P2P Live Internet Video
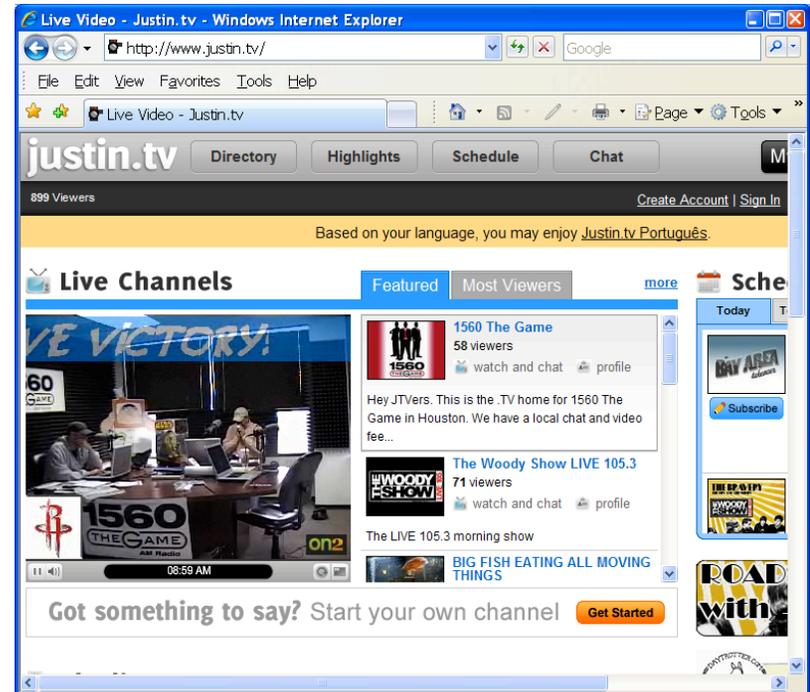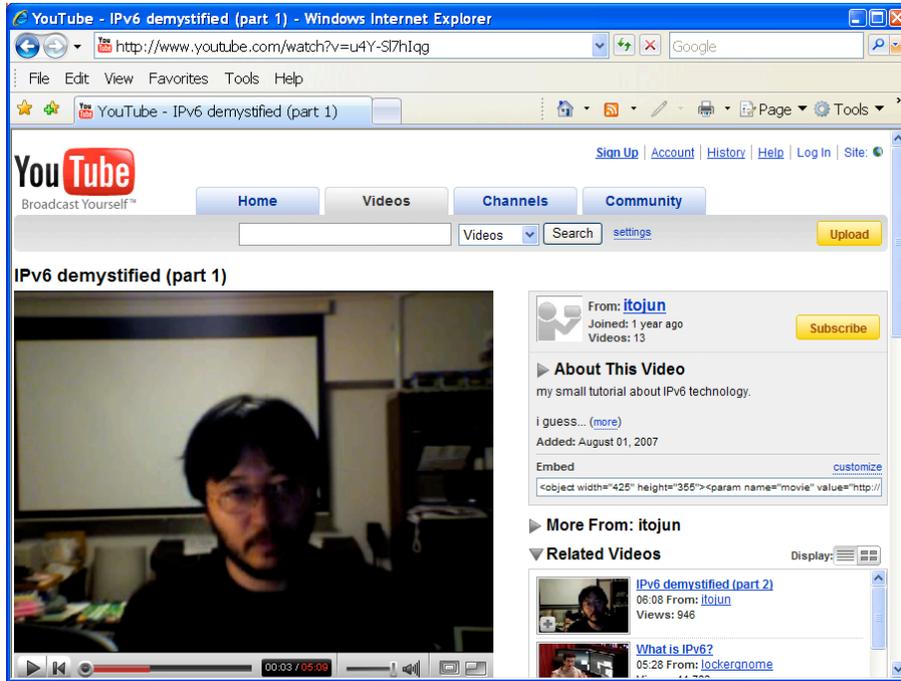
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Internet Video

Should it be called IPTV ?

We the people want:

- to share our video clips
- & our live video feeds
- with millions of users
- at high resolution
- searchable
- at low cost
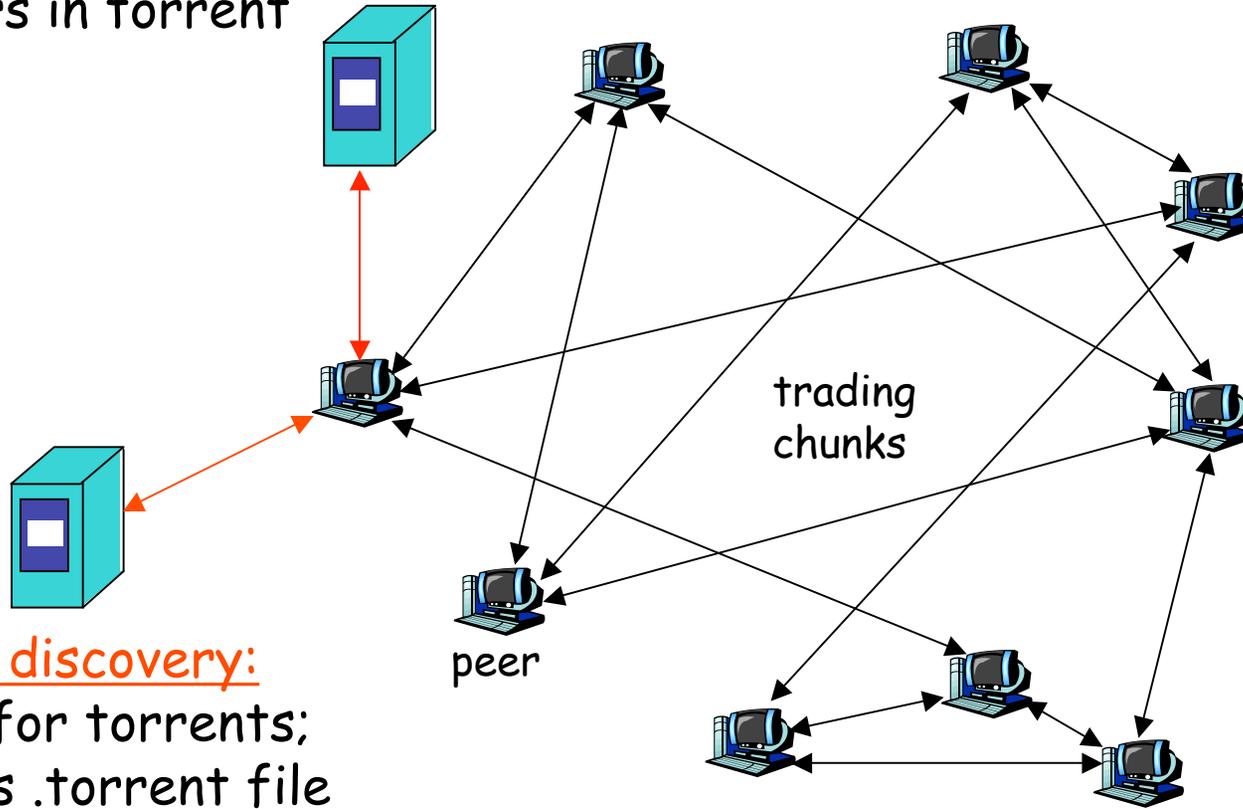
Solution: P2P !

P2P Live Video

- Major sporting events
- Presidential debates
- Little league baseball games
- Political demonstrations
- A day in Waldo's life

How do we make it happen ?

Lessons Learned from the BitTorrent Ecosystem

torrent: group of peers exchanging chunks of a file

Peer discovery: tracks peers in torrent

trading chunks

peer

torrent discovery: search for torrents; provides .torrent file

50+ client implementations

Dozen public trackers & open-source trackers
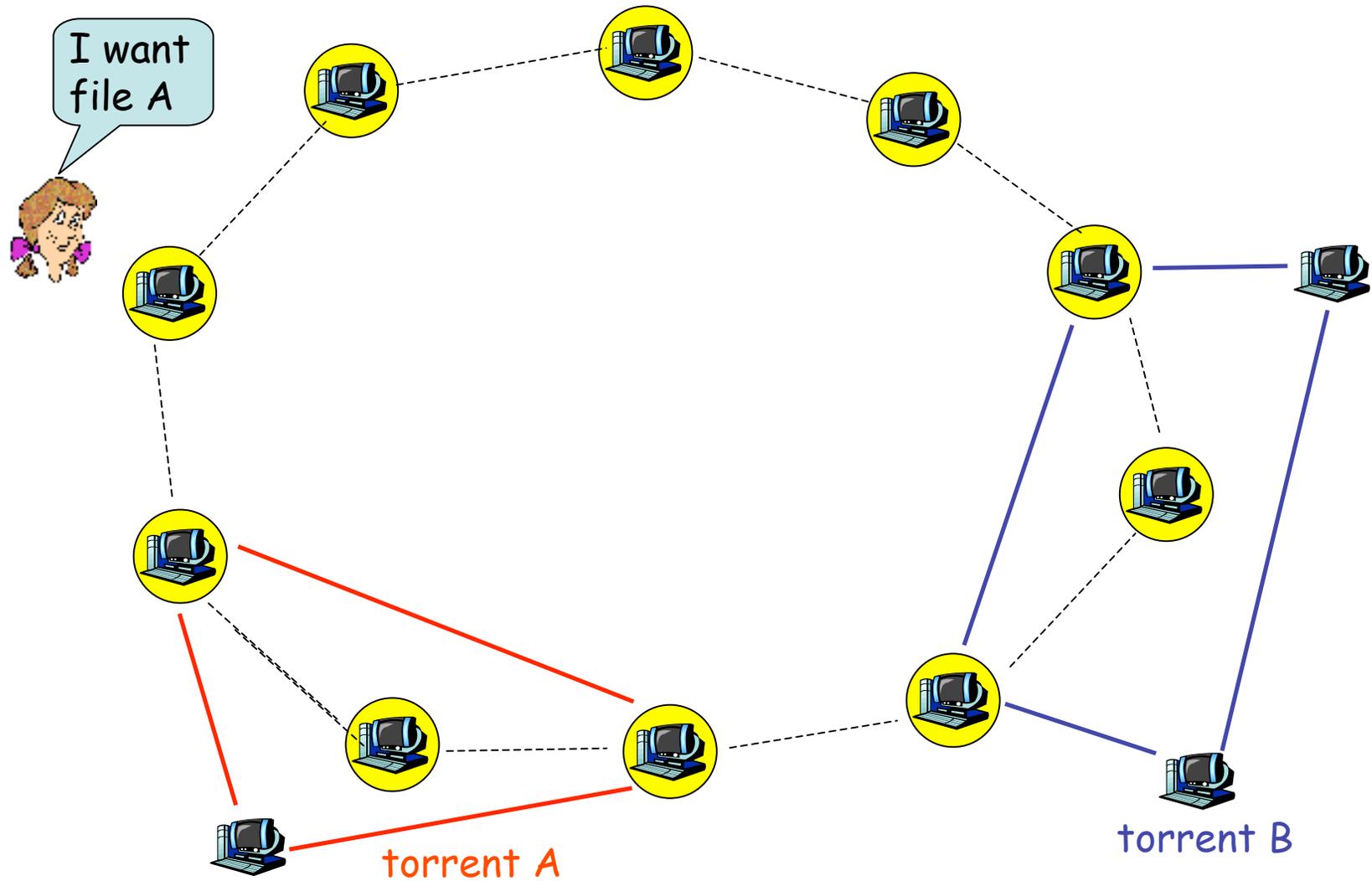
Dozens of torrent search sites

Distributed Trackers: DHT

torrent A

torrent B

Distributed Trackers: DHT

I want file A

torrent A

torrent B

Distributed Trackers: DHT

What peers in torrent A?

torrent A

torrent B

Distributed Trackers: DHT

IP/port pairs
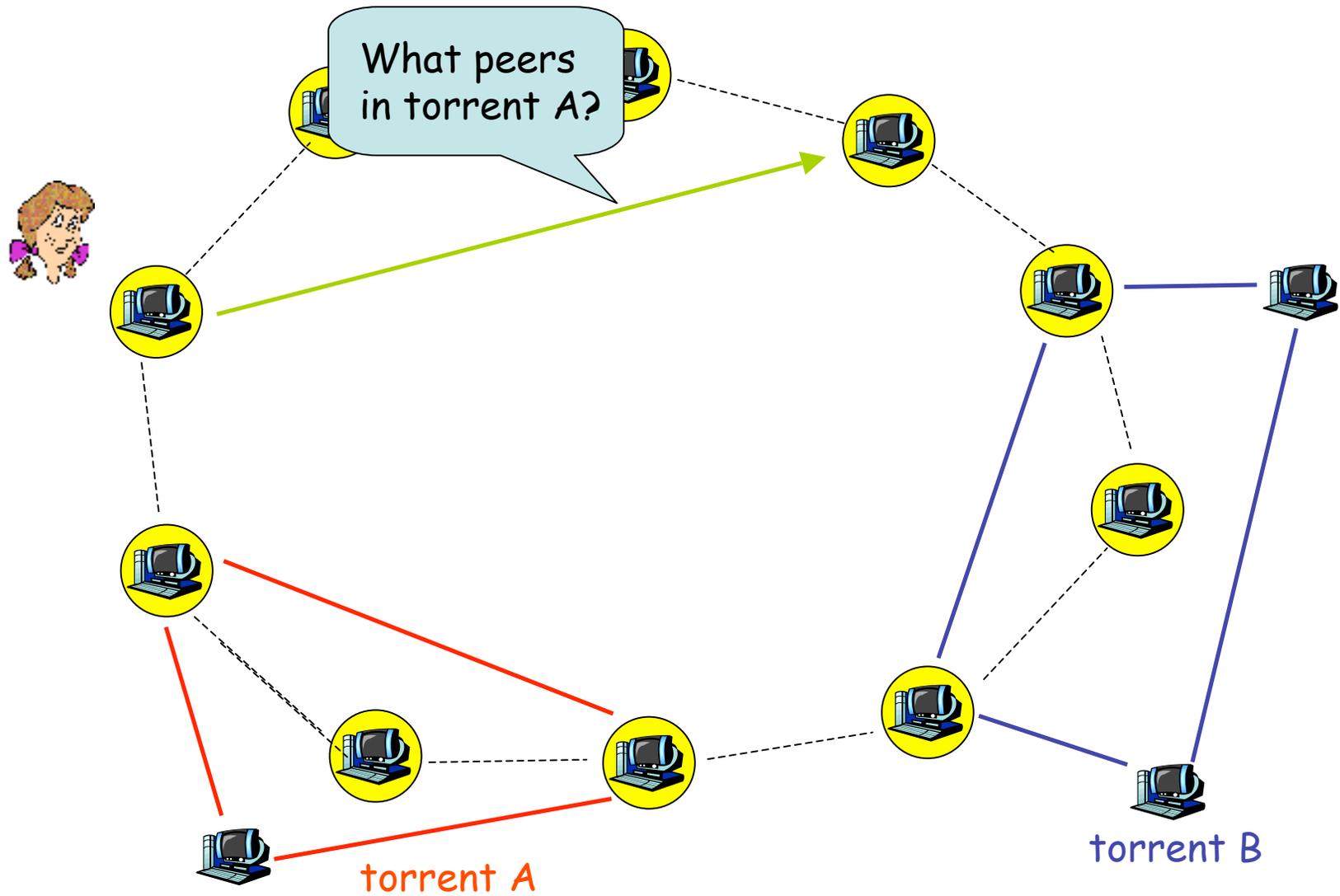
torrent A

torrent B
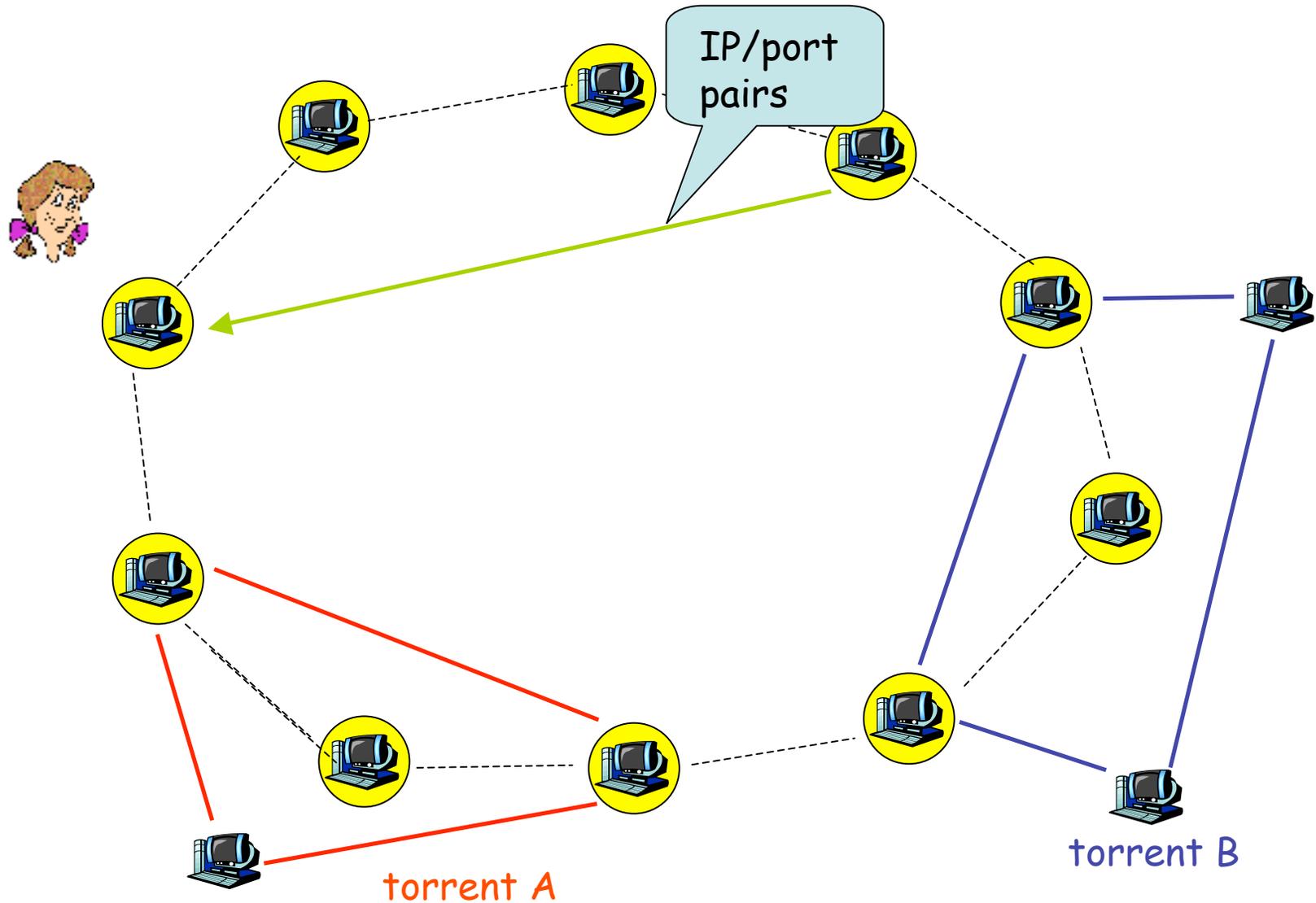
Distributed Trackers: DHT
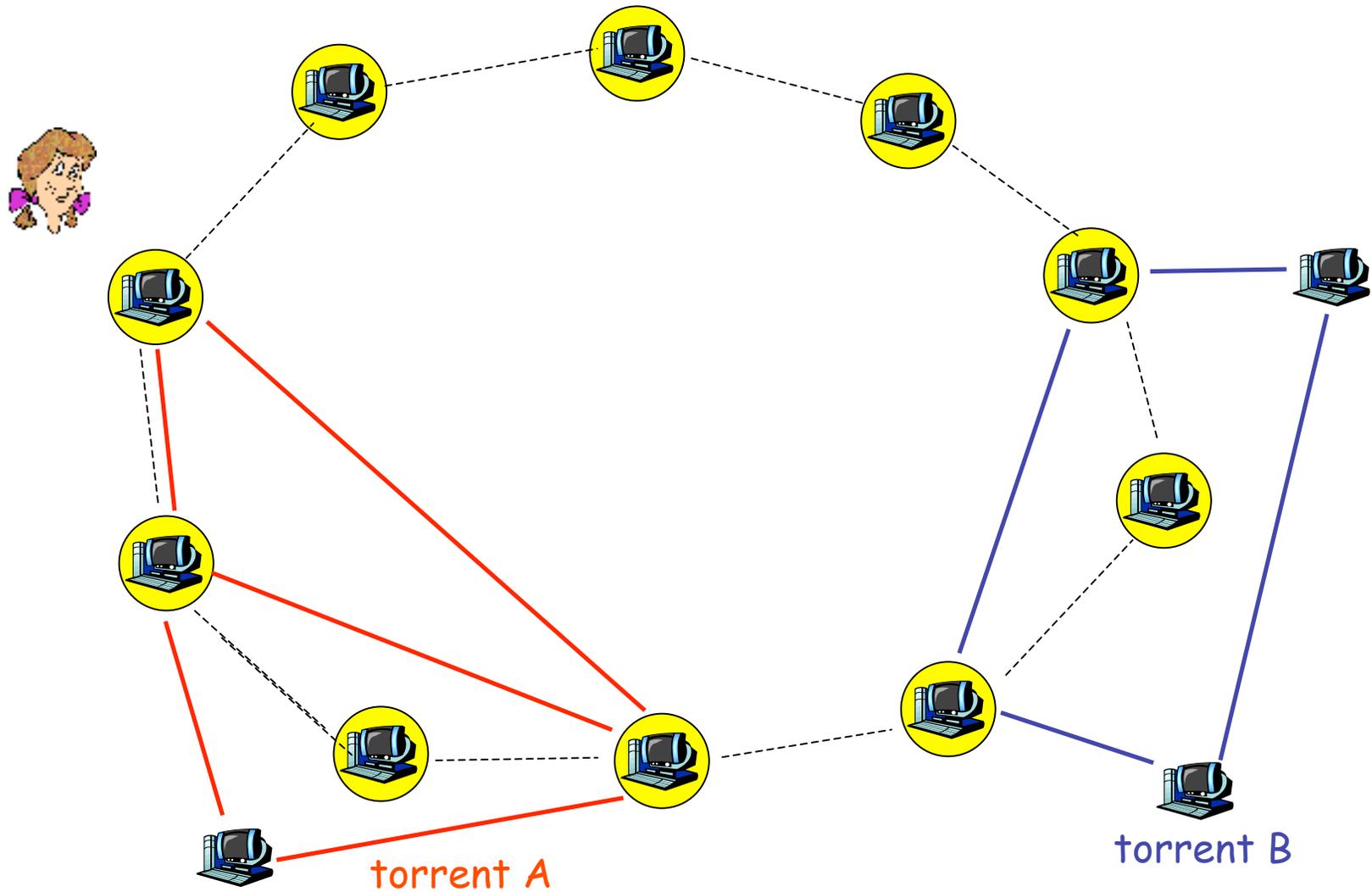
torrent A

torrent B

Evolving BT Ecosystem

- 5-10 million users
- Peer exchange (gossiping)
- Private torrents
  - Invitations
  - Psswd protected

- Seeding algorithms
  - Fastest downloaders
  - Round-robin
- Broadcatching
  - RSS feeds
- Interdiction companies
  - Decoy, leecher, seed attacks

BitTorrent: Incentive

- Torrent as whole benefits when all peers upload

- Question: What is the incentive to upload at higher rate?

- Answer: To get file faster

- Implementation: Tit-for-tat

P2P Live Streaming:
Many Incompatible Systems

ppStream

Coolstreaming

Eco-system for Live P2P Video?

- ## Common protocol
  - e.g. the P2PP Internet Draft (Basset, Schulzrinne, Matuszewski)
  - Messages and message formats, NAT traversal, enrollment and authentication server, …
- ## Incentive mechanism needed

Incentives for Live Streaming

- Why upload at all?
  - No incentives in existing deployments
- Is tit-for-tat a sufficient incentive?
  - No! Why contribute more upload bandwidth if you're receiving the video at the full rate?
- Main idea:
  - If you upload more, you get better quality.

Joint work with Zhengye Liu, Shiv Panwar, Yao Wang

Layered Video w/ Tit-for-Tat

- Generate multiple layers, each divided into layer chunks (LCs)

Layer 3	LC31	LC32	LC33	LC34
Layer 2	LC21	LC22	LC23	LC24
Layer 1	LC11	LC12	LC13	LC14
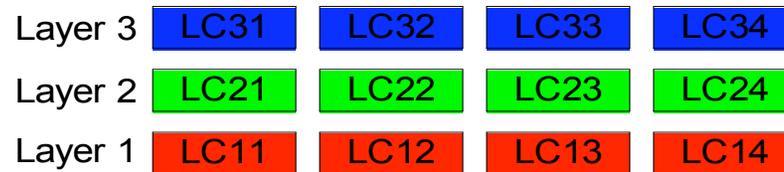
- Exchange LCs

- Measure download rates from neighbors

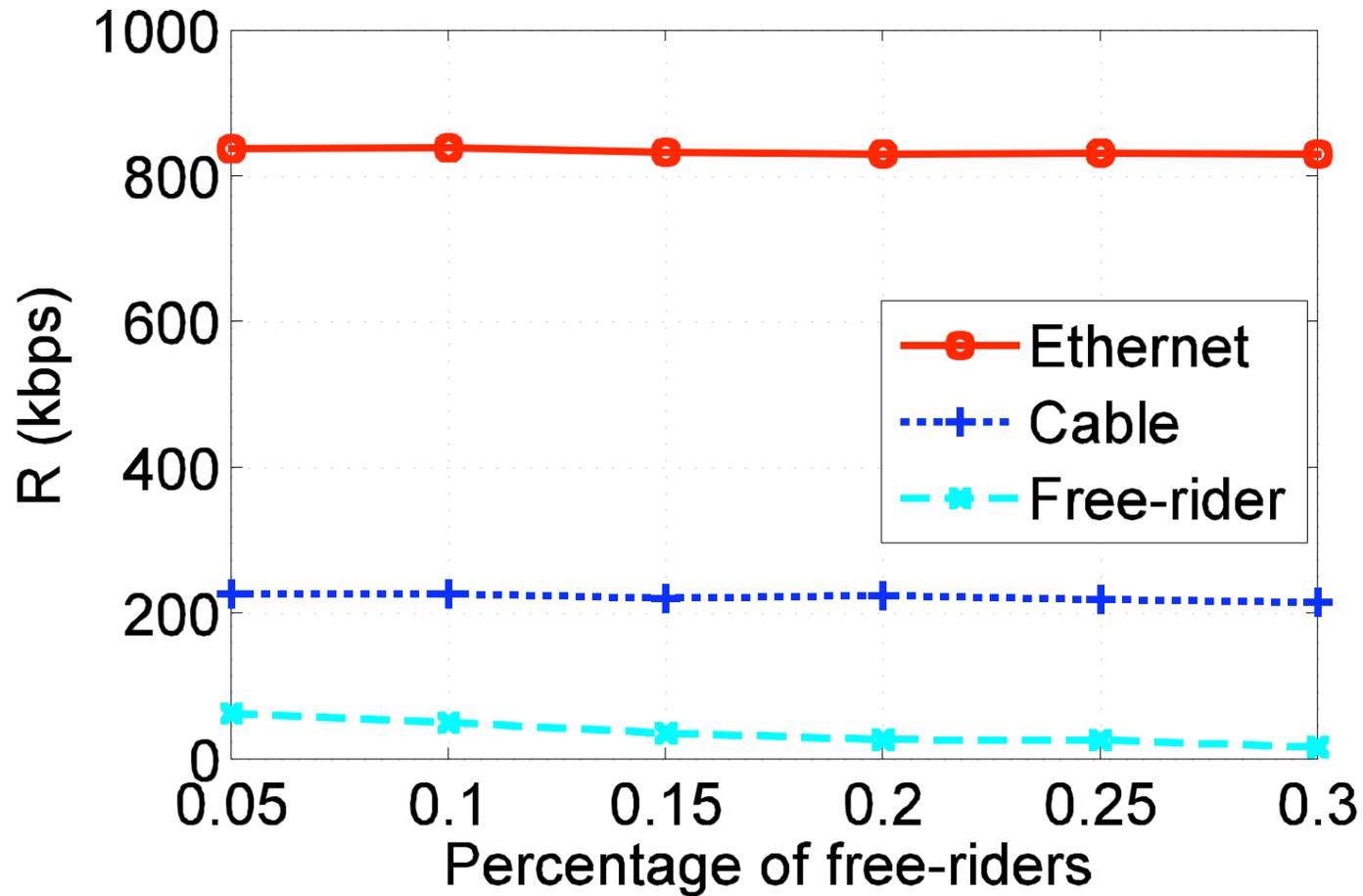- Reciprocate to neighbors based on their contributions

Performance Study Setup

- ## Peers
  - Ethernet peer: 1000 kbps; cable peer: 300 kbps; free-rider: 0 kbps

- ## Video
  - 20 layers, with each layer having a rate of 50 kbps

Differentiated Service
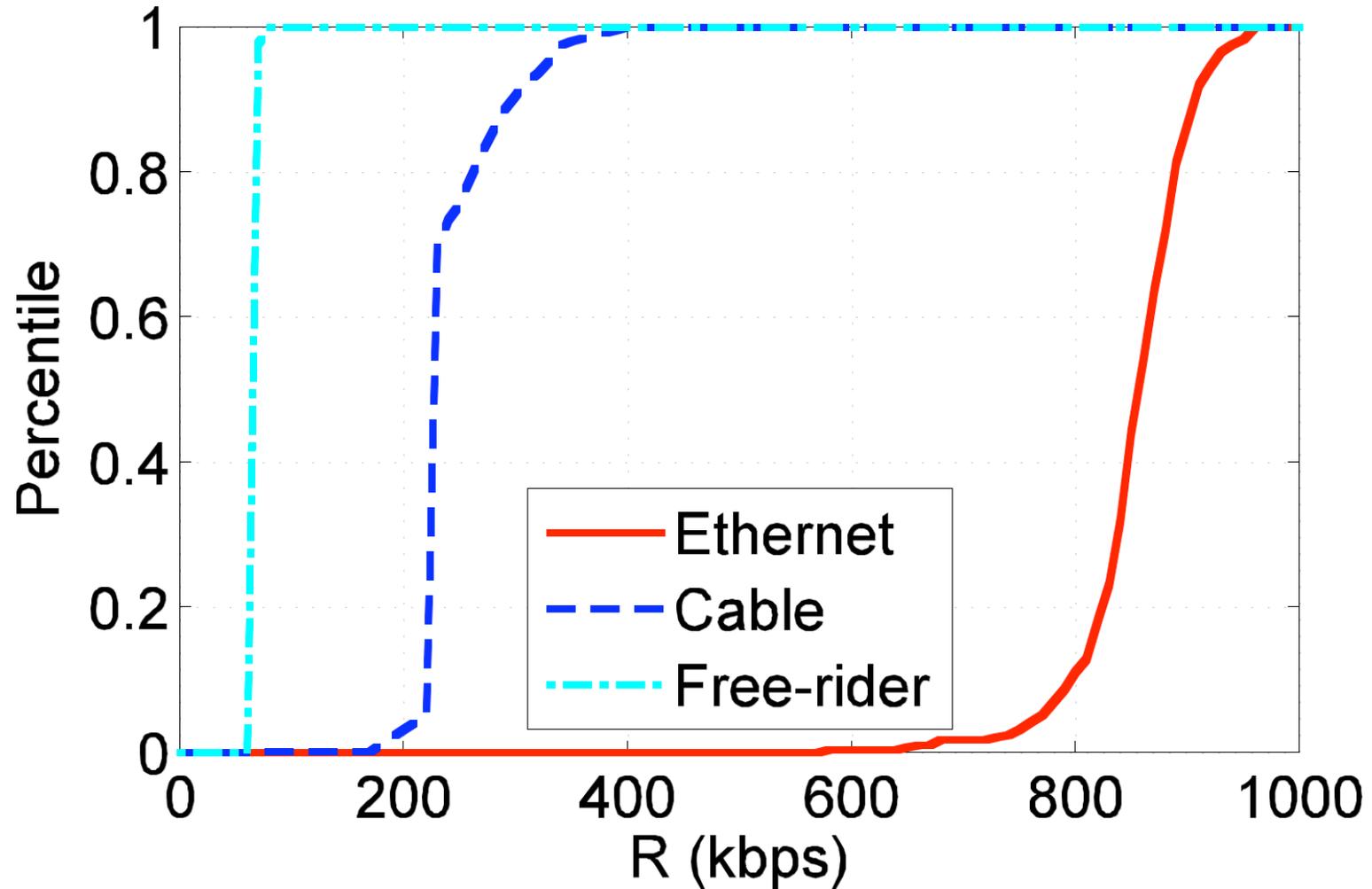
Free-Riding

Conclusion

- BitTorrent has been an enormous success for open protocols.

- Can we replicate with live P2P streaming?

- And with P2P VoD?

- As with BitTorrent, need common protocol and incentive mechanism

Thank You!