

Final exam: Simulation of Vehicle-2-X Applications (Microcredit course #2)

Lecturer: Prof. Dr. Sangyoung Park (TU Berlin)

1. How is 802.11p for vehicles achieve more reliable communication between vehicles passing by at high speeds?

Answer: They have simpler protocol by removing the authentication and association process, which takes several seconds in other 802.11 standards.

2. How would you compare the cellular option and 802.11p option for vehicular networks in terms of latency, coverage, and reliability?

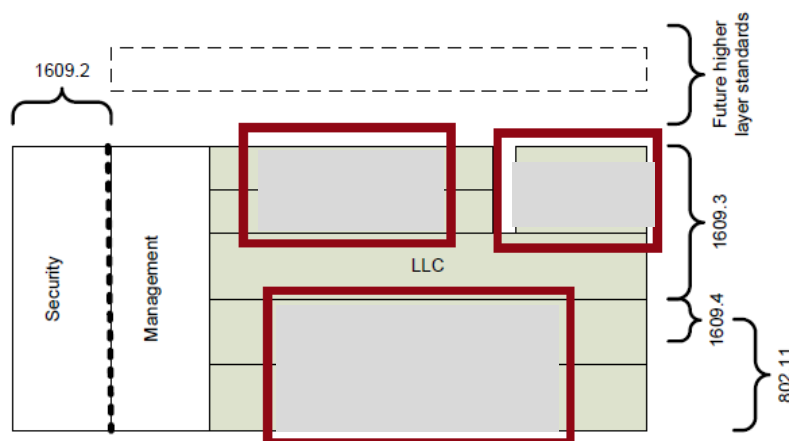
Answer: Latency is lower for 802.11p than cellular networks because the latter involves communication with base station where thousands of nodes may connect. Coverage is larger for cellular networks. Reliability is better also for 802.11p because there is uncertainty in cellular networks by having many nodes in the same network.

3. What are two types of phases (or intervals) in channel coordination scheme for WAVE communication standards? What is the difference between two phases?

Answer: The two types of phases are CCH interval and SCH interval. CCH interval is used for short, high-priority data and management frames. It is broadcast based, and used for safety critical communication requiring low latencies. It's also used for initializing communication which will happen on SCH later by WSA. There exists only one channel for CCH.

SCH interval is used by any other sorts of applications, tolling, internet access, etc. There are 6 channels for SCH. Requires setting up of WBSS prior to using SCH.

4. Where should WAVE Short Message Protocol (WSMP) be placed in the following network stack figure?



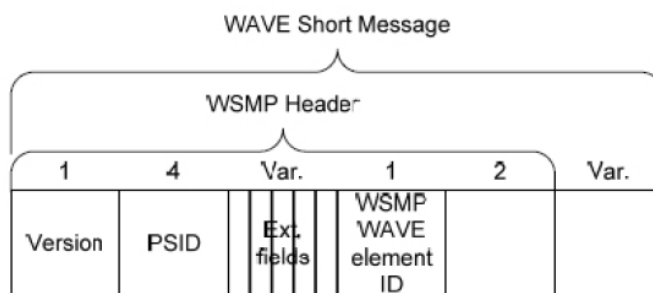
5. What is WBSS?

Answer: It is a communication zone among the vehicles and RSUs defined in 802.11p. It has a unique identifier and vehicles must associate with only one WBSS at a time.

6. What does WAVE Management Entity do, when announcing a WSA?

Answer: WME manages information related to advertising a service and maintaining a service. When a service is requested from an application, WME checks for the uniqueness of service and security credentials, and assigns the provider service IDs (PSID). This is done by maintaining “tables” such as provider service table (PST), and user service table (UST).

7. The following shows WAVE short message format. What should the final two fields contain?

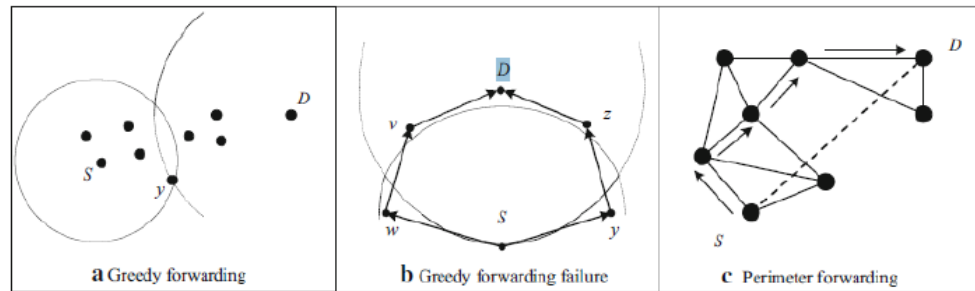


Answer: Length of data and the actual payload (WSM data).

8. What is the problem of broadcast based routing, where all nodes re-broadcast what they have received? How can you mitigate the problem?

Answer: The problem comes from “implosion” of data packets, which means there will be too many packets being exchanged leading to congestion. A solution can be that a node does not re-broadcast when they’ve transmitted the same packet already.

9. The following figures show an example of greedy geographic routing. Could you explain what greedy forwarding algorithm is and why it fails to deliver packets to the destination in the second figure?



Answer: In greedy geographic routing, the receiver of a packet forwards the packet only if the receiver is closer to the destination than the sender. In the second figure, greedy geographic routing fails because the nodes w and y are further away from the destination D than S even though there exists a path to the destination.

10. What is scheduling assignment in LTE networks? Describe i) where it happens, ii) what it schedules, and iii) what it does when the channel condition is bad.

Answer: 1) Scheduling assignment in LTE networks happens in the base stations. 2) It assigns resource blocks, i.e., a 2-D block in time-frequency domain to mobile devices. 3) It performs link adaptation by changing the choice of symbols and code rate.

11. How does LTE and LTE V2V differ? What is being done in the vehicles such that V2V is enabled?

Answer: Scheduling assignment is done in a distributed fashion in the vehicles instead of the base stations.

12. What is the benefit of using velocity information communicated from the preceding vehicle as opposed to measuring directly from the host vehicle?

Answer: Distance sensors such as radar or LIDAR are prone to noise such that when differentiated, there will be large spikes. Onboard sensors from the preceding vehicle are much more reliable to measure velocity.

13. In the longitudinal controller we covered in the lecture, what is the job of high level and low-level control respectively?

Answer: The job of the high-level controller is to determine the desired acceleration value of the host vehicle. The job of the low-level controller is to control the throttle valve and braking torque to achieve the desired acceleration.

14. Could you define string stability of a platoon in a mathematical form? What does it mean?

Answer: String stability of a platoon is defined as $\|H(s)\|_{inf} \leq 1$, where $H(s) = \frac{\epsilon_i(s)}{\epsilon_{i-1}(s)}$. It means that the error in desired distance in the preceding vehicles will not be amplified as it propagates to the tail of the platoon.

15. What is semantic gap in controller design? What sorts of assumptions result in this gap?

Answer: This is the discrepancy between the assumptions that control theorists make and the actual implementation details. Infinite numerical accuracy, negligible computation time, no delays between sensor-controller-actuator.

16. What does “tank-to-wheel” energy consumption mean? How does it differ from primary energy consumption?

Answer: Tank-to-wheel energy consumption means the energy conversion efficiency from the fuel tank/battery/hydrogen tank to the vehicles wheels. Primary energy consumption has a broader scope such that it considers the energy efficiency for generating electricity or hydrogen into account.

17. How can you designate the application which runs on a vehicle or on RSU?

Answer: You can do it in the omnetpp.ini file.

18. Could you explain the mechanism how BSM is sent periodically on Veins from C++ code? Please provide the names of two functions which are closely related to the process.

Answer: You can either set it on omnetpp.ini file or use the `scheduleAt()` function to schedule the first beacon and this will invoke `handleSelfMsg()` function which will reschedule the beacon event at the next interval with the `scheduleAt()` function.

19. What are the purpose of .ned .rou.xml .net.xml and .cc .ini files?

Answer: .ned file describes the network or a network module, .net.xml file describes the road network, .rou.xml file describes the car flow, .cc file describes the behavior of a network module, and .ini contains the initialization and simulation parameters.