Performance Evaluation of CCN

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Our Project Overview

• Performance Enhancement of Content-centric Networking
  – Sponsor: Korea Institute for Advancement of Technology
  – International Collaborative R&D Program
  – Overall Period: November. 1. 2011 ~ October. 31. 2013 (2 year project)
  – Lead Organization: Seoul National University
  – Participating Organizations: Korea Telecom, Samsung, PARC
Our Project Goals

• Goal: Address the inefficiencies in the current Internet caused by data explosion and resulting content dissemination

• What we propose to do
  – Conduct thorough evaluation of CCN to understand and quantify its scalability and performance
  – Develop use cases that can be deployed and commercialized
Progress to date

• Contribution to IRTF ICN RG
  – “Benefits and Research Challenges of Content-Centric Networking”
  – Advantages of CCN over current technologies such as CDNs
• Performance comparison of caching strategies in CCN using real P2P Traces
• Mobile CCN Experiment
  – CCN-aware evolved NodeB (eNB, wireless base station) implementation
Talk Outline

• Contribution to IRTF ICN RG
  – “Benefits and Research Challenges of Content-Centric Networking”
  – Advantages of CCN over current technologies such as CDNs

• Performance comparison of caching strategies in CCN using real P2P Traces

• Mobile CCN Experiment
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Performance Comparison of Caching Strategies in CCN using Real P2P Traces
Overview

• **Motivation**
  – One of the key features of ICN: universal caching
  – Is universal caching suitable for ICN?
    • *Information-Centric Networking: Seeing the Forest for the Trees*, ACM Hotnets’11
    • *Cache “Less for More” in Information-Centric Networks*, IFIP networking’12

• **Goal**
  – Evaluate and compare the performance of caching strategies using real P2P traces
    • *Single-positioned caching VS. universal caching*
Evaluation Approach (1/2)

• Trace-based simulation
  – Comparison of strategies
    • Universal caching (across all the routers) with small cache size
    • Single-positioned caching (border gateway) with large cache size

\[
\sum \text{cache size of universal caching routers} = \sum \text{cache size of single-positioned caching router}
\]

– Performance metrics
  • Completion time, hop count, hit ratio

– User requests
  • Generated from real P2P trace

<table>
<thead>
<tr>
<th>Days</th>
<th>2011.04.01 ~ 2011.04.07</th>
</tr>
</thead>
<tbody>
<tr>
<td>Category</td>
<td>Movie &amp; TV shows</td>
</tr>
<tr>
<td>Region</td>
<td>USA 20 states</td>
</tr>
<tr>
<td># of requests</td>
<td>181,113</td>
</tr>
</tbody>
</table>
Evaluation Approach (2/2)

- Tree topology with depth of 2
  - # of routers is chosen proportional to traffic-volume
  - First appearance of the P2P seeder is selected as content source
Preliminary Results (1/2)

• Intra-AS
  – Universal caching handles intra-AS traffic better
  – Since reachability of cache is improved for local traffic
Preliminary Results (2/2)

• Inter-AS
  – Single-positioned caching supports inter-AS traffic better
  – Since cache hit tends to occur on the destination AS in the universal caching case
Summary and Future Work

• Initial experiments
  – Trade off between universal caching and single-positioned caching
    • Universal caching supports intra-AS traffic better
    • Single-positioned caching handles inter-AS traffic better

• Future Work
  – Evaluate caching performance for other traffic scenarios and topologies
  – Conduct experiments on test-beds such as PlanetLab
Mobile CCN Experiment
Mobile CCN (1/3)

• Goal
  – Evaluate the benefit of CCN in mobile environment
    • CCN-aware eNB (base station) implementation

• Experiment environment

<table>
<thead>
<tr>
<th>Entity</th>
<th>New Functions for Mobile CCN</th>
</tr>
</thead>
<tbody>
<tr>
<td>UE</td>
<td>• End-device that supports CCN protocol</td>
</tr>
<tr>
<td>eNB</td>
<td>• Base station that filters CCN Packets</td>
</tr>
<tr>
<td></td>
<td>• Forwards CCN Packets between UE and Local CCN Node</td>
</tr>
<tr>
<td>Local CCNx Node</td>
<td>• Supports CCN protocol</td>
</tr>
<tr>
<td></td>
<td>• Supports Content Store</td>
</tr>
<tr>
<td></td>
<td>• Fetches Content from neighbors or wired CCN Node</td>
</tr>
</tbody>
</table>
Mobile CCN (2/3)

• Test scenario 1
  – Multi-Requests: UE1 requests the content A at time T(s) and UE2 requests the Content A at T+100(s)

• Test result
  – Single backhaul traffic is observed for multiple requests in live streaming (benefit of PIT)

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<th>Mobile CCN</th>
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<tbody>
<tr>
<td>Download Speed</td>
<td>1.2Mbps</td>
<td>1.2 ~ 8 Mbps</td>
</tr>
<tr>
<td>Backhaul Usage</td>
<td>34MB</td>
<td>17MB</td>
</tr>
<tr>
<td>Internet Usage</td>
<td>34MB</td>
<td>17MB</td>
</tr>
</tbody>
</table>
Mobile CCN (3/3)

• Test scenario 2
  – UE3 requests the content A after neighbor local CCN node stored content A

• Test result
  – No backhaul traffic is observed when neighbor Local CCN Nodes have the contents.
    → Contents are fetched from neighbor Local CCN Node 1

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only control traffic for Interest packet
Summary

• International Collaborative R&D Program
  – Performance Enhancement of Content-centric Networking

• Performance Comparison of Caching Strategies in CCN using Real P2P Traces

• Mobile CCN
  – CCN-aware eNB implementation to evaluate the benefit of CCN in mobile environment
Discussion