Optimizing Relay Sets with Link Metrics: The case of MPR

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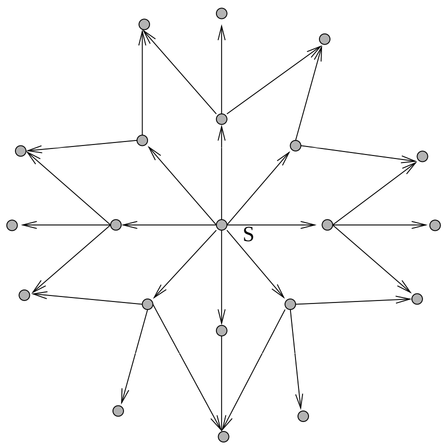
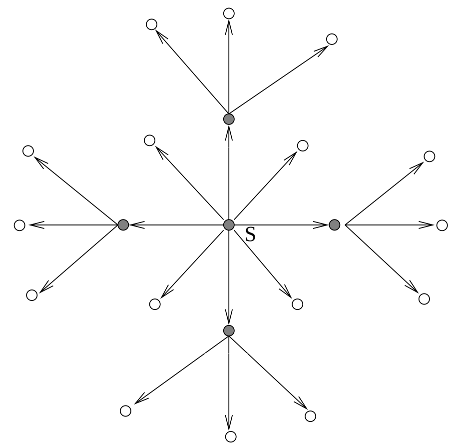
MultiPoint Relays (MPR)



Full Topology



MultiPoint Relays

- **Relays create a CDS for node S**
- **Hypothesis:**
  - **Graph Theory Concept**
  - **Unit Disc Graph (UDG)**
  - **Perfect Channel Condition**
  - **…**
  - **Static Topology !**

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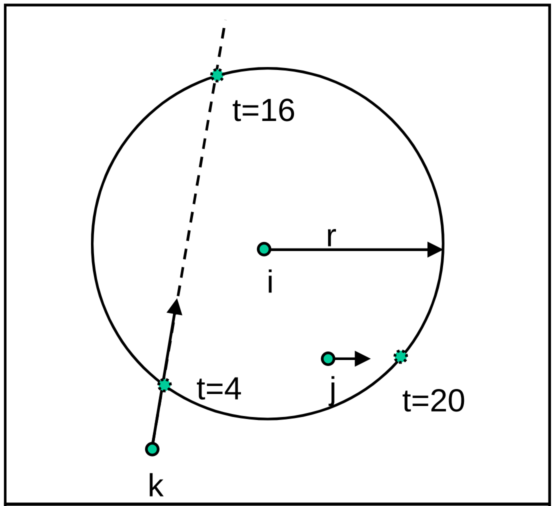
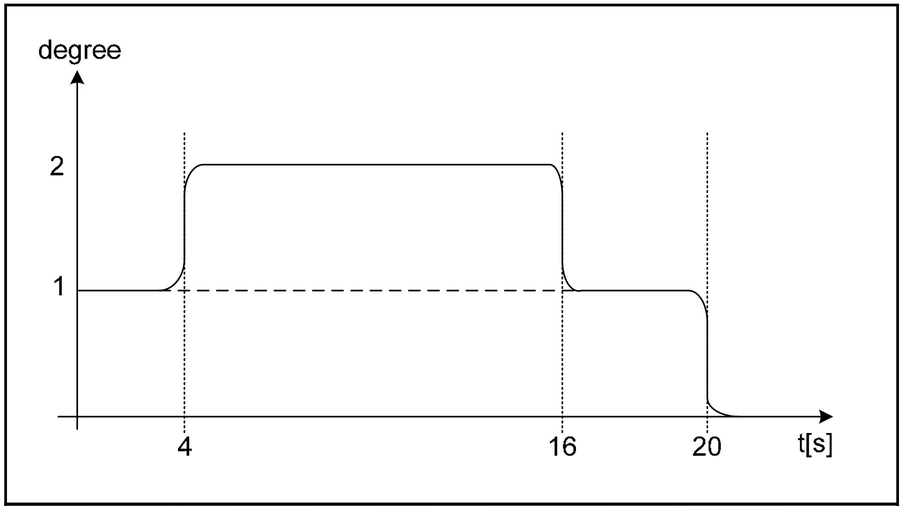
Kinetic Multipoint Relays (KMPR)

» **Same as MPR, but using a Kinetic Nodal Degree**

$$\overline{Deg}_i(t) = \int_t^{\infty} \left(\sum_{k=0}^{k=nbrs_i} \left(\frac{1}{1+\exp(-a\cdot(t-t_k^{from}))} \cdot \frac{1}{1+\exp(a\cdot(t-t_k^{to}))} \right) \right) dt$$



Node *i* Kinetic Neighborhood



Node *i* Kinetic Nodal Degree

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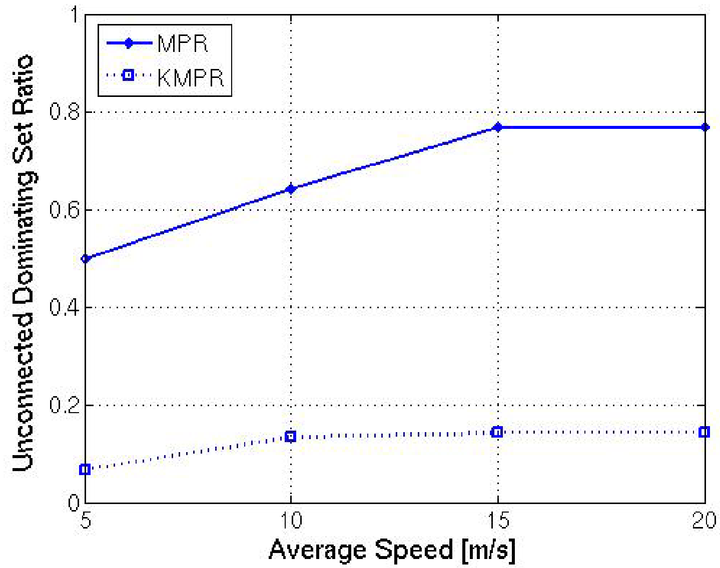
UnConnected Dominating Set (UCDS)

» **UCDS is the set of nodes that could not receive a broadcast packet on the first transmission attempt**

- **MPR according to graph theory**
  - **Should be zero**
- **MPR on a dynamic topology (here with Random Mobility)**
  - **Should be close to zero**
- **Why could 70% of mobile nodes NOT receive a broadcast packet ?**



» **When using Link Metrics, only 15% of the total topology could not receive the broadcast packet.**

[1] J. Härri et al.,"Kinetic Mobility Management applied to Vehicular Ad Hoc Network Protocols", in Elsevier Computer Communications (COMCOM) " Special Issue on Mobility Protocols for ITS Vanet", Spring 2008.
[2] J. Härri et al., "MANET Position and Mobility Signaling Format", IETF, http://www.ietf.org/internet-drafts/draft-haerri-manet-position-signaling-00.txt, work in progress.

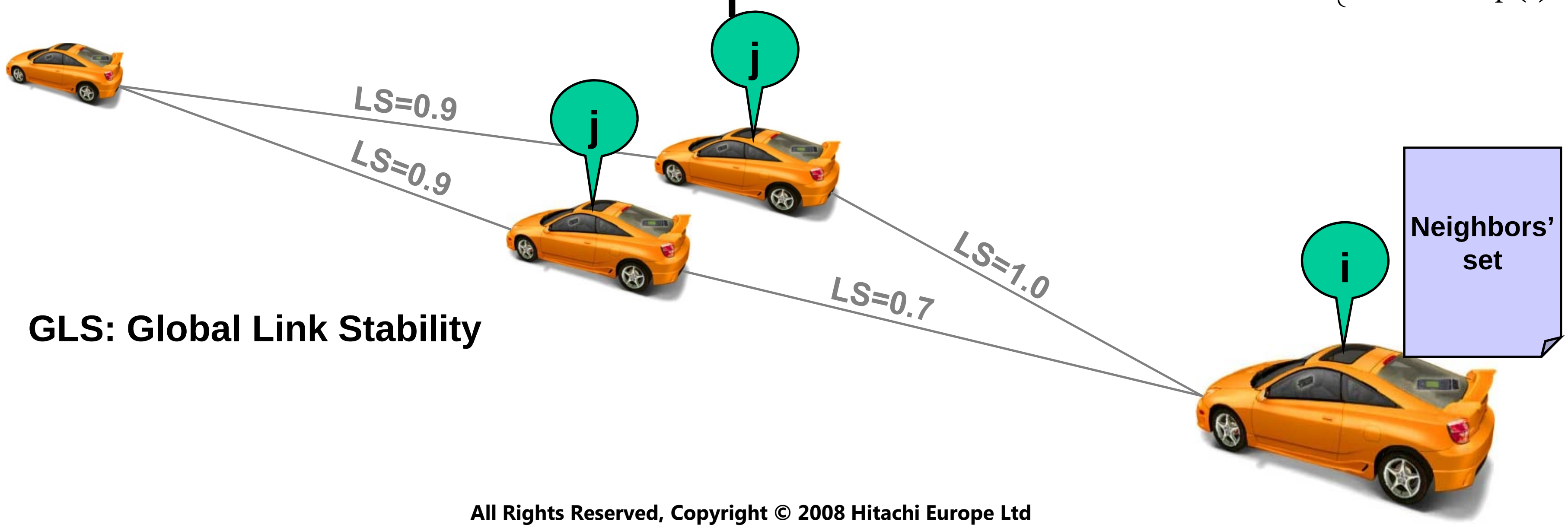
MOPR-assisted OLSR (Hitachi Europe)

MOPR-based MPRs selection

- ***NB1hop(i):*** **set of vehicles within the one-hop neighborhood of i**
- ***r(i):*** **number of vehicles in NB1*hop*(i)**

$$GLS(i,j) = LS(i,j)\frac{r(j)}{\sum_k r(k)} \quad wih \quad k \in NB1hop(i)$$

$$GLS(i,j) = LS(i,j)\frac{\sum_k LS(j,k)}{\sum_{l,k} LS(l,m)} \quad with \quad \begin{cases} k \in NB1hop(i) \\ l \in NB1hop(i) \\ m \in NB1hop(l) \end{cases}$$

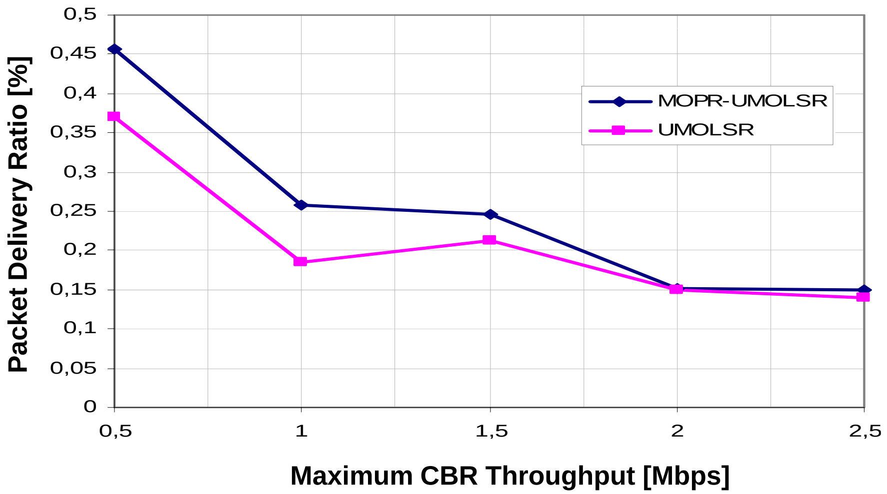


GLS: Global Link Stability

MOPR-assisted OLSR (Hitachi Europe)

» **MOPR has been applied to OLSR in two steps:**

1. **MOPR-based MPRs selection**
   - Based on one hop neighborhood movement information
   - Based on two hops neighborhood movement information
2. **MOPR-based Route construction**



1. H. Menouar, M. Lenardi, F. Filali, "*Movement Prediction-based Concept for Topology-based Unicast Routing Protocol in VANETs*", ITST 2007, 7th International Conference on ITS Telecommunications, Sophia Antipolis, France, June 2007.
2. H. Menouar, M. Lenardi, F. Filali, "*Movement Prediction-based Routing (MOPR) Concept for Position-based Routing in Vehicular Networks*", WiVec 2007, 1st IEEE International Symposium on Wireless Vehicular Communications.