Impacts of Improved Peer Selection on Internet Traffic in BitTorrent Networks

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P. Danielis, J. Skodzik, D. Timmermann
University of Rostock, Germany
Institute of Applied Microelectronics and Computer Engineering

T. Bahls, D. Duchow
Nokia Siemens Networks
Broadband Access Division
Greifswald, Germany
Outline

• Introduction & Motivation
• Computing Hop Count
• Improved Peer Selection
• Evaluation of Original and Improved BitTorrent
• Summary
Introduction & Motivation

Dominating Peer-to-Peer (P2P) traffic, especially BitTorrent

Why traffic engineering challenge?

More subscribers for ISPs*: P2P applications are nice
Traffic engineering challenge for ISPs*: Other traffic is choked down

*Internet Service Providers (ISPs)
Mismatch between **logical P2P overlay** and **physical underlay**
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Introduction & Motivation

Mismatch between **logical P2P overlay** and **physical underlay**

Logical P2P Overlay

Physical Underlay

Hop Count = 3
Reduce physical path lengths (**hop count**): Disburden ISP core network
Introduction & Motivation

Reduce physical path lengths (hop count): Disburden ISP core network

How to provide hop count?
Why should BitTorrent users participate?
Computing Hop Count

Hop Count computation rather than active hop count measurement

```
Initial TTL = 128
IPv4 TTL = 127
Initial TTL = 128
IPv4 TTL = 126
Initial TTL = 128
IPv4 TTL = 125

Final TTL = 125
Initial TTL = 128
```

- Include initial TTL in BitTorrent handshake messages
- Hop Count = Initial Time-to-Live value (TTL) - Final TTL = 3
Improved Peer Selection

Original BitTorrent choking algorithm
- Who may download from me – user A or B?
Improved Peer Selection

Original BitTorrent choking algorithm
- Who may download from me – user A or B?
- Only highest upload performance (UP) decides

User A
UP = 300 MB

User B
UP = 199 MB
Improved Peer Selection

Modified BitTorrent choking algorithm
- Additional peer selection criterion: hop count
- Introduction of quotient = upload performance / hop count
- Introduction of weighting factor (WF) to weight hop count
- Upload performance, hop count, and WF decide

User A
- UP = 300 MB
- Hop Count = 3
- Quotient = 100 MB
- WF = 0.1

User B
- UP = 199 MB
- Hop Count = 2
- Quotient = 99.5 MB
- WF = 0.1
**Improved Peer Selection**

**Modified BitTorrent choking algorithm**

**User A**
- UP = 300 MB
- Hop Count = 3
- Quotient = 100 MB
- WF = 0.1

**User B**
- UP = 199 MB
- Hop Count = 2
- Quotient = 99.5 MB
- WF = 0.1

Cond1:
A’s Quot > B’s Quot?

Cond2:
A’s Hop Count <= B’s Hop Count?
- True
  - A may download
- False
  - B may download

Cond3:
A’s Quot (1-WF) <= B’s Quot?
- True
  - B may download
- False
  - A may download

Cond4:
B’s Hop Count <= A’s Hop Count?
- True
  - B may download
- False
  - A may download

Cond5:
B’s Quot (1-WF) <= A’s Quot?
- True
  - A may download
- False
  - B may download
Simulation Setup

BitTorrent simulation in ns-2 (network simulator)

- Integration of dynamic nature of peers
- User download capacity = 6 Mbit/s, upload capacity = 1.5 Mbit/s
- Seeder = 1
- File size = 100 MB
- Maximum concurrent downloads from a user = 4
Simulation Setup

Topology according to Telefonica’s German network infrastructure (2010)

- Routers = 16

*Broadband Remote Access Server (BRAS)

**Access Node (AN)
Simulation Setup

Topology for ns-2 simulation
- Routers = 16
- BRAS* = 4 per router = 64
- ANs** = 6 per BRAS = 384
- Users = 200 (randomly distributed)

*Broadband Remote Access Server (BRAS)
**Access Node (AN)
Simulation Results

Comparison of original and modified BT algorithm
- Number of physical hops
- Data volume in the core network
- Time necessary for the last user to finish the download

38 measurements for varying WF values
- Mean value of measurements depicted
- Original BT algorithm independent from WF values → constant
Simulation Results

Number of physical hops

In Millions

Weighting Factor

Original BitTorrent

Modified BitTorrent

Reduction > 4 %
Simulation Results

Data volume in the core network

Reduction = 13 %
Simulation Results

Time necessary for the last user to finish the download

That’s why BitTorrent users should participate 😊
Summary: Improved peer selection algorithm for BitTorrent

- Considers hop count as additional selection criterion
- Is a completely self-sufficient approach → no network support necessary
- Disburdens ISP core networks by up to 13%
- Reduces number of hops by up to 4%
- Reduces time for file download by up to 96%

Future work

- Improved peer selection for eMule
Thanks for your attention!

Questions?