IP Interconnection charging

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Pedro Seixas, expert ITU

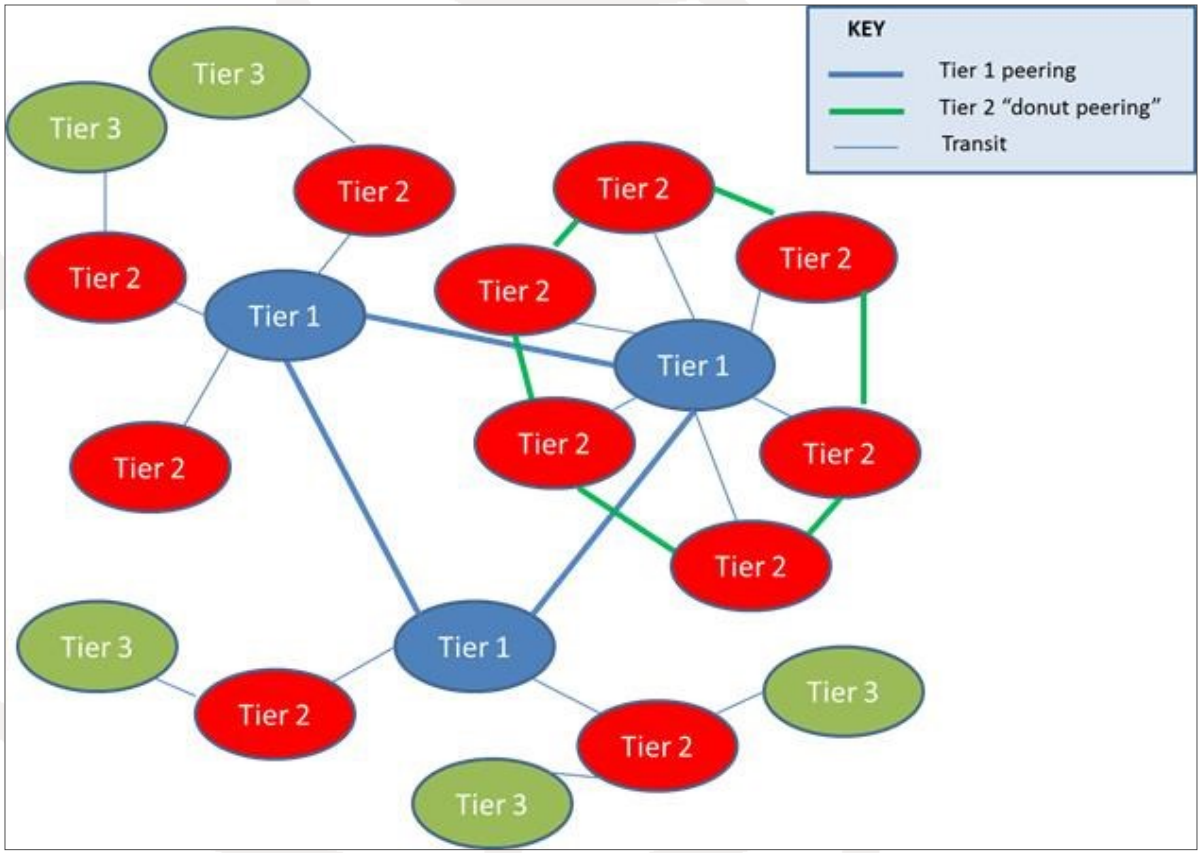
Agenda

IP Interconnection trends
The transition from PSTN to NGN
Conclusions

In the public Internet full connectivity has been achieved without price regulation

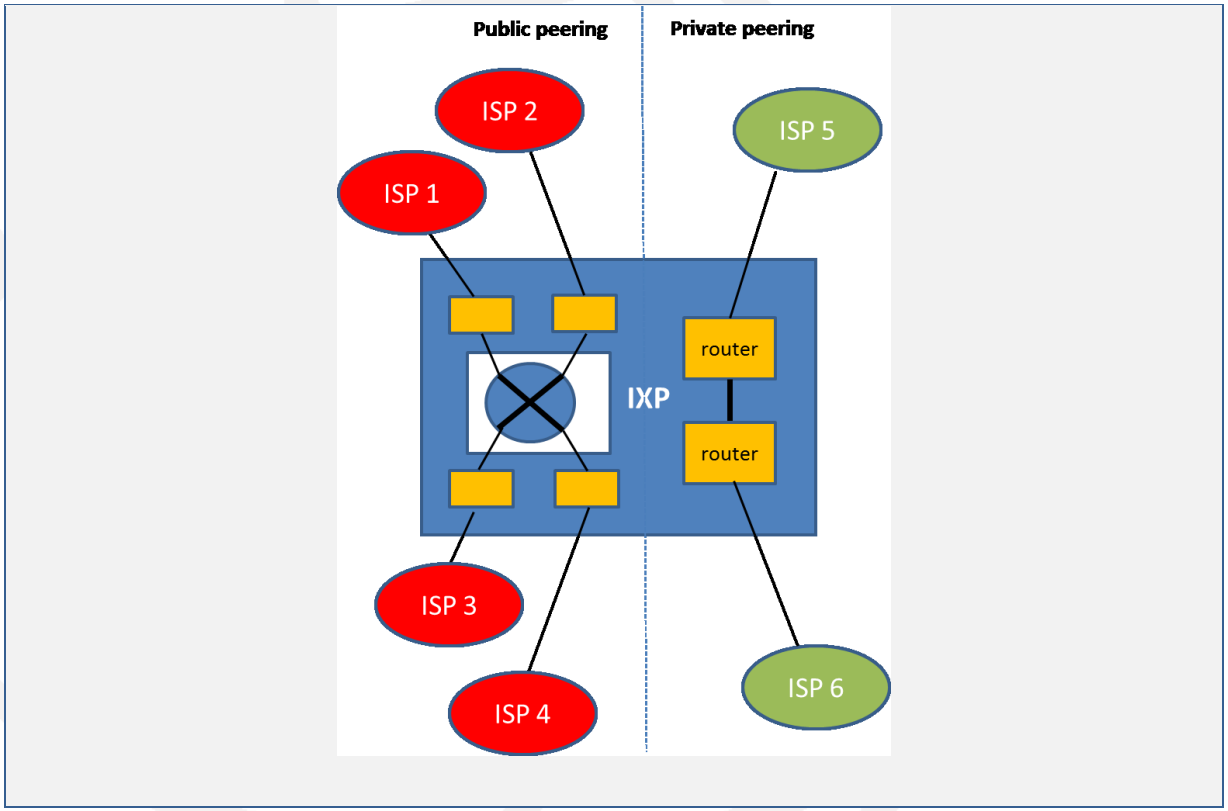
- **Peering**
  - Definition: a bilateral agreement between ISPs to carry traffic for one another and for their respective customers. Peering does not include the obligation to carry traffic to third parties
  - Symmetric
  - Often "bill and keep" (no charges in either direction)
- **Transit**
  - Definition: The transit provider (the ISP) carries traffic for the transit customer, but the transit customer is not under any obligation to carry traffic for the transit provider.
  - Asymmetric
  - Transit customer pays
  - Typically connects to entire Internet

Market players can choose from two options depending on type and volume of traffic



Source:"Interconnection charging models in a national broadband network Environment", GSR13 Discussion paper, David Rogerson, Director, Incyte Consulting, with permission of the author

In the case of peering this can be public or private



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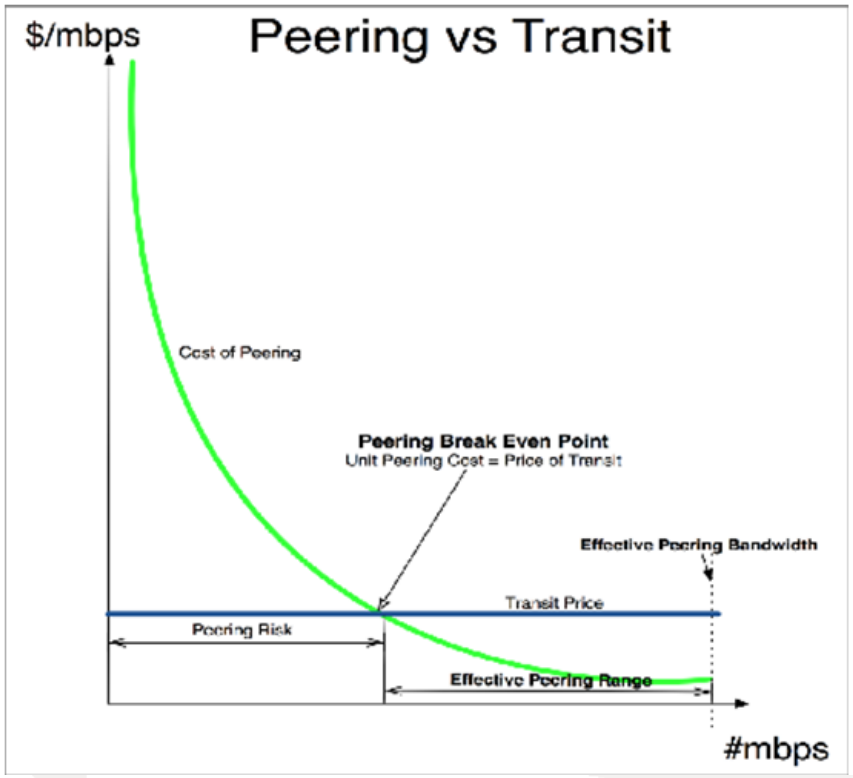
While peering between networks may be generally free, there are still costs associated

- Data centre costs (rack space, power, equipment), IXP costs (switch ports)
- The decision to peer will depend on how much traffic can be directly exchanged between 2 peering parts
- So when traffic volumes between networks are low, it may be more cost effective to buy transit
- However in cases where a better latency is required there might still be a rational to peer even if the amount of traffic exchanged is low

As the volumes of traffic grow, peering relationships begin to be cost-effective



As a result Peering has rapidly replaced transit as the norm and now the vast majority of traffic no longer gets through the major global backbone networks

Source: Dr Peering, http://drpeering.net/white-papers/A-Business-Case-For-Peering.php

Several factors are contributing to reduce the cost of interconnection arrangements

- Growth of regional peering
- Growth and distribution of Internet Exchange Points (IXPs)
- The development of regional content and content distribution networks (CDNs)
- The emergence of hyper players whom will reshape the economics of peering and transit balance

The importance of regional Internet Exchange Points (IXPs) has grown

- Because peering has a cost (requiring physical connections, routers and other equipment at each peering point), the availability of neutral points of IP traffic exchange for multiple parties reduces overall capital requirements and other costs associated with bilateral peering
- IXPs allow local traffic generated by neighboring ISPs to remain local, thus minimizing tromboning, a common process whereby local ISPs exchange traffic over transit routes provisioned by international backbone operators
- IXPs lower interconnection costs as a single connection to an IXP allows peering with multiple other operators. As the number of parties increases, the more valuable an IXP becomes

A CDN is a network of servers containing copies of the original content

- Storing popular content locally is an efficient alternative to international transit and has contributed to the "regionalization" of the internet. It has the advantage of reducing both network requirements and improving latency (and therefore end-user experience).

Akamai

- Year Incorporated: August 1998
- Revenue: 2012 annual revenue of $1.37 billion, up 19 percent year-over-year
- Current Employees: 3,400+
- Network Deployment: Akamai has deployed the most pervasive, highly-distributed cloud optimization platform with over 137,000 servers in 87 countries within over 1,150 networks.

Source: Facts & Figures

Internet traffic is growing more concentrated and changing hands rapidly

The Atlas Top 10 in 2007

Rank	Provider	Percentage
1	Level(3)	5.77
2	Global Crossing	4.55
3	ATT	3.35
4	Sprint	3.2
5	NTT	2.6
6	Cogent	2.77
7	Verizon	2.24
8	TeliaSonera	1.82
9	Savvis	1.35
10	AboveNet	1.23

- By 2007, the hierarchical structure of the Internet still prevailed and the top contributors in term of volume of traffic shifted where all traditional Telco's

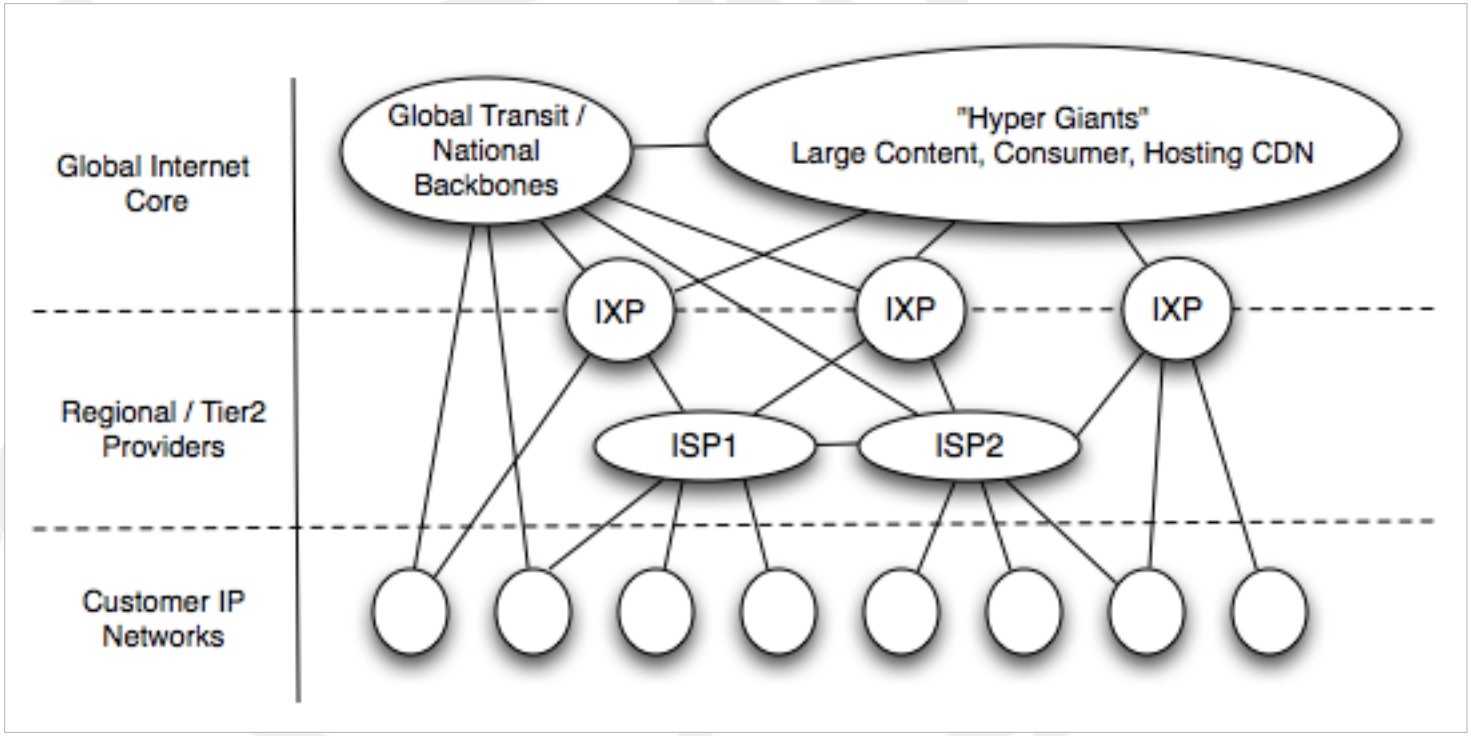
- By 2010, content heavy networks (Google, CDNs) have entered the Atlas Top-10
- Also the same number of providers (the top ten) is responsible for a bigger percentage of Internet traffic, from 30% in 2007 to 40% in 2010

The Atlas Top 10 in 2010

Rank	Name	%
1	ISP A	9.09
2	Google	7.00
3	ISP B	4.70
4	ISP F	3.00
5	ISP H	2.96
6	ISP K	2.89
7	ISP L	2.82
8	ISP M	2.60
9	ISP E	2.30
10	Comcast	2.07

Source: Internet Traffic Evolution 2007 – 2011, Craig Labovitz

As a result internet structure is becoming less hierarchical and more densely interconnected



Source: Internet Traffic Evolution 2007 – 2011, Craig Labovitz

Changing economics along the value chain are giving rise to commercial disputes

- This has led to increasing tensions between "hyper giants" that control popular content and ISPs that control access to significant numbers of eyeballs
- Examples include:
  - the peering dispute between Comcast and Level3;
  - a similar dispute between Cogent and France Telecom which at the time drawn attention from regulators; and
  - the attempt of several European incumbents [Telefonica, FT, DT, Telecom Italia] to introduce a 'data termination' charge for IP Interconnection to help fund NGA, in a proposal to the European Commission

Connectivity in fixed and mobile networks has been approached with price regulation

- Interconnection in the fixed PSTN and mobile networks has been working significantly differently from Interconnection in the world of the Internet

- As the migration from switched fixed/mobile networks to NGNs based on the Internet Protocol (IP) proceeds the traditional telephone network and the Internet are progressively brought together

- From a regulatory perspective which regulations should prevail in order to achieve a unified and integrated approach to network interconnection?

Interconnection price regulation of legacy networks has been designed to address the termination monopoly problem

- Switched fixed and mobile networks- ex-ante regulation
  - Regulation thought to address significant market power
  - Termination fees in the absence of regulation were very high, for both large and small operators
- Internet – unregulated business arrangements
  - Peering: two providers exchange traffic only for their respective customers, often (but not always) with no explicit charges
  - In most countries, no regulation of peering
  - Any-to-any connectivity
  - In the past some attempts to regulate have faced problems
  - The changes in market structure and commercial disputes have drawn the attention of regulators in Europe whom started asking information on regular basis in order to be prepared (if needed) for commercial arbitration (Ofcom in the UK and ARCEP in France)

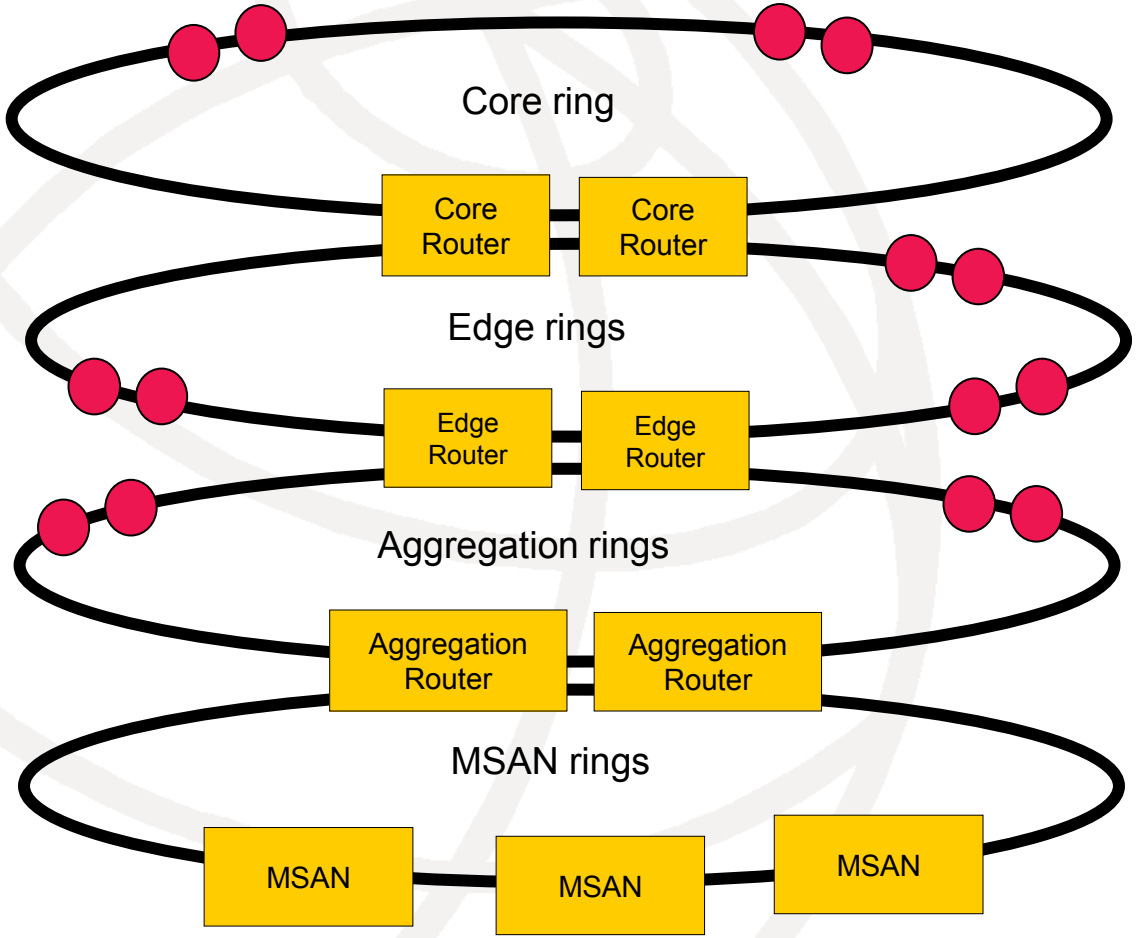
Characteristics of NGN's are substantially different from PSTN and mobile networks

Ring rather than star topology

Routers rather than switches

Fewer nodes

Costs driven by capacity rather than minutes of traffic



Shared transmission paths

End of SDH technology; Ethernet and DWDM

Access nodes further from customer

A number of key changes are relevant if one attempts to update cost models

- Asset-base changes:
  - Need to obtain new prices and asset lifetimes
  - Recalibration of numbers and types of nodes
- Cost drivers change:
  - Element costs need to be broken into fixed costs (chassis) and variable costs (per Mbps).
- Redesign the transmission network:
  - Each layer has to be costed separately (even where infrastructure is shared)
  - Costs to be allocated amongst traffic on capacity requirement and probability of usage by each service.

As the migration proceeds it will be increasingly difficult to model the cost of an efficient operator (legacy cost is a ceiling)

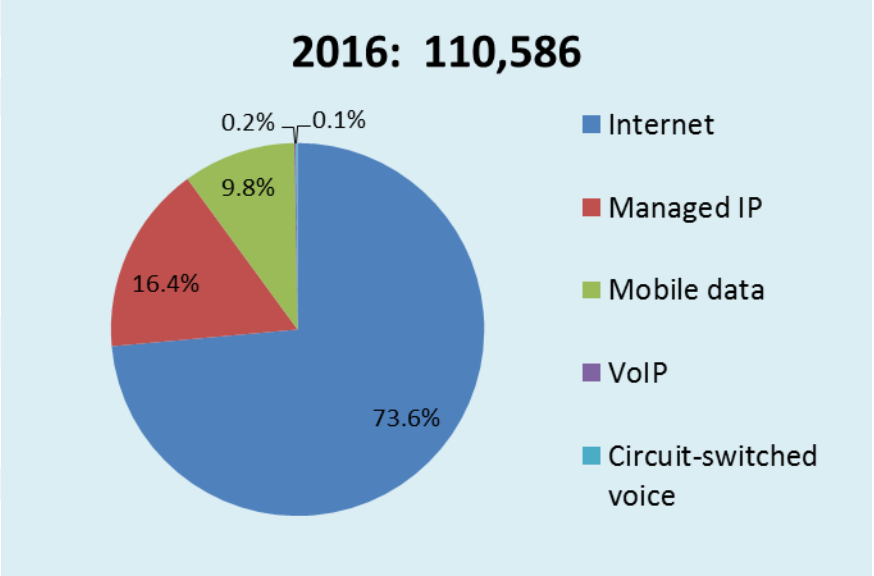
- NGN models are substantially different from PSTN models.
- The tendency is to have high fixed and low variable costs, thus making usage-based charges somewhat theoretical.
- It is hard to reconcile assumptions within the model between theoretical efficiency and actual deployment practice.
- This is especially hard during the transition phase from circuit-switched networks.

Is any-to-any connectivity necessary?

- Regulators set a requirement for any-to-any connectivity (A2A) to protect voice telephony users in a network system.
- But the Internet has shown us that:
  - A voluntary system of peering and transit can work equally well
  - Over time the model can mutate to the benefit of all – e.g. regional peering and IXPs
- Regulators should extend A2A beyond voice services if and only if three tests are met:
  - There is supply-side dominance
  - There are substantial network externalities
  - The benefits of any-to-any outweigh the costs.

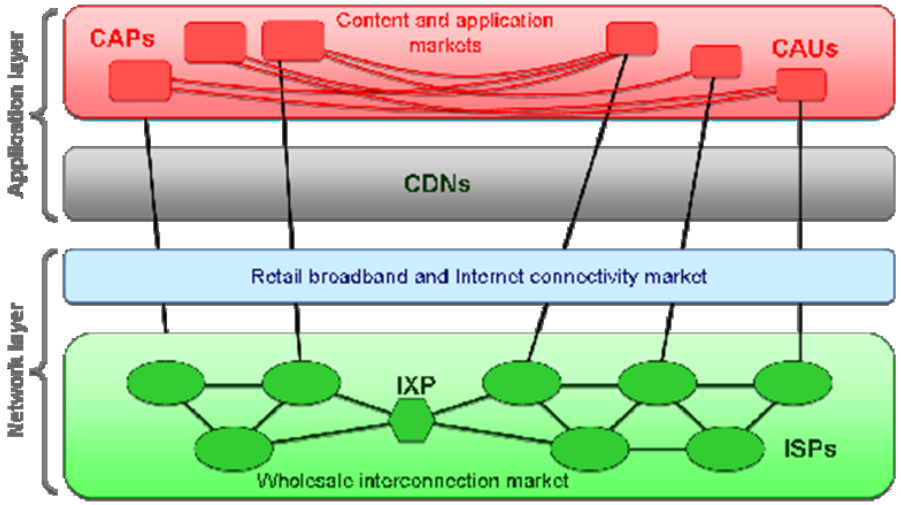
Should NGN interconnection be regulated?

- NGNs have not replaced circuit-switched networks as the principle 21st century service-delivery mechanism.
- They may still need some form of regulation:
  - Prevent monopoly rents from broadband infrastructure
  - Allow service development in competition with the Internet
  - Remain neutral as to technology (TDM or IP) for interconnection.



Are minimum QoS standards needed?

- There is a rapid increase in number and variety of market players, applications, traffic levels and interconnection relationships.
- Regulation needs to keep things simple as "what can go wrong will go wrong".



- On QoS regulatory forbearance is required:
  - It is difficult to set economically optimum QoS standards via regulation
  - Retain minimum (benchmark) standards for circuit-switched voice
  - Encourage industry to define and apply suitable standards for IP networks

Can dominance be fully overcome?

- Traditional regulation has focused on curbing market dominance … but experience tell us this is an almost impossible task
  - Inexorable falls in termination rates have not curbed dominance
- The Internet has shown us another model – dynamic markets find their own equilibrium over time, without regulatory intervention.
- There is increasing evidence that interconnection of broadband networks can do the same
  - (e.g. recent agreement between Google and Orange)
- Regulatory forbearance (and ex-post intervention where necessary) is generally the way forward

Conclusions

- Allow the market to establish interconnection arrangements within a principle of any-to-any connectivity.
- Do not extend circuit-switched regulation to IP networks unless justified and proportionate.
- Keep interconnection regulation as simple as possible to avoid unintended consequences.
  - Establish "bill and keep" or "free peering" wherever possible
  - Do not mandate minimum quality of service standards, other than those which apply to circuit-switched voice telephony
  - Increasingly focus on principles of transparency and non-discrimination.
- Regulate primarily on an ex-post basis.
- Retain ex-ante cost-based regulation for broadband infrastructure access (and backhaul in remote areas).

International Telecommunication Union

Committed to connecting the world