

IPWAVE Basic Protocols Project @ IETF-105 Hackathon



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Goal of IPWAVE Basic Protocols Project

❖ Implementation of IPv6 Over IEEE 802.11-OCB and IPv6 Vehicular Neighbor Discovery

1. IPv6 over IEEE 802.11-OCB with WAVE Logical Link Layer
2. Vehicular Neighbor Discovery (VND) with Address Registration and Multihop Duplicate Address Detection (DAD)
3. Multihop DAD and UDP/TCP Transmission via Intermediate Vehicles in VANET

IPWAVE Internet Drafts for Hackathon

- **IPv6 over IEEE 802.11-OCB**
 - **draft-ietf-ipwave-ipv6-over-80211ocb-50**
 - Basic Support for IPv6 over IEEE Std 802.11 Networks Operating Outside the Context of a Basic Service Set (IPv6-over-80211-OCB)
- **Vehicular Neighbor Discovery**
 - **draft-jeong-ipwave-vehicular-neighbor-discovery-07**
 - Vehicular Neighbor Discovery for IP-Based Vehicular Networks

IPWAVE Hackathon Project Poster

IP Wireless Access in Vehicular Environments (IPWAVE) Basic Protocols Project

Champion: Jaehoon Paul Jeong (SKKU)



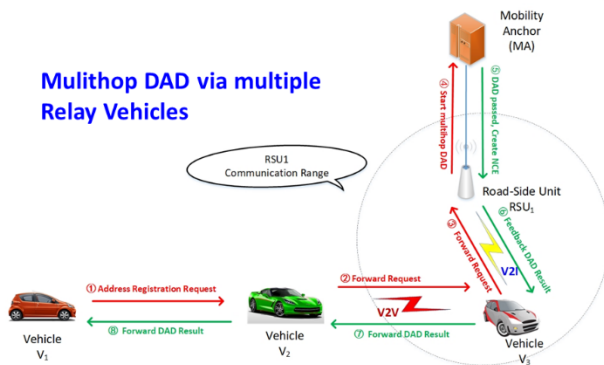
Professor

- Jaehoon Paul Jeong (SKKU)

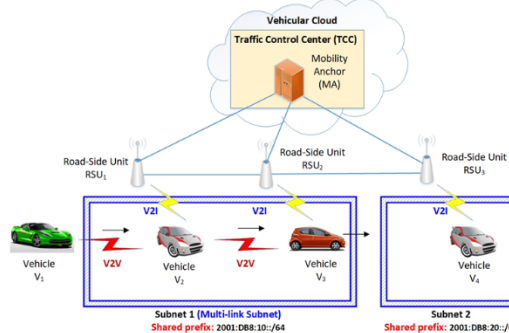
Students

- Zhong Xiang (SKKU)
- Yiwen Chris Shen (SKKU)
- Haesung Lee (SKKU)

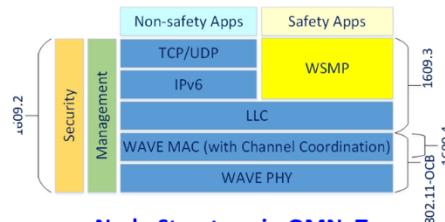
Multihop DAD via multiple Relay Vehicles



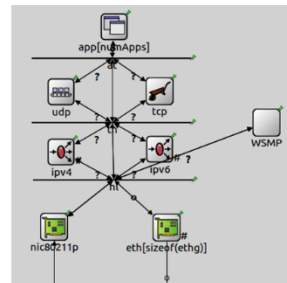
Vehicular Network Architecture



WAVE Stack



Node Structure in OMNeT++



Objective of this Hackathon

- Demonstrate IPWAVE basic protocols
- Discover technology gaps

Where to get code

- Github – Source Code
 - ✓ <https://github.com/ipwave-hackathon-ietf>

Where to get video clip

- Youtube – Demonstration
 - ✓ <https://youtu.be/5OnpnYUilHg>

What to pull down 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

Contents of Implementation

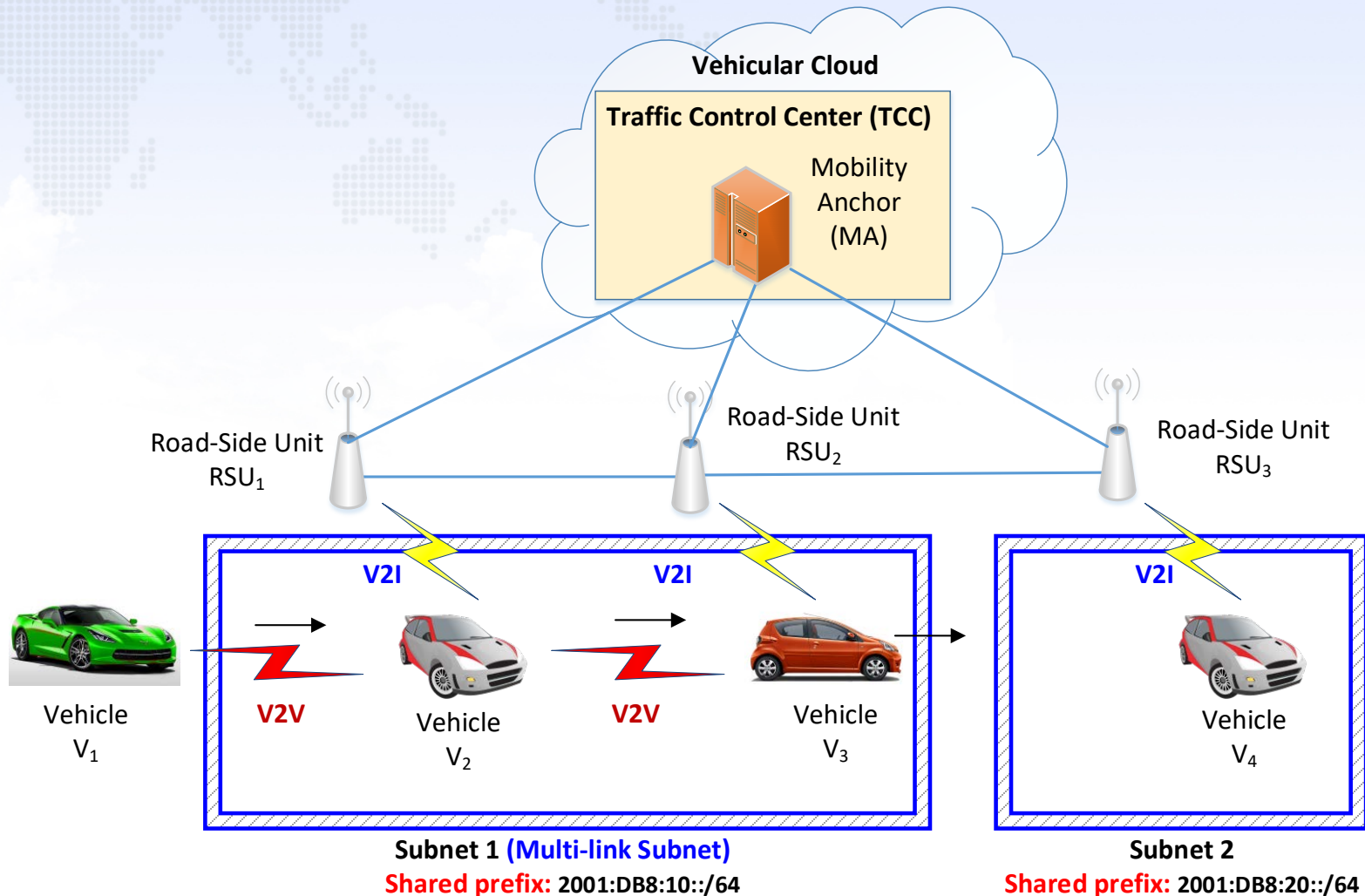
- Transmission of IPv6 Packets over IEEE 802.11-OCB
- IPv6 Neighbor Discovery for IP-Based Vehicular Networks
 - ✓ Address Registration and Duplicate Address Detection Process
 - ✓ Multihop DAD Process via V2V communications
 - ✓ UDP/TCP Transmission via intermediate vehicles
- Build IPv6/TCP/UDP protocol stack based on VEINS-4.7.1 and INET-4.0
- Build a basic IPWAVE running scenario via V2I and V2V based on VEINS-4.7.1 and SUMO-0.32.0

IPWAVE Hackathon Project Team



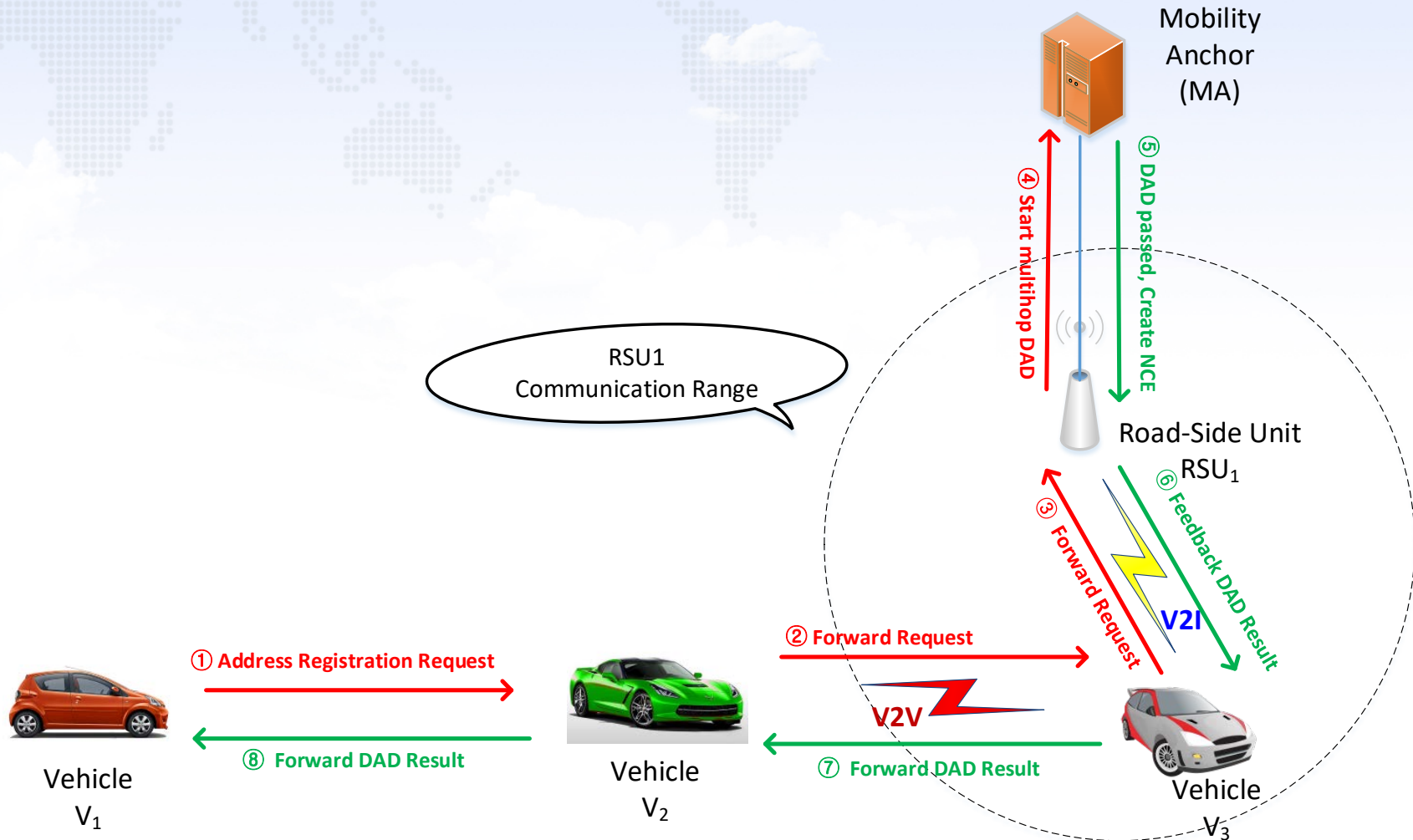
Vehicular Network Architecture

- Multihop V2X in Vehicular Ad Hoc Networks (VANET)



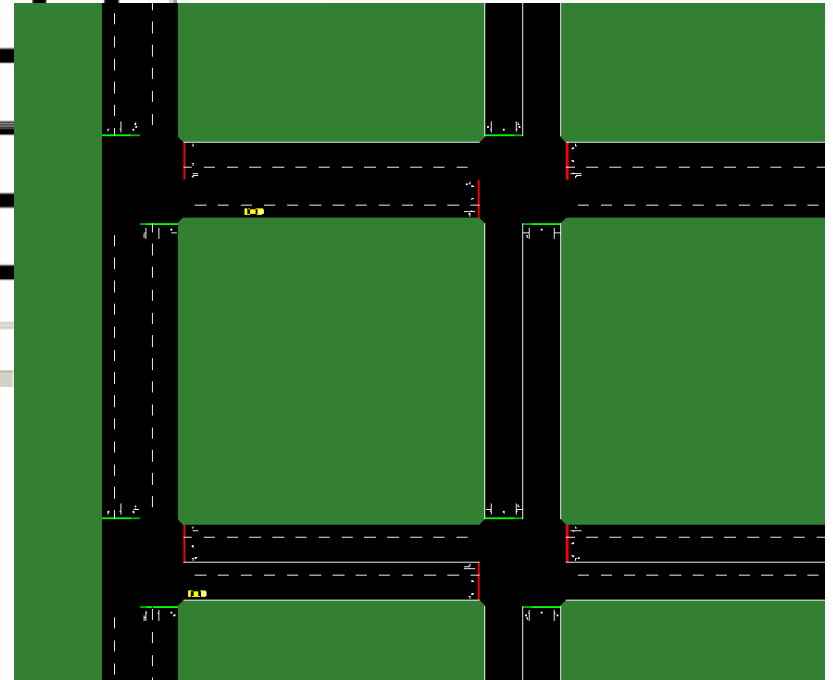
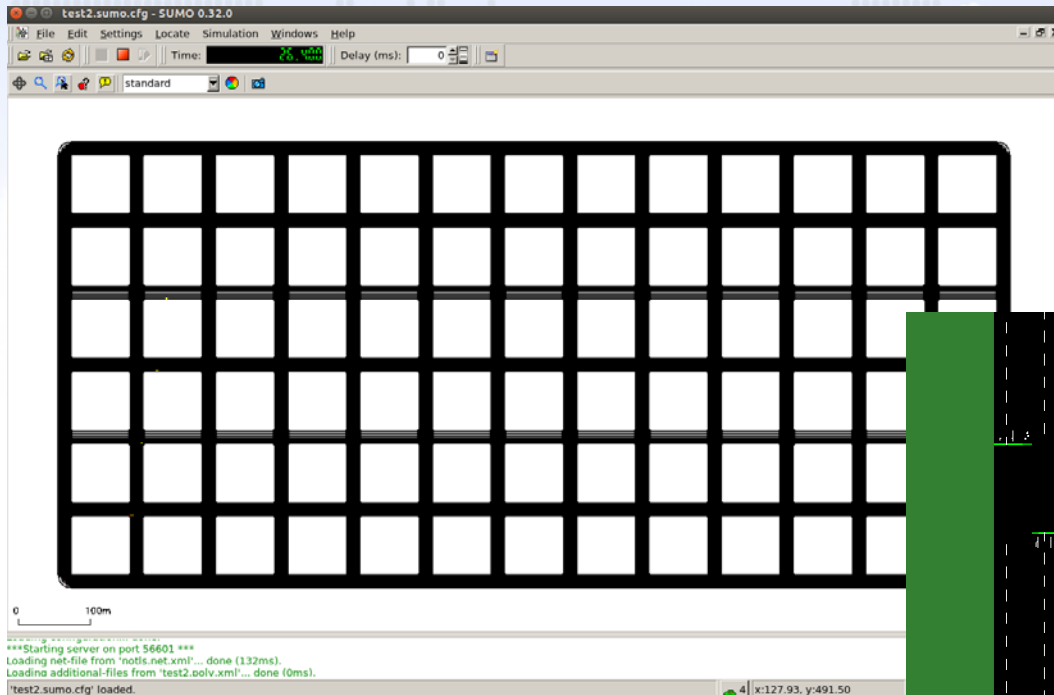
Vehicular Neighbor Discovery (VND)

- Multihop DAD for IP Address Registration with Intermediate Vehicles in VANET



Road Network Architecture (1/2)

- ✓ A 14×7 grid map with 3 lanes for a road network



Road Network Architecture (2/2)

✓ Two RSUs :

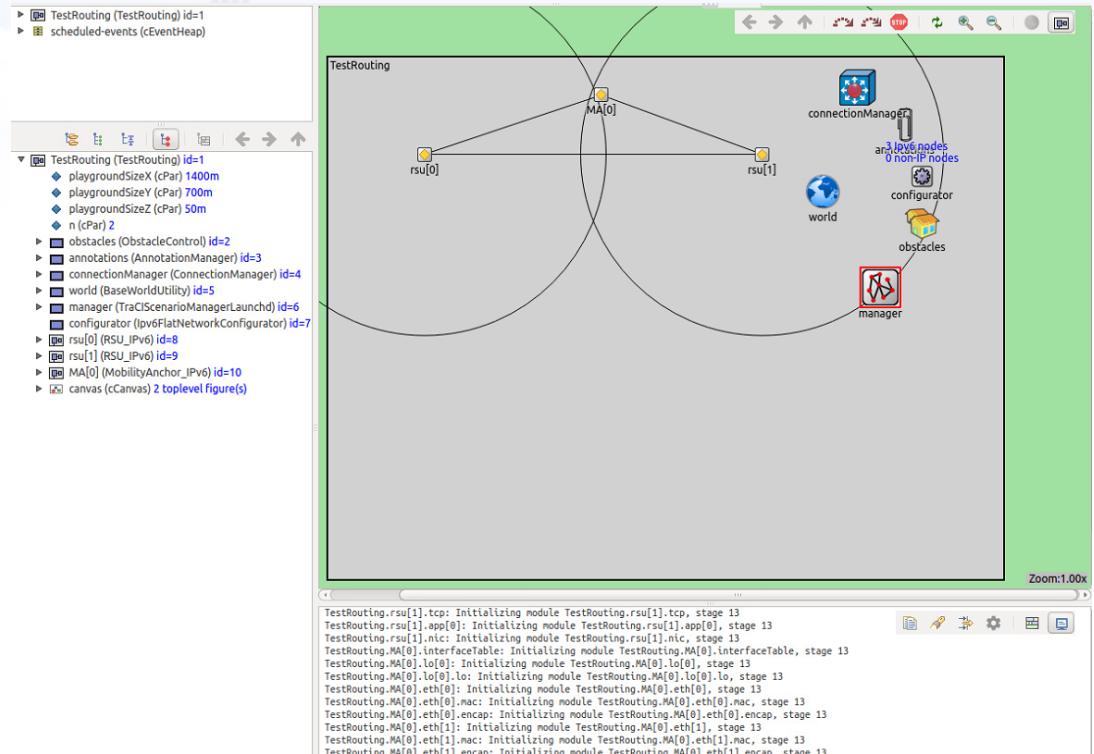
- They belong to one subnet.
- They are connect with each other through Ethernet.

✓ Multiple Vehicles :

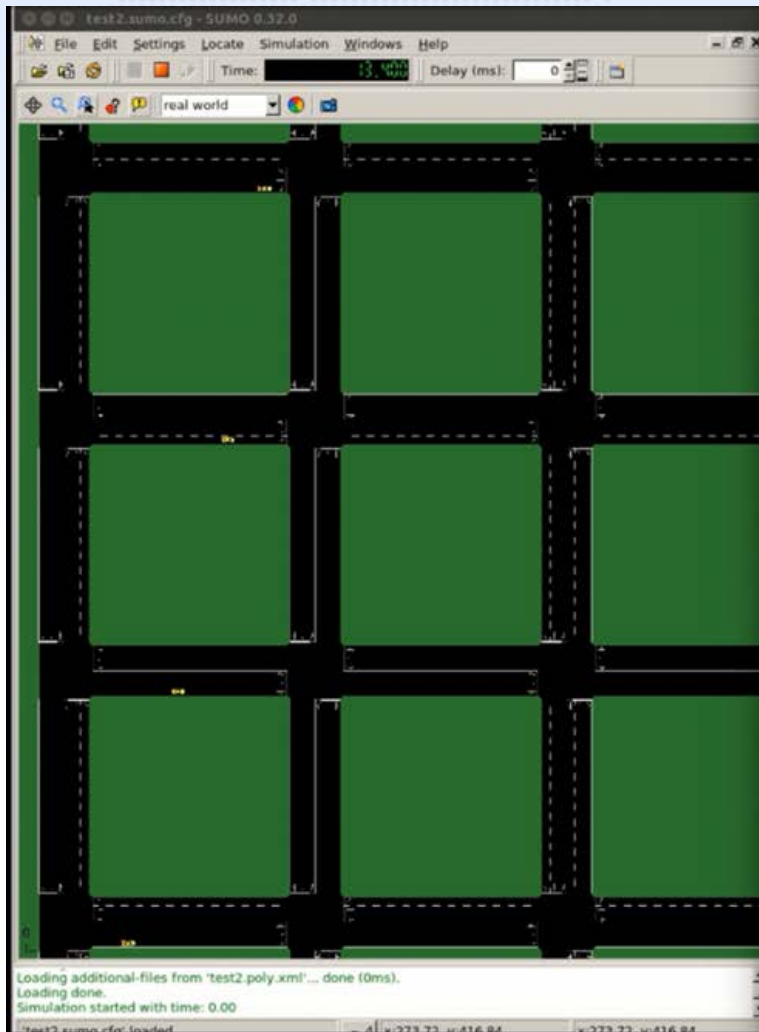
- Some are outside the coverage of RSUs.

✓ Mobility Anchor:

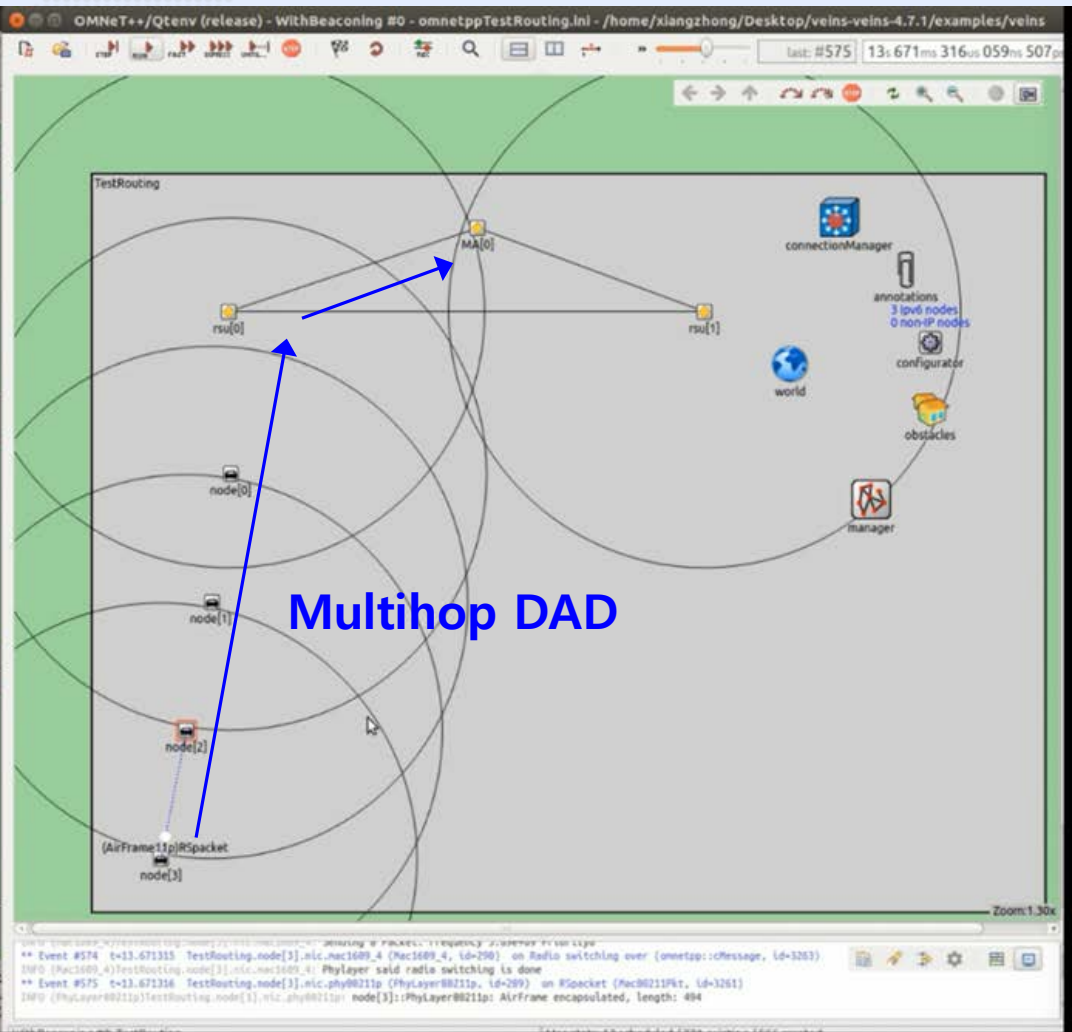
- It manages RSUs and Vehicles.



802.11-OCB and VND Simulation



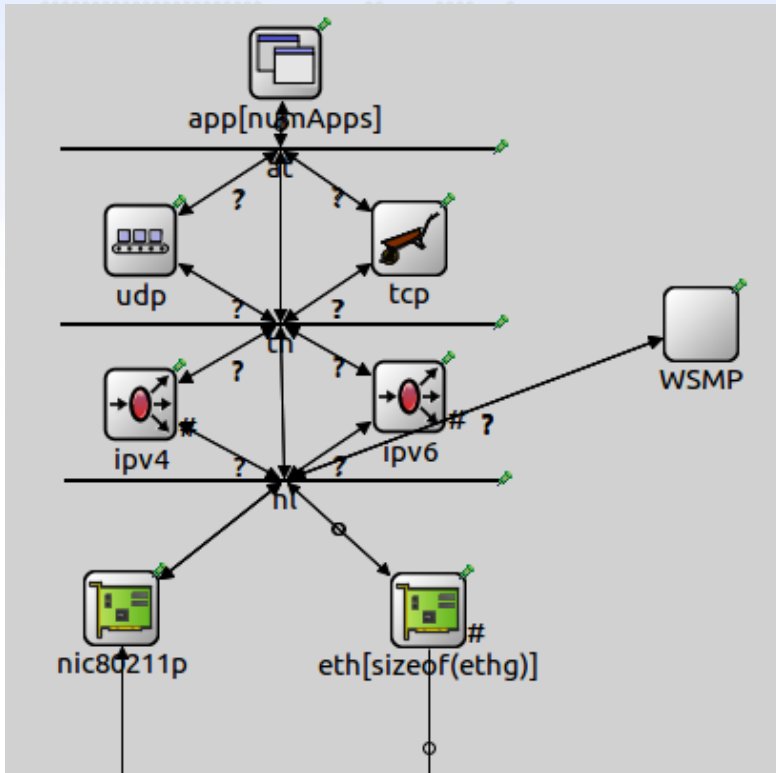
SUMO



Multihop DAD

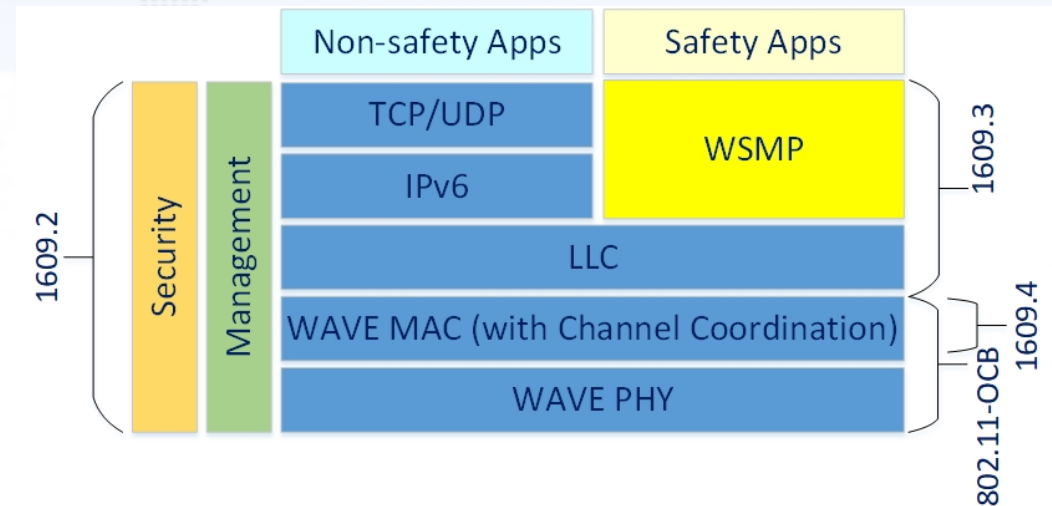
OMNeT++

Vehicular Network Stack in OMNeT++



Vehicle Structure

WAVE Stack



Simple Simulation Results

DAD Processing Time Comparison

- Legacy IPv6 ND Default Setting:

= Random (0, Max_RTR_SOLICITATION_DELAY) + Retrans_Timer

- Retrans_Timer: 1s
- Max_RTR_SOLICITATION_DELAY: 1s
- DuplicateAddressDetectionTransmit: 1 Transmission

#Vehicle	Legacy ND (s)	Vehicular ND (s)
5	1.665790753	0.000846651
10	1.614267702	0.000867451
15	1.622217908	0.000863119
20	1.593333245	0.000844052
25	1.631985633	0.000839892
30	1.661594873	0.000844486

* Average processing time
of multiple vehicles

* Fixed speed: 10m/s

⇒ Our VND takes 0.0508% time of the Legacy ND.

Lessons from IETF-105 Hackathon Project

➤ **Proof of Concept (POC) of IPWAVE VND Protocol**

- **IPv6 over IEEE 802.11-OCB**
- **Vehicular Neighbor Discovery (VND)**
- **Multihop DAD and UDP/TCP Transmission in VANET**

➤ **Design and Implementation of IPWAVE VND in OMNeT++ and SUMO**

- **Design of IPWAVE VND Framework in OMNeT++**
- **Implementation of IPv6 over IEEE 802.11-OCB**



Appendix

- Hackathon Development Environment
- Demonstration Video Clip of IPWAVE Basic Protocols Project
- Open-Source Depository of IPWAVE Basic Protocols Project

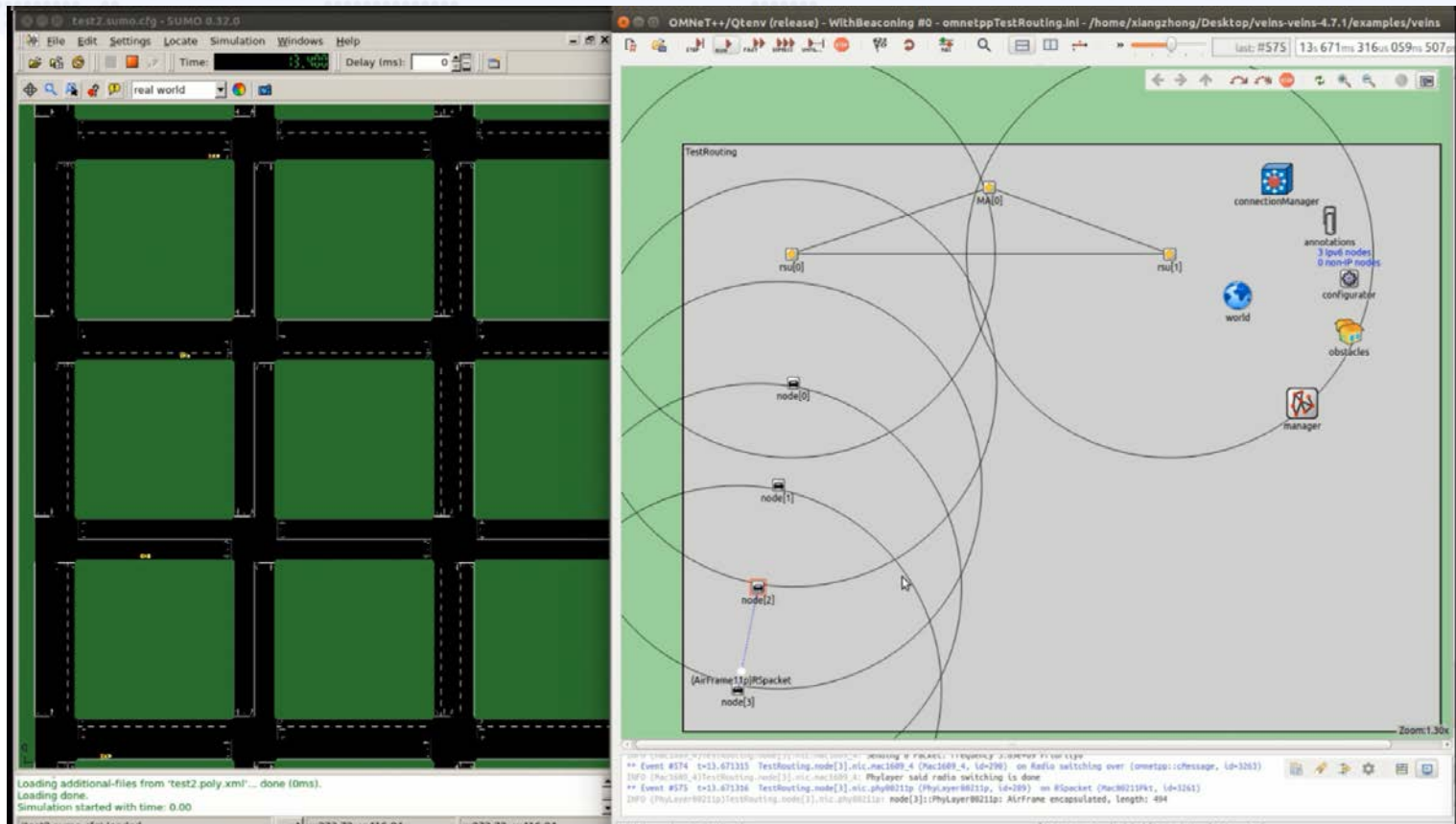
Hackathon Development Environment

Open Source	Description	Version
Ubuntu	Operating System	Version 16.04
OMNeT++	Network Simulator	Version 5.4.1
SUMO	Road Simulator	Version 0.32.0
Veins	IEEE 802.11-OCB	Version 4.7.1
INET Framework	IPv6, TCP/UDP	Version 4.0.0

Demonstration Video Clip of IPWAVE Basic Protocols Project

- Youtube link:

<https://youtu.be/5OnpnYUiLhg>



Open-Source Depository of IPWAVE Basic Protocols Project

- **Github link:**

<https://github.com/ipwave-hackathon-ietf>

Branch: master ▾ New pull request

Find File Clone or download ▾

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inet-ipwave-hackathon-105	First commit	9 days ago
sumo-0.32.0	First commit	7 days ago
veins-ipwave-hackathon-105	some changes	4 days ago
Installation- Manual-for-IPWAVE-Basic-Protocols-Project-20190714-v1.p...	Installation Mannual	1 minute ago