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

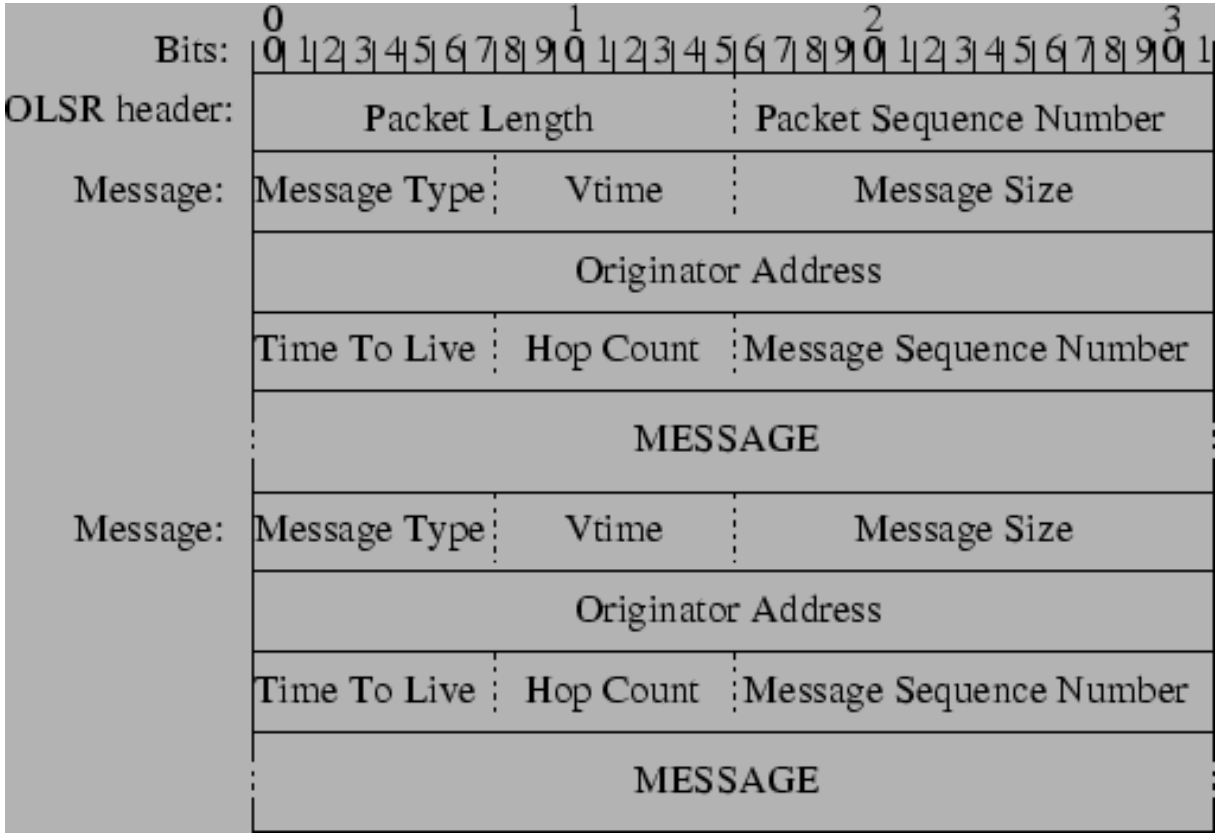
OLSR Overview

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

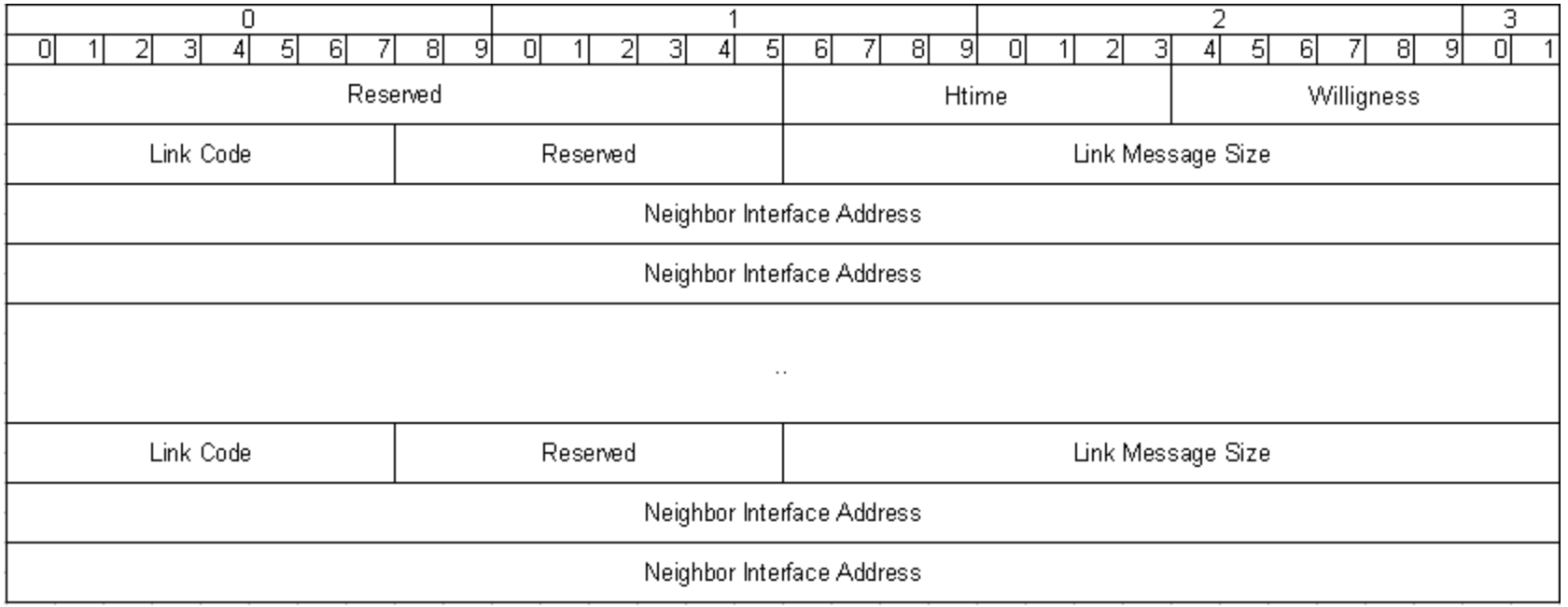
Neighbor Discovery

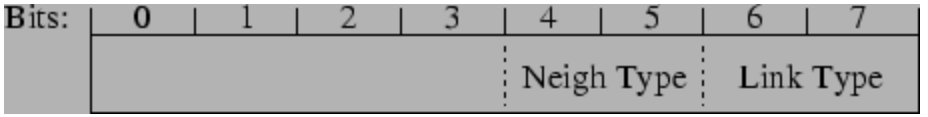
- Periodic exchange of HELLO messages
  - Link sensing
  - List neighbors
  - Neighbors "Quality"
  - MPR selection
- To maintain link, neighbor, 2-hop neighbor, MPR

OLSR Generic Packet Format



Hello Packet Format





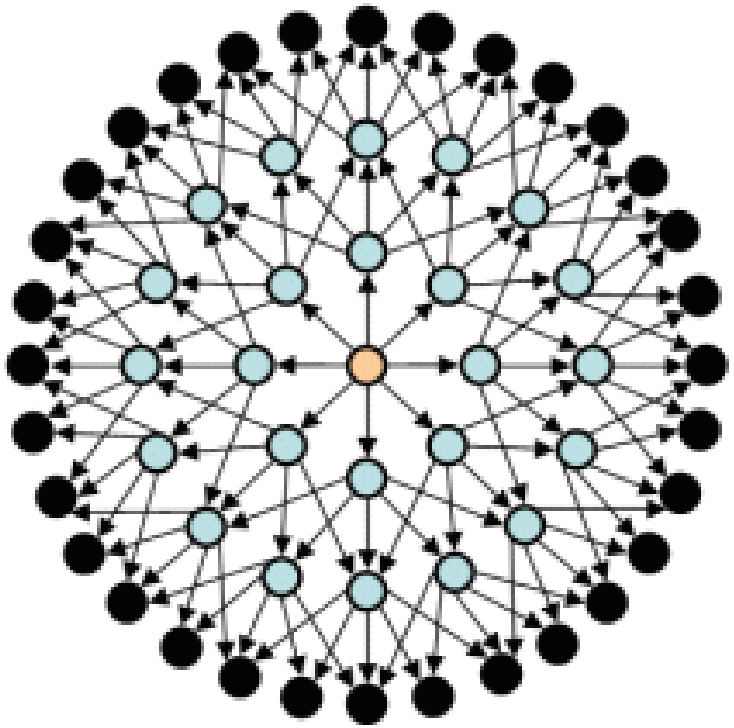
Link code: contains "link type" and "neighbor type"

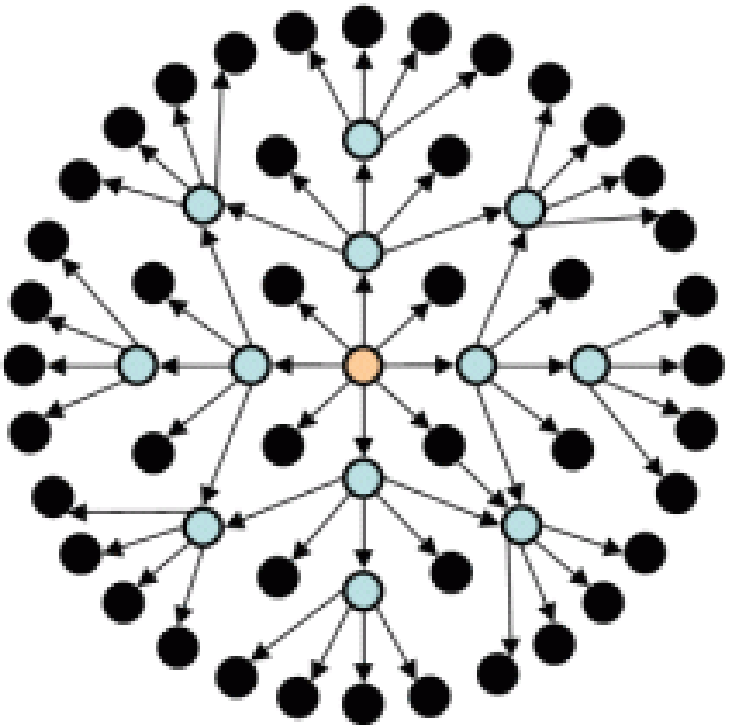
Htime: Hello emission interval
Willingness: willingness to carry and forward

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

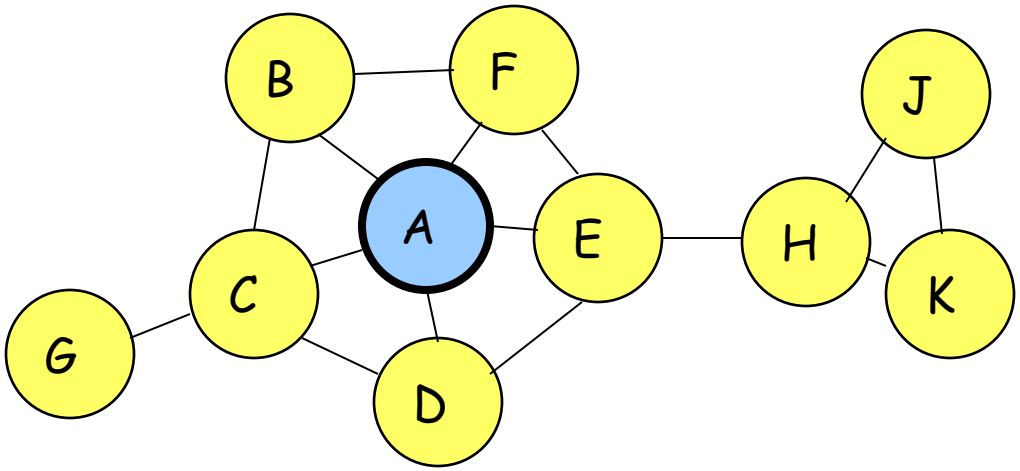
Flooding vs MPR





Optimized Link State Routing (OLSR)

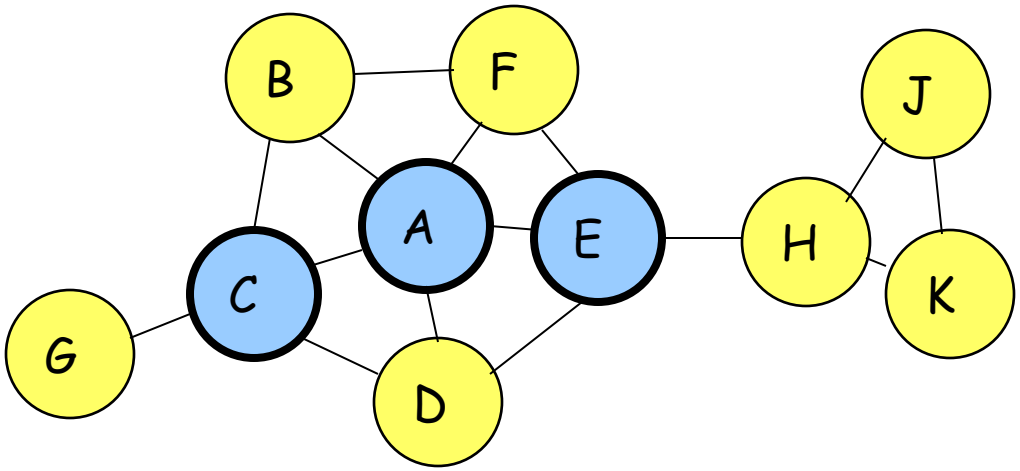
- Nodes C and E are multipoint relays of node A



Node that has broadcast state information from A

Optimized Link State Routing (OLSR)

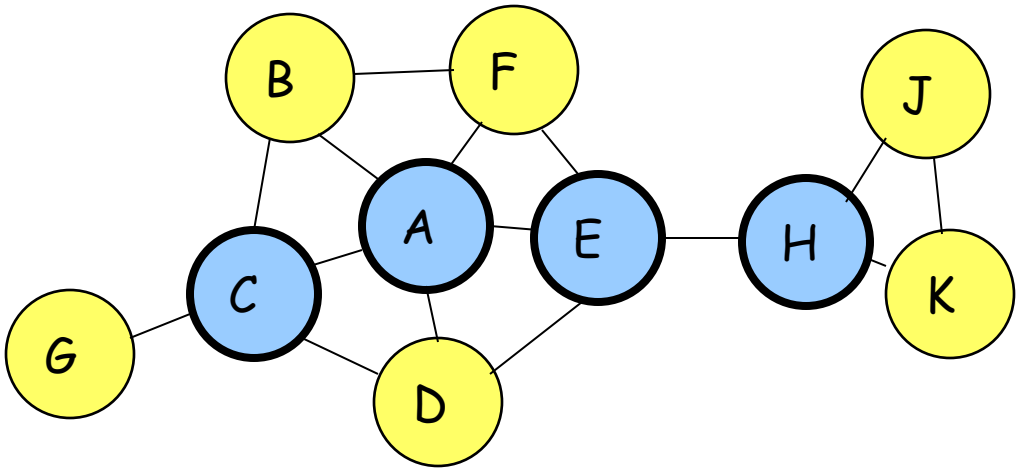
- Nodes C and E forward information received from A



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

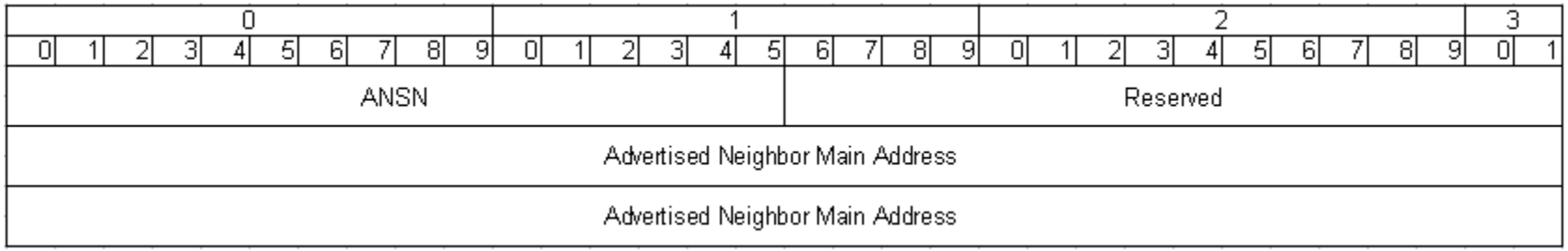
Topology Diffusion

- 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

Topology Diffusion

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

Topology Control Packet Format



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
  - Draft: http://tools.ietf.org/html/draft-ietf-manet-dymo-17

- NHDP
  - Draft: http://www.ietf.org/internet-drafts/draft-ietf-manet-nhdp-09.txt

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.