

MSO Usage and Forecast for Ethernet-based Services

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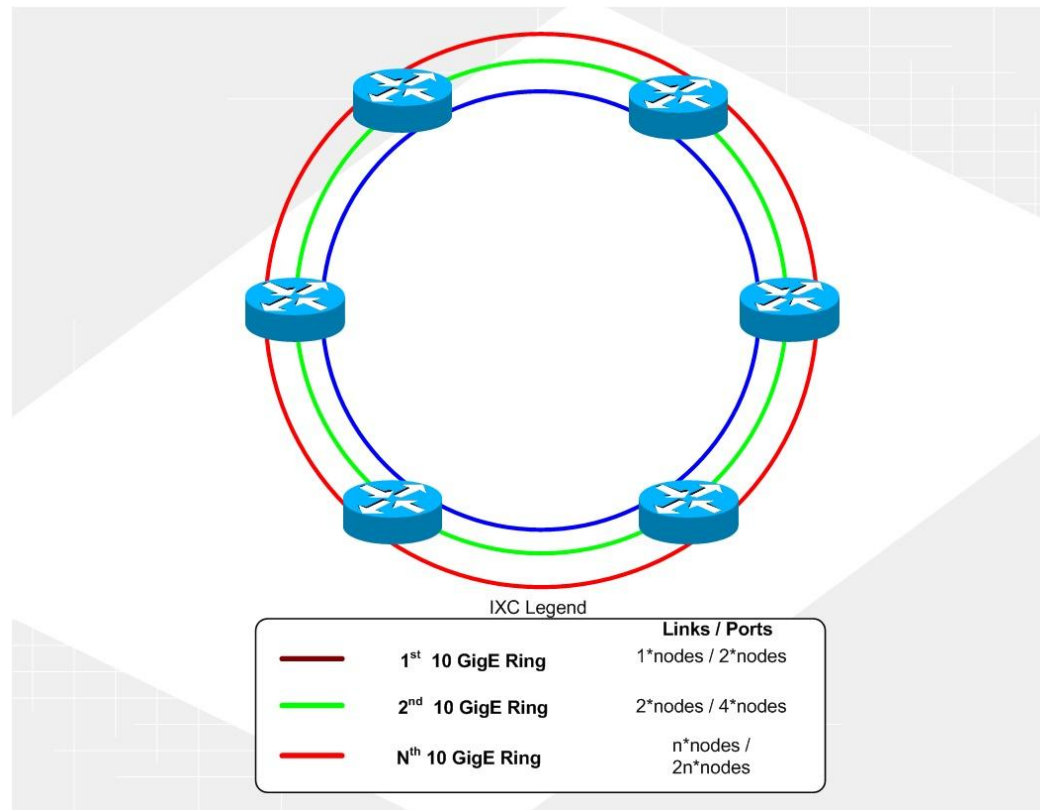
Supporters

- Donn Lee
 - Vish Yelsangikar
 - Peter Harrison
 - Ted Seely
 - Greg Hankins
 - Adam Bechtel
 - Henk Steenman
 - Jay Moran
 - Bill Trubey
- Google
 - Netflix
 - Netflix
 - Sprint
 - Force10
 - Yahoo
 - AMSIX
 - AOL
 - Timewarner Cable

Outline

- Network Ethernet Requirements
- Application Ethernet Requirements
- Market Data
- Conclusions

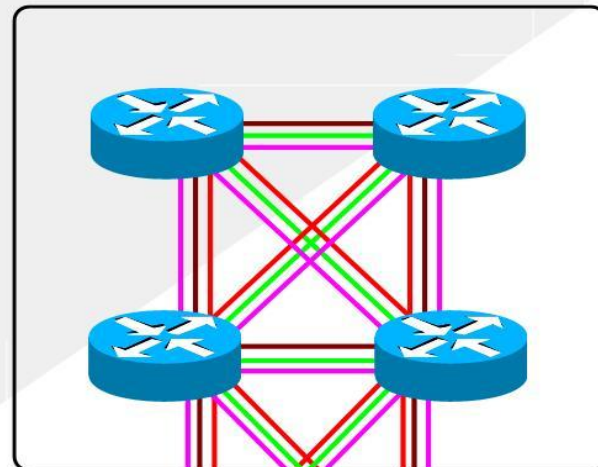
Metro Networks - General



Future Concern (2010-11)– Metro Traffic Growth

- Network Convergence – Voice, Video and Data
- Metro Timeline
 - 2006 – Begin Migration from ATM, POS and TDM to Gigabit Ethernet (1st 10GigE Rings Deployed)
 - 2007-10 – Additional 10 GigE Rings added
 - 2011 – LAG depletion/Chassis Depletion drive bandwidth upgrades
- Some Alternative Solutions
 - Express Routes – Beware full mesh syndrome
 - Split Rings – scales bandwidth at inverse ratio to operational complexity and cost – lack of metro fiber concerns
 - 40Gig POS – Forklift upgrade, cost, MTU concerns, etc
- 100GigE Preferred

Regional POP Aggregation

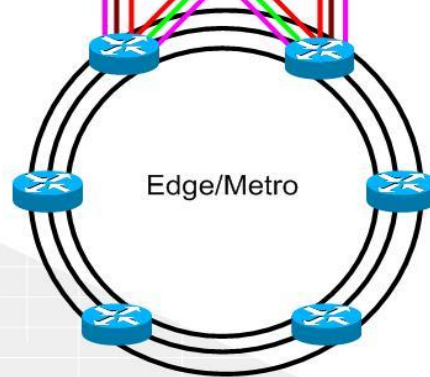


Core

Distribution

IXC Growth Legend

	1st 10 GigE Deployment	6 links/12 ports
	1st 10 GigE Upgrade	12 links/24 ports
	2nd 10 GigE Upgrade	20 links/40 ports
	3rd 10 GigE Upgrade	30 links/60 ports

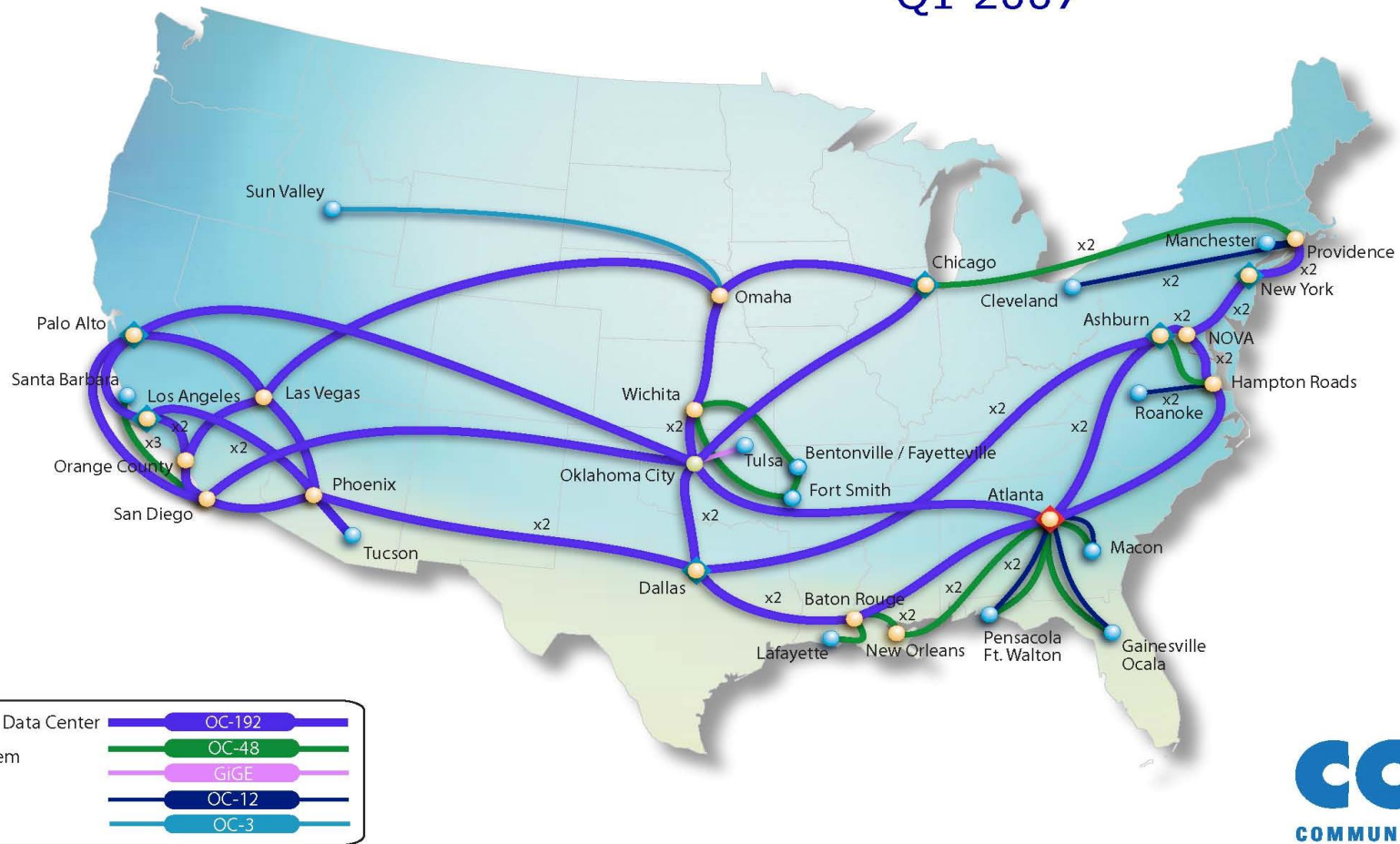


More Immediate Concern (2010) - Interconnect IP Port Growth

- Interconnect growth demands
 - Multiples of Metro growth
 - Fiber mgmt becomes a serious concern
 - At 6th IXC upgrade 100GigE is a requirement
 - Router chassis depletion
- Current Options
 - Multi-chassis
 - Displaces bandwidth concerns to box vendors (Backplane vs front-side Interface)
 - Space and power concerns
 - Split POP architecture
 - Suffers from exponential operational complexity and diminishing returns after two
- 100 GigE Required

Cox National IP Backbone

Q1 2007



OC-192 POS → **10Gig Ethernet** → **100Gig Ethernet**

Backoffice and VOD Ethernet

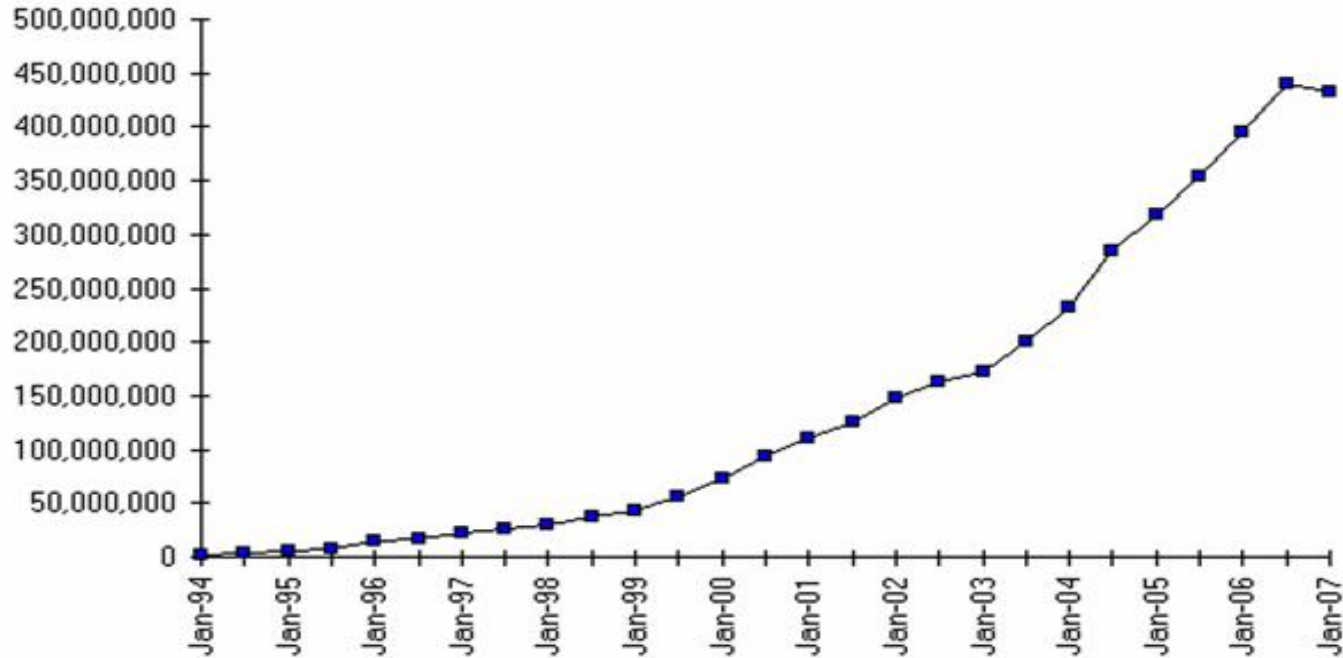
- Video On Demand (VOD) Ethernet Use
 - 1GigE Based Now
 - High-touch content distributed to the edge
 - Long-Tail content aggregated at hub site or regional centers
 - 10GigE Next-Generation Platforms
 - Beneficial in a regionalized CDN architecture
 - LAG would function effectively given the large number of distributed flows at least up to 4x10GigE
 - 10GigE hosts utilizing 100GigE aggregation practical 3-4 years out
 - A 40GigE NIC would not provide a clean aggregation path or upgrade strategy
- Backoffice Ethernet Use
 - 100Mbps FE predominates
 - Eventual 1GigE Migration

Server Aggregation

- Low-speed Copper Ports
 - Make heavy use of 100/1000 copper ports (10s of thousands of ports)
 - Distributed or clustered architectures used for fault tolerance, economical and strategic reasons
 - High-speed ports are generally not required on process intensive applications (billing, accounting, etc)
- Higher Speed Gigabit Ports
 - Primarily used for unicast streaming of content
 - 10GigE slowly evolving – can do the same thing cheaper with 1GigE clusters and/or distributed architectures
 - 10GigE use apparent in bladeserver format with eventual migration to 100GigE as market evolves

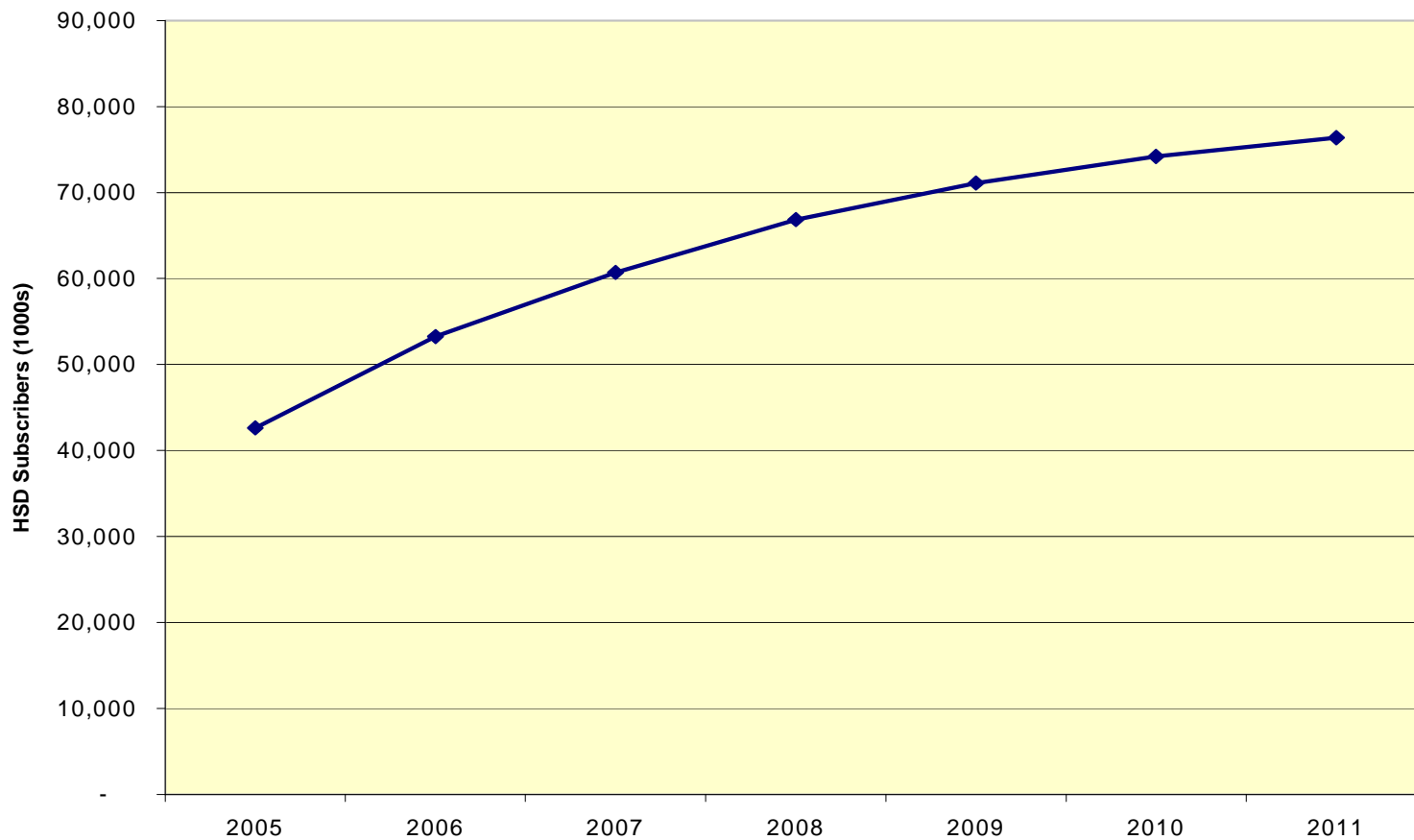
Stats - Internet Hosts

Internet Domain Survey Host Count



Source: Internet Systems Consortium (www.isc.org)

Stats - Broadband Households



Source: Consolidated data provided by Yankee Group and Forrester

Network Bandwidth Drivers

- Number of Hosts
- Applications (YouTube, MySpace, PtP, VOD)
- CPU speed does not drive network speed in the home
- Last Mile Upgrades (DOCSIS 2/3, VDSL+, E/GPON)

Conclusions

- 100GigE Needed for Broadband Customer Aggregation urgently in the core by 2009 and across the board by 2011
- Utilize commodity 10GigE interfaces on bandwidth intensive servers and server facing switchports
- Utilize more expensive 100GigE in the core and as high-speed uplinks at the aggregation layer
- Don't impact 100GigE development by pushing another MAC rate concurrently!
 - Improve upon LAG or develop a separate sub-rate mechanism that can be utilized with future generations of Ethernet
 - There is a proven market for 100Gig only at this time