MobiT: A Distributed and Congestion-Resilient Trajectory Based Routing Algorithm for Vehicular Delay Tolerant Networks

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Playground for VDTNs

Limited bandwidth, sparse communication infrastructure

Such as:

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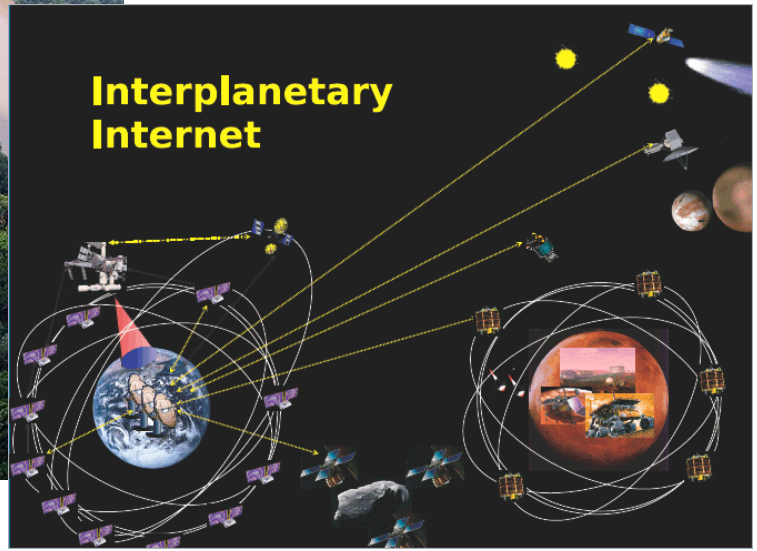
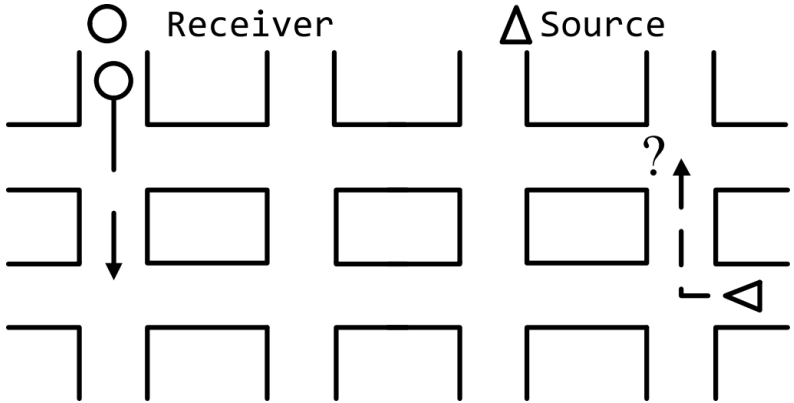


Why is packet delivery in VDTNs non-trivial?



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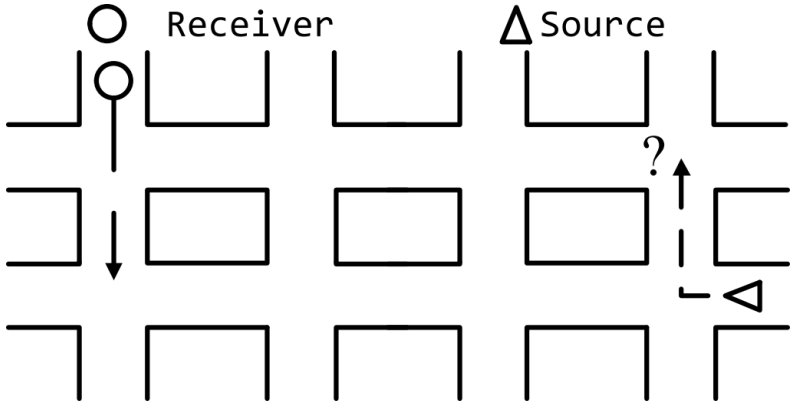

- Highly dynamic mobility of vehicles
- Disconnected nature of VDTNs

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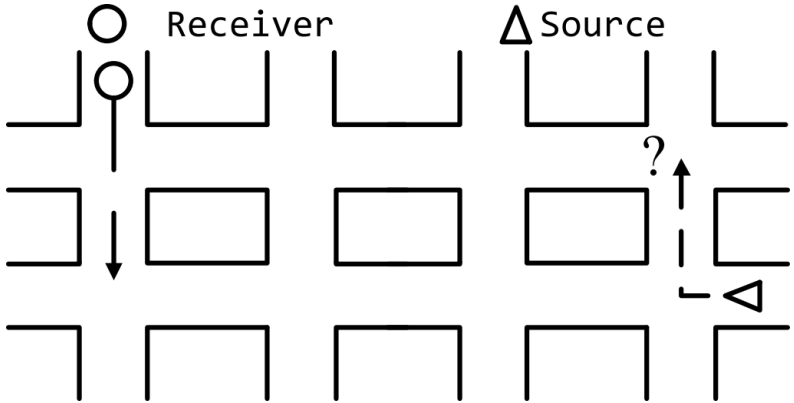


- Highly dynamic mobility of vehicles
- Disconnected nature of VDTNs

Efficient and accurate delivery of packet is not easy

1

Use vehicles' historical meeting records to schedule packet forwarding

Insufficiently accurate

1

Use vehicles' historical meeting records to schedule packet forwarding

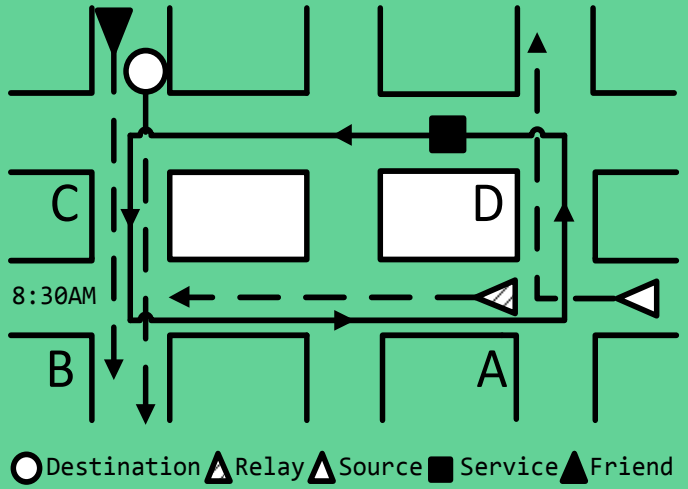
Insufficiently accurate

2

Use vehicles' trajectories to schedule the delivery of packets

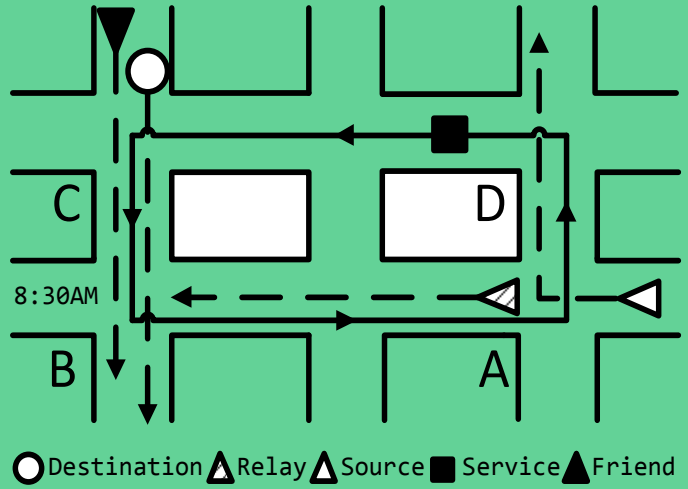
Depend on extra APs

MobiT: Packet routing method using Mobility derived from Trajectories



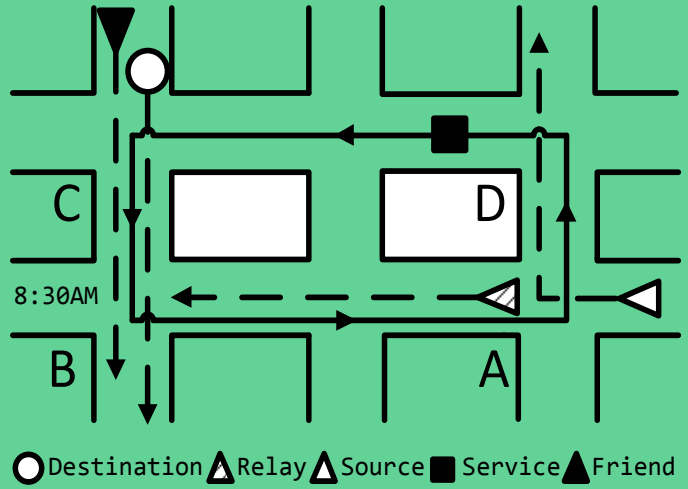
MobiT: Packet routing method using Mobility derived from Trajectories

- Source vehicle – starting vehicle of the packet



MobiT: Packet routing method using Mobility derived from Trajectories

- Source vehicle – starting vehicle of the packet
- Destination vehicle – target of the packet



MobiT: Packet routing method using Mobility derived from Trajectories

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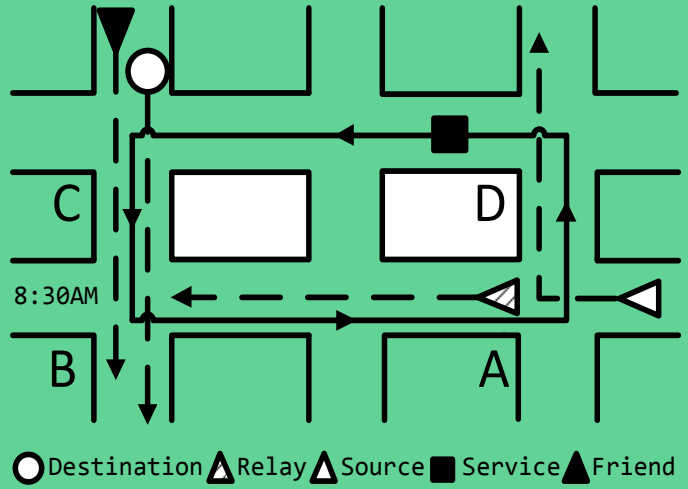
- Relay vehicle – intermediate vehicle in the forwarding of the packet



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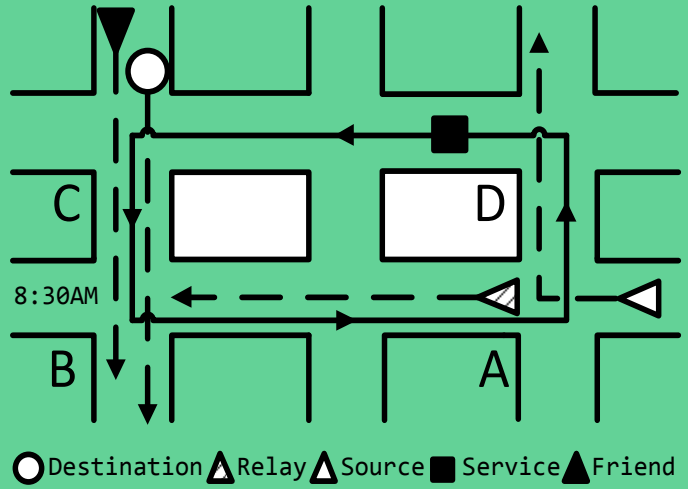

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- Source vehicle – starting vehicle of the packet
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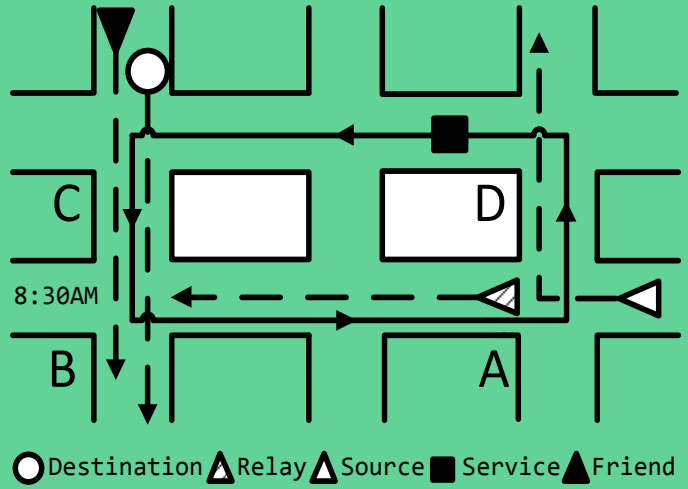
- Friend vehicle – shares similar mobility with the destination vehicle
- Service vehicle – vehicle with stable trajectory



Overview

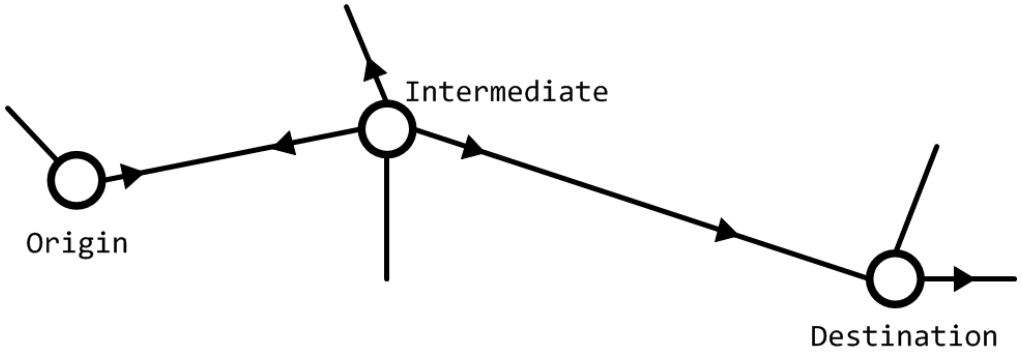
Design of MobiT

Experimental results

Conclusion with future directions

Representation of Short-term Vehicle Mobility

Vehicle trajectory



Representation of Short-term Vehicle Mobility

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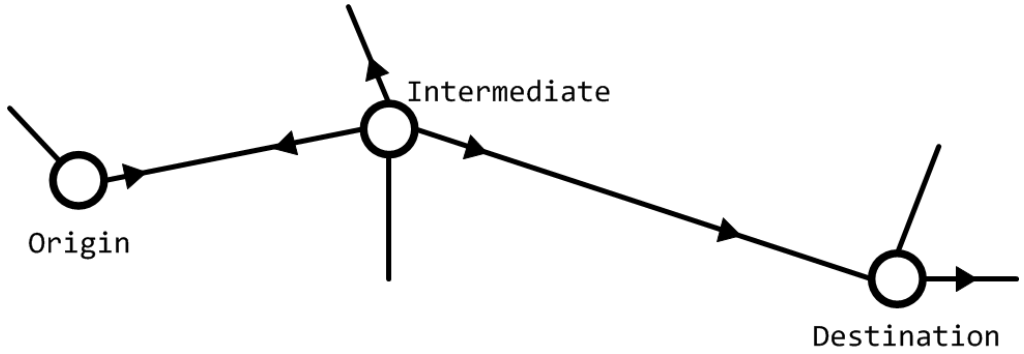

Table I: Table of road segment delays

Representation of Short-term Vehicle Mobility

Vehicle trajectory

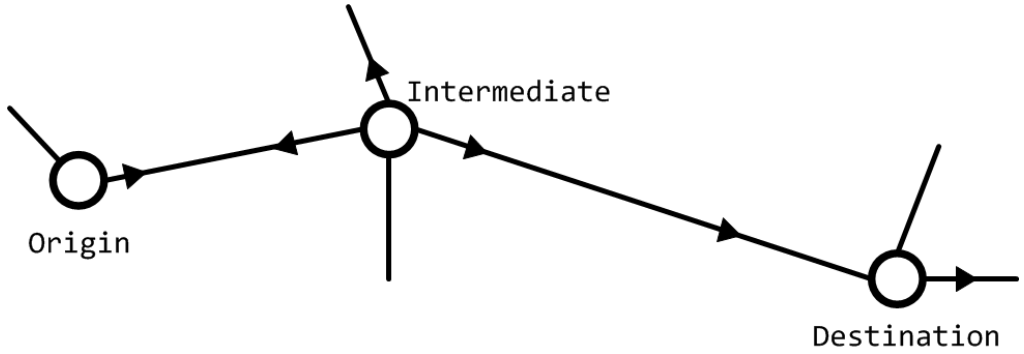

Table I: Table of road segment delays

Table II: Table of road segment congestion state

Representation of Short-term Vehicle Mobility

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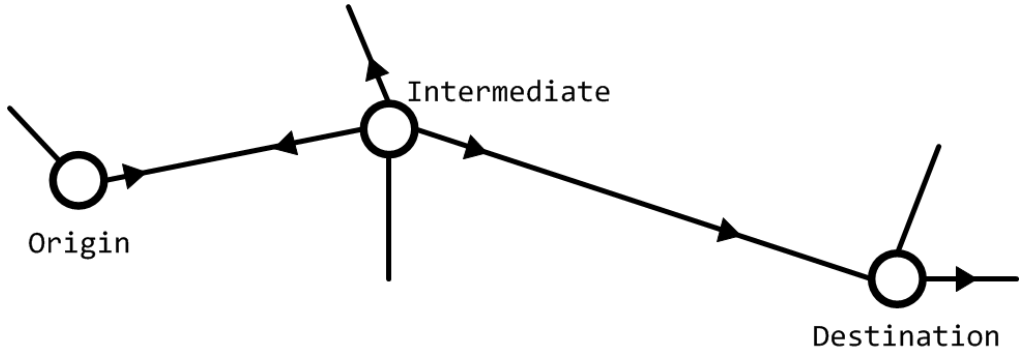

Table I: Table of road segment delays

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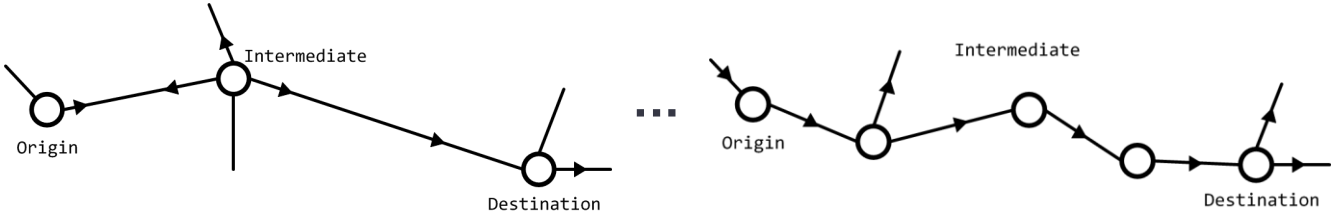
Estimate travel time of the trajectory

Representation of Long-term Vehicle Mobility

Vehicle routine



T_s: 08:10~08:20

T_e: 08:30~08:45

T_s: 13:00~13:20

T_e: 13:30~13:45

Representation of Long-term Vehicle Mobility

Vehicle routine

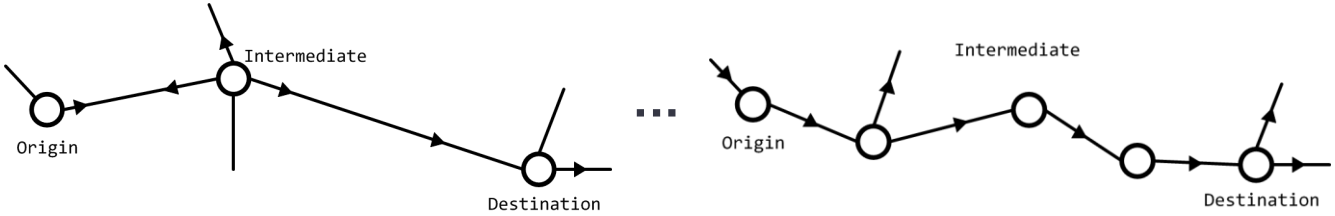


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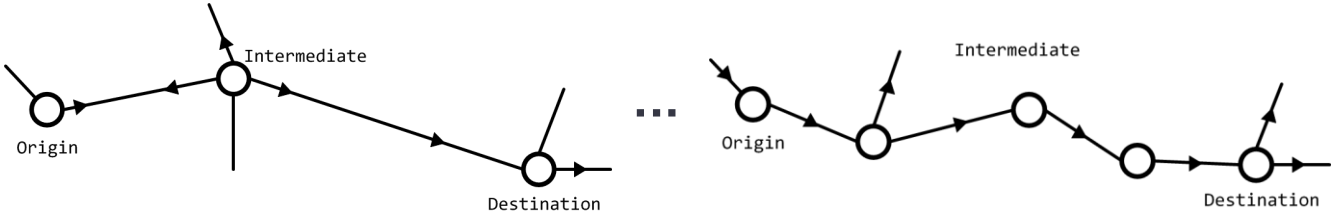
Table III: Table of routines

Representation of Long-term Vehicle Mobility

Vehicle routine



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T_s: 13:00~13:20

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Table III: Table of routines

$$\begin{aligned} \left|\bar{T}_{e1} - \bar{T}_{e2}\right| &< \tau_t \\ \left|\bar{T}_{s1} - \bar{T}_{s2}\right| &< \tau_t \\ \frac{|r_1 \bigcap r_2|}{|r_1 \bigcup r_2|} &> \gamma_s \end{aligned}$$

Representation of Long-term Vehicle Mobility

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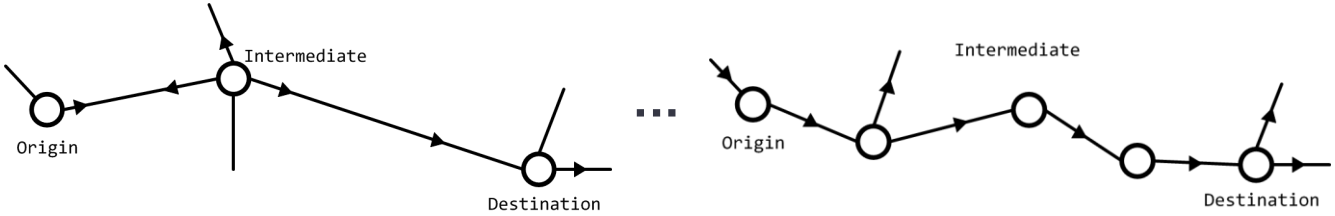

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Table IV: Table of friends

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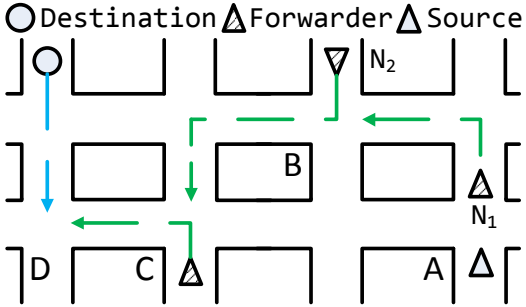
Routing Process based on Vehicle Mobility

1



Complete list of forwarders

Routing Process based on Vehicle Mobility

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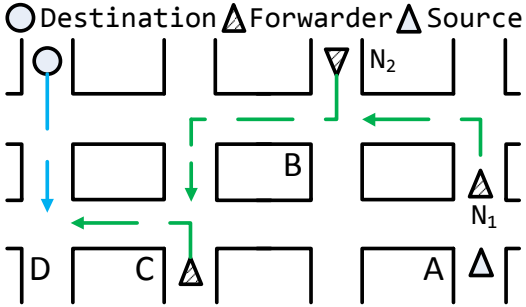

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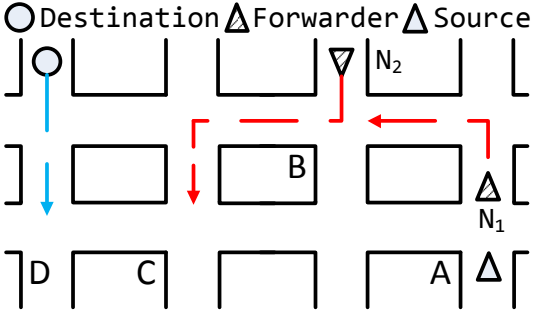

Incomplete list of forwarders

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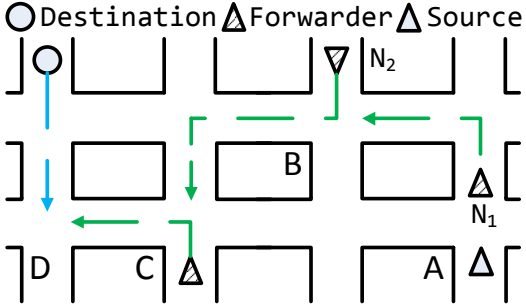

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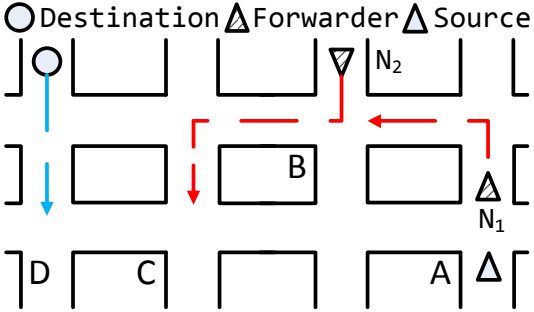


Incomplete list of forwarders

3 No short-term mobility

- Use long-term mobility
- Rely on service vehicle

Performance evaluation

Vehicle mobility traces

Rome [1]: 30-day taxi trace with 315 taxis and 4638 landmarks

Comparison methods

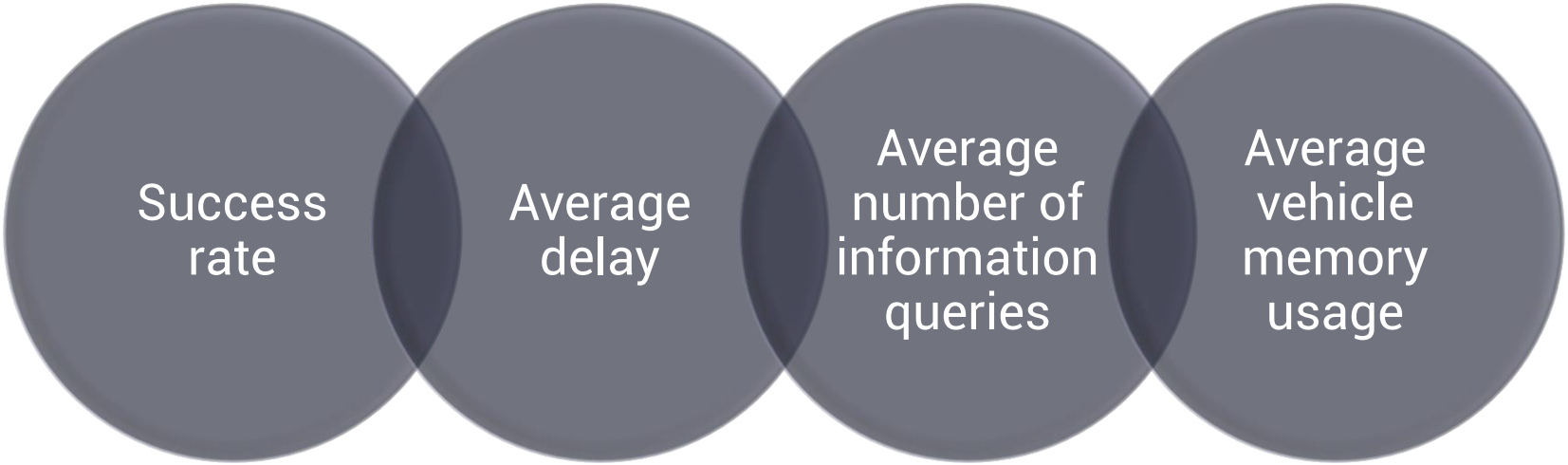
Robust Replication Routing (R3): Mobicom'11

Shared-Trajectory-based Data Forwarding (STDFS): Infocom'11

[1] R. Amici, M. Bonola, L. Bracciale, P. Loreti, A. Rabuffi, and G. Bianchi, "Performance assessment of an epidemic protocol in VANET using real traces," in Proc. of MoWNeT, 2014.

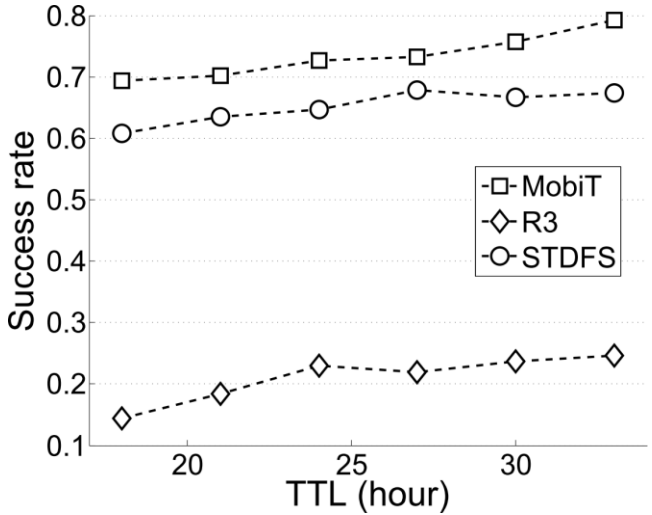
Performance evaluation (cont.)

Metrics

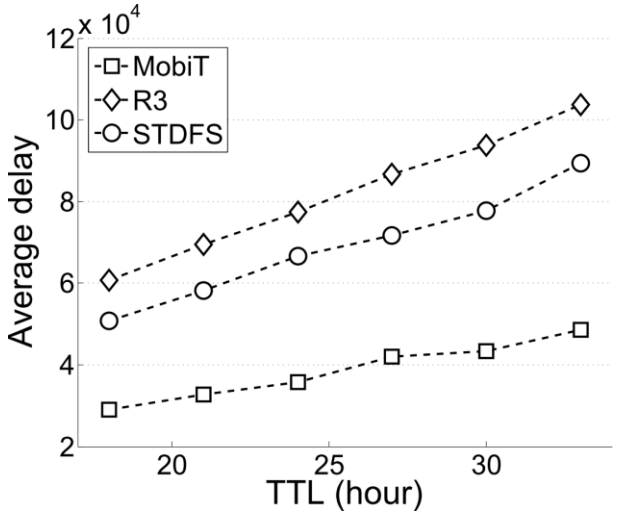


Performance evaluation (cont.)

Rome:



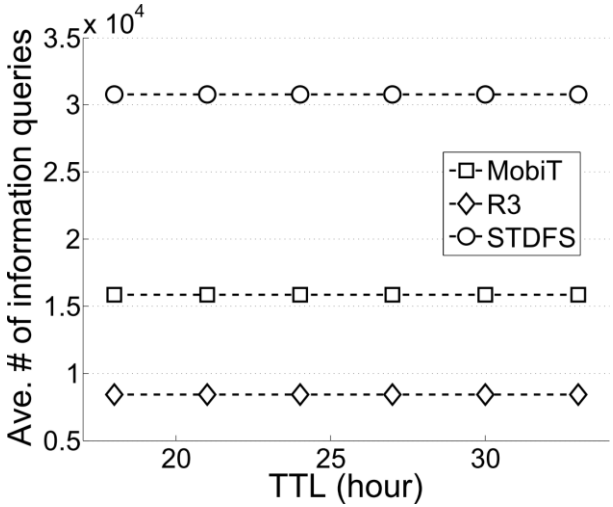
MobiT>STDFS>R3



R3>STDFS>MobiT

Performance evaluation (cont.)

Rome:



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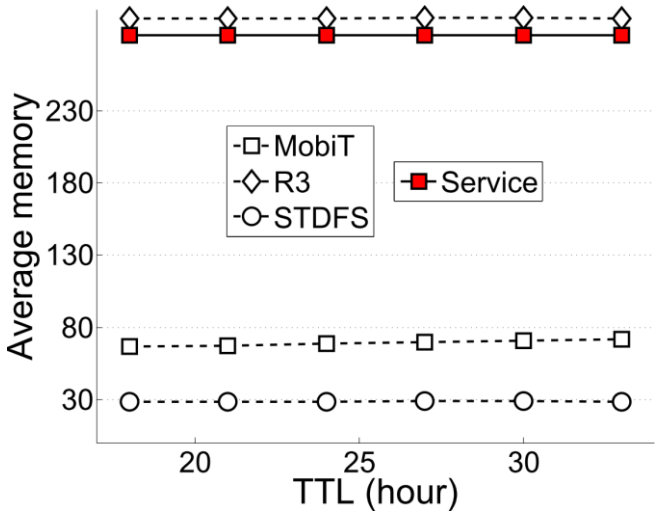

R3>Service>MobiT>STDFS

Summary

1. By utilizing vehicles' trajectories, MobiT can schedule the forwarding of packets in a distributed manner.

2. Through combining the vehicles' long-term mobility with their short-term mobility, MobiT can realize accurate and efficient delivery of packets with limited overhead.

3. In the future, we will further exploit vehicles' social relationship for the routing of packets.

Thank you!
Questions & Comments?

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