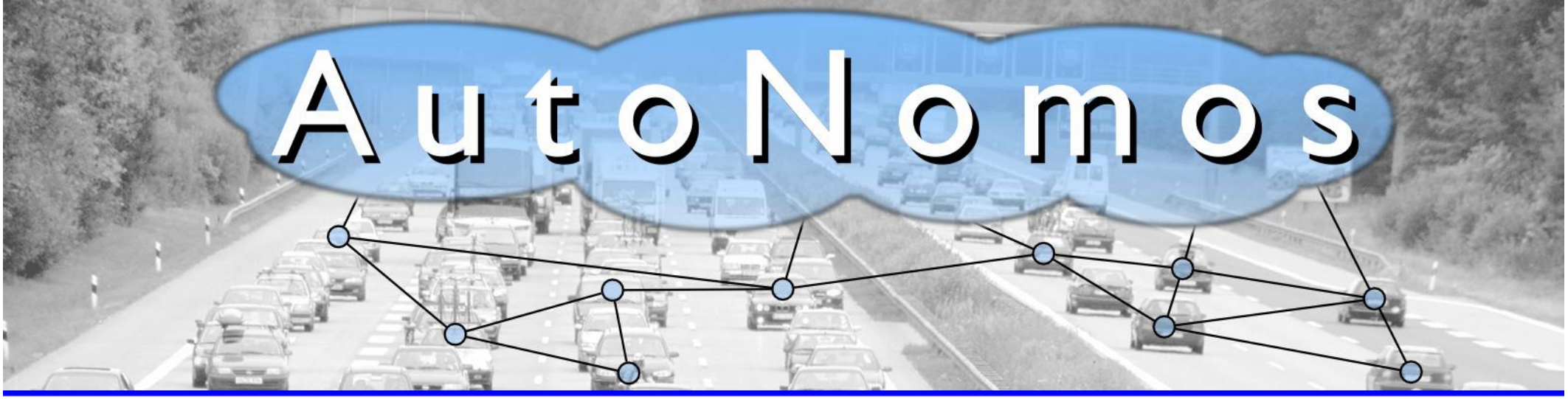

Results of 1st Phase

—

Research Objectives for 2nd Phase

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Overview

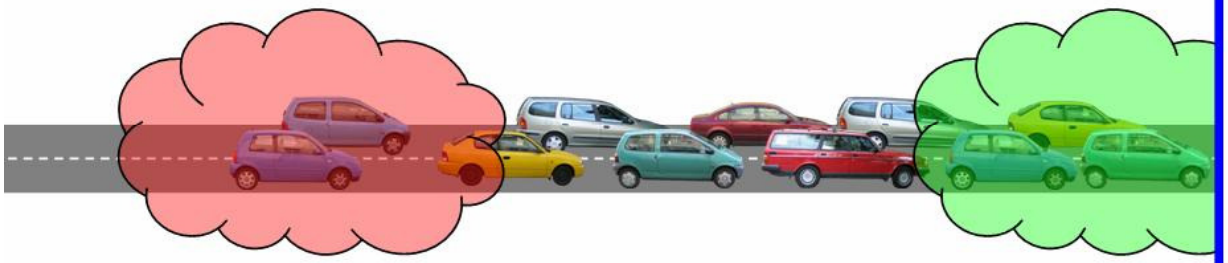
- Results of 1st Phase
  - Recognition of Traffic Jams
  - Transport Layer for Hovering Data Clouds
  - Mindstorms Demonstrator
- Research Objectives for 2nd Phase
  - Structures in Road Networks
  - Algorithms for Efficient Distributed Computing

Motivation

- Basic Scenario:

  Traffic Jam
- Recognition of
  - Front and Back
  - Type
  - Temporal and Spatial Changes
- Transmit Proper Data to other Road Users
- For that Purpose: Hovering Data Clouds (HDCs)

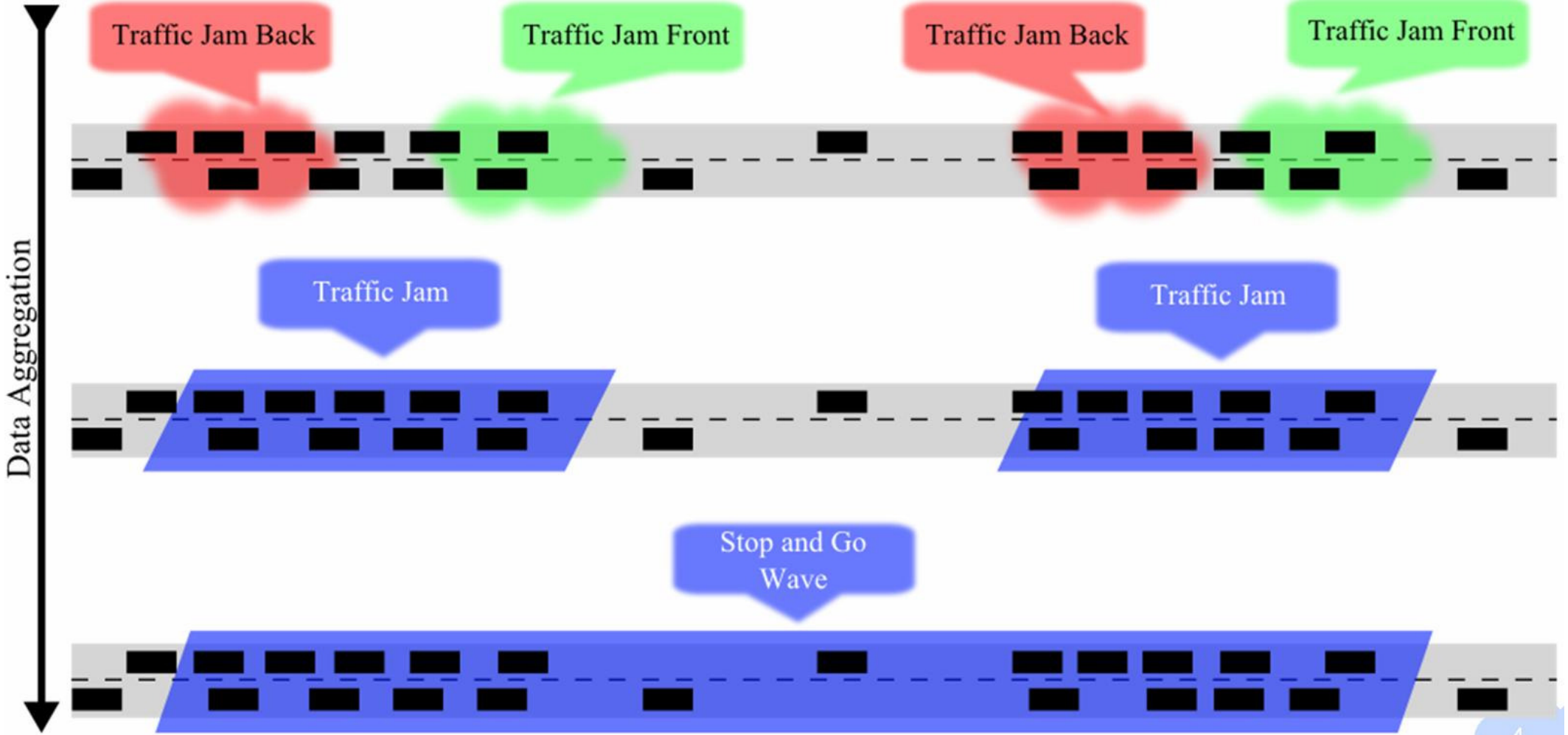
Motivation



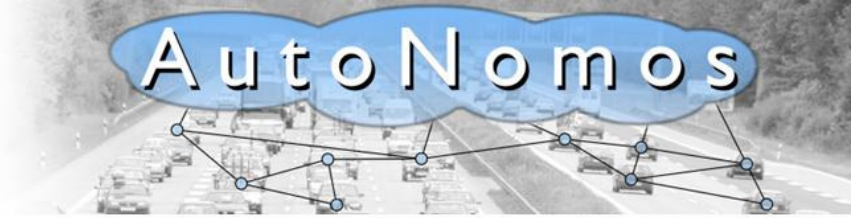
- Hovering Data Clouds
  - Form as a Result of a Certain Event
  - Hosted by individual Vehicles
  - But “Live” and “Evolve” independent of Them
  - Migrate from Vehicle to Vehicle

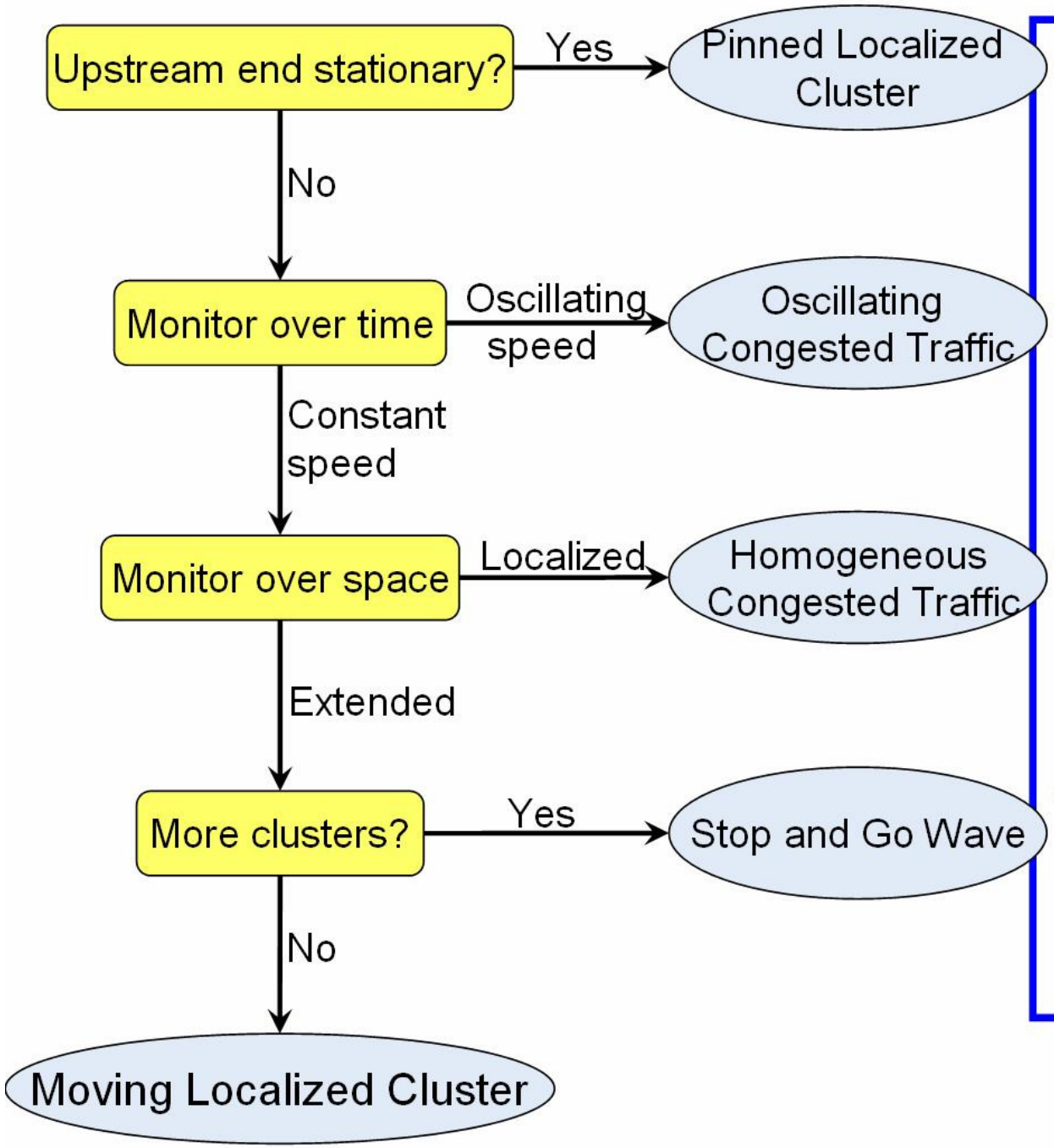
Recognizing Traffic Structures

- Local Rules to Detect Regional Structures
- Data Aggregation & Classification of High Level Structures



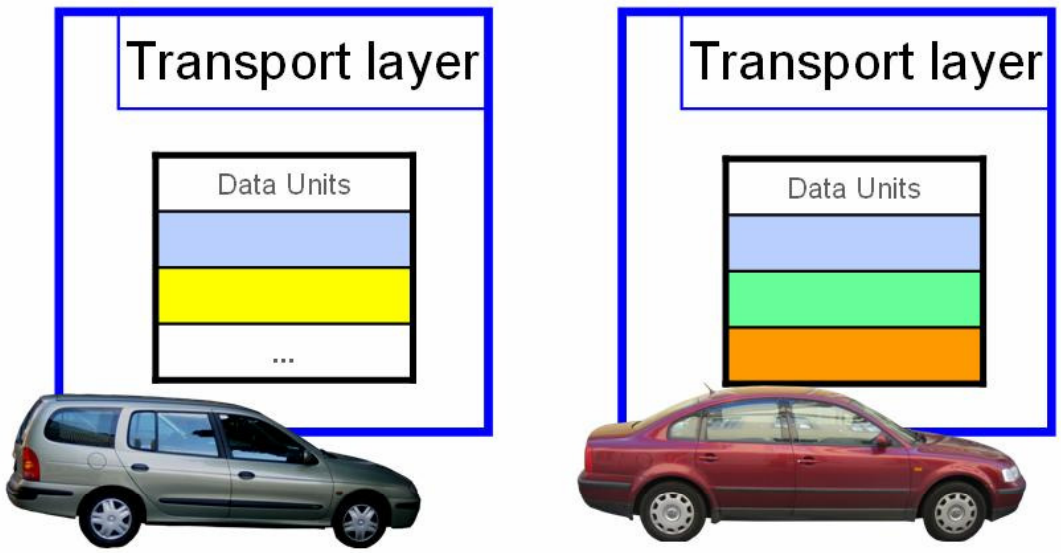
Decision Tree for Traffic Jam Type

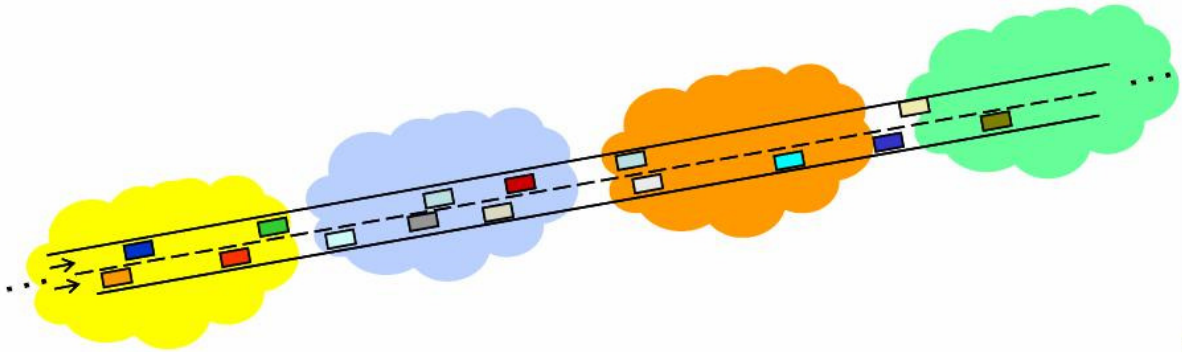




- Different Types of Traffic Jams
- Monitor Jam´s Front and Back by HDCs
- Collect Jam's Internals by Moving HDCs
- Example from Last Slide
  - Stop and Go Waves

Transportmechanism for HDCs

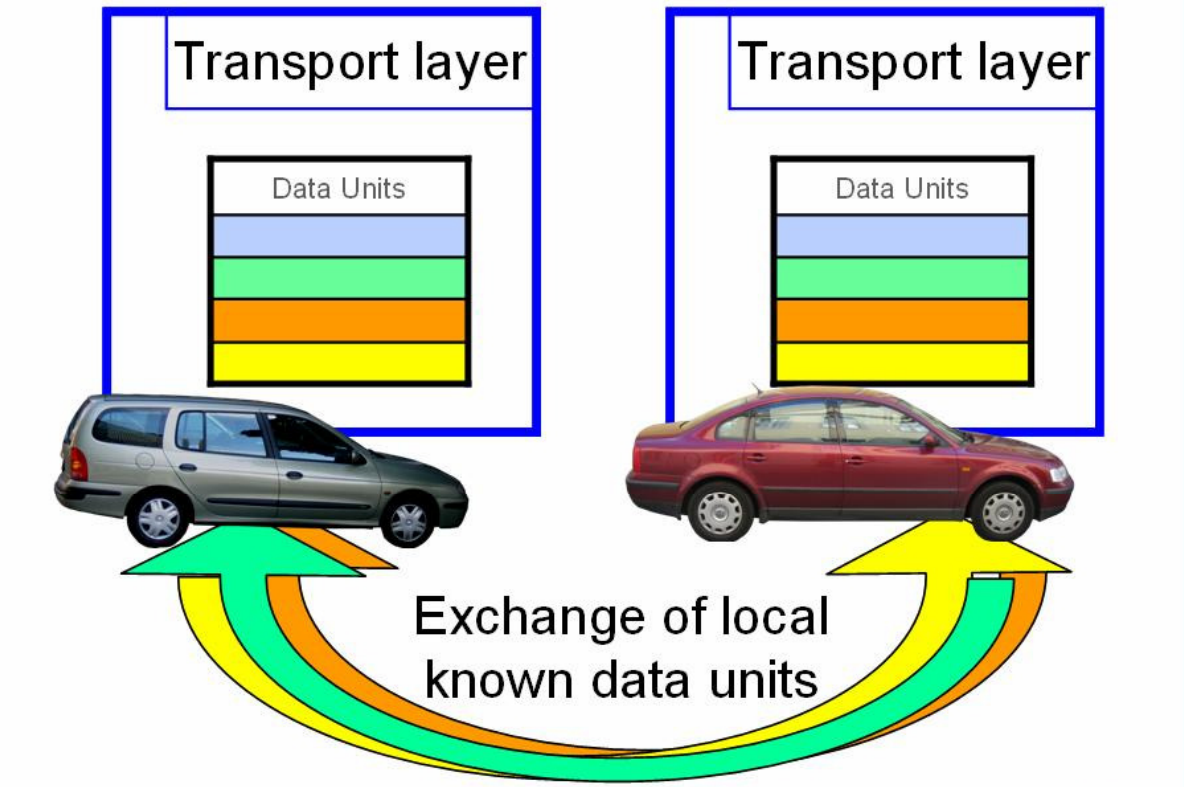


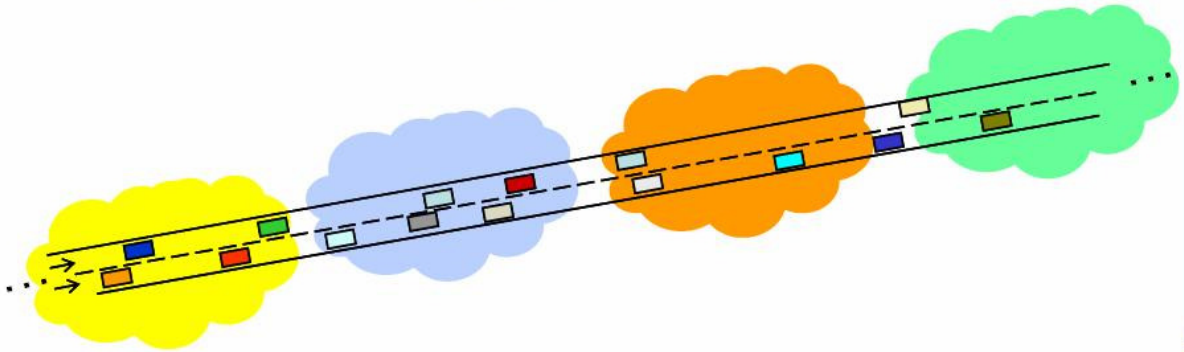


Design Ideas

- Data Dissemination Mechanism for new Class of Applications
  - Where Information is more important than Originator
  - Forwarding Nodes do not know each other
- Data Dissemination like Telling Gossip
- Utilize Broadcast Medium, no Unicast Communication
- Simple and Robust
- Priority Control

Transportmechanism for HDCs





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Protocols under Evaluation

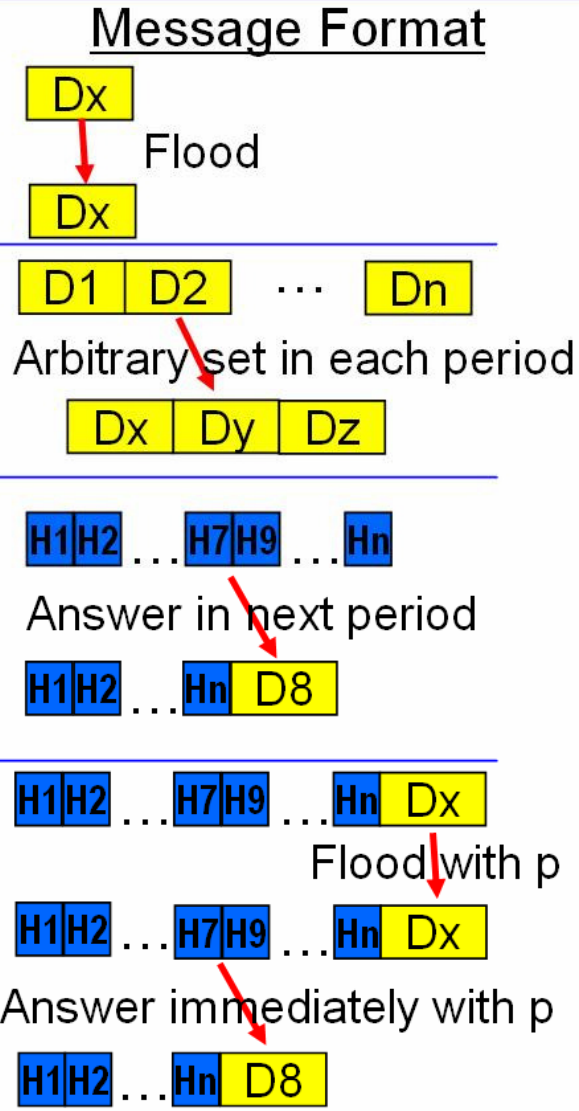
- Flooding
  - Rebroadcast Data Units immediately but only once
  - Q: What happens, when Network is partitioned
  - Q: What happens when Nodes join later?

- MILE
  - Broadcast periodically Parts of local known Data Units
  - Q: Is it fast enough?
  - Q: Is the bandwidth consumption too high?

- MILE on Demand
  - Broadcast periodically full List of Hash Values of Data Units
  - When receive an incomplete List, add Data Unit in next Broadcast
  - Q: What are the Bandwidth savings?
  - Q: Will it be fast enough?

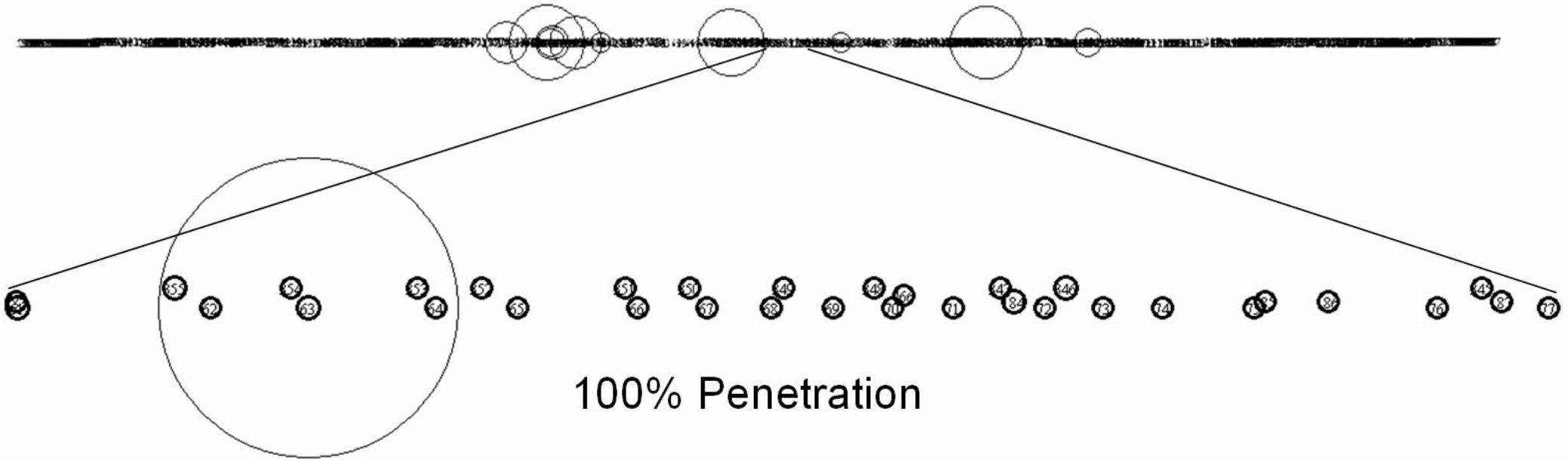
- AutoCast
  - Probabilistic Flooding depending on Neighborhood Size
  - Broadcast periodically full List of Hash Values of Data Units
  - When receive an incomplete List answer the Data Unit immediately with same probability as Flooding
  - Q: Is it near to the Optimum?
  - Q: Is it scalable?

- Theoretical optimum
  - Reference only: Nodes intuitively broadcast the required Data Units in the right moment.
  - Reaches as many Nodes as possible



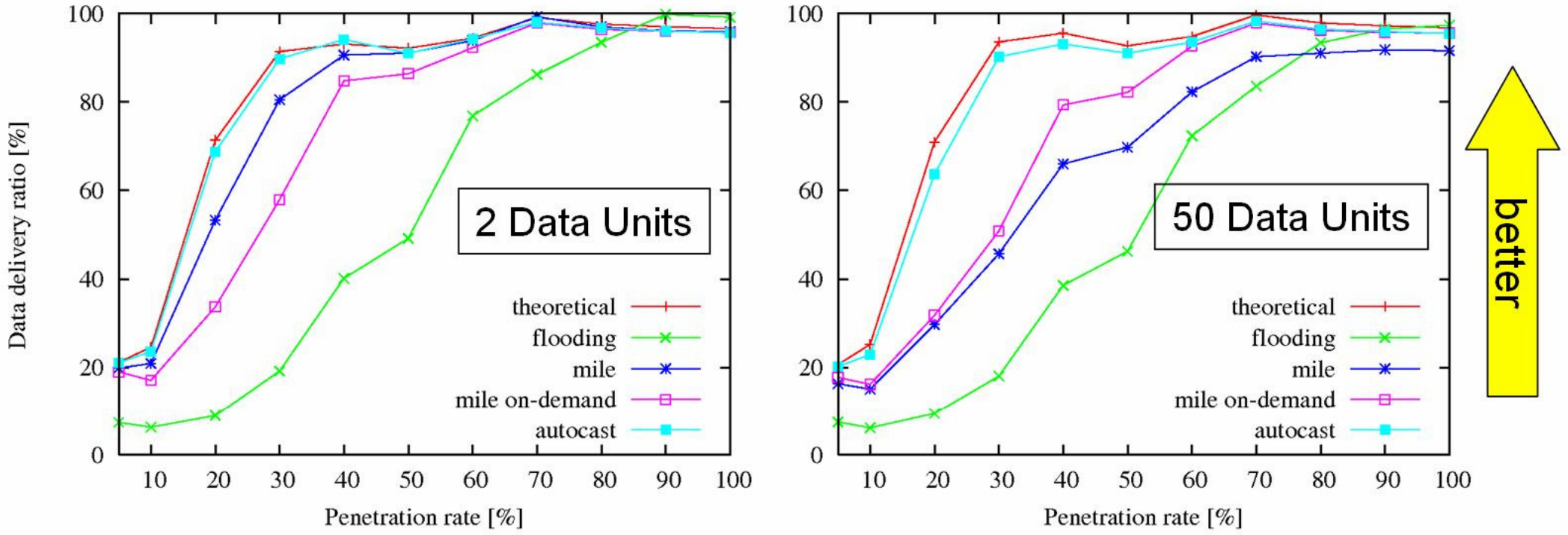
Simulation Setup

- Road of 10 km length
- 36 cars/km, 2 lanes in each direction (motorway)
- Penetration rates from 5% to 100%
- Simulator Sumo and ns-2
- Radio: 802.11, 250m radius, 1Mbit/s
- 2 to 50 concurrent Data Units generated at km 5 with lifetime 50s



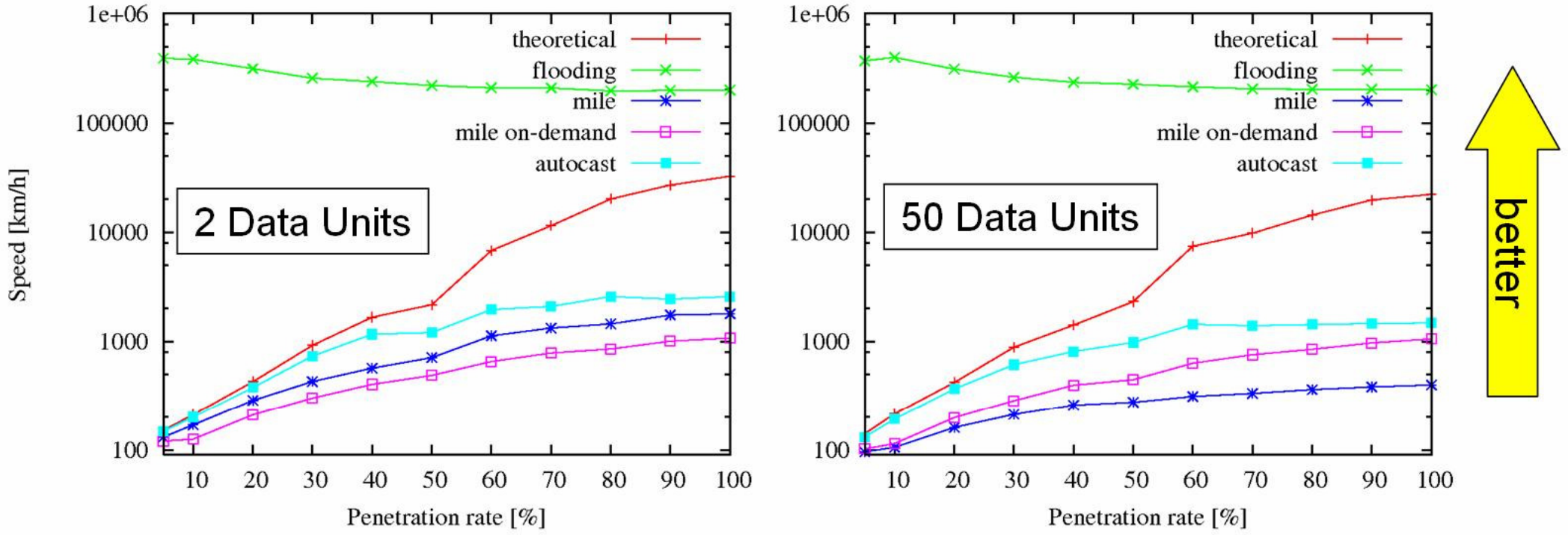
100% Penetration

Comparison
Data delivery



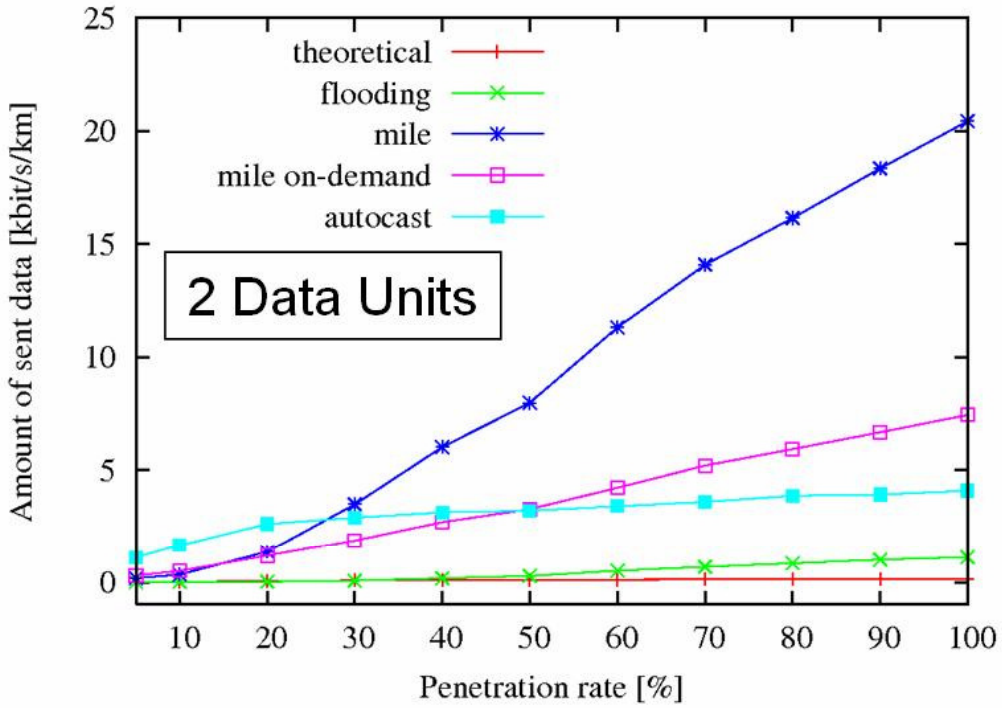
Protocol	Delivery Ratio	Scalability
Theoretical	Reference	Yes
Flooding	Worst	Yes
MILE	Average	No
MILE on Demand	Bad	Yes
AutoCast	Best	Yes

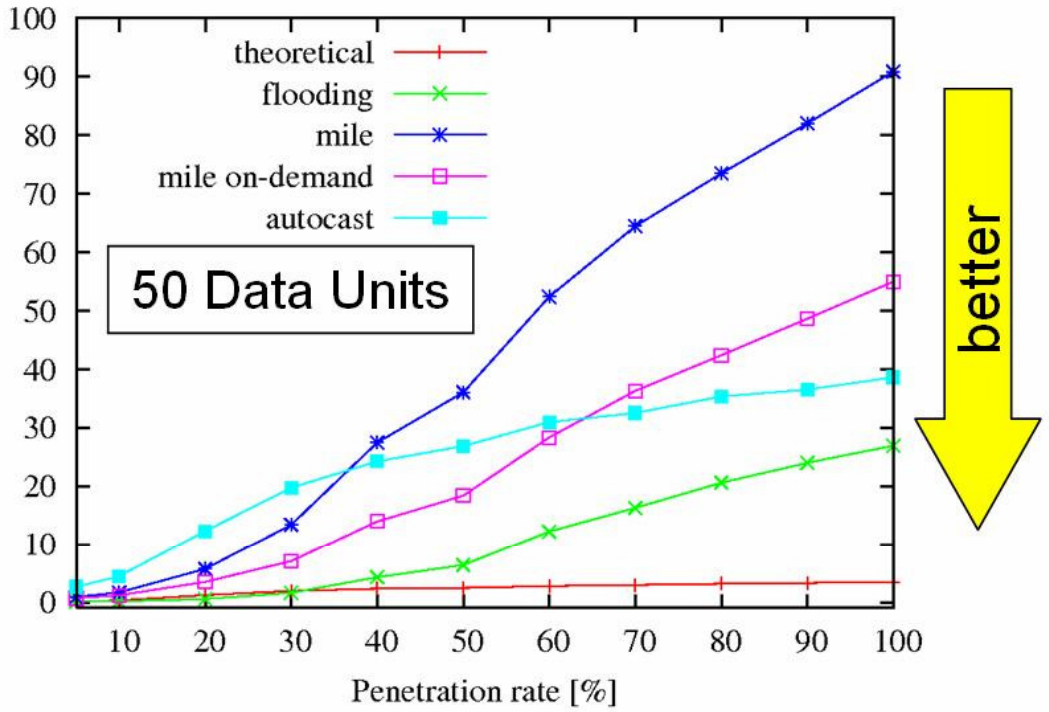
Comparison Speed



Protocol	Speed	Scalability
Theoretic	Reference	Yes
Flooding	Best	Yes
MILE	Bad	Yes
MILE on Demand	Worst	Yes
AutoCast	Average	Yes

Comparison
Radio Channel usage





Protocol	Channel Usage	Scalability
Theoretic:	Reference	Yes
Flooding:	**Best**	No
MILE:	Worst	No
MILE on Demand:	Bad	No
AutoCast:	Average	Yes

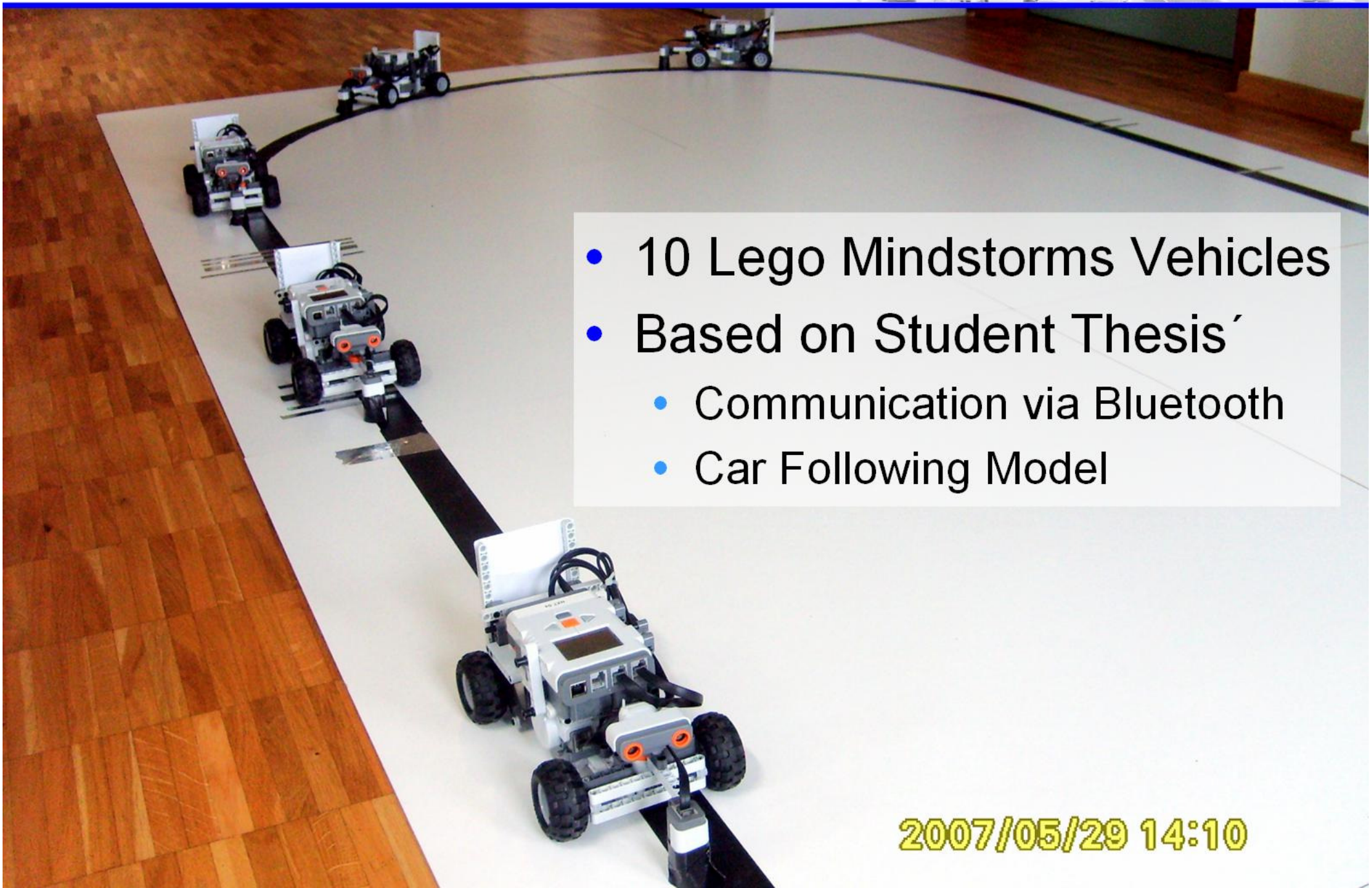
AutoCast – Conclusion

- AutoCast is a good Trade-off between
  - Data Dissemination speed
  - Communication Overhead
  - and Delivery Ratio.
- Good Efficiency in Comparison to Theoretical Optimal Reference
- 802.11 (1 Mbps): less than 5 % of Bandwidth (high density & 50 data units)
- AutoCast adopts to changing Conditions in a Self-Organizing Manner

Wegener, A.; Hellbrück, H.; Fischer, S.; Schmidt, C. & Fekete, S.
AutoCast: An Adaptive Data Dissemination Protocol for Traffic Information Systems
VTC 2007 Fall: 66th IEEE Vehicular Technology Conference, 2007

Traffic Jam Demonstrator

AutoNomos



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  - Structures in Road Networks
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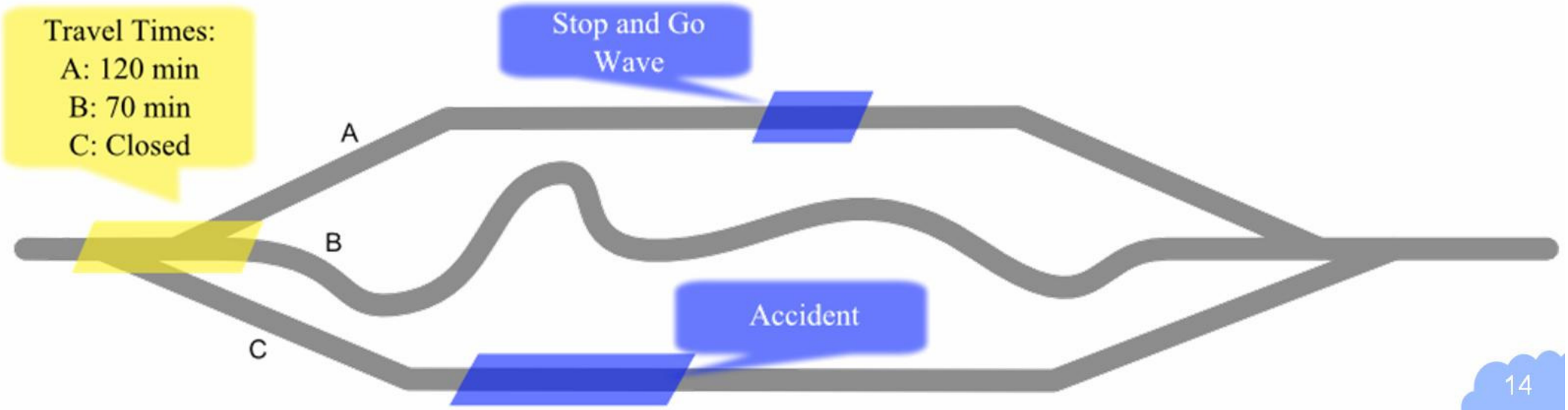
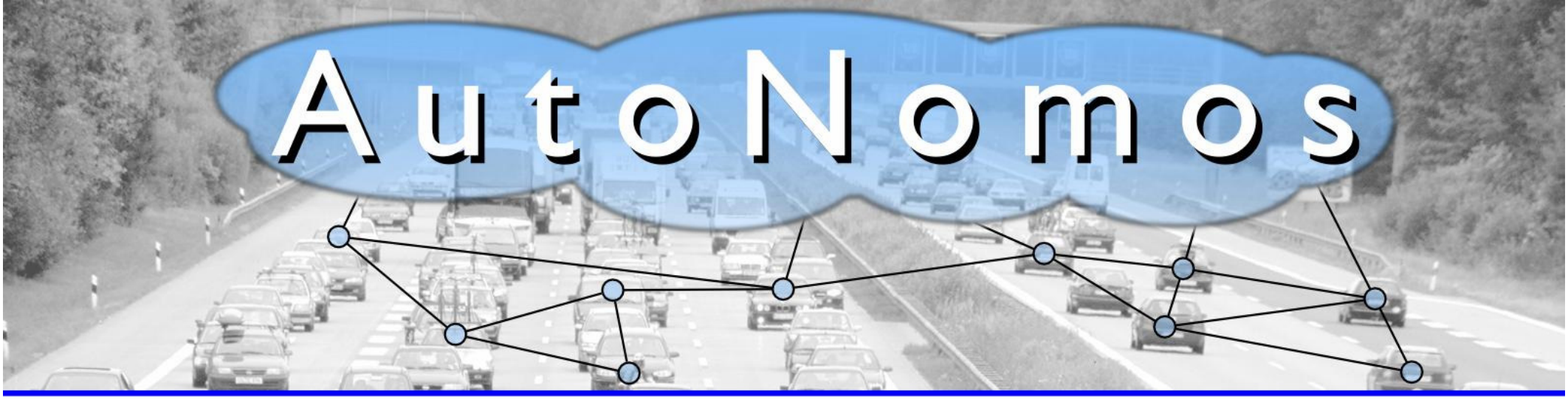
Structures in Road Networks

- HDCs in Road Networks
- Network-based Organic Information Complexes
- Hierarchical OICs
- Case Study
  - Road Network (~1000 km, 50.000 vehicles)



Algorithms for efficient distributed computing

- Forecasting of individual Travel Costs
  - Sending “Tracers” along intended Route
- Network-based Computation
  - Forecasting is done everywhere
  - Information is “pushed” to the Driver
- Predicting Changes in global Traffic Flow
  - Anticipate Reaction of Drivers to Traffic Information
- Personalized dynamic Routing



Thank you for your attention

Questions?

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