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 → 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?
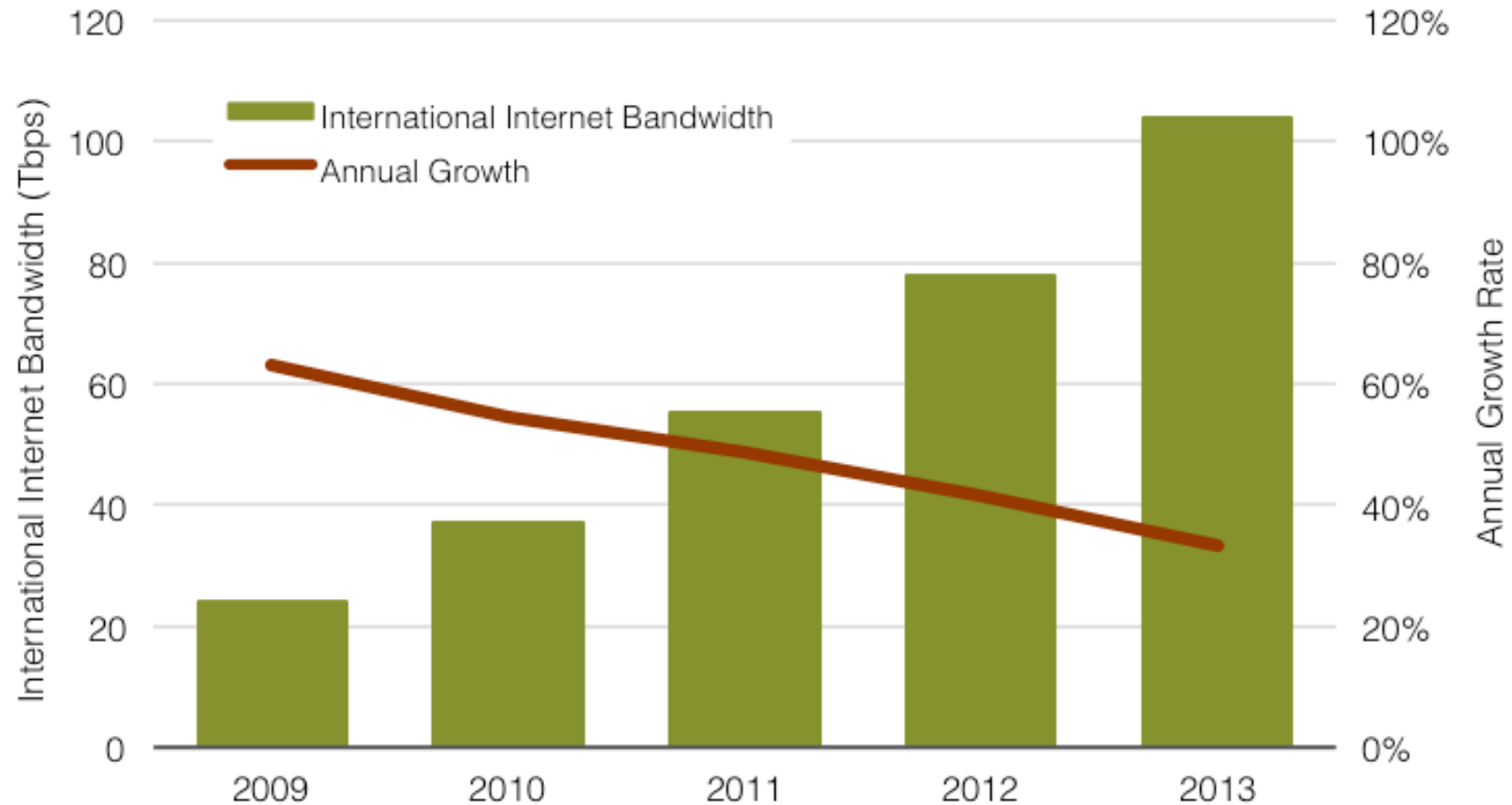
Bandwidth : Backbone Vs. Edge

- 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)

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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
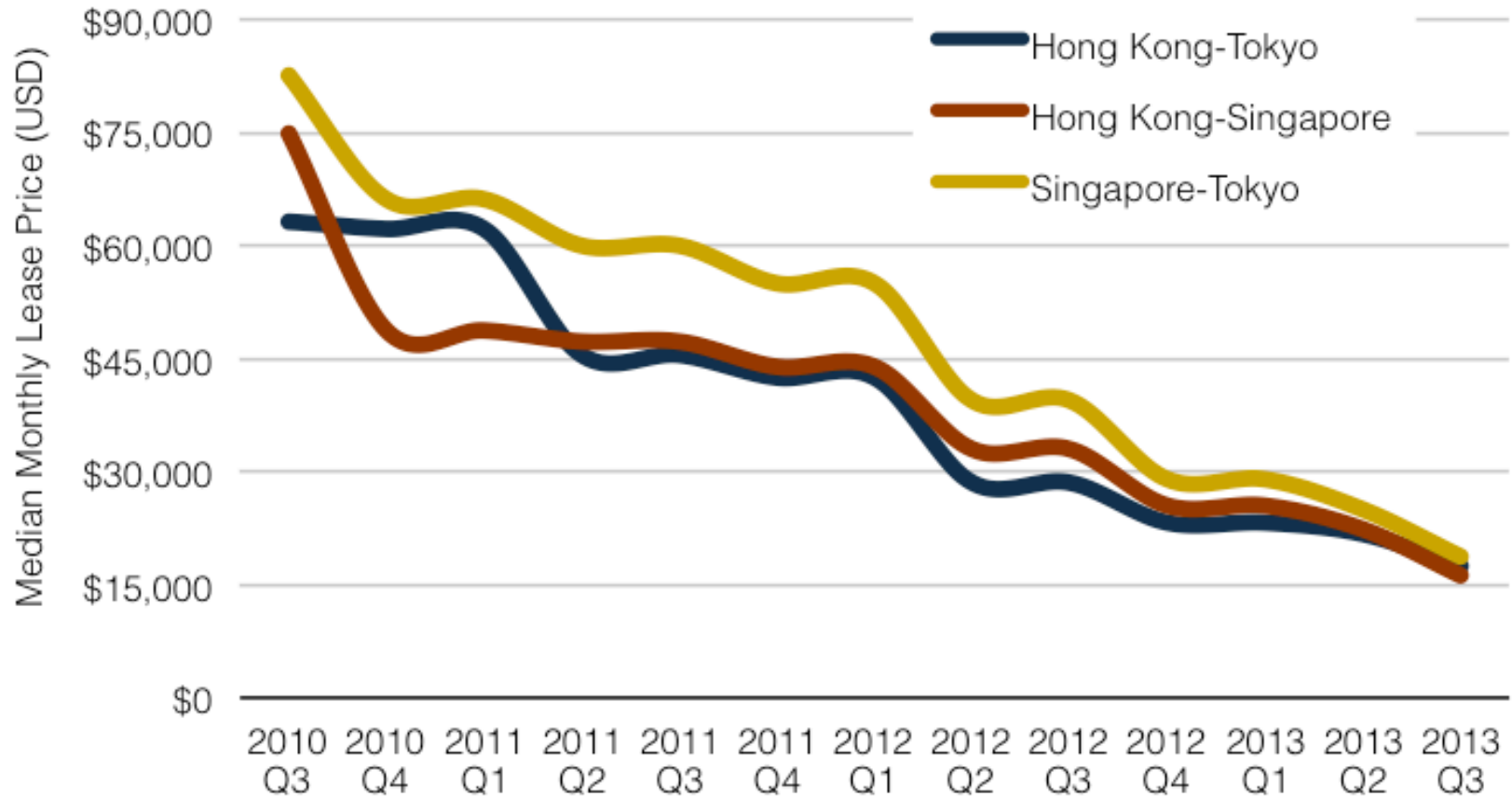
Complexity Vs. Costs

- 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
  - 95th 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)

Thanks

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