




















CSE 4/60373: Multimedia Systems

▶ Outline for today

- 32: Y.-F. Chen, Y. Huang, R. Jana, H. Jiang, M. Rabinovich, J. Rahe, B. Wei, and Z. Xiao. Towards Capacity and Profit Optimization of Video-on-Demand Services in a Peer-Assisted IPTV Platform. *Multimedia Systems Journal*.



AT&T U-verse

<p>Customize a package at a price that meets your needs</p> <p>Build Your Own</p> <p>starting at \$49/mo.</p> <p>U-verse TV View Channel Listings</p> <p>U-verse Internet</p> <p>U-verse Voice (where available)</p> <p>Included Offers</p>	<p>U200 Double Pack</p> <p> + </p> <p>Build and Price</p> <p>starting at \$94/mo.</p> <p>U200 Up to 220 Channels</p> <p> PRO Up to 3 Mbps downstream</p> <p>Add Unlimited Voice \$30/month</p> <ul style="list-style-type: none"> \$250 Cash Back Installation Included 30 Day Money Back Guarantee 	<p>U100 Triple Pack</p> <p> +  + </p> <p>Build and Price</p> <p>starting at \$109/mo.</p> <p>U100 Up to 120 Channels</p> <p> PRO Up to 3 Mbps downstream</p> <p>Unlimited Calling (US, Canada, Puerto Rico)</p> <ul style="list-style-type: none"> Installation Included 30 Day Money Back Guarantee 	<p>U200 Triple Pack</p> <p> +  + </p> <p>Build and Price</p> <p>starting at \$124/mo.</p> <p>U200 Up to 220 Channels</p> <p> PRO Up to 3 Mbps downstream</p> <p>Unlimited Calling (US, Canada, Puerto Rico)</p> <ul style="list-style-type: none"> \$250 Cash Back Installation Included 30 Day Money Back Guarantee 	<p>U300 Triple Pack</p> <p> +  + </p> <p>Build and Price</p> <p>starting at \$144/mo.</p> <p>U300 Up to 290 Channels</p> <p> ELITE Up to 6 Mbps downstream</p> <p>Unlimited Calling (US, Canada, Puerto Rico)</p> <ul style="list-style-type: none"> \$250 Cash Back Installation Included 30 Day Money Back Guarantee 	<p>U450 Triple Pack</p> <p> +  + </p> <p>Build and Price</p> <p>starting at \$204/mo.</p> <p>U450 (HD Included) Up to 360 Channels</p> <p> MAX 18 Up to 18 Mbps downstream</p> <p>Unlimited Calling (US, Canada, Puerto Rico)</p> <ul style="list-style-type: none"> \$250 Cash Back Installation Included 30 Day Money Back Guarantee
--	--	---	--	--	--

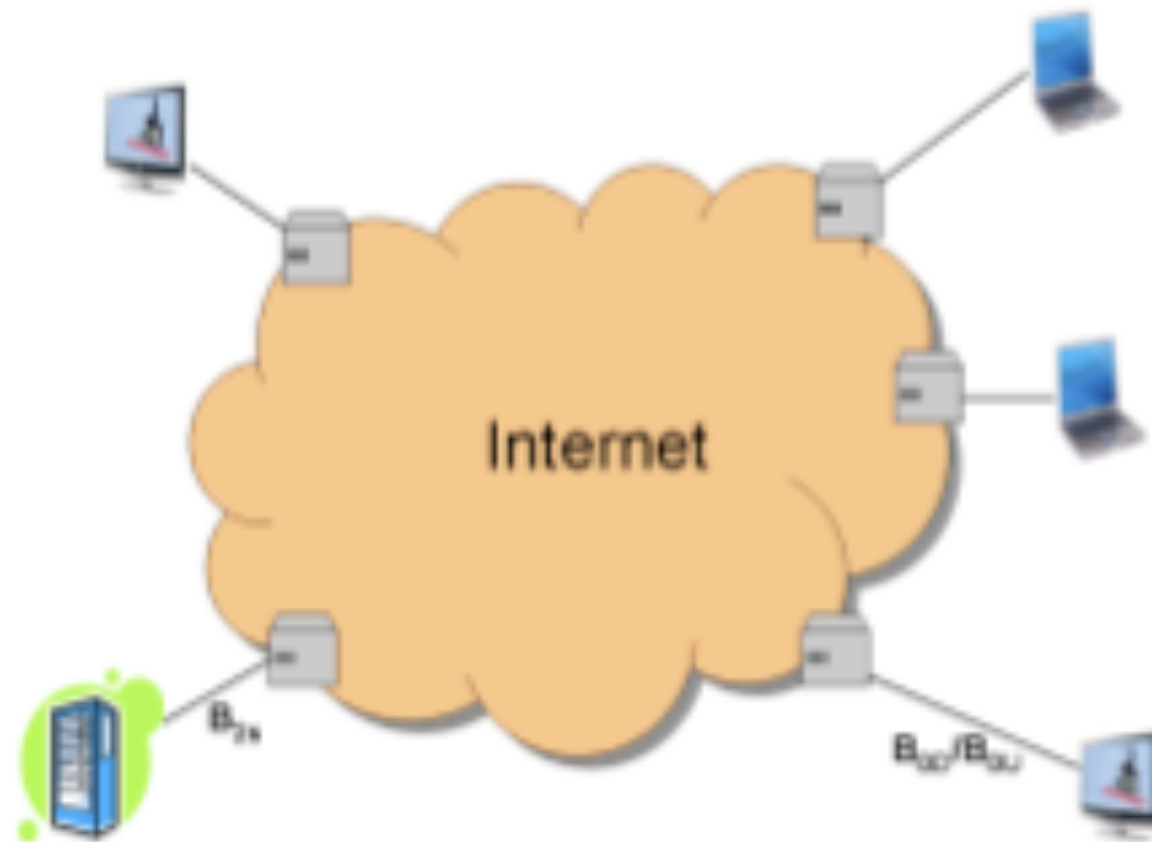


IPTV

- ▶ High bandwidth IP network to home
 - AT&T – xDSL (25 Mbps/1 Mbps upload), Verizon - FIOS
 - Assume 350 channels + Video on demand (periodic or completely on demand)
 - Assume MPEG-4 video – 6 Mbps for HD, 2 Mbps/SD
- ▶ Transmit each channel, setup box uses multicast and subscribes to the appropriate channel. Latency during channel switching can be a problem.
- ▶ P2P can be useful to receive streams: for example, if your neighbor was watching the same VOD, then we can form a P2P connection with out neighbor and reduce load from the servers.
 - We need to understand how the network is setup



Internet using a cloud model



IPTV deployment

- ▶ Fiber-to-the-Neighborhood (24 Gbps/1.244 Gbps)
- ▶ super head-ends
- ▶ video hub offices (9953.28 Mbits to SHE)



IPTV

- ▶ Operating entirely in the ISP network – easier to control the QoS, provision network
- ▶ Operators have motivation to ensure QoS
- ▶ Incentives for P2P delivery:
 - In Internet scenarios
 - In IPTV scenarios



Video on demand

- ▶ Considering the limitations of the physical network
 - Without limit: serve 5K users in all communities from SHE
 - With limits: serve about 2000 users

- ▶ P2P VOD
 - Upload capacity a bottleneck
 - @ 1 Mbps, if you use 50% for video, you need 12 peers for a HD video
 - ISP can increase the upload bandwidth for local users, especially since it helps ISPs
 - Prefetching and striping
 - Each set-top box can have some storage (say for DVR). Reserve some storage for other peers. Prefetching helps you (fast startup and others)
 - Challenge is to choose the right objects to prefetch, load balancing

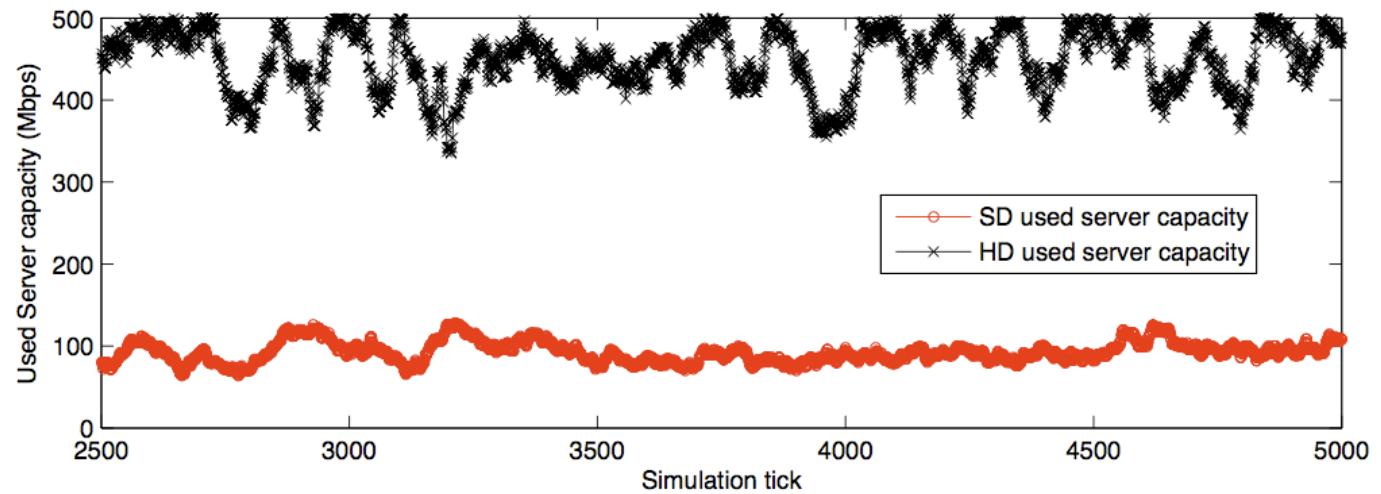
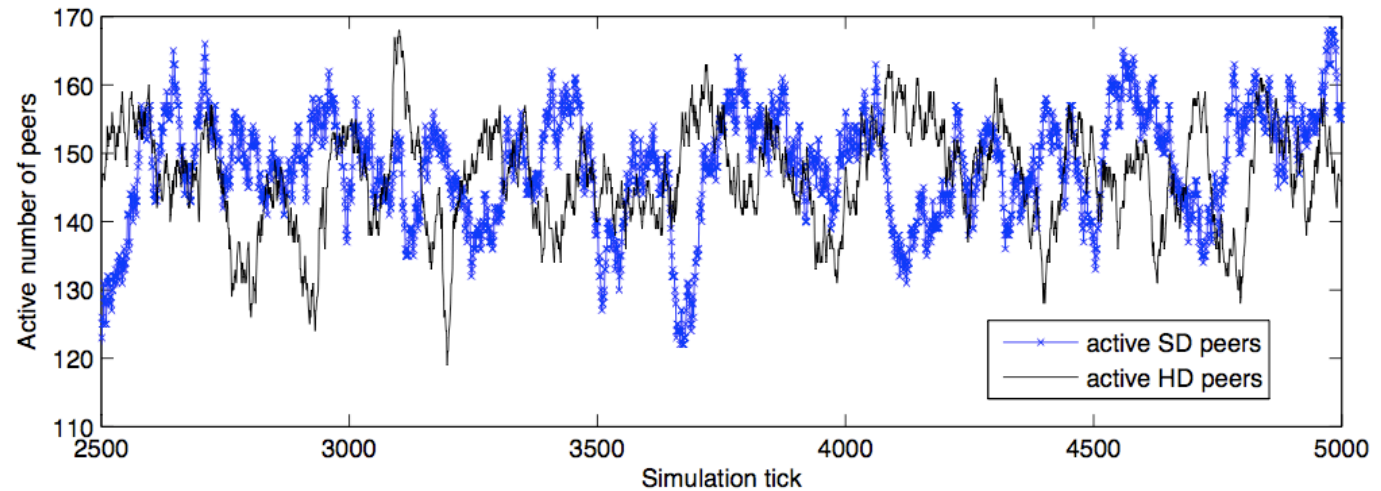


- ▶ Indexing and lookup
 - Easier because users have good availability
 - Server knows spare upload capacity of peers
- ▶ Long term profiling of set top boxes by server
- ▶ Erasure coding for 10 of 12 blocks
- ▶ Clients cache some movies so that they can rewind

- ▶ UDP is good enough because of control and monitoring of error rates



Server capacity utilization



Incentives

- ▶ P2P helps ISPs by reducing bandwidth costs and server capacity
 - It helps customers because
- ▶ What is the incentive for user to allow this
 - Built-in model: Maybe ISP should not even ask !!
 - Flat reward: ISP gives you some break
 - Usage based: based on byte count
- ▶ Under high utilization, built-in is best
- ▶ Need to balance usage based with unused capacity in server



Incentives in other systems

▶ YouTube?

- “Watch Global, Cache Local: YouTube Network Traffic at a Campus Network - Measurements and Implications” Michael Zink, Kyoungwon Suh, Yu Gu and Jim Kurose, MMCN '08
- video clips of local interest have a high local popularity
- client-based local caching, P2P-based distribution, and proxy caching can reduce network traffic
- How would you add incentives?
 - Our campus has 200 Mbps out, but lot higher internally

