TUM

WS 2025/26

Master Practical Course: Exploring Beyond 5G Networks Through Simulation

Pre-Meeting

11.07.2025

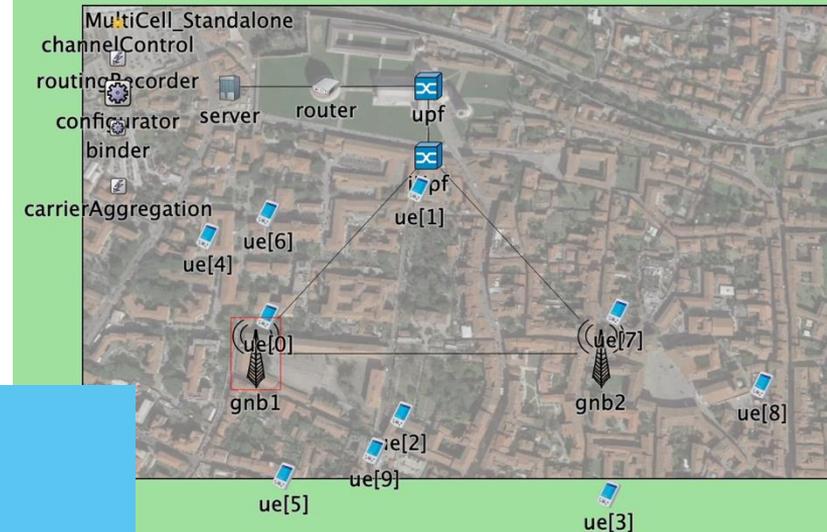Marcin Bosk

Mehmet Mert Bese

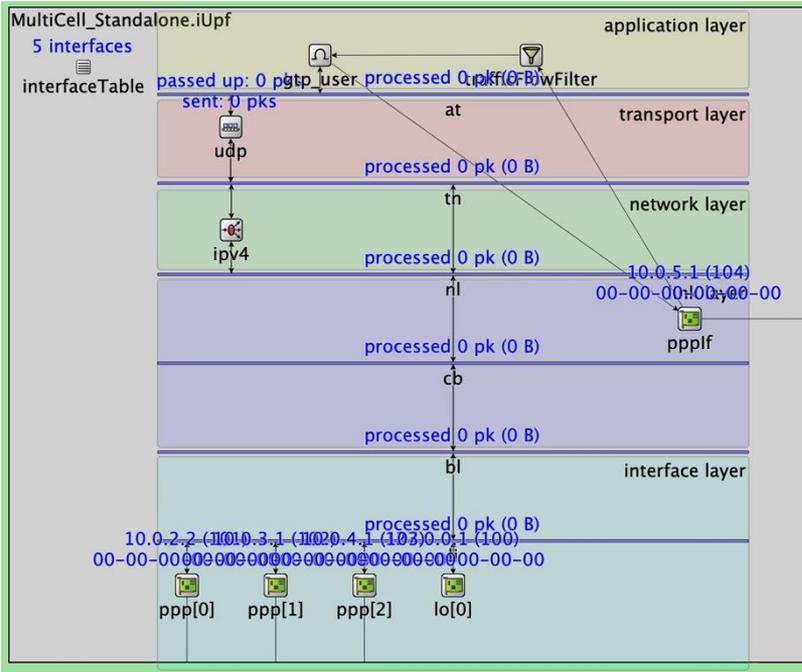# What is a Simulation?

In most basic terms

→ "imitation of a real-world process or system"

Advantages

- Less Financial Risk (avoid costly mistakes)
- Gain Insights on System Behaviour
- Test Non-Standard Situations
- Examine Long-Term Impacts

Why do we use network simulation?

- Testing and prototyping for new ideas

- Experimentation when it's infeasible to build new network infrastructure

- Verification of things that cannot be run in a testbed environment

- Method for rapid prototyping

Available Network Simulators

The ONE

NextGSim

NS-3 NETWORK SIMULATOR

MATLAB & SIMULINK

OMNeT++ FLoRaSat

INET FRAMEWORK

SIMU5G

NetSim NETWORK SIMULATOR

Mininet [emulator]

OPNET Optimum Network Performance

NS NETWORK SIMULATION TOOLS

GLOMOSIM Simulator Projects

Focus of the Course (Study Goals)

- Understand the usefulness of the simulation for bleeding edge network technologies development

- Learn how to operate the simulator software and extend it on the example of OMNeT++

- Get to know (beyond) 5G networks, their innerworkings and applications

- Learn how to obtain and visualize meaningful results

- Understand the limitations of simulation

INET FRAMEWORK

SIMU5G

FLoRaSat

Course Contents
Networking Technologies

- General Computer Networking Recap

- Various Networked Applications

- 5th Generation Mobile Networks (5G)

  - 5G Core

  - 5G Radio Access Network

  - Time-Sensitive Networking (TSN)

- LEO Constellation Satellite Communication

Structure of the Course

~5 weeks of lectures covering

- Introduction to simulation environment

- Computer networking recap

- Introduction to 5G and related relevant technologies [Edge Computing, TSN, etc.]

- **Five graded <u>individual</u> homework and feedback discussion sessions!**

~10 weeks of project work <u>in groups of up to 3 people</u>

- You can choose your project out of our suggestions or propose your own

- Use OMNeT++ and custom modules implemented by you to simulate a complex 5G scenario

- Provide visualized results covering various metrics

- **Three mandatory presentations**
  - **Initial project meeting and discussion**
  - **Mid-term project meeting and discussion**
  - **Final project presentation**

Structure of the Course

- Five Lecture Weeks
- ~Ten Weeks of Project Work

Week 1 (17.10.2025)

Lecture – Introduction to Discrete Event Simulation and OMNeT++ Simulator

A hands-on exercise with OMNeT++

First homework handout (1 week, submission 23.10.2025)

→

Week 2 (24.10.2025)

Lecture – Computer Networking Recap and Introduction to the INET Framework

A hands-on exercise with INET Framework

Second homework handout (1 week, submission 30.10.2025)

→

Week 3 (31.10.2025)

Lecture – 5th Generation Mobile Networks and Introduction to the Simu5G Framework

Lecture – 5G Core???

First Homework Discussion and Feedback

Third homework handout (1 week, submission 06.11.2025)

→

Week 4 (07.11.2025)

Lecture – Introduction into 5G Radio

Lecture – Excursion on Time-Sensitive Networking

Second Homework Discussion and Feedback

Fourth homework handout (1 week, submission 13.11.2025)

Timeline subject to change

Structure of the Course

- Five Lecture Weeks
- ~Ten Weeks of Project Work

Week 5 (14.11.2025)	→	Week 6 (21.11.2025)	→	Week 7 (28.11.2025)	→	Week ~10/11 (09.01.2026)
Lecture – Some other 5G topic(s)???		Fourth Homework Discussion and Feedback		Fifth Homework Discussion and Feedback		Mid-term project meeting and discussion
Lecture – Excursion on LEO Constellations		Initial project meeting and discussion		Consultation Hours		
Third Homework Discussion and Feedback						
Fifth homework handout (1 week, submission 20.11.2024)						

↓

Week 15 (06.02.2025)

Final project presentations

Final project submission

Timeline subject to change

Project Work

Use OMNeT++ as a simulation tool to implement and validate a 5G-related concept or scenario

→ Implement a new/enhanced idea into OMNeT++/Simu5G

Your testing environment and application must include

- Custom modules implemented by you

- Mobility of users and 5G networks

- Automatic execution and processing pipeline

- Multiple distinct experimentation scenarios

You can choose your topic!

We will offer specific topics you can work on

You can propose your own topics

Project Work
And Grading

Total of **100 points**

30 points for homework assignments

70 points for the project assignment
- **2 points** → initial presentation
- **3 points** → mid presentation
- **10 points** → final presentation
- **10 points** → final report
- **45 points** → implementation, including demo and idea realization

Projects done in groups of up to 3 students

Your project submission will cover
- 3 presentations
- code
- final report

Course Registration

Registration using the matching system

- Duration: **18.07.2025 – 22.07.2025**

To increase your chances, please send us your CV and a short motivation letter!

- Email: bosk@in.tum.de
          mehmetmert.bese@tum.de

- Always address your messages to both emails!

In Case of Acceptance

- We will contact you between 31.07.2025 and 14.08.2025 with more information
- Course deregistration possible until 30.09.2025
- **You will get a failing grade for the course if you get a place and not deregister!**
- We will register you for the course in TUMOnline and Moodle in the beginning of October

We look forward to welcoming you next semester!

Thanks for attending!
Any questions?

Feel free to contact us!

Marcin – bosk@in.tum.de

Mert – mehmetmert.bese@tum.de

Check the website!