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Dynamic Emergency Communications in 5G end-to-end Networks

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Credit Where Credit Due



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Problem Statement 1: Needs of NS/EP Community



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Work in Progress: Dynamic 5G Network Slicing for First Responders

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Abstract—Our paper describes a novel architecture using dynamic 5G network slices to support prioritized First Responder communications. Today, prioritized users are identified through their special Access Class (AC) 14 designation in their handsets as the basis for the Wireless Priority Service (WPS). However, under extreme events this best efforts approach to network access may not be sufficient, potentially resulting in loss of life or property. The 5G network has provisions for allocating virtual slices of the access network, most often for media type quality of service, such as non-real time video versus low-latency control versus low-bandwidth, delay tolerant messaging. This paper describes an approach to using dynamic 5G network slicing using on the number of active AC-14 devices in a region to trigger the resource characteristics of a network slice, irrespective of media type needed for a given session.

Keywords—Public safety, 5G Networks

I. INTRODUCTION

Cellular communication is a continually evolving

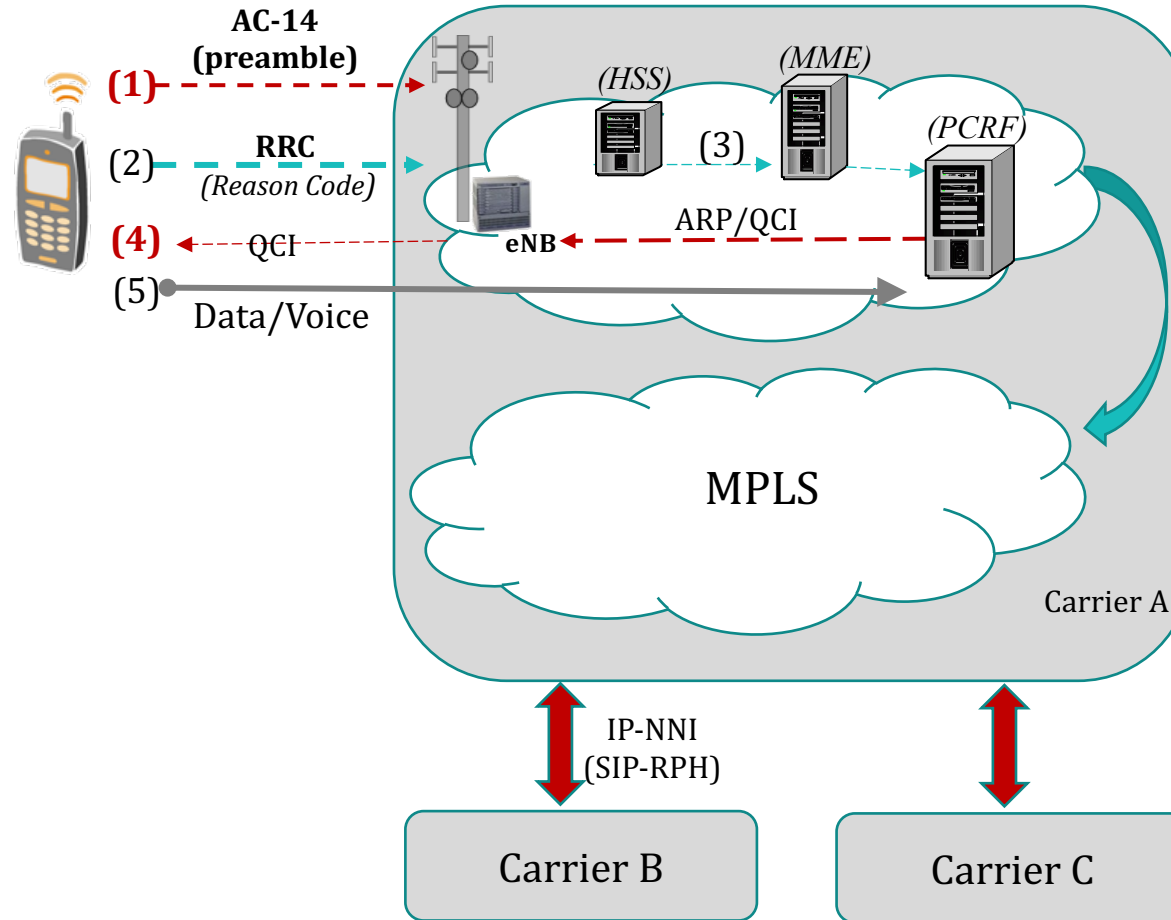
of establishing and maintaining voice communications over many wireless carriers within the U.S during times of congested conditions. The other system aimed at First Responders is known as FirstNet and its service is offered exclusively through a single carrier. Details of Firstnet's deployment is a work-in-progress [1], but capabilities such as preemption and the use of access class barring during congested periods have been discussed in various forums [2]. In Section III below, we revisit these two systems and discuss in more detail the design of Access Class Barring for LTE in support prioritized communications [3].

In looking ahead, 5G introduces the concept of network slicing, which allows carriers to divide the resources of a physical network into a multitude of virtual networks – each of which would be assigned to some segment of cellular traffic based on some pre-determined criteria. It is anticipated that initial deployments of network slicing would resemble static provisioning currently done for VLAN or VPN services. Our paper introduces an innovative architecture for dynamic network slicing



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Existing Priority Communication Systems in U.S.



From IPTComm 2019 presentation

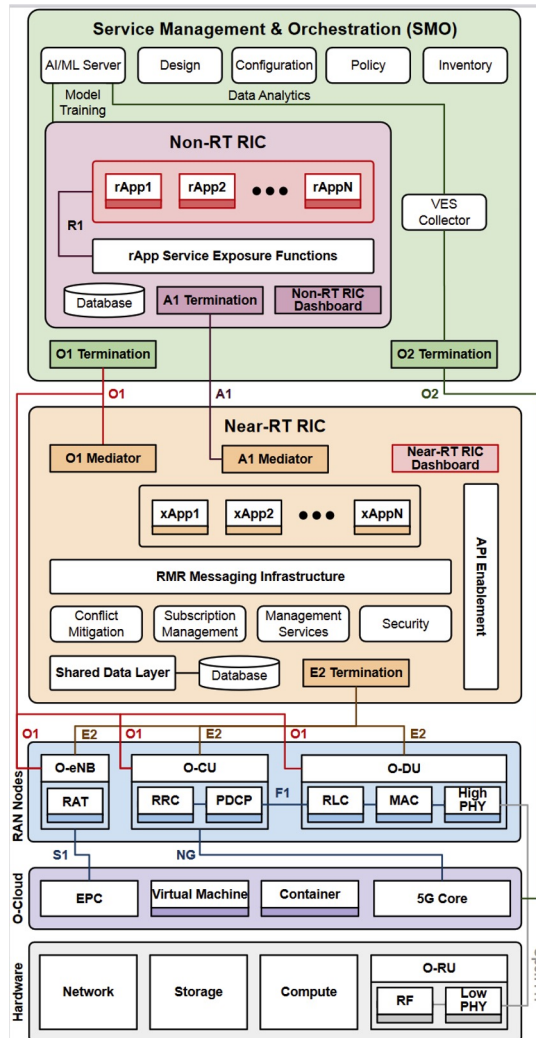


Open RAN Architecture

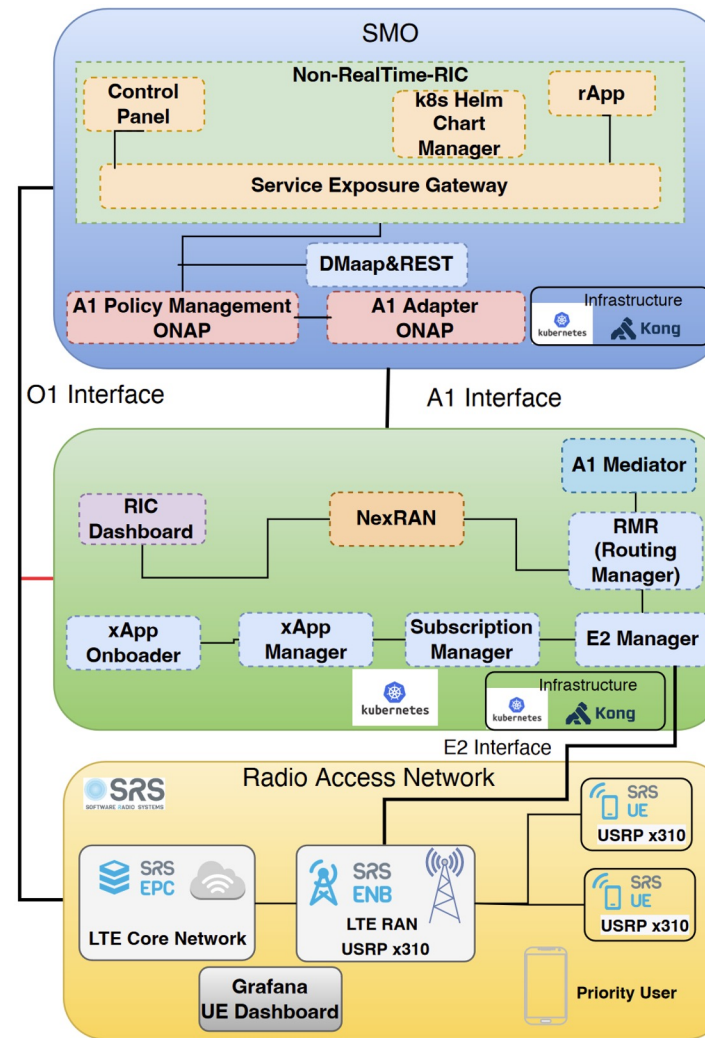


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Reference Architecture



Our Implementation



CCI xG Laboratory

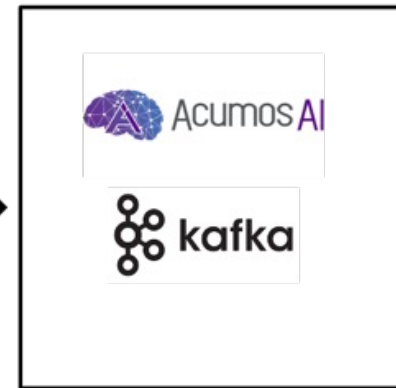
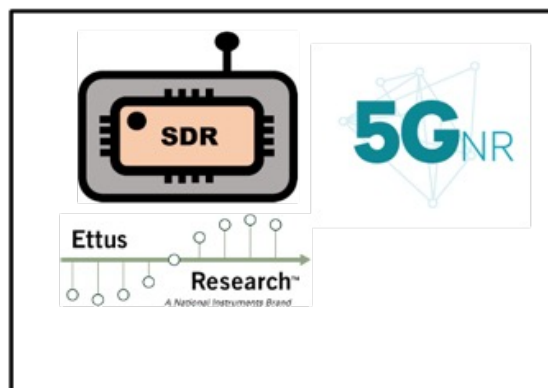
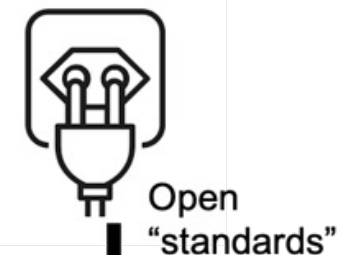
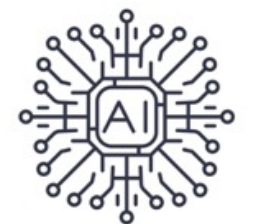


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In 2017 the United States was fighting a common enemy—robocalls from overseas operations that scammed people of their hard-earned savings.

Core Components



Open RAN Testing and Integration Center

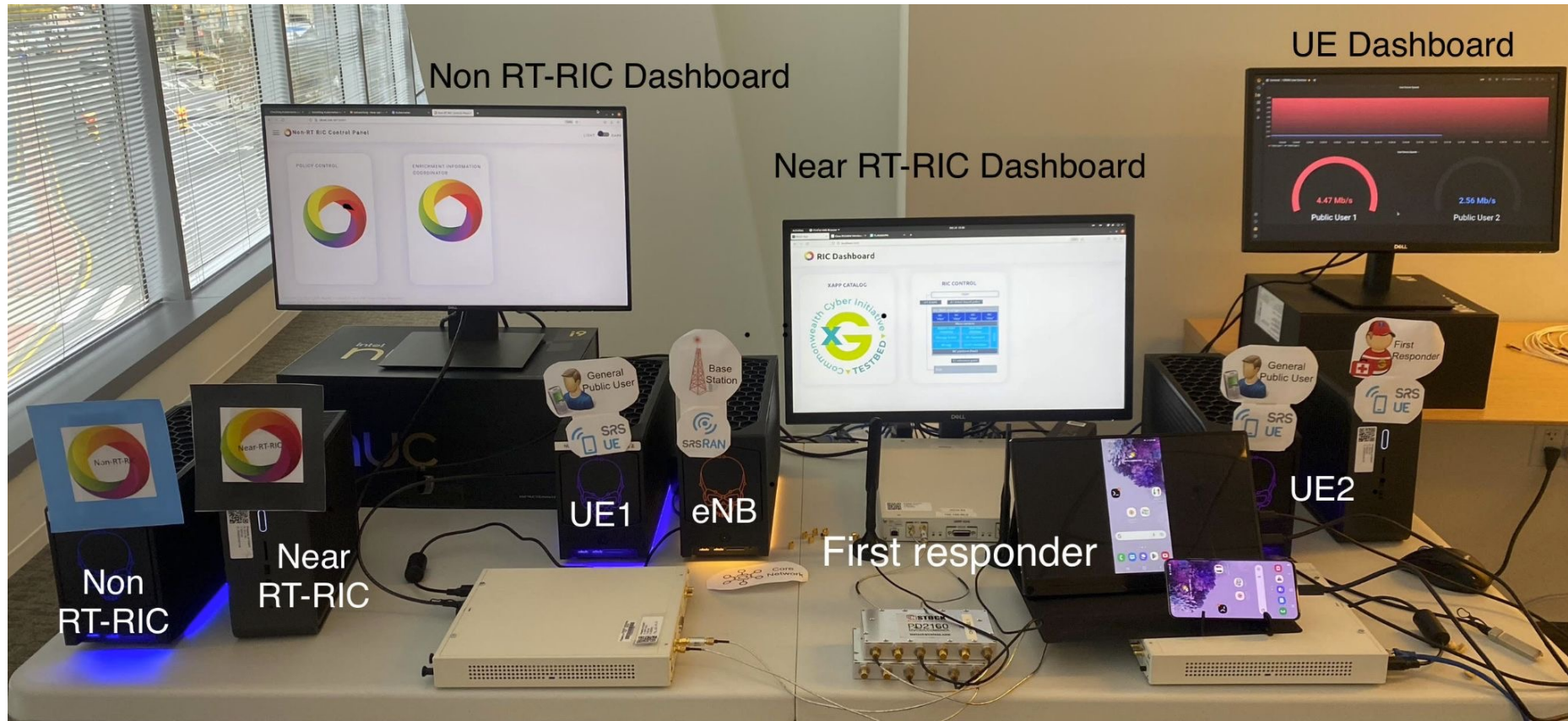


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- Only end-to-end open-source implementation of complete Open RAN / Core network

Experimental Setup



x-Apps and r-Apps

Commonwealth Cyber Initiative xG Testbed: First End-to-End O-RAN Demo

The screenshot displays the RIC Dashboard interface. On the left, the 'XAPP CATALOG' section features the Commonwealth Cyber Initiative XG Testbed logo. The right section, 'RIC CONTROL', shows a hierarchical architecture diagram. At the top is ONAP, which connects to O1 (O&M) and A1 Intent based policy. Below this is the RIC (RAN Intelligent Controller), which is divided into three columns of 'xApp' components. These xApps are supported by a 'Micro-services' layer containing 'Analytic stack streaming', 'Real-time database', 'Message broker', and 'ML framework'. The RIC platform (PaaS) layer includes 'API mgt' and 'E2/A1 mediation'. At the bottom, the RIC platform connects to an 'E2 reference point' and the RAN.

3:12 / 5:57 • Dashboards >



Old-Fashioned Allocation (default)

Commonwealth Cyber Initiative xG Testbed: First End-to-End O-RAN Demo

AnyDesk x 881235279

Firefox Web Browser

RIC Dashboard

Base Station

Type eNB

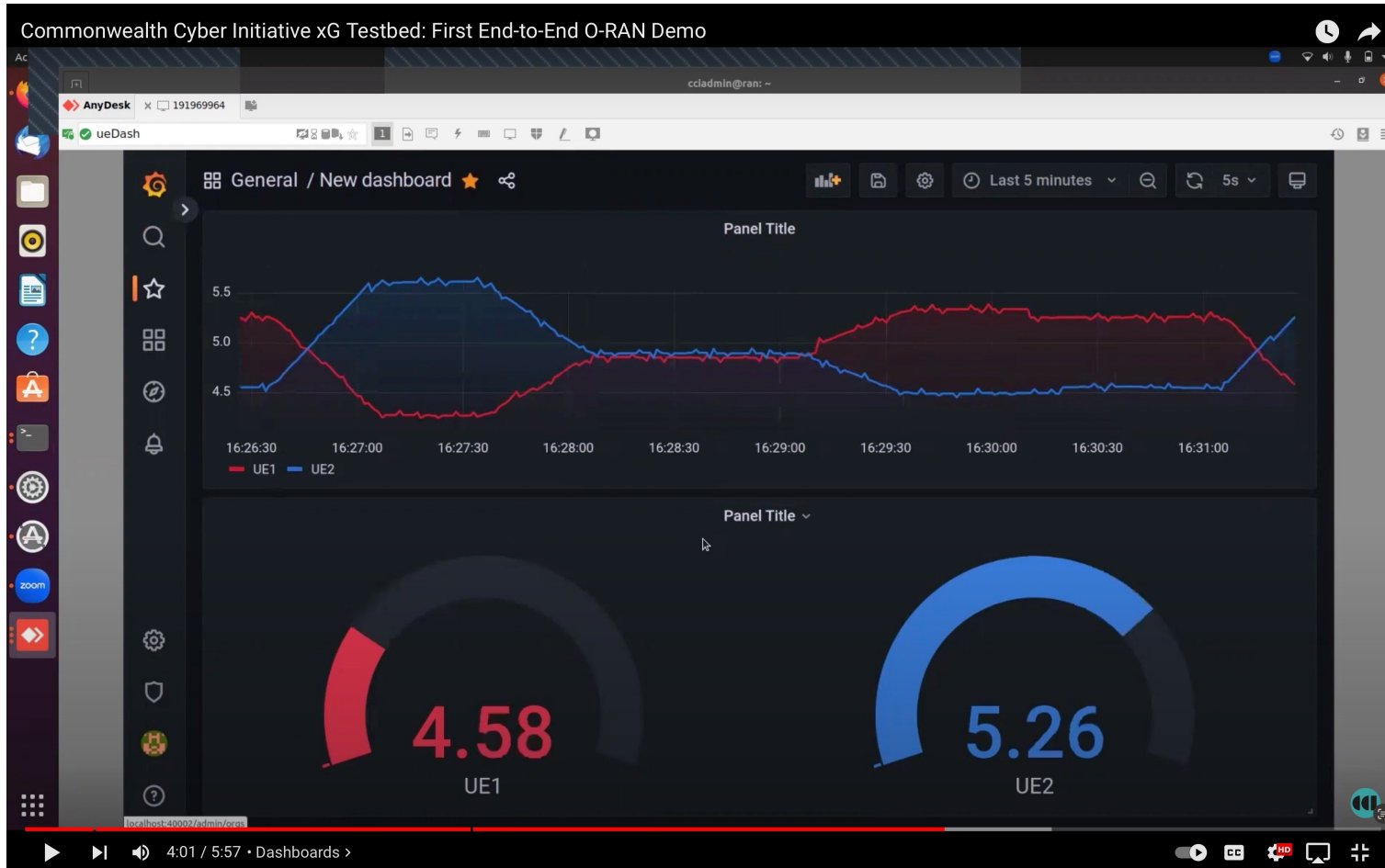
Slices ["slice1", "slice2", "slice3"]

Slice	Allocation Share	UEs
slice1	50	101010123456788
slice2	50	101010123456787
slice3	0	101010123456787

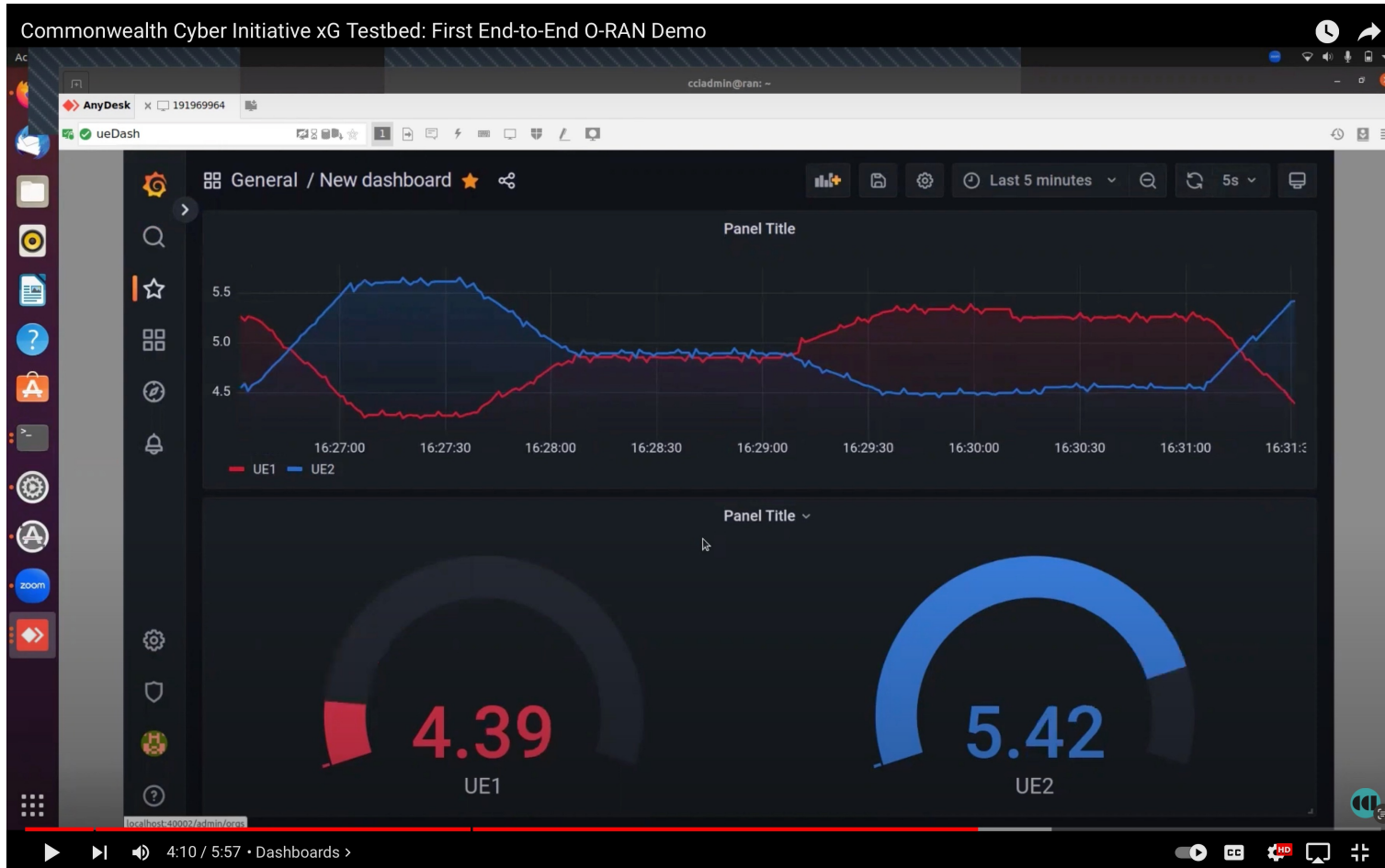
3:32 / 5:57 • Dashboards >



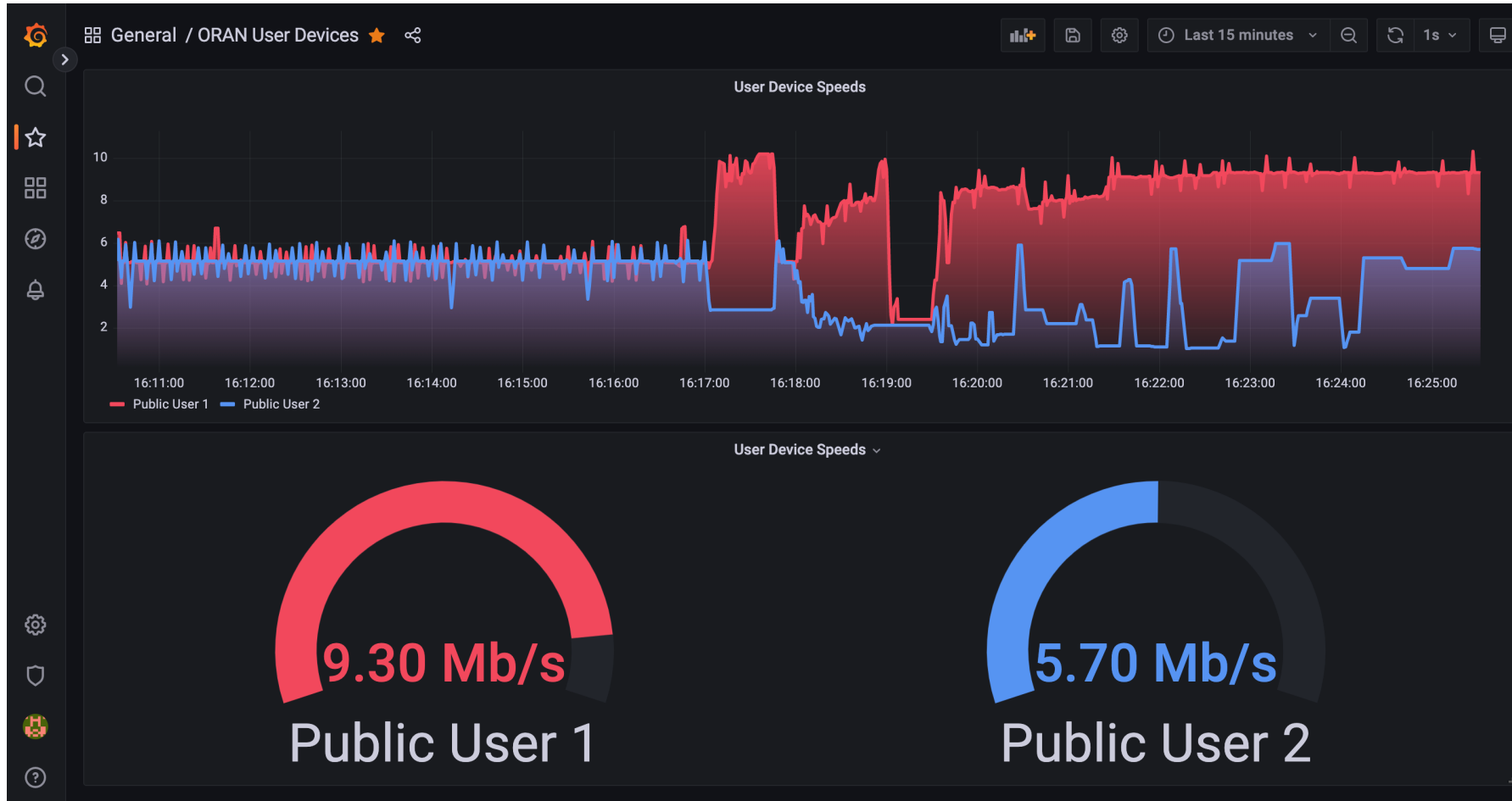
r-App Does Dynamic Resource Allocation



r-App Does Dynamic Resource Allocation



Nice Demonstration of Consumer On Demand



Here's Our First Responder

Commonwealth Cyber Initiative xG Testbed: First End-to-End O-RAN Demo

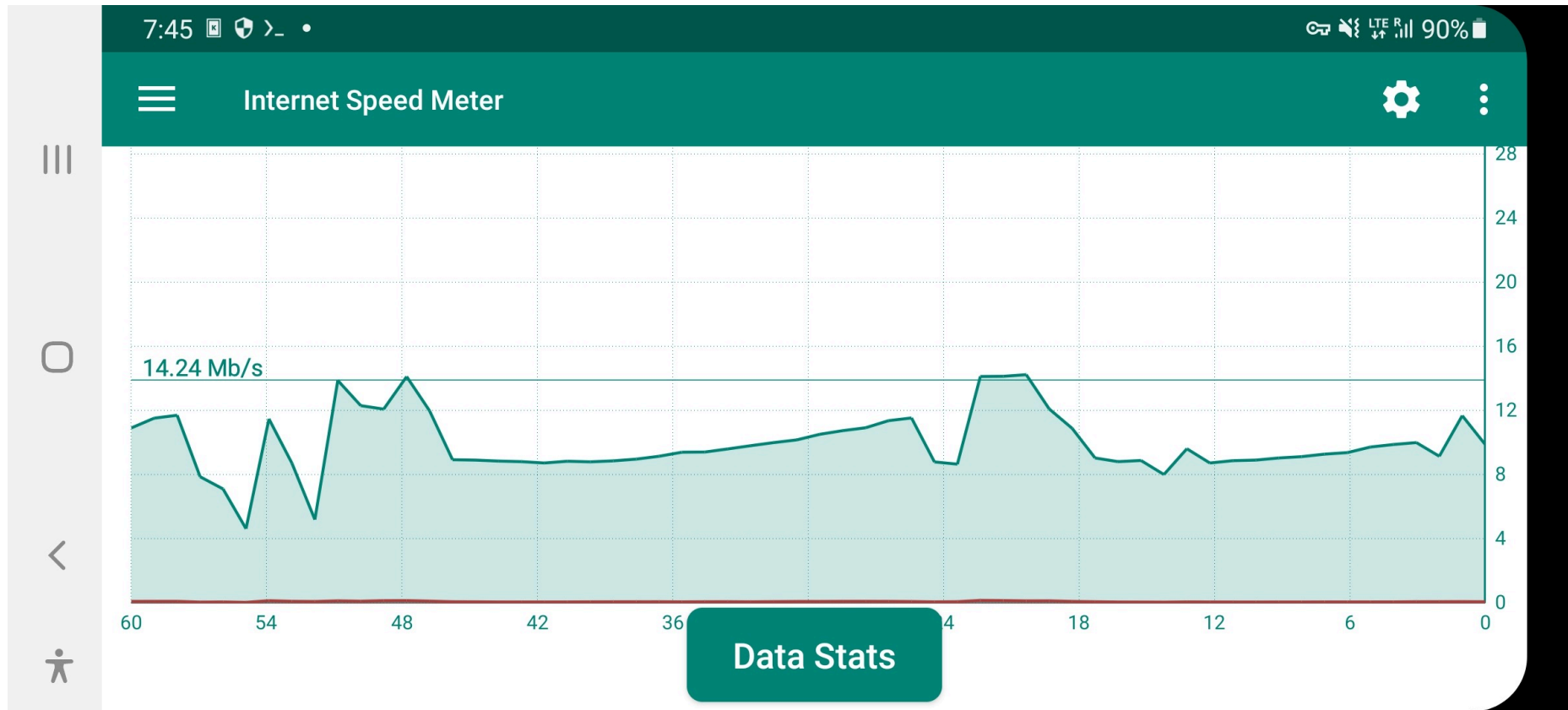
Firefox Web Browser: localhost:3000/ric

Slice	Type	Slices	Allocation Share	UEs
slice1	eNB	["slice1", "slice2", "slice3"]	24	101010123456788
slice2	eNB	["slice1", "slice2", "slice3"]	34	101010123456787
slice3	eNB	["slice1", "slice2", "slice3"]	42	101010123456789

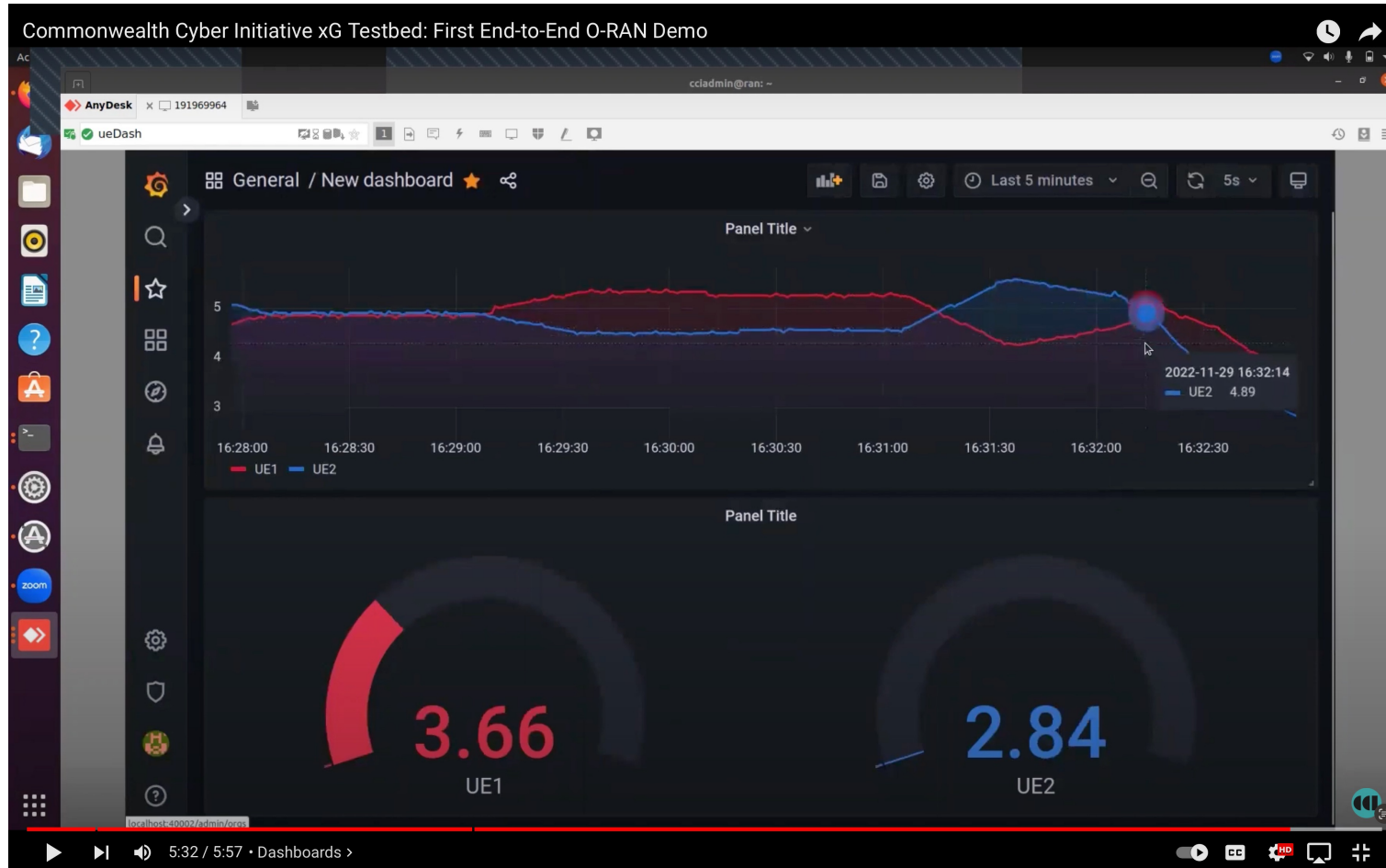
User Profile	IMSI
Public User	101010123456788
Public User	101010123456787
First Responder	101010123456789



What the First Responder Sees



What Users See



What's Next?



Wi-Fi Priority Calling

- “Work in Progress”
- What do we do when the cellular network is *totally* congested or unavailable?
- Is a priority service on unlicensed bands totally insane?



Questions?

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Thank you

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