CloudRAFT: A Cloud-based Framework for Remote Experimentation for Mobile Networks
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Motivation
Existing community experimentation platforms
➢ Focus on specific areas in wireless research
➢ Deployed in pre-selected environments with nodes installed at fixed locations
➢ Challenging to test the generalizability of the obtained results

Needs a systematic shift in the paradigm of sharing experimentation facilities for wireless research

Proposed Solution
A cloud-based framework called CloudRAFT, that allows experimenters to
➢ Remotely access and control experimental resources via public cloud AWS and
➢ Share the resulting data and code via the cloud

Three Plane Architecture

User Plane
➢ Manage three types of users, i.e., the CloudRAFT Administrator, the Testbed Owner, and Testbed User
➢ CloudRAFT administrator
➢ Oversees the operation of CloudRAFT
➢ Testbed owners
➢ Creates, Manages, and Configures new testbed profiles
➢ Testbed Users
➢ Subscribes and Reserves testbeds
➢ Conducts and monitors experiments
➢ Shares the collected datasets via CloudRAFT

Cloud Plane
➢ Provides software and tools that can be used for testbed owners to conveniently share their testbeds with the community
➢ Hides the complexity in accessing different testbeds
➢ Provides a bridge between researchers and testbed developers
➢ Accelerates the formation of a mature ecosystem for experimental research for the wireless community

Testbed Plane
➢ Provides a set of three tools in addition to the custom tools made available by the testbed owners
➢ Communication Agent - Relays between the Cloud Plane and the edge cloud
➢ Event Agent - Receiving and executes control commands
➢ Monitoring Tool - Feeds the real-time status of various computing and SDR devices

CloudRAFT Enabling Techniques

➢ Amazon Serverless Service
➢ Takes care of infrastructure management tasks allowing testbed and CloudRAFT developers to focus on the program development
➢ Offers a wide array of APIs including Representational State Transfer (REST) API Gateway, Websocket API Gateway, Lambda Function, DynamoDB, Simple Storage Service (S3), and Cognito, among others

➢ Websocket Based Real Time Communication
➢ Takes care of the communications between the CloudRAFT control plane and the testbed edge server

➢ Fast Reverse Proxy
➢ Redirects the Internet requests from one IP address to another using TCP or UDP connections
➢ Hides the testbed IP address and preserve the integrity of the testbed information

➢ VNC-Based Remote Command Line
➢ Allows desktop sharing and enables remote execution of commands from a unified webportal

UBNext Testbed Design

Front-end SDR
20 N210 and 4 B210 USRPs

Edge server
Dell EMC R340/PowerEdge workstations

Ground Robot
SuperDroid programmable robot
Marvelmind super beacon

Live Video Streaming
➢ Stream the live video of the experiment based on a combination of Open Broadcaster Software (OBS) and Real-Time Messaging Protocol (RTMP).

Conclusions
➢ We presented CloudRAFT, a cloud based remote experimentation framework for mobile networks
➢ We discussed the enabling techniques for CloudRAFT.
➢ We also developed a new software-defined testbed called UBNeXT and showcased the remote access to NeXT based on CloudRAFT.

Future Work
➢ Standardize the communication interfaces between the cloud plane and testbed plane within the CloudRAFT framework.
➢ Fully integrate the UBNeXT testbed by connecting other software radios available at University at Buffalo, including mmWave radios and UAV systems, among others.

References