On the Impact of Mobile Hosts in Peer-to-Peer Data Networks

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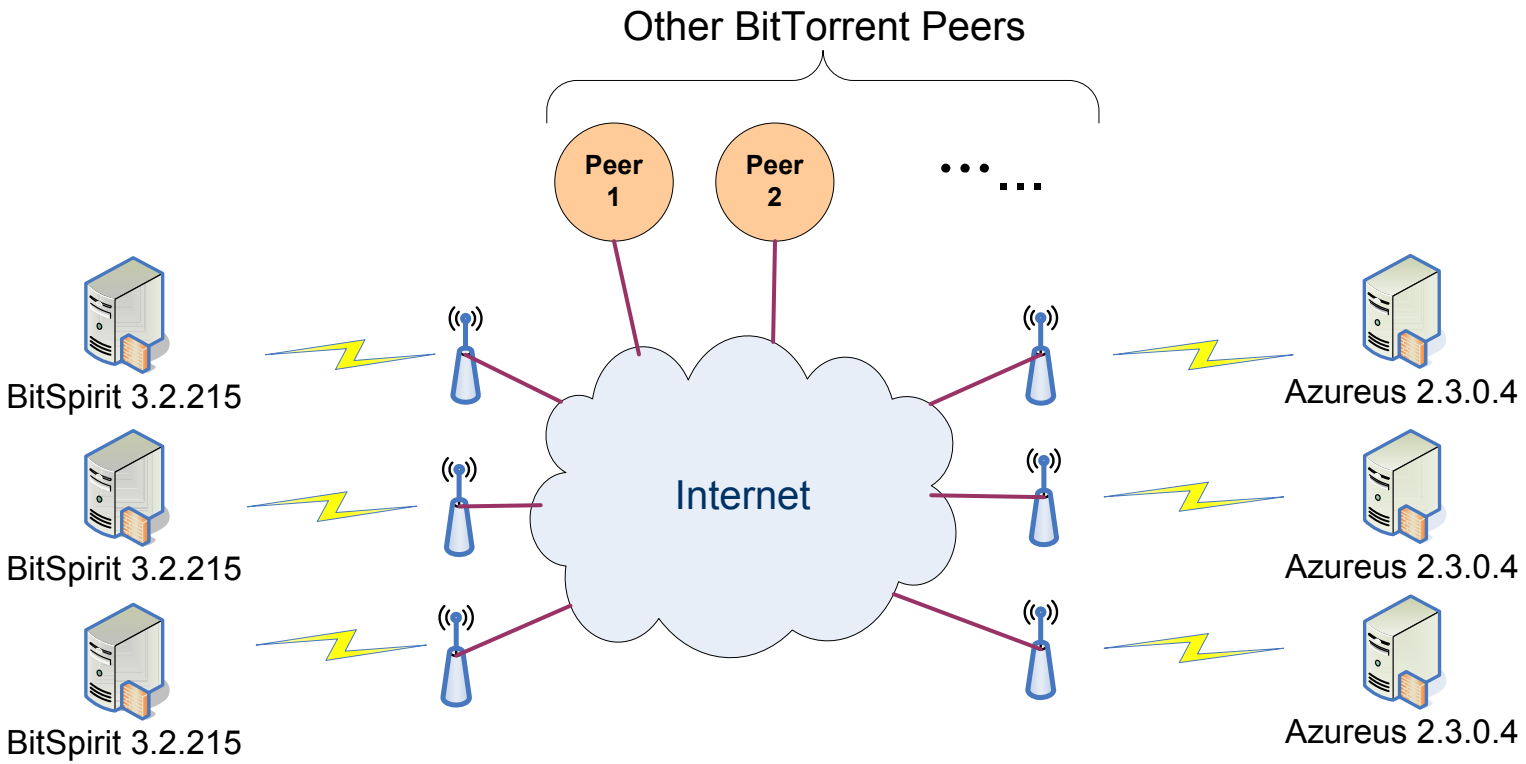
Introduction

- P2P data dominate Internet traffic
- Mobile users join P2P networks
- Questions:
  - Performance of mobile users?
  - Performance of fixed users?
- Mismatches
  - Mobile hosts functioning as servers
  - Use of bi-directional TCP
  - Incentive-based mechanisms
  - Data fetching
- Contributions
  - Identify a set of unique challenges
  - Present a wP2P solution

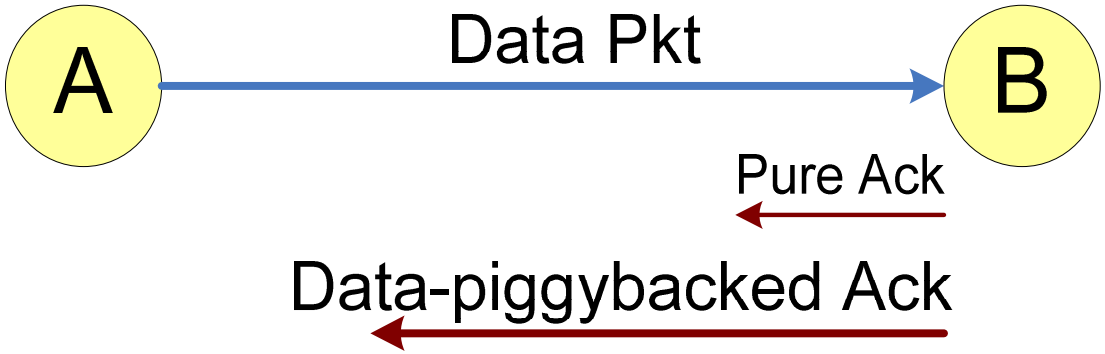
Scope and backgrounds

- P2P data sharing networks
  - BitTorrent
- Wireless technologies and mobile devices
  - Wireless LAN, Laptops
- Metric
  - Throughput
- BitTorrent
  - Torrent, tracker, seeds and leeches
  - Tit-for-tat, rarest-first fetching

Test bed

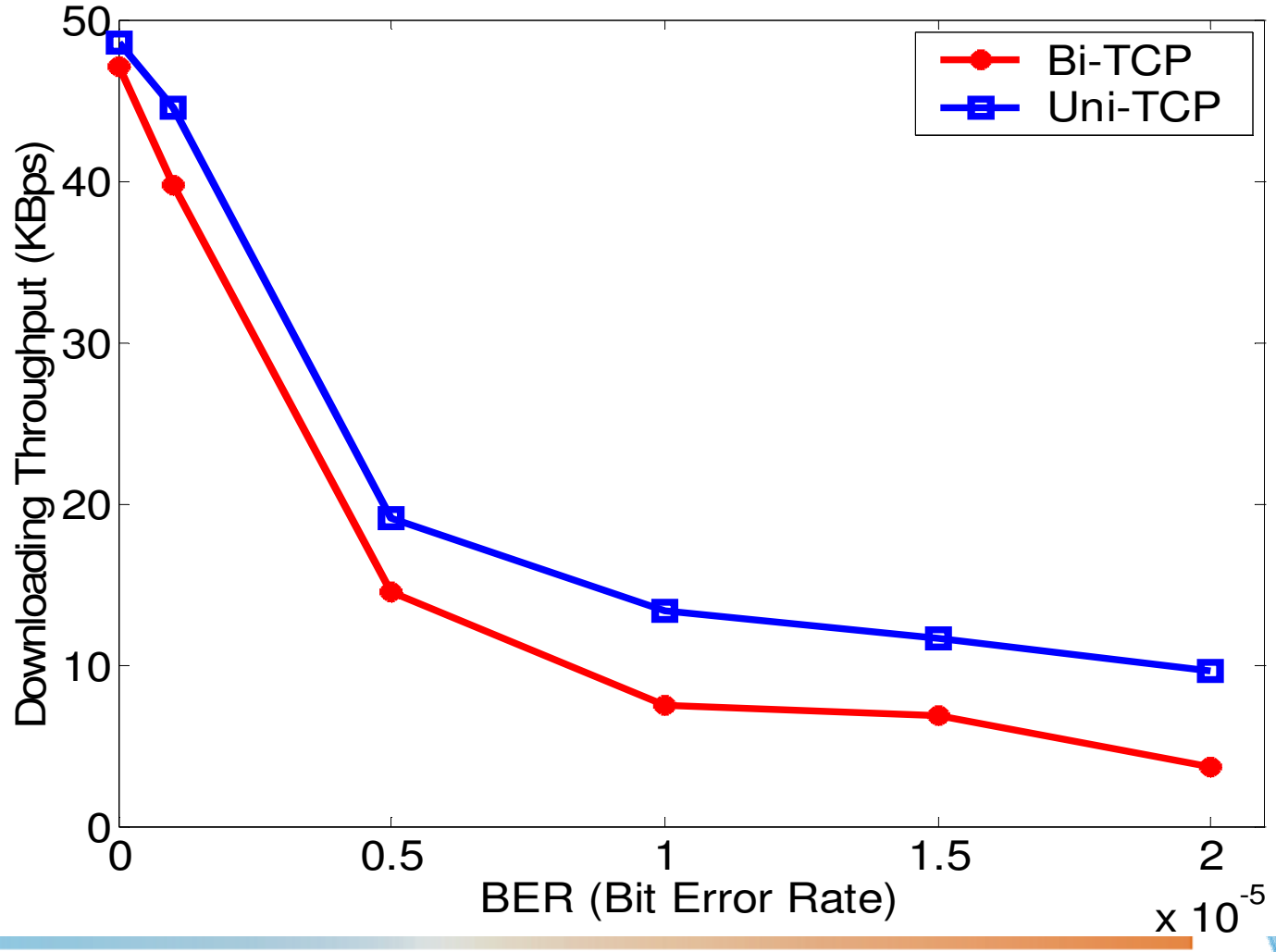

Other BitTorrent Peers
Peer 1
Peer 2
• • • ...
BitSpirit 3.2.215
BitSpirit 3.2.215
BitSpirit 3.2.215
Internet
Azureus 2.3.0.4
Azureus 2.3.0.4
Azureus 2.3.0.4

Motivation: Bi-directional TCP



- Data is exchanged in both directions
- Bi-directional TCP is used to carry data
- Data-piggybacked Ack packets are longer
- BER causes higher PER for longer packets
- Cumulative ACKs, small Cwnd
- Multiple connections cause small Cwnd

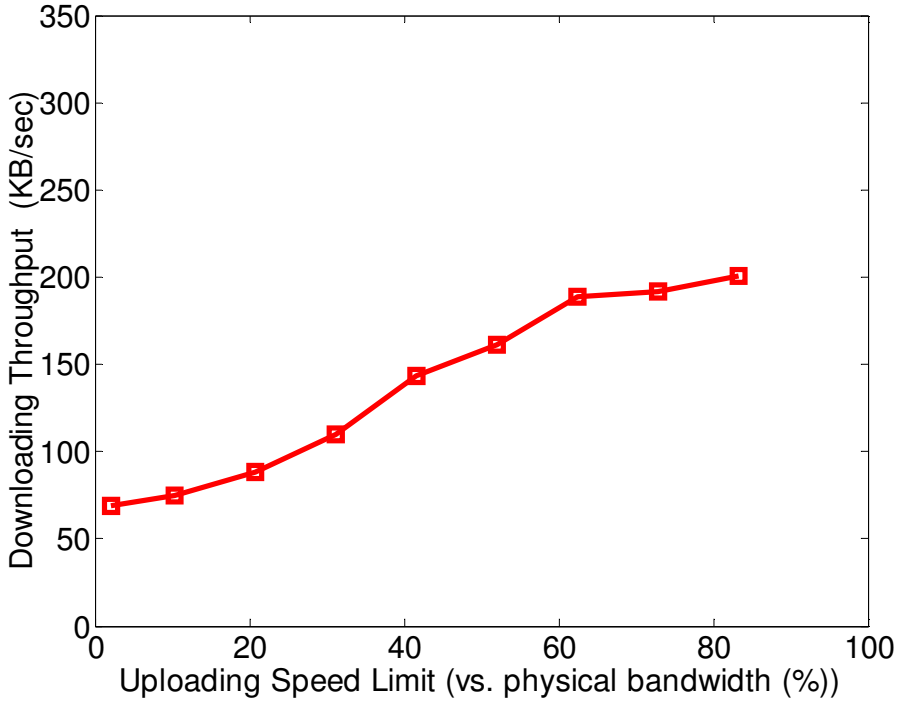
Motivation: Bi-directional TCP



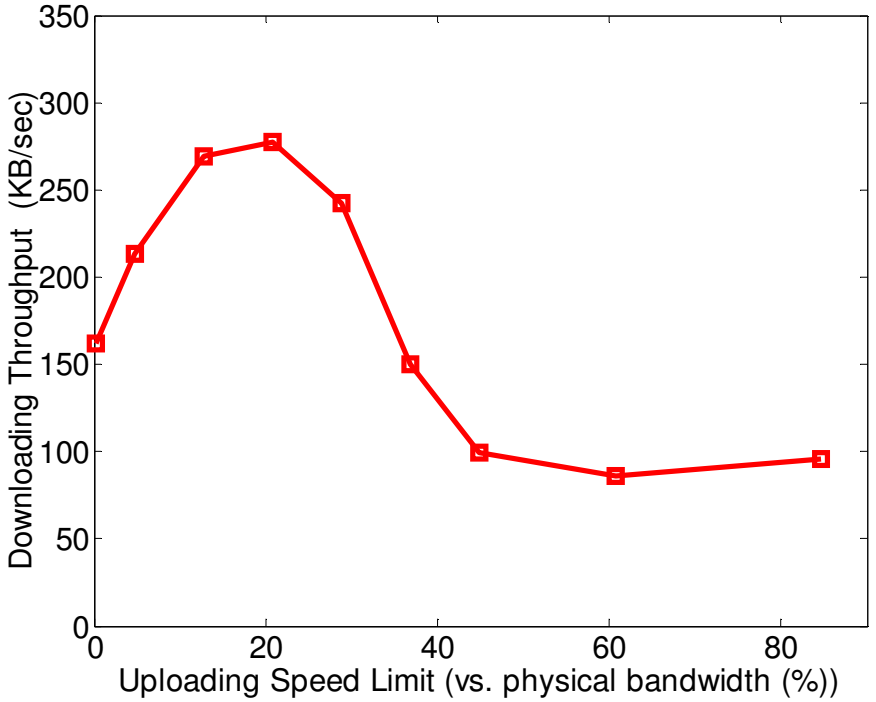
Motivation: Upload-based Incentives

- Incentive mechanisms
- Uploading for downloading
  - It is desirable to upload more
- Not a issue in wired networks
  - 80% of uploading capacity
- A severe issue in wireless networks
  - Contending for shared channel
- Upload or not?
  - Yes; from the incentive's standpoint
  - No; from the contention's standpoint

Motivation: Upload-based Incentives



Wired Networks

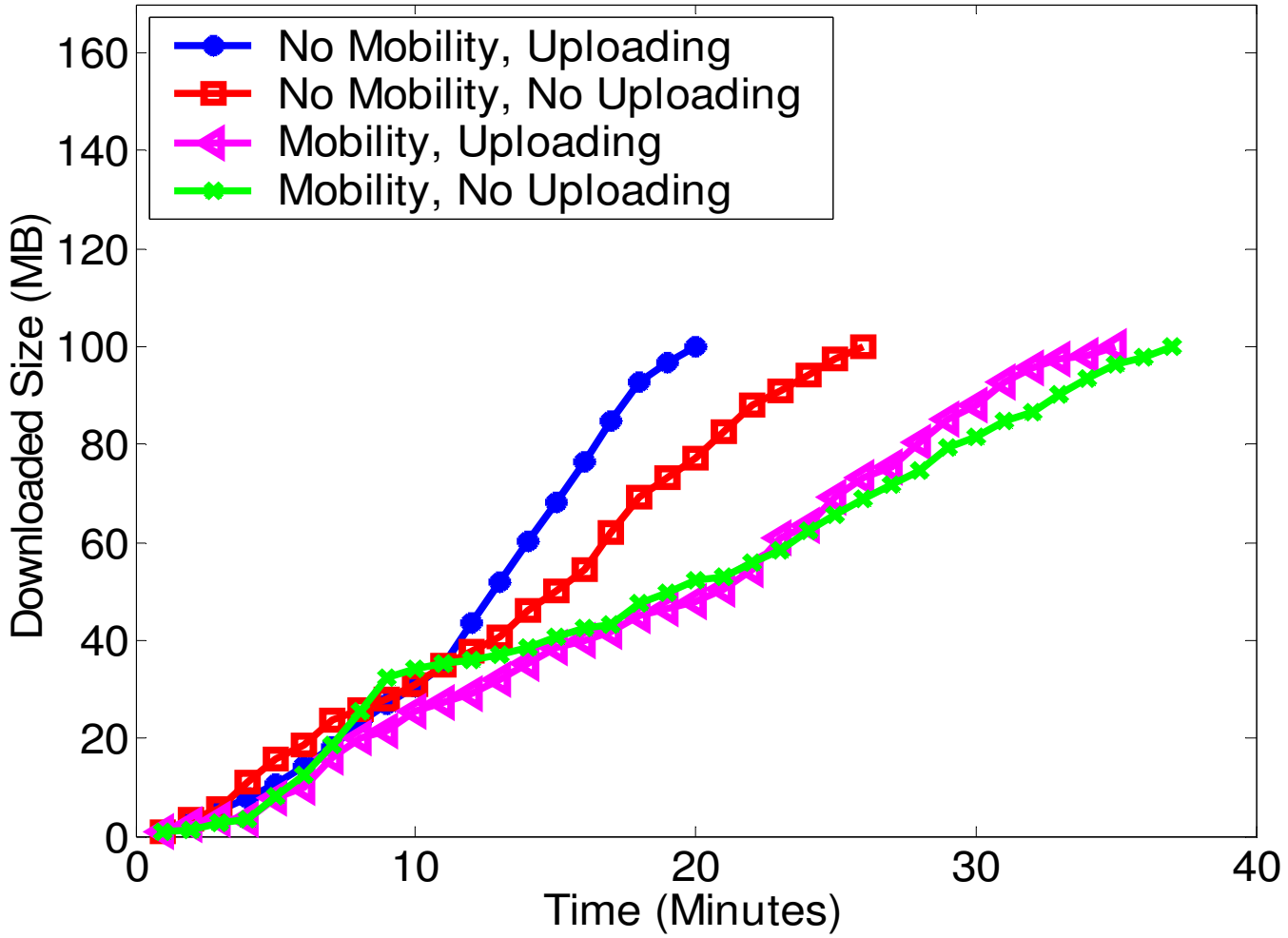


Wireless Networks

Motivation: Incentives and mobility

- Peers are identified by Peer-id
  - Unique identifier
  - Function of IP and random values
- Peer-id is generated with a new task
  - Wired environments rarely have disconnection
- Peers lose incentives in mobile environments
  - Mobile hosts are assigned with a new peer-id
  - Previous incentives are lost

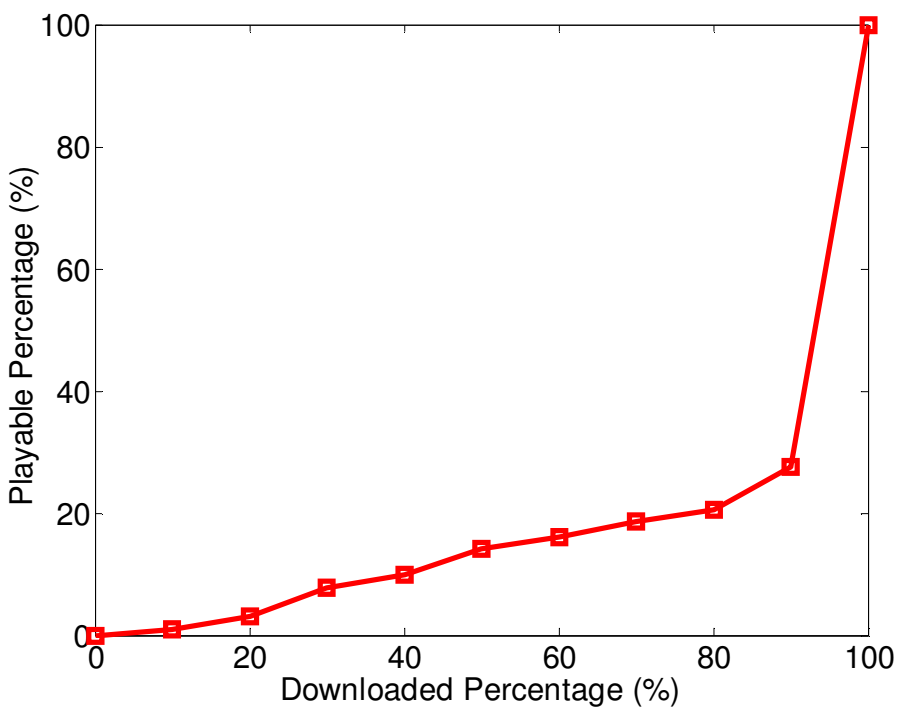
Motivation: Incentives and mobility



Motivation: Rarest-first Fetching

- Out-of-sequence data fetching
  - Rarest-first or random fetching
- Small playable fraction
  - Many media files allow partial playback
- Design justification in wired networks
  - Allow peers to contribute well
  - Disconnections are rare
- Disconnections in mobile environments
  - Cannot contribute
  - Cannot play

Motivation: Rarest-first Fetching



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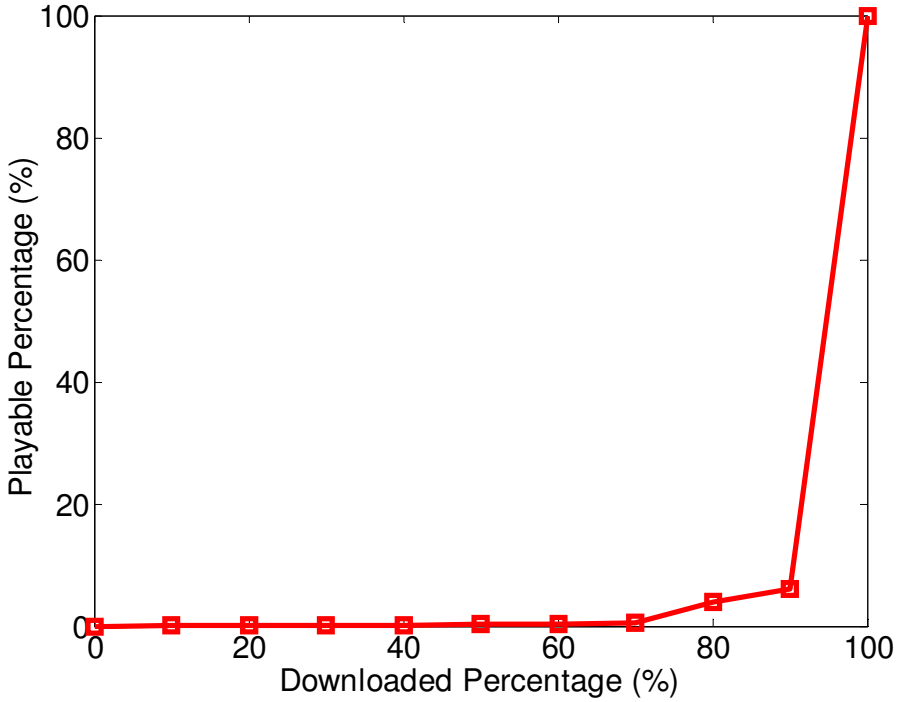

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Solution: wP2P

- Design
  - Age-based manipulation
  - Incentive-aware operations
  - Mobility-aware fetching
- wP2P
  - Client-only solution
  - Compatible with existing applications

Design: Age-based Manipulation

- TCP performance vulnerable to ACK losses only when Cwnd is small
- Adjust based on the age of a connection
- Ages are determined by Cwnd values
  - Young
  - Mature
- Decouple Ack and data when "young"

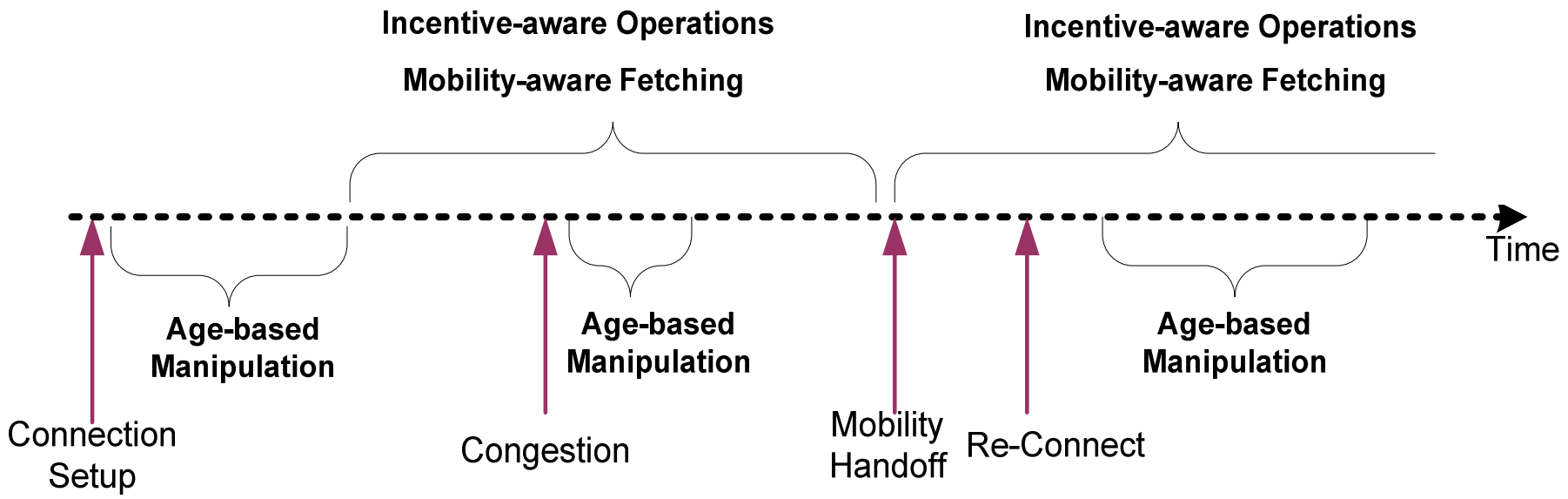
Design: Incentive-aware Operations

- Optimal unloading rate to achieve maximum downloading
- Dynamically adjust the uploading rate
  - Conservative when increasing
  - Aggressive when decreasing
- Incentive maintenance
  - Stores Peer-id when disconnecting
  - Resumes peer-id when reconnecting

Design: Mobility-aware Fetching

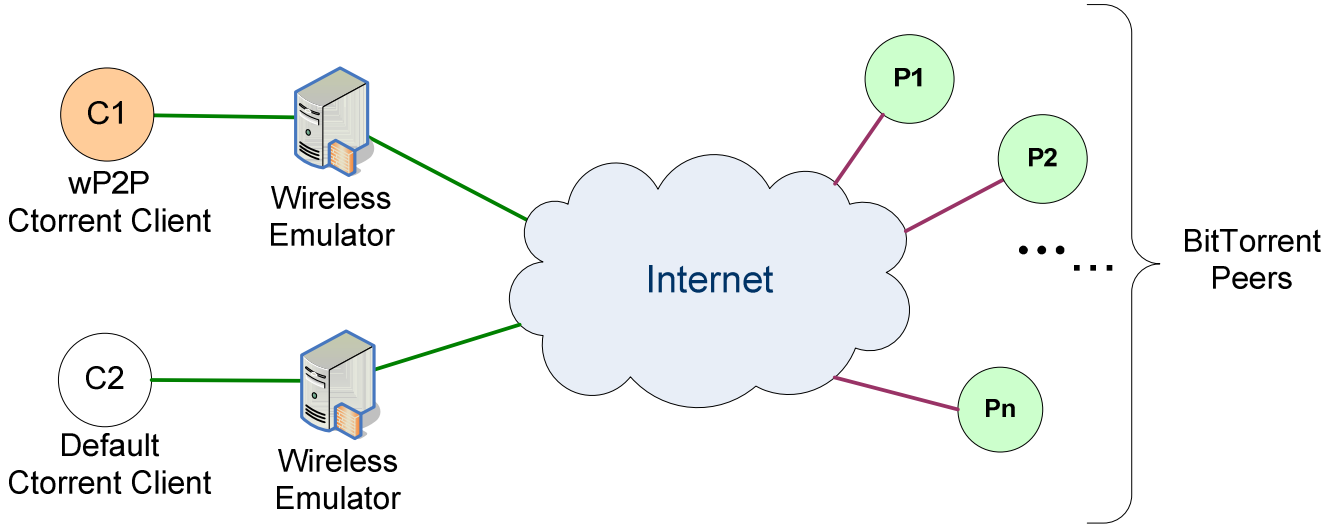
- Dynamically adjusting fetching
  - Decreasing selfishness
  - Increasing altruism
- Reasons for such treatment
  - During disconnections, no benefits of using rarest-first fetching
  - More desirable to fetch sequentially
  - Adjust to rarest-fetching as time goes on

Integrated Operations

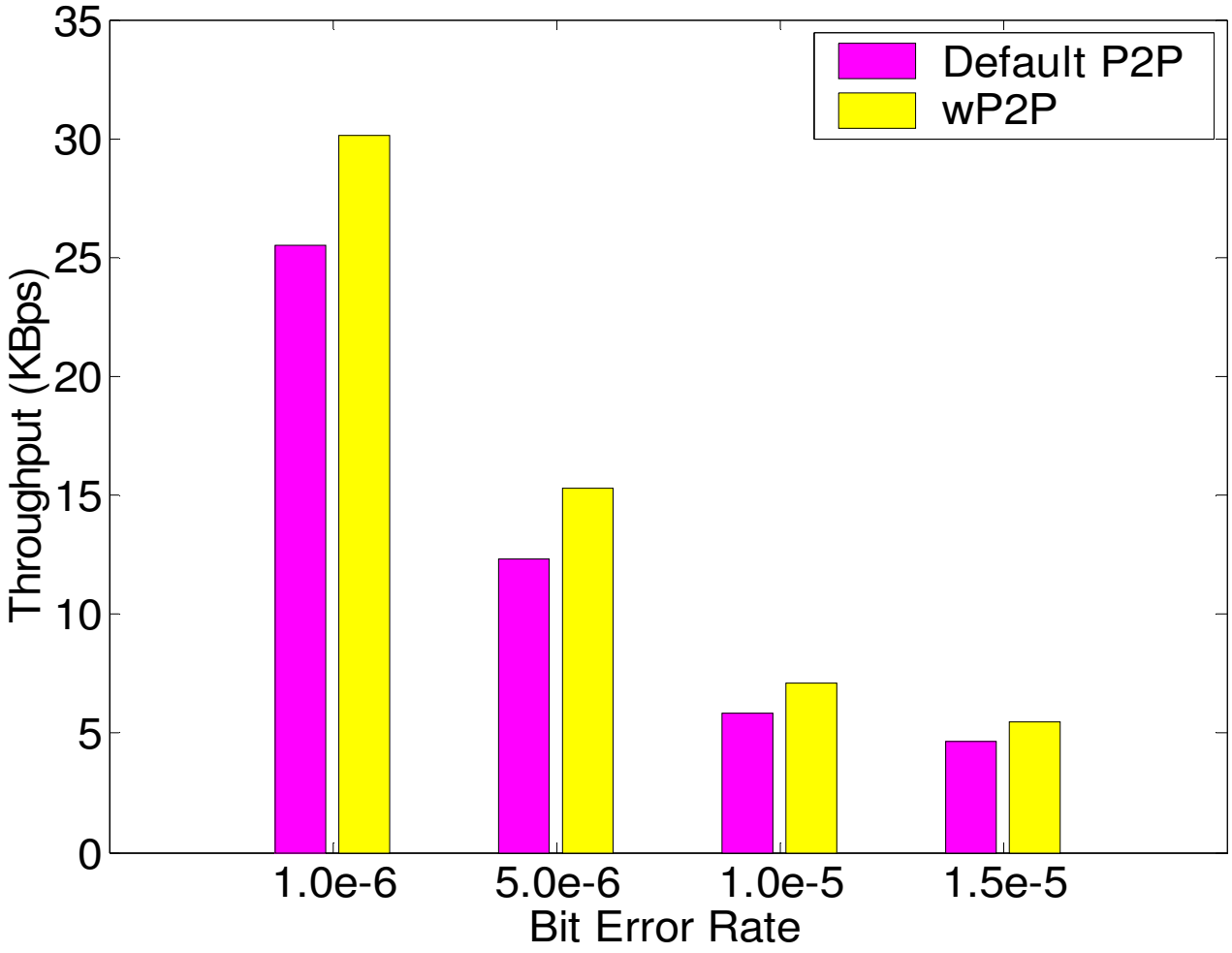


Evaluation

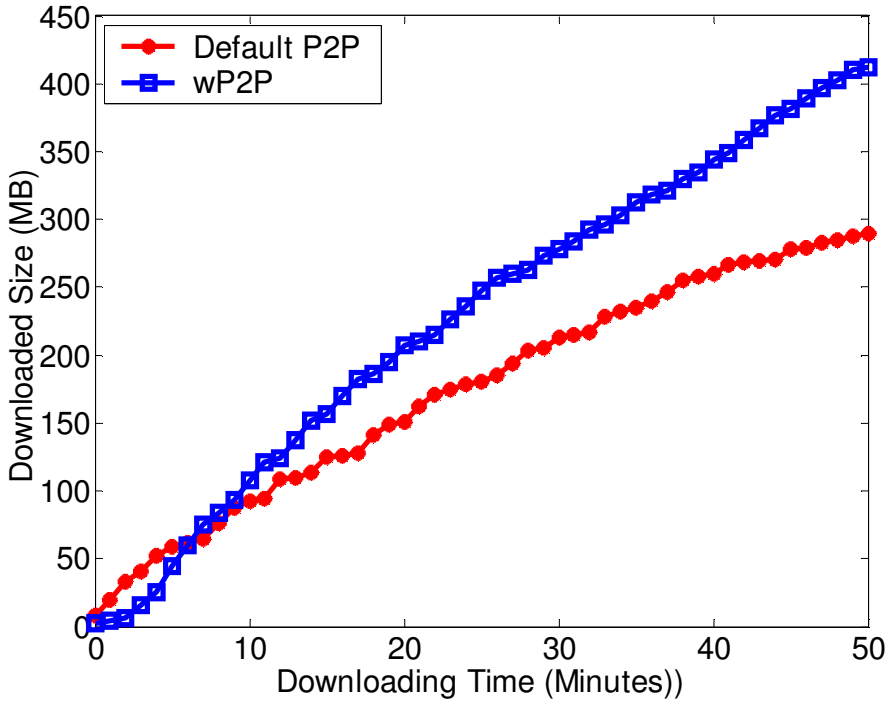
- Prototyping using CTorrent
- Test bed



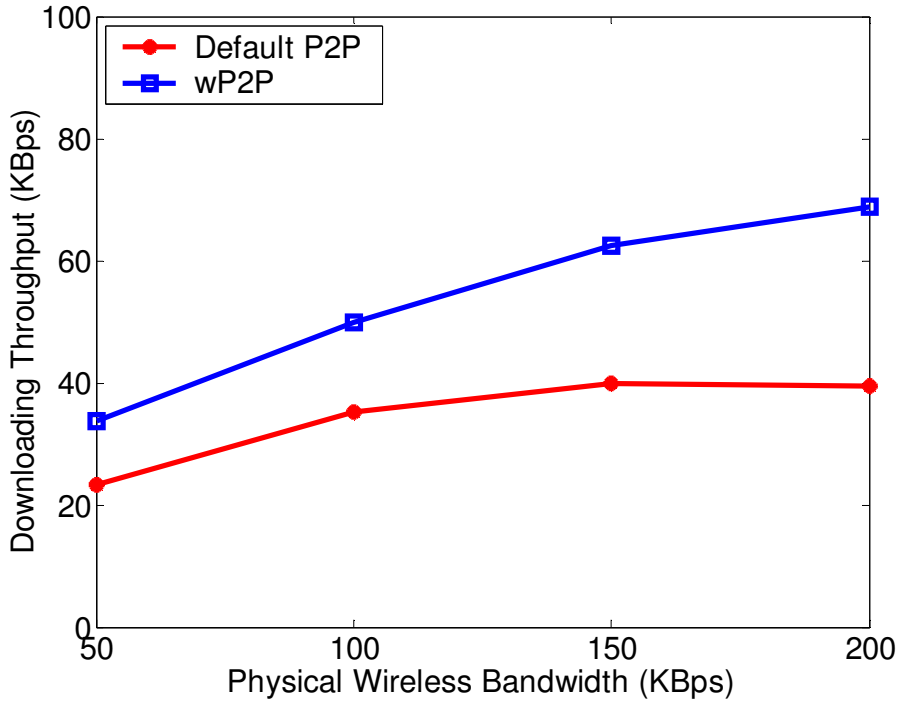
Evaluation Results: AM



Evaluation Results: IA

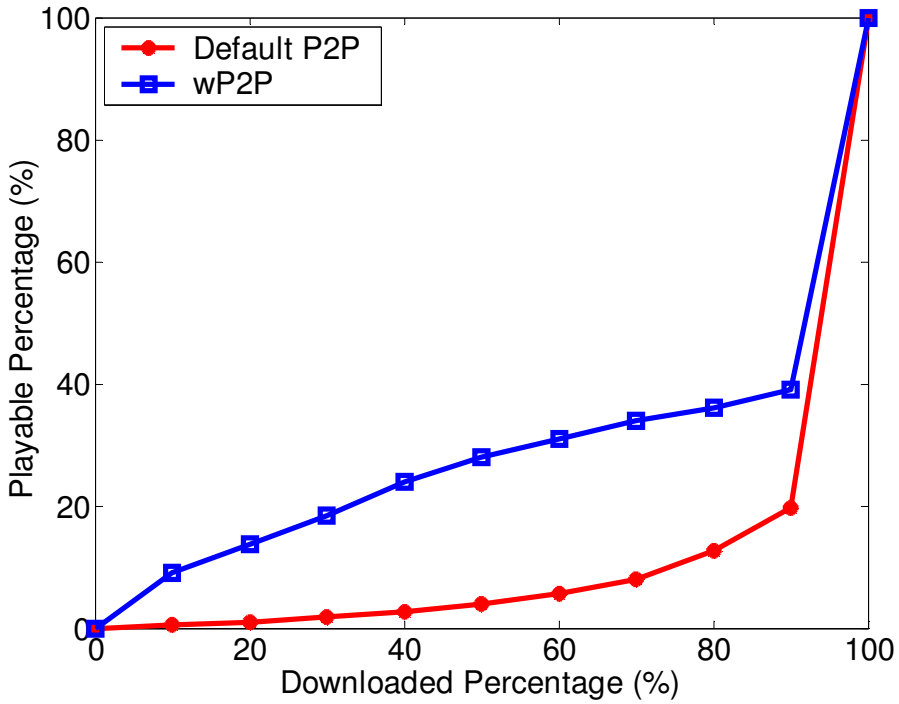


Maintaining Peer-id



Dynamic Uploading Adjustment

Evaluation Results: MF



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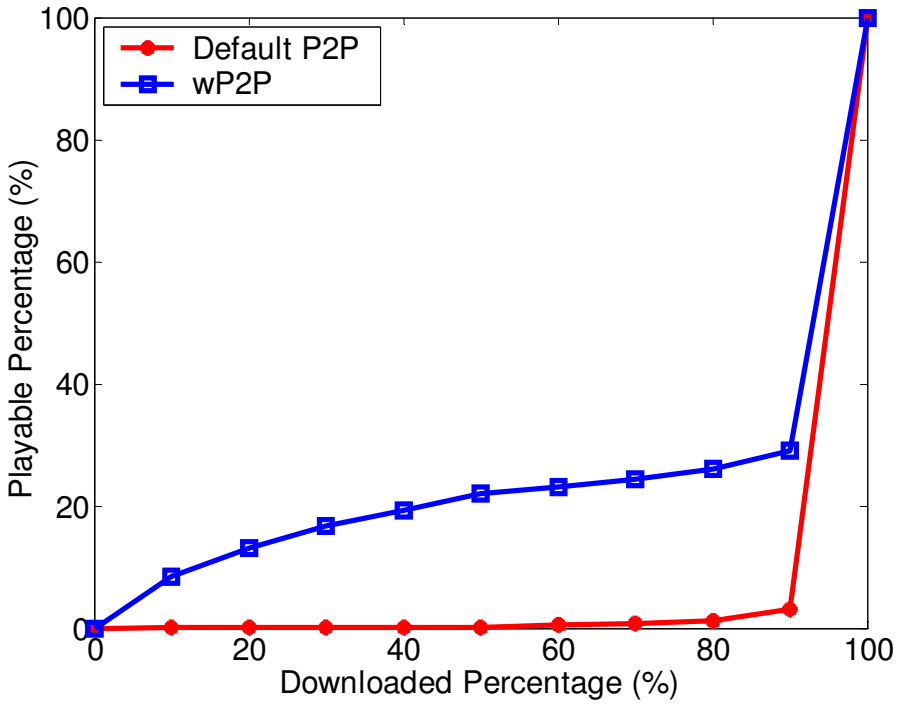

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Related work and Conclusion

- P2P Enhancements
- Other works
- Conclusion

- Thanks!
- Questions?
- Email: zhenyun@cc.gatech.edu