Emergency Vehicle Prioritization using Vehicle-to-Infrastructure communication

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Introduction – Emergency vehicles

- Ambulances, fire trucks, police cars
- Special rights (violate red lights, use special lanes,…)
- Blue flashing light and siren is signaling request for priority
- Emergency vehicles are more likely to be involved in a car accident
- Stressful and dangerous situation for drivers
Objectives of the paper

- Implementing emergency vehicle simulation model
- Analyzing strategy for emergency vehicles using cooperative communication technologies
- Improve travel time and safety of emergency vehicles
Vehicle2Vehicle communication

- Strategy 1:
  - Emergency vehicles are sending: “Emergency vehicle approaching warning” to other equipped vehicles
Vehicle2Infrastructure communication

- Strategy 2:
  - Emergency vehicles are sending their route information to road side units
  - Traffic management center sets traffic light to green for the emergency vehicle
  - And to red for all other vehicles
  - Continue normal operation after emergency vehicle passed the intersection
Vehicle2X- Traffic Simulation

Real world tests are expensive and dangerous

- Simulating V2X applications before implementing them
- Open-source system was developed in the project “iTETRIS”
iTETRIS

- Open-Source Simulator
- iCS couples Traffic Simulator, Communication Simulator and application
- Traffic Simulator: SUMO
- Communication Simulator: ns3
Scenario Description

- City of Bologna was used for the simulation
- Small crowded streets
- Football matches causing traffic jams
- Streets restricted to public transport
- The Aim of the iTETRIS project was to develop V2X strategies for improving traffic conditions in Bologna
Region of Bologna which was used for the simulation (Cartolano, et. al., 2010)
Scenario Description

- Chosen route of the emergency vehicle
- Simulating 1800 seconds to fill the network
Scenario Description

- Positions of the Road Side Units in the network
- Simulation of the peak hour between 8:00 and 9:00
Traffic Simulation

- No proper simulation model for emergency vehicles
- Traffic light switches to green for emergency vehicle
Traffic Simulation

- Vehicles give priority to emergency vehicle
Evaluation and Results

- Equipped emergency vehicle: blue
- Normal emergency vehicle: red

- Travel and waiting time have been improved
  (Travel time: about 8%, waiting time: about 15%)
Evaluation and Results

- Average Emissions for all vehicles
- Equipped emergency vehicle: blue
- Normal emergency vehicle: red
Evaluation and Results

- Average Emissions for all vehicles
- Equipped emergency vehicle: blue
- Normal emergency vehicle: red
Evaluation and Results

- Average travel and waiting time for normal vehicles could also be reduced (about 5%)
- Reduction of emissions (about 2.6%-3.5%)
- More vehicles benefit from this application
Conclusion

- Application improves travel time and safety of emergency vehicles
- Emergency vehicles do not have to violate red lights and overtake other vehicles
- Drivers of other vehicles also benefit from the application (They give priority to emergency vehicles automatically)
Further Research

• Extend emergency vehicle simulation model
  ▫ Violate red lights
  ▫ Exceed maximum speed
  ▫ Overtaking
  ▫ Use wrong direction
• Routing according to the current traffic state
• What will happen when the traffic light is red for a long time but they can not see an emergency vehicle?
Thank you for your attention.

Any questions?