5G CBRS Spectrum Demonstration
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Demonstration Leads

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CBRS Providers TBD

ABSTRACT

Many scientific and academic applications are exploring the deployment of small sensors and IoT devices as part of their research or teaching missions. Today, these devices often use WiFi technologies in the open Industrial/Scientific/Medical (ISM) spectrum to communicate. However, since ISM spectrum is open to all, the heavily congested WiFi areas heavily impact or even preclude latency sensitive and jitter sensitive applications, such as control for robotics or other real-time streaming applications.[i,ii] Not only is congestion of spectrum an issue, the management and scheduling of end devices utilizing the spectrum is not optimal. Therefore, large download or streaming application flows can dramatically impact the application flow experience for other use cases.[iii]

The Long-Term Evolution (LTE)[iv,v] wireless standard alleviates some of these issues, such as congestion and side by side application experience, by providing allocated spectrum with tight management and scheduling.[vi] However, spectrum is on the order of billions of dollars and LTE equipment has typically been very costly and hard to implement. In order to address some of these issues, the FCC has created a spectrum plan called the Citizens Broadband Radio Service (CBRS) [vii,viiiix] in the 3.5GHz spectrum. The CBRS plan allows users to request dedicated spectrum without the requirement of spectrum licenses. The users can then deploy private LTE networks with aggregation and backhaul to the existing provider networks. A vendor CBRS Alliance[x] has formed with the goal of making CBRS as easy and almost as cheap as WiFi to deploy.[xi]

Since the CBRS spectrum is setup for LTE and regulated use, the spectrum has tight limits on channel frequency width which translates directly to the amount of data bandwidth available. A first generation deployment might only see 50-150Mbps of bandwidth to the end device. However, since the bandwidth resides in allocated spectrum with tightly managed and scheduled end devices, real-time applications to those end devices *should* have a better and more consistent experience in a highly congested spectrum. This prototype will explore and validate this expectation.

The Utah Education and Telehealth Network (UETN)[xii], the Murray School District[xiii], the University of Utah Center for High Performance Computing[xiv], along with several partners in the technology and education community, propose to conduct a limited experiment of LTE wireless services using the CBRS spectrum in order

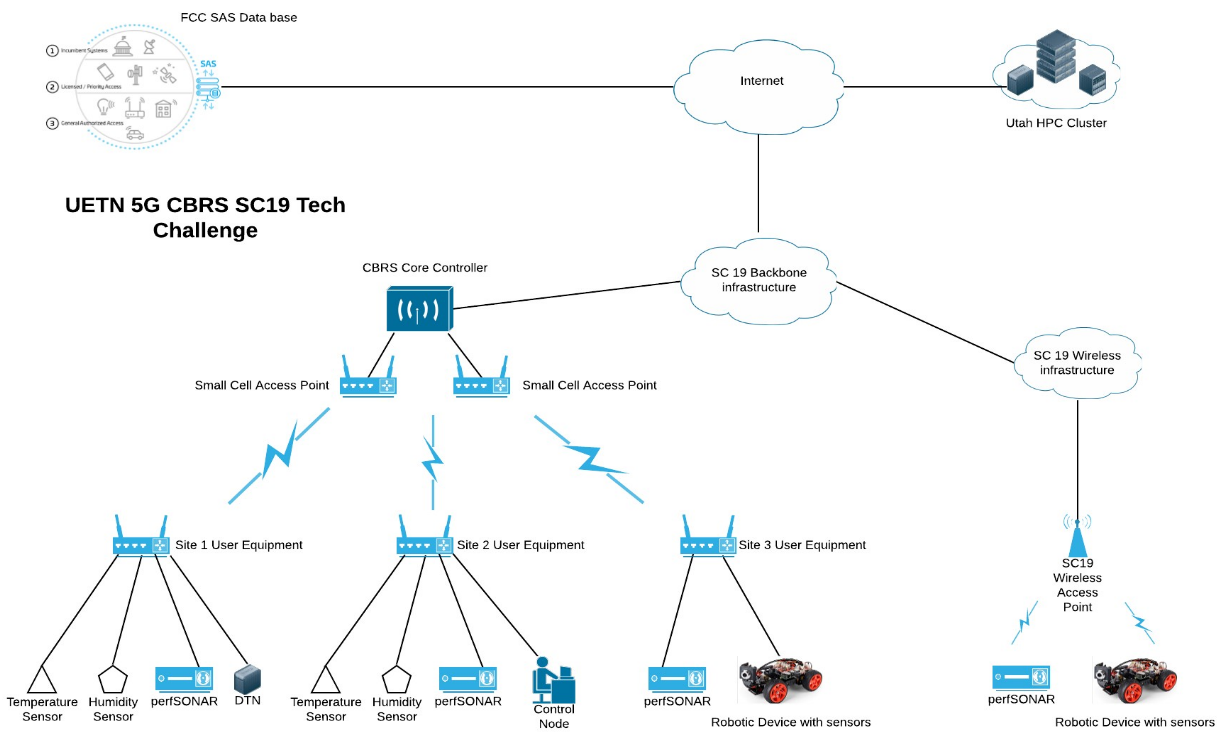
to demonstrate that example scientific and academic applications might function better within the context of a heavily congested scenario. We will secure a limited spectrum license from the FCC reaching up to a one-kilometer radius from the Colorado Convention Center. Wireless providers will be engaged to provide equipment (one provider has already committed, others are aware of this opportunity.) SCinet staff, exhibitors and attendees, in limited numbers, will have the opportunity to participate as part of this experiment.

As part of the deployment, the team will deploy perfSONAR[xv] testpoints on both the private CBRS LTE network and the conference wireless network for analyzing and comparing the wireless medium. These testpoints will focus on latency tests to highlight traffic jitter. Testpoints doing sample bandwidth tests will reside only on the CBRS LTE network to quantify the bandwidth of endpoints. A Maddash[xvi] dashboard will visualize the jitter for comparison and contrast.

For science and academic deployments, the team will deploy a small real-time science control application, i.e. a small robotics example, along with various sensors, and a real-time video stream application. The team will also deploy a small data transfer node which will take data from the real time science application and then transfer it to the University of Utah High Performance cluster for collection.

The focus of this iteration of a prototype is to explore basic feasibility of the concept. Future work, pending vendor technology development, will explore more in-depth analysis of spectrum, visualization and additional science applications.

Figure 1: Diagram of proposed SC19 CBRS prototype



DESCRIPTION:

Objectives: Driving application and scientific significance

1. Explore feasibility of utilizing emerging CBRS spectrum technology for scientific applications.

2. Demonstrate that traffic on 3.5-3.7 GHz (CBRS Spectrum) can co-exist in a heavily populated 802.11 environment without limitations or interference with the conference WiFi deployment.
3. Characterize bandwidth, latency and other network characteristics in the noisy wireless environment of the SC19 showroom floor utilizing first generation vendor technology and the CBRS spectrum.
4. Demonstrate stability and reproducibility of network characteristics for multiple simultaneous scientific IoT use cases, including real-time science control applications, sensors, science/academic video streaming applications and Data Transfer Node (DTN) traffic.
5. Demonstrate full science workflow from showroom floor to University of Utah HPC environment with minimal impact to each use case.
6. Demonstrate that video can be passed through building infrastructure and at a distance of up to one kilometer
7. Provide a limited Internet of Things (IoT) deployment and collect non Personally Identifiable Information (PII) data for analysis
8. Potential exploration of deployment of net terrain and other visualization tools to provide just-in-time data visualization of a basic nature in support of evaluating this demonstration's ability to meet the stated goals.

Future work:

The work for SC19 is an exploration whether a private LTE network in the CBRS frequency spectrum will be able to deliver a reliable service to science and academic applications within a congested environment. The SC19 floor will deliver scale and a real world noisy spectrum. Future investigations will potentially be able to more rigorously analyze and visualize spectrum, deploy additional real-time science and academic applications, observe additional network metrics, compare and contrast application usage of different spectrums, scale up number of science devices, compare direct science device feeds to cluster vs device feeds to local aggregate feeds.

References:

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xiii Murray School District, https://www.murrayschools.org/

xiv University of Utah Center for High Performance Computing, https://www.chpc.utah.edu/

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xvi Maddash, https://docs.perfsonar.net/maddash_intro.html