A New Cooperative Strategy for Deafness Prevention in Directional Ad Hoc Networks

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Chi-Han Lin
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Outline

- Introduction
- Related works
- Cooperative-MAC (CMAC)
- Simulation
- Conclusions
Introduction

What is deafness:

- A terminal is said to be deaf if it doesn’t answer an RTS message addressed to it.

B doesn’t answer RTS from A. B is deaf.
Introduction

- The problem of deafness in the directional scenario is more significant than in the omni-directional scenario.
- This paper proposes a protocol to solve this problem and improve the performance.
Introduction

- In directional scenario

A

B

C

D

E

F

I can't talk to A.

I can't talk to B.

I can't talk to B, C.

I can't hear anything now.

I can't talk to A.

I can't talk to A, B, D.

I can't talk to A, D.

I can't hear anything now.

I can't talk to B, C.
Introduction

- In omni-directional scenario

I can’t do anything now.

I can’t do anything now.
Circular RTS/CTS Mechanism (CRCM)
- RTS and CTS packets are broadcast omnidirectionally by means of a sequence of directional transmissions.
Cooperative-MAC (CMAC)

- Assumptions
  - Each node can decode more than one packets simultaneously, provided that they come from different directions.
  - Each node can’t receive anything during the transmission.
Cooperative-MAC (CMAC)

- CMAC employs three solutions to let the nodes have a fair image of their neighbors’ state:
  - Circular delivery of RTS and CTS.
  - Multiple Receptions.
  - Cooperation among nodes.
Cooperative-MAC (CMAC)

- Cooperation among nodes
  - The main cause of deafness is a mistaken idea of the network activity.
  - This mechanism helps the nodes to know the new links built during the transmission.
  - Each node maintains an internal table, called Communication Register (CR), where all the known ongoing communications are reported.
Cooperative-MAC (CMAC)

- Cooperation among nodes

I can’t hear anything now.

I wait a time interval.

I should update A’s CR.

Node id | Time left
---|---
A | 100
B | 0

I can’t send anything to B until time out.
Simulation

- Simulation environment:
  - Every node is equipped with 8 antennas.
  - The network was made up by 10 or 15 nodes.
  - Located inside a 1500m × 1000m rectangle.
# Simulation

<table>
<thead>
<tr>
<th></th>
<th>CRCM</th>
<th>MUD</th>
<th>L-CMAC</th>
<th>B-CMAC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Circular delivery of RTS/CTS</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
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<tr>
<td>Multiple receptions</td>
<td>—</td>
<td>○</td>
<td>○</td>
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<tr>
<td>Cooperation among nodes</td>
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<tr>
<td>The overhead of collaboration frames</td>
<td>—</td>
<td>—</td>
<td>○</td>
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<tr>
<td>Interference is generated by collaboration frames</td>
<td>—</td>
<td>—</td>
<td>○</td>
<td>—</td>
</tr>
<tr>
<td>The size of collaboration frames</td>
<td>—</td>
<td>—</td>
<td>120 bits (fixed)</td>
<td>optimal</td>
</tr>
</tbody>
</table>

The lower bound of CMAC

The upper bound of CMAC
Simulation

- Link failures vs. load (10 nodes)

Link failure =

- The total fault RTS
- All of the RTS

The traffic rate of each node.
Simulation

- Power consumption vs. load (10 nodes)
Simulation

- Throughput vs. effective load (10 nodes)

Throughput =
Successfully sent bits
Simulation time
*bit rate

Load =
Totally sent bits
Simulation time
*bit rate
Conclusions

- This paper proposes CMAC to solve the problem of deafness in the directional ad hoc networks.
- The cooperation in this paper is used for telling the nodes (which engages in data transmission) correct information.