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Perspectives on Internet Peering: Current Challenges & Future Hurdles

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Agenda



- **Some Historic Perspective**
- **Current Challenges to the Peering Model**
- **Future Hurdles**
- **Net Neutrality and Peering**

- **What factors shape Global Crossing's perspective, as well as my own personal viewpoint, on peering and traffic trends?**
 - GC is global carrier (EU, US, LatAm, Asia-Pac)
 - Tier1 status
 - 9 years experience managing GC peering
 - Provider of IP Transit to all types of customers—substrate to 10GE, content and eyeball—no one specific area of interest or dominance
 - Facilities based in EU, US, LatAm including subsea systems in between regions
 - ~1 Tbps of one way peering capacity (a 10Ge=10Gbps, not 20)
 - Almost entirely peered through private peering, very little traffic over public exchanges

Historic Perspective on Traffic Growth and the Interconnection Model



- **Global Crossing Network Traffic Growth**
 - 144x Growth in since early 1999
 - 5x Growth in last 24 months
 - 2006 growth: +185% (2.85x)
 - 2007 year-to-date: +65% (1.65x)
- **Old model, there was not very many types of relationships between carriers—it was either customer, peer, or provider.**
- **Pre-2001 Interconnection model relied heavily on local loops at OC3/OC12/OC48**
- **Little centralization of peering interconnect sites.**
- **Port speed hierarchy existed, where there was a capacity increase from customer->peer->backbone interconnects. (oc3->oc12->oc48 for example)**
- **For larger Tier-2's the idea was to attempt to obtain Tier1 status**

Historic Perspective on traffic growth and the Interconnection Model



- **“Web 1.0”**
 - 5-7 years ago, there was no such thing as “Web 2.0”.
 - In light of current set of apps and usage patterns, the Internet of 5 years ago was very different from today’s Internet.
 - YouTube, MySpace, Facebook, Wikipedia, Blogging, many Google Apps, Flickr, Pandora, iTunes Video, etc—all of these did not exist, or at least were not nearly as mainstream at the time.

Current Traffic Trends and the Current Interconnection Model



- **More variety in interconnect relationships**
 - Much more gray area in relationships: Paid peering, Partial Transit, Peering included with wave purchases, regional peering, regional peering + transit, and others.
 - Larger number of more complex relationships, requires more resources (human and network) to negotiate, build, bill, maintain, and troubleshoot.
 - Increased number and varied types of relationships between carriers create a more dense interconnection environment in the Internet as a whole (again, adding more complexity)

- **Interconnection Model has changed drastically**
 - Heavy reliance on lit buildings (Telehouse/InterXion, etc.) and Equinix/S&D type facilities to exchange most peering traffic
 - Larger networks are peering mostly at nx10GE with other large carriers.
 - Upgrades to new port speeds are often as simple as a hot cut, with no need to install new fiber, resulting in more resilient peering relationships and faster upgrade cycles (GE->10ge or STM16->10GE for example). Compare to the 6-9 month cycles in the days of local loop peering

Current Traffic Trends and the current Interconnection Model, cont.



- **Port speed Hierarchy is now nearly flattened**
 - Largest customers, most peers, and most backbone links are all now at 10G or nx10G (10GE/OC192/STM64).
 - Customers are connected at 10GE to routers that have 10GE uplinks to core routers which interconnect to other core routers over 10GE backbone links.
- **Becoming “Tier 1” is not necessarily the goal anymore**
 - Some networks are scaling back global peering efforts, in favor of more regional peering + transit...others no longer looking to eliminate their transit connections, but wish to keep them as “backup”
 - Continued IP Transit pricing erosion has enabled this as an option, as these largest Tier2’s can command single-digit / Mbps pricing
 - Cost of maintaining a global network (space, power, leased lines, peering, extra capita, etc.) vs. “staying home”
 - Peering “problems”, now become the responsibility of the upstream
 - Tier1’s have no transit—must ensure good peering capacity and relationships to *all* key carriers. Not willing to move into paid relationships

Current Challenges to the Traditional Peering Model



- **What challenges do these changes to the peering model in recent years present today?**
 - Increased diversity of content available and increasingly bandwidth intensive nature of content (web 2.0), combined with the ability of the users to download data at higher speeds, has fueled significant traffic growth, as well as more divergent traffic ratios between content and access networks.
 - What's the big deal about traffic ratios?
 - Increased traffic ratios cause problems for content providers, and the ISP's that serve them, when searching for new or maintaining existing settlement-free peering relationships.
 - Pure content providers can rarely get true settlement free peering from any of the largest networks.
 - Most Tier1 networks are not willing to peer on a settlement free basis with pure content providers (Google, Yahoo, Limelight, MySpace, YouTube etc) due to the traffic ratio argument.

Current Challenges to the Traditional Peering Model, cont.



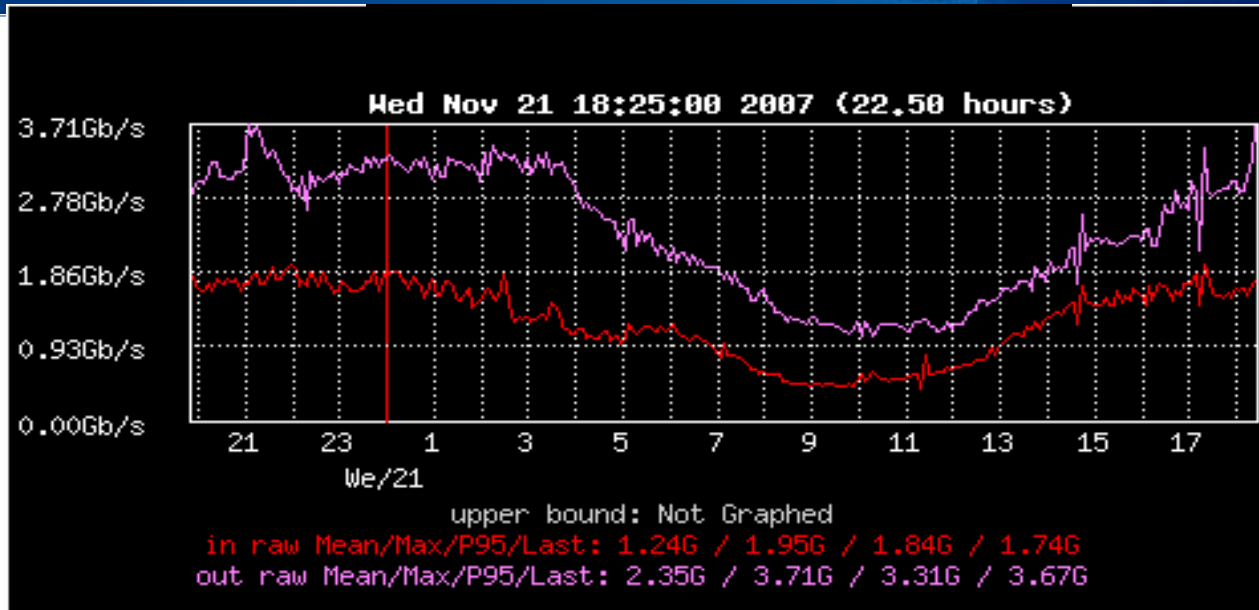
- **Flat port speed hierarchy.**
 - Individual customers are often generating traffic levels that are often on par with the networks providing them transit
 - Individual customer turnups or traffic shifts can have significant impact on a carriers peering links, uplinks, backbone, etc.
 - Compounded by the fact that some of the larger customers only need to reach a few top-tier networks as they are heavily peered.
- **Upgrade thresholds are still too high for many carriers**
 - GC peering upgrade strategy is to keep capacity at 3-5x actual usage to allow traffic to grow without congestion—other carriers will wait until 75% utilization or more before upgrading with peers. This practice constrains growth.

Current Challenges to the Traditional Peering Model, cont.

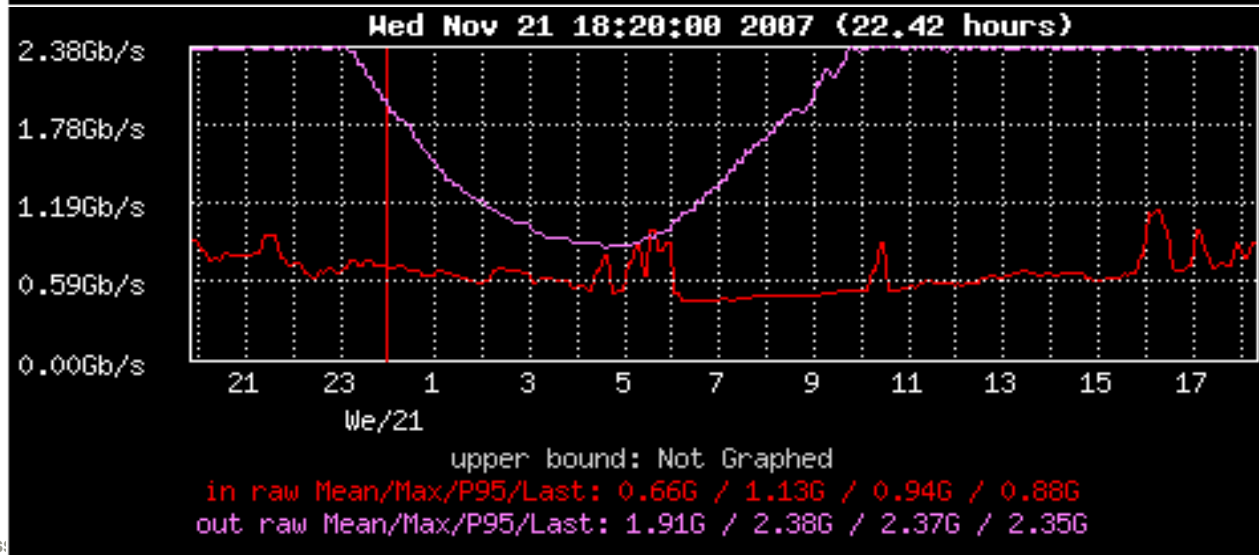


- In markets where aggregation of consumers is heavily dominated by only a few companies (France, Brasil, Germany, China) we are seeing actions taken by some carriers to block competition from entering or competing in the “home” market, and to slow traffic growth, thereby slowing need for their investment in infrastructure.
 - Freeze on new peering, demands for payment from peers to subsidize network build, even rate-limiting existing or turning away new customers, and often very uncompetitive prices
- **Key Point:** We are seeing a huge disparity in the upgrade strategies of networks (as applied to customer, edge, and core) based on their primary source of revenue (flat vs per Meg based). As Internet becomes more bandwidth intensive, the problems caused by these conflicting strategies become more significant as well (read: the consumers will begin to notice and feel the pain)

What Problems Do Conflicting Upgrade Strategies Cause?



10GE interface with a peer operating on a usage-based revenue stream



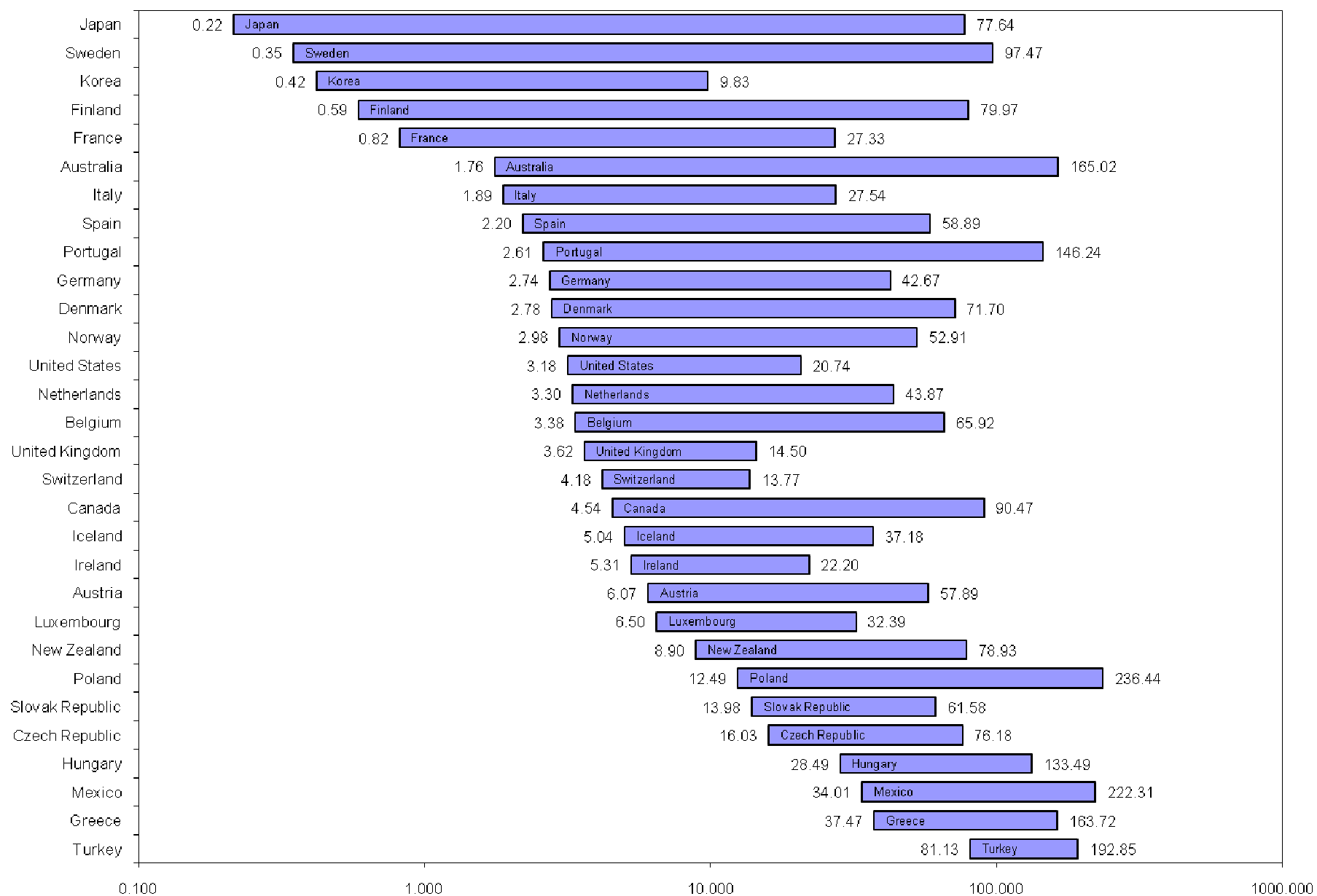
STM16 interface with peer unwilling to upgrade due to protectionist strategies and avoidance of new traffic and network investment

Current Challenges to the Traditional Peering Model, cont.



- **Some access providers are beginning to take the position that the eyeballs have a higher value than the content being viewed.**
 - Some access providers claim their costs to maintain their network with high capillarity in a focused region are significant enough, that even in their “home market” they must seek compensation from networks delivering too much traffic to their users. Remember that it is the users on the access networks that request this content.
 - Traffic ratio argument often used, but is a mask for the true issue, as offers to haul traffic from the US to the country of destination are not enough to trigger an upgrade.
 - These same providers still expect settlement free peering in non-home markets with the same networks they are trying to charge
 - The content and the user’s desire to view it both have equal value as they are simply two sides of the same coin. Without the current quality of content available, users would not use the Internet in the same way. Without good access to the users, content creators have no outlet for their work and no way to generate income from it (ads, subscriptions,..)

Range of broadband prices per mbit/s, October 2006, all platforms, logarithmic scale, USD PPP



Current Challenges to the Traditional Peering Model, cont.

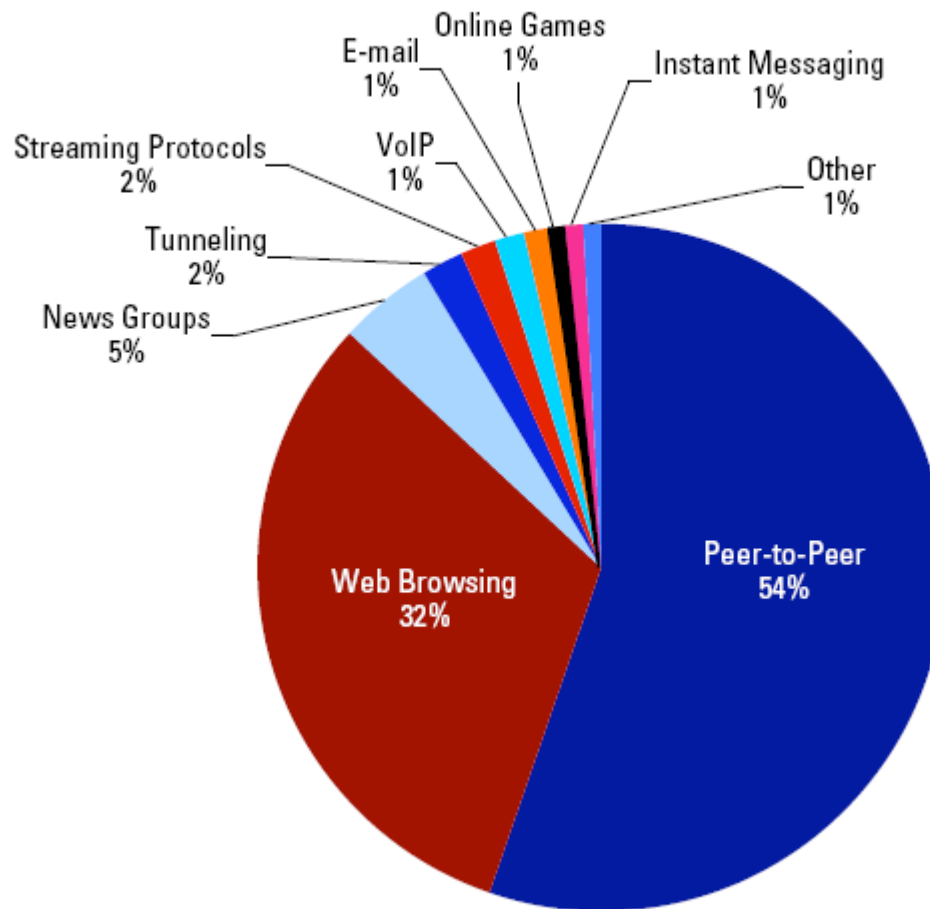


- **Key Statistics from the 2007 OECD (Organisation for Economic Co-Operation and Development) Communication Outlook:**
- Incumbent's DSL pricing from Sept. 2005 to Oct. 2006 fell an average of 19%, while the speeds of comparable packages during the same period increased 29%. Cable providers followed the same trend with 16% drop in price along with a 27% increase in speed.
- OECD report summarized the key issue facing access networks, which is now also impacting the way they deal with their peers and customers:
 - “Broadband subscribers tend to gravitate toward flat-rate data plans, but ISP’s have grappled with how to deal with users that consume an inordinate amount of network capacity. Some ISP’s have responded by implementing bitcaps on users. Other ISP’s have written abusive data consumption into their AUP’s. Many of the bitcaps in the OECD (report) have been low enough to stifle certain legitimate broadband uses such as podcast downloading and video streaming. In other countries bitcaps are high enough not to interfere with most common uses.”
- Denmark and Czech republic incumbent DSL operators have begun introducing bitcaps to help control bandwidth consumption.

Is the problem for an access provider really the incoming content traffic from their peers? Or could it be residing a little closer to home?



Internet Traffic by Application



Source: Sandvine, www.sandvine.com

Some possible solutions to current issues



- **Conflicting network upgrade strategies**
 - Providers must work together to find a mutually agreeable solution that does not include the incumbents freezing upgrades or charging other networks for access to it's subscribers in-country.
- **Access providers who experience problems with increasing traffic load, must adjust their cost models and service offerings relating to *customers*--not peering partners**
 - **Work to block illegal p2p traffic, and limit excessive legal p2p if necessary**
 - Comcast begins blocking some bittorrent traffic
 - http://www.mercurynews.com/search/ci_7225647?nclick_check=1
 - Problem: Comcast is now being sued for this ;)
 - **According to the OECD 2007 report, Australian provider BigPond allows users to choose between two types non-flat-fee-based plans:**
 - Flat fee up to a point—then per Mbps billed after that
 - Flat fee unlimited usage—but rate limited to 64kbps after reaching a certain threshold
 - **Same study cited a Belgium example where both Belgacom and Telenet are selling additional data past the bitcaps at 1 Euro / Gigabyte**

Some possible solutions to current issues



■ Flat port speed hierarchy

- With the current face of the Internet's "Web 2.0" unlikely to go away any time soon, the bandwidth consumption is going to continue its rapid pace
- Peering coordinators in the top tier networks must work closely together to resolve disputes between their companies swiftly, involving executive level management if needed to resolve peering disputes, and not allowing freezes to drag on for months on end.
- Backbone and Peering engineers will need to develop closer relationships with largest customers to manage traffic flow and exchange information.
- Drive to maintain capacity levels at 3-5x current traffic loads ensuring ability to grow and to encourage development of new applications / uses of the Internet.
- Swift adoption and implementation of 100GE standards will open the door for carriers to support the next phase of growth in the Internet.

Future Hurdles & Some Possible Solutions



- **Avoiding Government and / or Regulating Body Intervention**
 - As the Internet becomes increasingly relevant to everyday life, global economies, and financial transactions, governments and regulators will become increasingly intolerant of any outages, disputes, or service degradations that negatively impacts the consumer.
 - Most of the Internet community wants to avoid regulatory attention
 - Due to the global nature of the Internet, regulatory intervention would have only localized impact, and would only complicate network management for global networks
 - The Internet's current level success as a is largely based on it's "free an open" status, where your connectivity to any particular network does not typically affect your ability to reach the rest of the Internet
- **Solution: Networks must work together to ensure the overall quality and stability of the Internet (comprised of these relationships!) is intact.**

Future Hurdles & Some Possible Solutions



- **Traffic Ratios will continue to get worse for content providers and the networks that serve them when peered with pure access/incumbent networks**
- **Solutions: Content providers and the networks serving them will need to:**
 - find ways of balancing traffic ratios (take on more transit from user networks)
 - find ways of sourcing traffic closer to source of the request (may involve working with largest customers to develop local distribution networks)

Network Neutrality and Peering



- **Two sides of the debate will typically fall along similar lines as the groups mentioned so far in this presentation as being at odds: Access networks are in one category. Content creators, and the networks that perform a significant amount of the workload in distributing that content globally, fall in the second category.**
 - **Against Neutrality Regulation:** ATT, Verizon, most US Republicans, most access networks
 - No neutrality regulation means these networks can take discriminatory actions over what kinds of content are allowed over the “last mile”, and how that content is treated
 - **For Neutrality regulation:** Yahoo, Google, Ebay, Amazon, Microsoft, Cogent, Global Crossing, Moveon.org, most US Democrats, Vint Cerf)
 - Many supporters of neutrality regulation are probably supporting it only in light of the alternative.—not because they crave government intervention.

Network Neutrality Risks & Possible Scenarios



- **Incumbents (France Telecom, BT, Comcast, Verizon, etc.) still control most of the network infrastructure that links their customers with the outside world. They could, in theory, favor their own traffic over a third party's.**
 - Example: Google pays incumbent—they get traffic through untouched. Yahoo does not, so they get rate-limited.
 - Google pays incumbent even more, and they become the “exclusive” content provider for our network, while Yahoo is filtered out completely. (not that Google would participate in such a thing, as it would be “evil”.
 - Creates a hostile environment to newer apps/companies that don't have big cash to pay up to the incumbents.
- **Under this kind scenario, the “free and open” premise of the Internet begins to deteriorate rapidly**
- **Inconsistent user experience will hurt public perception of the Internet. Consider the random performance users would see with access speed and application performance.**

Network Neutrality and Peering



- ❑ The net neutrality debate is worthy of its own entire discussion, even its own conference. The point of bringing it up here is to note how it may come into play in the peering world.
- ❑ The turn up or turn down of a peering relationship has often been used as leverage point in negotiations between two companies.
- ❑ This tendency to use peering relationships, either their establishment or their removal, to make statements or to form/break alliances between carriers may very well put itself on display as net neutrality debates heat up.
- ❑ Long time peers may end their settlement-free peering status because of differences over net neutrality.
- ❑ Conversely, unusual alliances beyond the normal customer<>provider relationship may be formed between partners that fall on the same side of the debate (content originators and content distributors for example....Google<>Global Crossing, L3<>Ebay, etc.) in an attempt to “fight back” against net neutrality opponents.
- ❑ As discussed earlier, net neutrality issues have already arrived in Europe, simply with some new players representing the two sides in addition to the US players that have a stake in the EU markets.

Conclusions



- ❑ The misguided idea that the content companies are “causing” the high bandwidth growth rates on access networks, resulting in cost incursion and the need for them to constantly increase network capacity, needs to be stopped. Users must be held accountable for the content they *choose* to view (quantity and legality), and for the bandwidth they consume, by allowing their node to be a P2P distributor for example.
- ❑ Increased communication, cooperation, and collaboration is needed among network peering coordinators, as well as at executive levels, to avoid unwanted government intervention and regulation.
- ❑ The success of the Internet, especially “Web 2.0”, is founded on it’s “free and open” nature. A lack of net neutrality on access networks will lead to an Internet that is controlled by those who have the most cash to lay on the table at the feet of the broadband providers.
- ❑ Pricing models offered to users must begin to differentiate between grandma checking email and viewing a few pictures of the grandkids, and the user who “lives” online and sustains multiple high bitrate streams for hours at a time....OR-
- ❑ P2P must be dealt with, to provide some relief to the access networks that are supposedly struggling with the cost of maintaining their networks—either way, it’s an issue to be dealt with directly with customers—not at the peering level..

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Merci!

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