

Improving P2P Streaming in Wireless Community Networks

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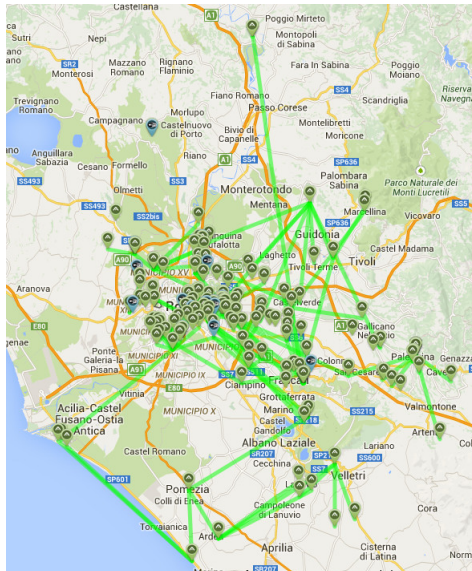
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Outline

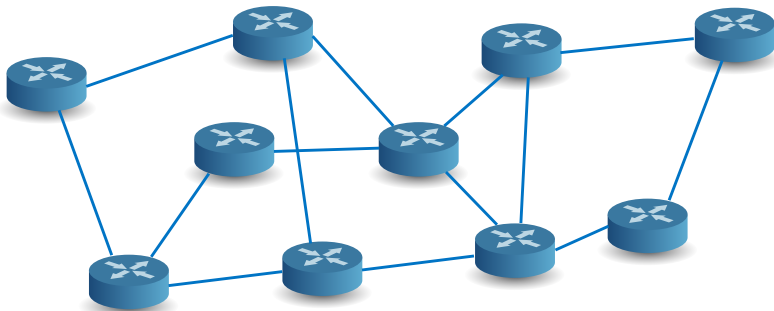
1. P2P on Wireless Community Networks
 - Optimization problem
2. Proposed solution
 - Our model
 - Topology algorithm
3. Our framework
4. Emulation results

Wireless Community Networks

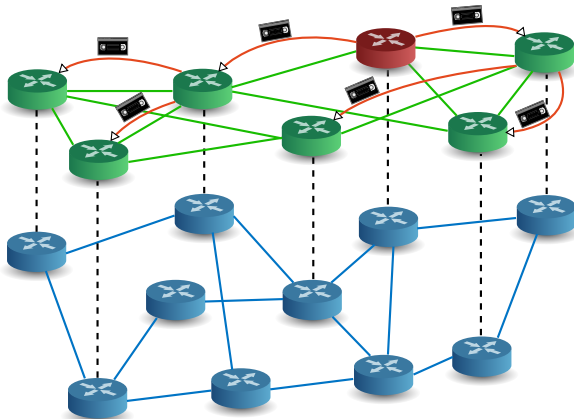


(source: <http://ninux.org>)

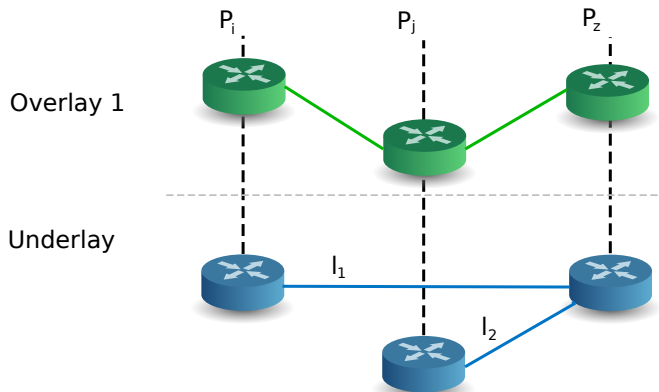
Wireless Community Networks (cont.)



P2P streaming on WCNs

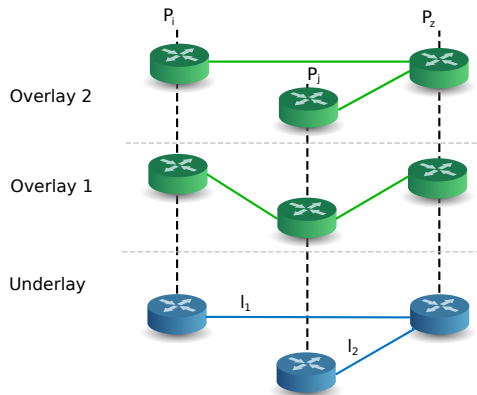


Resource optimization



Overlay 1: $P_i \rightarrow P_j \rightarrow P_z \implies l_1, l_2, l_2$

Resource optimization (Cont.)



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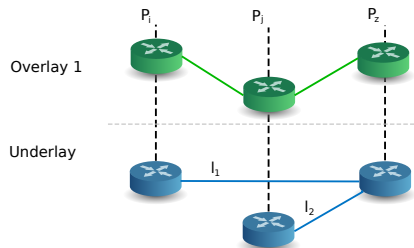
Overlay 2: $P_i \rightarrow P_j \rightarrow P_z \implies l_1, l_2$

Peer paths

- Each peer has to choose a neighbour set

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- Cross-layer path descriptor:
 - $P_i \rightarrow P_j : a_{ij} = (1, 1)$
 - $P_i \rightarrow P_z : a_{iz} = (1, 0)$
 - $P_j \rightarrow P_z : a_{jz} = (0, 1)$



Cross-layer performance functions

- Network load
 - Number of links involved

$$I^o = \sum_{i,j: P_i \text{ is linked to } P_j} \| a_{ij} \|_1$$

- Number of packets sent
- Link fairness
 - Jain fairness

$$F^o = \text{Jain}\left(\sum_{i,j: P_i \text{ is linked to } P_j} a_{ij}\right)$$

- Relative Jain fairness

$$\phi = \frac{F^o}{\text{Jain}(\sum_{i,j} a_{ij})}$$

Cross-layer peer metrics

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- Equalized hop-count metric

$$E_{H_c}(P_i, P_j) = \| W \circ (a_{ij} + b) \|_2$$

where

$$b = \sum_{i,j \neq i} a_{ij}$$

Topology algorithm

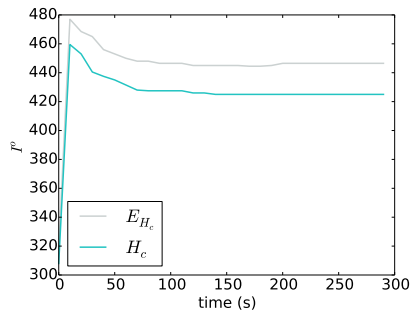
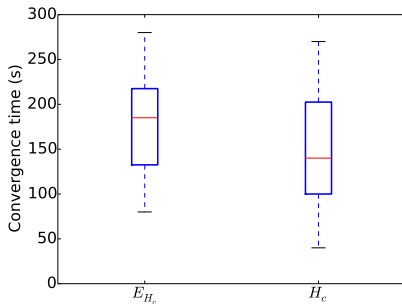
At each topology management loop

1. Get a snapshot of the peers through gossiping
2. Add the peers discovered via gossiping to the set of known peers
3. Order the peers according to a metric (H_c , E_{H_c} or random)
4. Select the best N as neighbourhood

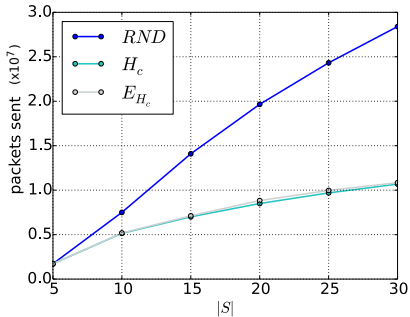
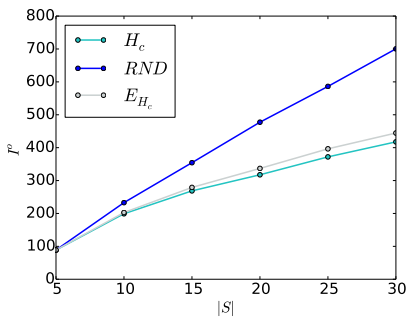
Framework

- Mininet
 - Emulator for software-defined networks
 - Capable of emulating large networks (thousands of nodes)
 - Complete access to the network component characteristics (through netem)
 - Our patches available
- Ninux topology snapshot
- Data from WCN analysis

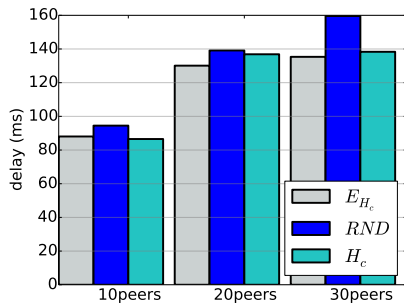
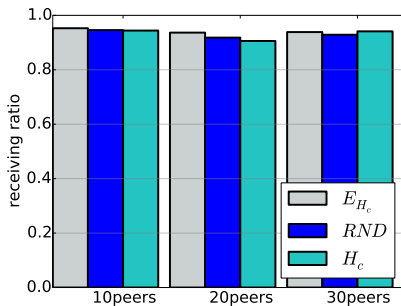
Convergence time



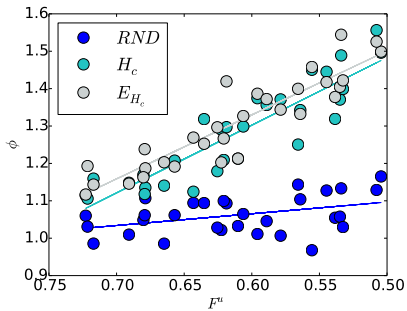
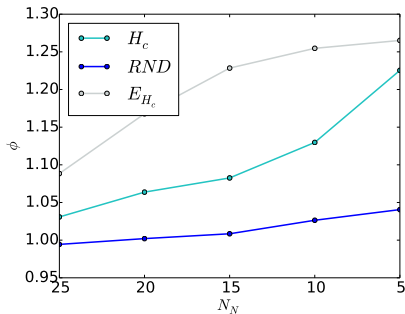
Network load



Streaming performance



Network fairness



Conclusions

- WCNs are an emerging reality all over the world
- P2P services can have a great role among WCN applications
- Cross-layer optimization proves to be a suitable solution for
 - Reducing the P2P network load
 - Increasing the link fairness.

Thanks for your attention

Any question?

