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

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V1.5

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 Sense Anyı
7) "Evc
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

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

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

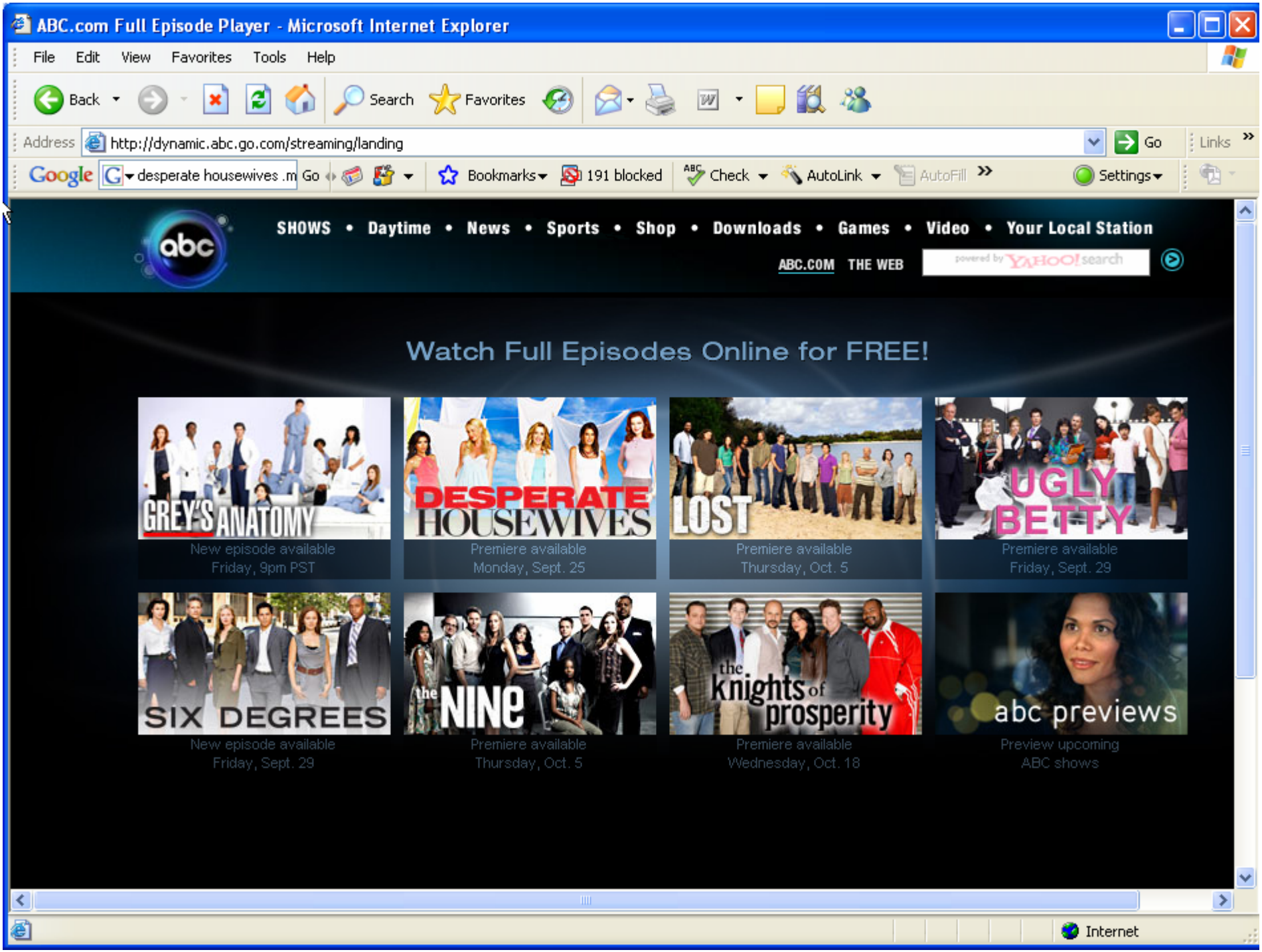
- YouTube – founded 2005
  - Short video clips – 50 million view per day!
  - 20Gbps of peering traffic Feb 2006
- DoveTail
- Video may dwarf current peered traffic
  - 2010 – 80-90% Internet is Video
  - Inculcate video guys into peering ecosystem

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

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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Watch Full Episodes Online for FREE!
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
Internet

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?

Transit =Metered pipe to the Internet
CDN =Content Distribution Network
Peering =free & reciprocal access to each others Customers
P2P =PeerToPeer

Modeling

Varying Sized Loads

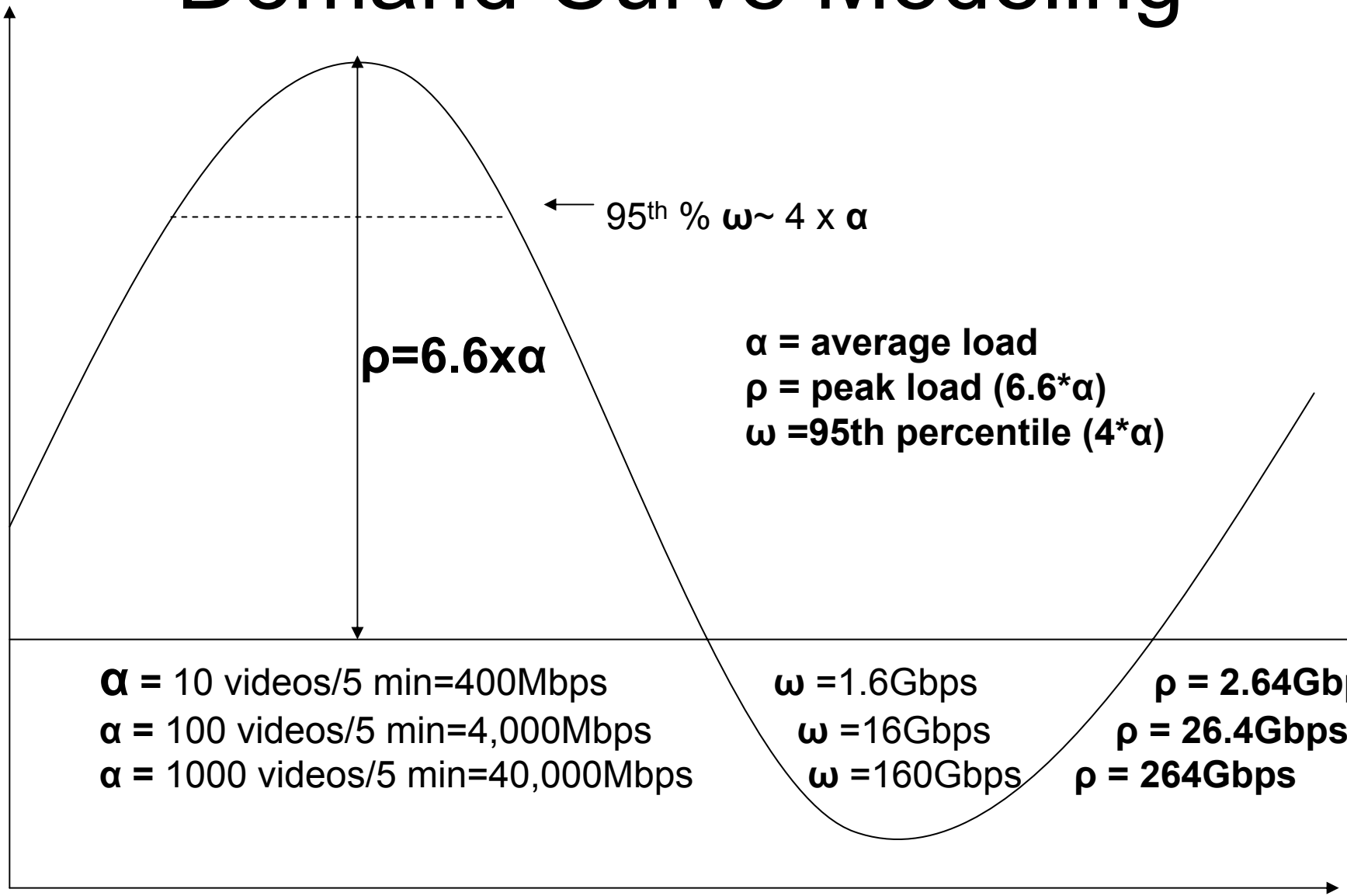
Small =Distribute 10 videos every 5 minutes on avg.
Medium =Distribute 100 videos every 5 minutes on avg.
Large =Distribute 1000 videos every 5 minutes on avg.

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

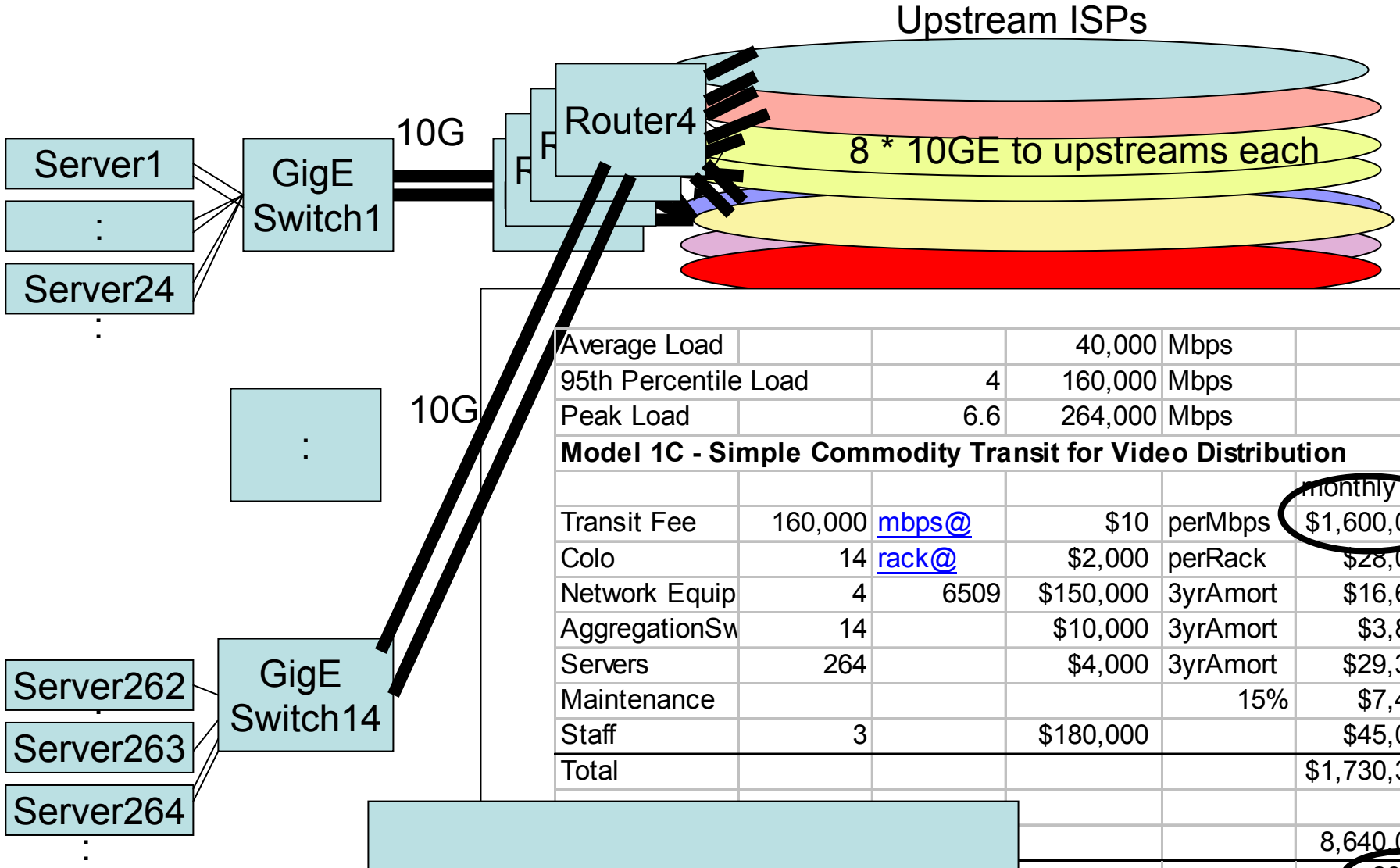
$ per video?

Shift from Avg to more typical demand curve...

Demand Curve Modeling



Model 1C – Large Load Commodity Transit



Average Load			40,000	Mbps	
95th Percentile Load		4	160,000	Mbps	
Peak Load		6.6	264,000	Mbps	
Model 1C - Simple Commodity Transit for Video Distribution					
					monthly
Transit Fee	160,000	mbps@	$10	perMbps	$1,600,000
Colo	14	rack@	$2,000	perRack	$28,000
Network Equip	4	6509	$150,000	3yrAmort	$16,667
AggregationSw	14		$10,000	3yrAmort	$3,889
Servers	264		$4,000	3yrAmort	$29,333
Maintenance				15%	$7,483
Staff	3		$180,000		$45,000
Total					$1,730,372
					8,640,000
					$0.20

But this can't work today. Why?

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

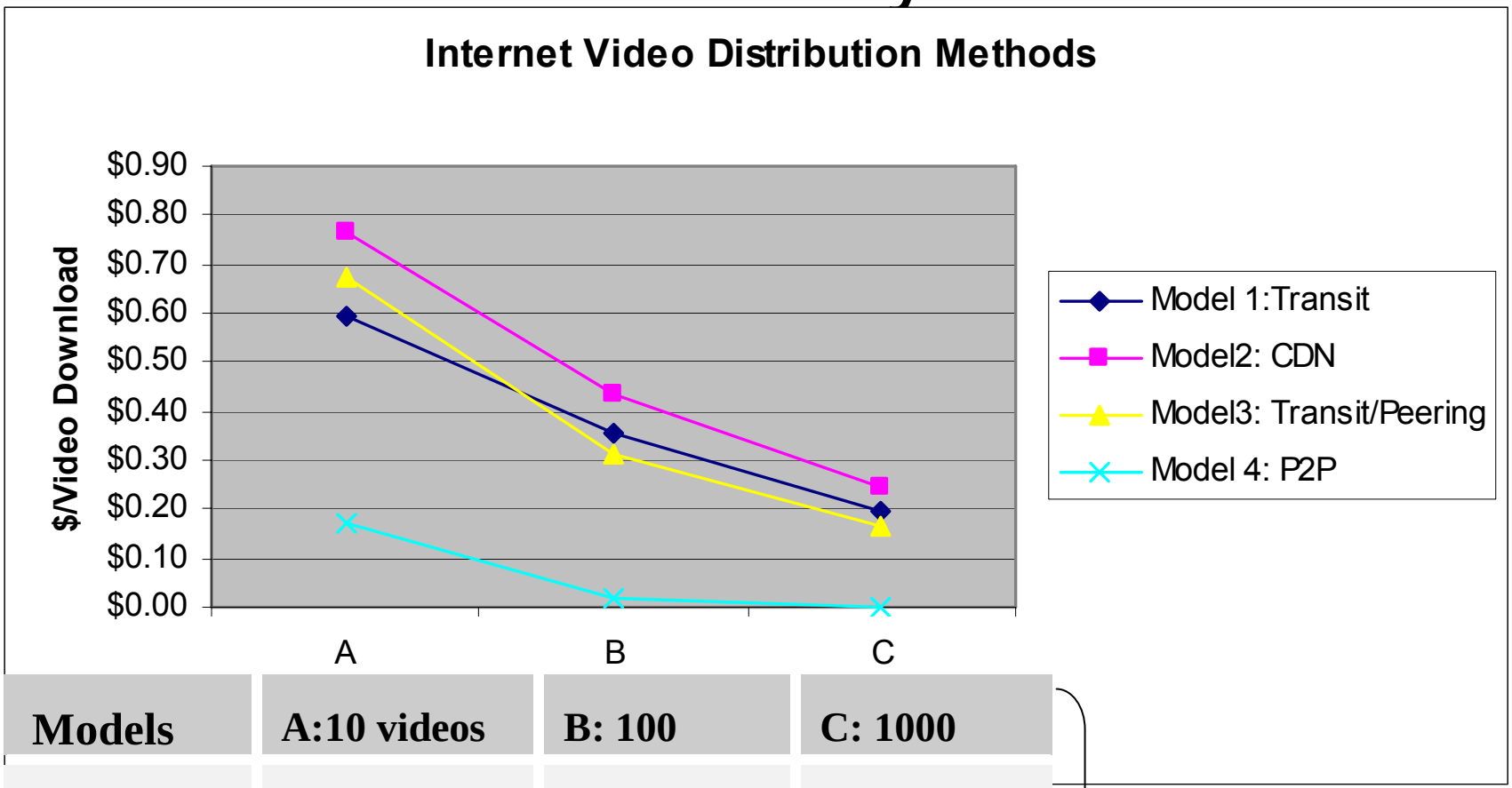
Model 3C: Transit/Peering Large Load

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



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
- Bottleneck**s**
  - 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."