“Design Approach for MAC Design in Vehicle Safety System Using Dedicated Short Range Communications (DSRC)”

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## INTRODUCTION:

### Attributes of a few candidate wireless systems:

<table>
<thead>
<tr>
<th>Wireless System</th>
<th>Attributes for vehicle links and safety</th>
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<tbody>
<tr>
<td>Satellite</td>
<td>Nationwide coverage, Provides vehicle tracking &amp; fleet mgmt, Not designed for low-latency safety links</td>
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<tr>
<td>Cellular</td>
<td>Near-nationwide coverage, Shared spectrum and channels, No direct V2V links (uncertain latency) Provides post-accident support (On-Star)</td>
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<tr>
<td>Electronic Toll collection</td>
<td>Medium-speed LOS roadway links, Interference from other in-band users, No direct V2V links</td>
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<tr>
<td>WIFI (Unlicensed 802.11)</td>
<td>High-speed broadband internet access, Interference from other in-band users, Direct V2V links (low latency)</td>
</tr>
<tr>
<td>5.9GHz DSRC</td>
<td>System dedicated to automotive safety Dedicated RF spectrum (ITS licensed) High-speed LOS/NLOS broadband links Dedicated channels for vehicle safety Direct V2V links (low latency)</td>
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</tbody>
</table>
5.9 GHz DSRC based Vehicle System:

- Vehicle safety communication using DSRC system (Active Safety System)
- Example:

Figure 1: DSRC Channel Arrangement and Control Channel Safety Communication Examples
Overview of DSRC:

- Use of DSRC system resources

Channel 178 used as Control Channel
All other channels used as Service Channels
Each channel is 10 MHz

- Safety and non safety Communications
### Applications of DSRC:

<table>
<thead>
<tr>
<th>Item</th>
<th>Range</th>
<th>Data Rate</th>
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<tbody>
<tr>
<td>Toll Payment</td>
<td>30 m</td>
<td>1 Mbps</td>
</tr>
<tr>
<td>Emergency Vehicle</td>
<td>1000 m</td>
<td>6Mbps</td>
</tr>
<tr>
<td>Roadside Safety Message</td>
<td>300 m</td>
<td>18Mbps</td>
</tr>
<tr>
<td>V2V Private Voice and Data</td>
<td>100-1,000 m</td>
<td>6-54 Mbps</td>
</tr>
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IEEE 802.11 MAC Protocol

- IEEE 802.11 is an international Standard for Wireless local Area Network (WLAN)

- 802.11 MAC algorithm called Distributed Foundation Wireless MAC

- Medium access is controlled by the coordination functions, the fundamental DCF(Contention Services) and optional PCF(Contentention free Services)
Distributed coordination function (DCF)

- DCF is a random access scheme based on carrier sense multiple accesses with collision avoidance (CSMA/CA).
- 1). If the channel is idle longer than DCF inter frame space (DIFS), the transmission can start immediately.
- 2). If the channel is sensed in busy, the transmission should wait until the channel is free, called as access deferral in 802.11, then the exponential backup procedure starts.
Operation of IEEE 802.11 DCF.
Point Coordination Function:

- The PCF used in contention-free period (CFP)

- In the PCF scheme, there is a central Point Coordinator (PC). The PC sends a beacon message to inform all stations to stop their DCF activities.

- The PC then polls each station for data transmission. During this Contention Free Period (CFP), stations are not allowed for data transmission until they are polled.
MAC implementation architecture:
Interfacing between the Segments:

1). Between driver and upper SMM, that provides several interface functions for driver

2). Between upper SMM and lower SMM

3). Between lower SMM and upper MAC, that lower SMM provides functions for upper MAC

4). Between upper MAC and lower MAC, that use register band in FPGA to transmit the information to each other

5). Between lower MAC and baseband, we use the register in FPGA to transmit the data and control signals.
Functions:

- **Driver:**

1. Interface between OS and upper SMM.
2. Translation of frame format, between 802.3 and 802.11.
3. Fragment and defragmentation.
4. Duplication detection and recovery.
5. Uni-cast and multicast.
6. SME, MAC management service, and MLME.
7. PCF management.
Upper MAC:

1. Set register for lower MAC, including TX queue address, IFS, back off CW, RTS/CTS flag, RX queue address.
2. Scheduling algorithm.
3. Retry counter.
Lower MAC

1. Set TX rate.
2. Provide the interface to baseband.
3. CCA scheme.
4. Beacon scheme.
5. NAV scheme.
6. FCS generation.
7. Check CRC.
8. Count IFS.
9. Run back off.
10. Send RTS/CTS.
11. Fill time stamp field.
12. Fill Duration field.
13. Answer ACK.
14. Send data.
15. Set TX rate according to RX rate.
V. Conclusions

- In this paper, we propose an examine prototype of DSRC MAC for vehicle safety system. For concerning the DSRC applications and high mobility capacity, we utilize the DCF & PCF infrastructure type of MAC to accomplish the safety role in vehicles.
References:


THANK YOU!

QUESTION???