Forming mesh mobs
multicast optimizations for batman-adv

(Linus Lüssing, Simon Wunderlich)
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Outline

1. Introduction to Multicast
2. Multicast in Mesh Networks
3. Multicast in BATMAN-adv
4. Experimental Platform
Multicast Introduction

Classification

- Communication schemes

Unicast

Broadcast

Multicast
Multicast Introduction

Applications

• Multimedia Streaming: Audio, Video
• Broadcasting of TV or Radio content (IPTV etc)
• Monitoring Systems (Sensors etc)
• Conferencing Systems
• ZeroConf/MDNS (Bonjour, Avahi ...)
• Your application?
Multicast Introduction
Forming Groups

- Network nodes must announce their membership of multicast groups
- IGMP (Internet Group Management Protocol) is used by IPv4 nodes to join or leave groups
- For IPv6, MLD (Multicast Listener Discovery) is used
Multicast Introduction
Addressing (1)

- Source IP/MAC addresses are always [tm] from the sending host, destination addresses depend on the communication scheme

- **Unicast**: Use IP address (Layer 3) and MAC address (Layer 2) in the destination field

- **Broadcast**: Use last IP address of the subnet (Layer 3) or Broadcast MAC address (like FF:FF:FF:FF:FF:FF) in the destination field
Multicast Introduction
Addressing (2)

- **Multicast**: Use Group IP address (one out of 224.0.0.0/4) and according MAC address (01:00:5E:xx:xx:xx)

- Other addresses (e.g. for IPv6 or Cisco) exist

<table>
<thead>
<tr>
<th>IPv4 address:</th>
<th>239</th>
<th>255</th>
<th>42</th>
<th>12</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ef</td>
<td>ff</td>
<td>0c</td>
<td>2a</td>
</tr>
<tr>
<td></td>
<td>1110111111111110000110000011010</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

```
IPv4 Multicast Prefix
```

<table>
<thead>
<tr>
<th>MAC address:</th>
<th>01</th>
<th>00</th>
<th>e5</th>
<th>7f</th>
<th>0c</th>
<th>2a</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>000000001000000000111001010</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

```
last 23 bits
```

```
11111110000110000011010
```
Multicast in Mesh Networks

- Mesh networks support unicast, some support broadcast (batman-adv does)

- Multicast can always be “emulated” by Broadcasting (nodes which are not members should drop)

- Most simple scheme is “Classic Flooding” - a node repeats a broadcast packet when it receives the packet the first time
Multicast in Mesh Networks

Classic Flooding
Multicast in Mesh Networks
Optimized Algorithms

Dense networks
- Group size > 50% of Mesh
- Special Nodes only Forward (MPR)
- Examples: OLSR/MPR, CDS

Sparse networks
- Group size < 50% of Mesh
- Build Distribution Infrastructure
- Only nodes on this infrastructure forward packets
Multicast in batman-adv

- Initial implementation has been developed at saxnet for a customer
- Batman-adv already supports multicast by handling it as Broadcast through Classic Flooding
- Our multicast optimizations are designed for sparse networks
- Communication infrastructure is pro-actively built
Multicast in batman-adv
Membership Announcements

- OGMs are periodically flooded through the network
- Group membership is “sniffed” on the local host
- These MAC addresses are then announced with OGM packets
Multicast in batman-adv
Tracker packets

- Establish distribution infrastructure using tracker packets
Multicast in batman-adv
Payload packets

- Send Multicast Payload via the infrastructure

Diagram: Nodes color-coded:
- Green: multicast member node
- Pink: forwarder
- Gray: non multicast member node

Arrows indicate:
- Multicast data via unicast transmission
- Multicast data via broadcast transmission
Multicast in batman-adv

Advantages

- Builds upon batman-adv unicast routing
- Last node on in a tree does not rebroadcast
- Therefore, massive decrease of duplicates when all nodes are in one hop range
- Packets are only sent to members – useful for local groups
Multicast in batman-adv

Limitations

- Not designed for “big” groups (dense multicast networks) or as general broadcast replacement (overhead too high)
- Current implementation does not distinguish between “senders” and “receivers” (to be done)
- Current implementation only reads local multicast memberships, IGMP/MLD snooping is currently worked on
Experimental Platform

- We have set up a platform for the Workshop
- Nodes are used to distribute multicast data
- A VLC streaming server for voice and video data
Experimental Platform
Instructions

- You may connect with your laptop to Ethernet or ESSID 'batman-mcast-5' or 'batman-mcast-24' and use VLC to view:
  - IPv4 audio: `vlc rtp://239.255.12.42`
  - IPv6 audio: `vlc "rtp://@[ff12::123%wlan0]”`
  - IPv4 video: `vlc rtp://239.255.12.42:1234`