TRANSIMS Training Course at TRACC

Transportation Research and Analysis Computing Center

Part 16

TRANSIMS on the TRACC Cluster
Best Practices

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Transportation Research and Analysis
Computing Center

Unit **16**

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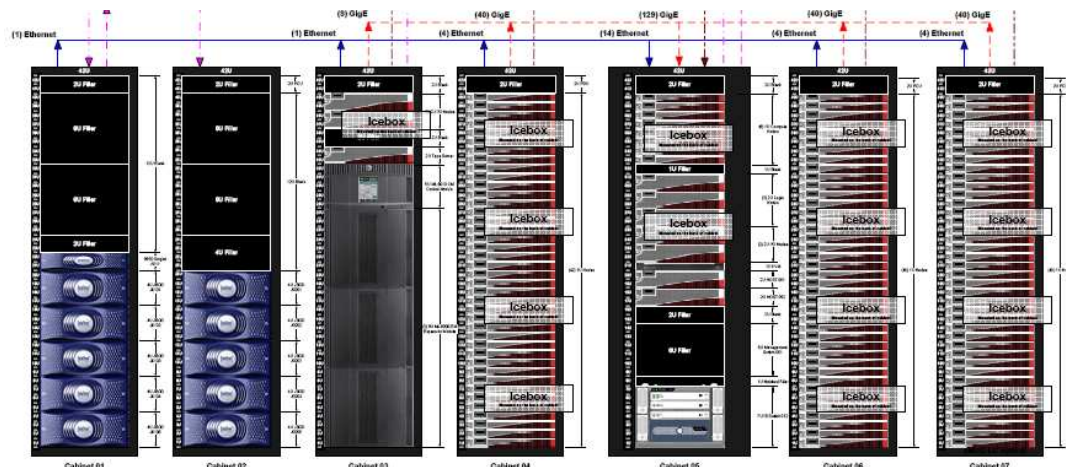# TRACC - High Performance Computing for Transportation Research and Applied Technology

- USDOT and USDOE transportation research programs, private industry and state and regional transportation agencies are moving to simulation based design and analysis for improvements in efficiency, economics and safety

- Higher fidelity analysis in areas such as crashworthiness, aerodynamics, combustion, thermal management, weather modeling and traffic simulation require access to state-of-the-art computational and visualization facilities

- ANL has the necessary expertise in high performance computing and transportation system analysis to provide both a national HPC user facility and a focal point for computational research for transportation applications

TRACC - High Performance Computing for Transportation Research and Applied Technology
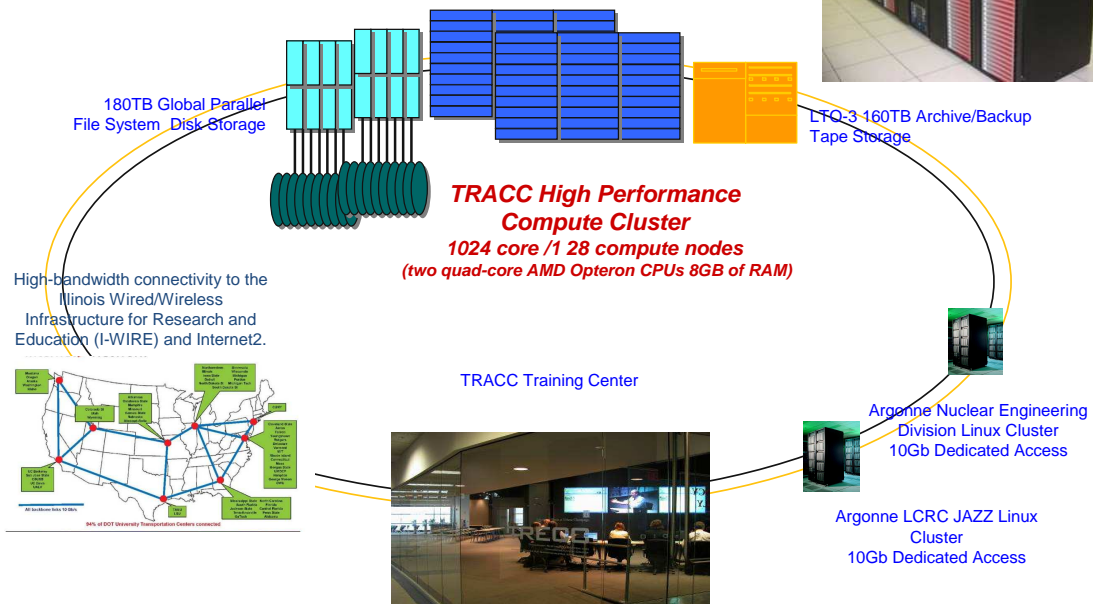
Thermal Management *

Crashworthiness *

Bridge Hydraulics*

Occupant Safety Assessment and Crash Biomechanics *

Bridge Structural Analysis *

Aerodynamics *

Intelligent Transportation Systems*

Road Weather Research *

Traffic Modeling *

TRACC HPC Configuration Diagram

The TRACC computational cluster is a customized system consisting of 1024 core 128 compute nodes, each with two quad-core AMD Opteron CPUs and 8GB of RAM, a DataDirect Networks storage system consisting of 180TB of shared RAID storage, expandable to 750TB, a high-bandwidth, low-latency InfiniBand network for computations, and a high-bandwidth Gigabit Ethernet management network. The system also includes the highest-performance compiler and MPI library available for the AMD Opteron architecture. with a peak performance of ~4 TFlops
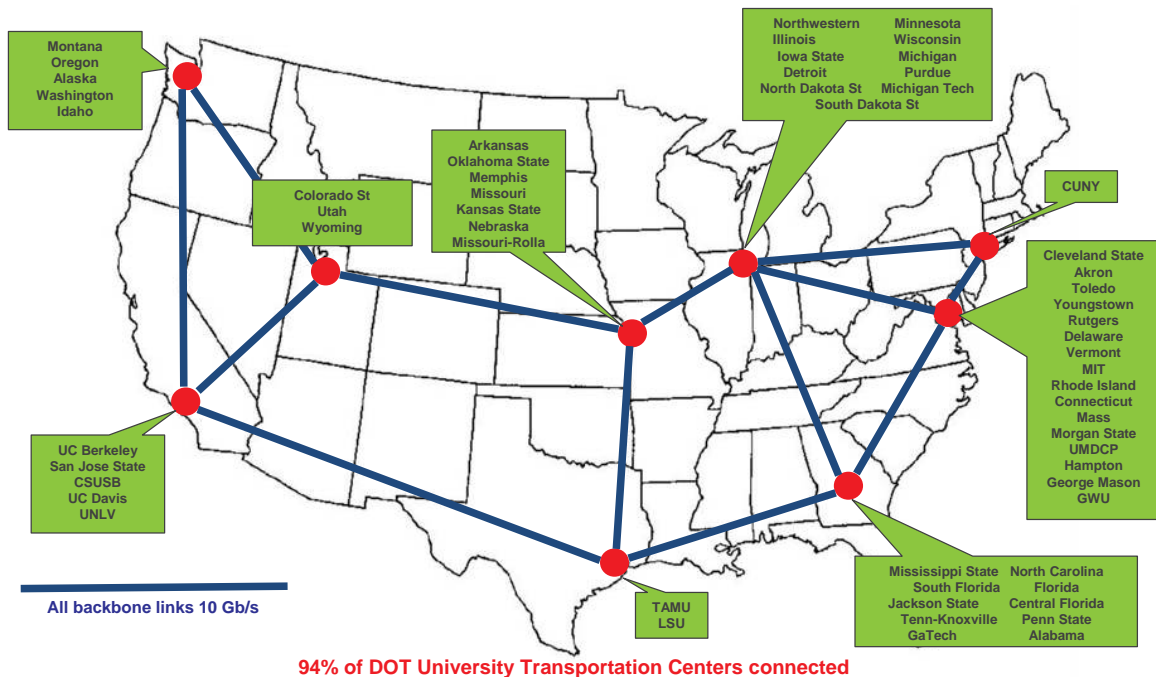
TRACC Is Being Built as a National DOT Supercomputer Facility

180TB Global Parallel File System Disk Storage

LTO-3 160TB Archive/Backup Tape Storage

TRACC High Performance Compute Cluster
1024 core /1 28 compute nodes
(two quad-core AMD Opteron CPUs 8GB of RAM)

High-bandwidth connectivity to the Illinois Wired/Wireless Infrastructure for Research and Education (I-WIRE) and Internet2.

TRACC Training Center

Argonne Nuclear Engineering Division Linux Cluster
10Gb Dedicated Access

Argonne LCRC JAZZ Linux Cluster
10Gb Dedicated Access

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Internet2 Network

Montana
Oregon
Alaska
Washington
Idaho

Northwestern Minnesota
Illinois Wisconsin
Iowa State Michigan
Detroit Purdue
North Dakota St Michigan Tech
South Dakota St

Arkansas
Oklahoma State
Memphis
Missouri
Kansas State
Nebraska
Missouri-Rolla

Colorado St
Utah
Wyoming

CUNY

Cleveland State
Akron
Toledo
Youngstown
Rutgers
Delaware
Vermont
MIT
Rhode Island
Connecticut
Mass
Morgan State
UMDCP
Hampton
George Mason
GWU

UC Berkeley
San Jose State
CSUSB
UC Davis
UNLV

Mississippi State North Carolina
South Florida Florida
Jackson State Central Florida
Tenn-Knoxville Penn State
GaTech Alabama

TAMU
LSU

All backbone links 10 Gb/s

94% of DOT University Transportation Centers connected

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Security Considerations

- SSH is at this time the only protocol provided for accessing the cluster remotely

- Accounts and passwords can be obtained through:
  - http://www.anl.gov/TRACC/Users/becoming.html

- Accounts are assigned under the rules of the Department of Energy

- Accounts are not allowed to be shared with anyone – sharing an account and password will result in a permanent loss of user privileges

- Don't expect any privacy when using the machine – this is a federal computing system and therefore subject to many restrictions

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Signup and Allocation

- The proposed project must be a large-scale, complex application of either national or regional transportation significance
- Massively parallel computing and visualization resources for the project are not readily available elsewhere
- The project should provide education, technology transfer, or training (capacity building for national, regional, state, and local transportation practioners)

Transportation Research and Analysis Computing Center
Request for Allocation of Services

Please complete the below information and send it to TRACC at: TRACC-Help@anl.gov, or fax it to: Karen Ley – 630-578-4257.

Project Name:		
Focus Area		
TRACC Contact/Sponsor		
Requester Contact Information:	Name:	
	Title:	
	Organization:	
	Address:	
	Telephone:	
	Fax:	
	Email:	
Cognizant Engineer or Sponsor: (USDOT, State DOT, TRB, ASSCHTO, USDOT Cooperative Research Programs:	Name:	
	Title:	
	Organization:	
	Address:	
	Telephone:	
	Fax:	
	Email:	

Conditions of Use

Security Notice

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The TRACC Cluster - Design

- All individual machines are based on the same hardware to increase reliability and compatibility across the system:
  - CPUs: Two Quad-Core AMD Opteron(tm) Processors
  - Clocking Speed: 2.4GHz
- 3 Login Servers provide user-level access to the cluster
  - Round robin assignment on a single public address, 8GB of memory
- 128 Computing Nodes with 8GB available through PBS job scheduling
- 2 Administrative Servers for cluster management
- 4 File Servers to provide a shared 180 Terabyte GPFS file system
- 1 Tape Server for backup services
- A 180TB shared RAID file system with 480 x 500GB SATA drives
- A 160TB tape capacity robot
- InfiniBand interconnectivity between servers and computing nodes
- Additional high speed Ethernet for management
- Performance is approximately 4 Tera Flops

Access to the TRACC Cluster

- Access to the TRACC cluster is provided primarily by SSH (secure shell) protocol
- Suggested Client Software:
  - SSH Secure Shell (www.ssh.com) for Windows (terminal access)
  - PuTTY (www.putty.org) for Windows (terminal access)
  - Standard ssh client software under Linux
  - WinSCP (winscp.net) for Windows (for efficient file access)
- Login is provided under a single address (round robin assignment to one of the three login servers):

login.tracc.anl.gov

- To use the cluster, an ANL domain account or collaborator account is required

http://www.anl.gov/TRACC/Users/becoming.html

Terminal Sessions

- SSH Secure Shell
  - Allows for terminal (tty) shell access
  - Provides a file manager for uploads and downloads
  - Commercial version is available
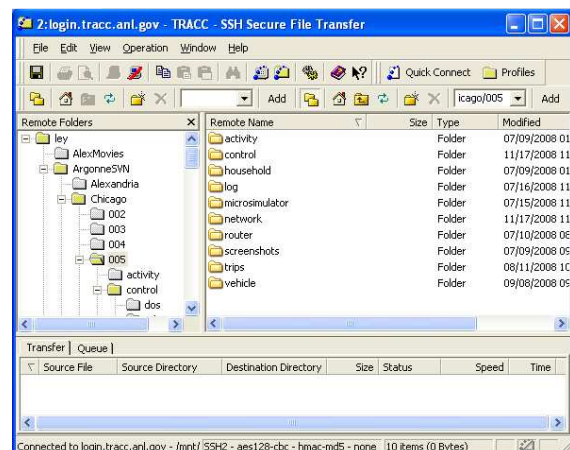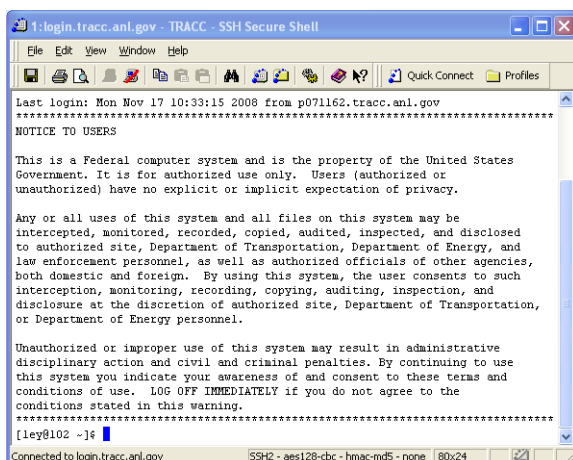
- Commercial Version at
  - www.ssh.com
- Comments on the non-commercial version at:
  - http://www.ssh.com/support/downloads/secureshellwks/non-commercial.html
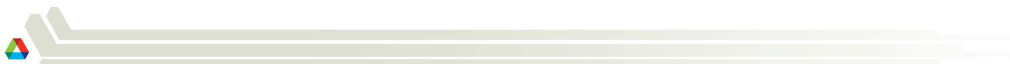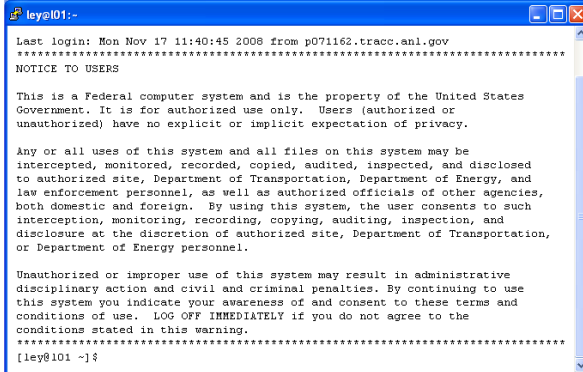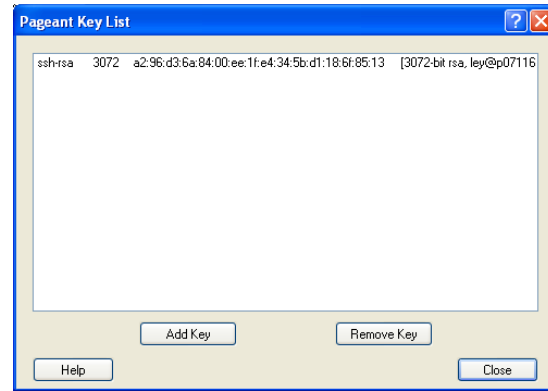
Terminal Sessions

- **PuTTY**
  - Open source software
  - Allows for terminal (tty) shell access
  - Authentication manager is available to cache private keys for multiple concurrent sessions
 - Does not support file downloading and uploading directly

- **Downloadable from**
  - http://www.chiark.greenend.org.uk/~sgtatham/putty/download.html
  - PuTTY can be run as a user application without installation
  - This is non-commercial software and can be used freely (under the conditions outlined in the license)

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Terminal Sessions and Remote File Managers

- **WinSCP**
  - File manager functionality only, no terminal sessions
  - But, WinSCP Interoperates easily with PuTTY
  - Allows better integration with Windows applications than SSH tools
- **Free software from**
  - Winsp.net
- **Sourceforge is an open source project just like TRANSIMS**
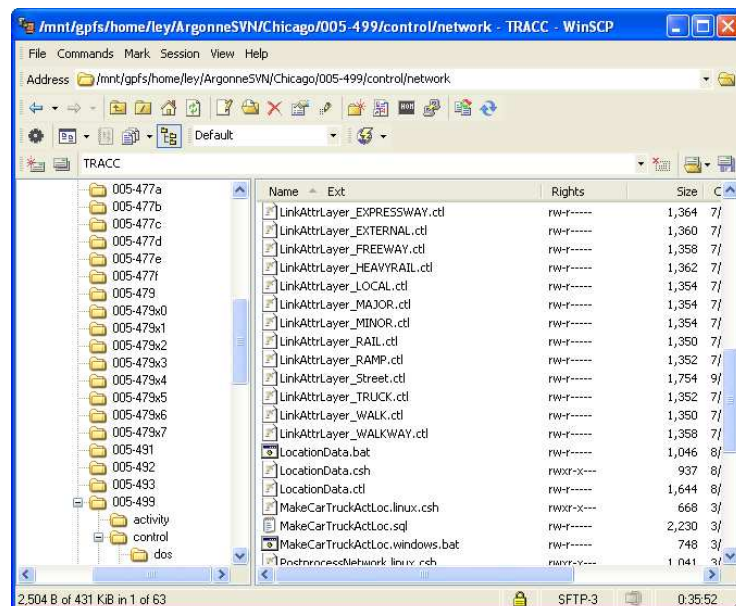

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Graphical Terminal Sessions

- **NoMachine NX**
  - Full screen Linux desktop
  - Efficient, secure, and fast
- **www.nomachine.com**
  - NX Client can be used to establish a complete desktop connection
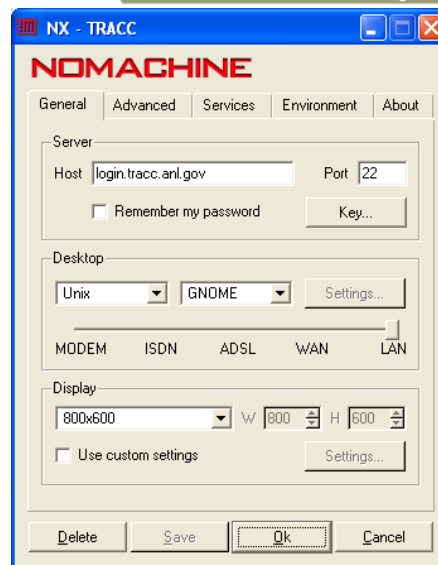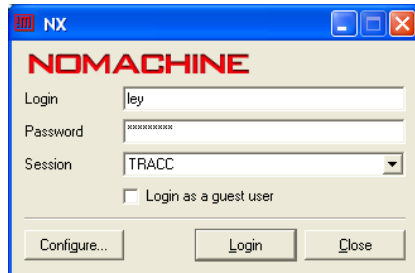
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Graphical Terminal Sessions

- Access to a complete Linux desktop
- Compressed data transfer
- Optimized for slow data connections, e.g. DSL
- Based on X protocol
- Can be used for nearly any Linux application
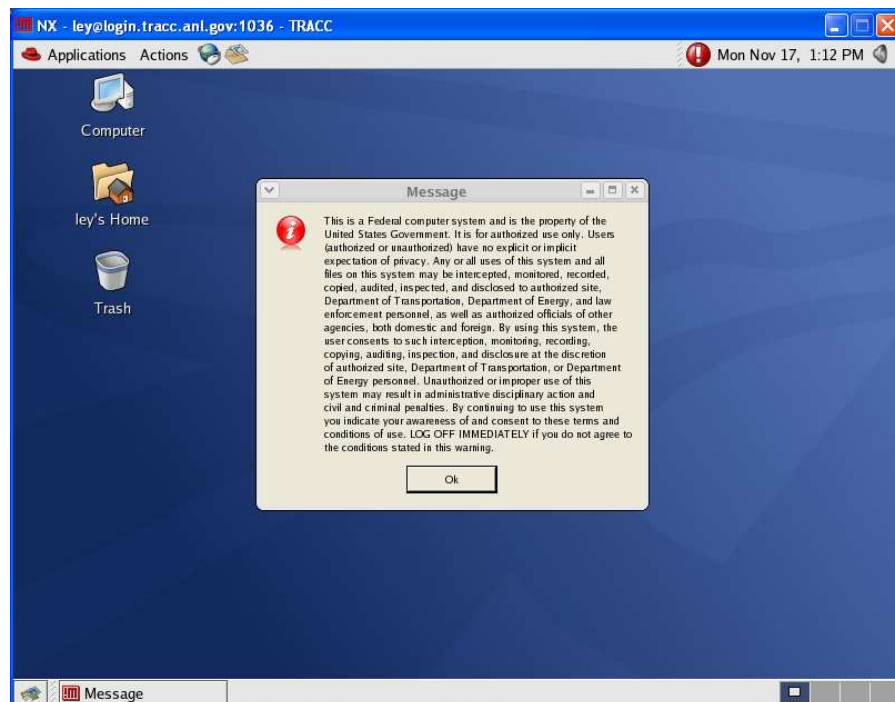
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## Job Control and Job Submission

- The three login servers are primarily used to access the cluster, to edit files, to prepare data, and to compile codes
  - The login nodes are shared by all users concurrently using the cluster
  - Each login node may provide access to dozens of users concurrently
  - No jobs should be run on these machines that require significant CPU time or memory

- The cluster nodes are assigned to run jobs through a job scheduling system (PBS – Portable Batch System)
  - Submission of jobs using "qsub"
  - Status inquiries using "qstat"
  - Details using "tracejob"

- Instructions can be found at:
  - https://wiki.anl.gov/tracc/Using_the_cluster

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TRACC User Support and Wiki

- Access to the cluster is currently restricted to pre-approved hosts. Please contact us with the static hostnames or IP addresses of the systems from which you would like to access the cluster.

- Under Windows, you can find out your host name and IP address with the command "ipconfig". Note that IP addresses beginning with "10." or "192.168." are private addresses, and are not accessible outside your own network. If you have such an address, you can find out your public address at (for example) http://whatismyip.com
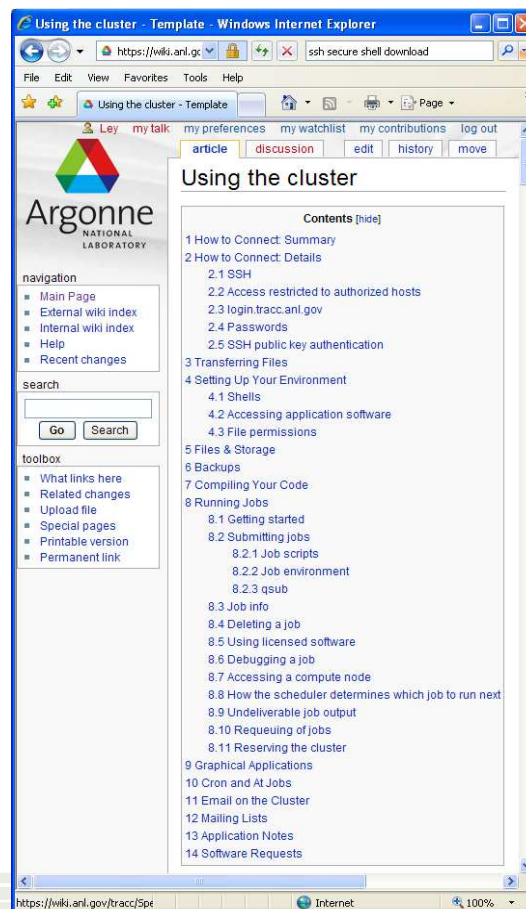
Credits and Acknowledgements

– USDOT provided the funding for the development of these training materials

– USDOT provided the funding for the TRACC computing center and the resources necessary to perform these training session