

Facilities, Equipment and Other Resources (CCI)

The Commonwealth Cyber Initiative (CCI) operates two testbeds at Virginia Tech: a 5G testbed and an Artificial Intelligence (AI) testbed.

CCI 5G Testbed

The goal of the CCI 5G Testbed is to enable research and development from physical to application layers. Its architecture envisions the softwarization, management, and orchestration of network functions. The testbed is used to develop open, secure and reliable infrastructure and architecture for 5G and Beyond. This includes universally-accessible radio access network (RAN) software running on general purpose processors, and flexible and interoperable wireless network management and orchestration.

The testbed is currently composed of a Sandbox and one 5G non-standalone (NSA) portable node. The Sandbox is located in the 5G testbed laboratory at Virginia Tech in Arlington, VA. It currently contains:

- 3 USRP N310
- 6 USRPs X310
- 6 USRPs B210
- 5 USRP B205-mini
- 4 GPS (are available to attach to the USRP on demand)
- 4 UBX 160 board (are available to attach to the USRP on demand)
- 4 Intel NUC with GPUs,
- 1 Signal generator
- 2 Spectrum analyzer
- 2 iPhone 12 pro unlocked
- 2 Google Pixel 5 unlocked
- 1 Samsung S20 unlocked
- 1 Huawei P40 unlocked
- 20 programmable SIM cards
- DELL servers

The 5G NSA portable node is composed of:

- 5G core (Amari Callbox or free5GC)
- eNodeB (Amari Callbox or srsLTE)
- gNodeB (Amari Callbox)
- User equipment (smartphones) are the same ones available in the Sandbox

The following are also available to connect to the eNodeB/gNodeB:

- 1 pair of Omni antenna 600-02: Freq Bands: 3300 MHz – 3800 MHz Radiated Power: 23 dBm, EIRP: 30.7 dBm, Mean/Peak Gain: 2/6.2 dB, Freq. Tolerance: 5 MHz
- 1 pair of directional antennas XPOL-2-5G: Freq Bands: 3300 MHz – 3800 MHz, Radiated Power: 23dBm, EIRP: 35.5 dBm, Mean/Peak Gain: 9/11 dB, Freq. Tolerance: 5 MHz

An RF enclosure is available: experiments that require access to licensed spectrum must be carried out in the RF enclosure.

CCI AI Testbed

The CCI AI Testbed provides a Platform as a Service (PaaS) to facilitate Artificial Intelligence (AI) research. The AI Testbed is accessible to researchers across academia, industry and government. As a PaaS, CCI provides the networks, servers, storage, operating system (OS), middleware, database and other services to enable AI research. Research activities using the testbed may include data transformations/wrangling, feature engineering, algorithm development, machine learning model training, and model evaluation.

The AI Testbed currently provides or plans to provide solutions for:

- AI Marketplace: A “one-stop-shop” for access to the testbed’s offerings, including datasets, pre-trained models, APIs, libraries, cluster access, etc.
- Researcher Social Network: Tools to enable researchers to connect about common research interests and collaboration opportunities.
- Experiential Learning Modules: Step-by-step educational material for how to perform AI research for different domains, applications, and methods.
- Integrations with CCI 5G Testbed: Ability to leverage the capabilities of both testbeds to perform research at the intersection of 5G & AI.

The current hardware consists of:

- 1 X NVIDIA DGX-2
- 2 X NVIDIA A100s
- 200 TB of IBM General Parallel File System (GPFS) storage

This hardware provides more than:

- 288 CPU cores
- 6 TB of system memory
- 32 GPUs
- 1,792 GB of GPU memory (16 X 80 GB GPUs, and 16 X 32 GB GPU)

All hardware is networked with 100G fabric, with the GPU machines featuring fully connected 100G HDR Infiniband. The testbed is staffed by a team of a hardware engineers, a systems administrator, two developers, and a testbed director.

The platform utilizes OpenShift Container Platform for Kubernetes container orchestration, RedHat Enterprise Linux as the underlying operating system, and a suite of industry standard configuration and management software. The result is a highly configurable system where new capabilities can be rapidly deployed – often at the push of a button – to support expanding research needs.

Users can interact with the systems at multiple levels of abstraction:

- Jupyter notebooks provide a straightforward user interface for scientists and engineers to interact with the system.
- Datasets on the testbed are stored in an object-storage based Data Repository.
- Public datasets in the Data Repository are catalogued in a meta-data repository that facilitates discovery of datasets for AI experimentation and model development.
- Testbed documentation, including guides and tutorials, is provided to educate users on how to best leverage the testbed for AI research including, how to develop AI model development pipelines/experiments and leverage GPU accelerated training.
- An online community for the testbed includes a wiki along with a searchable question-answer forum to support accelerated responses to inquiries.