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
**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

![Data Packet Diagram](image-url)
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

![Graph showing downloaded size vs time for different mobility and uploading scenarios.](image-url)
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

5 MB File

100 MB File
**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
Evaluation

- Prototyping using CTorrent
- Test bed
Evaluation Results: AM

![Graph showing throughput vs. bit error rate for Default P2P and wP2P.]
Evaluation Results: IA

Maintaining Peer-id

Dynamic Uploading Adjustment
Evaluation Results: MF

5 MB File

100 MB File
Related work and Conclusion

- P2P Enhancements
- Other works
- Conclusion
Thanks!

Questions?

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