

Internet Video: The Next Wave of Massive Disruption to the U.S. Peering Ecosystem

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Internet Operations White Papers

- 1) "Interconnection Strategies for ISPs"
- 2) "Internet Service Providers and Peering"
- 3) "A Business Case for Peering"
- 4) "The Art of Peering: The Peering Playbook"
- 5) "The
- 6) "Do
Any
- 7) "Evo
- 8) "The Asia Pacific Internet Peering Guidebook"
- 9) "The Great (Public vs. Private) Debate"
- 10) "The Folly of Peering Traffic Ratios?"
- 11) **"Video Internet: The Next Wave...."**

On the Internet,
Everyone if a Publisher

Sense

Internet makes anyone a publisher, similar effect now emerging for video

Massive Disruption in U.S. Peering Ecosystem → Short Videos

- YouTube – founded 2005
 - Short video clips – 50 million view per day!

200bps of peering traffic Feb 2006

Now, On the Internet
Everyone is a **Broadcaster**

- DoveTail
- Video may dwarf current peered traffic
 - 2010 – 80-90% Internet is Video
 - Inculcate video guys into peering ecosystem

Short video clips...Full TV shows...

Source: http://digg.com/tech_news/YouTube_Gets_Bandwidth_Boost_from_Level_3

Source: <http://www.nanog.org/mtg-0606/norton.html>



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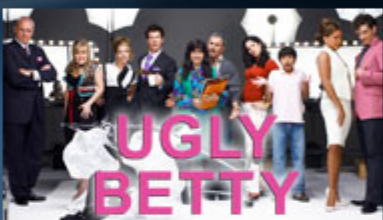
GREY'S ANATOMY
New episode available
Friday, 9pm PST



DESPERATE
HOUSEWIVES
Premiere available
Monday, Sept. 25



LOST
Premiere available
Thursday, Oct. 5



UGLY
BETTY
Premiere available
Friday, Sept. 29



SIX DEGREES
New episode available
Friday, Sept. 29



the NINE
Premiere available
Thursday, Oct. 5



the knights of
prosperity
Premiere available
Wednesday, Oct. 18



abc previews
Preview upcoming
ABC shows

Massive Disruption in U.S. Peering Ecosystem → Full Episodes

- “Desperate Housewives” – 210MB/hour
 - For 320x240 H.264 Video iTunes image
- 10,000,000 households
- 2,100,000,000 MB = 2.1 peta-Bytes
- How long will that take to download?
3 days @ 64Gbps non-stop !
Just one show
Try 250M*180 Channels*HDTV

The Point: Massive Wave of Incremental Traffic to document...

Source: <http://www.pbs.org/cringely/pulpit/pulpit20060302.html>

The Research Questions

How to distribute video across the Internet ?

How much does it cost per video?

Modeling

Varying Sized Loads

Transit =Metered pipe
to the Internet

CDN =Content Distribution
Network

Peering =free & reciprocal
access to each others
Customers

P2P =PeerToPeer

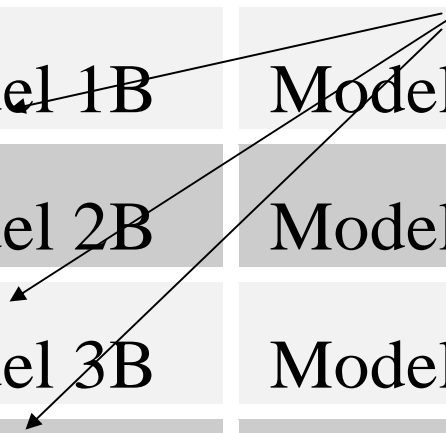
Small =Distribute 10 videos
every 5 minutes on avg.

Medium =Distribute 100 videos
every 5 minutes on avg.

Large =Distribute 1000 videos
every 5 minutes on avg.

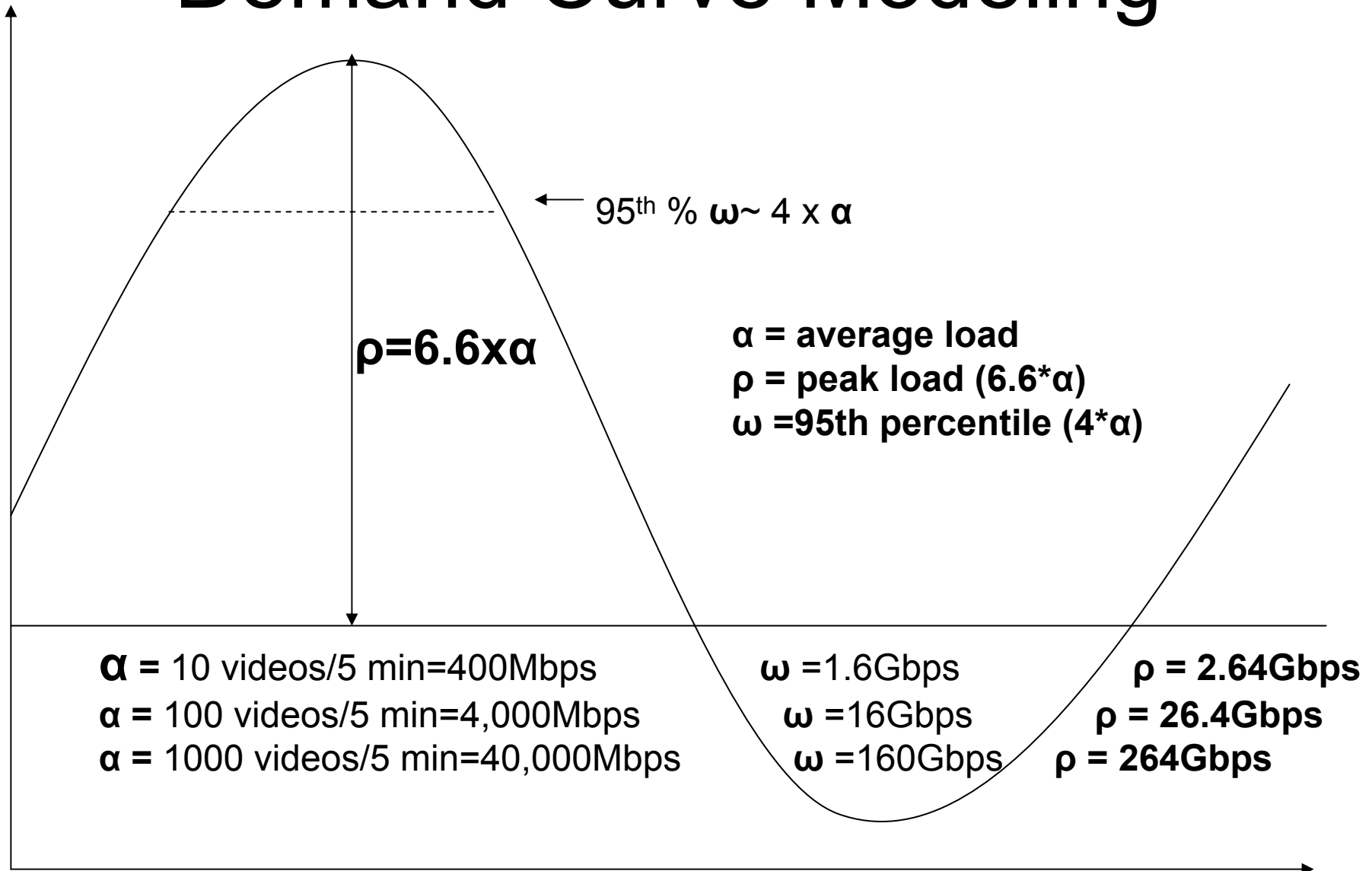
Models	A:10 videos	B: 100	C: 1000
1: Transit	Model 1A	Model 1B	Model 1C
2: CDN	Model 2A	Model 2B	Model 2C
3: Hybrid	Model 3A	Model 3B	Model 3C
4: P2P	Model 4A	Model 4B	Model 4C

\$ per video?

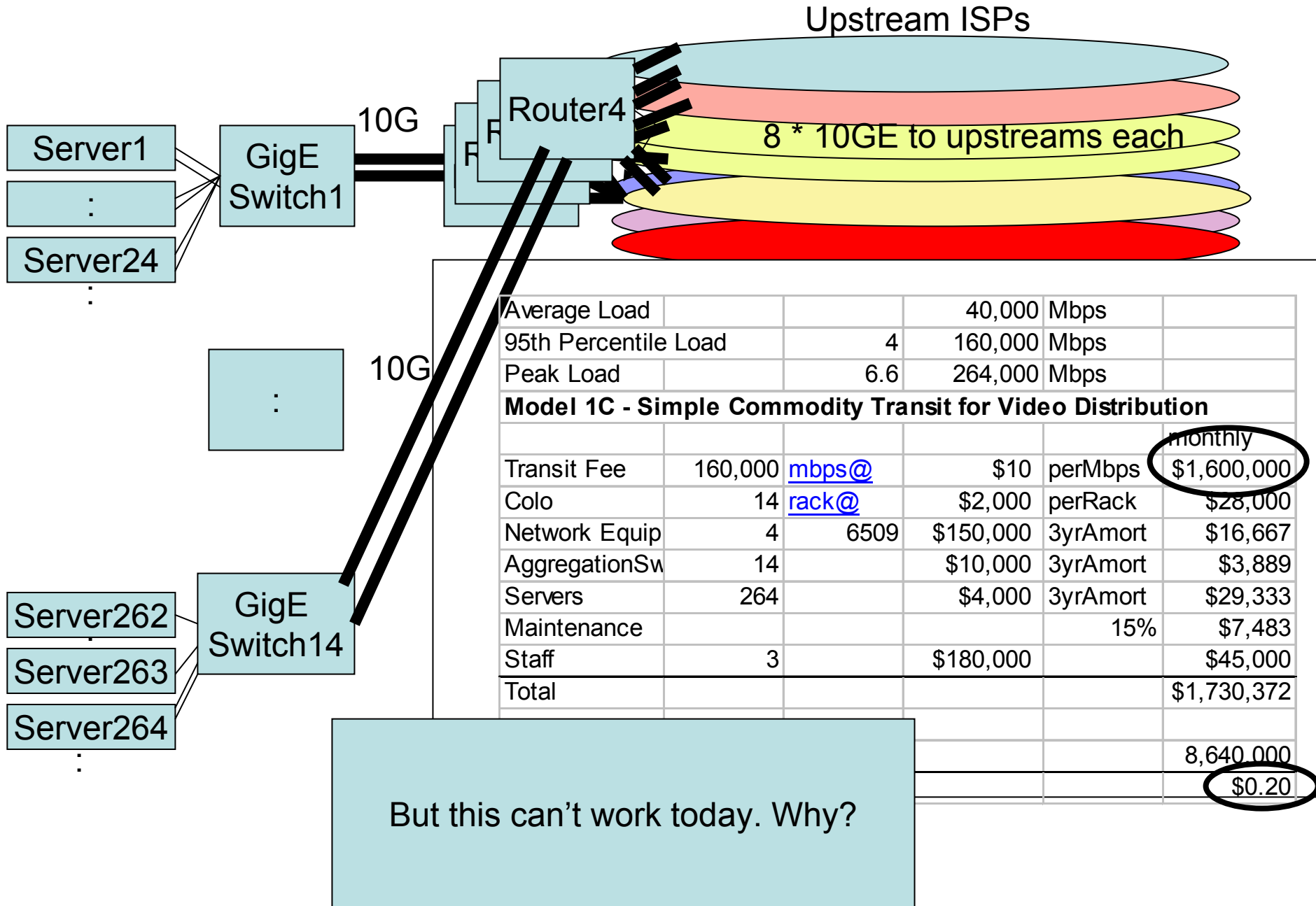


Shift from Avg to more typical demand curve...

Demand Curve Modeling



Model 1C – Large Load Commodity Transit



Model 2C: CDN Large Load

Average Load			40,000	Mbps	
95th Percentile Load		4	160,000	Mbps	
Peak Load		6.6	264,000	Mbps	
Model 2C - Content Delivery Network for Video Distribution					
					monthly
Transit Fee	160,000	mbps@	\$13	perMbps	\$2,080,000
Colo	1	rack@	\$1,500	perRack	\$1,500
Network Equip	1	6503	\$30,000	3yrAmort	\$833
Servers	1		\$4,000	3yrAmort	\$111
Maintenance				15%	\$367
Staff	0.5		\$180,000		\$7,500
Total					\$2,090,311
# videos downloaded per month					8,640,000
Cost per video downloaded					\$0.24

Model 3C: Transit/Peering Large Load

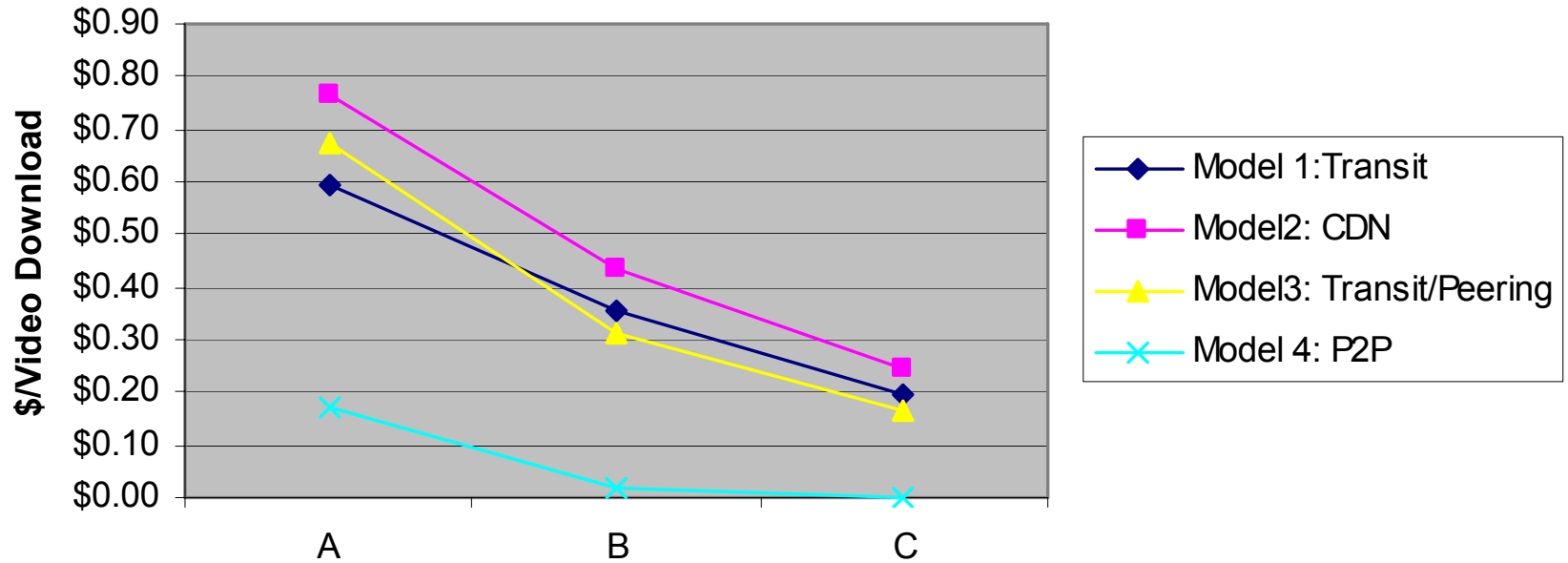
Average Load			40,000	Mbps	
95th Percentile Load		4	160,000	Mbps	
Peak Load		6.6	264,000	Mbps	
Model 3C - Blended Transit and Peering for Video distribution					
3 site	25%	peering			monthly
Transit Fee	120,000	mbps@	\$10	perMbps	\$1,200,000
Colo	42	rack@	\$2,000	rack+port	\$84,000
Network Equip	12	6509	\$150,000	3yrAmort	\$50,000
AggregationSw	42		\$10,000	3yrAmort	\$3,889
Servers	792		\$4,000	3yrAmort	\$88,000
Maintenance				15%	\$21,283
Staff	3		\$180,000		\$45,000
Total					\$1,492,172
# videos downloaded per month					8,640,000
Cost per video downloaded					\$0.17

Model 4C: P2P Large Load

Average Load		Mbps		Mbps	
95th Percentile Load		4	160,000	Mbps	
Peak Load		6.6	264,000	Mbps	
Model 4C - Peer-to-Peer Network for Video Distribution					
single-site stormcasting					monthly
Transit Fee	100	mbps@	\$50	perMbps	\$5,000
Colo	1	rack@	\$1,500	perRack	\$1,500
Network Equip	1	6503	\$30,000	3yrAmort	\$833
Servers	1		\$4,000	3yrAmort	\$111
Maintenance				15%	\$367
Staff	0.5		\$180,000		\$7,500
Total					\$15,311
# videos downloaded per month					8,640,000
Cost per video downloaded					\$0.0018

Summary

Internet Video Distribution Methods



Models	A: 10 videos	B: 100	C: 1000
1: Transit	1A: \$0.60	1B: \$0.36	1C: \$0.20
2: CDN	2A: \$0.77	2B: \$0.44	2C: \$0.24
3: Hybrid	3A: \$0.69	3B: \$0.31	3C: \$0.17
4: P2P	4A: \$0.18	4B: \$0.0177	4C: \$0.0018

Per Video Cost
Of delivery

Observations

- Internet Transit Supply ▼ Price ▲
- Internet Transit Model → src/dst specific
- Bottlenecks
 - IX Power, Router Capacity, Peer's Capacity,
 - Backbone Capacity, Last Mile bottleneck, 100G NIC?
 - Do I need to upgrade \$\$\$\$ gear to support my competitor (peer)?
- Identify Players, Positions, Motivations, Behavior
- Geoff Huston: “P2P has won. Telco/Cable co trying to keep its 1998 biz plan relevant.”