IP 차량 네트워킹 기반 주변 인식 내비게이터

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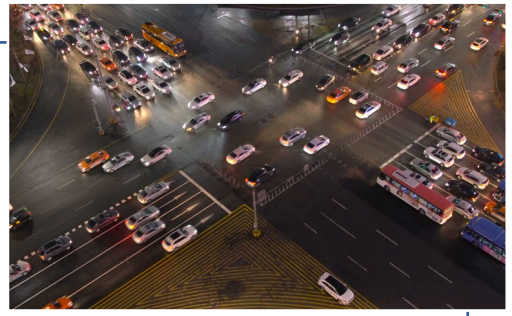
목차

Introduction to Vehicular Networking

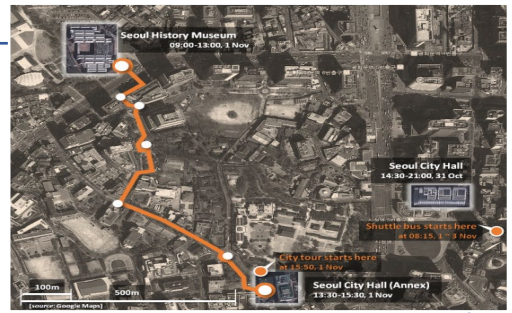
Use Cases of Vehicular Networking

Vehicle Traffic Release

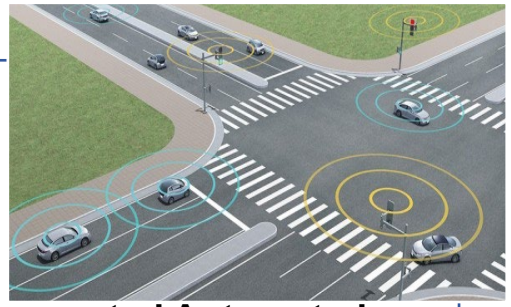
City Road Emergency



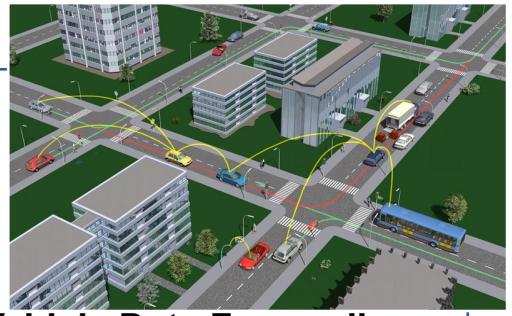
Road Intersection Passing



Navigation

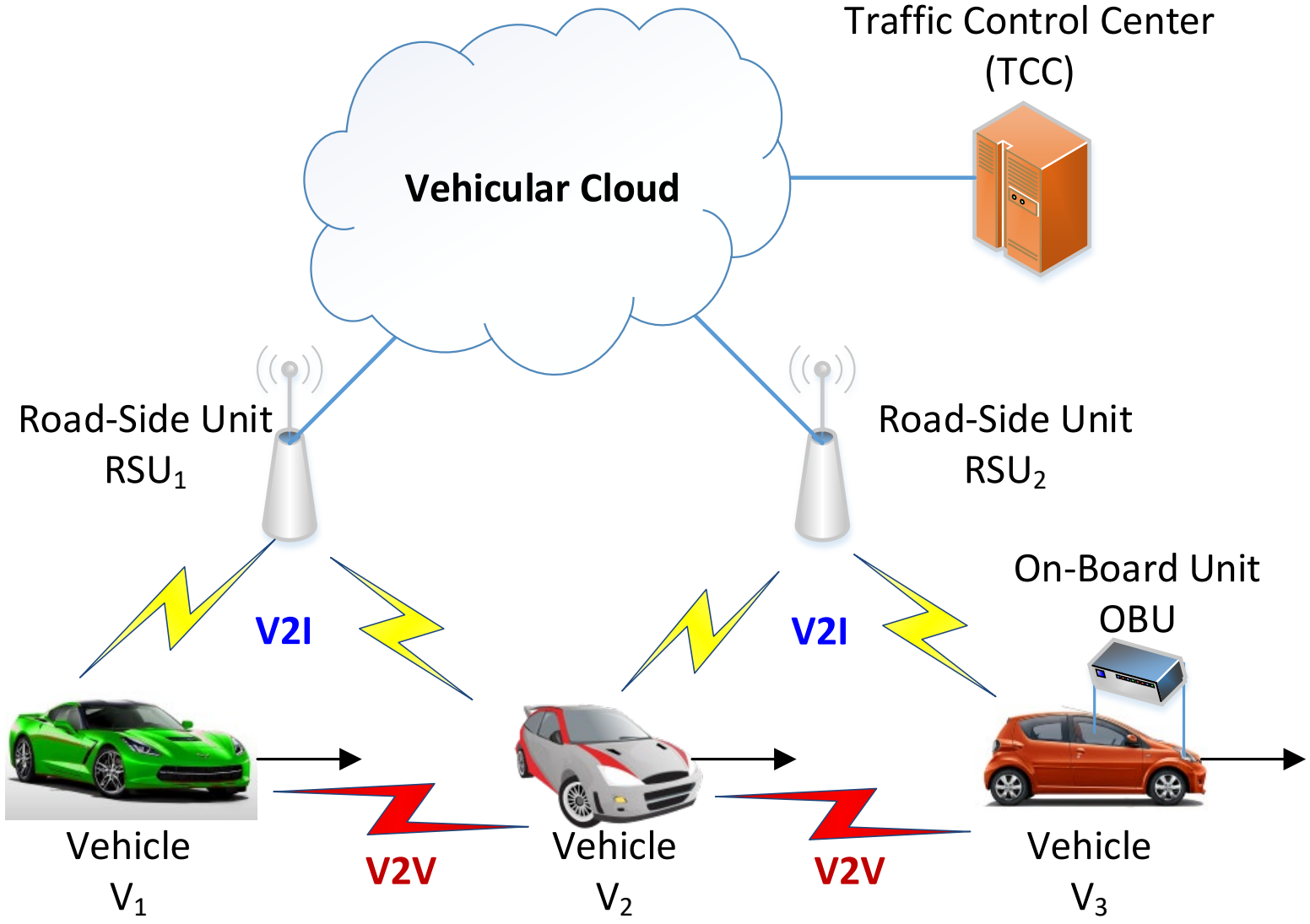


Connected Automated Vehicles



Vehicle Data Forwarding Services

Vehicular Networks



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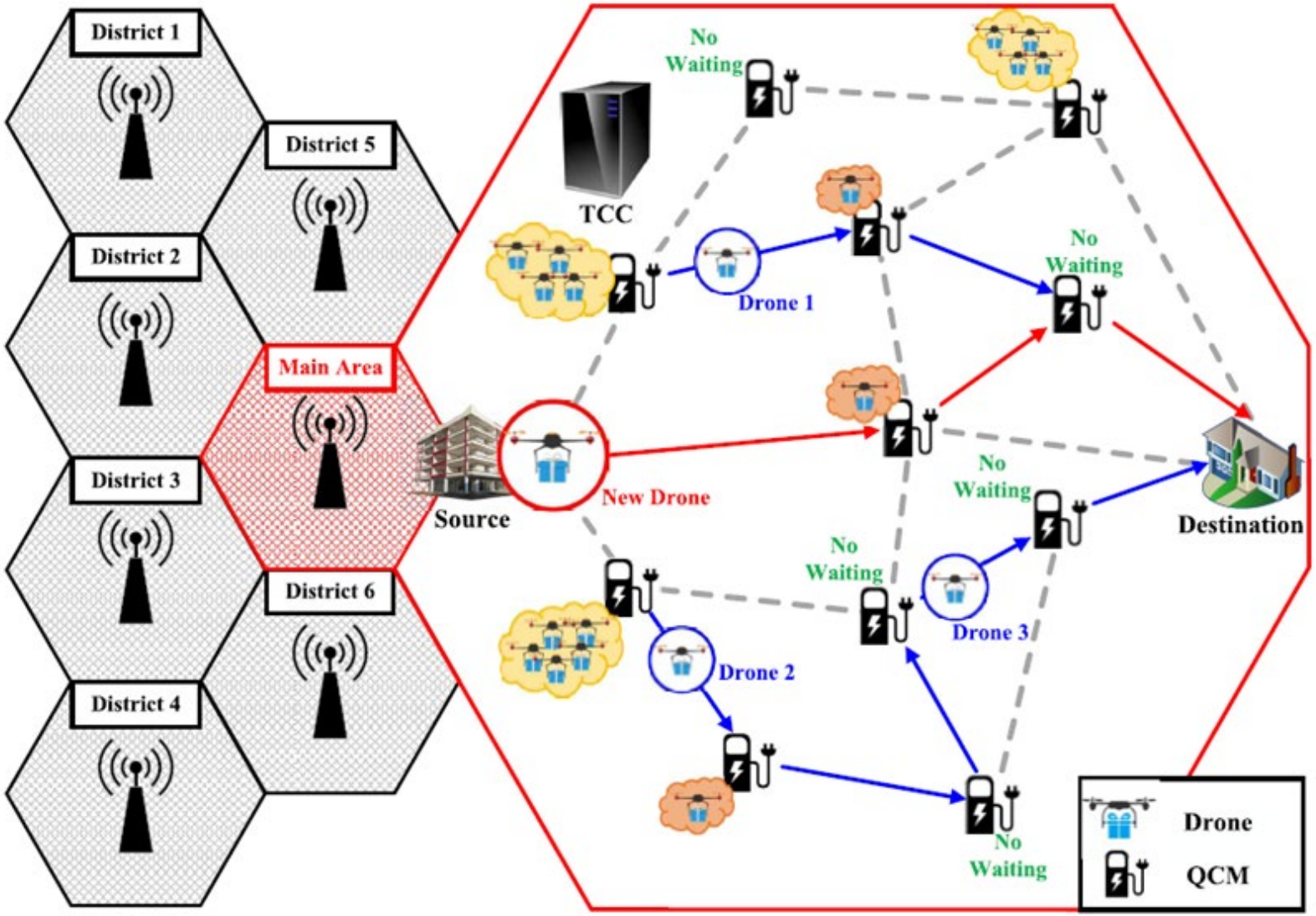
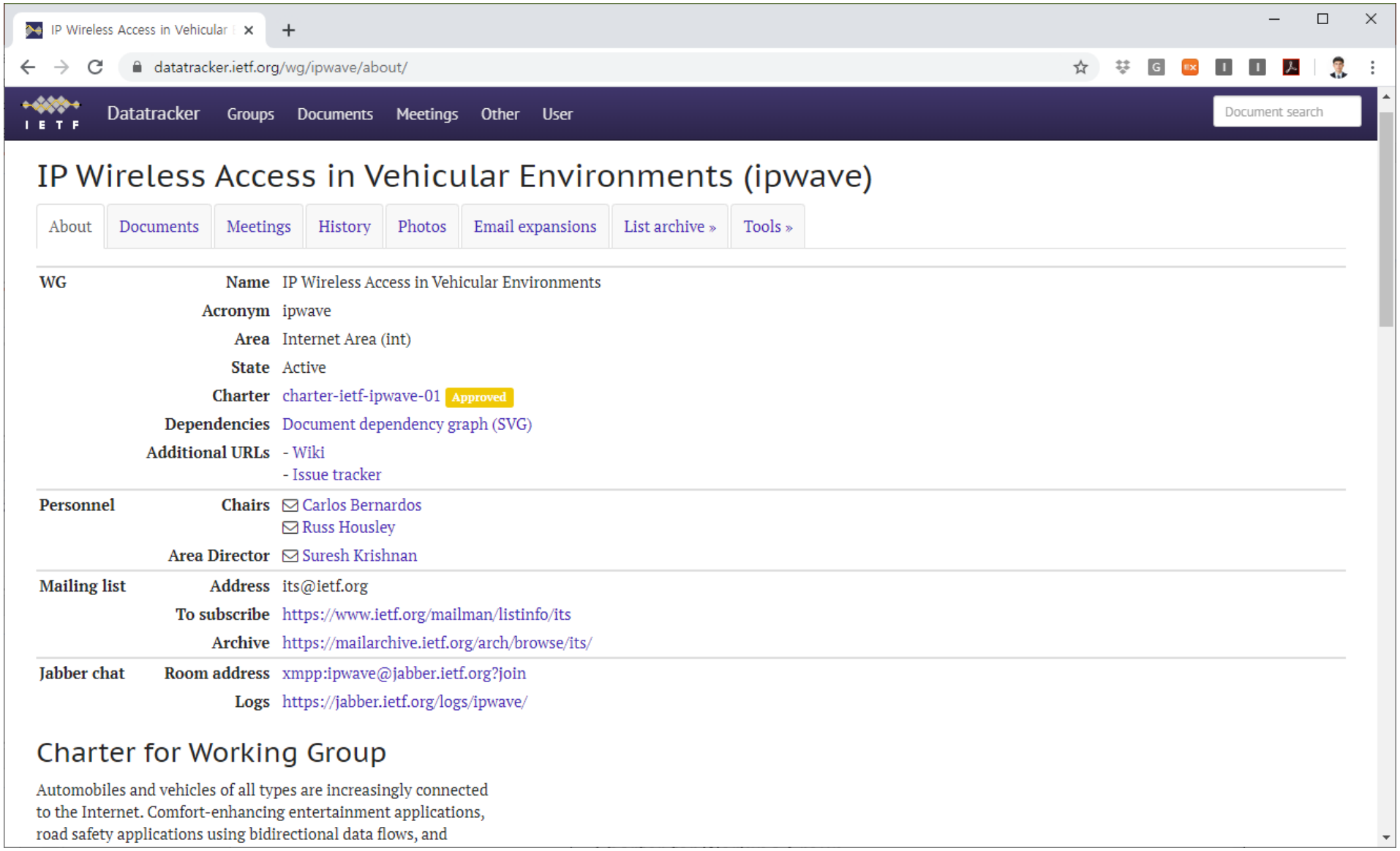
Wireless Drone Networks



IPWAVE 워킹그룹 표준화

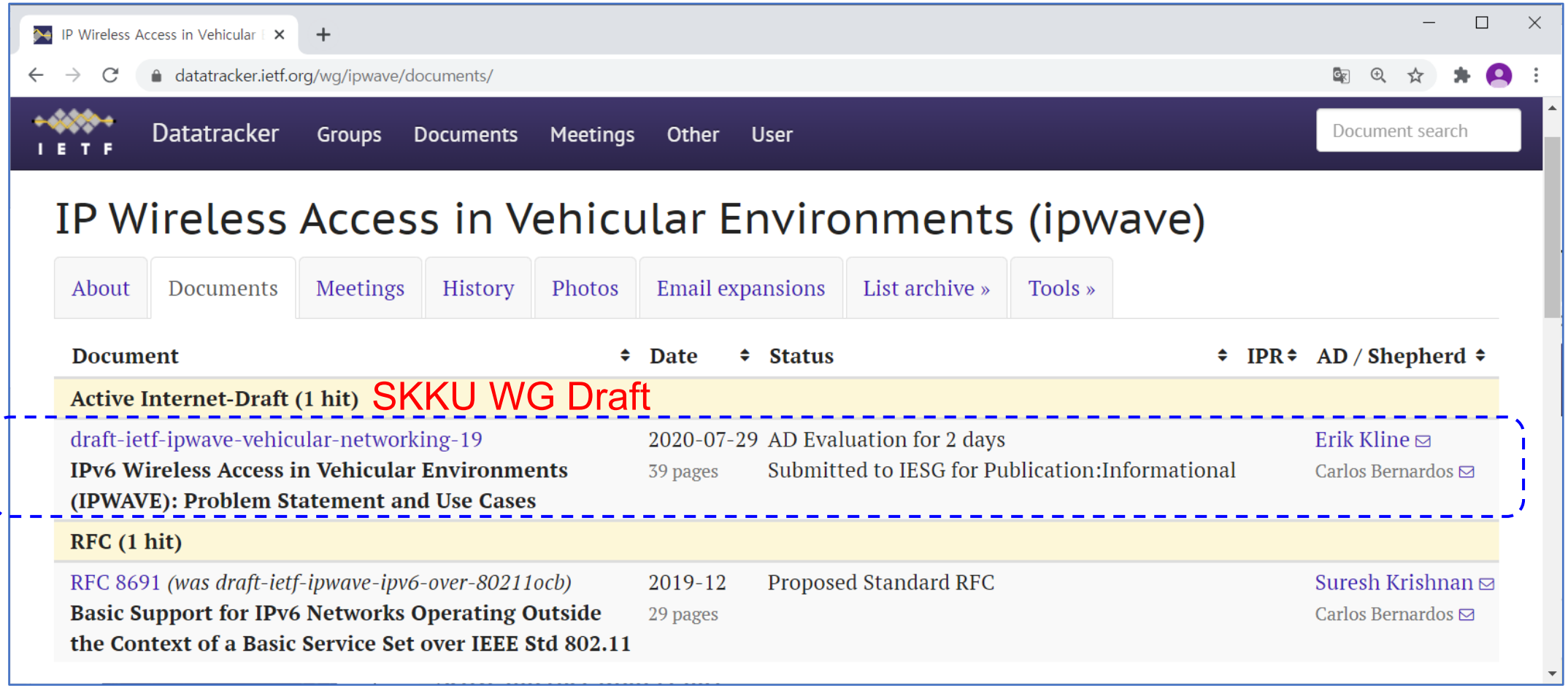
IPWAVE Working Group (1/2)



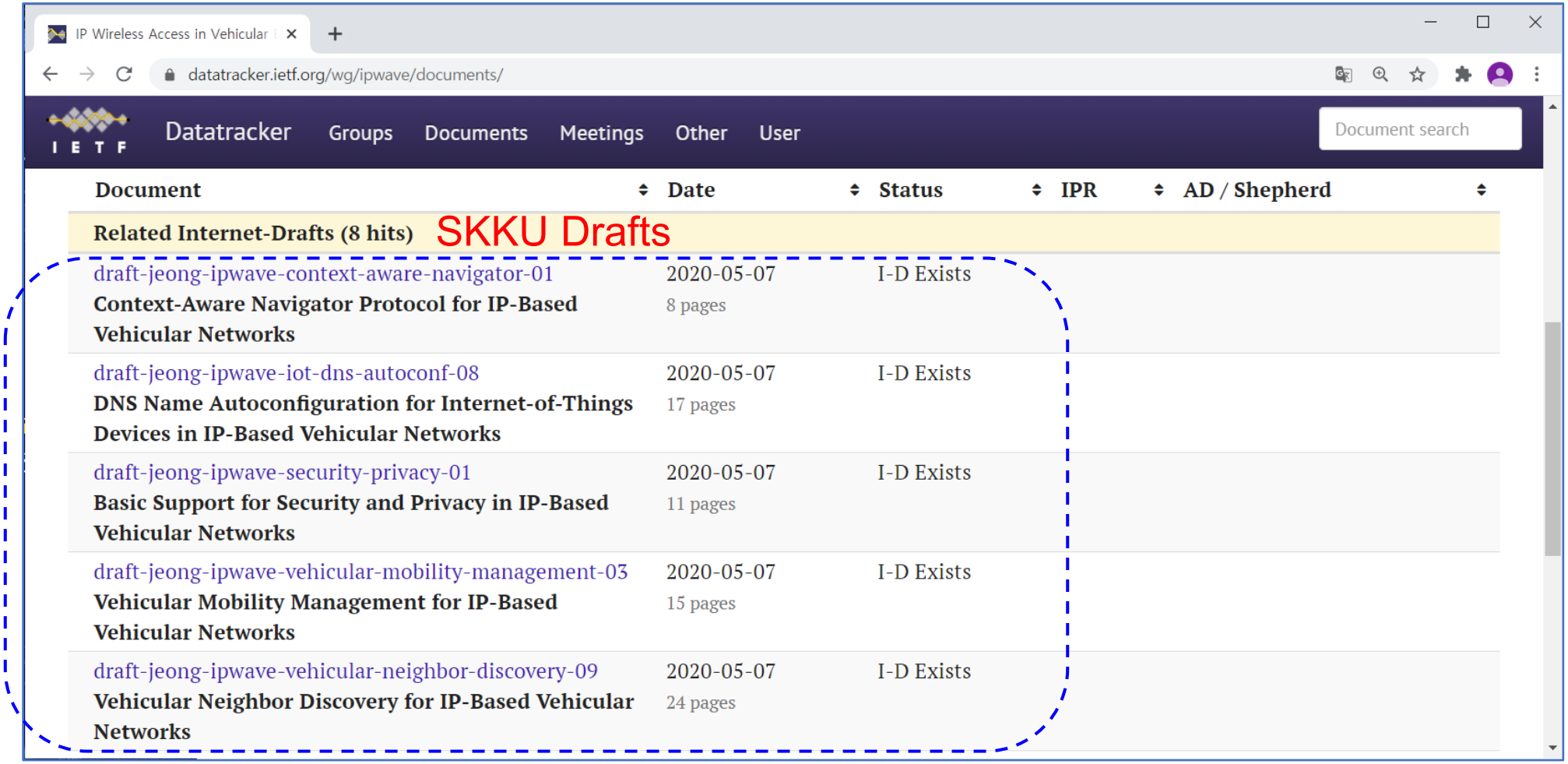
IPWAVE Working Group (2/2)

- IPWAVE (IP Wireless Access in Vehicular Networks) Working Group (WG)
  - IPWAVE WG aims at the standardization of IP-based networking such as Vehicle-to-Vehicle (V2V) and Vehicle-to-Infrastructure (V2I).
  - The main deliverable documents are:
    - IPv6 over IEEE 802.11-OCB (Outside the Context of a Basic service set).
    - IPWAVE Problem Statement and Use Cases
  - After the IPWAVE Problem Statement document is published, IPWAVE WG will work for rechartering to develop IPWAVE protocols such as
    - Vehicular Neighbor Discovery
    - Vehicular Mobility Management
    - Vehicular Security and Privacy

IPWAVE Documents (1/2)



IPWAVE Documents (2/2)



Document	Date	Status	IPR	AD / Shepherd
Related Internet-Drafts (8 hits)				
draft-jeong-ipwave-context-aware-navigator-01 **Context-Aware Navigator Protocol for IP-Based Vehicular Networks**	2020-05-07 8 pages	I-D Exists		
draft-jeong-ipwave-iot-dns-autoconf-08 **DNS Name Autoconfiguration for Internet-of-Things Devices in IP-Based Vehicular Networks**	2020-05-07 17 pages	I-D Exists		
draft-jeong-ipwave-security-privacy-01 **Basic Support for Security and Privacy in IP-Based Vehicular Networks**	2020-05-07 11 pages	I-D Exists		
draft-jeong-ipwave-vehicular-mobility-management-03 **Vehicular Mobility Management for IP-Based Vehicular Networks**	2020-05-07 15 pages	I-D Exists		
draft-jeong-ipwave-vehicular-neighbor-discovery-09 **Vehicular Neighbor Discovery for IP-Based Vehicular Networks**	2020-05-07 24 pages	I-D Exists		

IPv6 over IEEE 802.11-OCB

(RFC 8691 - Basic Support for IPv6 Networks Operating Outside the Context of a Basic Service Set over IEEE Std 802.11)

IPv6 over IEEE 802.11-OCB (1/3)

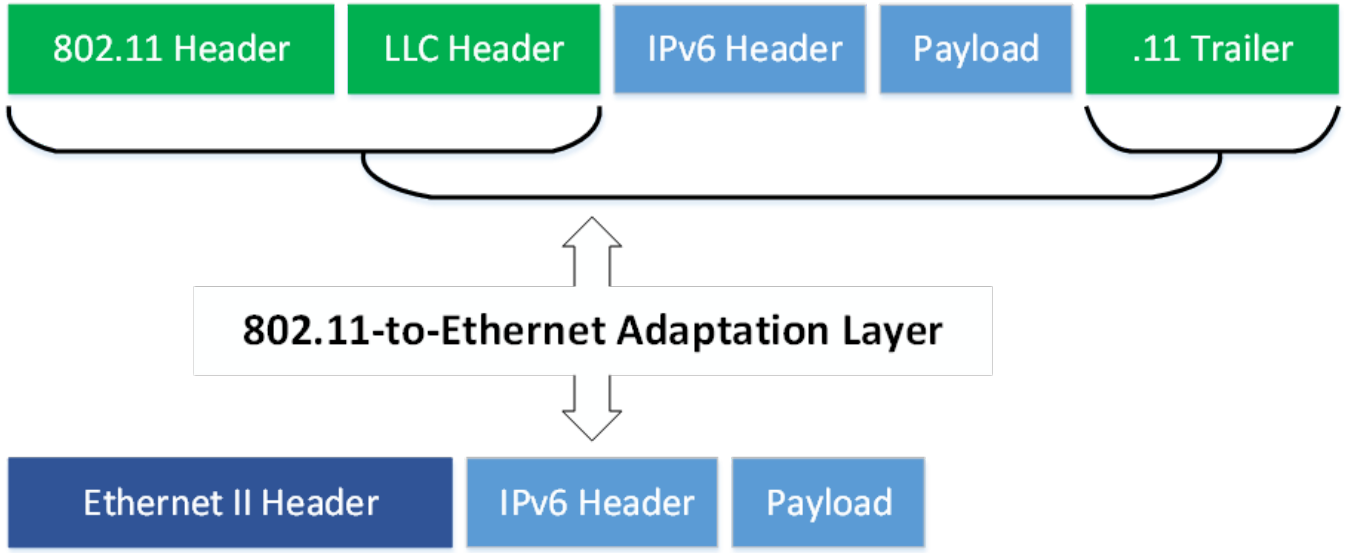
- IPv6 over IEEE 802.11-OCB Document
  - Objective
    - It aims at the specification of IPv6 extension for delivering an IPv6 packet in V2V and V2I over IEEE 802.11-OCB link.
    - It provides methods and settings, and describes limitations for using IPv6 to communicate among nodes over a IEEE 802.11-OCB link with minimal change.
  - Document name
    - RFC 8691
  - Document link
    - https://datatracker.ietf.org/doc/rfc8691/
  - Document status
    - RFC - Proposed Standard

IPv6 over IEEE 802.11-OCB (2/3)

- Main Subjects of IPv6 over IEEE 802.11-OCB
  - Maximum Transmission Unit (MTU)
  - Frame Format
  - Link-Local Address
  - Stateless Autoconfiguration
  - Address Mapping
  - Subnet Structure
  - Security and Privacy Considerations

IPv6 over IEEE 802.11-OCB (3/3)

- Frame Format
  - IP packets must be transmitted as QoS Data frames over 802.11-OCB.
    - The QoS Data frame format is specified in IEEE 802.11 specification.
  - The 802.11-OCB QoS Data Frame contains an 802.11 header + a Logical Link Control (LLC) header + IPv6 datagram.
    - The Type field in the LLC header must be set to 0x86DD (IPv6).
    - The mapping to the 802.11 data service must use a “priority” value of 1, which specifies the use of QoS with a “Background” user priority.



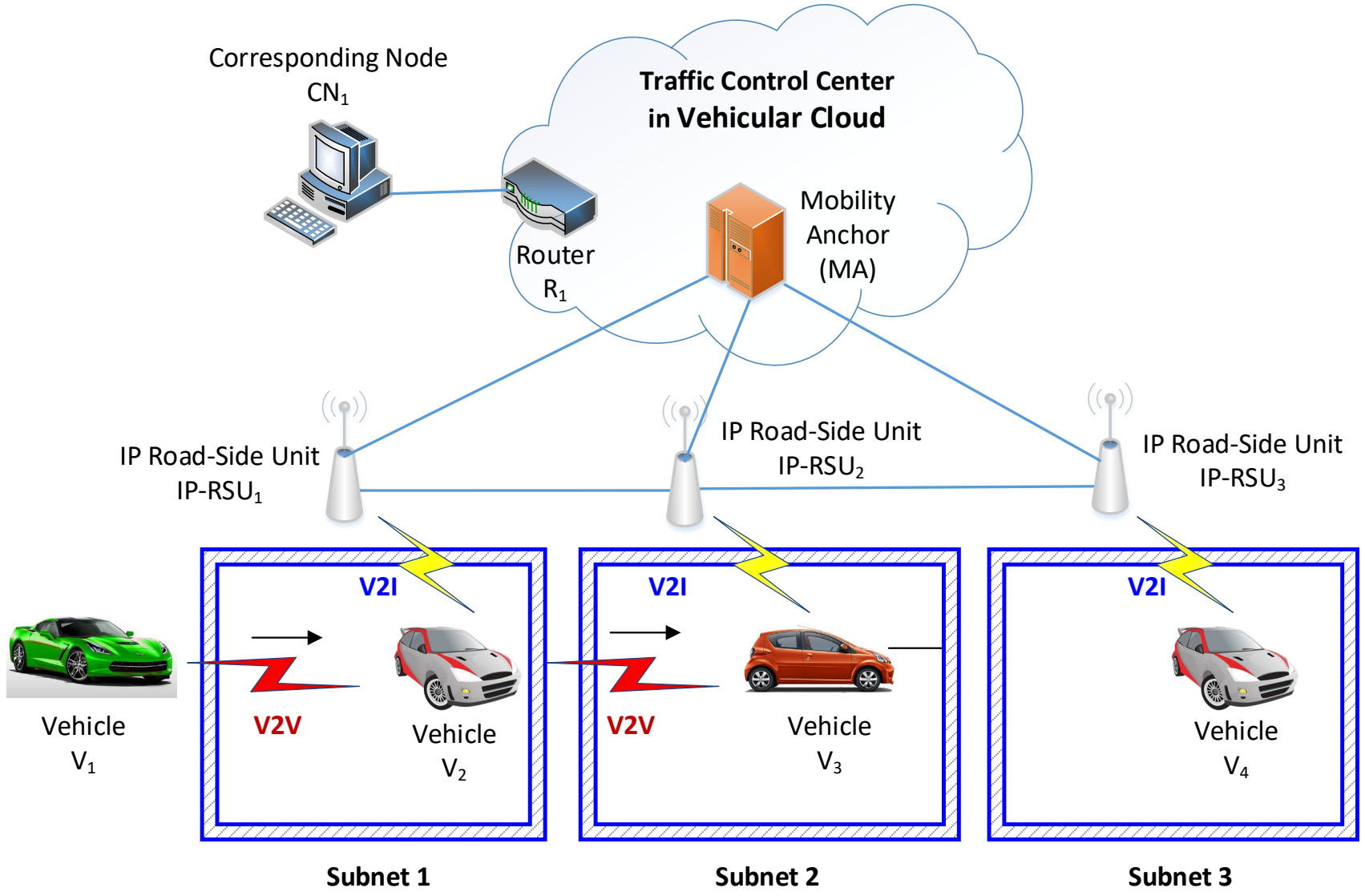
IPv6 Wireless Access in Vehicular Environments (IPWAVE): Problem Statement and Use Cases
(draft-ietf-ipwave-vehicular-networking-19)

Jaehoon Paul Jeong
(Editor)

IPWAVE Problem Statement Draft

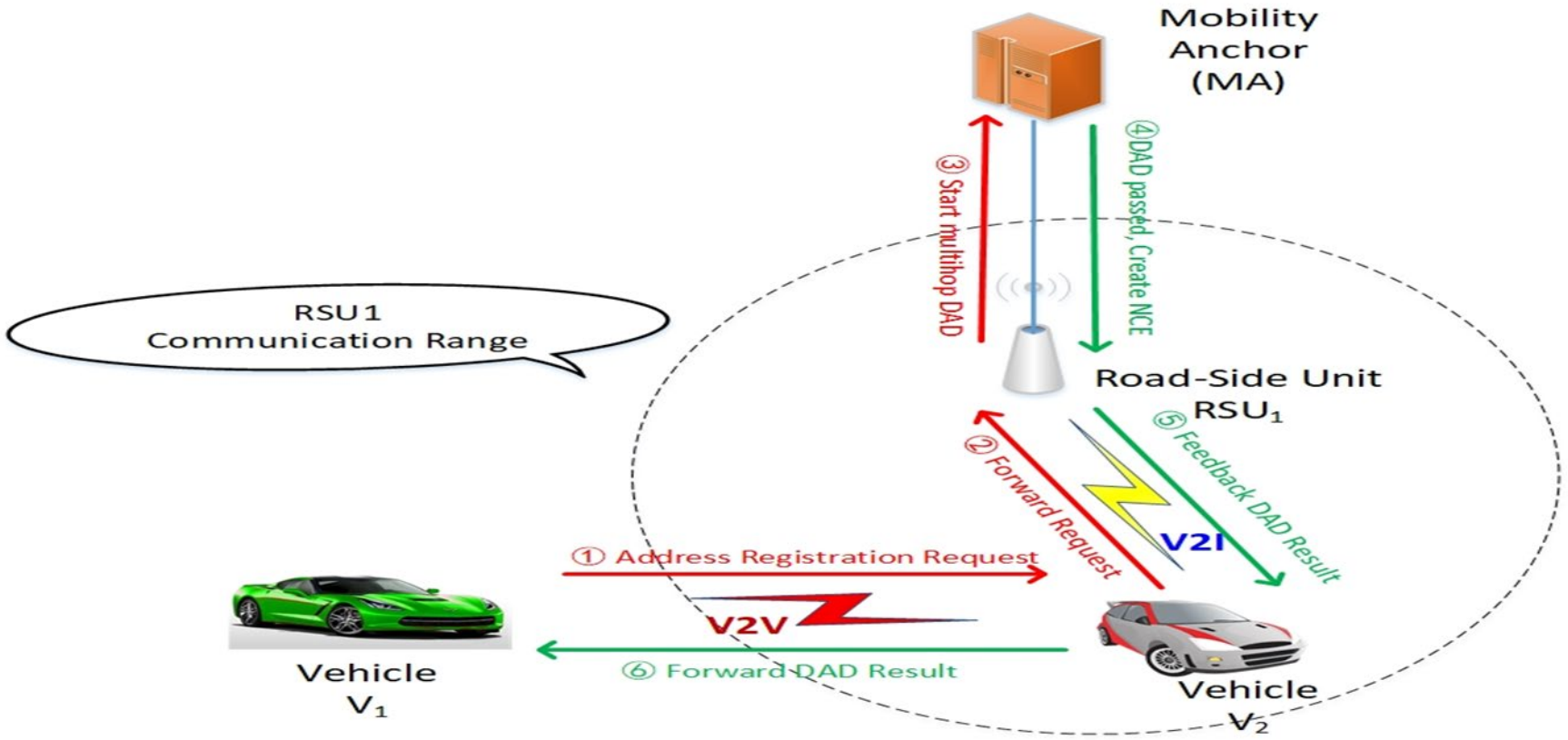
- IPWAVE Problem Statement and Use Cases Document
  - Objective
    - It aims at the problem statement of IPWAVE along with possible use cases in V2V, V2I, and V2X using IEEE 802.11-OCB links.
    - It covers three subjects such as IPv6 Neighbor Discovery, IP Mobility Management, and Security & Privacy.
  - Document name
    - draft-ietf-ipwave-vehicular-networking-19
  - Document link
    - https://datatracker.ietf.org/doc/draft-ietf-ipwave-vehicular-networking/
  - Document status
    - Submitted to IESG

Vehicular Network Architecture



Vehicular Neighbor Discovery (VND)

- Address Registration and DAD via a Relay Vehicle



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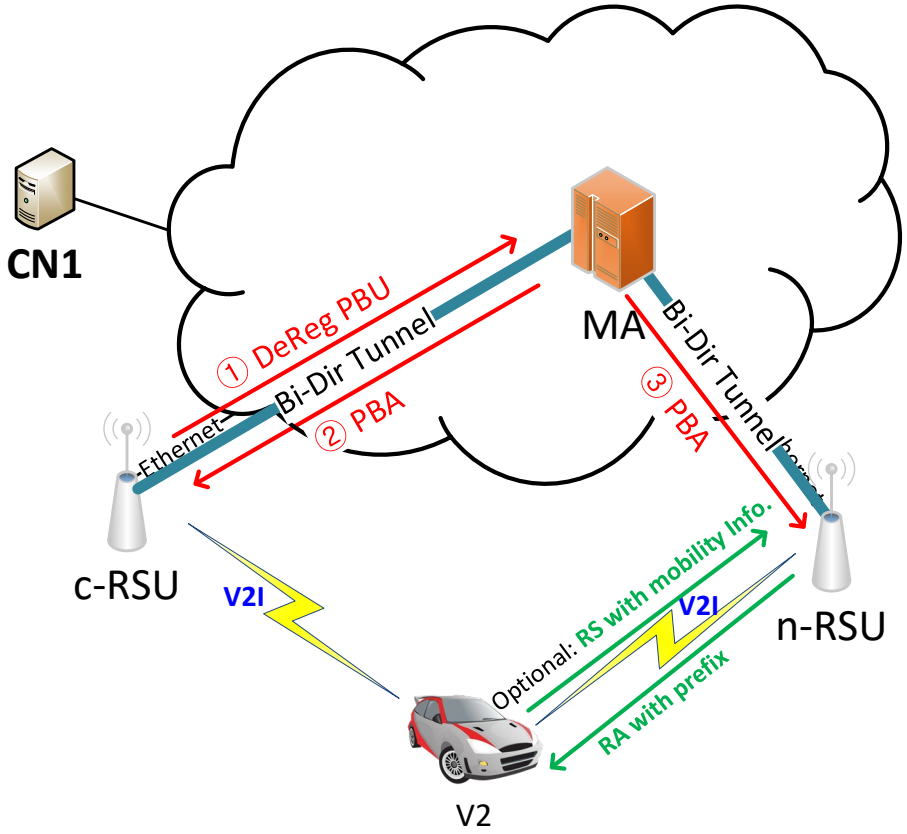
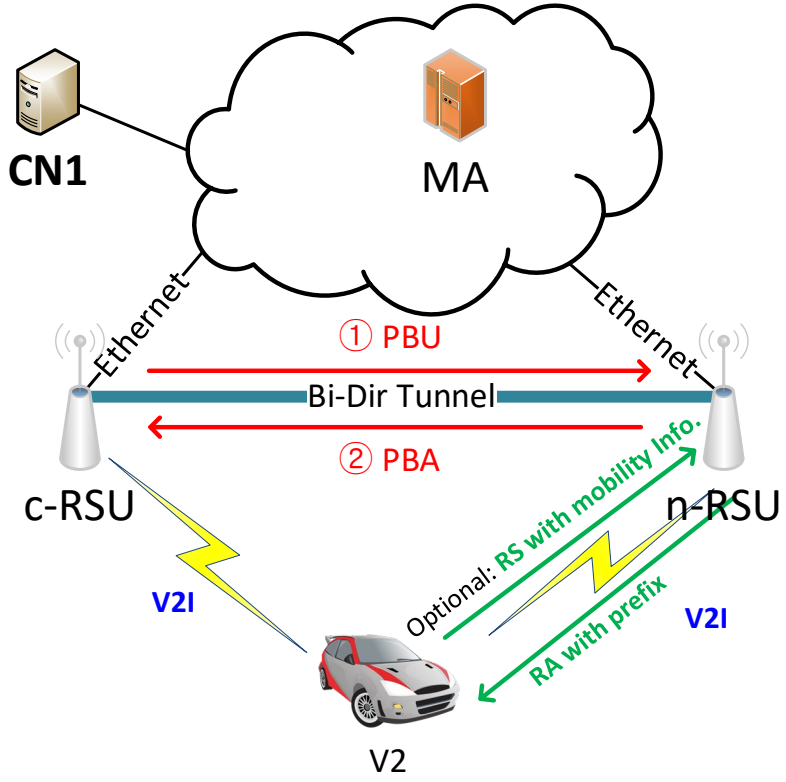
Vehicular Mobility Management (VMM)

- Seamless and Fast Handover for Vehicle



PMIPv6-based MM



DMM-based MM

주변 인식 내비게이터 프로토콜

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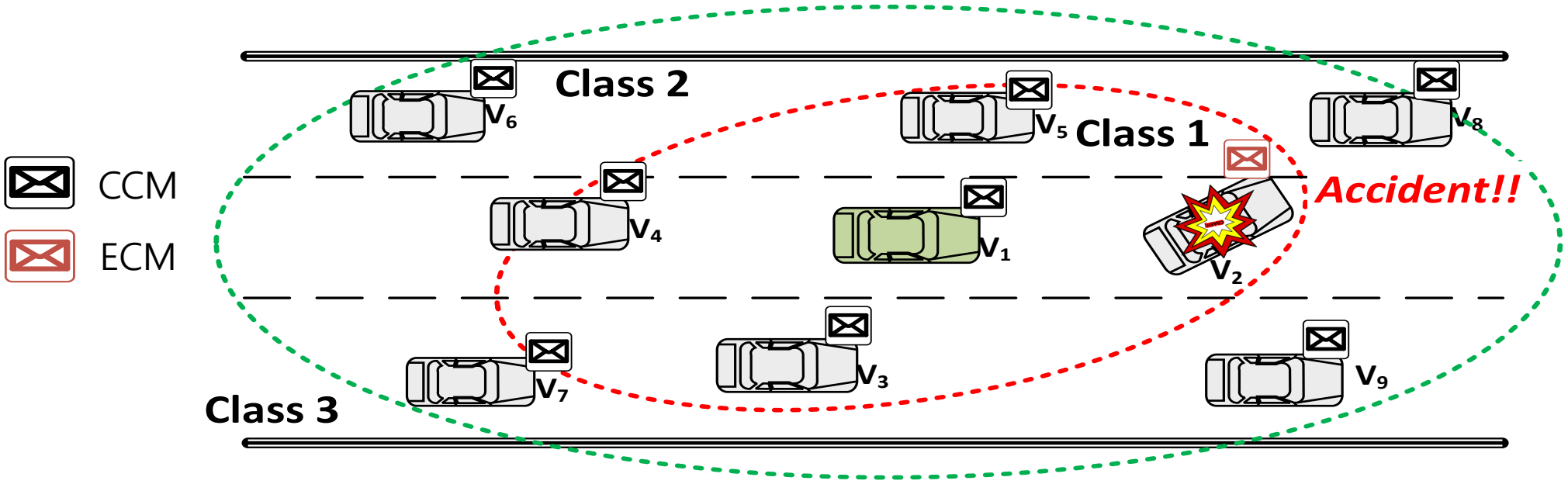
Context-Aware Navigator Protocol (CNP)



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

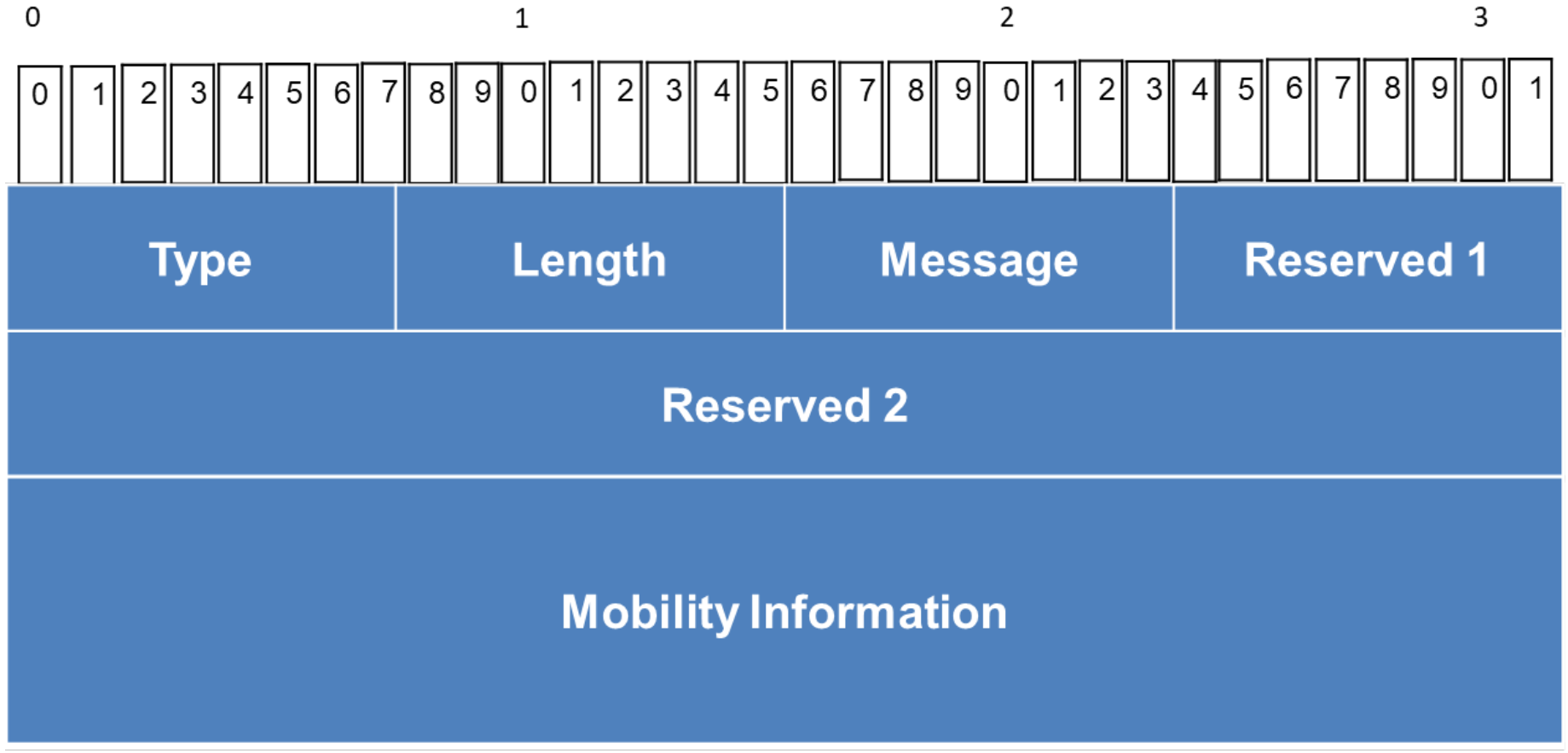
- **Cooperation Context Message (CCM) and Emergency Context Message (ECM)**

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)

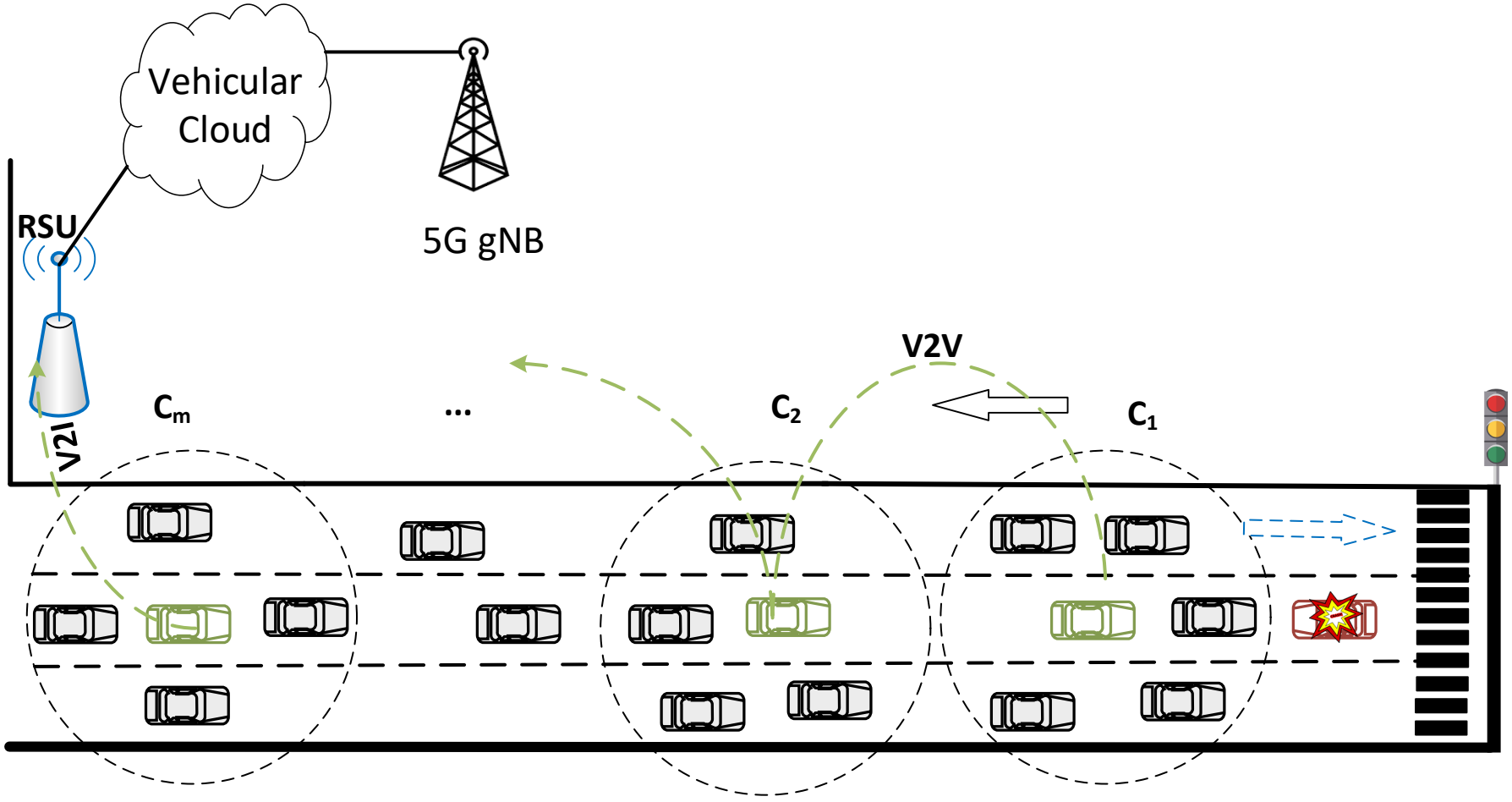
VMI Option as an ND Option:

- Type: CCM or ECM
- Mobility Information: Vehicle Speed, Direction, Position, Driver's Action (e.g., Braking and Accelerating)



https://www.ietf.org/id/draft-jeong-ipwave-context-aware-navigator-01.txt

Collision Avoidance with CNP



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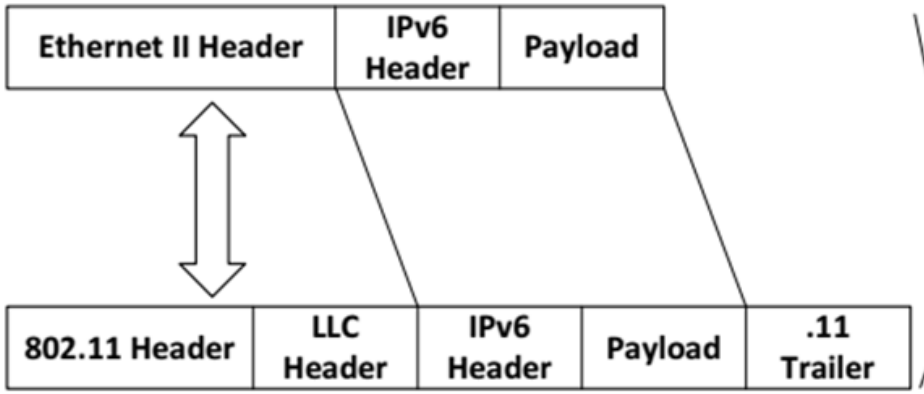
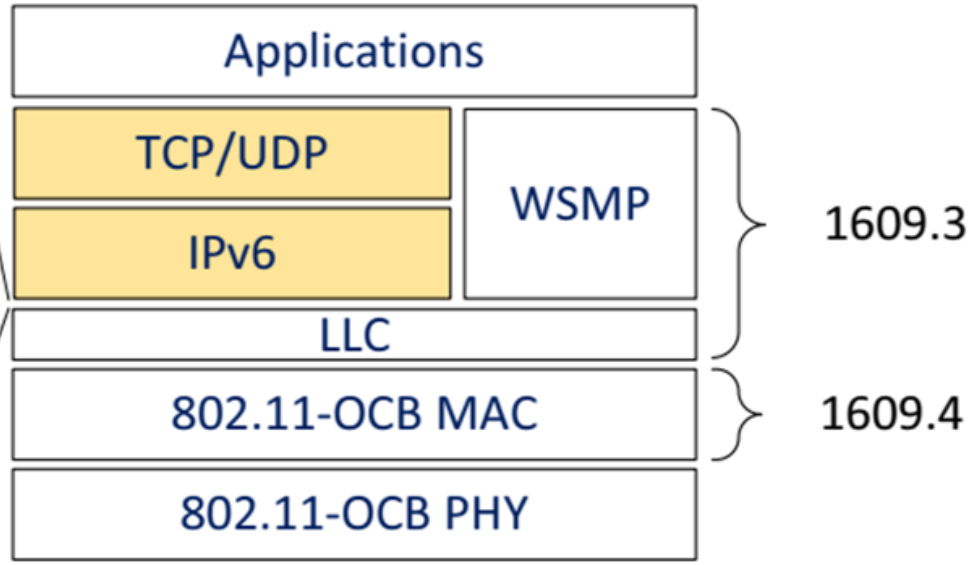
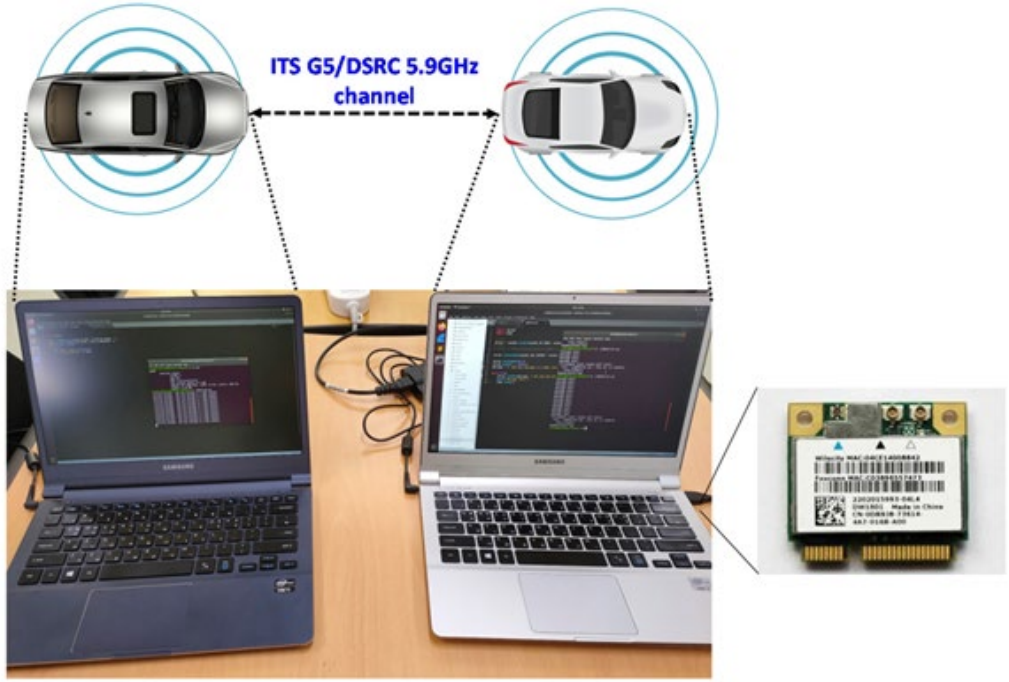
IPWAVE Communications for CNP



Ethernet Adaptation Layer



IEEE WAVE Protocol Stack



Video Delivery over IPWAVE

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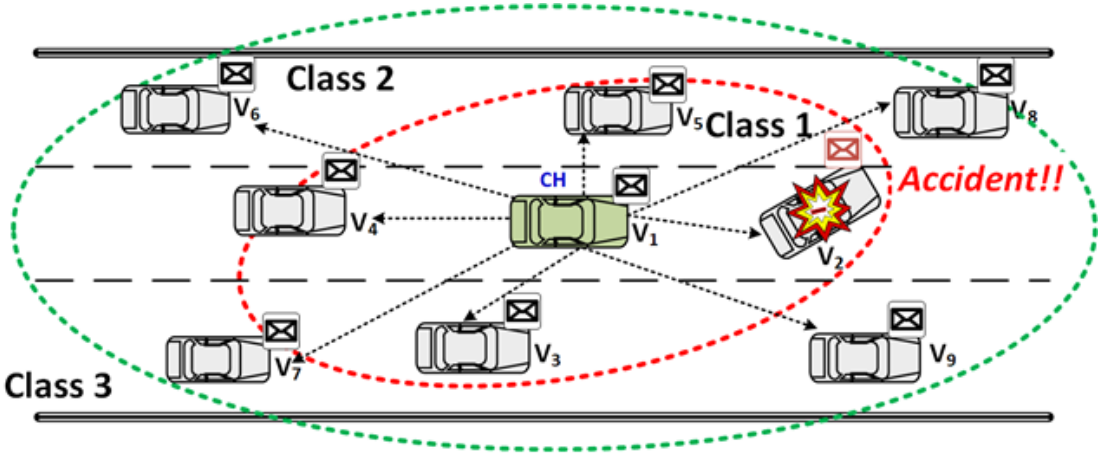
Simulation and Implementation of CNP



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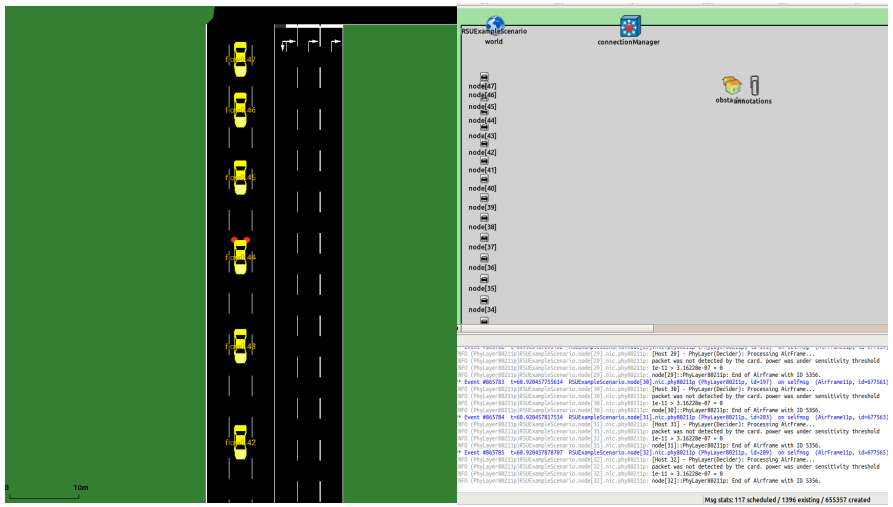
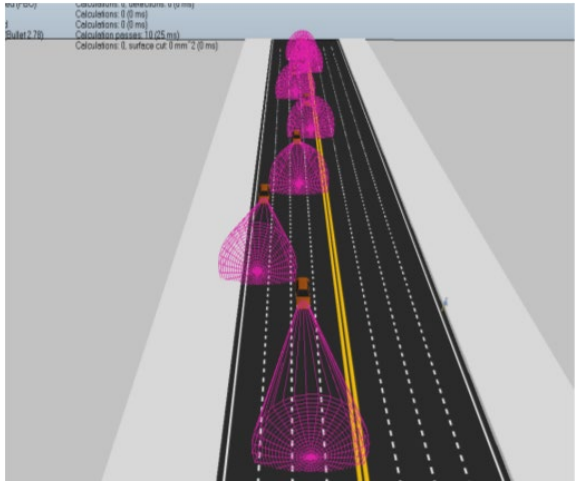
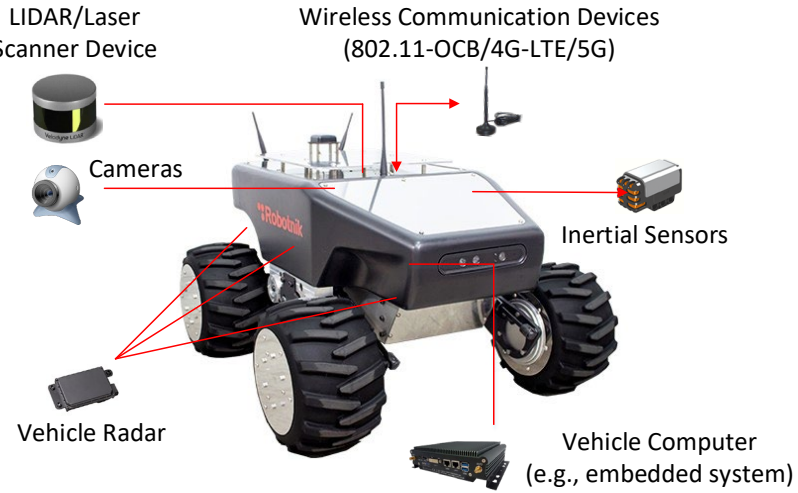


차량 네트워크 시뮬레이터



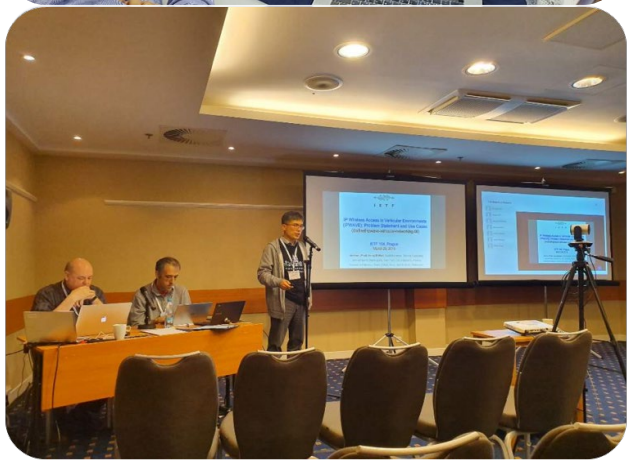
주변 인식 내비게이터 앱



자율주행 로봇카 시작품

성균관대의 IPWAVE 워킹그룹(WG) 표준화 진행상황

1) IPWAVE WG 표준화 문서
   - IPWAVE Problem Statement and Use Cases
   - Vehicular Neighbor Discovery
   - Vehicular Mobility Management
   - Vehicular Security and Privacy
   - Context-Aware Navigator Protocol
   - IPWAVE DNS Name Autoconfiguration



2) IETF 해커톤에서 오픈소스로 구현하여 기술 PoC
   - IPWAVE Basic Protocols Project

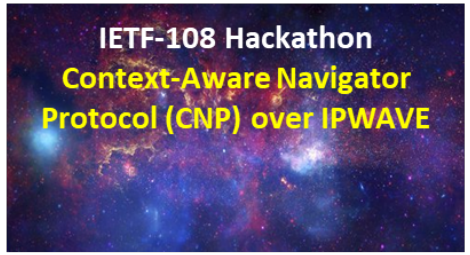
3) IETF IPWAVE WG에 해커톤 프로젝트 기반 표준 제안
   - Vehicular Neighbor Discovery와 Context-Aware Navigator Protocol을 구현하여 POC함
   - 차후에 IPWAVE WG이 Rechartering을 하여 Protocol을 개발할 때 제안한 기법들을 WG 문서로 추진할 계획임.

IETF-108 IPWAVE Hackathon Project

IETF-108 Hackathon Project Poster

IP Wireless Access in Vehicular Environments (IPWAVE) Basic Protocols

Champion: Jaehoon (Paul) Jeong (SKKU)



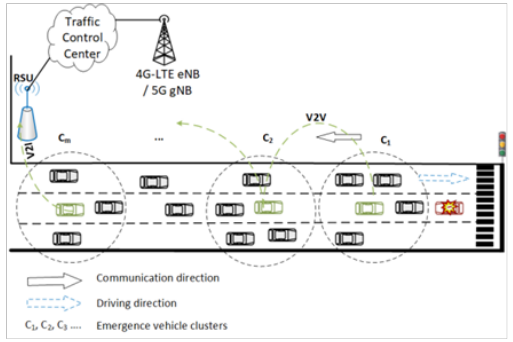
Professor:

- Jaehoon Paul Jeong (SKKU)
- Younghan Kim (SSU)

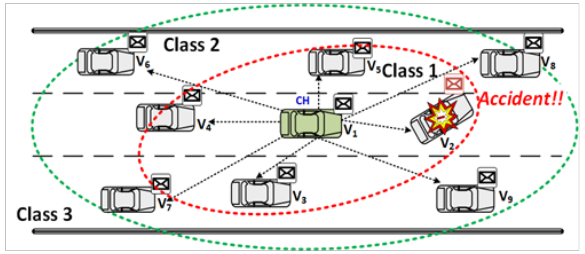
Students:

- Bien Aime Mugabarigira (SKKU)
- Yiwen Chris Shen (SKKU)
- Ahn Yeoseop (SKKU)
- Kyoungjae Sun (SSU)

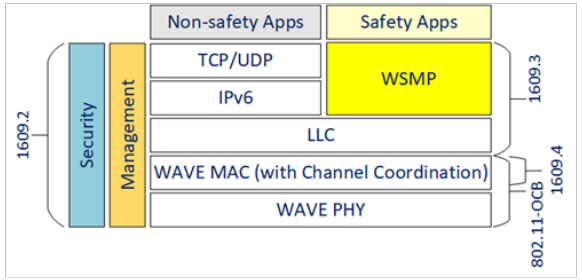
Vehicular Network Architecture



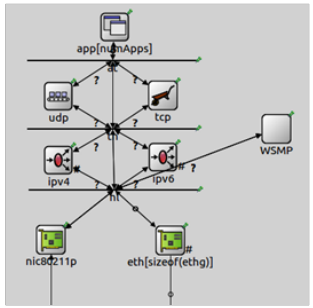
Context-Aware Navigator Protocol



WAVE Protocol Stack



Vehicle Structure in OMNeT++



Objectives:

- Demonstrate IPWAVE Basic Protocols
- Discover technology gaps for IPWAVE

Where to get source code:

- Git-hub open source: https://github.com/ipwave-hackathon-ietf

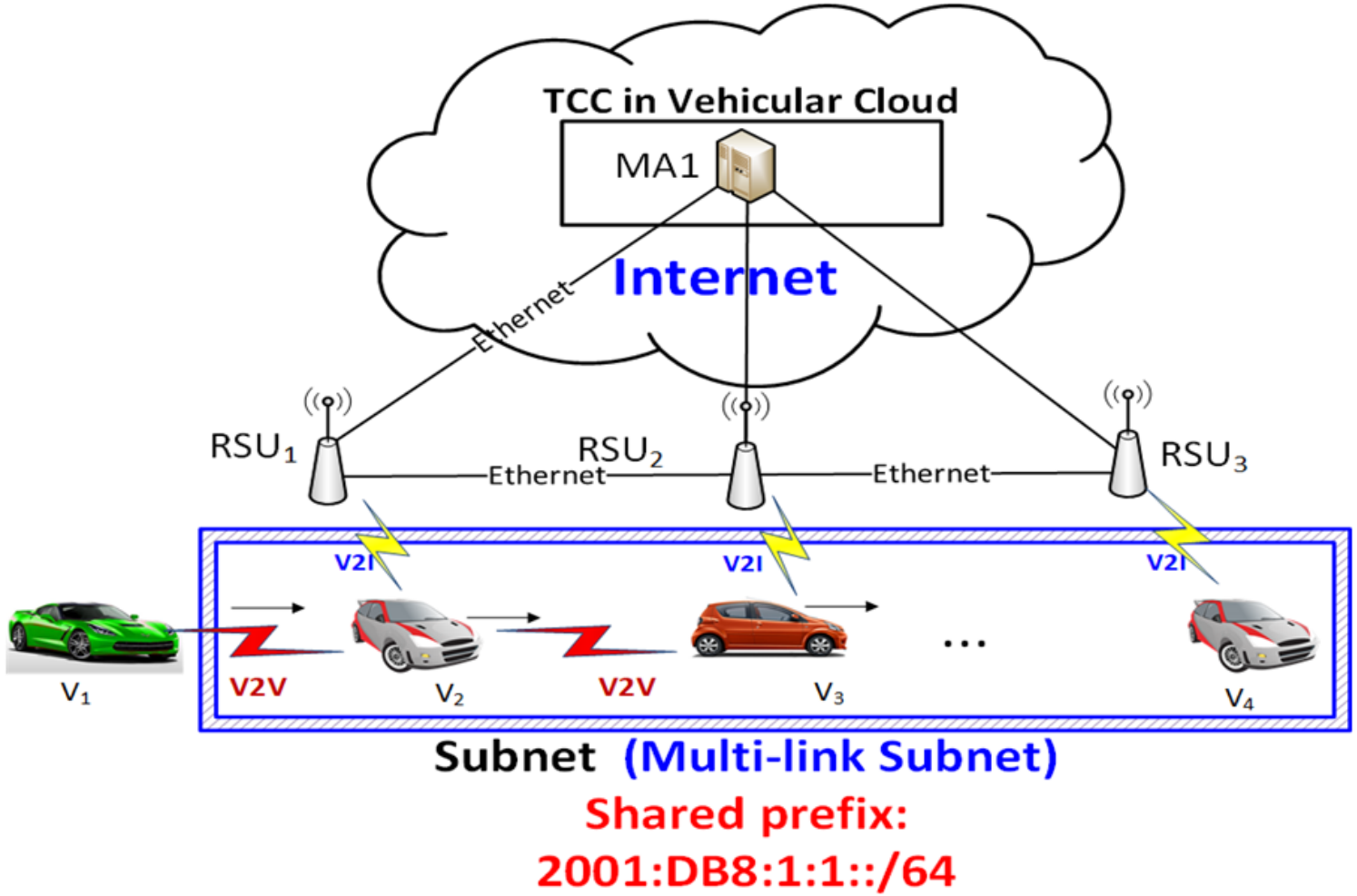
How to set up an environment:

- OS: Ubuntu 16.04
- OMNeT++: 5.4.1
- SUMO: 0.32.0
- Veins: 4.7.1
- INET Framework: 4.0.0

Implementation Contents:

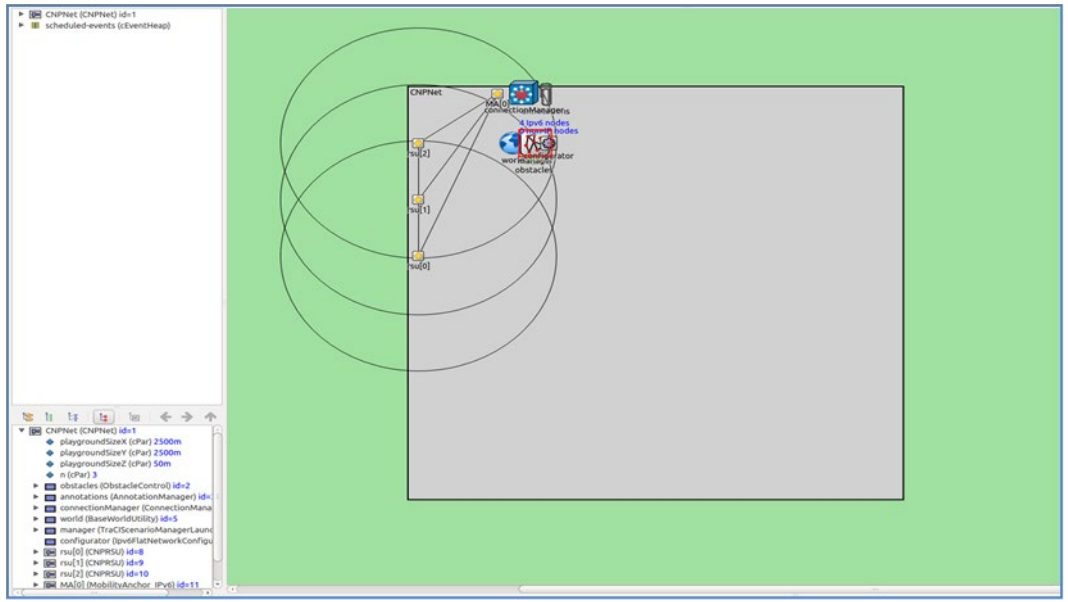
- Proof of Concept (POC) of IPv6-Based Context-Aware Navigator Protocol
- IPv6 mobility information sharing for safe driving in roadways
- Coordinated path planning for obstacle and collision avoidance in roadways
- Efficient driving information exchange in IP-based vehicular networks
- Network-based coordinated driving environment sensing and perception
- Vehicular Simulations of IPWAVE with OMNeT++, SUMO, and VEINS

Vehicular Network for Simulation of CNP



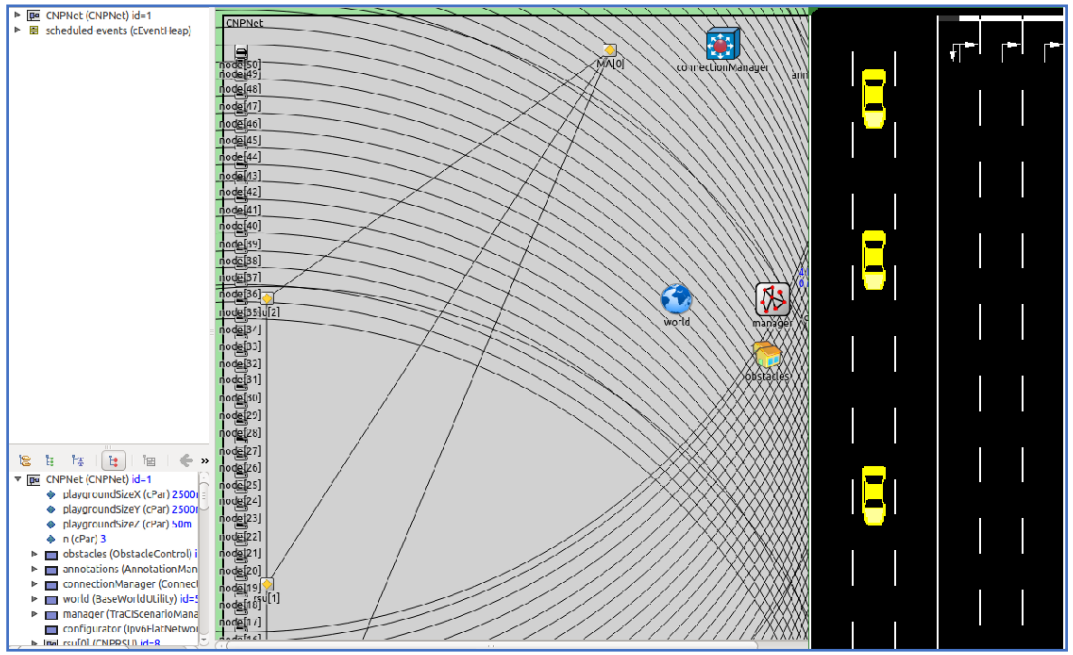
Simulation of CNP (1/2)

- ✓ 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 m obility management of the vehicles.

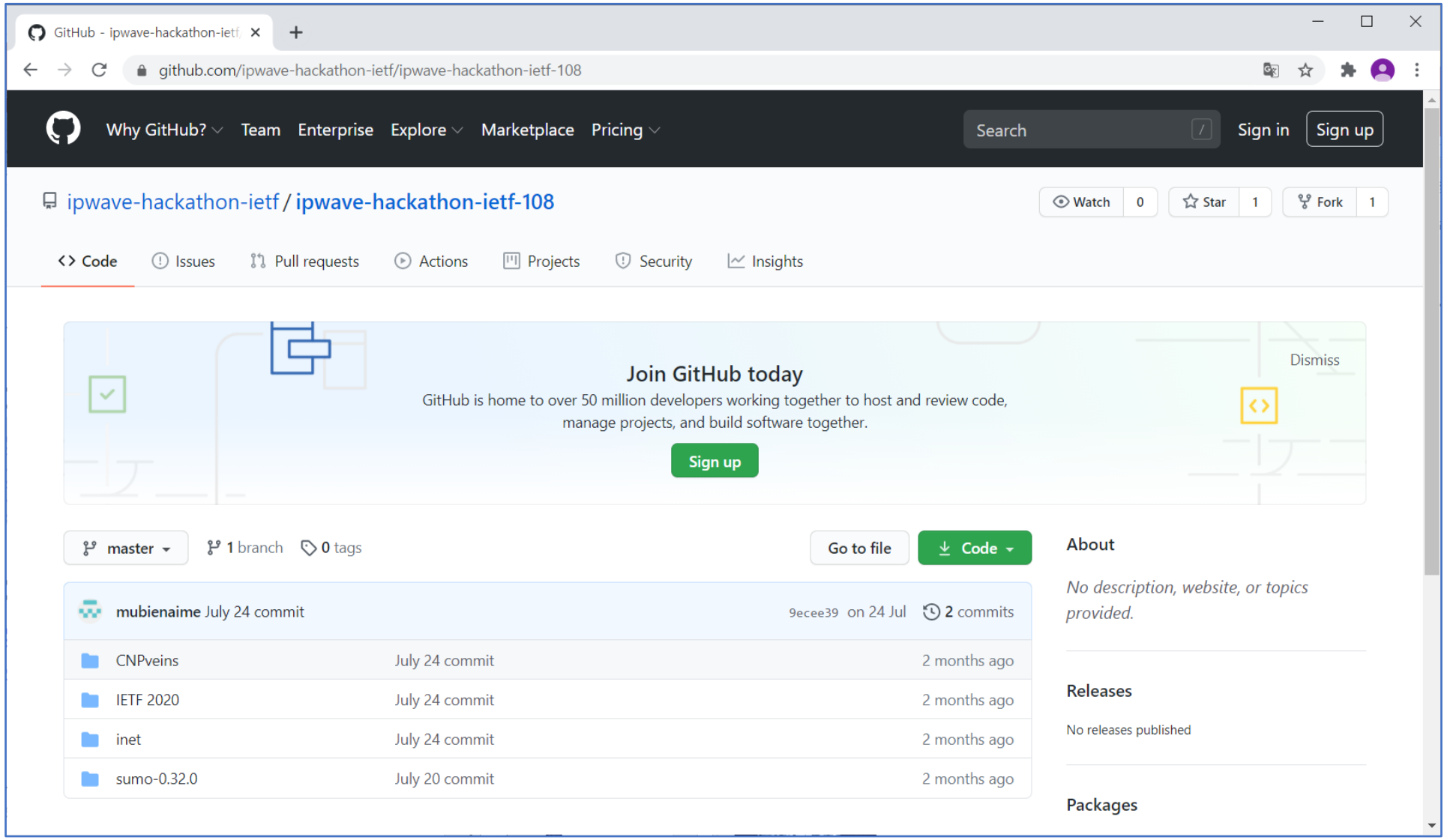


Simulation of CNP (2/2)

- 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.

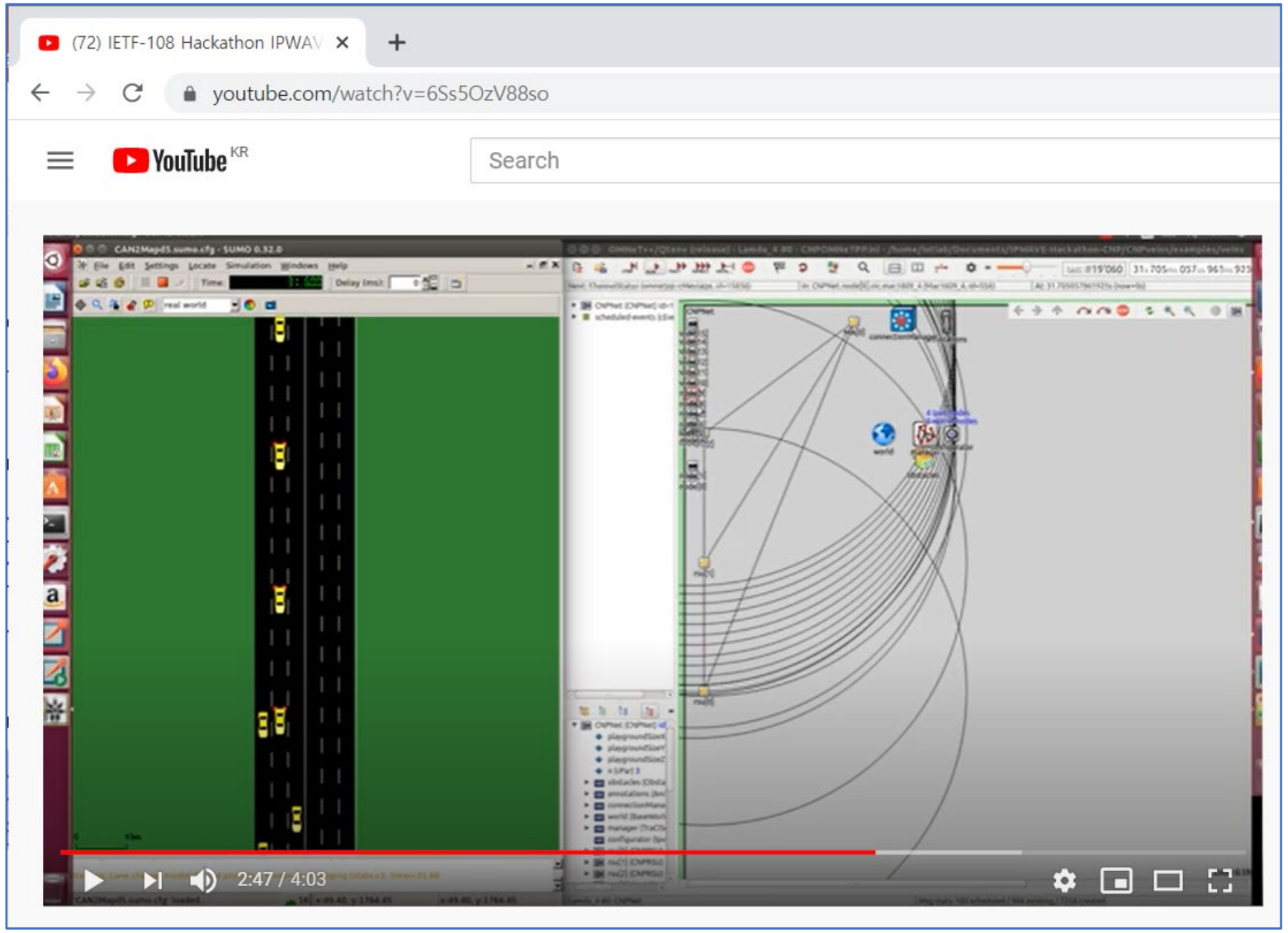


IPWAVE Open Source Project in GitHub



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

Demonstration of CNP in YouTube



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

결론 및 향후 계획

- 차량 네트워킹을 위한 IETF IPWAVE 표준화 동향을 살펴보았다.
  - Use Cases of IPWAVE
  - IPv6 Delivery over IEEE 802.11-OCB
  - IPWAVE Problem Statement and Use Cases
    - Vehicular Neighbor Discovery and Vehicular Mobility Management
- IP WAVE 기반 주변 인식 내비게이터 프로토콜을 살펴보았다.
  - Context-Aware Navigator Protocol (CNP)
  - Collision Avoidance with CNP
  - IPWAVE Communications for CNP
  - Simulation and Implementation of CNP
- IETF-109 해커톤 참석 및 IPWAVE WG 표준화
  - 2020년 11월에 개최되는 IETF-109 정기회의 및 해커톤에 참석
  - CNP를 로봇카에 구현하여 POC를 하여 IPWAVE 표준화에 활용