Movie Delivery in the Internet
- in 5 minutes -

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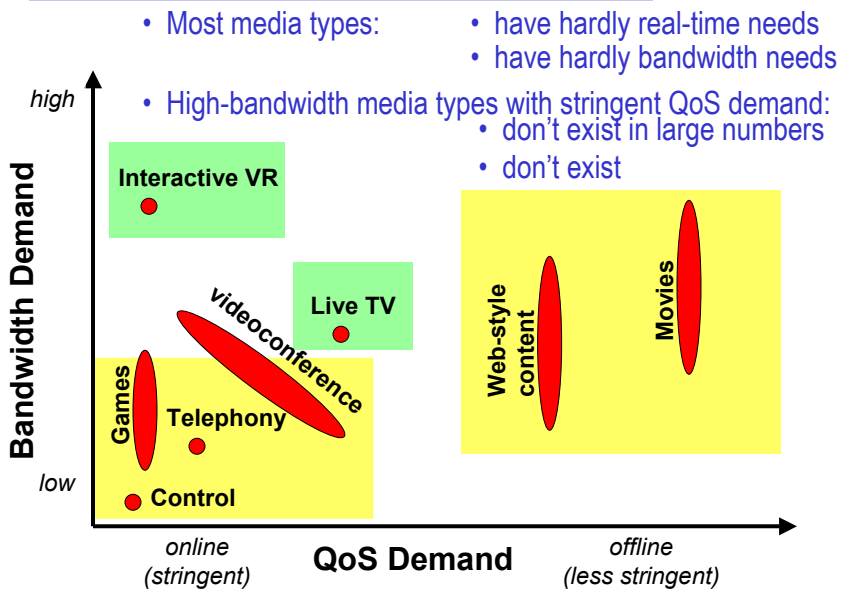

Interesting Issues

- Streaming vs. Download
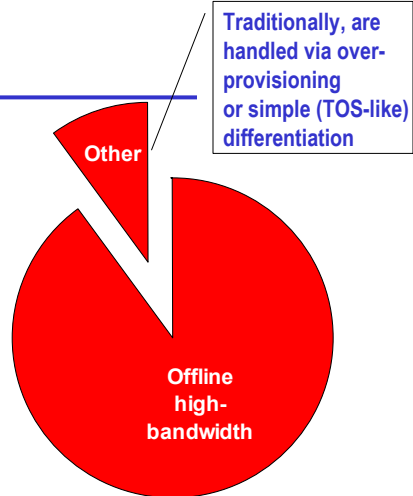- Storage
- VBR vs. CBR
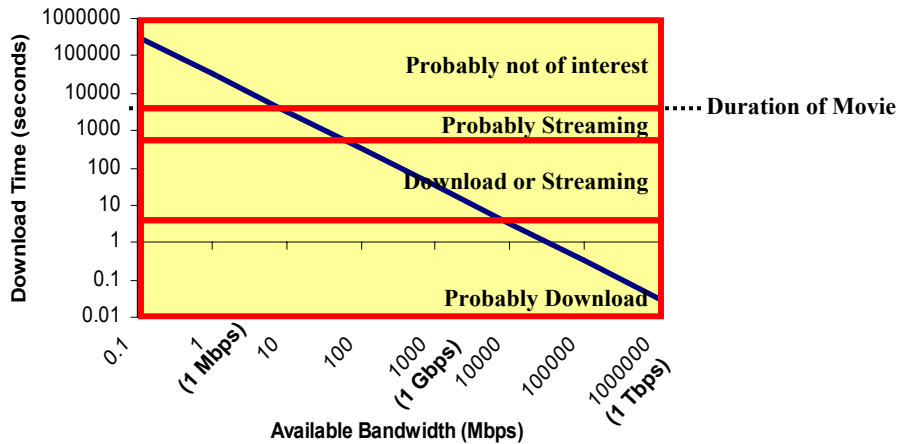- class-level vs. flow-level QoS

Media Types and their Demand

- Most media types:
- have hardly real-time needs
- have hardly bandwidth needs
- High-bandwidth media types with stringent QoS demand:
  - don't exist in large numbers
  - don't exist

Bandwidth Demand (high / low)

Interactive VR

videoconference

Live TV

Games

Telephony

Control

Web-style content

Movies

QoS Demand

online (stringent) — offline (less stringent)

Unsubstantiated claim

- **Claim**:
  For media delivery, most of the bandwidth will be consumed by "offline high-bandwidth" media types

Other

Offline high-bandwidth

Traditionally, are handled via over-provisioning or simple (TOS-like) differentiation

- Two ways to transmit these media:
  - Download
  - Streaming

Download Time of an MPEG-2 Movie

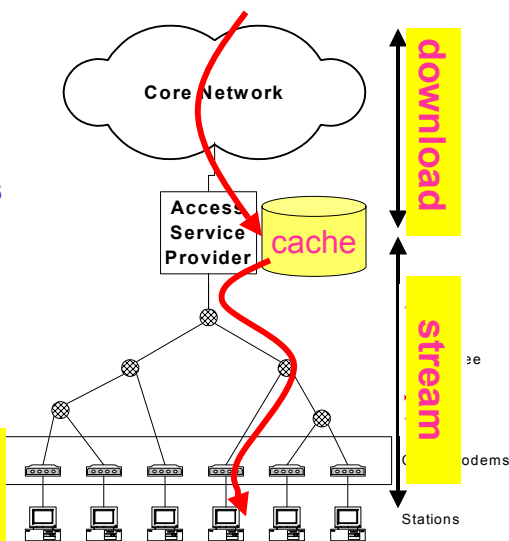• 90 min @ 6 Mbps → approx. 4 GB

Download vs. Streaming

• Operating point will be determined by available technology

• **QoS issues:**

• probably none for downloads in core network (due to high data rates)

• probably none for down-stream streaming in access network (due to lack of contention for resources)

Key Issue:
Placement of content at the edges of the core network determines user-level latencies.

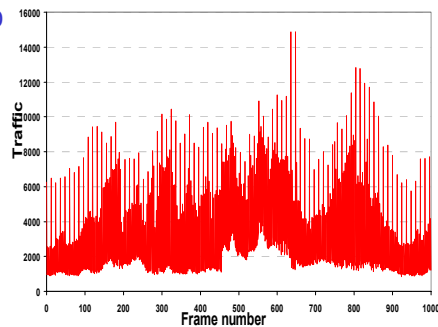## Summary: Movie delivery in the Internet within 5 years

- **Classical QoS concepts may not be useful**

- **Storage issues seem more important** → **Good target for QoS research**

- **Disclaimer:** The above comments do not apply to media types with stringent QoS demands:
    - telephony
    - games
    - control
    - interactive VR

Streaming Media: How to deal with VBR traffic?

• **Add delay:** Smoothing turns VBR into CBR traffic

• **Traffic theory:** Statistical multiplexing theory tells us that aggregated VBR sources appear smooth

•**Economy of scale:** If number of receivers is large, peak rate allocation is justifiable

Class-level vs. flow-level QoS

• **This is a matter of desired effort of deployment and desired QoS:**

  • Theoretical understanding of flow-level QoS is very good, and catching up for class-level QoS

  • Class-level QoS is useful to protect legacy traffic (best effort, TCP)

• **Problems (of both types of QoS):**

  • QoS notions are revamped before they mature

  • The quality of commercial QoS implementations is insufficient