QoS Routing in OLSR with Several Classes of Service

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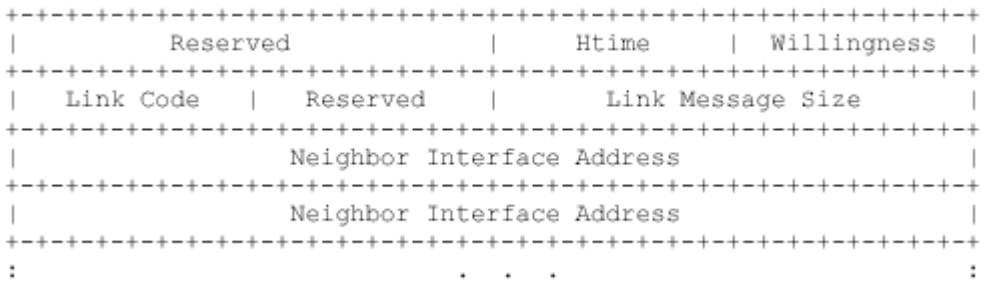
- Outline
  - Standard OLSR
  - Existing propositions
  - Effect of OLSR optimisations on QoS routing
  - Toward the support of several QoS classes
  - Conclusion and future work

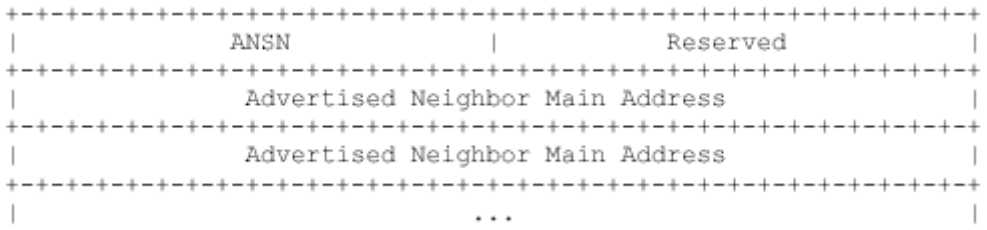
- Shortest (hop count) path is not enough!
  - Selection of poor quality links
    - Poor end-to-end performance
  - Need QoS routing to compute:
    - Efficient paths
    - Optimize global network performance
- Need to satisfy application needs
  - Different regarding their types and services:
    - Audio/video streaming
    - VoIP
    - Web browsing
    - Alert triggering

- Proactive protocol
  - No route establishment latency
- Link-state
  - Route computation with the knowledge a subset of the network topology
- Forwarding is hop by hop
  - Rather than path based
- Strongly optimized for ad hoc networks
  - Via the use of MPR (Multipoint relays)

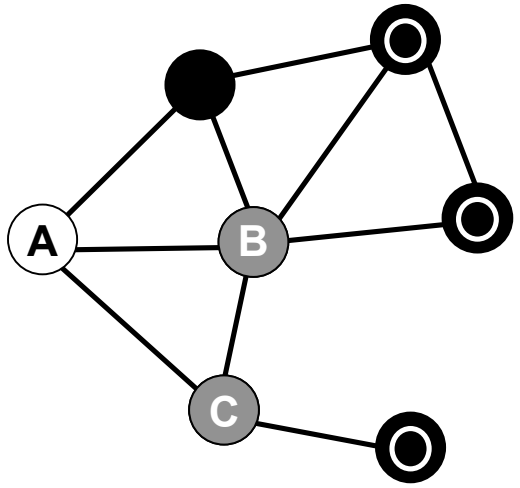
- 2 types of control messages
  - HELLO
    - 2-hop neighborhood discovery



  - TC (Topology Control)
    - Announcement of a subset of links to all the nodes

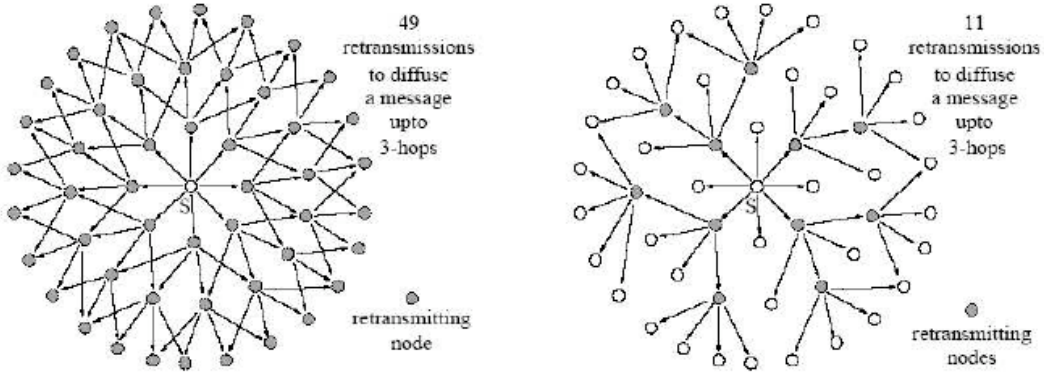


- MPR definition
  - Each node chooses its MPR set
  - The MPR set is a minimum subset among the 1-hop neighborhood through which one must pass to reach all nodes 2-hops away



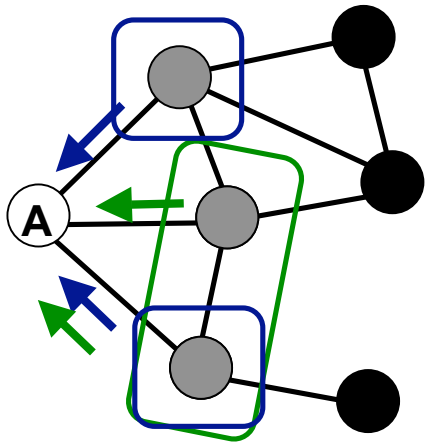
  - Nodes maintain two sets:
    - B and C are in the *MPR* set of A
    - A is in the *MPRSelector* set of B and C

- MPR usage
  - Only MPRs send TC messages
  - By default, MPRs advertise their MPRSelector set
- Benefits of MPR
  - An efficient broadcast structure
    - Not the best existing but better than basic broadcast



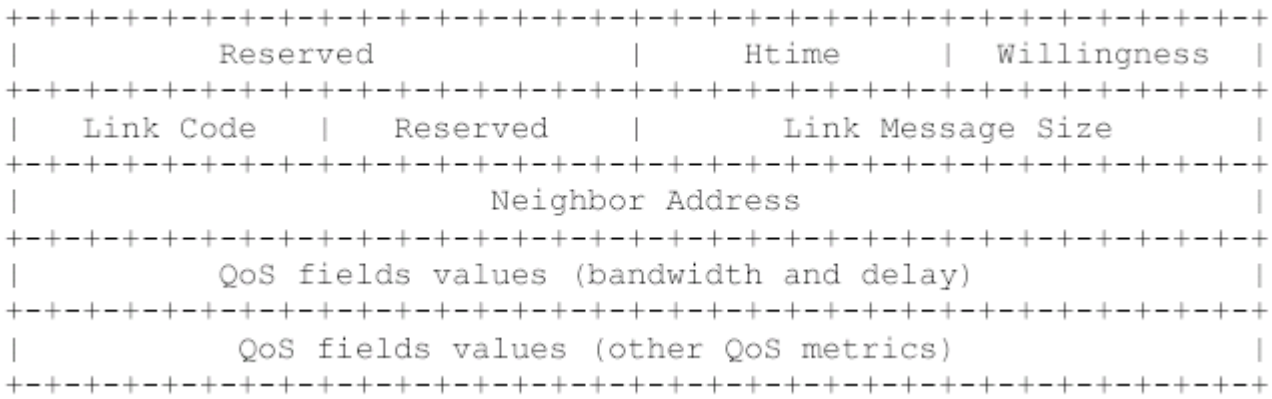
  - Link advertisement control mechanism
    - Avoid announcing *useless* links
    - Guarantee to find the shortest paths (hop count)

- MPR selection only
  - Prefer *good* links to be advertised

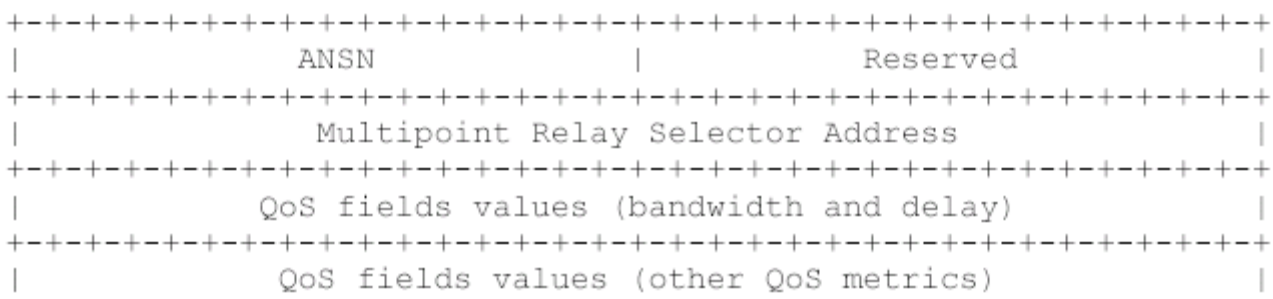


- Benefits:
  - No need to change OLSR messages (depending on the metric)
  - Only change MPR selection algorithm
- Drawbacks:
  - End-to-end route non optimal
  - Handle only one set of constraints

- QOLSR
  - Defines modifications to
    - HELLO



    - TC



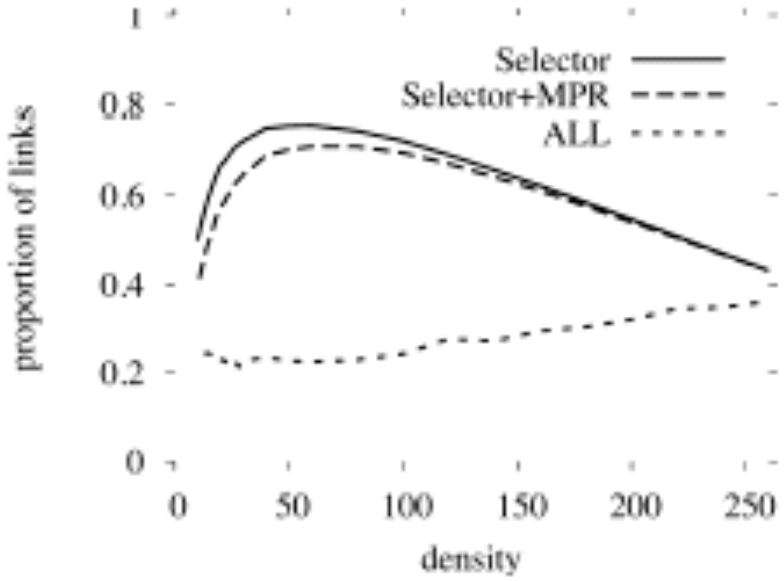
- QOLSR
  - Use the concept of *shortest-widest* path*:*
    - Find the maximum BW path (widest path)
    - If more than one widest paths exist, it chooses the one with lower delay
  - Choose the MPR set according to the *shortest-widest* strategy
  - Perform route computation also in this way
  - Can propagate other metrics in control messages
  - Benefits:
    - Optimal end-to-end route regarding the one strategy
  - Drawbacks:
    - Need to change OLSR control messages
    - BW & delay are hard to measure
    - Self-interference (MPR computation based on BW & delay)

Several classes of service support

- Existing solutions drawback
  - Reduce the subset of advertise links according to only one set of constraints
- Challenges
  - Improve the ability of OLSR to perform route computations with different constraints, i.e. need for more link advertisements
  - Without affecting the network too much

Consequences of OLSR optimizations on QoS routing

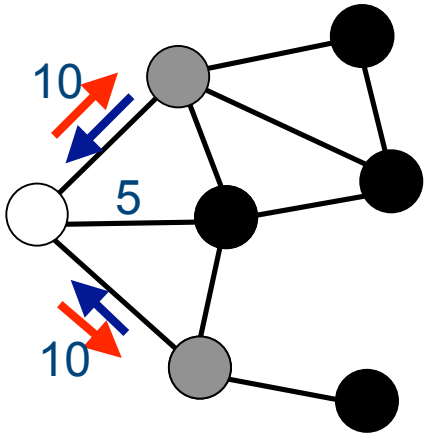
- Non advertisements of links
  - Hypothesis: each link is potentially interesting
  - Graph-based simulations:
    - 500 nodes
    - 1000m large square playground



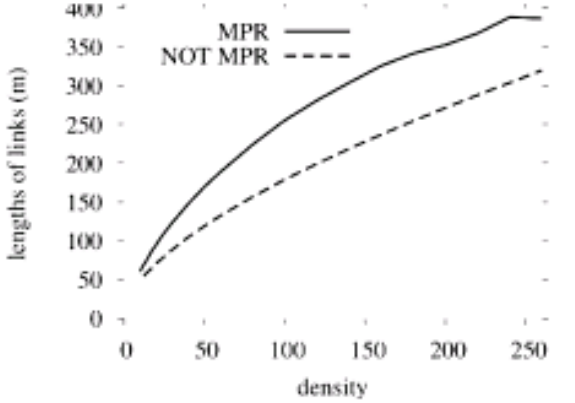
Useful links missed

Consequences of OLSR optimizations on QoS routing

- Direction of advertisement
  - Reverse way is announced

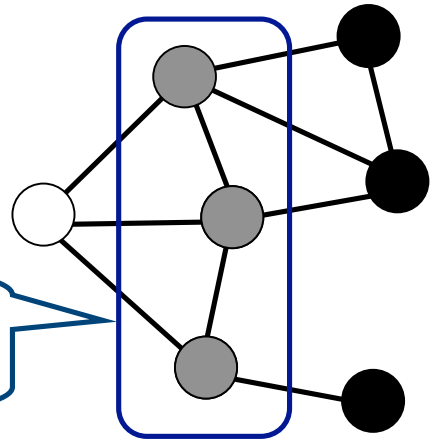


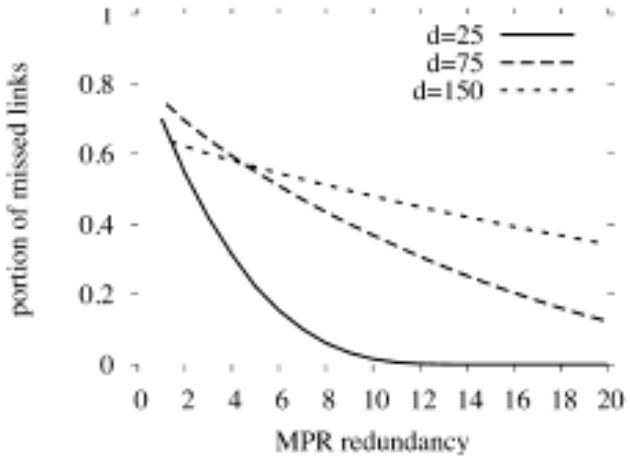
- Length of links
  - Tend to propagate longer links



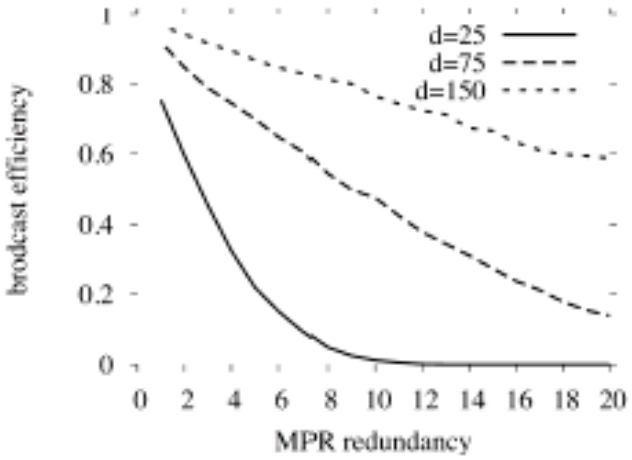
(a) Average length of links with 1-hop neighbors.

- MPR redundancy
  - Defines the minimum number of nodes to be selected if possible per 2-hop neighbor





(a) Useful links missed



(b) Broadcast efficiency

- Multiple MPR set based
  - Compute a MPR set for each constraints set
  - Use one of the sets to perform broadcast operations
  - Merge the different MPR sets and apply the classic OLSR link advertisement

- Benefits:
  - Advertise every *interesting* link
  - Optimal end-to-end route regarding all the strategies

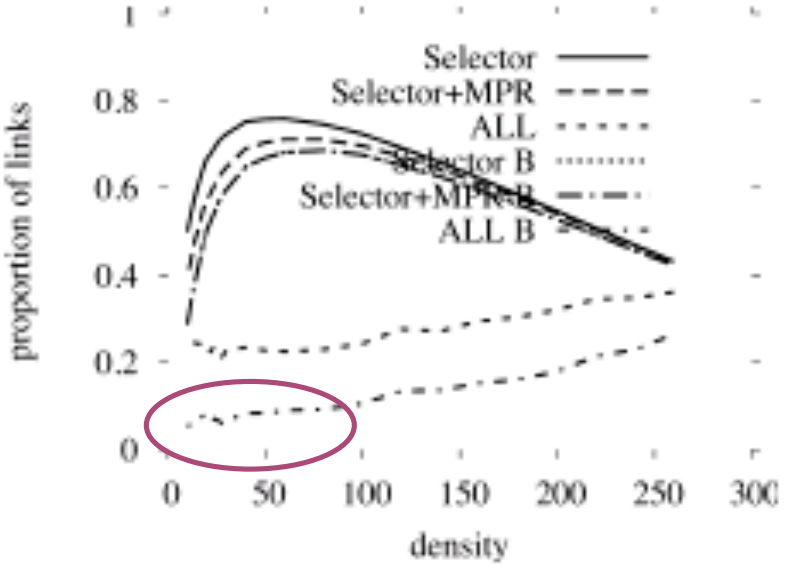
- Drawbacks:
  - Can lead rapidly to a wired-like link state protocol (depending on the number of constraints sets, topology,…)

- QOLSR+ proposition:
  - MPRs are chosen only to create a stable and reliable broadcast structure (To be defined)
  - TC messages advertise bi-directional QoS information
  - Links are just announced once. A mechanism is used to avoid a link being advertised by both end nodes (the one with the highest main IP address)
  - Only MPRs can send TC messages to advertise all their 1hop neighbors.

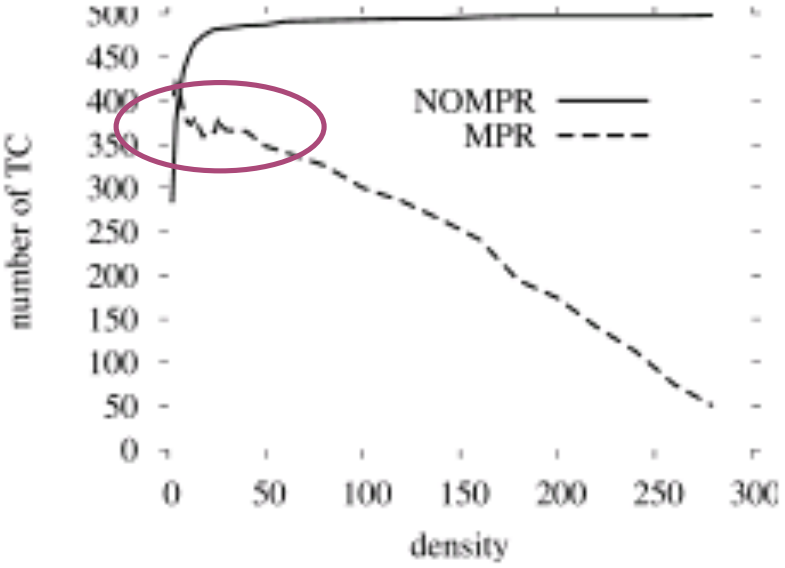
- Benefits:
  - Limit network overhead, while advertising a large part of the network.

- Drawbacks:
  - Still misses some interesting links

- Results
  - Useful links missed

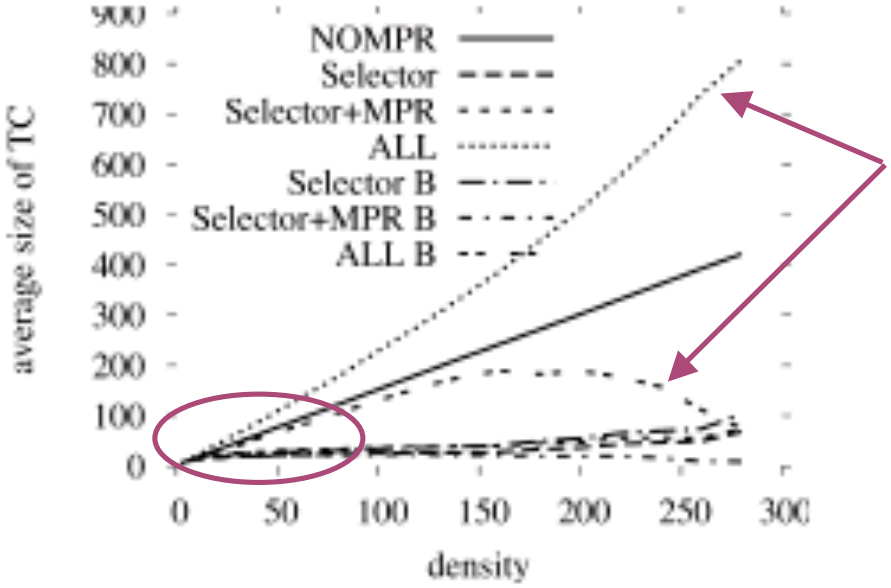


(a) Useful links missed



(b) Number of TCs

- Results
  - Network overhead



Average TC size

Interest of Bi-directional advertisements

- Conclusion
  - Analysis of OLSR mechanisms impact on QoS routing
  - Analysis on existing solutions ability to support several classes of service
  - Introduction of possible improvements
- Future works
  - Network simulations to compare all the solutions with *real* metrics
  - Metrics to create a reliable and stable broadcast structure