

Adaptive Resource Management in O-RAN

Project topic adaptable Student Thesis, or Master/Diploma-Thesis

Description:

Open Radio Access Networks (O-RAN) enable openness, programmability, and interoperability in 5G and beyond systems by allowing third-party applications (xApps) to operate within the Near-Real-Time RAN Intelligent Controller (Near-RT RIC). These xApps are responsible for optimizing key functions such as resource allocation, interference management, and mobility control. However, the dynamic and heterogeneous nature of O-RAN—arising from fluctuating traffic loads, varying radio link qualities, and diverse service modalities (e.g., video, audio, haptic)—makes accurate and timely network state estimation highly challenging. This limitation can lead to inefficient control decisions, degraded Quality of Service (QoS), and suboptimal network utilization.

This thesis aims to design, implement, and evaluate a Machine Learning (ML)-based framework for intelligent network state estimation and adaptive resource control in O-RAN. The proposed approach involves collecting multimodal communication data, developing data-driven ML models to infer meaningful network state representations, and integrating these models into the Near-RT RIC for closed-loop control. The framework will be validated end-to-end through testbed experiments, ensuring compliance with O-RAN Alliance specifications via the E2 interface. The ultimate goal is to enable more accurate, interpretable, and responsive RAN control while maintaining compatibility with the O-RAN ecosystem.

Tasks:

1. Survey and analysis of O-RAN and ML-based network control approaches
2. Design of a data collection and preprocessing framework
3. Development of an ML-based network state estimation and control scheme
4. Evaluation and benchmarking performance on end-to-end O-RAN framework
5. A report describing the completed work

Keywords:

O-RAN resource allocation, 3GPP 5G/6G, RIC xApp

Language:

English

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