Wireless Internet Routing

Optimized Link State Routing (OLSR) Algorithm and Other Standards
Optimized Link State Routing (OLSR)

- [Jacquet00ietf, Jacquet99Inria]
- RFC 3626 http://www.ietf.org/rfc/rfc3626.txt
- Proactive / link state algorithm for wireless ad hoc and mesh networks
OLSR Overview

- Neighbor discovery
- MPR flooding mechanism
- Topology diffusion mechanism
- Attached networks diffusion
Neighbor Discovery

- Periodic exchange of HELLO messages
  - Link sensing
  - List neighbors
  - Neighbors “Quality”
  - MPR selection

- To maintain link, neighbor, 2-hop neighbor, MPR
# OLSR Generic Packet Format

| Bits: 0 1 2 3 4 5 6 7 8 9 $ |   0   |   1   |   2   |   3   |   4   |   5   |   6   |   7   |   8   |   9   | $ |
|--------------------------------------------------------------------|
| OLSR header:       | Packet Length | Packet Sequence Number |
| Message:           | Message Type  | Vtime                  | Message Size |
|                    | Originator Address |
|                    | Time To Live   | Hop Count              | Message Sequence Number |

```
MESSAGE
```

| Message:           | Message Type  | Vtime                  | Message Size |
|--------------------| Originator Address |
|                    | Time To Live   | Hop Count              | Message Sequence Number |

```
MESSAGE
```
**Hello Packet Format**

<table>
<thead>
<tr>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
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</table>

<table>
<thead>
<tr>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>9</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

**Reserved**

**Link Code**

**Reserved**

**Htime**

**Willingness**

**Link Message Size**

**Neighbor Interface Address**

**Neighbor Interface Address**

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..
```

<table>
<thead>
<tr>
<th>0</th>
<th>1</th>
<th>2</th>
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<tbody>
<tr>
<td>4</td>
<td>5</td>
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**Bits:**

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<table>
<thead>
<tr>
<th>0</th>
<th>1</th>
<th>2</th>
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<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neigh Type</td>
<td>Link Type</td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>
```

**Link code:** contains “link type” and “neighbor type”

**Htime:** Hello emission interval

**Willingness:** willingness to carry and forward
Multipoint Relays (MPR) Flooding

- The overhead of flooding link state information is reduced by requiring fewer nodes to forward the information.

- A broadcast from node X is only forwarded by its multipoint relays.

- Multipoint relays of node X are its neighbors such that each two-hop neighbor of X is a one-hop neighbor of at least one multipoint relay of X:
  - Each node transmits its neighbor list in periodic beacons, so that all nodes can know their 2-hop neighbors, in order to choose the multipoint relays.
Flooding vs MPR
Nodes C and E are multipoint relays of node A

Node that has broadcast state information from A
Optimized Link State Routing (OLSR)

- Nodes C and E forward information received from A

Node that has broadcast state information from A
Optimized Link State Routing (OLSR)

- Nodes E and K are multipoint relays for node H
- Node K forwards information received from H
  - E has already forwarded the same information once

Node that has broadcast state information from A
Topo\text{logy Diffusion}

- **OLSR declares partial topology**
  - All destinations
  - Subset of links
    - Only those which represent MPR selections
  - Only subset of nodes declare topology (MPR)

- **How?**
  - MPR nodes transmit TC (topology control) messages (periodically)
  - TC message contains MPR selector set of the source
    - MPR selector set: enumerates nodes that have selected it as an MPR node
  - TC can be triggered by link failures
Topography Diffusion

- Forwarding path for TC messages not shared among all nodes
  - Varies depending on the source
Topology Control Packet Format

| 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 0 | 1 |
| ANSN | Reserved |
| Advertised Neighbor Main Address |
| Advertised Neighbor Main Address |

ANSN: Advertised Neighbor Sequence Number
Home Network Address (HNA)

- TC disseminate host routes
- HNA disseminate network route advertisements
OLSR Summary

- OLSR floods information through the multipoint relays
- The flooded information itself is for links connecting nodes to respective multipoint relays
- Routes used by OLSR only include multipoint relays as intermediate nodes
Ongoing Work in the MANET WG

- **DYMO**

- **NHDP**
Dynamic On-Demand (DYMO) Routing

- On-demand
- Route discovery (RREQ-RREP)
- Route maintenance
  - To preserve routes in use, DYMO routers extend route lifetimes upon successfully forwarding a packet.
  - RERR: When a data packet is received for forwarding and a route for the destination is not known or the route is broken, then the DYMO router of source of the packet is notified.
- Sequence numbers to ensure loop freedom
- Bidirectional links
**Neighborhood Discovery Protocol (NHDP)**

- Discover 1-hop and symmetric 2-hop neighbors
- Local 1-hop broadcast
- Advertises the presence of a router and its interface addresses.
  - Discovers links from neighboring routers.
  - Performs bi-directionality checks on the discovered links.
  - Advertises discovered links, and whether each is symmetric, to its 1-hop neighbors, and hence discovers symmetric 2-hop neighbors.