O-RAN and Spectrum Sharing

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***Abstract*—The number of wireless devices and their required data rates are increasing with time. Spectrum is an expensive and shared resource that has to be used effectively. Spectrum sharing is a key challenge for service providers that enables the sharing of the same frequency band amongst multiple users of different priorities without impeding one another. Open Radio Access Networks (ORAN) is a new architecture that provides open interfaces and AI/ML capabilities to promote innovation for future networks. In this work, we study existing work done for spectrum sharing in ORAN and replicate one of these solutions.**

***Index Terms*—ORAN, spectrum sharing, Environmental Sensing Capability (ESC)**

I. Introduction

With the popularity of the Internet of Everything, numerous devices have been added to the network. The ability to observe, analyze, and control the system has revolutionized multiple industries. Legacy systems like power distribution, which had to be manually monitored and maintained by the operators, are moving to efficient and predictable maintenance by leveraging the benefit of connectivity. Industry 4.0 is a concept that aims to achieve full digitization and automation in factories for efficient and reduced-cost operations, while Industry 5.0 pushes the need for connectivity forward and provides connectivity in their products for their better customer service, hyper customization, responsive and distributed supply chain, and interactive product [5]. Soon, UAVs will be used commercially for various operations like disaster response, delivery services, content collection/distribution, or as temporary base stations. Similarly, applications such as virtual reality, augmented reality, video streaming, and cloud-based services have emerged in recent years, which demand high data rates from the network. This increase in potential users has changed the cellular network and demands spectrum sharing to cater to new devices with different requirements like high capacity, high data rates, and ultra-low latency. Cellular networks have wide coverage and provide wireless connectivity required by many of these devices. Wireless connectivity depends upon the spectrum, an expensive resource that must be utilized efficiently to serve future users.

II. Background

A. Spectrum sharing

Spectrum sharing is a technique that enables multiple users or services to operate on the same frequency band, optimizing the use of limited wireless resources. In the context of 5G and LTE, spectrum sharing allows both technologies to coexist on the same frequency, facilitating a more efficient use of bandwidth [6]. The key benefits of spectrum sharing include reduced costs for service upgrades, faster access to 5G, and improved network performance for both 5G and LTE [11].

B. Open Radio Access Network (O-RAN)

O-RAN (Open Radio Access Network) refers to standards and architecture designed to make radio access networks (RAN) more open, flexible, and software-driven. O-RAN allows the disaggregation of hardware and software, enabling operators to source equipment from different vendors and integrate them seamlessly using open interfaces. This removes the traditional vendor lock-in, giving operators more flexibility and lowering costs [7]. Besides, O-RAN integrates advanced AI and machine learning technologies through the RAN Intelligent Controller (RIC) [8], enabling real-time network optimization by automating decision-making processes and adapting network behavior dynamically. This integration allows for the intelligent orchestration of network resources, ensuring optimal performance and energy efficiency. O-RAN also enhances resource management, including spectrum allocation, by enabling dynamic spectrum sharing between operators, which leads to improved spectrum utilization and reduced operational costs [2]. Additionally, O-RAN supports network slicing, which enables the creation of multiple virtual networks on a shared physical infrastructure [9]. This capability allows operators to tailor specific slices to different services, such as IoT, autonomous vehicles, or enhanced mobile broadband, ensuring that each use case receives the appropriate bandwidth, latency, and reliability. Furthermore, O-RAN significantly improves quality of service (QoS), by enabling real-time monitoring and automated adjustments based on network demand, traffic patterns, and service-level agreements, resulting in a more responsive and resilient network capable of meeting diverse user requirements [10].

C. Spectrum sharing with O-RAN

For spectrum sharing, it is essential for commercial cellular service providers to detect interference with incumbent traffic and prioritize them. Commercial networks can allocate the same resources to their users if an incumbent does not use

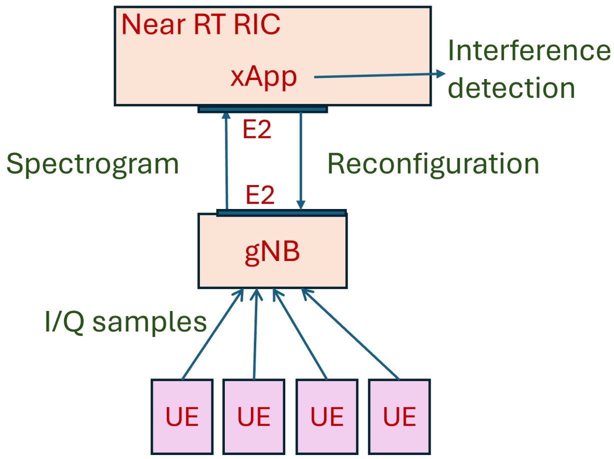

Fig. 1. Overview of system

them. Today, networks use dedicated sensors known as Environmental Sensing Capability (ESC) to detect the presence or absence of incumbent transmission. Establishing and maintaining such a dedicated sensor infrastructure is expensive. The emergence of O-RAN has enabled innovation in spectrum sharing and interference detection without depending upon such an additional infrastructure. In this work, we will study some solutions proposed in the literature that use O-RAN to detect interference in spectrum sharing.

III. Problem definition

SenseORAN is a solution that uses O-RAN-compliant base stations for sensing to maximize the accuracy of radar detection in the Citizens Broadband Radio Service (CBRS) band (3.55-3.7 GHz) while maintaining an acceptable level of service for the associated clients. This solution is especially effective for scenarios where pulses fully overlap with interfering LTE signals requiring immediate detection of such occurrence. The authors proposed two stages: sensing slice and network reconfiguration. In the Sensing slice stage, all the base stations observe the RF spectrum for a finite duration and create a spectrogram. This spectrogram is sent to xApp, which consists of a trained image classification network. The xApp can detect interference under diverse traffic conditions by using an off-the-shelf convolutional neural network (CNN) architecture. The network reconfiguration stage turns off all the network operations and excludes the bands where the interference is detected. This solution was implemented in the Open AI Cellular (OAIC) platform, which uses open cellular software and software-defined radios [4]. Figure 1 shows the system setup for SenseORAN. In this work, we propose to implement and replicate results from SenseORAN.

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