OPEN-SOURCE PROTOTYPING FOR WIRELESS 5G SYSTEMS FOR UAV/UGV

Team 36 Fall 2020   Advisor: Hongwei Zhang   Client: Iowa State University

Ibrica Tutic, William Byers, Samuel Stanek, Andrew Eschweiler, Nicholas Lorenz, Natham Whitcome

Introductions

Intended Use: Surgeons operating from a distance.
UGV/UAV's allow quick exchange of safety information.
Military or other avionic application that require real time information.

Problem: Lack of modern 5G implementations that allow for low latency and high throughput and reliability specifically in highly mobile networks. Current solutions for 5G networks do not guarantee reliability between two nodes in highly mobile environments. Due to this, there is a need for an improved algorithm.

Solution: A variant of the CPS algorithm to achieve high reliability. This will be tested and implemented in the MAC layer of Open-Air Interface, then compared to current implementations on the market.
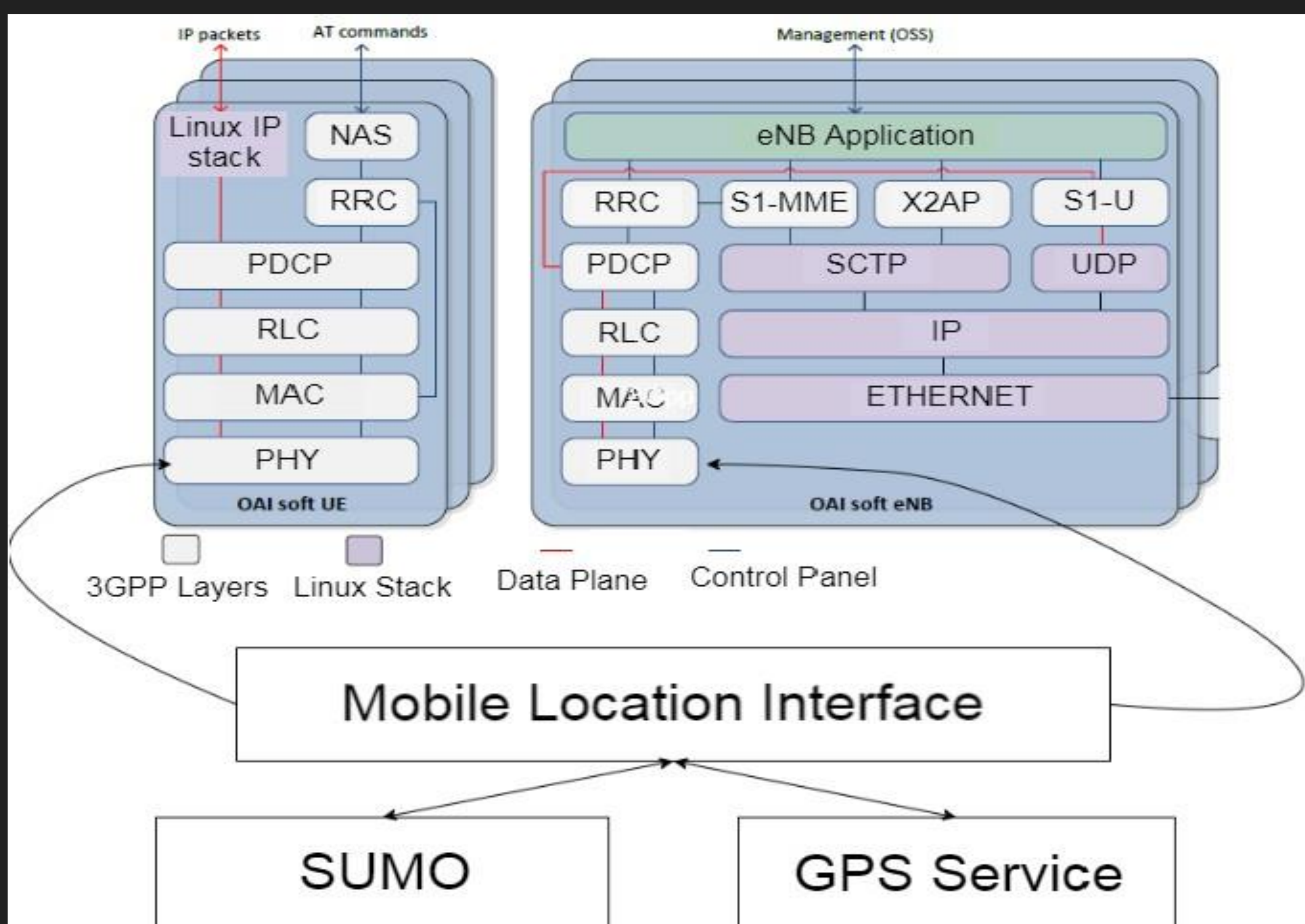
Requirements

Functional: Ensure per-packet communication reliability while achieving high throughput/concurrency. Also must have low latency and be interoperable with current solutions.

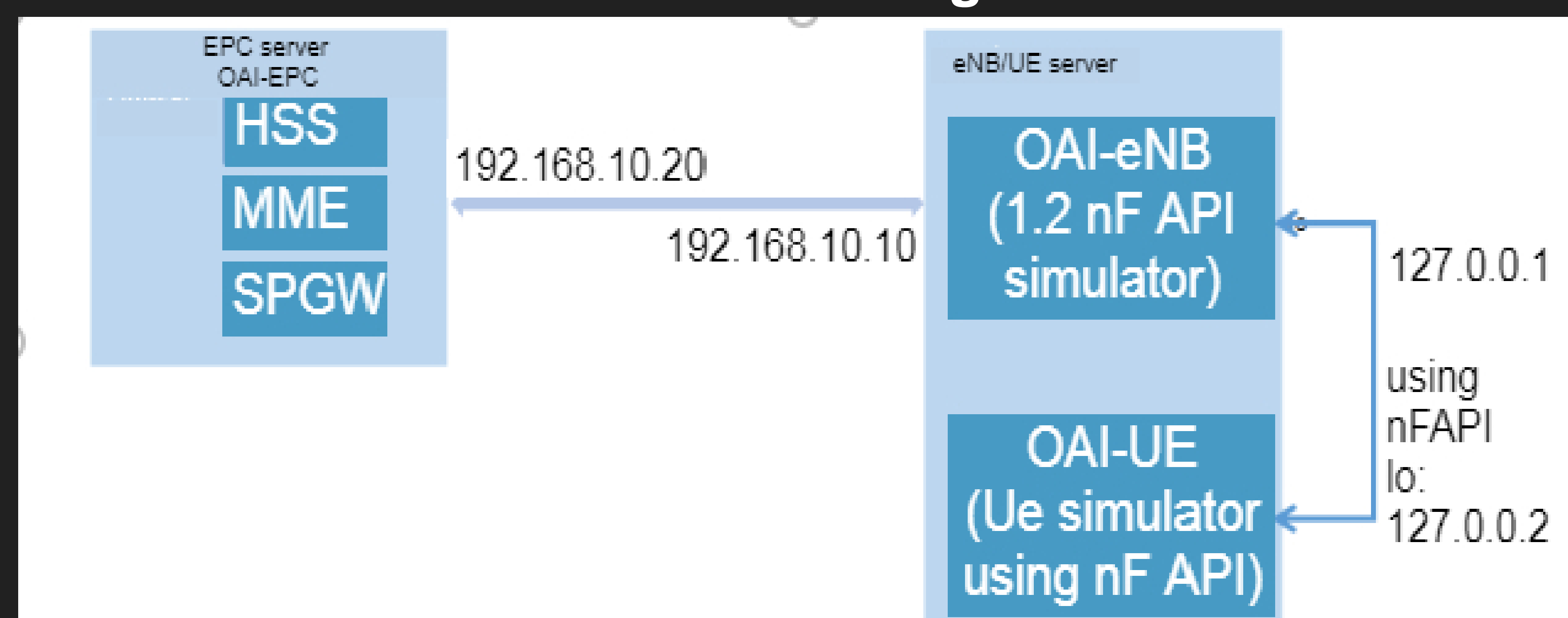**Non-Functional:** Easy to simulate, maintainable code

Environment: Environment for this project will be primarily in vehicles, which means the algorithm and network will need to be able to operate during extreme temperatures, natural disasters, and other detrimental conditions found on roadways.

The Design Approach

Mobile Location Interface

Interface interacts between SUMO and OAI/GPS system. Mobile Location Interface sends location data to MAC or PHYS layer of the OAI eNB and UE. The PHYS layer encodes/decodes the packets and MAC layer handles packet scheduling.

OAI nFAPI Network Configuration

ENB and UE run on a single system (shown on the right), and are connected by nFapi using loopback IP interface. OAI allows us to conduct purely software-based network simulations and eventually deploy the network to physical hardware.

UE - A user's mobile device, such as a cell phone, tablet, or modem
ENB - Base stations connected to the network that communicate wirelessly with mobile handsets
EPC – handles authentication, mobility, user/voice sessions

Testing

Testing: Using OAI and SUMO together, we have been able to simulate vehicles and environments for testing purposes. It allowed us to test current technology versus our new approach in urban, rural, and roadway conditions.

Engineering Standards and Design Practices

WI-FI Standard 802.11
Software Standard 830-1998

Technical Details

OAI: Low level network simulations, written in C code, able to run on wireless communication hardware, VERY flexible, but VERY picky.
Requires power saving features and c-states to be disabled, low latency kernel, specific Ubuntu 16.04, and other extensive hardware/software requirements.

SUMO: Customizable traffic simulator. Uses Python API.