Colosseum as a Digital Twin: Bridging Real-world Experimentation and Wireless Network Emulation

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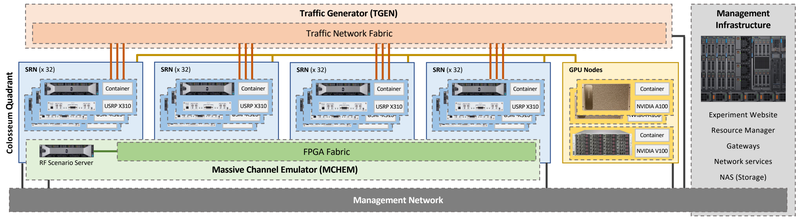
Platform



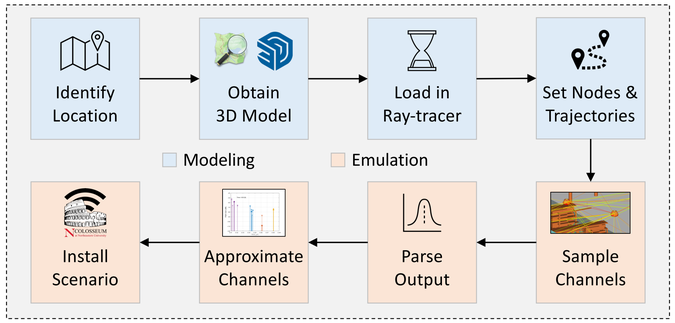
Colosseum architecture

- 128 Standard Radio Nodes with CPUs and GPUs
- 256 USRP X310s software-defined radios
- Massive Channel Emulator for diversified 5G+ scenarios
- Enabler of AI/ML with 2 NVIDIA DGX A100 (8 GPUs each) and a large memory node with 6 GPUs through MassTech Collaborative "AI Jump Start" grant
- 98 teams (500+ users) from 65 institutions
- Annual Young Gladiator outreach events & tutorial at international venues (300+ attendants)
- Used in courses of the ECE curricula

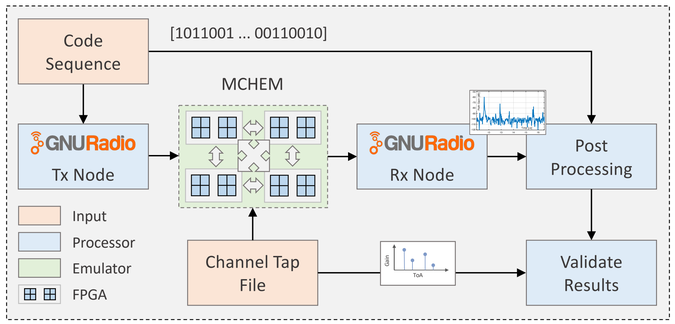
Massive $20M+ wireless systems testbed developed by DARPA for Spectrum Collaboration Challenge. Transfer to Northeastern and opening to community supported by the U.S. National Science Foundation under CCRI grant #1925601.

Digitizing the Real World

RF Scenario Twinning

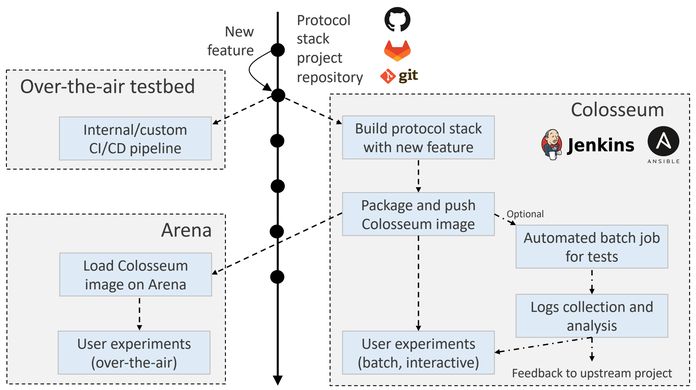


Scenario creation workflow



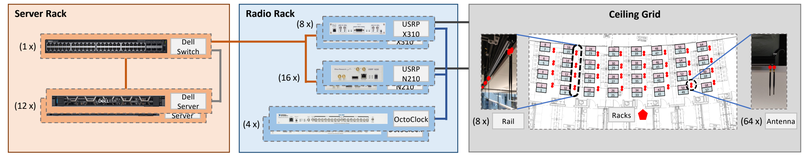
Channel sounding workflow

Protocol Stack Twinning



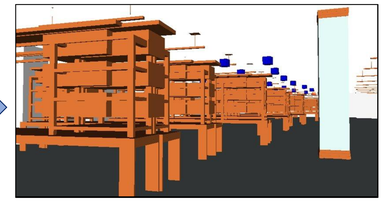
Testing Results

We create the digital twin of **Arena**, an indoor sub-6 GHz testbed

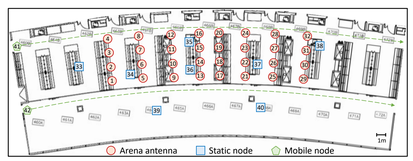


Arena architecture

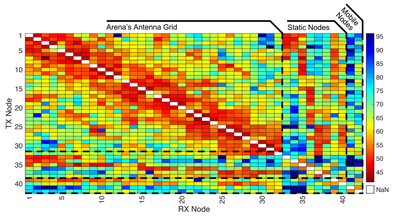
Real-world location



Digital twin scenario

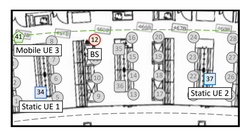


Node locations of Arena digital twin

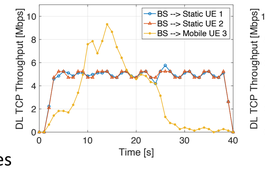


Heatmap of the Arena scenario

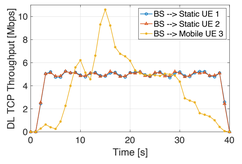
Experimental Use Cases



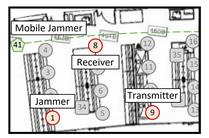
srsRAN cellular experiment nodes with 5 Mbps downlink TCP traffic



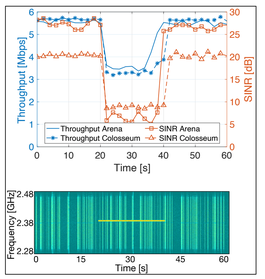
Arena



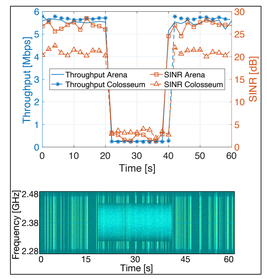
Colosseum



Wi-Fi jamming experiment nodes with a narrowband and a wideband jammer



Narrowband



Wideband