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Demo: Efficient Multi-Service RAN Slice Management and Orchestration

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- 2) **Multiple slicing algorithms.** We implemented (i) static resource reservation for each slice in every subframe, (ii) NVS [5] and (iii) a QoS-sensitive (latency) slicing algorithm [2]. These algorithms guarantee resource isolation to a varying degree between multiple slices. Also, this allows a fair comparison of these algorithms.
- 3) **Description of different slice requirements.** Through a descriptor, an SLA for each slice is expressed. Consider the scenario in Figure 1. Two eMBB slices are present and are multiplexed using a static slicing algorithm. A third slice owner wishes to embed a URLLC slice. The controller decides that the current static slicing is not appropriate for this scenario and switches to a QoS-aware slicing algorithm which can express the latency requirements by this slice while keeping the SLAs of the two eMBB slices.
- 4) **Encapsulation of slices.** The interface between the slice algorithm and the slice packet schedulers allows a clean separation of concern with encapsulated state of each slice with respect to its users and resources. This creates network functions that can be added, removed and customized to correspond to slice owner needs without impacting the overall network.
- 5) **End-to-end slicing.** We added support to dynamically add and remove core network (CN) connections to OpenAirInterface through an S1 management module, highlighting the operational aspect of our solution. This allows to connect on demand to slice-specific dedicated CNs under the control of an orchestrator. Consider again Figure 1: the URLLC slice requires a CN with short packet handling delays. Before embedding the slice, the base station connects to CN_{LL} before adding the slice.

III. DEMO IMPACT

Note that a number of contributions follow from this demo. The above architecture allows the research community to readily implement and evaluate algorithms for both slicing or packet scheduling [6] in a real base station, both to date rather difficult to implement in OpenAirInterface. Further, it is feasible to reimplement the Orion [7] architecture (of which the code has not been published) to functionally isolate slices from each other.

IV. DEMO SETUP

The demo will concentrate on the life cycle of a URLLC slice. Before adding the slice, the controller will connect the base station to an indicated CN and possibly dynamically change the slicing algorithm to a QoS-based one. Then, the URLLC slice is added in the base station. As soon as no users are active anymore, the outlined changes will be rolled back by the controller.

Users in the URLLC slice will experience an improved performance: their latency will be kept low, while an optimal system resource usage will be guaranteed. Visitors of the demo will be able to see this on a dashboard, tracing key performance indicators.

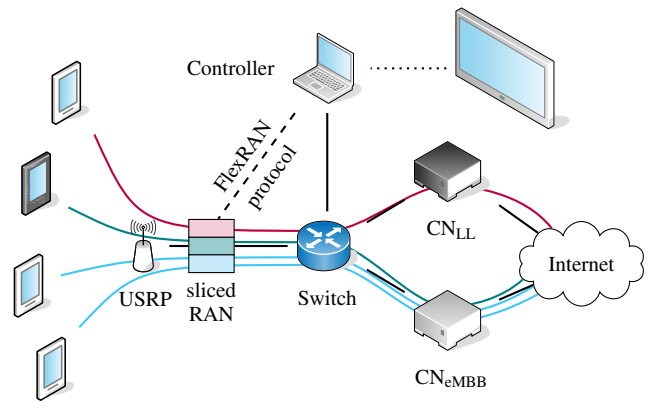


Fig. 2. Demo setup. An additional screen will show the slice life cycle and slice performance indicators.

We will use the demo setup illustrated in Fig. 2, consisting of LTE phones, an Ettus USRP B210-mini frontend with radio equipment, four computers and a switch. The USRP is connected to one computer running OpenAirInterface as the RAN with slicing capability and data plane functionality. Via the switch, the RAN is connected to two CNs, each being a standalone CN (consisting of HSS, MME, and S/P-GW) and connecting the end-to-end slices to the internet.

The demo is controlled from a laptop hosting the FlexRAN controller. The controller reconfigures the RAN (slicing and CN management) through the FlexRAN protocol. A dashboard on a separate screen allows the visitor to follow the demo.

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