Facilities, Equipments, & other Resources

LONI is the premier high-performance computing and high-capacity middle-mile fiber-optic network provider for Louisiana higher education and research entities. The technology assets include a 1,600-mile-long system of fiber optics cables that provides subscribers with private and public cloud access at an improved level of service over a typical service provider and enhanced support for digital activities for teaching, learning, and administrative functions. The high-performance computing (HPC) service allows researchers to conduct and store highly complex experiments using compute powers specialized for highly intensive computational processing. This HPC service provided by LONI enables greater collaboration on research that produces results faster and more accurately. LONI is owned and operated under the authority of the Louisiana Board of Regents. Through the LONI Executive Director at LSU, the position provides day-to-day management and fiduciary responsibility through a contract with the Louisiana Board of Regents. Louisiana researchers and universities are leading a concentrated, collaborative effort to advance statewide research through LONI's cyberinfrastructure: computing systems, data storage systems, and people, especially people linked by a shared vision, and the underlying technologies support that vision. This vision is to establish interlinked projects, whether from single research, single college, single university, or multiple institutions, to make a significant difference to the state by creating an environment that encourages increased collaboration leading to a new domain and applied research.

LONI builds heavily on existing strengths in Grid Computing efforts and applications across the state and leverages strategic projects underway with global leaders in the scientific community. LONI is poised to be one of the leading research facilities of its kind in the world. By providing a base for training and enabling researchers across the state, LONI will provide the people of Louisiana an unprecedented opportunity to join an international community of world-class scientists, leading the way for the development and deployment of technologies that will change the face of science, technology, art, and communication in the coming century. As one of the pillars of Louisiana's Science and Technology (S&T) plan, deploying this ground-breaking network has brought national accolades to the State.

LONI provides the necessary raw capacity for advances in multiple domains. However, our cyberinfrastructure is more than a stack of equipment. The LONI Network and HPC is a human-supported venture in advanced network and computational infrastructure that enables scientists, researchers, and users from all disciplines across the state to fully exploit the capabilities of LONI. Advances in the tools of their research will raise the level of their work, aid them in their competition for federal funding, and access to leading-edge facilities outside Louisiana, and will help users become engaged in collaborative projects at the highest levels around the world.

LONI is a complex facility with several central components: hardware, software, and most importantly, a human component:

- LONI is an advanced optical network facility, capable of carrying huge amounts of data between research campuses in Louisiana and providing a central connection point to the research world beyond the state.

- LONI has computational resources deployed at multiple sites; applications can run on any of these resources which can be managed centrally, making computing cycles available for all users.

- LONI has an advanced Grid software architecture deployed across all sites, with Grid services closely connected to the hardware components available across it.

- LONI has an expert staff of researchers and developers to manage the tightly coupled environment connecting the network components, computing components, and Grid software components. This enables LONI researchers to partner closely with other groups in the state and beyond and helps educate and train users and researchers across the state.

LONI Network Factoids

- 1600 total fiber miles under management

- 130 owned fiber miles

- 1000+ managed circuits

- 235+ managed devices

- 7 perfSONAR nodes

- 5 data centers

- 44+ 100G circuits

- 121 served sites in 44 parishes

Internal Network Connectivity: LONI is in the midst of a major network lifecycle replacement project. Over the next 12 to 18 months, every network device providing traffic transmission will be replaced. Each of our optical channels is being upgraded from either 10 or 100G to 400G. Every institution that accepts our fiber-optic cable service is being upgraded to 100G. In the fall of 2022, the LONI Management Council authorized the LONI Executive Director to establish a cybersecurity framework within LONI to offer a managed service portfolio to its members, including but not limited to a Security Operations Center (SOC).

External Network Connectivity: LONI is currently the mid-south network connector to Internet2 with 2x100G connections supporting research and workforce development across our flagship, statewide, regional, and special institutions, including our community and technical college campuses. Researchers at LONI member schools have shown successful dynamic network allocation services using our ScienceDMZ across Internet2 through numerous NSF-awarded projects. We also have dedicated optical bandwidth with our border state through ARE-ON and LEARN. In 2019, LONI along with ARE-ON, LEARN, and OneNet created a consortium known as MUS-IX to own and operate an internet exchange point in Dallas, TX for the purpose of exploring and identifying opportunities for collaboration on networking, high-performance computing, procurement, and other areas to be defined by the participants. This consortium provides LONI with over 200G of commodity Internet and Internet and Content peering, and there is another 30G outside of MUS-IX.

LONI HPC Factoids

LONI provides Louisiana researchers with one of the most advanced optical networks in the country and the most powerful distributed high-performance computing (HPC) resources available to any academic community with just under 2 Petaflops of computational capacity. A brief glimpse of the HPC resources available to the community can be reviewed below.

- QB-2 cluster: a 480 node 16-way (8,144 total cores) Red Hat Enterprise Linux (RHEL v6) cluster (Intel 2.7 GHz 64-bit Ivy Bridge-EP processors), 64 GB to 1.5 TB of RAM per node, 56 Gbps (FDR) InfiniBand fabric, 481 pairs of NVIDIA K20X GPUs, 17 pairs of Intel Xeon Phi accelerators, 4 pairs of NVIDIA K40 GPUs, 1.5 PB Lustre file system (shared with QB-3).

- QB-3 cluster: QB3 a 202 node 24-way (79,696 total cores) Red Hat Enterprise Linux (RHELv6) cluster (Intel 2.4 GHz Cascade Lake processors), 193 GB to 1.5 TB RAM per node, 8 pairs of NVIDIA V100 GPUs, 100 Gbps (HDR) InfiniBand fabric, 1.5PB Luster file system (shared with QB-2).

In 2022, the State Legislature appropriated $12.5M to LONI for an AI Supercomputer. Shortly after that announcement in the following summer, LONI initiated an internal project to begin the process to source and fit the ISB for the arrival of this new machine during the summer of 2023.

Network connectivity and Data Center Infrastructure

LONI HPC is located in the LONI Science DMZ connected to Internet2 via two (2) dedicated 100 Gbps connections and other LONI member institutions through the LONI Network backbone ("LONI Core"), which operates at multiple 100/400 Gbps. In addition, the LONI network offers seven fully functional perfSONAR instrumentation nodes for performance monitoring and troubleshooting. Traffic between LONI HPC and other research IT systems within the DMZ is facilitated over 25/40/100 Gbps links, while users outside of the DMZ will be able to access ACCEL via a 1/10 Gbps link

LONI HPC system is housed in the state-owned data center known as the Information Systems Building (ISB). Within the ISB, LONI operations 2,124 ^{2} of raised floor space houses QB2 and QB3 HPC clusters, a VMWare virtual infrastructure, and the LONI Network optical router core and WAN infrastructure. The room has an 800KW battery UPS, redundant 100-ton chillers backed up by the State's Capital Park chilled water loop and ISB's forced-air cooling system, and three (3) 1.2 MW generators in an N+1 configuration. An FM-200 fire suppression system also protects the space. ISB is manned and monitored 24x7x365. LSU's Network Operation Center (NOC) monitors the power and cooling system within the room on a 24x7x365 basis. The GlobalNOC provides observation and situational awareness 24x7x365.

LONI/LBRN Summer Scientific Computing Bootcamp

Since 2016, responding to the community demands and collaborating with Louisiana Biomedical Research Network and Louisiana Optical Network Infrastructure, LONI HPC has been holding the one-week-long scientific computing bootcamp each summer. The bootcamp focuses on data analytics and AI/ML methods and covers content from basic theoretical background to hands-on practice using Python and R so that attendees can apply this knowledge directly into their course study and research projects. In the last few years, the bootcamp was attended by more than 150 faculty members, research staff, graduate, undergraduate, and high school students, many of whom come from the under-served institutions and HBCUs through REU, LONI, and LBRN.

LONI HPC training

LONI HPC offers weekly training tutorials year-round for 25-30 each year. They are open to anyone at the LONI institutions across the state, and the attendees can join the training either in-person or through remote video broadcasting. The tutorials include general topics such as introduction to Linux, shell scripting, parallel programming concepts, programming with MPI, OpenMP, Python, R, and Matlab, and domain science-specific topics such as computational chemistry, visualization, and computational fluid dynamics. In the past few years, responding to the research community's demand, we added GPU programming and an introduction to deep learning and its applications to our training portfolio.