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

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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
Why is packet delivery in VDTNs non-trivial?

- Highly dynamic mobility of vehicles
- Disconnected nature of VDTNs

Efficient and accurate delivery of packet is not easy
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
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▲ Source vehicle – starting vehicle of the packet
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▲ Source vehicle – starting vehicle of the packet

○ Destination vehicle – target 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

▲ Relay vehicle – intermediate vehicle in the forwarding of the packet
MobiT: Packet routing method using Mobility derived from Trajectories

- Triangle: Source vehicle – starting vehicle of the packet
- Circle: Destination vehicle – target of the packet
- Inverted triangle: Relay vehicle – intermediate vehicle in the forwarding of the packet
- Triangle with down arrow: Friend vehicle – shares similar mobility with the destination vehicle
MobiT: Packet routing method using Mobility derived from Trajectories

- **Source vehicle** – starting vehicle of the packet
- **Destination vehicle** – target of the packet
- **Relay vehicle** – intermediate vehicle in the forwarding of the packet
- **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

Vehicle trajectory

Table I: Table of road segment delays
Representation of Short-term Vehicle Mobility

Table I: Table of road segment delays

Table II: Table of road segment congestion state
Representation of Short-term Vehicle Mobility

Vehicle trajectory

Table I: Table of road segment delays

Table II: Table of road segment congestion state

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

$T_s$: 08:10~08:20
$T_e$: 08:30~08:45

$T_s$: 13:00~13:20
$T_e$: 13:30~13:45

Table III: Table of routines
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

Table III: Table of routines
Representation of Long-term Vehicle Mobility

Vehicle routine

\[ T_s: 08:10 \sim 08:20 \]
\[ T_e: 08:30 \sim 08:45 \]

\[ T_s: 13:00 \sim 13:20 \]
\[ T_e: 13:30 \sim 13:45 \]

Table III: Table of routines

Table IV: Table of friends

\[ |\bar{T}_{e1} - \bar{T}_{e2}| < \tau_t \]
\[ |\bar{T}_{s1} - \bar{T}_{s2}| < \tau_t \]
\[ \frac{|r_1 \cap r_2|}{|r_1 \cup r_2|} > \gamma_s \]
Routing Process based on Vehicle Mobility

Complete list of forwarders
Routing Process based on Vehicle Mobility

Complete list of forwarders

Incomplete list of forwarders
Routing Process based on Vehicle Mobility

1. Complete list of forwarders
2. 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

Performance evaluation (cont.)

Metrics

- Success rate
- Average delay
- Average number of information queries
- Average vehicle memory usage
Performance evaluation (cont.)

Rome:

MobiT > STDFS > R3

R3 > STDFS > MobiT
Performance evaluation (cont.)

Rome:

STD>FS>MobiT>R3

R3>Service>MobiT>STD>FS
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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