IETF-117
IPMON Hackathon Project

July 22~23, 2023

Champion: Jaehoon (Paul) Jeong

Presenter: Junhee Kwon

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IP-Based Mobile Object Networking (IPMON) Project

Champion: Jaehoon (Paul) Jeong (SKKU)

IETF-117 IPMON Hackathon Project

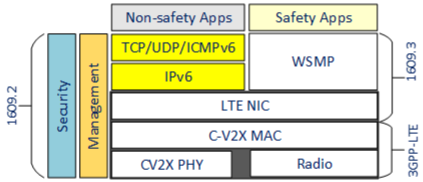
Professors:

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

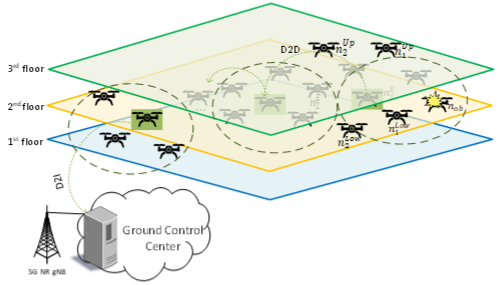
Students:

- **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)

INET FRAMEWORK

SIMU5G

성균관대학교 SUNG KYUN KWAN UNIVERSITY

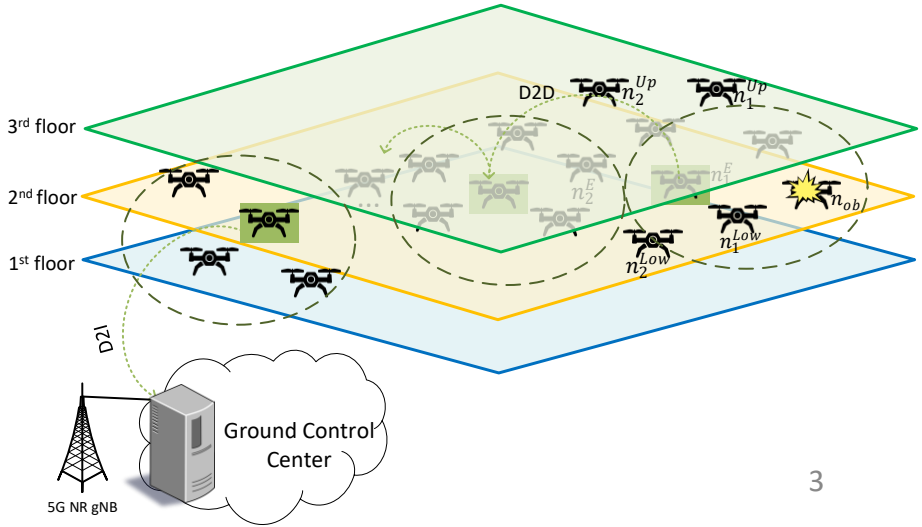
Hackathon Plan

- 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/

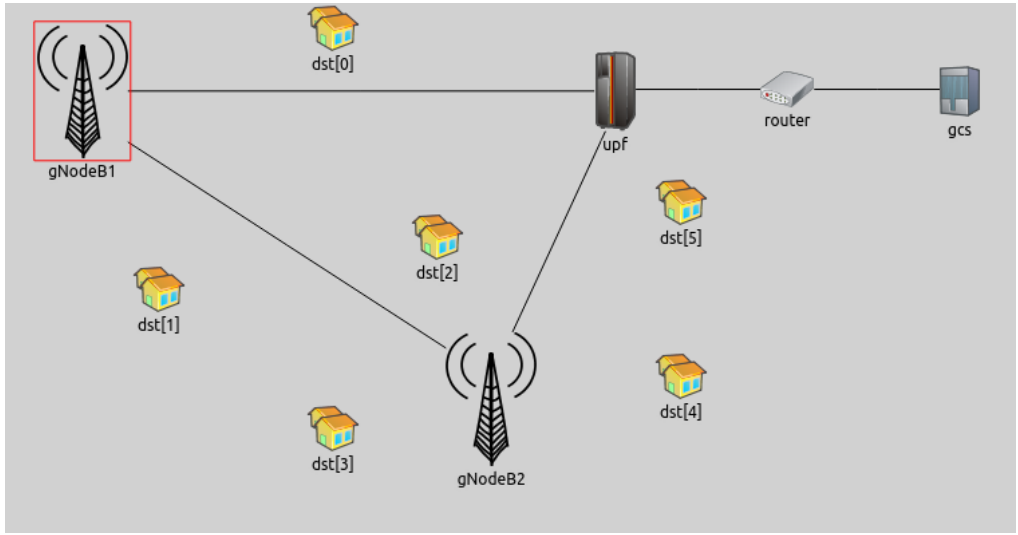
- Simulation
  - To simulate an efficient 5G-based drone networks suitable for safety drone flight.
  - To extend the Simu5G infrastructure by deploying the gNodeBs along with a Ground Control System (GCS).

- Support of Drone to Drone (D2D) and Drone to Infrastructure (D2I) Communications.

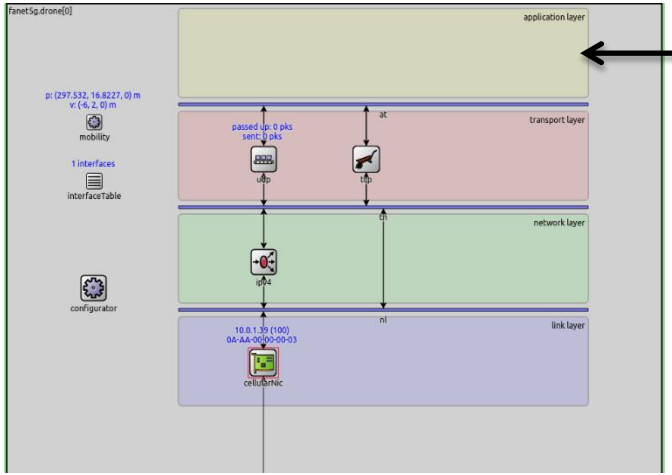
- Simulation of a Lightweight Vehicle Mobility Information (VMI) Exchange for Safe Drone Flight:
  - Cooperation Context Message (CCM) for mobility information exchange.
  - Emergency Context Message (ECM) for rapid hazardous information sharing.



What got done (1/2)



VMI Options: CCM & ECM exchange built in application layer



OMNeT++

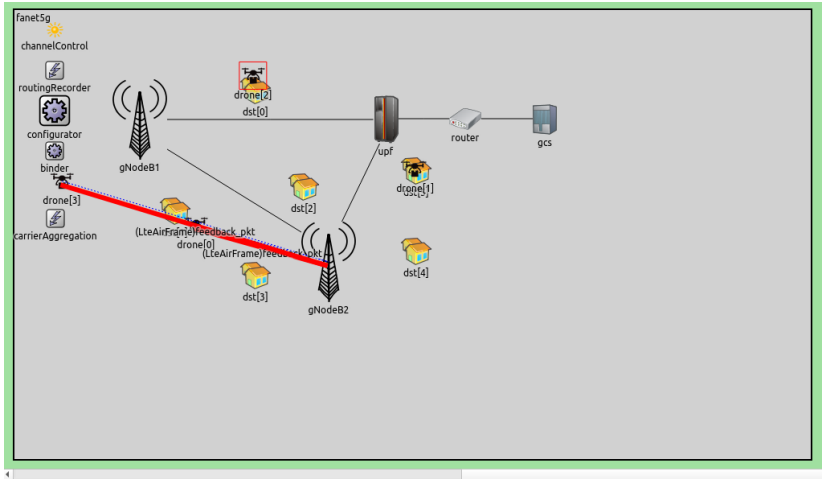
INET FRAMEWORK

SIMU5G

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.

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INFO:LteSchedulerEnb::schedule performed by Node: 2
INFO:11.393 LteAmc::cleanAmcStructures. Direction UL
INFO:LteSchedulerEnb::schedule carrier [2]
INFO:_____________________start RTX _____________________________________
INFO:11.393 LteSchedulerEnbUl::racschedule ----------------------::[ START RAC-SCHEDULE ]::----------------------
INFO:11.393 LteSchedulerEnbUl::racschedule eNodeB: 2
INFO:11.393 LteSchedulerEnbUl::racschedule Direction: UL
INFO:11.393 LteSchedulerEnbUl::racschedule ----------------------::[  END RAC-SCHEDULE  ]::----------------------
INFO:11.393 LteAllocationModule::computeTotalRbs UL - total 25, allocated 0, 25 blocks available
INFO:11.393 NRSchedulerGnbUl::rtxschedule ----------------------::[ START RTX-SCHEDULE ]::----------------------
INFO:11.393 NRSchedulerGnbUl::rtxschedule eNodeB: 2
INFO:11.393 NRSchedulerGnbUl::rtxschedule Direction: UL
INFO:11.393 LteAllocationModule::computeTotalRbs UL - total 25, allocated 0, 25 blocks available
INFO:11.393 NRSchedulerGnbUl::rtxschedule residual OFDM Space: 25
INFO:11.393 NRSchedulerGnbUl::rtxschedule ----------------------::[  END RTX-SCHEDULE  ]::----------------------
INFO:_____________________ end RTX _____________________________________
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INFO:_____________________ end SCHED _____________________________________
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INFO:================================================ DOWNLINK ================================================
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INFO:_____________________start RTX _____________________________________
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INFO:_____________________ end RTX _____________________________________
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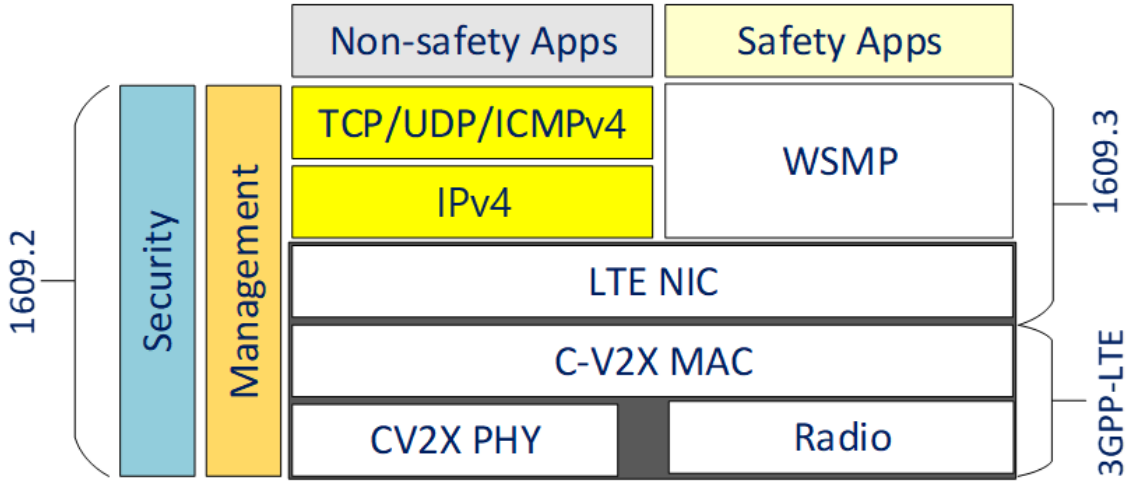
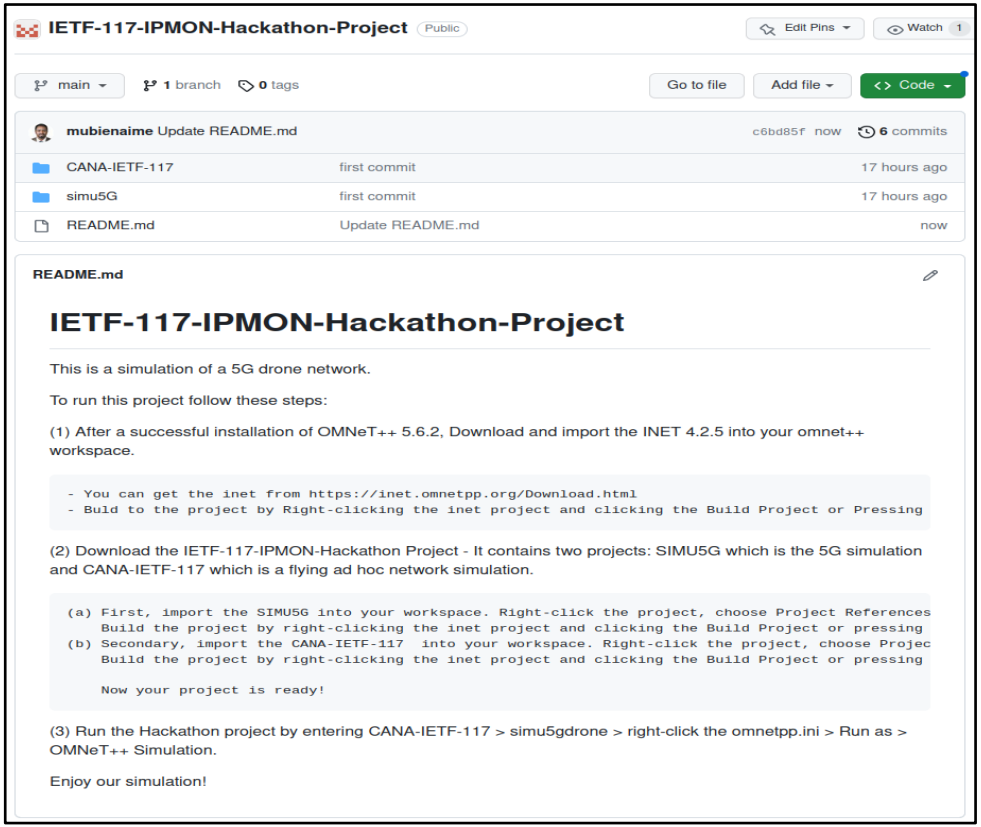
What we learned

- 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



IETF-117-IPMON-Hackathon-Project Public

Edit Pins | Watch 1

main | 1 branch | 0 tags | Go to file | Add file | Code

mubienaime Update README.md c6bd85f now 6 commits

CANA-IETF-117	first commit	17 hours ago
simu5G	first commit	17 hours ago
README.md	Update README.md	now

README.md

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
- Buld 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.

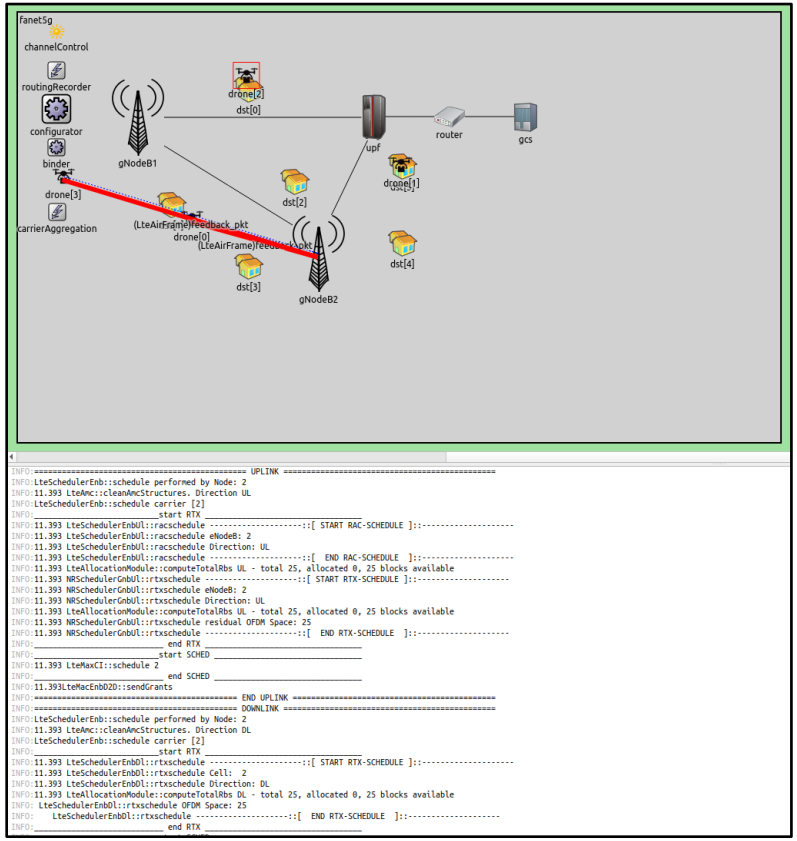
```
(a) First, import the SIMU5G into your workspace. Right-click the project, choose Project References
    Build the project by right-clicking the inet project and clicking the Build Project or pressing
(b) Secondary, import the CANA-IETF-117  into your workspace. Right-click the project, choose Projec
    Build the project by right-clicking the inet project and clicking the Build Project or pressing

    Now your project is ready!
```

(3) Run the Hackathon project by entering CANA-IETF-117 > simu5gdrone > right-click the omnetpp.ini > Run as > OMNeT++ Simulation.

Enjoy our simulation!

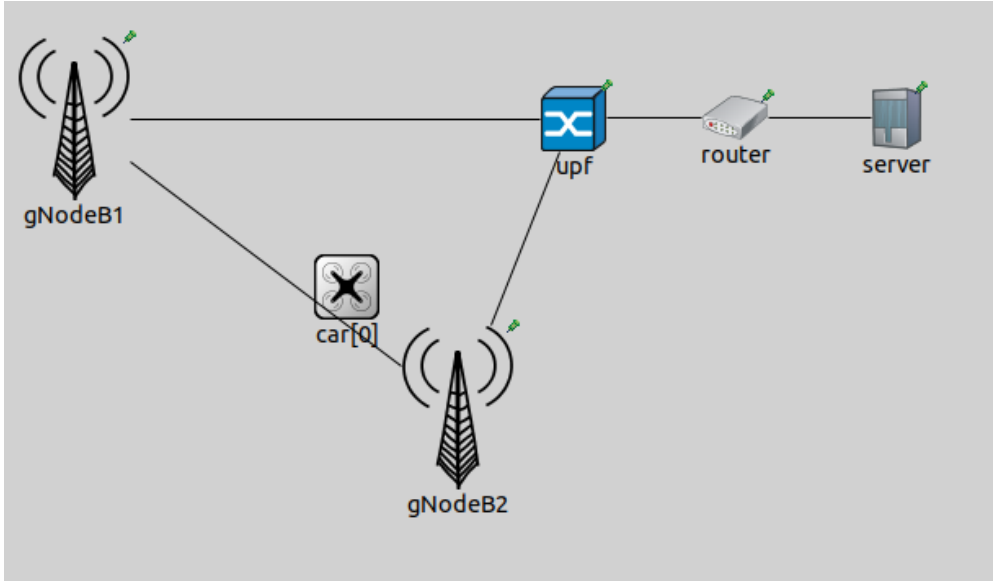
Demonstration Video Clip at YouTube

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

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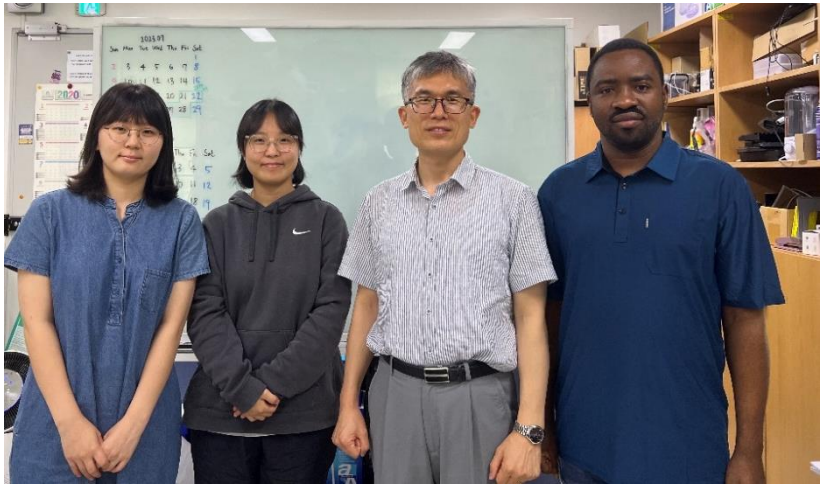
Hackathon Team Photo



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: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