IMPLEMENTATION OF A 5G TESTBED WITH O-RAN AND SOFTWARE DEFINED RADIO

S2 2024

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PROJECT BACKGROUND / RATIONALE

- Addressing restricted access to cellular communications, vendor lock-in, reducing cost, enhancing network scalability, and ensuring greater availability in 5G infrastructure through the use of open-source solutions.
- Emulating 5G small cell site functionality using off the shelf SDR modules and open-source software (srsRAN) to create a flexible, cost-effective 5G testbed.
- Creating knowledge resources to aid in future research and development, and expansion of the university knowledge pool.

OBJECTIVE / DELIVERABLES

Test Environment

- Two compute units with Ubuntu 22.04 running srsRAN software, each connected to a Ettus Research USRP B205mini-i radio module - able to establish and maintain a stable cellular network.

Docker Deployment

- Development of a Docker image to allow plug-and-play deployment for users, significantly simplifying setup during replication of testbed.

Comprehensive Documentation

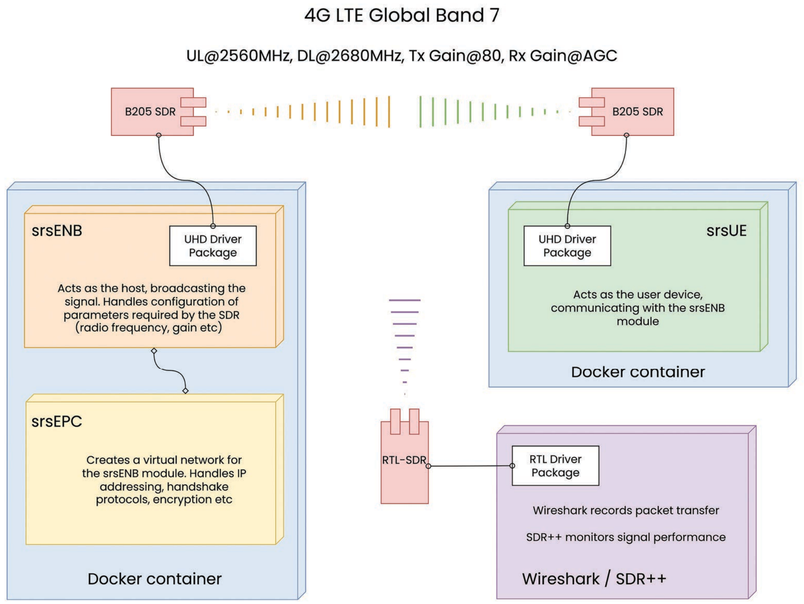
- Detailed how-to guides detailing the installation, troubleshooting, and configuration of each component for accurate replication.

Feasibility Demonstration

- Able to achieve successful communication between two SDR modules using standard laptops and off-the-shelf SDRs, validating the project's feasibility for smaller-scale or educational purposes without the need for expensive, high-performance hardware.

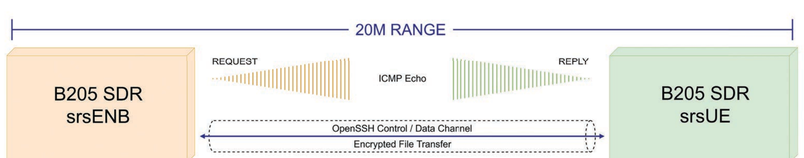
Project Methodology: secSDLC

- A structured approach for embedding security into each phase of the software development lifecycle, ensuring robust protection from the initial design through to deployment.
- Docker containers are set up with pre-configured security elements, such as secure USB passthrough and controlled privilege, providing built-in security measures for applications.



SETUP / TESTING

- Host and receiver setup uses the O-RAN architecture to establish LTE connectivity between the two devices and simulate real-world small cell operations. It consists of SRSeNB/SRSEPC running on one computer, transmitting LTE signals as the host. SRSUE acts as the receiver on another device.
- Both setups operate on Ubuntu 22.04 connected to SDRs with compatible cellular antennas, ensuring accurate and reliable data transmission. Docker containers are pre-configured to enable primary connection with no adjustment by the user.
- Connectivity was validated using ping tests, Apache2 web server access, OpenSSH, and SCP for file transfer between devices. Conducted physical distance testing to observe the testbed's performance and stability in different environments.



CHALLENGES / SOLUTIONS

Fragmented Resources

- Faced difficulties due to the lack of cohesive and imitative resources; our solutions involved piecing together fragmented information across various forums, papers, and technical guides, in the hope future research would not need to repeat the process.

Hardware Troubles & Solutions

- Issues such as virtual machine USB passthrough and hardware procurement delays were resolved through direct mentor support and equipment adjustment. Access to 5G SDR's was prohibitively expensive resulting in testing being done on 4G LTE units.

Strict Dependencies

- Overcame software installation challenges by creating precise step-by-step guides - ensuring dependencies like UHD drivers were correctly set up before configuring srsRAN.

PROJECT IMPACT / FUTURE EXPANSION

- The documentation and lessons learned serve as a practical learning platform to teach future students about open-source cellular networking.
- The testing platform and Docker container provides a consistent, reproducible environment for testing new features and protocols, and developing or validating network applications.
- Provides a starting point and baseline environment for future R&D projects, offering a tested and documented open-source setup. Implementing 5G modules and additional O-RAN architecture elements would expand the knowledge pool. Automation of the Docker install with Ansible would further streamline the process.

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