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A Movement Prediction based Routing Protocol for Vehicle-to-Vehicle Communications

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Outline:

1- Introduction & Motivations

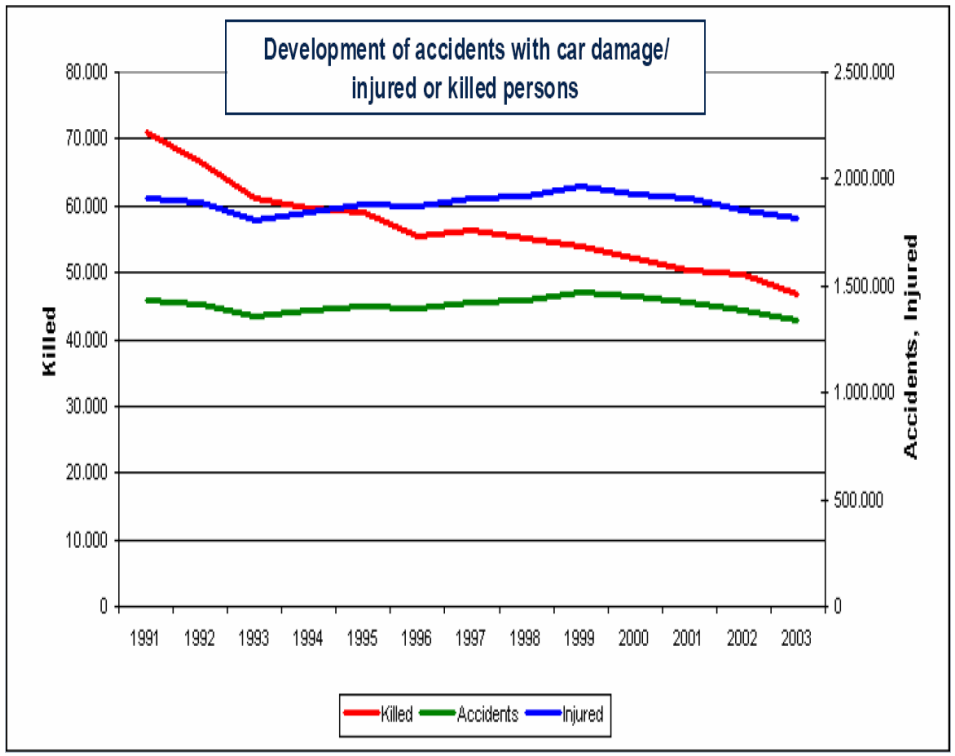
2- Cross-Layer Paradigm in Wireless Networks

3- MOvement Prediction based Routing (MOPR) Algorithm

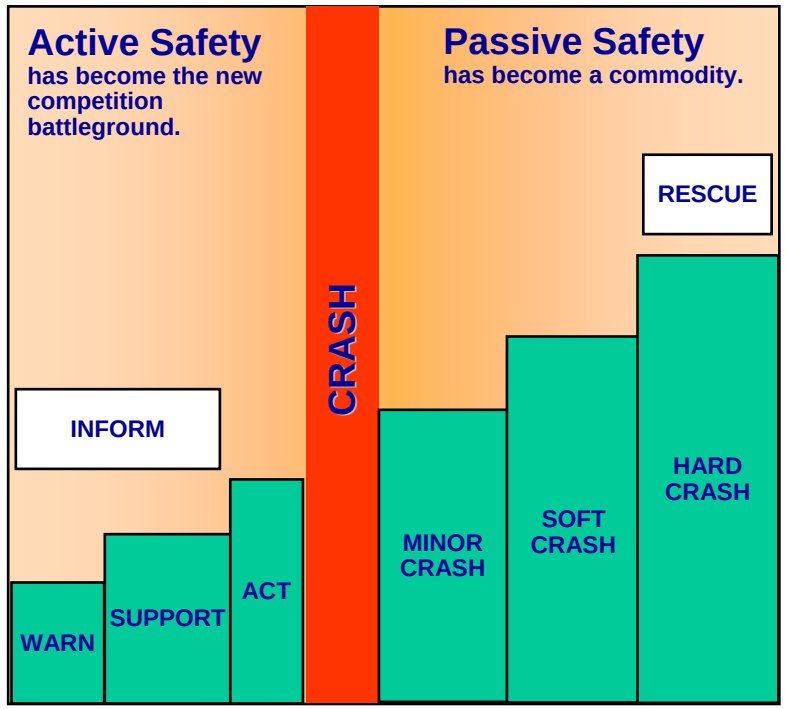
4- Conclusions & Future Works

Introduction & motivations

Traffic Accidents in the European Union



Well informed drivers are susceptible to avoid dangerous situations.



- **Over the last decades passive safety systems have helped to reduce the number of fatalities.**
- **The further reduction of severe accidents will be achieved by adding active safety systems to vehicle.**

VANETs: introduction & motivations

Vehicular *Ad-hoc* NETworks (VANETs) are special cases of MANETs where:

1) Nodes are highly mobile, so network topology is changing very fast

2) Nodes are vehicles, so there are less power and storage constraints

3) Nodes move non-randomly along specific paths (roads)

Therefore, for VANETs we can assume :

- Potentially longer transmission ranges
- Extended lifetime and good storage capacities
- Continuous GPS usage (when available)
- Constrainted-mobility area

Interaction between layers:

Signal level
List of neighbours
QoS
Data Rates
Applications
…

External information:

Movement information
Services
Environment
Number of users
…

- Existing **routing protocols** (as they are) designed for MANETs are note suitable for VANETs
- Our target is to improve the routing process for V2V communications, based on vehicles' movement information like Position, Direction, Speed and road topology

MOvement Prediction based Routing (MOPR) algorithm:

- MOPR predicts future positions of vehicles involved in each routing path based on their positions, speeds, and directions
- So MOPR is able to estimate links lifetime
- The source, by knowing the data size to send and using MOPR, can therefore estimate the transmission time and decide for better routes

In other words,

MOPR predicts if an intermediate routing node is likely to cause a rupture link during the transmission time or not

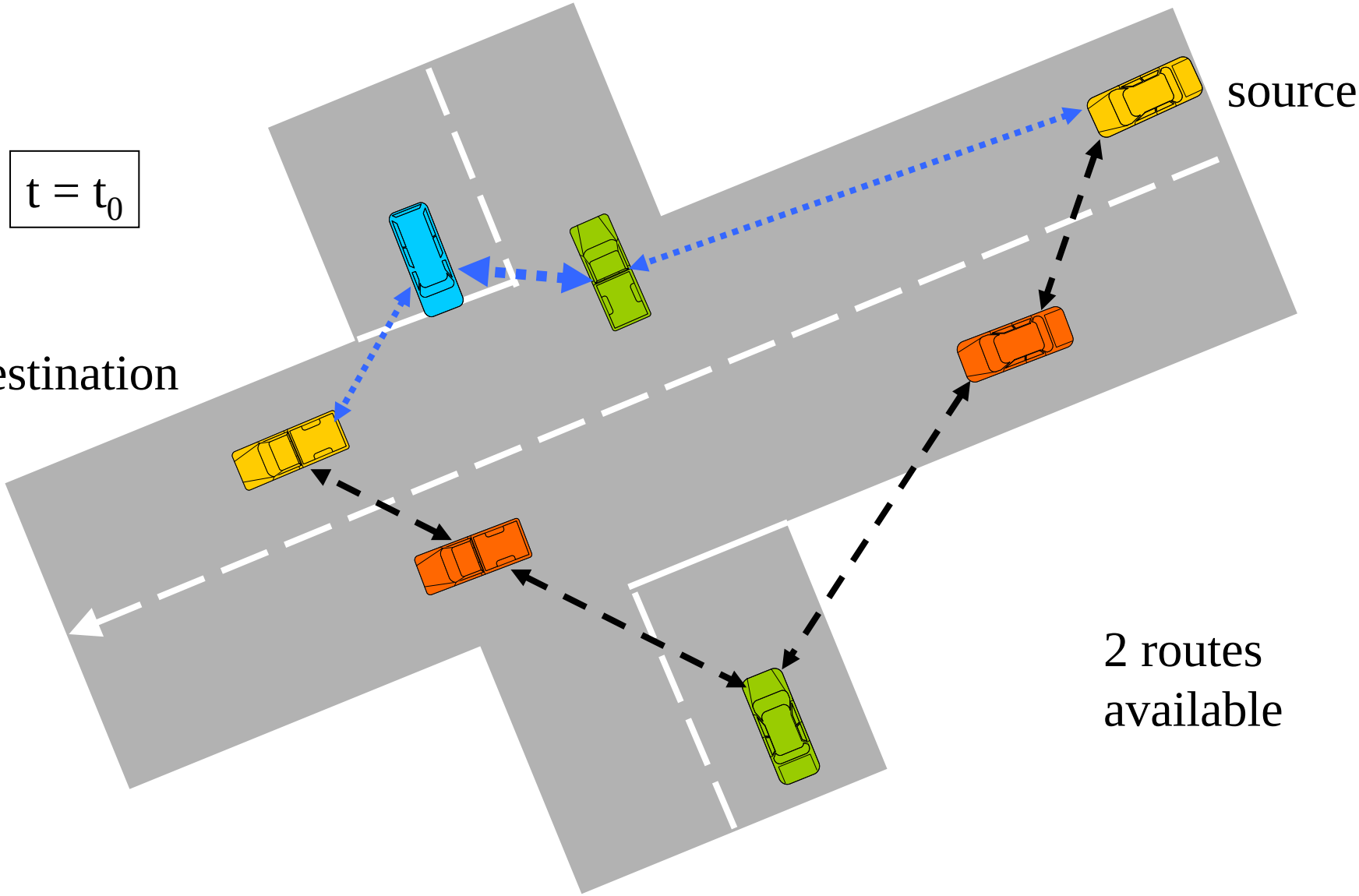
MOPR dynamically selects the most stable route among the routes provided by classical multi-path routing algorithms

- What is a stable route ?
  it is the one composed by (more) stable nodes

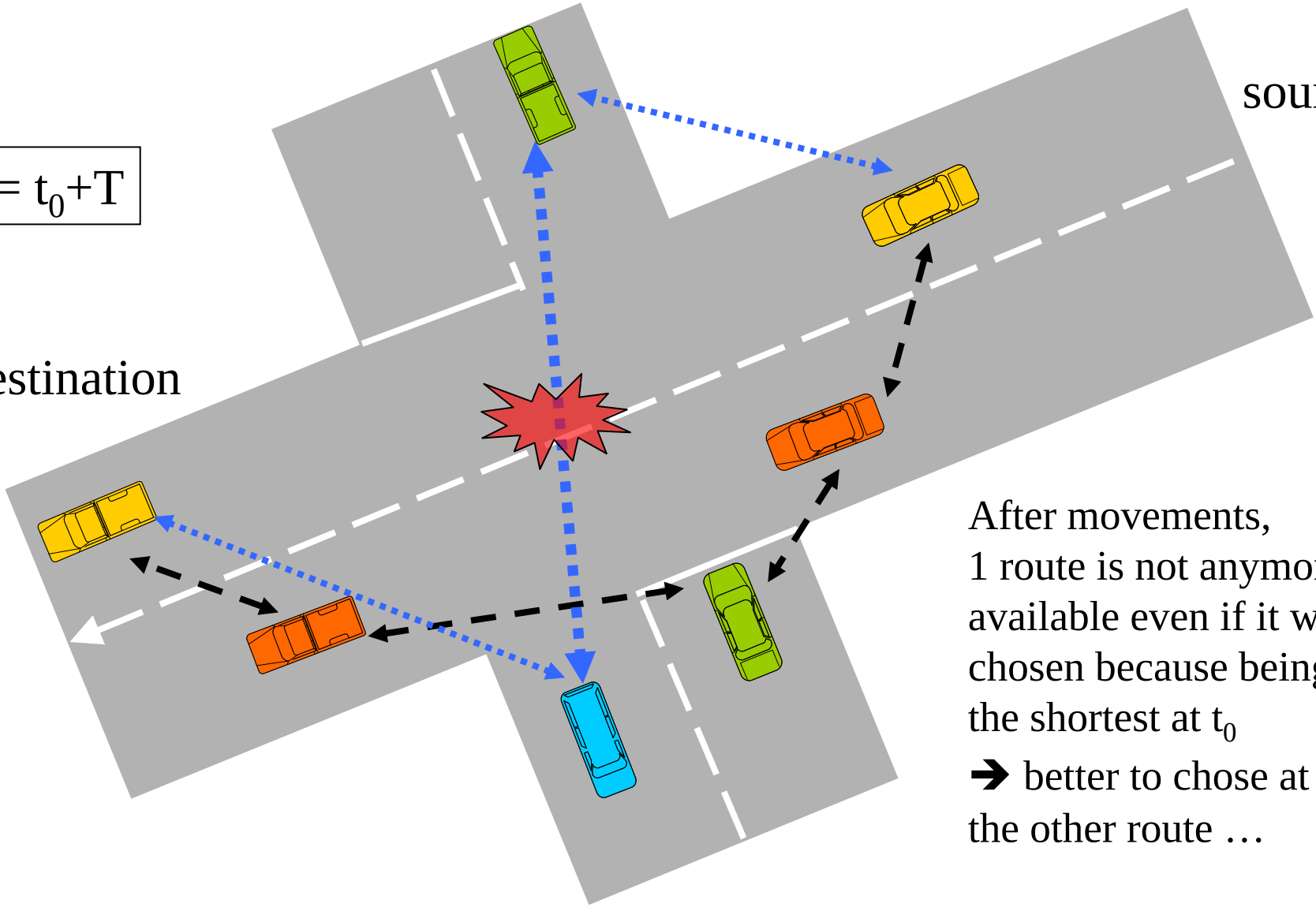
- What is a stable node ?
  it should have a direction and a speed similar to the ones of the destination node (and the source node)
  Note that intermediate nodes can be moving or static.

MOPR can also include road topology notions:
"Moving on the same road (same number of Street/Road)"

MOPR animation



MOPR animation



$t = t_0 + T$

After movements,
1 route is not anymore available even if it was chosen because being the shortest at t_0

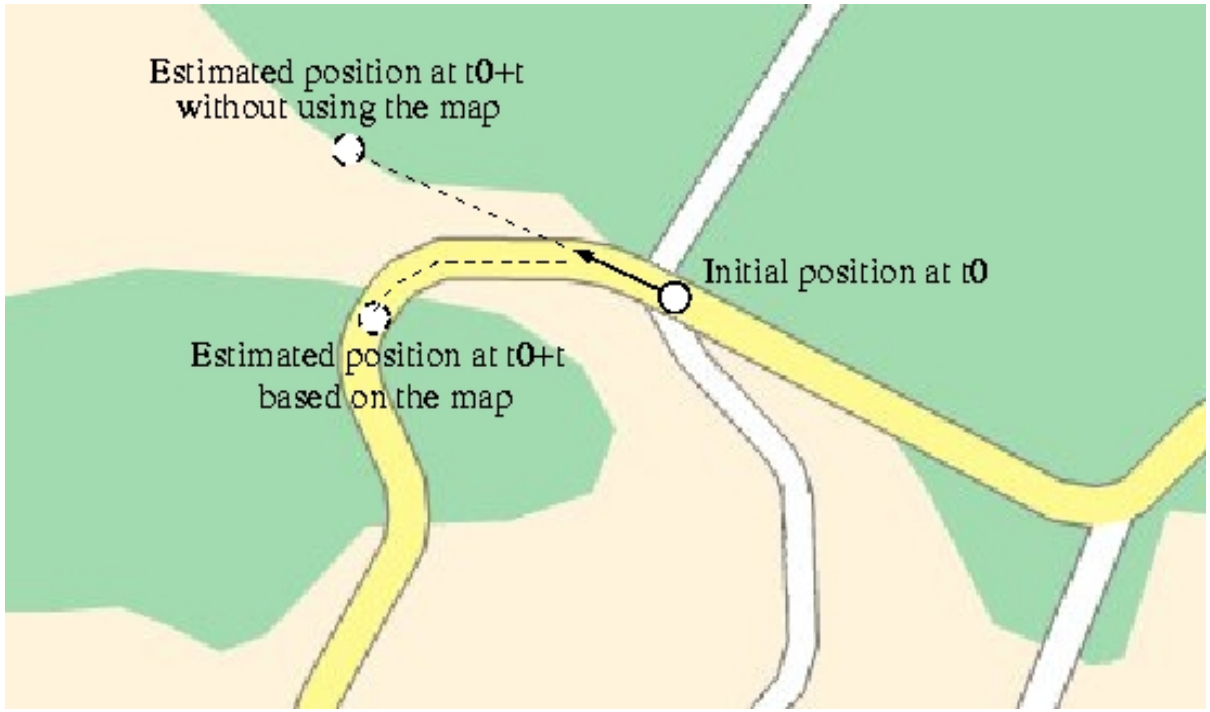
➔ better to chose at t_0 the other route …

Movement Prediction-Based Routing (MOPR) Algorithm

We can also improve our algorithm ***by using a digital map***

The position prediction based on digital map is more realistic.

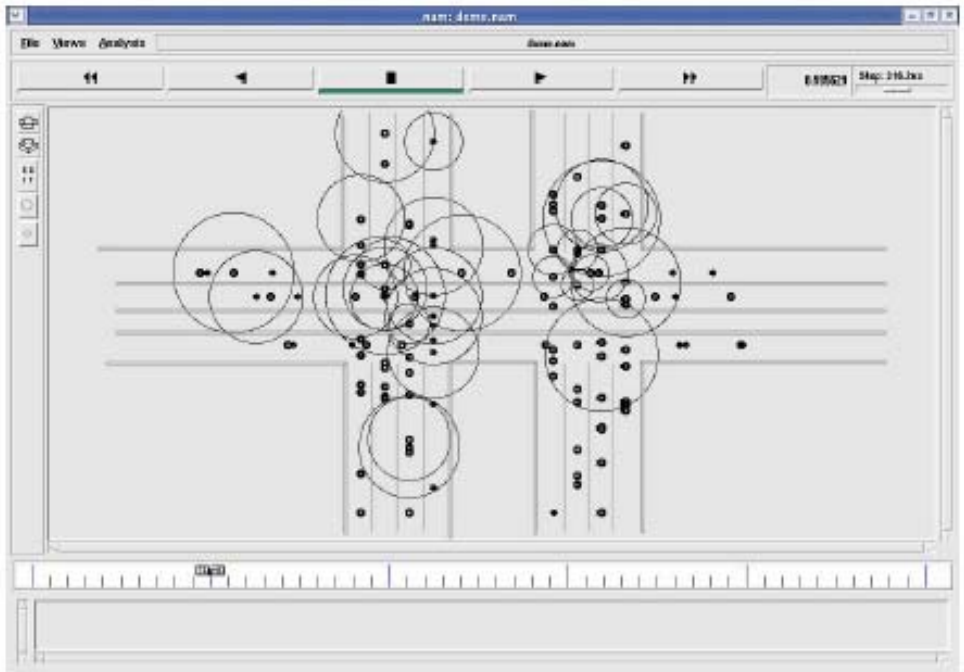
Same improvement if two roads are superposed with or without different running directions.



We used NS2 to evaluate performance of MOPR.

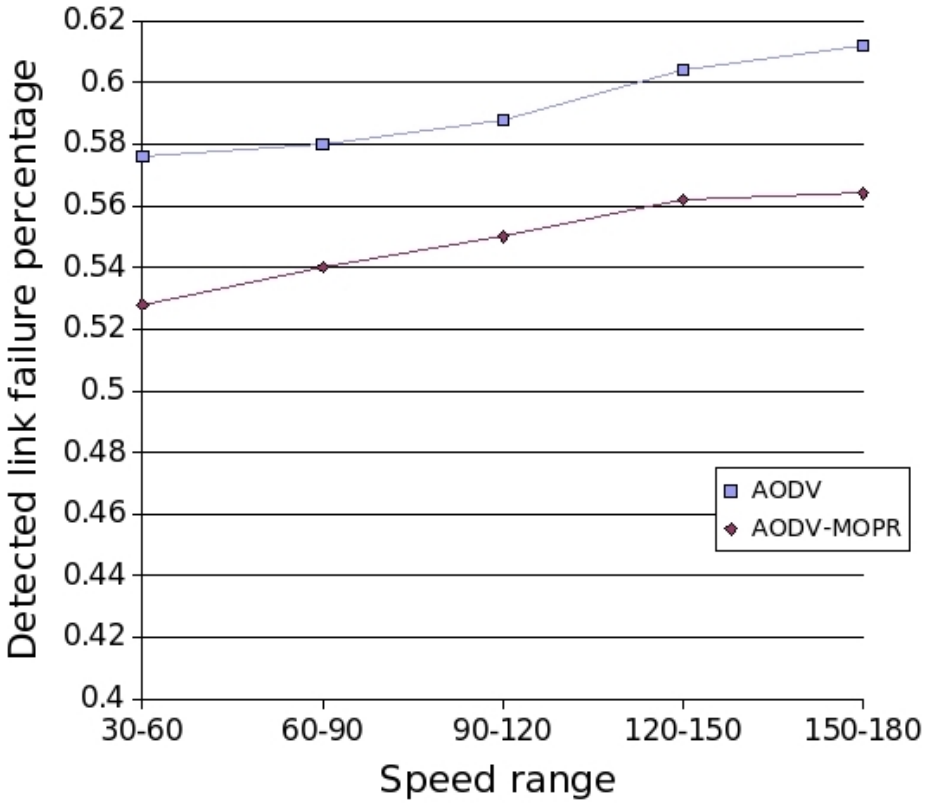
We modified AODV such that a destination will reply to any RREQ coming from the source and such that MOPR algorithm is used.

Vehicular environment
or
Random way point

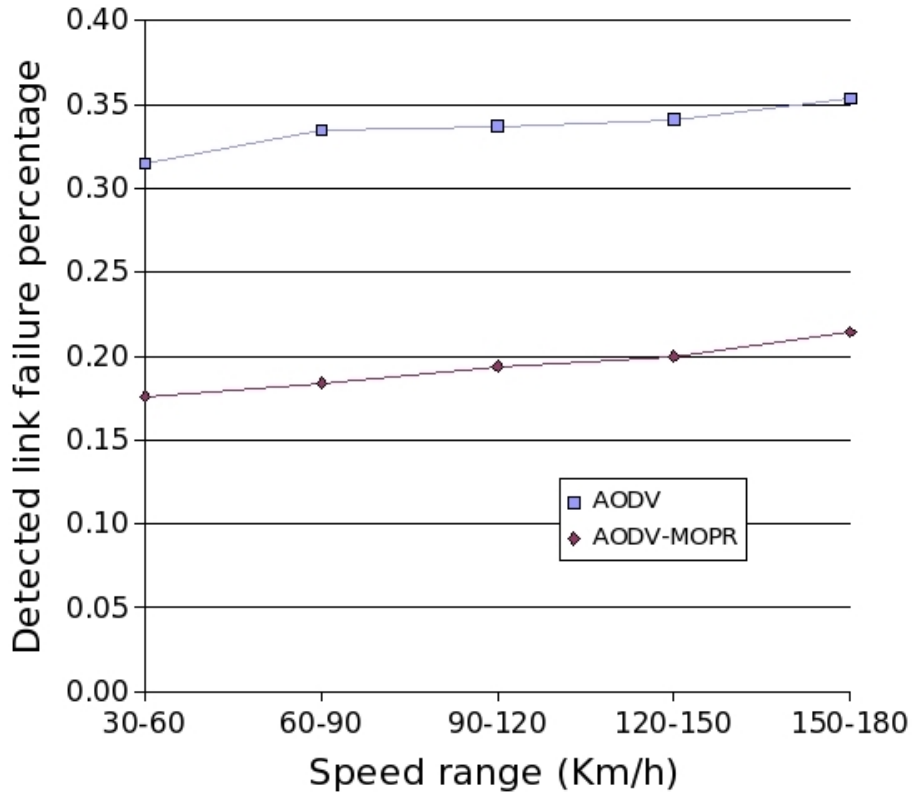


MOPR vs. AODV : 1)

Vehicular

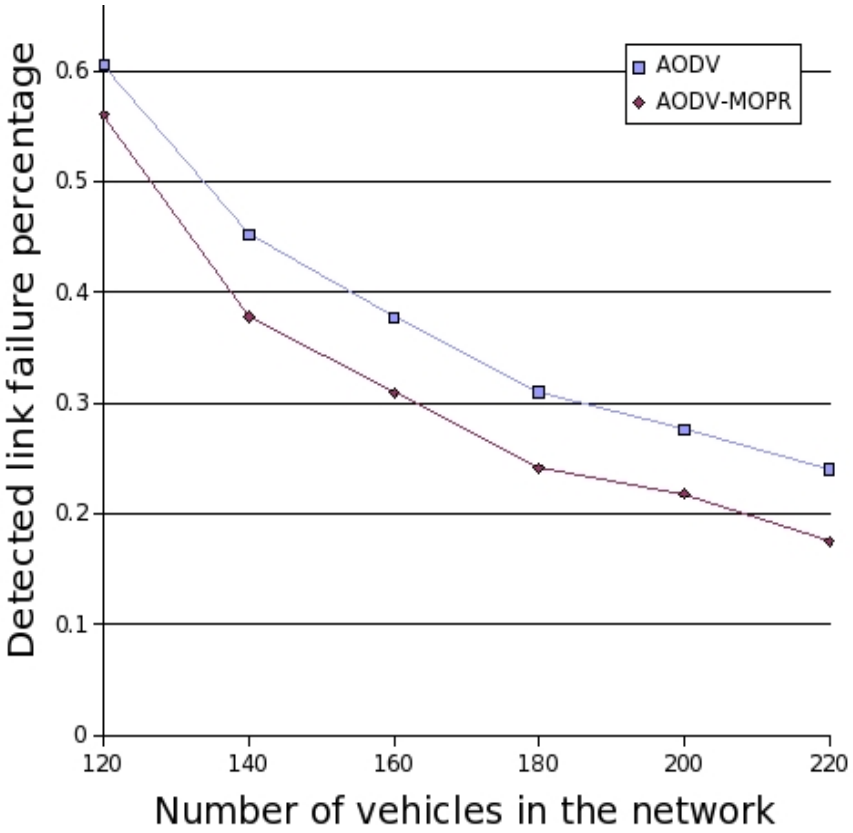


Random way point

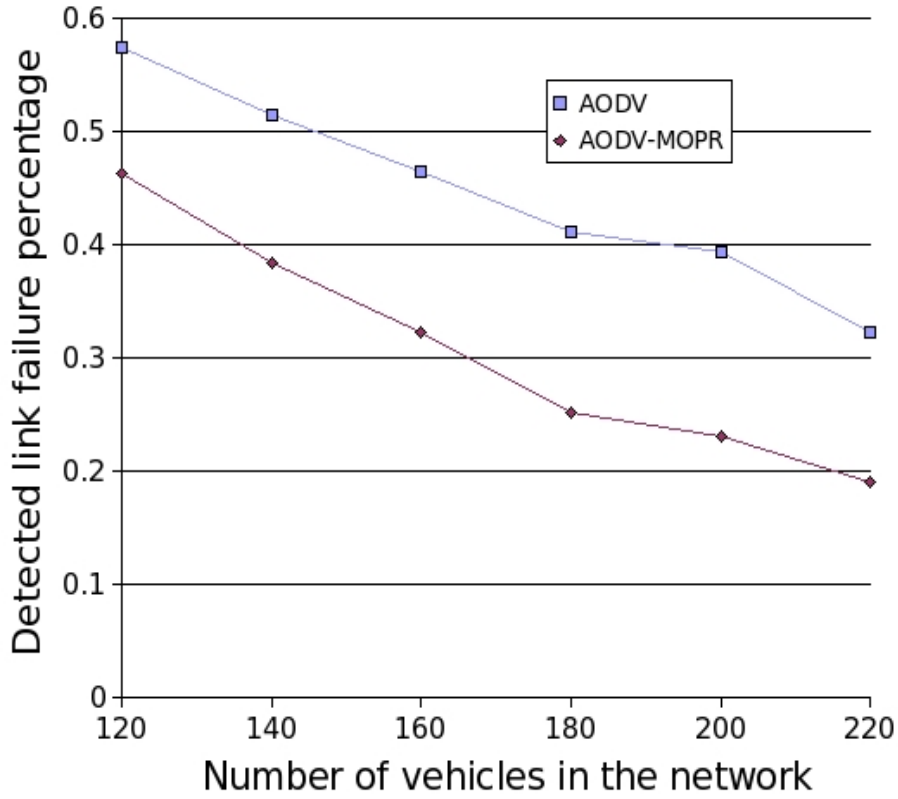


MOPR vs. AODV : 2)

Vehicular



Random way point



Conclusions & Future works

+ Improvement of routing in VANETs based on vehicles postion prediction, while coping with the high mobility

+ A new algorithm has been proposed for determining more stable routes between vehicles: MOPR

+ MOPR performs better than the basic AODV in terms of number of link failures

– MOPR uses 10-20% more signalling than basic AODV

In the future: *We will optimize MOPR implementation, providing as well more simulations and comparisons among different unicast routing protocols.*

Thanks

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