A Passive Geographical Routing Protocol in VANET

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Outline

- Introduction
- Related Works
- Routing Process
- Simulation and Performance Analysis
- Conclusion and Future Work

Introduction

- VANET have some characteristics
  - Maybe no stable infrastructures are available
  - Network topology and states may change rapidly. Nodes may perhaps have no long communication session time
  - Power and memory are not problems in VANET
  - VANET may have many building obstacles between nodes in city urban environments
- Traditional ad hoc routing protocols require high routing overhead and do not use any available information to maximize routing performance

Related Works

- Source routing protocol
  - Dynamic Source Routing (DSR)
- Distance vector protocol
  - Destination Sequence Distance Vector (DSDV)
  - Ad hoc On-demand Distance Vector (AODV)
- Position based protocol
  - Greedy perimeter stateless routing (GPSR)
    - Grid Location Service (GLS)
  - Weak State Routing (WSR)

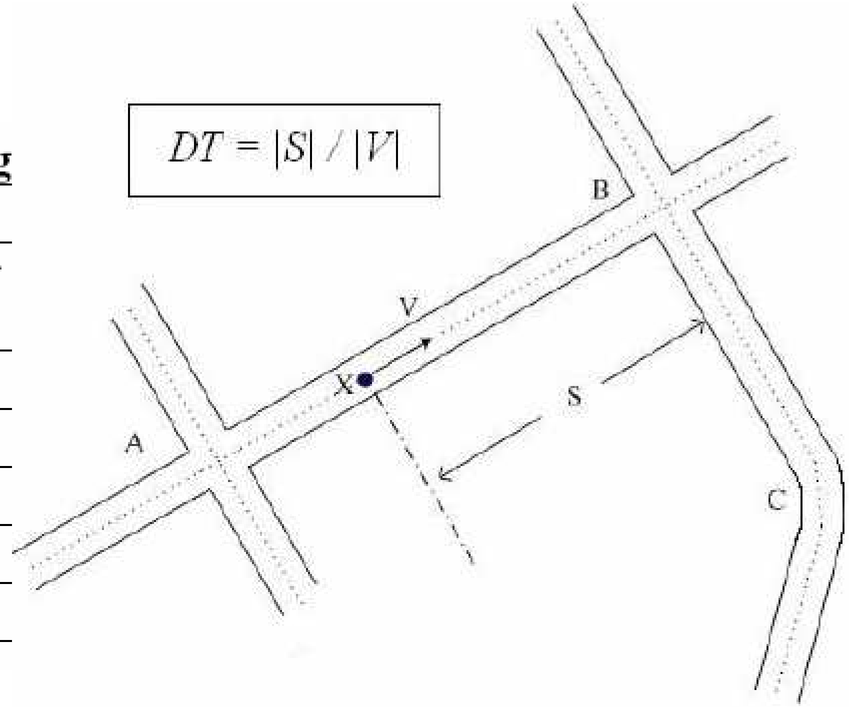
Assumptions

- On-board GPS device
  - Position and velocity information
- City road map
  - Position prognostication
- Beacon messages
- Route announcement packet
- If source has no destination geographical Information, it simply sends packets towards its movement direction

Geographical information local propagation (Beacon)

Table 1: Notation description sent in beacon messag

Notation	Description
TS	Local time stamp, integer variant for each node
X	x coordinate
Y	y coordinate
V	Velocity magnitude
D	Velocity direction
DT	Velocity direction stable duration



- DV will be used to determine the geographical information cache time by others and route announcement propagation frequency by the source

Geographical information remote propagation (Announcement)

- We must have a mechanism to disseminate information to some longer distance
  - Route announcement messages
- Intermediate nodes which receive announcement packets will forward them along the direction they are sent

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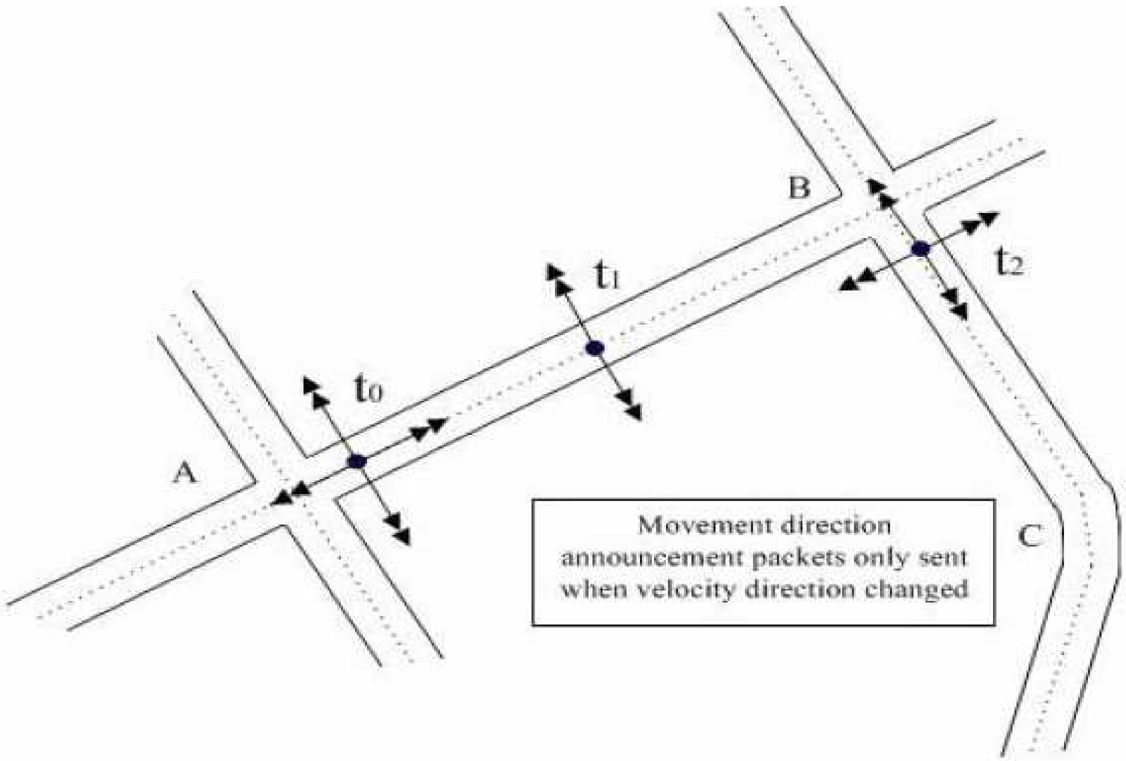


Figure 2: Announcement sending. Nodes send out announcement packets in 4 orthogonal directions along their velocity direction. I.e. nodes send 4 packets as 0, 90, 180, 270 degree, which 0 degree is related to their movement direction. 90 and 270 degree announcement packets will be sent periodically. Other 2 direction announcement packets will only be sent when nodes' velocity direction change.

Packet Forwarding

- For data packet sending, we may have destination's geographical information or not
  - Bad situation: source sends data in its movement direction. Packet forward direction can be fixed by intermediated nodes, which have destination's info.
  - Good situation: source will prognosticate destination's current location and then forward packet to the best next hop

Location prognostication mechanism

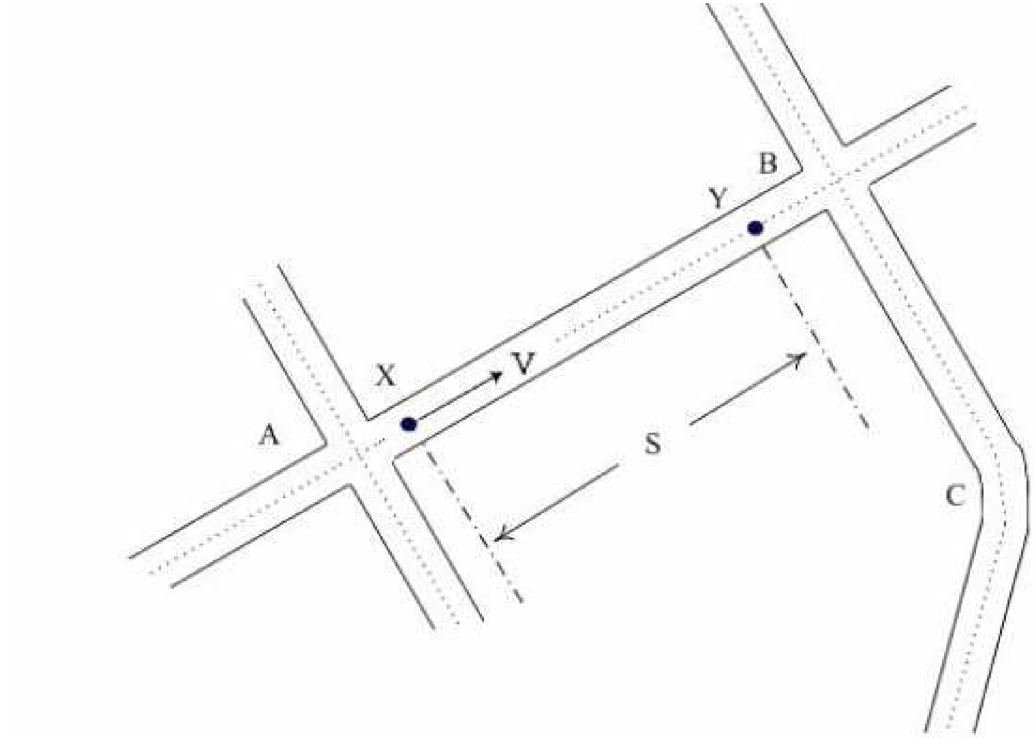


Figure 3: location prognostication is as, Y = X + S, Node was at X at time t0, then moves to Y at time t1. S is defined as S = |V| ×△T, △T = t1 – t0.

Algorithm for packet forwarding in PGR

PacketForward (*p*)

```
Src <- p.Header[Source]
Des <- p.Header[Dest]
entrySrc <- RouteTable[Src.ip]
entryDes <- RouteTable[Des.ip]
//Update source's route table entry if necessarily
if(Src.TS > entrySrc.TS) then
    RouteTable[Src.ip] = Src
end if
//Update destination's route table entry, or packet header
if(Des.TS > entryDes.TS) then
    RouteTable[Des.ip] = Des
else
    p.Header[Dest] = RouteTable[Des.ip]
end if
// Prognosticate dest new location
DestLocation <- Prognosticate(Des.ip)
//Find nearest next hop
Nexthop <- FindNearestNexthop(DestLocation)
SendPacket(Nexthop)
```

Simulation and performance analysis

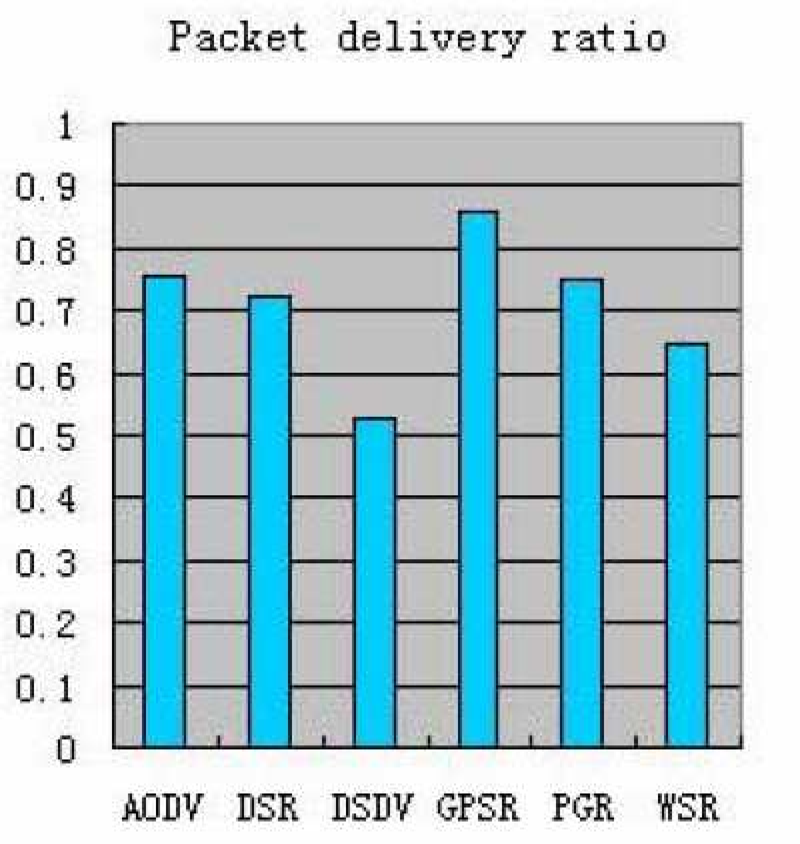
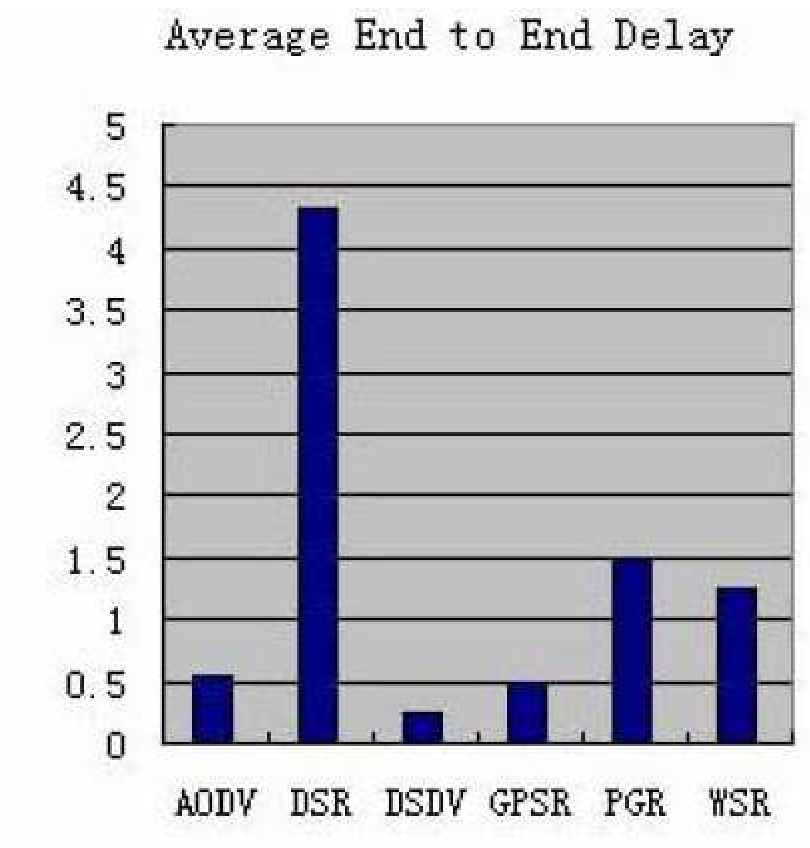
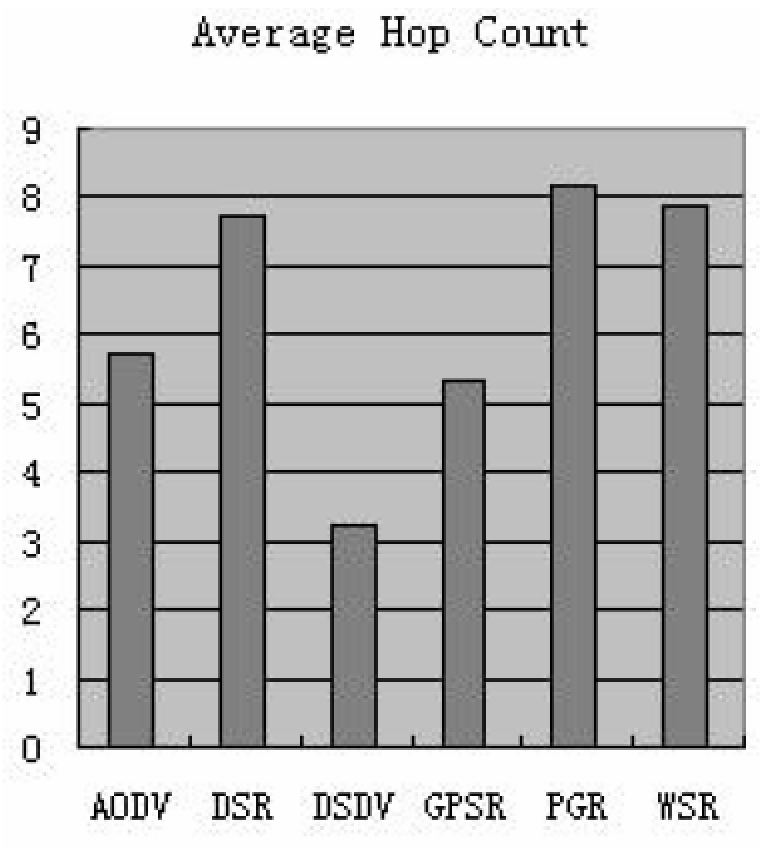


Figure 4. Packet delivery ratio

Network Simulator (NS2)
Topology :20Km * 20Km
Data packet : 512 bytes
Number: 100 vehicles
Simulation time :180 seconds

Simulation and performance analysis





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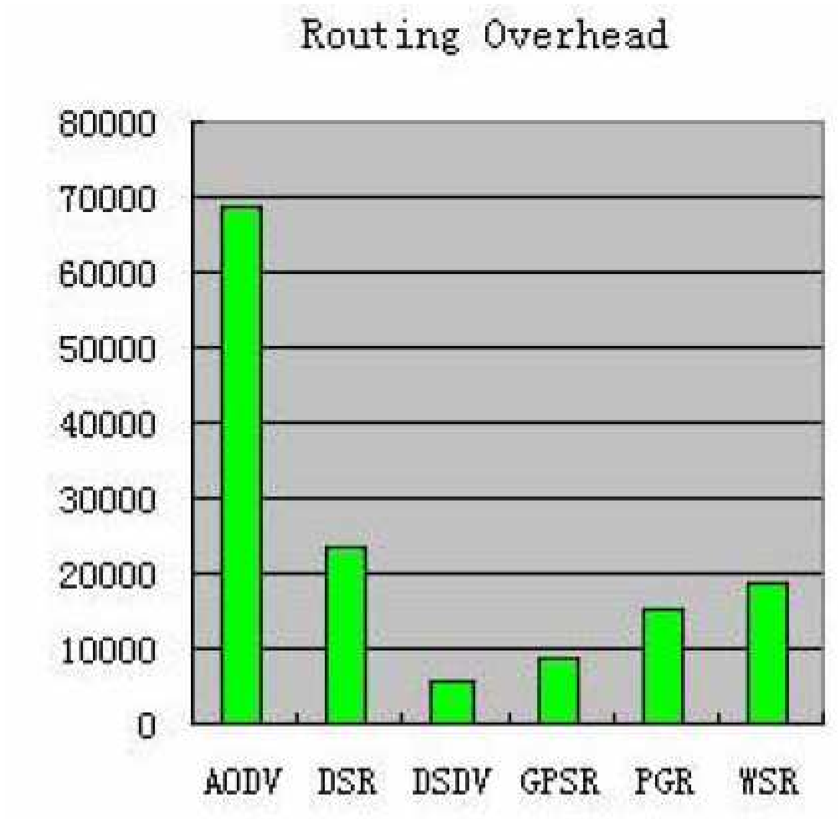

Figure 7. Routing Overhead

Conclusion

- The algorithm does not assume a global location query service system to be pre-deployed, which is most of the practical case in VANET environments
- PGR provides high data packet delivery ratio in high dynamic topology of VANET with lower overhead comparing to the traditional routing protocols

Future work

- In realistic urban environment , there may be many obstacles such as buildings and trees along the street, which make communication of nodes in adjacent streets impossible
- Some nodes are isolated when they go far from others, which makes the network many sub-networks. We may change out algorithm to adapt to DTN