Implementing Service Management and Orchestration for ORAN Software Community

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***Abstract*— This study analyzes the scalability constraints of System Management and Orchestration (SMO) in O-RAN SC, mainly focusing on the increase in RAM consumption correlated with the rising count of DU/RU. The analysis unveils a significant influence on RAM utilization, emphasizing the requirement for competent resource management in ORAN infrastructures. This research contributes to understanding SMO's behavior in ORAN networks by identifying potential constraints and prospective areas for future exploration. The results offer pertinent information for network operators and developers in ORAN environments, underscoring the effects of SMO on network performance.**

***Keywords*— Open Radio Access Network (O-RAN), Service Management and Orchestration(SMO), Network Efficiency, Network Quality.**

I. Introduction

The evolving architecture of mobile networks is increasingly embracing Open Radio Access Networks (ORAN), which provides flexibility into radio access networks using principles such as disaggregation and virtualization [1]. With this transition, Service Management and Orchestration (SMO) in ORAN networks has emerged as a vital tool for enhancing operational efficiency and decreasing network maintenance costs [2].

Although the crucial role of SMO, its performance in ORAN environments still needs to be explored in the existing literature [3], [4]. Our paper addresses this gap by offering a rigorous evaluation of SMO performance in ORAN networks, shedding light on its strengths and potential areas for enhancement.

Our assessment includes varied scenarios, with increased RU's and DU's traffic, enabling us to pinpoint potential limitations and identify opportunities for improvement in network management. This assessment not only broadens the understanding of SMO's capabilities but also elucidates its impact on operational efficiency and cost savings in ORAN networks. In essence, our study contributes valuable insights into the ORAN network field, illuminating the significant role of SMO in network management.

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II. Open RAN-Based Environment

As represented in Figure 1, ORAN architecture is the guiding blueprint for the software stack evaluated in this study. It encompasses the software required for virtualization and management hosted on Commercial Off-The-Shelf (COTS) servers. The architecture consists of two main components: intelligence components and forwarding components.

SMO is a crucial function in the ORAN architecture. It is an effective solution for boosting operational efficiency and reducing network maintenance costs. SMO enables remote monitoring and control of functions and devices within the ORAN network, providing real-time diagnostics and troubleshooting.

The ORAN Software Community (ORAN SC) and the Open Network Automation Platform (ONAP) are essential components of the ORAN architecture. The ORAN SC is a software community that focuses on developing and defining specifications for ORAN implementations. It is a collaborative platform for network equipment vendors, operators, and software developers to drive innovation and interoperability in the telecommunications industry.

ONAP as the SMO functionality. ONAP is an open-source network automation platform designed to facilitate orchestration and service management in virtualized network environments, including ORAN. It provides a comprehensive set of tools and resources for process automation, resource management, and service deployment in heterogeneous networks. Therefore, our study focuses on evaluating the performance and effectiveness of the SMO functionality of ONAP in ORAN networks.

In this study, we utilized software components provided by the ORAN SC, such as the ORAN Software-Defined Network Controller (SDNC), ORAN Radio Unit (ORU), and ORAN Distributed Unit (ODU). These components establish a standardized interface for connecting the Radio Unit (RU) to the network and enabling SMO functionality.

Although our specific architecture does not include the Central Unit (CU) and the Near-Real Time Radio Intelligent Controller (NearRTRIC), it is essential to acknowledge that these components are part of the broader ORAN architecture. The CU plays a significant role in centralizing control and management functions, while the NearRTRIC is responsible for real-time radio control and intelligence. While not directly included in our experimental setup, their presence in the overall architecture highlights the complexity and functionality of ORAN networks.

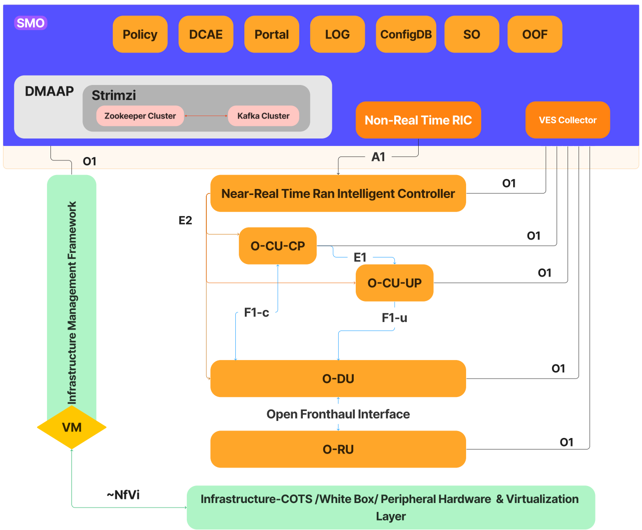

Fig. 1: Open RAN Reference Architecture

By focusing on the components included in our architecture and leveraging software provided by the ORAN SC, we aim to evaluate the performance and effectiveness of SMO functionality in ORAN networks. This research contributes to a better understanding of the role of the ORAN SC and ONAP in ORAN, as well as the challenges and opportunities associated with SMO in these networks.

III. Experimental Evaluations

The experimental setup was based on a network architecture provided by the Open RAN Software Community, with a high-performance machine acting as server and client. The machine was equipped with an Intel(R) Core(TM) i7-10700F CPU @ 2.90 GHz, 64 GB RAM and a 1 TB hard drive, running Ubuntu 20.04.

We leverage scripts and tools provided by the O-RAN software community [5] to simulate network traffic and device failures. The SMO package was used for these experiments and performance data was collected at regular intervals and by increasing the number of simulated RU's and DU's to evaluate the network behavior. Our results, as shown in Tables I, provide a detailed account of RAM usage in various network configuration simulations.

ONAP maintained a consistent usage of around 20GB of RAM, with slight increases proportional to the number of simulated nodes. Additionally, we analyzed memory usage on specific pods in different configurations. This exam provided valuable insight into memory consumption patterns across infrastructure and critical pods in ORAN environments. As the infrastructure configuration expanded, there was a slight but consistent increase in memory usage. It was also observed and shown in Table II that certain specific pods contributed significantly to the overall memory consumption.

These findings emphasize SMO's performance in resource management and reliability compared to other solutions. However, potential areas of improvement were also identified, such as occasional latency spikes in certain scenarios and the need for further optimization to handle high-traffic situations more effectively.

TABLE I: Memory Usage of Infrastructure Configuration.

Infrastructure	Memory Usage (GB)
2DU+4RU	25.442 GB
4DU+8RU	25.510 GB
6DU+12RU	25.668 GB

TABLE II: Memory Usage of Top-5 Pods in Different Configurations.

Top-5 Pods	2DU+4RU	4DU+8RU	6DU+12RU
onap-sdnc-0	3.239 GB (12.73%)	3.240 GB (12.70%)	3.244 GB (12.63%)
onap-strimzi-kafka-0	1.700 GB (6.68%)	1.702 GB (6.67%)	1.704 GB (6.63%)
onap-strimzi-kafka-2	1.524 GB (5.99%)	1.561 GB (6.11%)	1.613 GB (6.28%)
onap-aaf-cass-667f45bdd8-clmdf	1.346 GB (5.29%)	1.347 GB (6.28%)	1.347 GB (5.24%)
onap-strimzi-kafka-1	1.202 GB (4.72%)	1.202 GB (4.71%)	1.204 GB (4.69%)

IV. Conclusions

In summary, certain limitations exist, such as increased latency in specific scenarios and further optimization to handle high-traffic situations. Ongoing research and improvements are crucial to enhancing SMO performance in ORAN environments. The evaluation also highlighted the significance of memory consumption in ORAN environments and identified critical pods contributing to overall memory usage. The study contributes to understanding SMO's role in network management and its impact on operational efficiency and cost savings in ORAN networks. Further research should address the identified limitations, particularly in high-traffic scenarios, to optimize SMO's performance in ORAN environments.

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