

A New Information Propagation Scheme for Vehicular Networks

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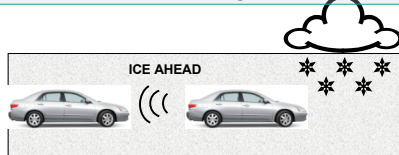
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Introduction

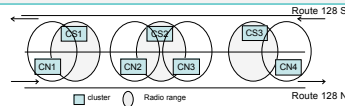
- Goal - propagate Information Warning Functions to all nodes (vehicles on a highway)
- Challenges -
 - Time varying network fragmentation
 - Lack of fixed infrastructure and scalability of system
 - High mobility of nodes
 - Flooding of network
 - Maintaining global naming scheme
- Proposed Solution -
 - Cluster nodes on each side of the road
 - Use attributed data to perform local routing decisions

Information Warning Functions

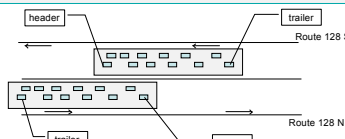


Problem Description and Solution

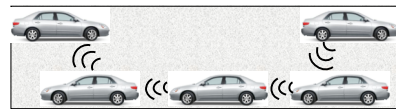
Fragmentation – Time Varying Connectivity



Clustering Nodes on each side

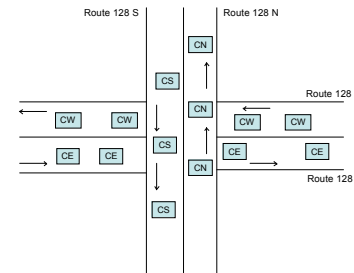


Custody Transfer Mechanism



Attribute Based Routing

Node Attributes	Message Attributes
- Location	- Location_Source
- Direction	- Direction
- Speed	- Time_To_Live
- Destination	- Location_Sink
- Current_Time	- TimeStamp



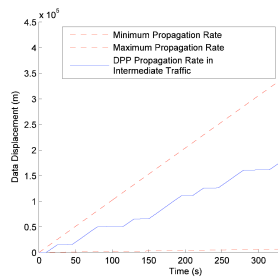
Directional Propagation

Algorithm : Routing at Header Nodes

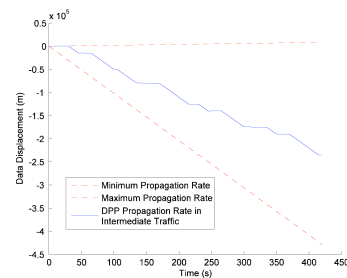
1. Initialize Node_Direction
2. For any Message
3. if Message is not in Queue
4. add Message to Queue
5. if (Message_Direction = Node_Direction) then
6. send ACK
7. do Forward Propagation
8. else
9. Route to trailer
10. else
11. if (Message_Direction = Node_Direction) then
12. send ACK
13. else
14. if ACK for Message exists
15. send ACK // re-transmission
16. else
17. do nothing // duplicate message
18. End

Performance Evaluation

Forward Propagation



Reverse Propagation



$$x_i = x_{i-1} + \max(c, c + v, -c + v, -c) * t$$

$$x_i = x_{i-1} + \min(-c, -c - v, c - v, c) * t$$

x : Distance Propagated

t : Time

c : Speed of Vehicle

v : Speed of Message Propagation

Research Contributions

- A novel distributed algorithm for propagating data along two opposing directions in an otherwise fragmented network
- Information propagation in the absence of continuous end-to-end connectivity in the system
- Isolating vehicular from network traffic
- Upper bound, lower bound and typical performance characterization
- Information propagation in the absence of global naming scheme and fixed infrastructure
- Limiting data traffic congestion by potentially localizing and reducing message exchange
- Future Work: detailed performance characterization by considering latencies due to MAC contention, clustering and message handling

Selected Publications

- Thomas DC Little and Ashish Agarwal, "A New Information Propagation Scheme for Vehicular Networks", to appear in *IEEE Intelligent Transportation Systems Conference (ITSC) 2005*, Vienna, Austria, Sep 13-16, 2005.
- J. Tian, L. Han, K. Rothermel, and C. Cseh. "Spatially Aware Packet Routing for Mobile Ad Hoc Inter-Vehicle Radio Networks", *Proc. IEEE 6th Intl. Conf. on Intelligent Transportation Systems (ITSC)*, Shanghai, China, October 12-15, 2003.
- Lars Wischhof, André Ebner and Hermann Rohling. "Self-Organizing Traffic Information System based on Car-to-Car Communication: Prototype Implementation". *Proc. 1st Intl. Workshop on Intelligent Transportation (WIT 2004)*, Hamburg, Germany, March 2004.
- C. R. Lin and M. Gerla, "Adaptive Clustering for Mobile Wireless Networks" *IEEE Journal on Selected Areas in Communications*, Vol. 15, No. 7, September 1997, pp. 1265-1275.
- H. Wu, R. Fujimoto, R. Guensler and M. Hunter, "Analytical Models for Information Propagation in Vehicle-to-Vehicle Networks", *Proc. VANET '04*, Philadelphia, USA, 2004.
- Lars Wischhof, André Ebner and Hermann Rohling. "Self-Organizing Traffic Information System based on Car-to-Car Communication: Prototype Implementation". *Proc. 1st Intl. Workshop on Intelligent Transportation (WIT 2004)*, Hamburg, Germany, March 2004.