Exploiting the Height of Vehicles in Vehicular Communication

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Outline

• Motivation
• Method
  ▪ Experiments
  ▪ Model
• Results
• Conclusion
Motivation

• Vehicles obstruct V2V communication [1, 2]
• Significant impact on received power

Idea

• Use tall vehicles as next hop relays
• Important: tall vehicles ≥ short vehicles + 1 m
• How much adverse shadowing can we avoid by choosing tall vehicles as next hops?
Method

- Perform small-scale experiments
- Implement realistic model
- Use same location
- Extend measurements using model

(c) Google Maps
Experiment Setup

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Channel</td>
<td>180</td>
</tr>
<tr>
<td>Center frequency (MHz)</td>
<td>5900</td>
</tr>
<tr>
<td>Bandwidth (MHz)</td>
<td>20</td>
</tr>
<tr>
<td>Data rate (Mbps)</td>
<td>6</td>
</tr>
<tr>
<td>Antenna gain (dBi)</td>
<td>5</td>
</tr>
<tr>
<td>Tx Power (dBm)</td>
<td>10</td>
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DSRC (802.11p): 5.9 GHz
## Experiment Setup

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![Image of vehicles and equipment setup.](image-url)
Model for evaluating the impact of vehicles [1]

(a) Stereoscopic aerial photography

(b) Abstracted model showing possible connections

(c) Received power calculation

Results: PDR (NLOS)

- Good match between measurements & model

Red: Car-Car  Green: Van-X

Measurements  Model
Results: Received Power

- Approximately 5 dB difference throughout
- For -95 dBm recv. sens., 25% more packets
Results: Effective Range

- Min: 20 meter increase for 90% delivery rate
- Max: 190 meters for 60% delivery rate
- Avg: 100 meters increase
Best Next Hop

• Largest number of second hop neighbors for farthest tall and farthest short vehicle

![Graph showing the ratio of best hop tall vehicles as a function of sensitivity threshold and ratio of tall vehicles.](image)
Conclusions

• Tall vehicles significantly improve:
  ▪ Received signal power (**5 dB** on average)
  ▪ Packet delivery ratio (**up to 30%**)
  ▪ Effective communication range (**10% to 50%**)

• Can be used to enhance different routing protocols (overhead: 1 bit)

• Need two antennas on tall vehicles

• Correlate distance with vehicle type
Thank you

Questions?

Data will be available at http://drive-in.cmuportugal.org

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