Locality-awareness in BitTorrent

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24.11.2010
Agenda

- Problem statement: cross-ISP traffic

- Evaluated Application: BitTorrent
  - The most important mechanisms...
  - ...and their adaptations for locality awareness

- Evaluation methodology

- Results for different scenarios
  - Homogeneous peer distribution
  - Heterogeneous peer distribution
  - Heterogeneous access bandwidth

- Summary & Conclusions
Problem Statement: Cross-ISP Traffic

Cost-efficient scenario: Peer A connects to Peer B (both in ISP 1)

Costly Scenario: Peer A (ISP 1) connects to Peer C (ISP 2); provider boundaries are traversed (ISP1 pays ISP2)

No difference between scenarios, since network topology is unknown!
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Biased Neighbor Selection

Local overlay neighbors with BNS
New Algorithm: Biased Unchoking

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Evaluation Methodology

- Simulation study based on
  - ProtoPeer framework
  - BitTorrent library
- Simulated scenario
  - Single swarm
  - Shared file of size 150 MB
  - Access bandwidth of peers: 1 Mbit/s up-, 16 Mbit/s down
- Steady-state analysis
- Measurements
  - Download times
  - Inter-domain traffic
- Swarm size: around 120 to 200 peers concurrently online, approx. 2300 peers/simulation
Peer Distributions

- Fraction of peer arrivals $P(k)$ in the $k$-th largest AS of a swarm

- Homogeneous distribution
  - Used in most related studies
  - Leads to a win-no lose situation for ISPs and P2P users

- Heterogeneous peer distribution
  - Measured in different studies (Hoßfeld et al., Wang et al.)
  - “Common denominator”:
    
    $$P(k) = \frac{1/k}{\sum_{i=1}^{n} 1/k}, k \in \{1, \ldots, n\}$$
  
  - Leads to different results
Results for Heterogeneous Peer Distributions

High reduction of inter-AS traffic
- Improvement on the effects from BNS with BU
- Pure locality-awareness leads to unfair download times
Impact of Heterogeneous Access Bandwidth

- **Scenario**
  - Homogeneous peer distribution over the 20 ASes
  - 10 ASes with fast peers (1 Mbit/s up, 16 Mbit/s down)
  - 10 ASes with slow peers (256 kbit/s up, 4 Mbit/s down)

- **Locality-awareness**
  - Increases the performance of the fast peers
  - Decreases the performance of the slow peers
  - Decreases the average performance of all peers
Conclusions

- Inter-AS traffic is problematic due to its amount and cost impact
- Locality-awareness is one generally accepted solution for this
  - We developed BU in addition to the existing BNS
- The straightforward approaches lead to mixed results in heterogeneous scenarios
  - Result of a simulation study based on extensive BT measurements
- Countermeasures feasible without sacrificing too many benefits
  - Example: AS grouping