

IPMON Side Meeting



# IETF-117

## IPMON Hackathon Project

July 22~23, 2023

Champion: Jaehoon (Paul) Jeong

**Presenter: Hyeonah Jung**

Members: Junhee Kwon and Bien Aime Mugabarigira

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# IP-Based Mobile Object Networking (IPMON) Project

Champion: Jaehoon (Paul) Jeong (SKKU)

## IETF-117 IPMON Hackathon Project



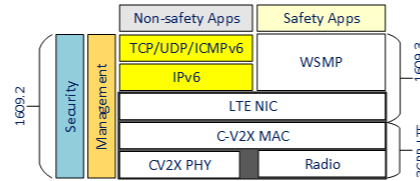
### Professors:

- Jaehoon (Paul) Jeong (SKKU)
- Yiwen (Chris) Shen (SKKU)
- Younghan Kim (SSU)

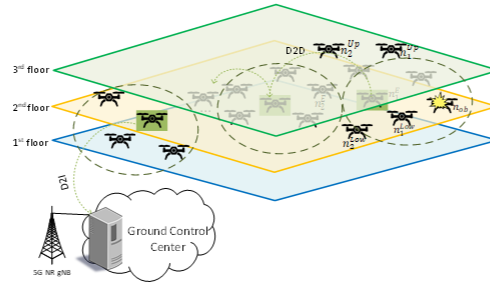
### Students:

- Junhee Kwon (SKKU)
- Hyeonah Jung (SKKU)
- Bien Aime Mugabarigira (SKKU)

### C-V2X Protocol Stack



### IPv4 Drone Networks



### Objectives

- To demonstrate IP-MON Basic Protocols
- To let drones exchange their mobility information options for context-awareness
- Simulation of Context-Aware Navigation Protocol over simu5G
- To discover technology gaps for IPMON

### Where to get source code:

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

### System requirements:

#### - Software

- OS: Ubuntu 20.04
- OMNeT++ 5.6.2 and INET 4.2.5s
- SIMU5G

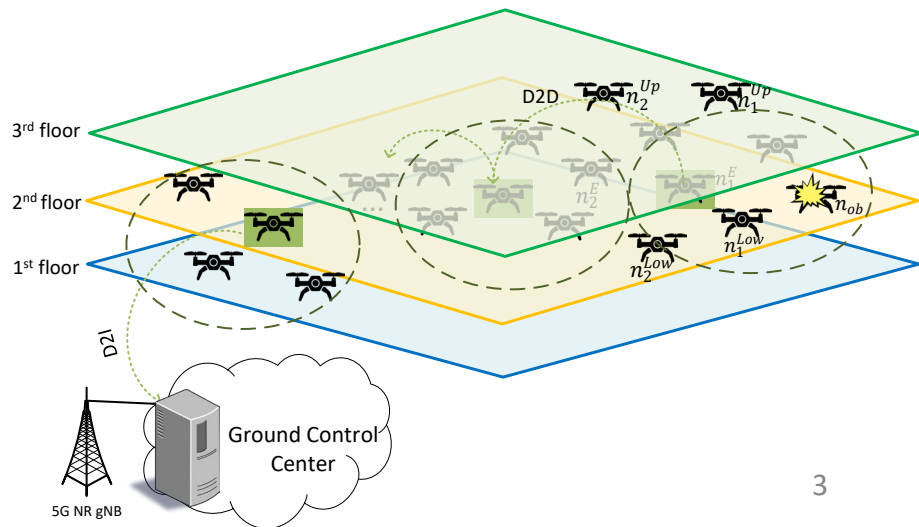
### Implementation Contents:

- Development of a 5G enabled drone communication system for safe and secure flight using IETF protocols.
- Vehicular Mobility Information (VMI) option in IPv6-based drone networks over 5G V2X
  - ✓ Light-weight message exchange with Cooperation Context Message (CCM) and Emergency Context Message (ECM) for safety in a Flying Ad Hoc Network (FANET)

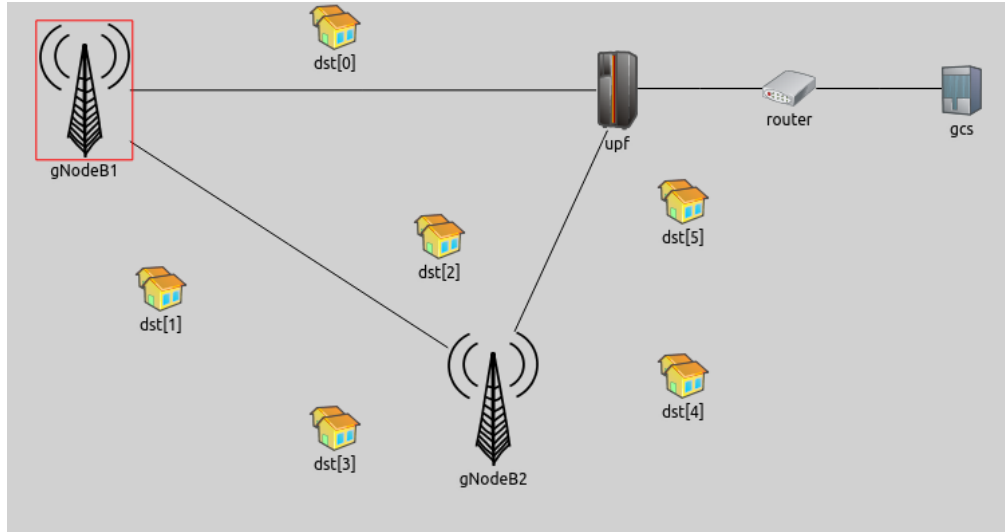


# Hackathon Plan

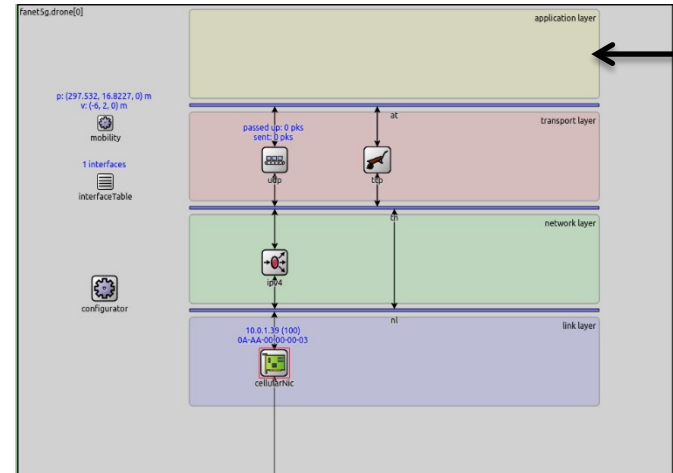
- Drafts for the IP-Based Mobile Object Networking (IPMON) Project
  - <https://datatracker.ietf.org/doc/draft-jeong-6man-ipmon-problem-statement/>
  - <https://datatracker.ietf.org/doc/draft-jeong-6man-ipv6-over-5g-v2x/>
  - <https://datatracker.ietf.org/doc/draft-jeong-ipwave-context-aware-navigator/>
- Simulation
  - To simulate an efficient 5G-based drone networks suitable for safety drone flight.
  - To extend the Simu5G infrastructure by deploying the gNodeBs along with a Ground Control System (GCS).
- Support of Drone to Drone (D2D) and Drone to Infrastructure (D2I) Communications.
- Simulation of a Lightweight Vehicle Mobility Information (VMI) Exchange for Safe Drone Flight:
  - Cooperation Context Message (CCM) for mobility information exchange.
  - Emergency Context Message (ECM) for rapid hazardous information sharing.



# What got done (1/2)



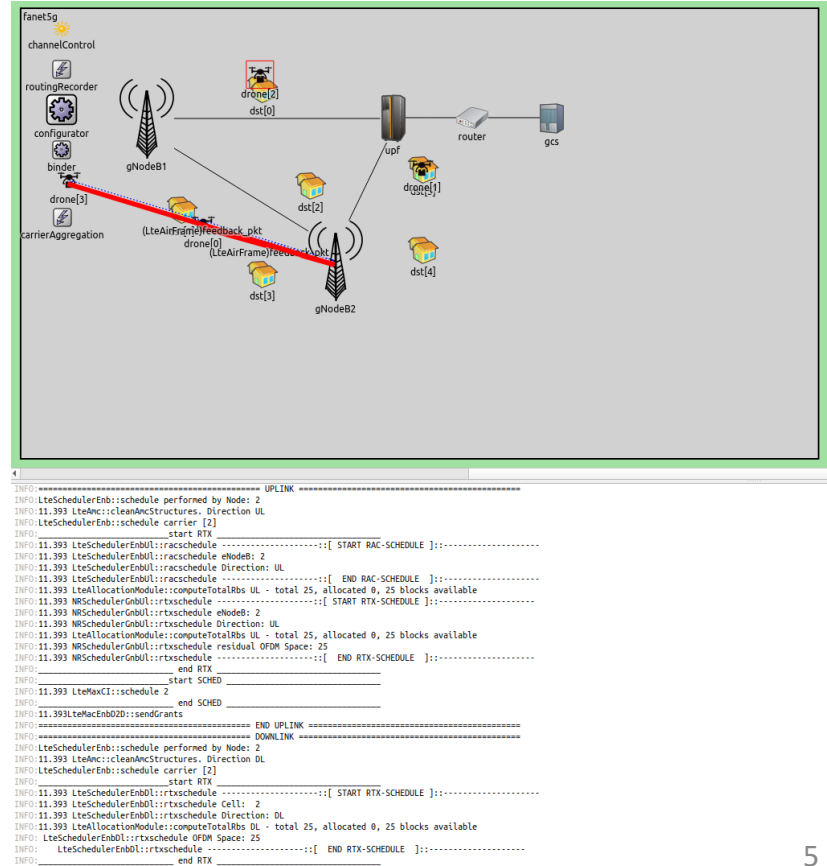
**VMI Options: CCM & ECM**  
exchange built in application layer



A 5G drone protocol stack structure

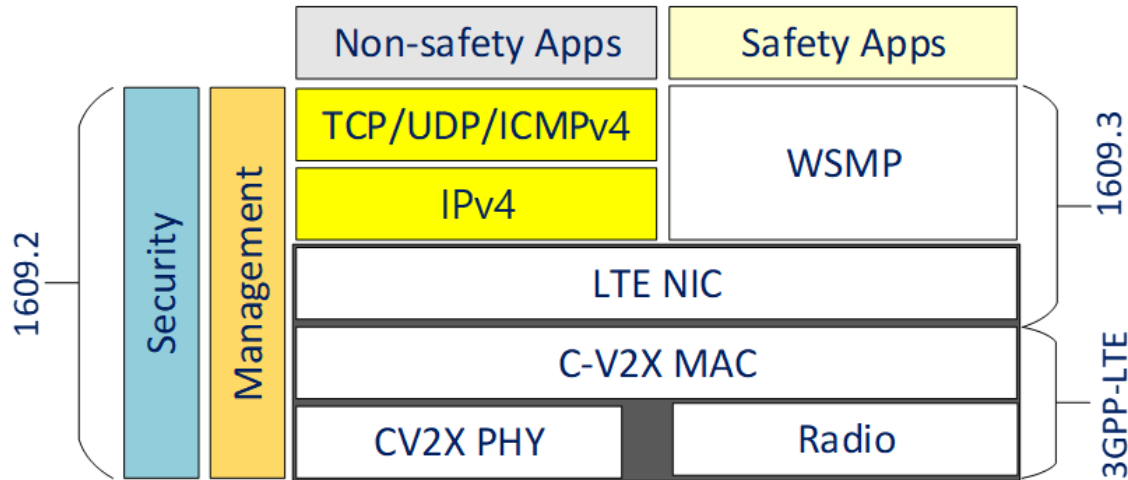
# What got done (2/2)

- Simulation implementation of 5G-based safe drone networks through:
  - Exchange of Cooperation Context Message (CCM) via D2X.
  - Exchange of Emergency Context Message (ECM) via D2X.



# What we learned

- Through safety App on top of UDP in a 5G protocol stack, safe messages like CCM can be shared among drones in drone networks with IPv4 over 5G V2X.
  - A 5G Cellular Infrastructure can be used to handle safety message communication in a complex drone networks.
  - CCM messages can be used for sharing drone mobility information through application layer over UDP/IPv4/5G-V2X.



# Open Source Project at Github

URL: <https://github.com/ipwave-hackathon-ietf/IETF-117-IPMON-Hackathon-Project>

The screenshot shows the GitHub repository page for 'IETF-117-IPMON-Hackathon-Project'. At the top, the repository name is displayed with a 'Public' badge. Below this, there are buttons for 'Edit Pins', 'Watch', and a '1' badge. The main navigation bar includes 'main' (selected), '1 branch', and '0 tags'. There are also buttons for 'Go to file', 'Add file', and a green 'Code' button. The commit history section shows a commit by 'mubienaime' titled 'Update README.md' with a commit hash 'c6bd85f' and the time 'now'. Below this, a list of files is shown: 'CANA-IETF-117' (first commit, 17 hours ago), 'simu5G' (first commit, 17 hours ago), and 'README.md' (Update README.md, now). The 'README.md' file is expanded, showing the title 'IETF-117-IPMON-Hackathon-Project'. The content of the README includes a description: 'This is a simulation of a 5G drone network. To run this project follow these steps:'. It then lists three steps: (1) After a successful installation of OMNeT++ 5.6.2, Download and import the INET 4.2.5 into your omnet++ workspace. (2) Download the IETF-117-IPMON-Hackathon Project - It contains two projects: SIMU5G which is the 5G simulation and CANA-IETF-117 which is a flying ad hoc network simulation. (3) Run the Hackathon project by entering CANA-IETF-117 > simu5gdrone > right-click the omnetpp.ini > Run as > OMNeT++ Simulation. The README concludes with 'Enjoy our simulation!'.

**IETF-117-IPMON-Hackathon-Project**

This is a simulation of a 5G drone network.

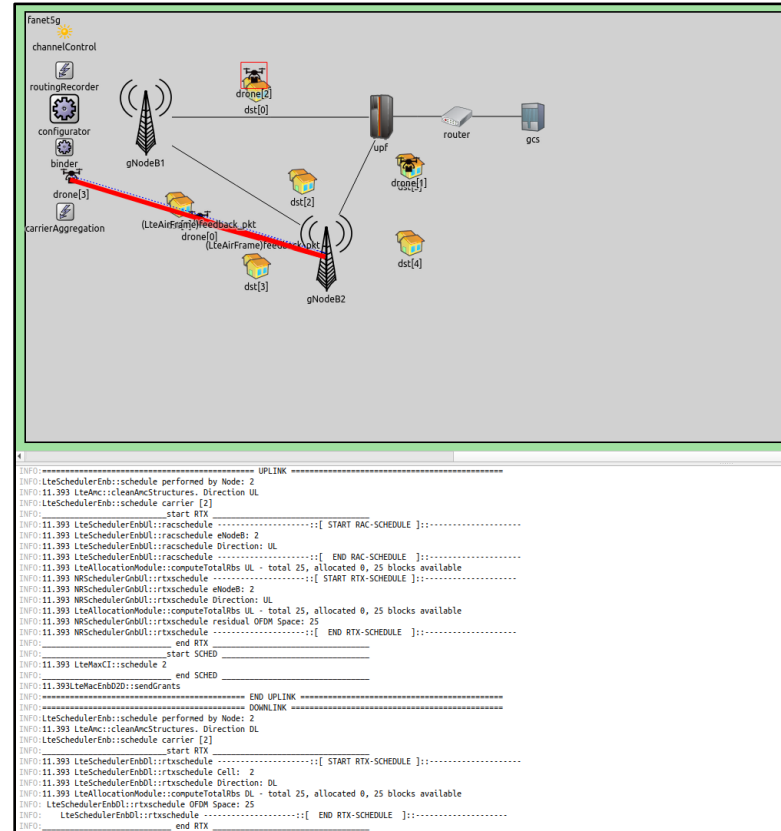
To run this project follow these steps:

- (1) After a successful installation of OMNeT++ 5.6.2, Download and import the INET 4.2.5 into your omnet++ workspace.
  - You can get the inet from <https://inet.omnetpp.org/Download.html>
  - Build to the project by Right-clicking the inet project and clicking the Build Project or Pressing
- (2) Download the IETF-117-IPMON-Hackathon Project - It contains two projects: SIMU5G which is the 5G simulation and CANA-IETF-117 which is a flying ad hoc network simulation.
  - (a) First, import the SIMU5G into your workspace. Right-click the project, choose Project References Build the project by right-clicking the inet project and clicking the Build Project or pressing
  - (b) Secondary, import the CANA-IETF-117 into your workspace. Right-click the project, choose Project Build the project by right-clicking the inet project and clicking the Build Project or pressing
- (3) Run the Hackathon project by entering CANA-IETF-117 > simu5gdrone > right-click the omnetpp.ini > Run as > OMNeT++ Simulation.

Enjoy our simulation!

# Demonstration Video Clip at YouTube

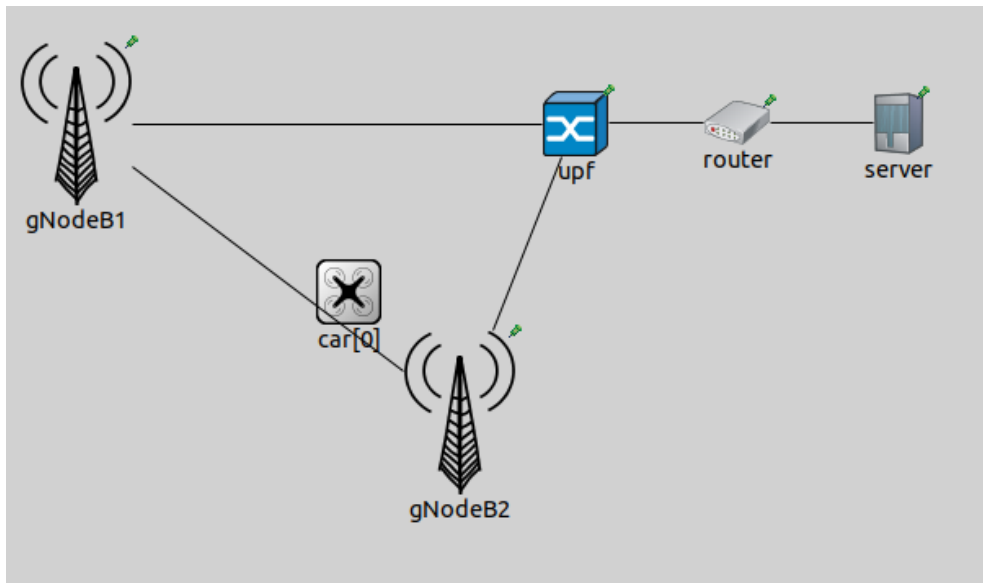
URL: <https://youtu.be/wJrh3LsIF44>





# Next Step

- We will implement an IPv6-based 5G drone networking in IETF-118.
  - We will implement the CCM and ECM as ICMPv6 Neighbor Discovery options with IPv6 over 5G V2X.



# Wrap Up

## Hackathon Team

### Champion:

- Jaehoon (Paul) Jeong (SKKU)

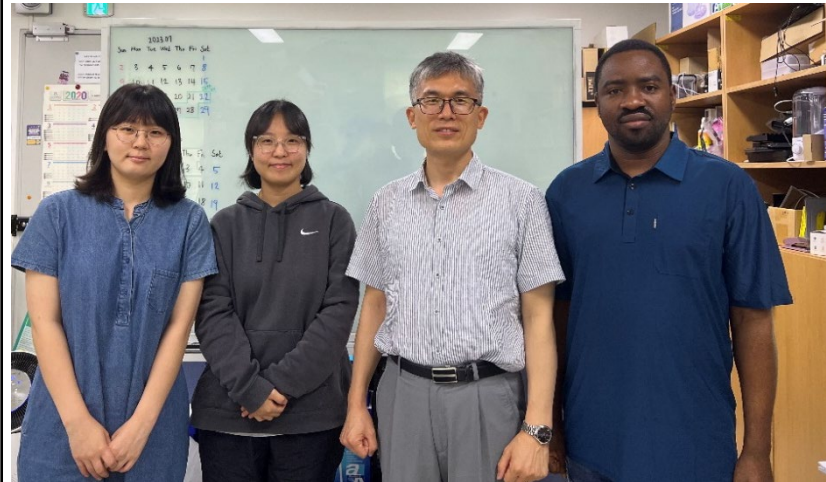
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## Hackathon Team Photo



# Appendix

- (1) Simulation Environment
- (2) Configuration
- (3) Running Simulation

# Simulation Environment



**OS: Ubuntu 16.04**



**Simulators:**

OMNeT++ 6.0



**GNU GCC 5.4**



**Open Sources:**

<https://github.com/ipwave-hackathon-ietf/IETF-117-IPMON-Hackathon-Project>

# Configuration

- Install OMNeT++ following the procedure in the installation manual:  
<https://doc.omnetpp.org/omnetpp/InstallGuide.pdf>
- Import projects in OMNeT++ workspace
  - (a) Import SIMU5G into your workspace.
    - Right click the project, choose Project References, tick the inet, and click apply and close.
    - Build the project by Right clicking the inet project and clicking the Build Project or Pressing the Ctrl + B.
  - (b) Import the CANA-IETF-117 into your workspace.
    - Right click the project, choose Project References, tick the inet and simu5G, and click apply and close.
    - Build the project by Right clicking the inet project Band clicking the Build Project or Pressing the Ctrl + B.

# Running Simulation

- Run the Hackathon Project by entering the following:
  - CANA-IETF-117 > simu5gdrone
  - right click the omnetpp.ini > Run as > OMNeT++ Simulation