

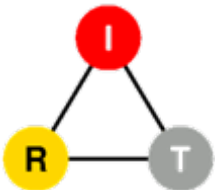
Bandwidth costs

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July 29, 2008

IETF 72 (Dublin)

Overview

- Video bandwidth consumption
- Cost of providing video content
- Economics
- Mechanisms
 - network topology indication
 - scavenger service
 - indication of charge
- Problem mainly of economics

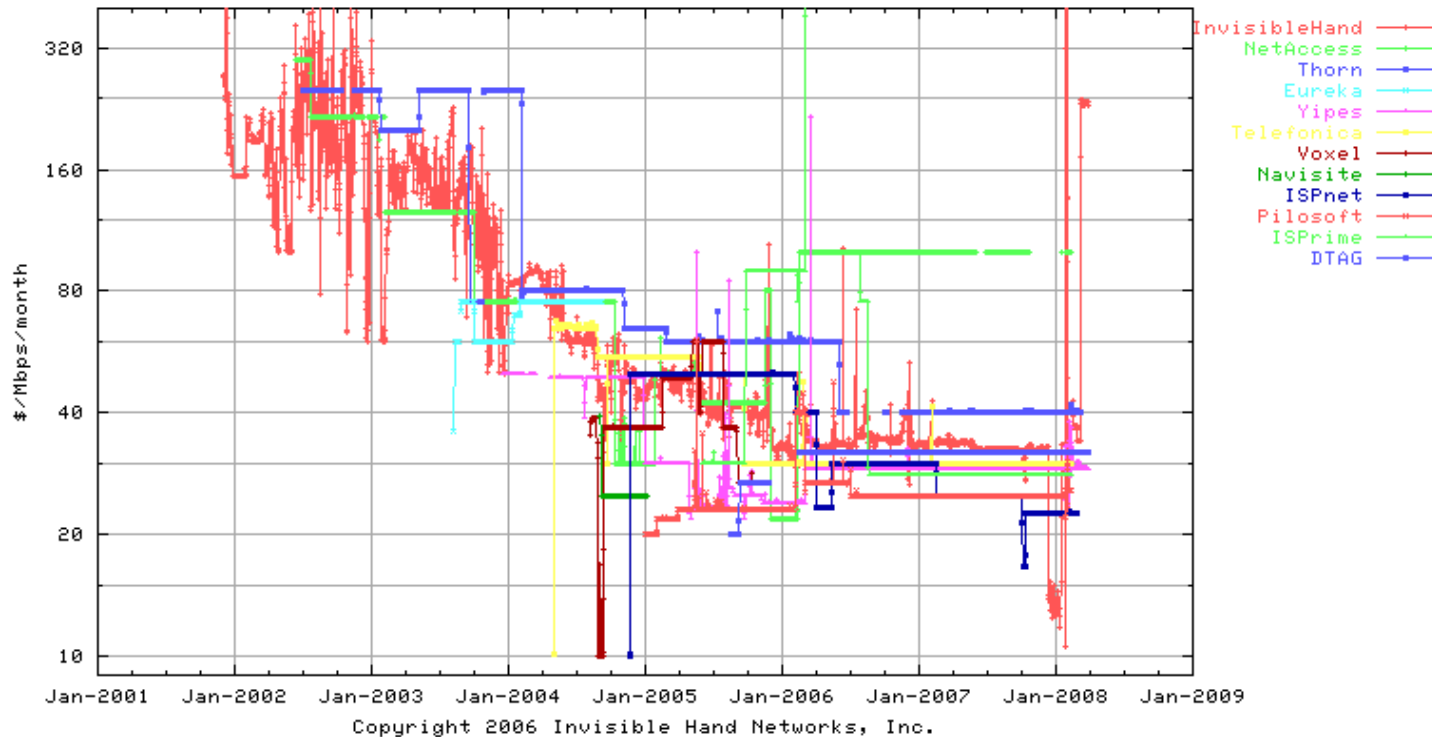
Bandwidth consumption

- 4 hours/day of TV @ 18 Mb/s HDTV \implies 972 GB/month
- Columbia University caps at 350 MB/hour \approx 252 GB/month

Economics of the eco system

- Long term, minimize **overall** cost of content delivery
 - across end user, provider, ISP
 - thus, focusing only on efficiency of HTTP misses the complete story
- Components
 - media storage
 - media server bandwidth (can't serve whole ISP from one disk)
 - delivery bandwidth (upstream & downstream)
- Re-use of existing components vs. new components
 - e.g., end user DVR storage vs. dedicated cache servers
 - local bandwidth vs. wide-area bandwidth vs. content provider bandwidth
- Allow cost allocation
 - e.g., rentable caches --> both content provider and ISP benefit

Economics of bandwidth

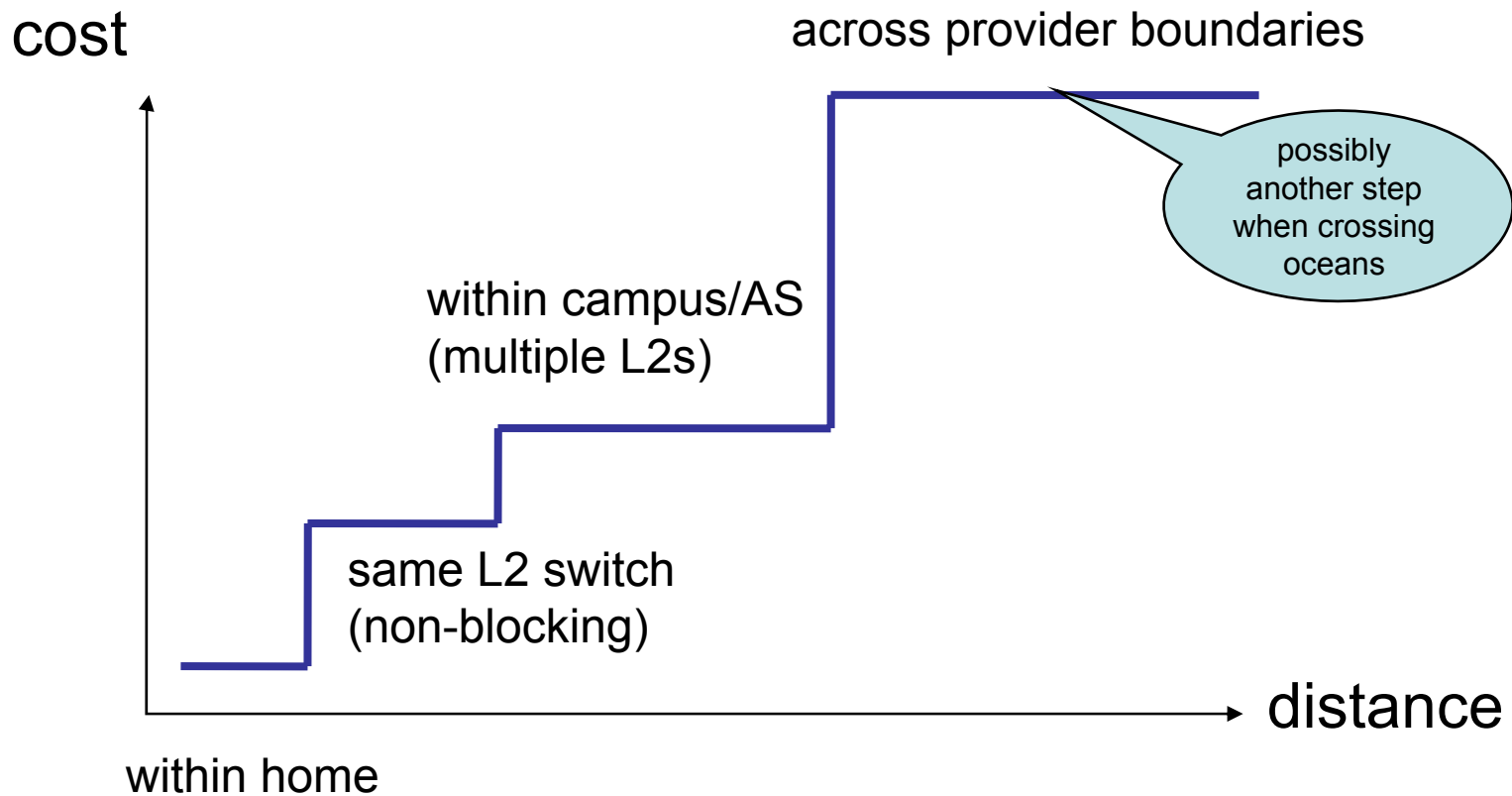


- Transit bandwidth \$40/Mb/s/month ~ \$0.125/GB
- US colocation providers charge \$0.30/GB to \$1.75/GB
 - CDNs: \$0.08 to \$0.19/GB

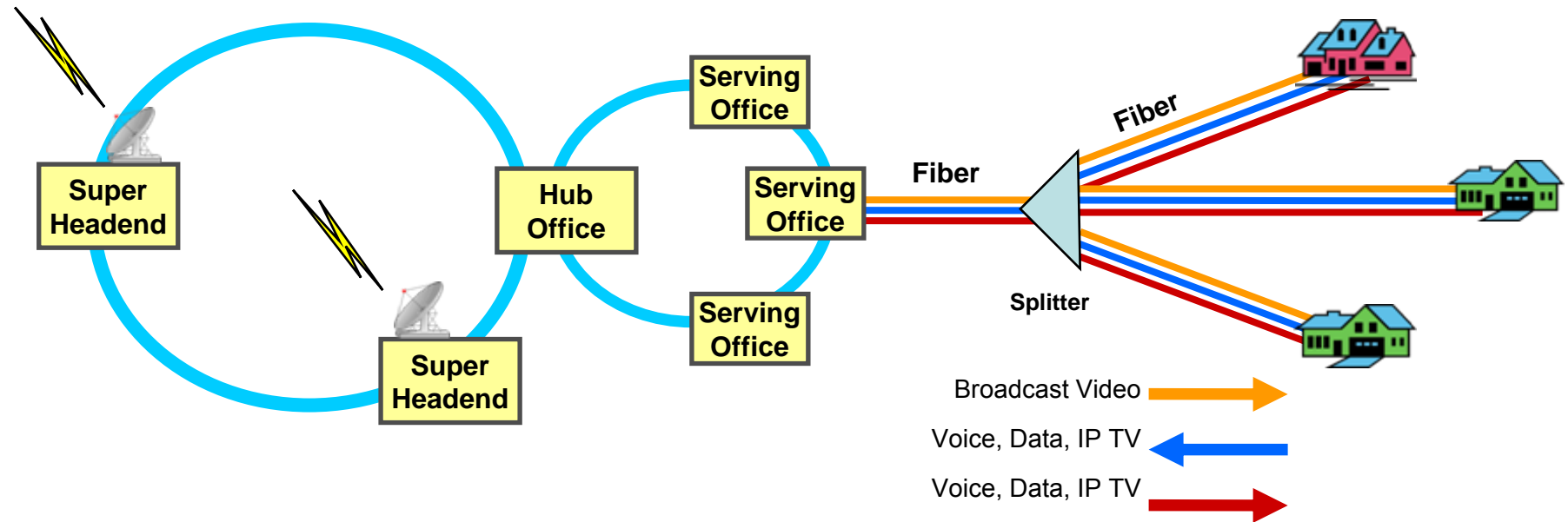
Cost of bandwidth

- Thus, 7 GB DVD → \$1.05
- HDTV viewing □ \$120/month for WAN bandwidth
- Netflix postage cost: \$0.70 round-trip
- Typical PPV charges: \$4/movie (7 GB)
- Local bandwidth cost is amortization of infrastructure
 - driven by peak load, not average
- Asymmetric vs. symmetric networks

Cost for providing content



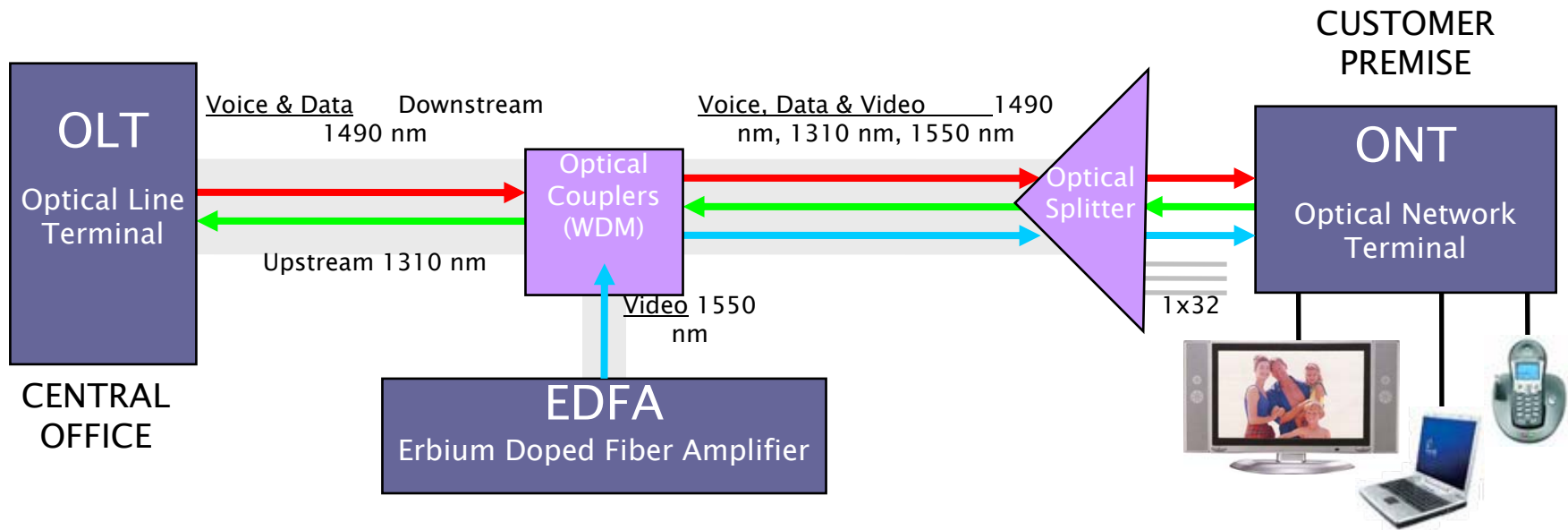
Example: FiOS TV architecture



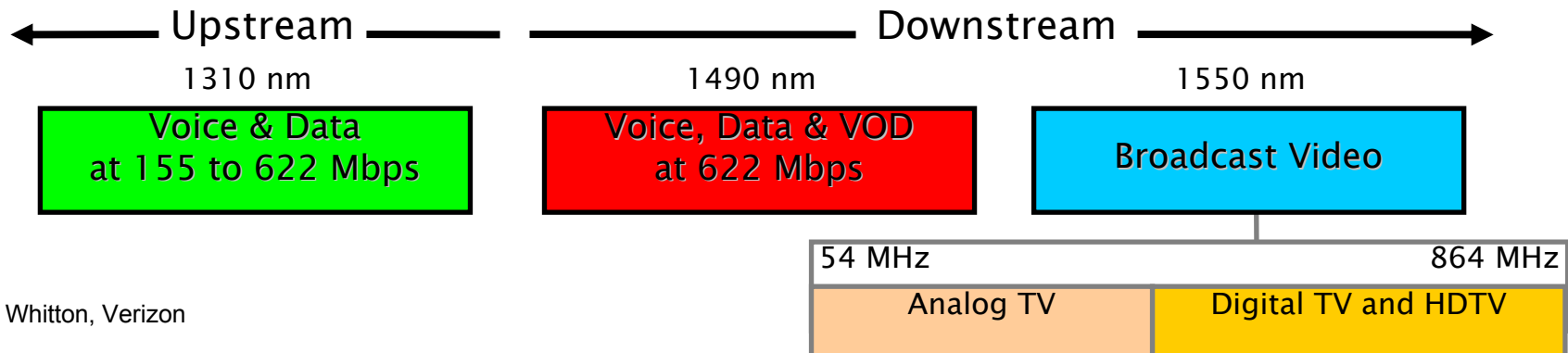
J. Savage (Telecom ThinkTank), Nov. 2006

- 2 national super headends
- 9 video hub offices
- 292 video serving offices

Verizon's FTTP Architecture



Bandwidth & Services



Indication of charging

- If volume-based, need application-visible charging indication
 - “current cost of 1 GB to 128.59.16.1 is \$0.15”
 - “predicted cost in 3 hours is \$0.05”
 - “you have 47.5 GB of free local traffic left”
 - “you are currently in penalty box”
- May differ upstream vs. downstream
- Applications can then prefer local content
- or defer to later
 - “Do you want to watch the movie now (\$4) or wait until 10 pm (\$2.52)?”

DiffServ & Bandwidth charging

- Only two options:
 - limit supply of (high-priority) bandwidth (“1000 minutes of VoIP/month”) OR
 - charge for bandwidth
- Probably need to differentiate “local” and “long-distance” traffic
 - see “free local calls”
- Charging exposes user to risk
 - mis-behaving application or malware
 - need SE-Linux-like capability limitation
 - DoS attacks
 - need permission-based sending