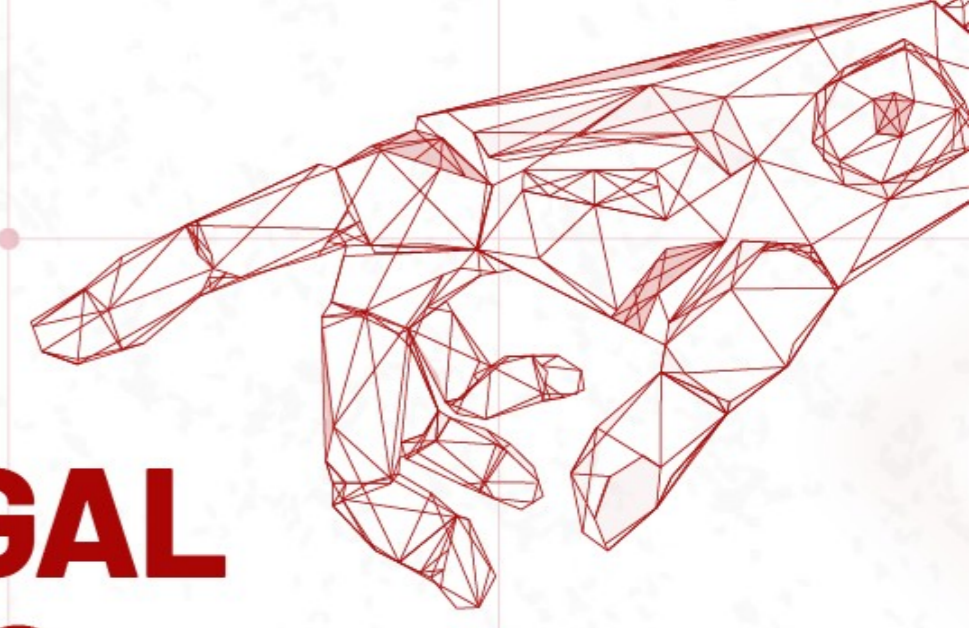


Wireless Protocols for Flexible and Stable Long Platoons



Saeid Sabamoniri (PhD student in FEUP)

Advisors: Prof. Luis Almeida & Dr. Pedro Santos
CISTER Research Center, ISEP, IPP, Porto

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Context

Platooning: is one of the exciting applications in ITS system.

Main advantages of platooning:

- Improving traffic safety, road use efficiency, achieving reduced fuel consumption [1, 2].
- Decrease emissions [3].
- Leveraging information provided by the communications infrastructure and remote computation capabilities, both for vehicle dynamics and at ITS level.

The most common technology to communicate vehicles in platooning:

- IEEE 802.11p (WiFi-based standard)
- 3GPP cellular technology (sidelink LTE-V2X and sidelink 5G-V2X)

L-Platooning solution in [4]:

- Supports formation of a 'long' platoon consisting of many vehicles.
- It does not cover applications like overtaking, emergency brake, and cut-in.

Problem & Objectives

- How can support heterogeneity of vehicles in terms of their resources and size in a long platoon?
- How should provide various maneuver operations of non-platoon vehicles?
- Which of the vehicles deserves to be AL or VL in a long platoon?
- Continually using most of the road capacities is required.
- Platoon formation with various types of vehicles
- Performance analysis for long platoons
- Attempting to reduce latency by leveraging edge layer computations
- Considering platoon clusters to provide dynamic flexibility (similar to water drops)

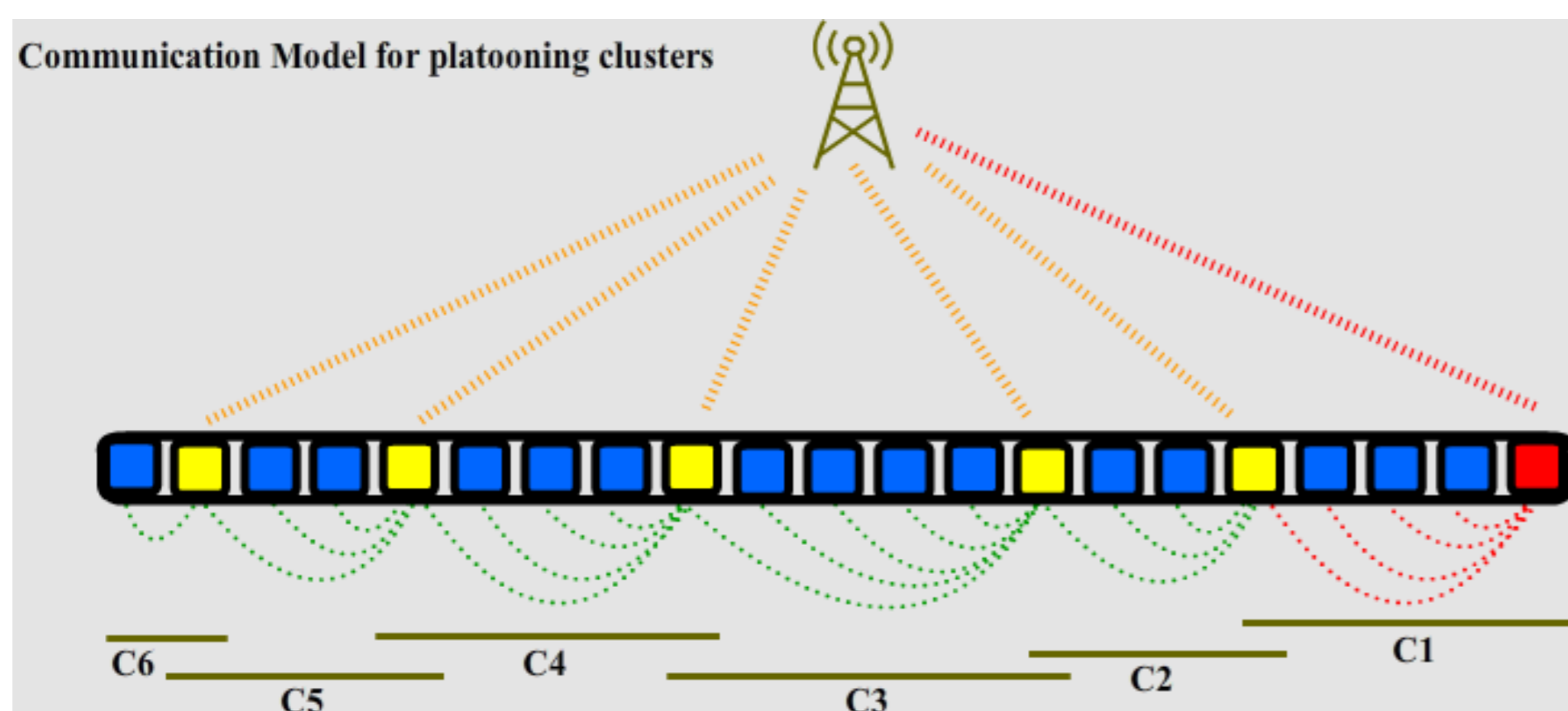


Figure 1. Clusters Communication model.



Figure 2. Water drops smooth joint [4].

Challenges

- Determining the best virtual leader for each cluster
- Providing the optimal number of clusters for maximizing safety and efficiency
- Applying both IEEE 802.11p and 3GPP technologies in the system
- Composed possible latency for the two technologies message conversions
- Managing emergency situations for long platoons
- Managing periodic reconfigurations

Methodology

- Attempting to provide flexibility for long platoons by defining a new term called "Platoon Cluster".
- Clusters can reduce the number of messages between member vehicles and the front leader in a long platoon (Figure 1).
- Smooth and dynamic flow of the surrounding vehicles in highways can be facilitated by clusters.
- From the flexibility point of view, clusters can be imagined as water drops joining together to flow on the roads toward their paths to destination (Figure 2).
- To manage dynamicity of the whole platoon, periodic reconfiguration algorithm is required to change virtual leaders of each cluster if necessary.

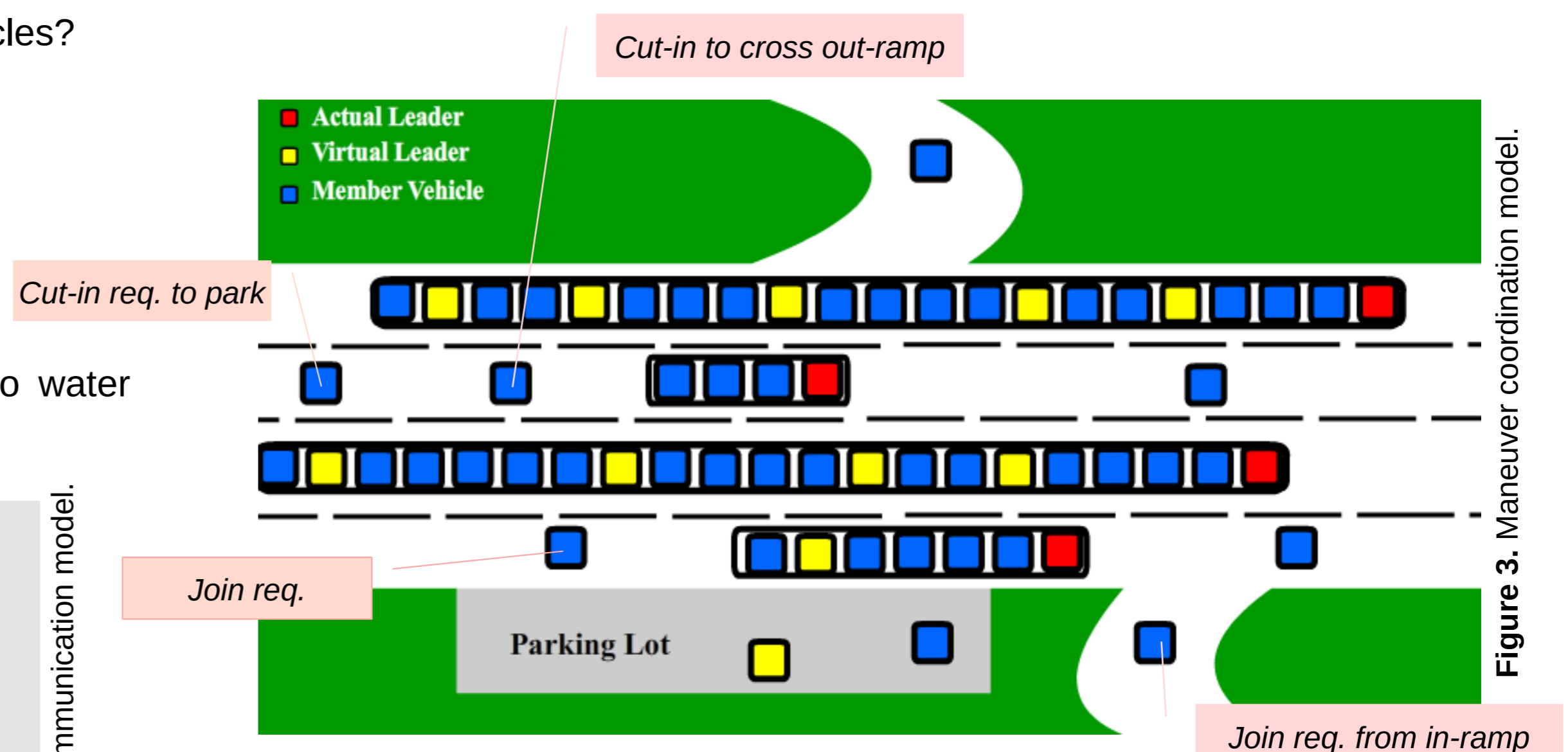


Figure 3. Maneuver coordination model.

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