IETF Hackathon:
IPWAVE Basic Protocols Project

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Online

Champion: Jaehoon Paul Jeong
Computer Science & Engineering
Sungkyunkwan University
pauljeong@skku.edu

Hackathon Plan

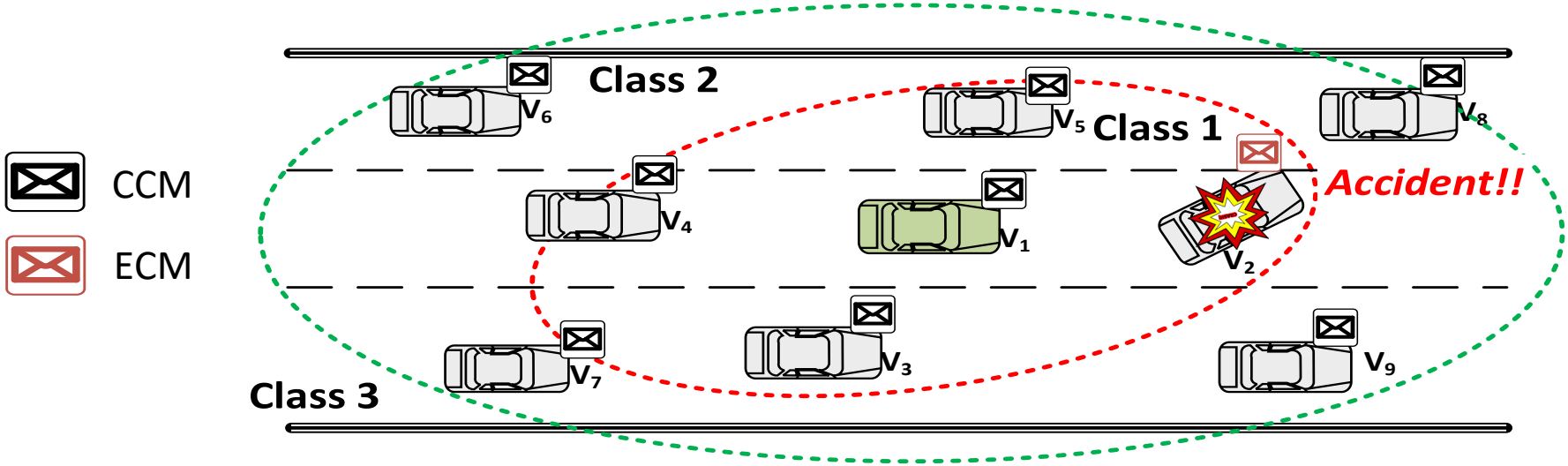
- **To implement Context-Aware Navigator Protocol (CNP) for IP-Based Vehicular Networks**:
  - Proof of Concept (POC) of an IPv6-Based Context-Aware Navigator Protocol (CNP)
  - IPv6 mobility information sharing for safe driving in roadways
  - A coordinated path planning for obstacle and collision avoidance in roadways
  - An efficient driving information exchange in IP-based vehicular networks
  - A network-based driving assistance service with environmental sensing and perception

- **Proof of Concept (POC) for IPWAVE CNP**:
  - Vehicular Simulations of IPWAVE with OMNeT++, SUMO, and VEINS

OS	Ubuntu Linux 16.04
OMNeT++	Version 5.4.1
SUMO	Version 0.32.0
Veins	Version 4.7.1
INET Framework	Version 4.0.0

- **IPWAVE Internet-Drafts for this Hackathon Project:**
  - **IPv6 over IEEE 802.11-OCB:** RFC 8691
  - **Vehicular Neighbor Discovery:** draft-jeong-ipwave-vehicular-neighbor-discovery-09
  - **Context-Aware Navigator Protocol:** draft-jeong-ipwave-context-aware-navigator-01

Context-Aware Navigator Protocol over IPWAVE



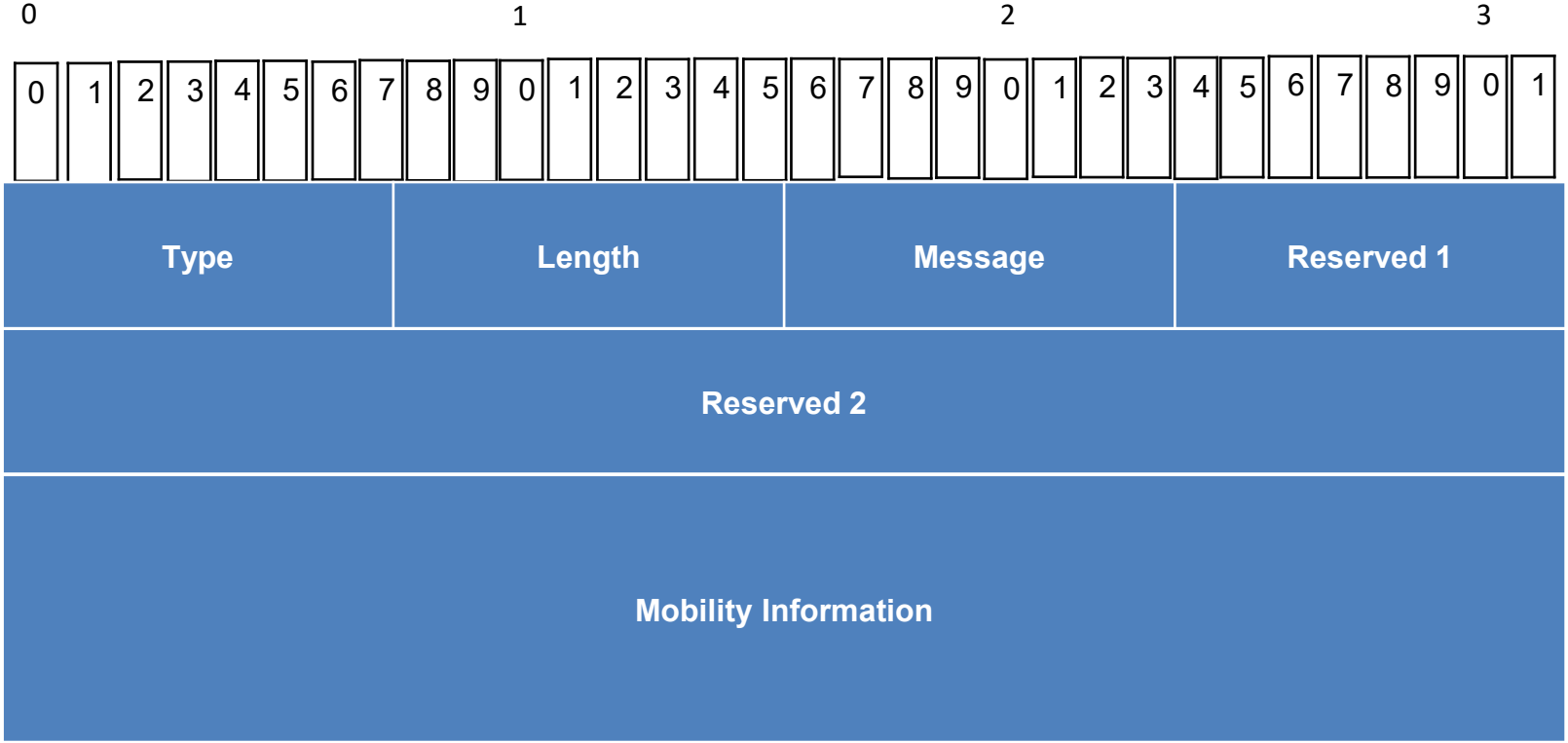
❖ **Road-Context Awareness through Light-weight Message Exchange**

- **Cooperation Context Message (CCM) and Emergency Context Message (ECM)**

Reference: "Context-Aware Navigator for Road Safety in Vehicular Cyber-Physical Systems", The Third International Conference On Consumer Electronics (ICCE) Asia, June 2018.
http://iotlab.skku.edu/publications/international-conference/ICCE-ASIA-CAN.pdf

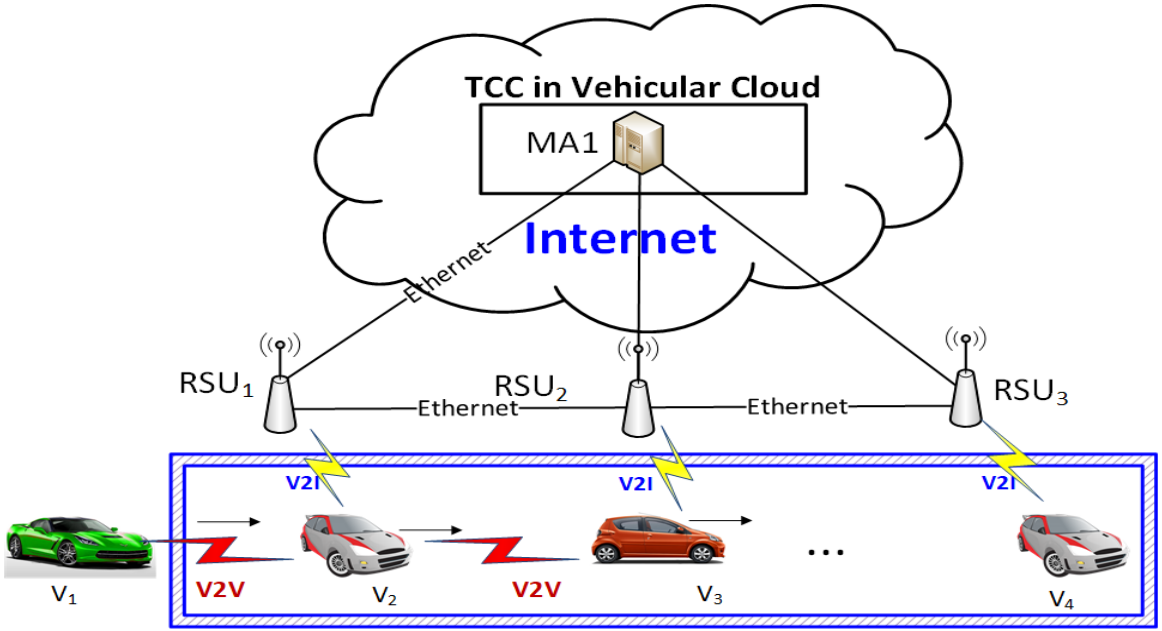
Vehicle Mobility Information (VMI)

VMI Option as an ND Option:



Type: CCM or ECM

Simulation Network Structure (1/2)



Simulation Network Structure (2/2)

✓ Two RSUs:

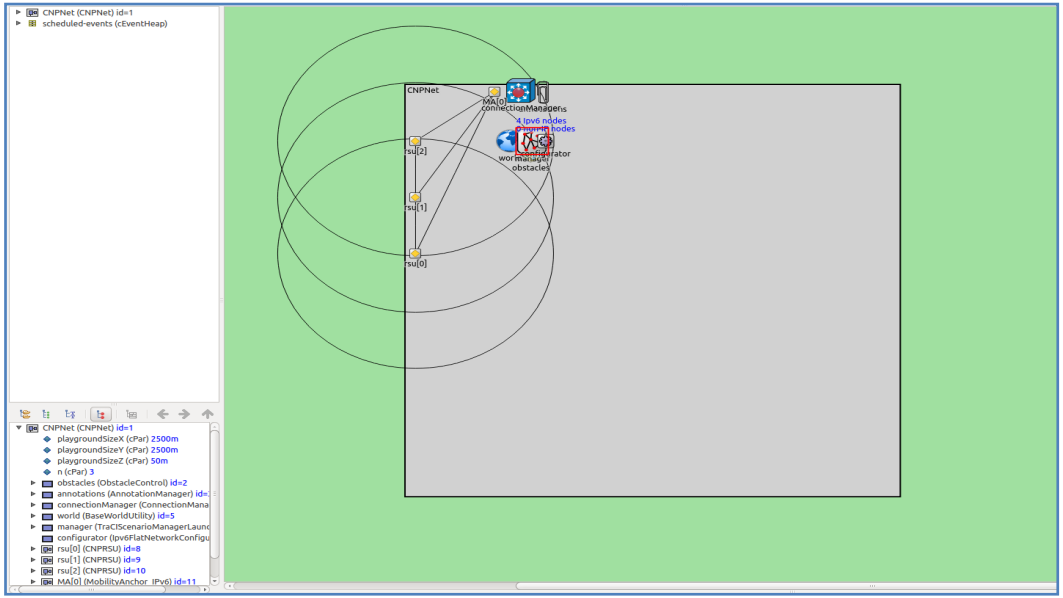
- They belong to one subnet.
- They are connected with each other through Ethernet.

✓ Multiple Vehicles:

- They are driving through a road segment.

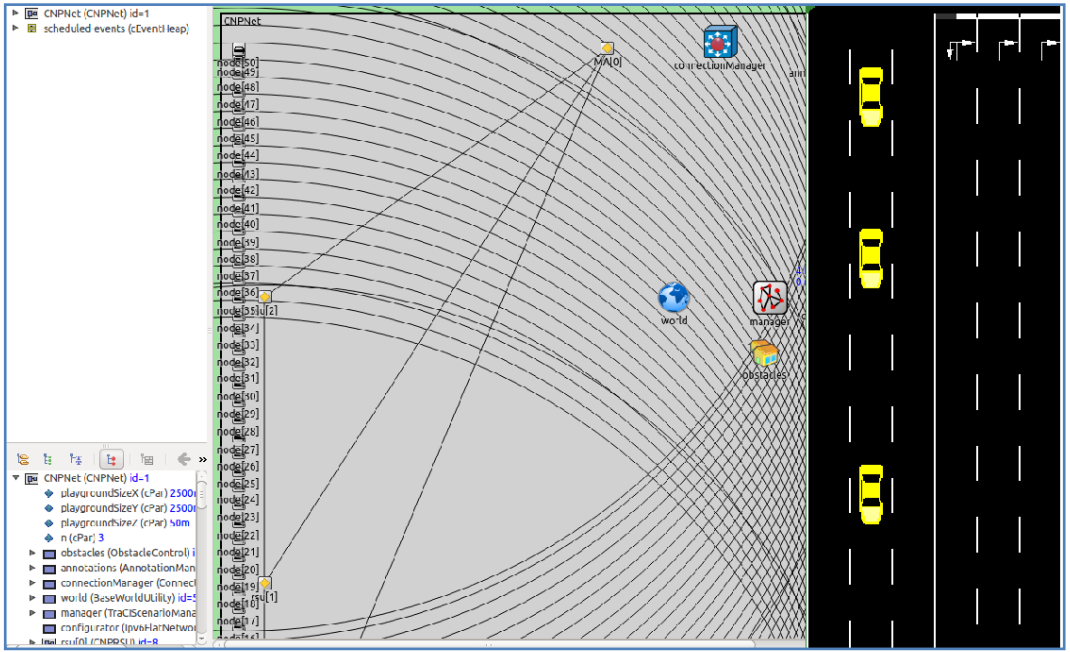
✓ Mobility Anchor (MA):

- MA manages RSUs and vehicles for the mobility management of the vehicles.



What got done

- We set up an IP-based vehicular network with 3 RSUs and 1 MA.
- Mobility information is exchanged among vehicles by CNP over IPWAVE.
- A coordinated maneuver for collision avoidance is performed by vehicles when an obstacle is detected.
- We implemented CNP, but the types of VMI are not separated yet.
  - This separation will be done in the IETF-109 Hackathon Project.



What we learned

- Lessons learned from this hackathon:
  - Vehicles can exchange their mobility information over IPWAVE through the modification of INET packet handling in OMNeT++.
  - A maneuver control by CNP can orchestrate vehicles' maneuvers to avoid collisions when an obstacle is detected in a roadway.
  - It is shown that IPWAVE can effectively facilitate IP-based vehicular application protocols (e.g., Context-Aware Navigator).

Wrap Up

Hackathon Team:

- **Champion:**
  - Jaehoon Paul Jeong (SKKU)
- **Members:**
  - Bien Aime Mugabarigira (SKKU)
  - Yiwen Chris Shen (SKKU)
- **Participants:**
  - Younghan Kim (SSU)
  - Kyoungjae Sun (SSU)
  - Jinho Park (KNU)
  - Niket Agrawal (TU Delft)
  - Alexandre Petrescu (CEA)
  - Yali Wang (Huawei)

- **Open Source Project**:

https://github.com/ipwave-hackathon-ietf/ipwave-hackathon-ietf-108

- **Demo Video Clip**:

https://www.youtube.com/watch?v=6Ss5OzV88so