Energy-aware Autoscaling of Virtualized Radio Access Networks(V2GRAN) Noureddine Boujnah

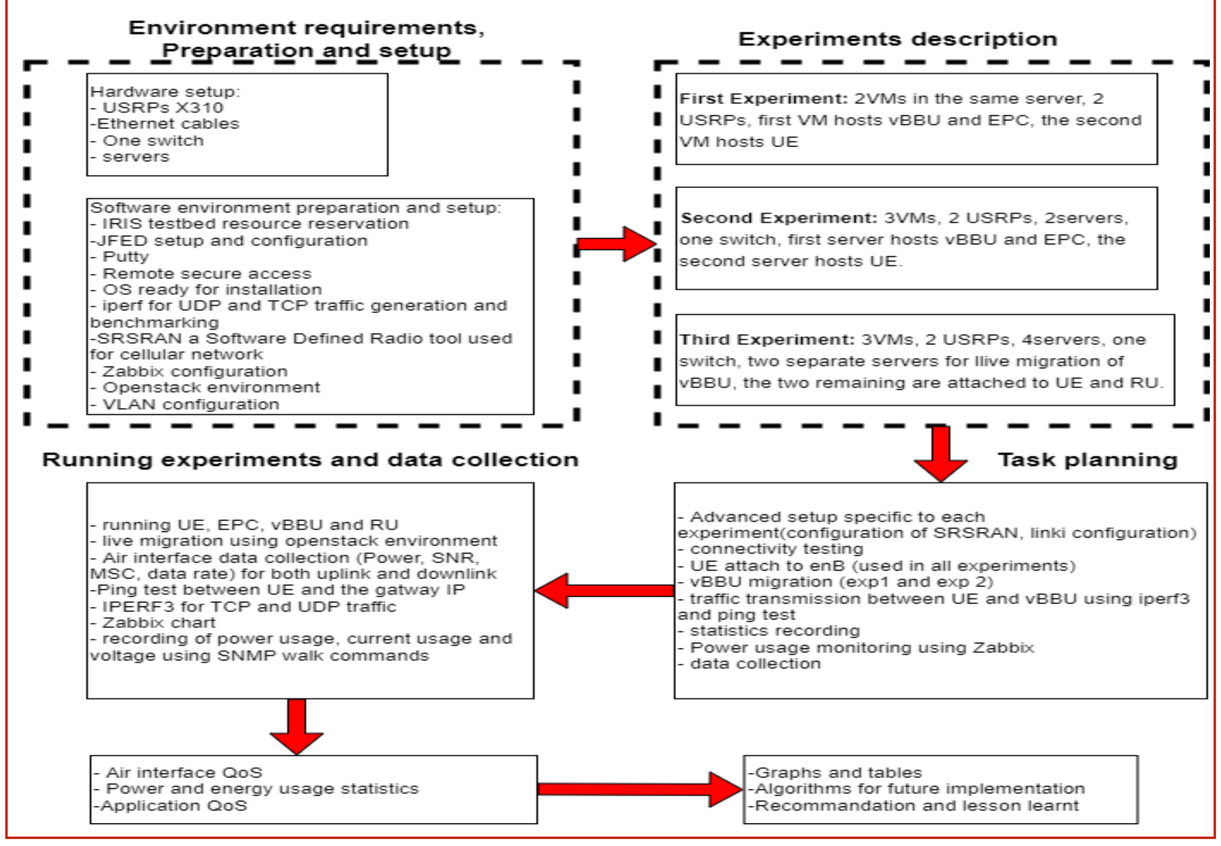
GOALS

- Providing more felxibility and scalability to 5G RAN
- Migration of virtual BBU to a new geographical location
- Improving energy efficiency of 5G RAN system
- Automation of vBBU scaling using graph neural network

CHALLENGES

- Migration of vBBU to a new location
- Reduce energy consumption
- Acceptable Quality of service during the vBBU migration(Delay and packet loss)
- Seamless connectivity after migration

DEMO SETUP



COLLECTED RESULTS

Data collected	Description
EPC data	Messages showing all messages flow from the the initiation of EPC located at vBBU VM to the UE detach, the detach can be caused due to the vBBU migration or a normal detach
eNB data	- eNB message: configuration, random access, link failure, link re-establishment - DL: Radio Access Technology(RAT), Radio Network Temporary Identifier (rnti), Cell Quality Indicator (cqi), Modulation and Coding Scheme (mcs), bit rate(brate), frames ok frame nok, Block Error Rate (BLER) (%) - UL: Physical Uplink Shared Channel (pusch); Physical Uplink Control Channel (pucch), power headroom (phr) mcs brate , frame ok, frame nok, BLER (%) Buffer Status Reporting(bsr) PHR= UE Max Transmission Power – PUSCH Power
- **UE data**	- Signal characteristics and frequencies: cc, pci, rsrp, pl, cfo - DL: mcs, Signal To Noise Ratio (snr), iter, brate, bler, ta_us - UL: mcs, buff, brate, bler
UDP transmission statistics	Data collected using IPERF tool, by setting up a traffic generator, and transmission : Instantaneous data rate, jitter, packet loss
Ping statistics	Ping test performed to test connectivity between UE and SPGW, delay metrics reflect the impact of migration on network QoS
SNMP statistics of power usage	Used to collect attributes for power consumption, collected data from servers are: - powerUsageTable: 1.3.6.1.4.1.674.10892.1.600.60 - powerUsagePeakWatts: 1.3.6.1.4.1.674.10892.1.600.60.1.9 - powerUsageIdlePower: 1.3.6.1.4.1.674.10892.1.600.60.1.15 - powerUsageMaxPotentialPower: 1.3.6.1.4.1.674.10892.1.600.60.1.16 - powerUsageInstantaneousHeadroom: 1.3.6.1.4.1.674.10892.1.600.60.1.20 - powerUsagePeakHeadroom: 1.3.6.1.4.1.674.10892.1.600.60.1.21

MORE RESULTS

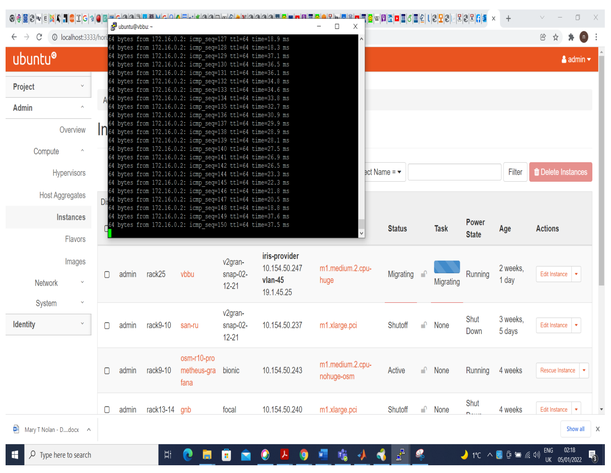


Figure 1: Live igration of vBBU using openstack and seamless connectivity (Experiment2)

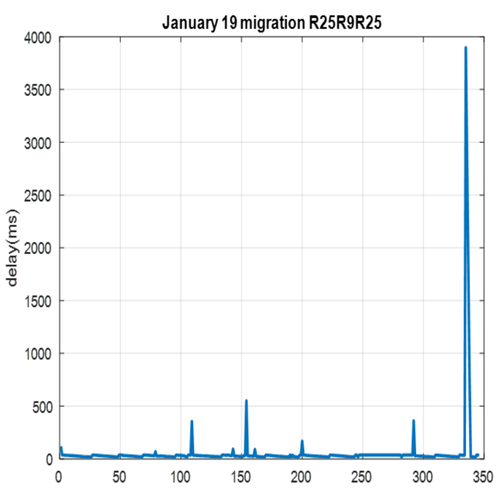


Figure 2: Impact on delay (Experiment 2)

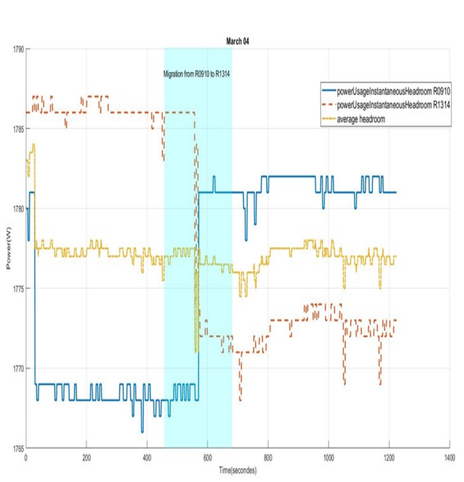


Figure 4: Impact power consumption(Experiment 3)

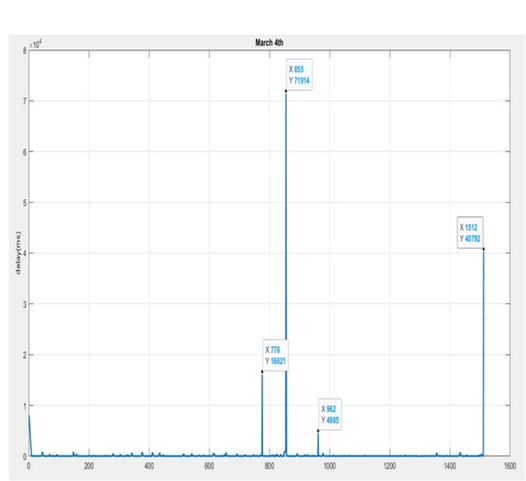


Figure 5: Impact Delay (Experiment 3)

CONCLUSIONS

- Setup of different architecture of virtual 5G RAN @IRISTESTBED
- Migration of vBBU from one locaton to a new locations proved through this project
- Advanced migration can be applied based on information collected: power consumption, CPU and memory
- Advanced algorithms based on AI can be applied to automate migration using collected data

POST MORTEM

- Publication of results, FED4FIRE will be acknowledged in any paper using genrated dataset
- Exploitation of results in future works and projects
- Boosting research activities on open RAN and paving the way to 6G network