This document details the equipment resident in the Holland Computing Center (HCC) as of August 2016.

HCC has two primary locations directly interconnected by a pair of 10 Gbps fiber optic links (20 Gbps total). The 1800 sq. ft. HCC machine room at the Peter Kiewit Institute (PKI) in Omaha can provide up to 500 kVA in UPS and genset protected power, and 160 ton cooling. A 2200 sq. ft. second machine room in the Schorr Center at the University of Nebraska-Lincoln (UNL) can currently provide up to 100 ton cooling with up to 400 kVA of power. Brocade MLXe routers, one in each location, provide both high bandwidth and Software Defined Networking (SDN) capability. The Schorr machine room connects to campus and Internet2/ESnet at 100 Gbps while the PKI machine room connects at 10 Gbps.

HCC’s resources at UNL include two distinct offerings: Sandhills and Red. Sandhills is a linux cluster dedicated to general campus usage with 5,408 compute cores interconnected by low-latency Infiniband networking. 175 TB of Lustre storage is complemented by 50 TB of NFS storage and 3 TB of local scratch per node.

The largest machine on the Lincoln campus is Red, with 6,960 job slots interconnected by a mixture of 1 Gb and 10 Gb ethernet. More importantly, Red serves up over 4.6 PB of storage using HDFS (Hadoop Distributed File System), an open source version of the file system Google uses. Red is integrated with the Open Science Grid (OSG), and serves as a major site for storage and analysis in the international high energy physics project known as CMS (Compact Muon Solenoid).

The largest HCC clusters, named Tusker and Crane, are located at PKI (Peter Kiewitt Institute) in Omaha. Tusker offers 6,784 cores interconnected with Mellanox QDR Infiniband along with 523TB of Lustre storage. Each compute node is an R815 server with at least 256 GB RAM and 4 Opteron 6272 (2.1 GHz) processors.

Crane debuted at 474 on the Top500 list with an HPL benchmark or 121.8 TeraFLOPS. Intel Xeon chips (8-core, 2.6 GHz) provide the processing with 4 GB RAM available per core and a total of 7,232 cores. The cluster shares 1.5 PetaBytes of lustre storage.

Attic and Silo form a near line archive with 1 PB of usable storage. Attic is located at PKI in Omaha, while Silo acts as an online backup located in Lincoln. Both Attic and Silo are connected with 10Gbps network connections.

Anvil is an OpenStack cloud environment consisting of 1,520 cores and 400TB of CEPH storage all connected by 10 Gb networking. The Anvil cloud exists to address needs of NU researchers that cannot be served by traditional scheduler-based HPC environments such as GUI applications, Windows based software, test environments, and persistent services.

These resources are detailed further below.

1. **HCC at UNL Resources**:

1.1 Sandhills

* 62 4-socket Opteron 6376 (2.3 Ghz/192GB RAM/64 bit) (64 cores per node)
* 42 4-socket Opteron 6128 (2.0 Ghz/128GB RAM/64 bit) (32 cores per node)
* 2   4-socket Opteron 6168 (1.9 Ghz/256GB RAM/64 bit) (48 cores per node)
* QLogic Infiniband (QDR)
* 1 and 10 GbE networking
	+ 5x Dell N3048 switches
* 50 TB shared storage (NFS) -> /home
* 175TB shared scratch storage (Lustre) -> /work
* 3TB local scratch

1.2 Red

* (USCMS Tier-2 resource, available opportunistically via the Open Science Grid)
* 60 2-socket Xeon E5530 (2.4GHz/64 bit) (16 cores per node)
* 20 2-socket Xeon E5520 (2.27 GHz/64 bit) (16 cores per node)
* 36 2-socket Xeon X5650 (2.67GHz/64 bit) (24 cores per node)
* 16 2-socket Xeon E5-2640 v3 (2.6GHz/64 bit) (32 cores per node)
* 40 2-socket Xeon E5-2650 v3 (2.3GHz/64 bit) (40 cores per node)
* 30 2-socket Opteron 2354 (2.2 GHz/64 bit) (8 cores per node)
* 28 2-socket Xeon E5-2650 v2 (2.6GHz/64 bit) (32 cores per node)
* 48 2-socket Xeon E5-2660 (2.2GHz/64 bit) (32 cores per node)
* 2 2-socket Xeon E5-1660 v3 (3.0GHz/64 bit) (16 cores per node)
* 4,600 TB HDFS storage (2,300 TB usable)
* Mix of 1GbE and 10GbE networking
	+ 1x Dell S6000-ON switch
	+ 1x Dell S4048-ON switch
	+ 5x Dell S3048-ON switches
	+ 2x Dell S4810 switches

1.3 Silo (backup mirror for Attic)

* 1 Mercury RM216 2U Rackmount Server 2 Xeon E5-2630 (2.6GHz/64 bit) (12 cores)
* 10 Mercury RM445J 4U Rackmount JBOD with 45x 4TB NL SAS Hard Disks

2. **HCC at PKI Resources**:

2.1 Tusker

* 106 PowerEdge R815 systems
	+ 102x with 256 GB RAM, 2x with 512GB RAM, 2x with 1024GB RAM
	+ 4-socket Opteron 6272 Interlagos (64-core, 2.1GHz / 64Bit)
* Mellanox QDR Infiniband
* 1 GbE networking
	+ 3x Dell Powerconnect 6248 switches
* 523TB Lustre storage over Infiniband

2.2 Crane

* 452 Relion 2840e systems from Penguin
	+ 452x with 64 GB RAM
	+ 2-socket Intel Xeon E5-2670 (8-core, 2.6GHz / 64Bit)
* Intel QDR Infiniband
* 1 and 10 GbE networking
	+ 1x QuantaMesh 10 GbE switch
	+ 11x QuantaMesh 1 GbE switches
* 1500 TB Lustre storage over Infiniband
* 3 Supermicro SYS-6016GT systems
	+ 3x with 48GB RAM
	+ 2-socket Intel Xeon E5620 (4-core 2.4GHz / 64Bit)
	+ 2 Nvidia M2070 GPUs
* 3 Supermicro SYS-1027GR-TSF systems
	+ 3x with 128GB RAM
	+ 2-socket Intel Xeon E5-2630 (6-core 2.3GHz / 64Bit)
	+ 3 Nvidia K20M GPUs
* 1 Supermicro SYS-5017GR-TF systems
	+ 1x with 32GB RAM
	+ 1-socket Intel Xeon E5-2650 v2 (8-core 2.6GHz / 64Bit)
	+ 2 Nvidia K40C GPUs
* 5 Supermicro SYS-2027GR-TRF systems
	+ 5x with 64GB RAM
	+ 2-socket Intel Xeon E5-2650 v2 (8-core 2.6GHz / 64Bit)
	+ 4 Nvidia K40M GPUs

2.3 Attic

* 1 Mercury RM216 2U Rackmount Server 2 Xeon E5-2630 (2.6GHz/64 bit) (12 cores)
* 10 Mercury RM445J 4U Rackmount JBOD with 45x 4TB NL SAS Hard Disks

2.4 Anvil

* 76 PowerEdge R630 systems
	+ 76x with 256GB RAM
	+ 2-socket Intel Xeon E5-2650 v3 (10-core, 2.3GHz / 64Bit)
	+ Dual 10Gb Ethernet
* 12 PowerEdge R730xd systems
	+ 12x with 128GB RAM
	+ 2-socket Intel Xeon E5-2630L v3 (8-core 1.8GHz / 64Bit)
	+ 12x 4TB NL SAS Hard Disks and 2x200GB SSD
	+ Dual 10Gb Ethernet
* 2 PowerEdge R320 systems
	+ 2x with 48GB RAM
	+ 1-socket Intel E5-2403 v3 (4-core 1.8GHz / 64Bit)
	+ Quad 10Gb Ethernet
* 10 GbE networking
	+ 6x Dell S4048-ON switches