

ABSTRACT

Along with the rapid adoption of 5G networks, their increasingly complex and decentralized architecture demands effective design and testing tools. Research and development, particularly the integration of Software-Defined Networking (SDN) into the 5G Core architecture, require a platform capable of replicating real-world scenarios accurately and efficiently. However, there is currently a limitation of testing tools that can facilitate the prototyping of 5G networks based on Network Functions Virtualization (NFV) in an integrated manner with SDN features. The lack of emulators equipped with a graphical user interface (GUI) makes the design process cumbersome, reliant on complex manual configurations, and prone to errors, thereby hindering innovation and efficiency.

To address these issues, NetFlux5G was developed, an SDN-based 5G Core network emulator system equipped with an interactive graphical interface. This solution is implemented using a Virtual Network Functions (VNF) approach, chosen for its optimal balance of performance, accuracy, and ease of installation. The system integrates various open-source technologies into a unified platform: Open5GS for 5G Core functions, UERANSIM running on Mininet-WiFi for Radio Access Network (RAN) simulation, and an SDN controller for traffic flow management. All these network components are packaged using Docker containerization technology and managed through a desktop application built with the PyQt5 framework, allowing users to visually design, configure, and run network topology simulations.

System testing results show that NetFlux5G was successfully implemented with a high installation success rate across various versions of the Ubuntu operating system. End-to-end connectivity testing successfully validated the communication flow from User Equipment (UE) to the core network through a complex SDN topology. The culmination of the evaluation was a User Acceptance Test (UAT) involving 30 users from student and professional backgrounds, which yielded a System Usability Scale (SUS) score of 81.0, categorized as "Excellent". These results prove that NetFlux5G has successfully become a functional, reliable, and user-friendly solution to support the design and analysis of 5G networks.

Keywords: 5G Core, Graphical User Interface, Network Emulator, SDN, VNF