

Background & Motivation

The Open Radio Access Network (O-RAN) architecture disaggregates the traditional RAN into Radio Unit (O-RU), Distributed Unit (O-DU), and Central Unit (O-CU) using standardized interfaces.

Since the RAN is the largest contributor to mobile network energy consumption, improving O-RU energy efficiency is essential. The power amplifier is the dominant source of O-RU power consumption, thus motivating the development of energy-efficient O-RU management to adapt to traffic demand.

Goals

- Implement the June 2026 O-RAN/OSC Energy Saving demonstration at WINLAB using an open-source K3s Kubernetes platform.
- Enhance M-Plane management of energy saving features on the O-RU for energy efficiency.

Implementation

Kubernetes Deployment:

- Deployed an open-source K3s Kubernetes environment. Integrated Duranta O-CU, SMO, Non-RT RIC, OAI Core, and ES rApps
- Configured Multus CNI, local-path StorageClass, and Strimzi Kafka version

O-DU Deployment:

- Implemented the Duranta O-DU deployment using Docker. Established F1 connectivity and fronthaul communication with benetel O-RU

UE Integration:

- Configured the Quectel RM520N-GL 5G UE and subscriber profile. Successfully established UE registration and PDU session.

Open-Source Contribution

- Built upon the OSC June 2026 O-RAN Energy Saving open-source deployment framework, and made contributions to open-source.
- Enhanced the deployment by implementing it on an open-source K3s kubernetes platform and adapting it for a different O-DU server.

Deployment Status

Kubernetes Pod Status

oai-core	ins-69779cd8b7-4jk7d	1/1	Running	0	3h1m	
oai-core	oai-ant-74d58686c-99nsc	1/1	Running	0	183m	
oai-core	oai-ausf-7544d4d4-glvrx	1/1	Running	0	183m	
oai-core	oai-core-mysql-678dbfcd7-54bpz	1/1	Running	0	180m	
oai-core	oai-lmf-6b75f4d64d-bnz55	1/1	Running	0	3h1m	
oai-core	oai-nrf-5d056f4d74-h55qk	1/1	Running	0	3h1m	
oai-core	oai-smf-7458c57b47-g5pzw	1/1	Running	0	3h1m	
oai-core	oai-traffic-server-85408fc4d7-z5skg	1/1	Running	0	3h1m	
oai-core	oai-udm-85d7ff45d5-tqznd	1/1	Running	0	183m	
oai-core	oai-udr-76f8b64cd-1q65j	1/1	Running	0	183m	
oai-core	oai-upf-7949fd79c5-wjmq9	1/1	Running	0	3h1m	
oai-gnb	oai-cu-65f6cc474-7kp7c	1/1	Running	0	172m	
nonrttric	rapmanager-0	1/1	Running	0	175m	
nonrttric	servicemanager-7848c844d8-mqt7f	1/1	Running	0	3h1m	
nonrttric	topology-5dcff58cbb-gdqfh	1/1	Running	0	3h1m	
onap	onap-policy-clamp-ac-a1pms-pont-fb85574f5-bkkqd	1/1	Running	0	3h1m	
onap	onap-policy-clamp-ac-http-pont-6fc9f887fd-1qk92	1/1	Running	0	3h1m	
onap	onap-policy-clamp-ac-k8s-pont-786dfcff9-wmj4g	1/1	Running	0	3h1m	
smo	kafka-producer-pm-json2influx-0	1/1	Running	0	175m	
smo	kafka-producer-pm-json2kafka-0	1/1	Running	0	175m	
smo	kafka-producer-pm-xml2json-0	1/1	Running	0	175m	
smo	keycloak-599dc866f9-9x8sp	1/1	Running	0	3h1m	

OAI core
& OAI CU

Non-RT RIC
& ES rApps

ONAP

SMO

UE Registration

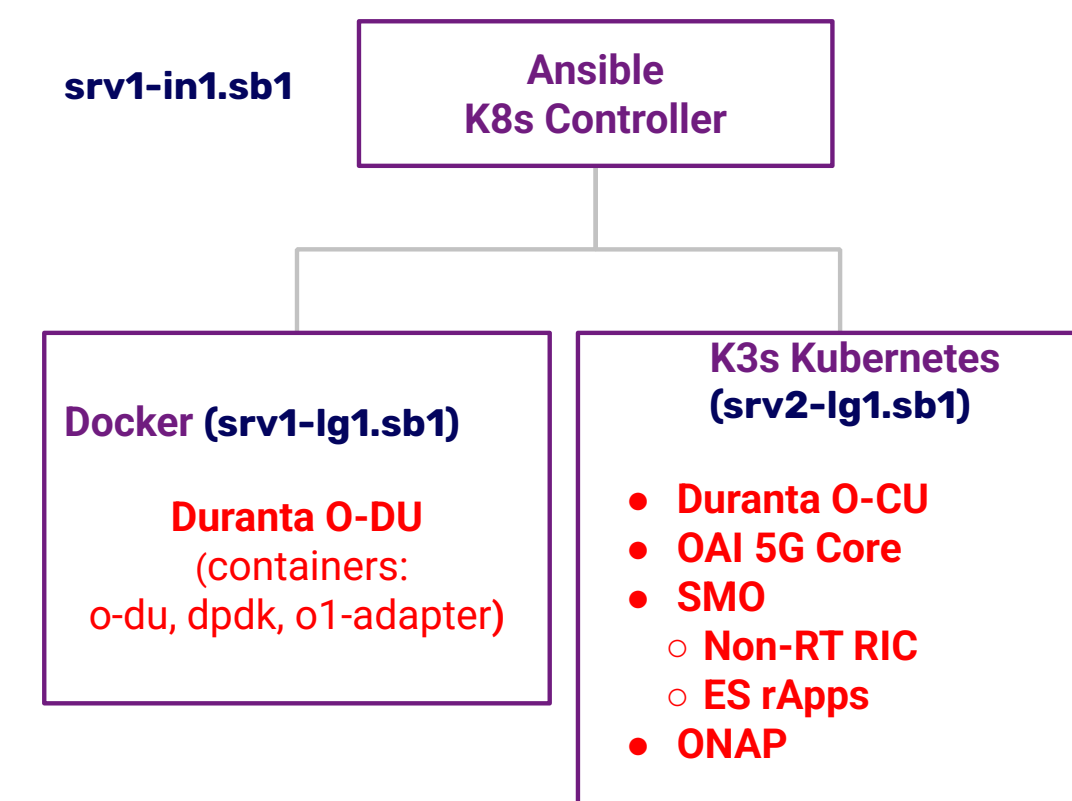
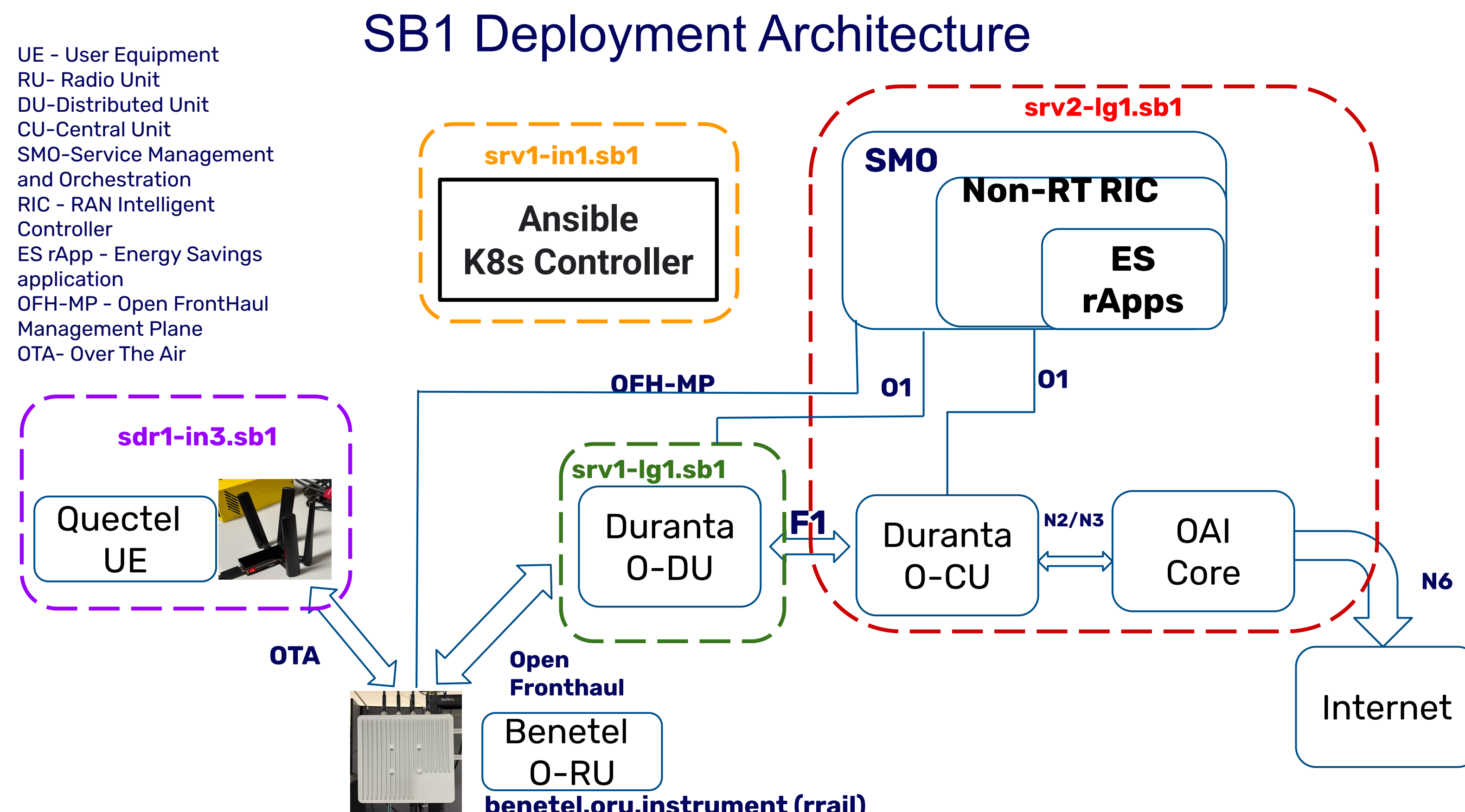
gNBs' Information				
Index	Status	Global Id	gNB Name	PLMN
1	Connected	0x0E00	oai-cu	001,01

UEs' Information							
Index	5GMM State	IMSI	GUTI	RAN UE NGAP ID	AMF UE NGAP ID	PLMN	Cell Id
1	5GMM-REGISTERED	001010000000032	00101010041347259476	0x02	0x02	001,01	0000e0001

O-RAN Deployment Architecture

SB1 Deployment Architecture

- UE - User Equipment
- RU- Radio Unit
- DU-Distributed Unit
- CU-Central Unit
- SMO-Service Management and Orchestration
- RIC - RAN Intelligent Controller
- ES rApp - Energy Savings application
- OFH-MP - Open FrontHaul Management Plane
- OTA- Over The Air



Deployment Tools:

- Ansible - Deployment automation
- Open-source K3s Kubernetes - Container orchestration
- Docker - Container Platform
- WINLAB SB1 testbed - Deployment Platform
- Ubuntu Linux - Operating system
- Open-source O-RAN Software - OAI, Duranta, ONAP

Conclusion

Successfully deployed O-RAN open source platform enhancements with validated control-plane functionality.

Future Work

Improve and validate management of O-RU M-Plane energy-saving features.

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