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LiveShift: Peer-to-Peer Live Streaming with Distributed Time-Shifting

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Motivation
LiveShift | P2P Streaming
Conclusion



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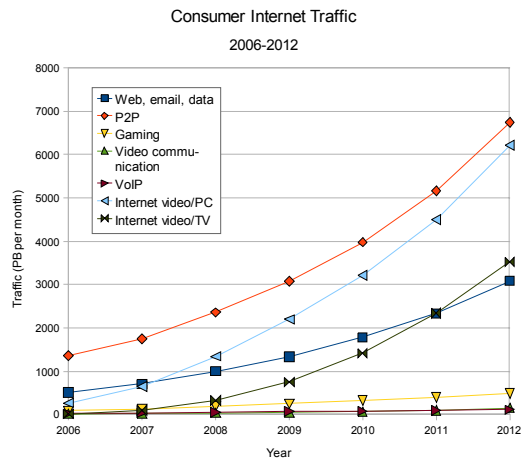
Overview

- Motivation
- State-of-the-Art
- P2P Streaming + LiveShift
 - Content discovery
 - Stream exchange
- Incentives
- Summary and Conclusion

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Motivation



Source: Cisco Systems, Inc.

- Internet video is ~ 1/4 of consumer Internet traffic
 - Not including P2P
- All forms of video ~ 90% by 2012
 - TV, VoD, Internet, and P2P
- Mobile data traffic will double every year from now through 2012

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Peer-to-Peer Potential

- Lower cost for distributor
 - Infrastructure (e.g. number of servers, bandwidth)
 - Cost can be distributed to users
- Traffic distribution
 - Scalable, resistant to flash crowds
- IP reachability may be higher than TV signal
 - Especially in mobile/UMTS
 - Global audience possible
- Entirely community-driven
 - No censorship, no relying on a few big companies

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State-of-the-Art in P2P Streaming

- Two business models
 - Commercial
 - Authorized content only – users may not broadcast their own content
 - Superpeers to compensate asymmetric bandwidth
 - e.g. Zattoo, Joost
 - Non-commercial
 - Everyone can broadcast for free – possible copyright break
 - No dedicated superpeers
 - e.g. SopCast, TVAnts, PPLive
 - All of them
 - Support either live streaming or video on demand (VoD)
 - Support for time shifting using only local storage
 - Closed source, centrally controlled

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LiveShift

- Open source P2P Streaming application
- Combines VoD and live streaming
 - Peers selectively record what they watch
 - Recorded content is shared among peers
 - Makes time shifting and VoD possible from a live stream
- Allows everyone to broadcast their own channel
- Open standards
 - Allow for a free market e.g. on deployment of super peers
- Work in progress – still a prototype

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Content Discovery

- What to watch?
- Two approaches: pull and push
- Pull
 - Reactive
 - Triggered by the user
 - Keyword search
 - Exact search
 - Metadata search
 - Similarity search
 - Semantic search – items similar or equal
 - Relevance ranking
 - “Best” matches on top

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Content Discovery

- Push
 - Proactive
 - Epidemic or gossip protocols
 - Recommendations based on interest match
 - Peers constantly exchange information in the background
 - Semantic search
 - Moderation/voting
 - YouTube
 - Promoted videos, featured videos, subscriptions, channels, recommended for you, Most Active, Spotlight, Rising, Most Discussed, Most Viewed, Top Favorited, Recent Videos, Most Responded, Top Rated, Video Responses, Related Videos, more ▼
 - Social network

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Content Discovery

The screenshot shows the YouTube homepage for user 'asdrubalman'. The main content area is titled 'Videos' and 'All - Most Viewed (Today)'. A featured video is 'Spotlight: Finger Lickin' Good' by 'richtfets', showing a cat eating blueberries. Below it are four video thumbnails: 'Josh Howard Disrespecting', 'Fred: A Star in His Own Mind', 'My Love Secrets to Seduce Me!', and 'Teaching Porn in Schools!'. Each video includes its title, source, view count, and duration.



Content Discovery

The screenshot shows a torrent search results page for the query 'cool video'. The search results are displayed in a table with columns for Type, Name, Uploaded, Size, SE, and LE. The results include various video files such as 'Bickford Shmecklers Cool Ideas 2006 DVD Rip - Morsan', 'The Last Lear (2008) [HxD] PDVDrip (xv-D)', and '2008 MTV Video Music Awards HDTV + BONUS FEATURES'.

Type	Name	Uploaded	Size	SE	LE
Video - Movies	Bickford Shmecklers Cool Ideas 2006 DVD Rip - Morsan	Y-day 19:07	705.64 MB	5	4
Video - Movies	Lin Is Cool [2008] [DVD Rip] (xv-D) - BPOIS	09-13 22:26	1.38 GB	9	22
Video - Movies	Let's Get Lost (1988) DVD Rip + Extras	09-15 18:31	2.25 GB	3	10
Video - Movies	Dantes Intern [2007] [DVD Rip] (xv-D) - FRAGMENT	09-17 11:24	689.34 MB	29	28
Video - Movies DVDR	Our Daily Bread - Unser Taglich Brot 2005 PAL - DVDR	09-16 11:04	3.83 GB	6	16
Video - Movies	THE LADIES MAN [2003] [AC3 5.1] [DVD Rip] - FLAWL3SS	09-15 01:15	970.5 MB	26	42
Video - Movies	The Last Lear (2008) [HxD] PDVDrip (xv-D)	09-14 18:49	700.03 MB	264	686
Video - Music videos	Melanka - The day that never comes (LIVE VIDEO)	08-29 01:28	174.22 MB	25	3
Video - Music videos	gregory issac s live at the briston academy 1984 video	08-24 03:07	3.14 GB	0	0
Video - Movies	Slow Burn DVD Rip DivX	08-21 22:05	700.19 MB	8	4
Video - Other	Die schoen Bahnsrecken - Drivers-eye Trains - France 02/Italy 0	08-22 15:44	1.12 GB	1	2
Video - TV shows	The History Of Beavis And Butthead Parts 1 & 2 ipod Classic	08-27 02:19	715.99 MB	5	3
Video - TV shows	Mary Hartman, Mary Hartman 1x11 PLUS EXTRAS	09-06 04:13	179.48 MB	7	2
Video - Movies	In Too Deep [1999] [Eng] - Hammer71	08-30 06:13	700.03 MB	17	4
Video - Movies	Women in Love - 1949 Drama - Gerald Jackson, Oliver Reed	09-09 22:02	700.6 MB	8	5
Video - TV shows	2008 MTV Video Music Awards HDTV + BONUS FEATURES	09-09 02:00	1.49 GB	1	178



Content Discovery

- Where to store the information?
 - Centralized Tracker
 - Simplest and easiest to control
 - Used in Napster, BitTorrent
 - Single point of failure and scalability problems
 - Distributed Tracker (e.g. DHT)
 - Used in BitTorrent, eMule
 - Routing, Flooding etc.
 - Connectivity issues – NAT & Firewall
 - DHT
 - Still good mainly for exact matches
 - Can take a long time to stabilize if churn is high
 - Optimizations (e.g. semantic routing, locality aware)

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Content Discovery



- LiveShift – current research
 - P2P similarity search (P2PFastSS)
 - Locality and resource-aware DHT
 - Semantic search is future work

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Stream Exchange

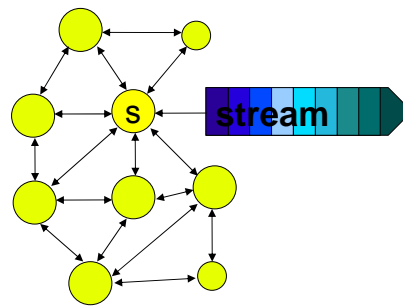
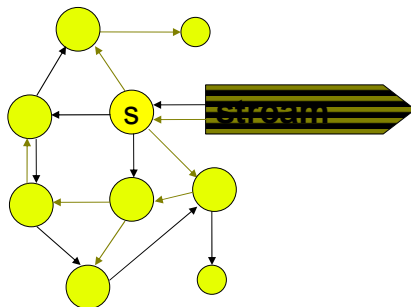
- How to get the stream?
- Objective: maximize QoE
 - High quality, low and uniform delay
 - Resist to churn, jitter, asymmetric bandwidth
- Structure
 - IP multicast
 - Tree
 - Multiple trees
 - Mesh

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Stream Exchange

- Multiple-tree
 - Layers or descriptions
 - Less delay
 - MDC, partial stream
- Mesh
 - Chunks – constant size
 - More resistant to churn
 - Asymmetric bandwidth



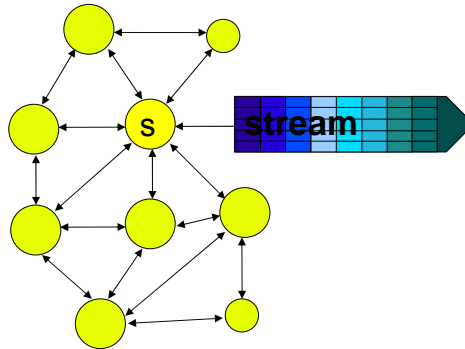
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Stream Exchange

□ LiveShift

- Supports MDC
- Live Streaming
 - Uses multiple trees
 - Quick tree maintenance
- Time-shift and VoD
 - Mesh-based
 - Peer request specific layers
 - Chunks with fixed length (time)



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Stream Exchange

□ Policies to be defined

- Download
- Upload
- Playback
- LiveShift: storage

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Stream Exchange

- Download policy
 - Which peers or pieces to request data from?
 - Proposed approaches:
 - Rarest piece
 - Peer with highest reputation
 - Next useful chunk – sliding priority
 - Find the ideal fan-in
 - Normally slots are allocated according to bandwidth
 - Bandwidth must be adjusted/declared by user
 - Traffic from other applications/users interfere
- LiveShift
 - Still simple approach: random peer selection, localization

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Stream Exchange

- Upload policy
 - Which peers to “unchoke”?
 - Important since this is the scarce resource
 - Current approaches
 - Prioritize pieces/chunks: earliest, rarest, random
 - Prioritize peers: largest upload capacity, closest (locality), reputation
 - Fan-out
 - Similar problem as Download policy
- LiveShift
 - Still simple approach: accepts all until fan-out reached

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Stream Exchange

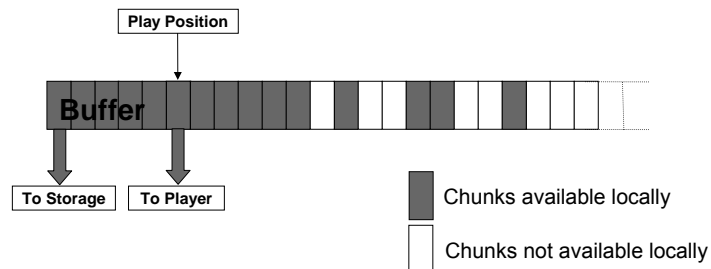
□ Playback policy

- When reception is slower than playback time and buffer is exhausted

- When to stall?
- When to skip?

□ LiveShift

- Stalls if VoD / time shift
- Skips if live stream – may enlarge buffer, thus delay



Stream Exchange

□ Since peers in LiveShift selectively store stream

□ Storage policy

- What to store to serve other peers?
- First: fill storage as much as possible
- If storage is full: what to get rid of?

- Chunks stored have a priority level
- Priority is calculated based on
 - Redundancy level (constant)
 - Popularity/swarm size
 - Time
- First, get rid of unimportant chunks until a minimum redundancy level
- Then, get rid of old data – idea is to have a long lasting storage!

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Incentives

- Network depends on peers providing resources
 - Energy, bandwidth: they need to be online
 - They need to follow the protocol correctly
 - Network must be resistant to attacks

- LiveShift
 - Currently studying PSH as a promising alternative

Summary and Conclusions

- P2P Streaming: promising technology
- Many challenges
 - Network not designed to transport such information
- Interesting research field
- LiveShift
 - Early stage
 - Proof-of-concept to live streaming + distributed timeshift + VoD
 - Prototype for experiment new algorithms

Thank You

Questions?

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It's over!

Go back!

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