Interconnection, Bandwidth, Complexity and Costs

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About Myself

• Director, International Networking at Limelight Networks
• Executive Council Member – APNIC
• Previously (2002-2010), Sr. Internet Analyst at Packet Clearing House
• Focus on Backbone Operations, Internet Exchange Points, Research on routing and peering relationships
The Internet

• Inter connected Networks
• People build their own networks
• The networks interconnect
  – Backbone speeds ever increasing (n x10G)
• Consumers adapt to what is available
  – Nothing is big enough (i.e 256Kbps $\rightarrow$ 1Gbps+ )
Interconnection Markets

- Internet interconnections are concentrated in few hubs around the world
  - US West Coast (Silicon Valley, Los Angeles)
  - US East coast (New York, Ashburn)
  - London, Amsterdam, Frankfurt, Stockholm
  - Singapore, Hong Kong, Tokyo
Interconnection Markets

• It takes time and lots of efforts to create a viable interconnect market.
  – Singapore is a very recent entrant into this ‘hub’ status.

• It doesn’t always work at scale for everyone
  – Local relevance may sometimes be more value
    • Moscow, Miami, Prague, Budapest

• Open and easy access are the key drivers
  – Why are Rio / Mumbai / Dubai not real hubs yet?
Global Internet Bandwidth

- International Internet Bandwidth
- Annual Growth
Bandwidth : Backbone Vs. Edge

• How much bandwidth do you build into the core, when your users are connected at 1G.
• Traditionally, ISPs have oversubscribed the edge and variations in usage to make money
• But with ‘always-on’ services and high mobility use, their traditional models will be under pressure
• Do you provision more or start believing in QoS/TE. ?
Content Delivery Routing

• CDNs all have their routing priorities based on their customer needs
  – Customers/Network needs may not be same as end users’ ISP.

• Some care about latency, some don’t.

• Some have larger footprint, some don’t.

• The larger the traffic they push, they start becoming more network heavy
Latency Vs. cheap path

• Network Providers have a hard time with diverse demands from their users
  – High paying / higher margin customers like financial industry wants lowest latency
  – Low paying / lower margin volume residential customers don’t really care, but need large amounts of bandwidth

• Where is the balance?
Costs, Complexity and Scaling

• Bigger Scale leads to more complexity and increased costs
  – But does it?

• Will reducing complexity lead to better scaling while reducing cost?
  – How does that work?
Where can complexity be reduced

• Backhaul
  – Simpler backhaul Network, 10G waves based, protection or non protection
• Middle Network services
  – Virtualization and cloud based 3rd party services
• Access Networks
  – Fiber Based is the long term and best investment
  – Legacy technologies will stay for a while.
The cost of Bandwidth, in bulk, per Mbps
Western Europe, Fall 2013, based on 10Gbps, 300GB
(Data from Remco Van Mook)

A EUR80 fiber cross connect: $0.01
Internet Exchange traffic: $0.12*
**Backbone traffic Western Europe:** $0.10
Transatlantic traffic, wholesale: $0.35
Internet Transit, wholesale: $0.30
Internet Transit, retail: $10
Broadband Internet, consumer: $25
National Ethernet service: $120
3G mobile data, data plan: $5,063
3G mobile data, outside plan: $40,500
3G mobile data, roaming low: $12,698
3G mobile data, roaming high: $3,685,500
SMS Text Messages, roaming: $928,972,800
Cost of Backhaul – NA/Europe

- Intra Europe 10G terrestrial wave Costs
  - 800-1200 USD for 10G between major points
  - 1000-1500 USD for extended locations
  - Bucharest to London is ~2500KMs, costs like below 2500 USD, or roughly 0.0001/mbps-km.

- Intra-US 10G wave costs are similar
Cost of Backhaul in APAC

• Intra Asia is mostly Sub sea, costs are traditionally higher, but going down drastically
  – Intra Asian Hub prices range from 12-20K/Month, depending on locations
  – Cost of local loop are a key driver, but with POP to POP design changes, the local loop is no longer a consideration for most providers.
    • Metro area 10G waves go as low as $350
  – What is the costs in South Asia?
    • India : Delhi-Mumbai: 10G ~50-60K a month
    • Bangladesh : Dhaka-Cox’ 10G – 25K/month
    • Nepal : Kathmandu-Pokhara : - 10K/month
Intra-Asian Median Monthly 10 Gbps Wavelength Prices, Q3 2010-Q3 2013
Complexity Vs. Costs

• This is what will drive the Internet in the next generation
• Reducing Backhaul complexity and costs is the easy target, and already proven in Europe/North America.
• Bigger backhaul helps ISPs scale much faster and aggregate and plan in ‘wholesale’.
• Fiber assets are used for both Backhaul and Access.
• 10G / 100G ports are much more affordable.
Where will we go?

• Cost structures that were applicable in the past are no longer applicable.
  – For example, Pricing based on multiples of STM1
  – 95\textsuperscript{th} percentile billing is the norm

• Think of scaling and scaling and scaling
  – From operators perspective, they don’t know where to build to scale

• Innovation is coming from various places
  – Operators needs keep up (ref. opening keynote)
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