MESHMERIZE

A MULTIPATH WIRELESS MESH ROUTING PROTOCOL

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• We are Ph.D. Students from Deutsche Telekom Chair of Communication Networks at TU-Dresden.

• In the past 10 years, Simon Wunderlich has been actively developing the B.A.T.M.A.N. mesh software, which is also part of the Linux kernel.

• We want to introduce our research project 'Meshmerize' to gather feedback and ask for collaborations.
What is Meshmerize?

- A multipath opportunistic wireless mesh routing protocol based on network coding.
- Exploit the broadcast nature of wireless medium.
- *Relay* nodes - not just packet forwarding; but recode the packet.

Objectives

- High resilience to topology change
- Aggregated throughput from multiple paths
**Typical WiFi Network**

- Packets are acknowledged
- Lost packets are resent

**Coded Network**

- No packet specific retransmissions
- Only sufficient number of linear combinations needed.

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**Encoder**

Generate linear combinations

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**Decoder**

Solve linear combinations
• **Recoder** - mixes packets to create new coded packets

• **Different recoders create different coded packet**
Recoding

• **Recoder** - mixes packets to create new coded packets

• Different recoders create different coded packet
Network coding characteristics

- Resilient in chaotic environments.
- Low feedback required.
- Independent of packet arrival order.
- Applied to mesh network:
  - multihop
  - multipath
Problems with general mesh networks

- Loss compounds with each hop

\[ 0.6 \times 0.5 = 0.30 \]

Network coded Wireless mesh

- Overall link quality is the minimum of individual link qualities

\[ \min(0.6, 0.5) = 0.50 \]

\[ 0.6 \times 0.5 \times 0.5 = 0.15 \]
Problems with general mesh networks

• Loss compounds with each hop

Network coded Wireless mesh

• Overall link quality is the minimum of individual link qualities
Leverage the Broadcast medium

- Route through *corridors*, not paths.
- Every transmission is a custom multicast.
- Relay nodes that hear the packet determines whether to participate in the transmission based on *routing metrics*.
- Different relays hear different packets due to channel losses and therefore contribute uniquely to the transmission.
Leverage network coding characteristics

- Recoders only send out packets upon increase in rank.
- **rank** - number of linear independent packets in the recoder.
- Implicitly avoid **routing loops**.

Not possible because of rank hierarchy
Leverage Multipath

- Dropping of some corridor nodes does not affect the overall route.
- Feedback restricts the number of recoded packets sent.
- No need to wait for periodic updates (like the usual proactive protocols) upon link failure.
- Size of the corridor can be dynamically controlled using the metric.
PRELIMINARY RESULTS

Route A

Throughput (Mbps)

<table>
<thead>
<tr>
<th></th>
<th>BATMAN</th>
<th>NC R2</th>
<th>NC R1</th>
<th>NC MP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Throughput</td>
<td>0.53</td>
<td>0.58</td>
<td>1.54</td>
<td>1.90</td>
</tr>
</tbody>
</table>
We apply network coding in wireless mesh:

• to exploit the broadcast nature of the wireless medium.
• to improve error resilience.
• to (possibly) improve network throughput.
• to eliminate the need for explicit scheduling and path finding.

Currently in evaluation phase.
THANK YOU

Questions or Suggestions?