Bandwidth costs

Henning Schulzrinne
Dept. of Computer Science
Columbia University
New York, NY
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 → 972 GB/month
- Columbia University caps at 350 MB/hour ≈ 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

Cost across provider boundaries

- within campus/AS (multiple L2s)
- same L2 switch (non-blocking)
- within home

possibly another step when crossing oceans
Example: FiOS TV architecture

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

J. Savage (Telecom ThinkTank), Nov. 2006
Verizon’s FTTP Architecture

OLT
Optical Line Terminal

ONT
Optical Network Terminal

Optical Couplers (WDM)

EDFA
Erbium Doped Fiber Amplifier

Optical Splitter

Voice & Data
1490 nm

Upstream 1310 nm

Video
1550 nm

Voice & Data & Video
1490 nm, 1310 nm, 1550 nm

Bandwidth & Services

Upstream
1310 nm

Voice & Data
at 155 to 622 Mbps

Downstream
1490 nm

Voice, Data & VOD
at 622 Mbps

1550 nm

Broadcast Video

54 MHz

Analog TV

864 MHz

Digital TV and HDTV

CENTRAL OFFICE

CUSTOMER PREMISE

Brian Whitton, Verizon

July 29, 2008
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)?”
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