Optimizing Video P2P Streaming over Wireless Mesh Networks

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Outline

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Introduction

• Internet paradigm is changing in the recent years

• WLANs are
  – Changing the way people access Internet
  – Contributing to the Always Best Connected concept
  – Wireless Mesh Networks (WMN) enables further possibilities

• Peer-to-Peer is playing a decisive role in Internet
  – P2P traffic produced is one of the dominant on the Internet
  – User-side overlay networks created over physical networks
  – Video P2P is an emerging research topic
Work Context: WMN

- WMNs are dynamically self-organized and self-configured

- WMNs features
  - Links to multiple neighbours
  - L2 routing
  - Extended coverage

- Can be deployed on
  - Urban centres
  - Shopping areas
  - Public transportation systems

- Some standards
  - 802.11s, 802.15.5, 802.16j
Work Context: Video P2P

- Distribution types
  - Video-on-demand
  - Live feed streaming

- Applications can be classified as
  - Tree based
  - Swarm based

- Important parameters
  - Delay
  - Jitter
  - Chunk priority
Work Context: Swarm based

- Similar with the traditional P2P file sharing
- Each peer can receive from multiple parents
- A peer can be parent or child in different times
  - Request-reply scheme
  - More flexible
- More resilient to node departures
- Allows better support for mobility
Work Context: Motivation

- **P2P applications**
  - Deployed over physical networks
  - Peers selected from those having the demanded contents
  - Closest path defined at the application layer
  - Application layer paths may be suboptimal

- **In the Internet is difficult to match the physical and the overlay topologies**
  - Multiple domains and types of routing
  - Not all nodes support applications
  - Usually only the edge nodes are in the overlay network
Work Context: Motivation

- In Wireless Mesh Networks, these limitations may not apply

- WMNs have features that may improve P2P performance:
  - Routing behaviour similar to P2P applications
  - Nodes often appear/disappear/move, as in P2P applications
  - Most of the nodes may contain P2P application layer

- WMN topology and overlay topology can mapped in more effective way
Problem Statement: Reducing duplicated content

- In real-time more than one node may need the same chunk
  - Duplicated content
  - Wasted bandwidth

- Minimize requests for the same chunk
  - Opportunistic capture
  - Multicast-like behaviour but maintains P2P nature
  - Avoid nodes using other streams
  - Define routes (dynamic trees)
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Testbed

- 3 virtual machines
- P2P App: Swarmplayer
  - Swarm-based app
  - Uses modified Bittorrent
- Video stream of 100 kbyte/s
- Traffic captured at middle node
  - Application based on libpcap
  - Stores data for P2P app
  - P2P app modified to use capture data
Results

• Objectives
  - Show the reduction of duplicated content
  - Usage of the links

• 4 flows defined
  - Seeder to middle node
  - Seeder to farthest node
  - Middle node to farthest node
  - Farthest node to middle node

\[ T_{\text{total}} = T_{s \rightarrow m} + T_{s \rightarrow f} + T_{f \rightarrow m} + T_{m \rightarrow f} \]
**Results: Duplicated Content – Original Solution**

![Diagram of network with nodes S, M, F and traffic flow]

\[ TFS = \frac{T_{s \rightarrow m} + T_{s \rightarrow f}}{T_{total}} \]

\[ TFF = \frac{T_{f \rightarrow m}}{T_{total}} \]

\[ TTF = \frac{T_{m \rightarrow f}}{T_{total}} \]

\[ DT = \frac{T_{\text{duplicated}}}{T_{total}} \]

**Traffic From Seeder**  **Traffic To Farthest node**  **Traffic From Farthest node**  **Duplicated Traffic**
Results: Duplicated Content – Original Solution

\[
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\]

- Traffic From Seeder
- Traffic To Farthest node
- Traffic From Farthest node
- Duplicated Traffic
Results: Duplicated Content – Proposed Solution

Duplicated content reduced from 47% to 1.32%

Almost no traffic between receivers
Results: Link 1

Original solution: 192.52 kbyte/s
Proposed solution: 105.72 kbyte/s
Results: Link 2

Original solution: 109.73 kbyte/s
Proposed solution: 105.72 kbyte/s
Future Work

- Modify Bittorrent to explicit inform other nodes
- Test with more nodes
- Tweak some parameters
- Explore locality awareness
- Address mobility
Conclusions:

• WMNs and Video P2P are emerging

• WMNs can be explored to improve Video P2P performance
  – Reducing duplicated content by opportunistic capture
  – Multicast-like behaviour whilst maintaining P2P nature

• Modified P2P app to support captured traffic

• Results show
  – Reduction of duplicated content using the proposed solution
  – Reduction of traffic on the links - 300 kbyte/s to 211 kbyte/s