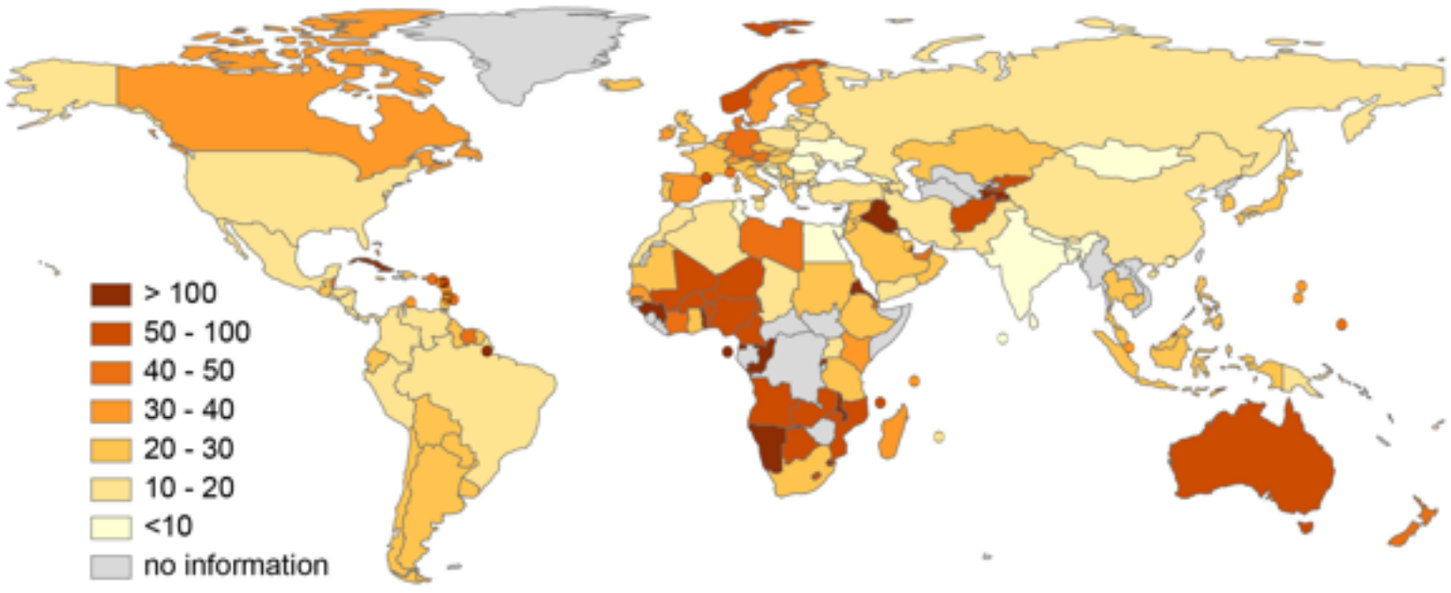
Source: geography.oii.ox.ac.uk

Broadband Affordability



Cost of broadband subscription as a percentage of average yearly income





Cost of one month of broadband subscription in 2011 (USD)

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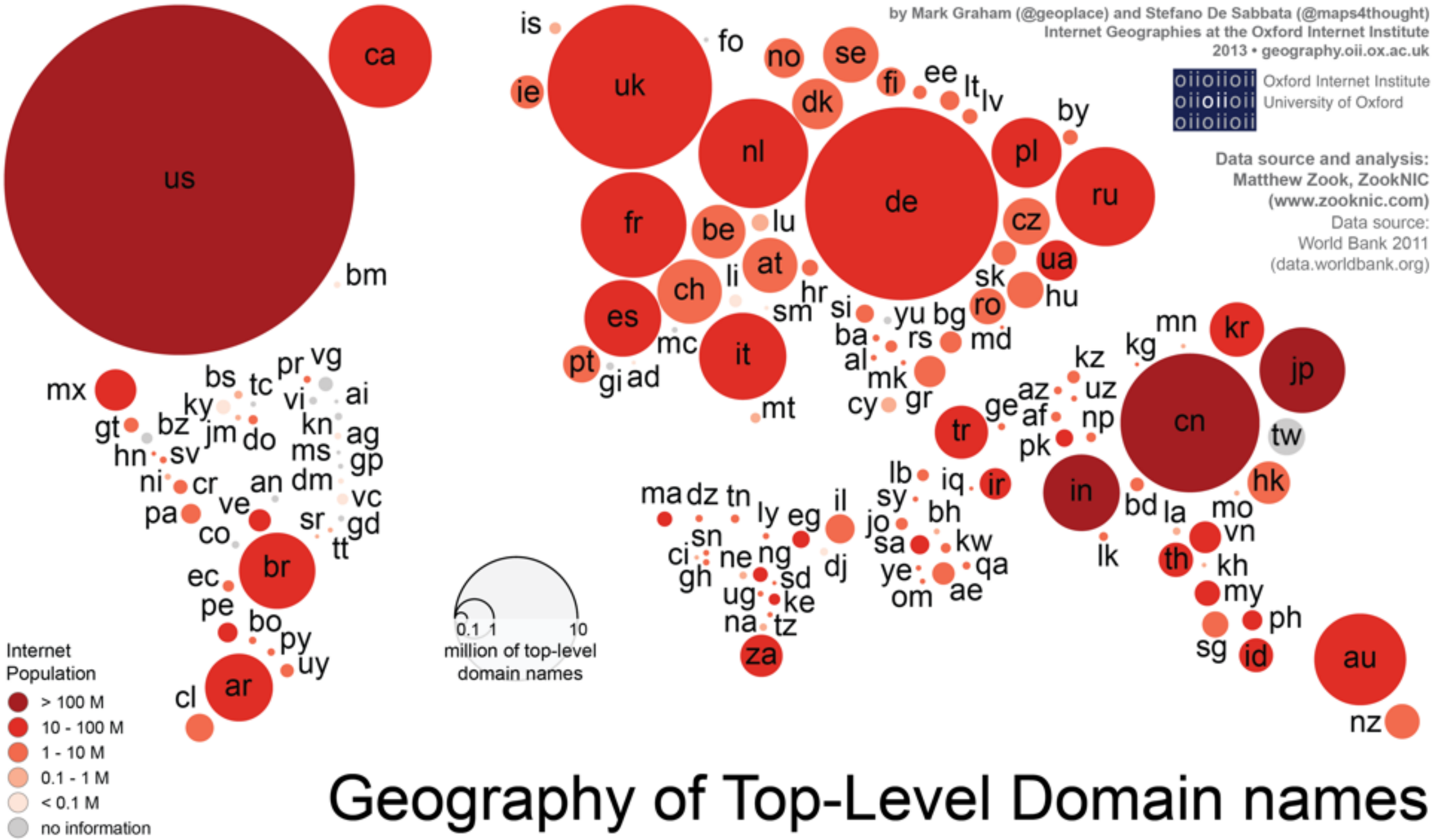
Oxford Internet Institute
University of Oxford

by Mark Graham (@geoplace)
and Stefano De Sabbata (@maps4thought)
Internet Geographies at the Oxford Internet Institute
2014
geography.oii.ox.ac.uk

data sources:
ITU • itu.int
World Bank • data.worldbank.org

Source: geography.oii.ox.ac.uk

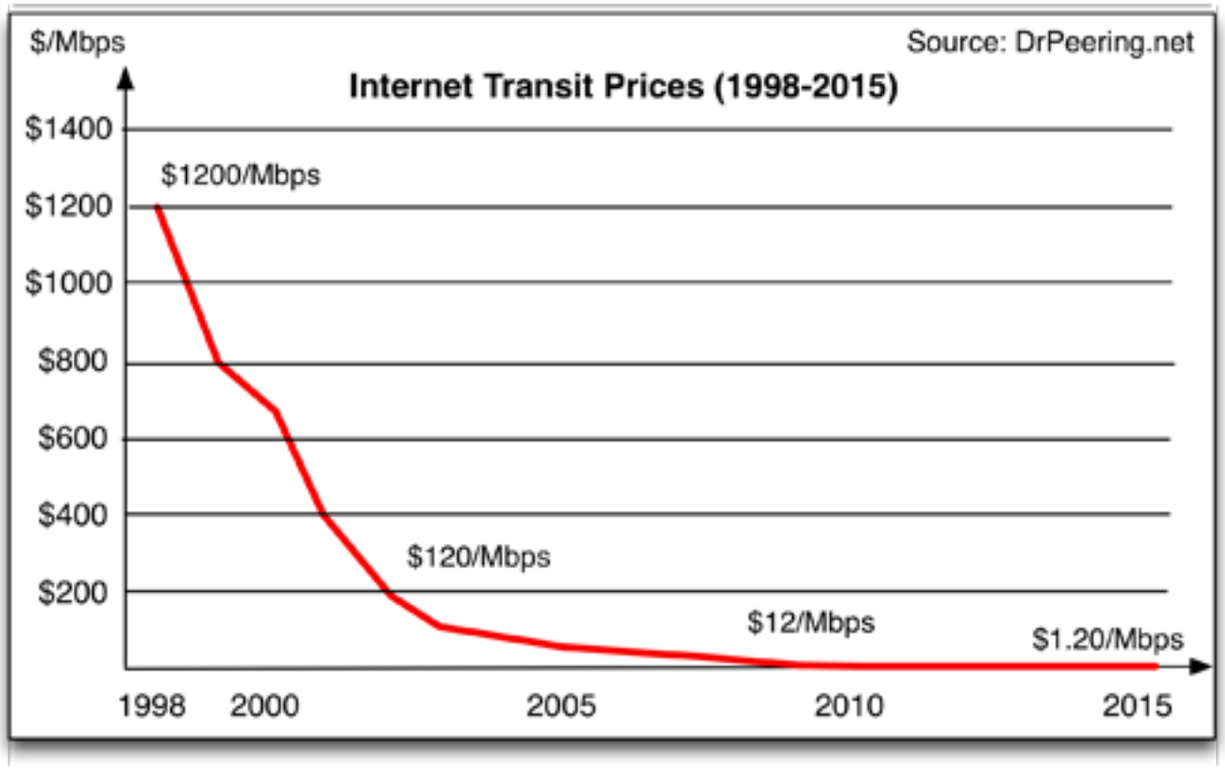


Source: geography.oii.ox.ac.uk

Internet Transit — Trends

- Internet transit prices keep decreasing every year

- Internet transit tariffs gap between countries: Competition in many countries still needs to be promoted



- In many countries, regulatory reforms are needed in order to decrease the internet transit prices (wholesale prices of the infrastructure)

- While the prices are dropping, the internet traffic volumes have always grown

Exchange Points — IXPs

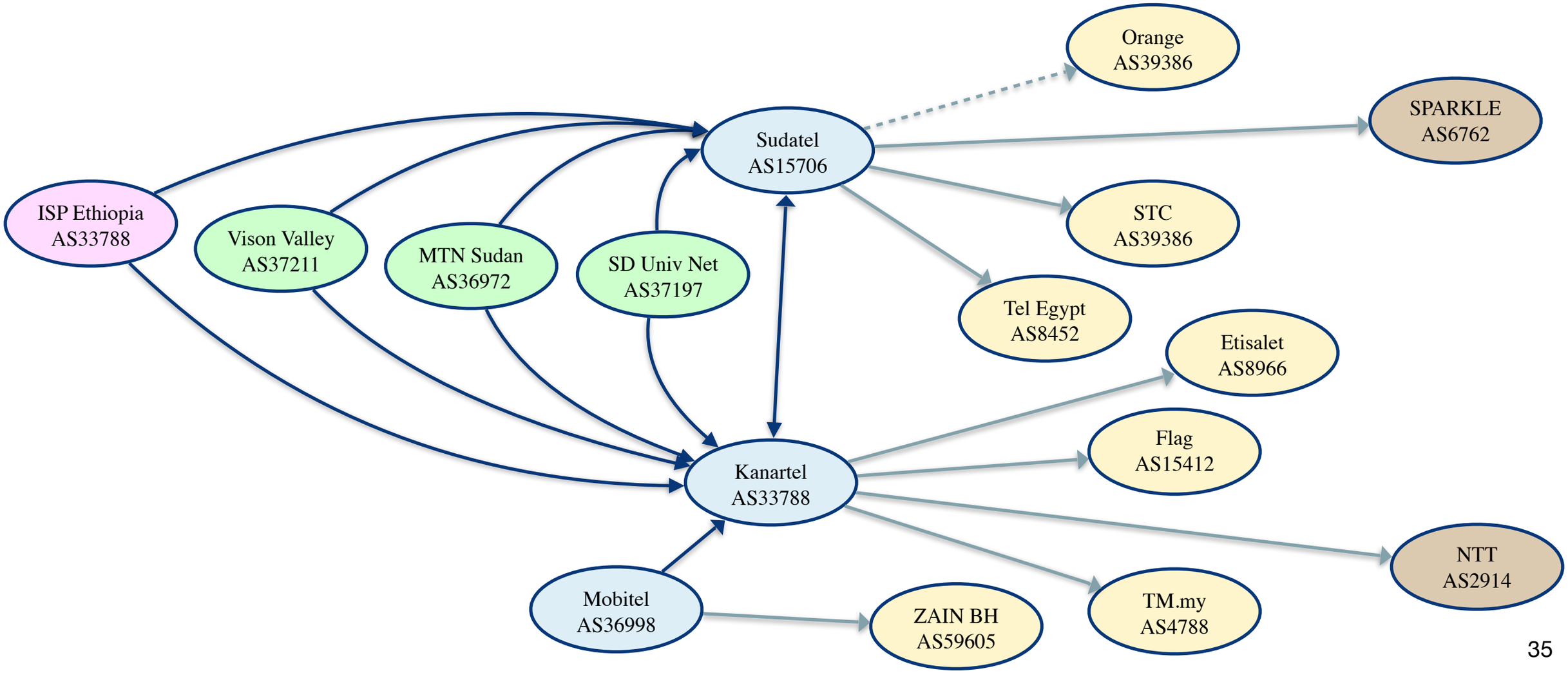
- Only 7 countries in the Arab region have at least an IXP that is running: AE (1), BH (1), EG (2), LB(1), PT (1), SD (1), TN (2).

DNS ROOT Servers

- Only 9 countries in the Arab region have at least an instance of a DNS ROOT Server: AE (4), BH (2), EG (4), LB (1), OM (1), QA (2), SA (3), TN (1), YE (1).

Case Study: IP Connectivity in Sudan

- IXP is running with two major IP Transit Service Providers
- 4 Submarine cables: SAS-1, SAS-2, Essay and Falcon
- BUT, ONE Landing Station at Port Sudan operated by Sudatel.



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Thanks for your attention

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