A Token-Based MAC Protocol for Achieving High Reliability in VANET

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Goals
- Address the short-comings of IEEE 802.11p
- Support the strict requirements on timing and reliability
- Using standardized 802.11-based hardwares

Background
- CAM (Cooperative Awareness Messages) or beacon [1]
  - Short, periodic status messages (2-10 times per second)
  - Broadcasted by every car
  - No multi-hop intended (so far)
  - Include: position, speed, direction, other status information (e.g. blinker status)
- DENM (Decentralized Environmental Notification Message) [2]
  - Event-based warning message
  - Broadcasted only during specific event
  - Broadcast stops when event is over
  - No multi-hop intended (so far)
  - Include: position, speed, direction, other status information (e.g. blinker status)

Protocol Description
1. Ring establishment and maintenance
2. Data age list generation
   - Each vehicle maintains a data age list logging the age of the latest successfully received beacon from individual nodes.
   - Next token holder is the node with the highest data age on the current token holder’s list.
3. Token Passing
   - Token is circulated with beacon packets
   - Whoever holds the token has unique right to access the channel
   - Each token holder is responsible for the choice of the next token holder
4. Transmission order

Highway Scenario
- Metrics
  - Channel utilization
  - Beacon Delivery Ratio (BDR)

Propose an alternative solution specially for high densities when IEEE 802.11p is not able to handle a high number of beacons.

The way DTB-MAC uses the token passing not only does not produce more delay, but also improve it for some network densities.

Conclusions
- Support for delay-sensitive data traffic through deterministic channel access is needed
  - In the current standard this support is compromised due to the properties of IEEE 802.11p MAC
- A distributed, token-based MAC method supports reliable beacon broadcast before a given deadline
  - Prioritizing vehicle that is in most need to communicate to keep its deadline.
  - Built-in retransmission opportunities (if bandwidth available)

Simulation Settings
- Beacon Send Rate: 10 packet/s
- Beacon size: 500 Bytes
- Data Rate: 6 Mbps
- Transmission Range: 500 m
- Simulation time: 300 s
- Simulation package: Veins

Simulation Scenarios
- Highway Scenario
  - 2.2 km highway with 2 lanes

Urban Scenario
- Downtown of Milan
- 2.6°2.6 km²

References

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