

CHTC Student Handbook

Edition 0.1

Center for High Throughput Computing

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1 Student Work 101

1.1 Tasks and Workflow

As a student worker for the CHTC you will be responsible for a large variety of tasks to help keep the CHTC Cluster up and running, but there are a few basic things you will find yourself doing most often. Our primary job is to fix individual machines in the cluster that go down. Most often machines can be brought down by kernel panics, networking issues, or hardware issues. To fix a machine, we take a simple approach to diagnose the issue and come up with a solution.

1. Diagnose the problem. You might need to plug into the machine with a console, or SSH into it if it is still online. If a machine kernel panics it will often print a memory stack trace to the console and freeze up. You will need to physically reboot the machine to proceed.
2. Find a solution. Often times rebooting the machine will clear up minor problems such as kernel panics or networking issues.
 - Kernel Panic (crash) - reboot, check server for errors.
 - Networking issue - reboot machine or restart networking, then go to advanced networking troubleshooting if still needed.
 - Hardware issue - diagnose the hardware issue and fix it. (Replace a bad disk, make note of a bad RAID card, etc)
3. Fix the problem and confirm that condor is running jobs again.
 - This might mean rebooting the machine, rebuilding the machine, replacing a bad disk and rebuilding, or something else entirely. Fix it if possible. If not - make note of the issue in the ticket and await further instructions.

Some other tasks you might be assigned include, but are not limited to: archiving condor releases to DVD, building new execute machines, working with Dell/Cisco Tech Support to get replacement parts, moving servers, and other random tasks assigned by full time CHTC staff.

1.2 RT Ticket System

We use the Request Tracker (RT) Ticket System for managing work at the CHTC. crt.cs.wisc.edu is the web address to access our Request Tracker. This will be your home for managing work tickets. The basic flow is: You are assigned a ticket, click on the ticket name to open it. By default, your 10 highest priority, or newest, tickets will be listed on your home page. You can view all of your tickets by clicking the "10 Highest Priority Tickets I Own" link (counter-intuitive, I know).

Once you have selected a ticket, you can read all correspondence related to that particular issue. Under the "actions" button (top right) the most common things you will do are "reply" and "resolve." Whenever you make changes to a machine, make sure to log what you did in the ticket. When the machine is fixed or the task is completed, you can resolve the ticket.

1.3 Monitoring Nodes

You can monitor the cluster on monitor0.chtc.wisc.edu. This has links to Icinga, our host monitoring application, Grafana, and Ganglia. All of these are extremely powerful tools that can be used to monitor the status of machines in the cluster and diagnose problems with individual nodes.

1.4 How to Use This Guide

- Any line or section beginning with "\$" is a command line operation. Enter it directly as it appears, without the preceding "\$".
- Any bracketed item (eg. [System Name]) needs to be replaced with the corresponding entity. (eg. change [System Name] → e1000.chtc.wisc.edu).

- Following the step-by-step walkthroughs to complete most basic tasks and use this as a reference manual.
- The appendix includes a complete list of node locations, useful for location a machine for physical changes (hard reboot, HDD swap, etc).

2 Rebuilding a Node

Rebuilding nodes is one of the primary responsibilities of student CHTC employees. Here's a step-by-step walkthrough for you.

1. Enable netboot in cobbler.

(a) Via Command Line:

- i. SSH into wid-service-1.chtc.wisc.edu
- ii. `$ sudo cobbler system edit --name=[server name] --netboot-enabled=True`
- iii. Check that netboot is enabled → `$ sudo cobbler system report --name=[server name]`
- iv. Sync Cobbler → `$ sudo cobbler sync`

(b) Via Web Interface

- i. Open Cobbler in your web browser
 - ii. Click on "Systems" under the Configuration tab on the left side.
 - iii. Find the node you want to rebuild and click on it's name in the list to open the node configuration tool.
 - iv. Alternatively, navigate directly to `wid-service-1.chtc.wisc.edu/cobbler_web/system/edit/[node name]`
 - v. Click on the "general" drop down button to reveal more options
 - vi. Check the "enable netboot" option
 - vii. Hit "save" on the bottom of the page
 - viii. When you are redirected to the cobbler system list page, hit "Sync" Under the Actions tab on the left side.
 - ix. Once you get a popup notification on the top-right of the screen, the sync has complete. This may take a few seconds.
- (c) Make sure you have the correct profile enabled in Cobbler as well. If you are doing a standard rebuild you probably won't have to change it, but make sure if it's a multi-disk execute node that it is set to the correct SL66 Exec profile.

2. Reboot the machine and netboot it.

- (a) Most machines are set to netboot by default, meaning if you reboot them they will search for a netboot entry and if they find it, they will netboot automatically. If a machine is not netbooting automatically, you may need to press a button on the keyboard (Often F12) when it POSTS in order to force it to netboot. If you have tried these and it still won't boot from the network, go into the BIOS and change the boot order to set netboot as boot priority #1.
- (b) If done correctly, it should launch the Scientific Linux installer. Once you see this is happening, move on to the next step.
- (c) To diagnose problems with the boot process, when the loading bar appears, you can press Alt+d to display a verbose boot screen.

3. Run Puppet.

- (a) We are going to need to run puppet once the machine is rebuilt in order to configure it.
- (b) While the machine is rebuilding, SSH into wid-service-1.chtc.wisc.edu
- (c) Run this command: `$ sudo puppetca -c [node name] on wid-service-1.`
- (d) If you do this before the machine finishes rebuilding, it may run puppet automatically when it rebuilds. To see if it is doing this: When the machine is booting Scientific Linux, hit an arrow key ← or →, or ALT+D on the console keyboard to view the verbose boot log. If the log is paused on "Starting: anamon... [OK] " for a while, that mean's it's running puppet. Good job! Once it finishes booting now, you should be able to log in with your username.
- (e) If the machine does not run puppet automatically, connect a console to the machine and log in as a root user (ask Admin for root login)

- (f) ON THE TARGET NODE: run `$ sudo rm -rvf /var/lib/puppet/ssl` (After clearing the puppet files from wid-service-1 in the previous steps). DO NOT RUN THIS ON wid-service-1.
 - (g) After clearing the puppet files from wid-service-1 in the previous steps, run `$ sudo rm -rvf /var/lib/puppet/ssl` on the target node. DO NOT RUN THIS ON wid-service-1.
 - (h) Then run `$ sudo puppetd -tv --configtimeout=1000`
 - (i) Note: Puppet will not run if networking is broken (try to restart networking or reboot the machine if this is the case) or the system clock is broken. To set the clock run: `$ rdate -s ntp.doit.wisc.edu`
4. Log in and confirm condor is running.
- (a) Once puppet finishes running, you should be able to log in with your own username
 - (b) Confirm condor is running: `$ condor_status $HOSTNAME`
 - (c) You should also see Condor running with `$ ps aux | grep condor`

3 Building a New Node

TODO - Flesh out this section.

Building a new node is very similar to rebuilding a current machine, with the added caveat of configuring the node in Cobbler and DHCP.

1. First, we need to create a new entry for the node in Cobbler. You should be provided a hostname and IP address to use for the new machine. You can create a new Cobbler entry via the Web interface or CLI.
 - Via Web Interface
 - Go to cobbler web.
 - Create a new system. The Easiest way to do this is to copy an existing entry and change the relevant information.
 - Open up the new machine entry you just created, change the hostname, the IP address, and MAC address, and make sure that the profile and image are set to the correct one.
 - Enable netboot, save it, and sync cobbler once it's configured correctly.
 - Via CLI
 - CLI instructions... TODO
2. Next, we need to create a DHCP entry for this machine.
 - DHCP is managed by different machines depending on the node location.
 - B240: cobbler-b240
 - 2360/CSL & WID Data Center: wid-service-1
 - 3370: host-6
 - SSH into the correct server and become root. Then open up dhcpd.conf in VIM.
 - Copy an exec node entry and edit it to create a new entry with the correct IP and MAC address of the new machine. Save the file.
 - run `$ service dhcpd restart` - if an error comes up, you screwed up the .conf file.

4 Decommissioning a Node

1. Label the server for spare parts with ticket #, or SWAP it.
 - If you SWAP a server, remove the HDDs and any hardware that might be useful (eg, RAM).
 - If it has a CSL Inventory Sticker, email the CSL with the Inventory number and tell them you are sending the server to SWAP.
 - Drop the server off in the SWAP area of the CS basement (by the elevators).
2. Remove it from the DHCP config.
 - SSH into the relevant DHCP server.
 - B240: cobbler-b240
 - 2360/CSL & WID Data Center: wid-service-1
 - 3370: host-6
 - Become root with `$ sudo -i`
 - Open up the dhcpd.conf file under /etc/dhcp/dhcpd.conf on the correct server.
 - Delete the entry for the server you are decommissioning.
 - Restart DHCP - Run `$ sudo service dhcpd restart`, make sure that it restarts OK. If not, you deleted something you shouldn't have.
3. Remove it's cobbler system object.
 - From the cobbler web interface, view the list of systems by going to https://wid-service-1.chtc.wisc.edu/cobbler_web/system/list
 - Locate the server on the list, and then press the "Delete" button next to it.
 - Sync cobbler. (Press the "Sync" button under actions.)
4. Remove it's puppet entry.
 - SSH into wid-service-1, and become root.
 - Open up the correct file in this directory: /etc/puppet/environments/production/modules/site/manifests/cthc/nodes/
 - B240: chtcexecsl66_b240.pp
 - 2360/CSL: chtcexecsl66_2360.pp
 - WID Data Center: chtcexecsl66_wid.pp
 - 3370: chtcexecsl66_3370a.pp
 - Delete the puppet entry for the server you are decommissioning.
5. Remove it's Icinga & Nagios entry.
 - Icinga
 - SSH into monitor0.chtc.wisc.edu
 - Become root and open up /etc/icinga2/conf.d/hosts.conf
 - Delete the entry for the server you are decommissioning.
 - Restart Icinga - Run `$ sudo service icinga2 restart`
 - Nagios
 - SSH into monitor.chtc.wisc.edu
 - Become root and open up /etc/nagios/objects/hosts.cfg
 - Delete the entry for the server you are decommissioning.
 - Restart Nagios - Run `$ sudo service nagios restart`
6. Remove it's htcondor configuration host/*.local file (Ask Moate to do this).

5 Creating Tickets

If you don't have any tickets assigned to you in your RT Queue that you can work on, then you can go ahead and create your own tickets for work that needs to be done.

We'll use a simple example to outline how to create tickets.

Let's say your queue is empty - you can log into Icinga (Or another monitoring tool that we use) to look for any nodes that might be offline or experiencing other issues.

1. Head to `monitor0.chtc.wisc.edu` in your browser.
2. Click on the link to Icinga, and log in (ask Admin for login info). This will take you to the Icinga dashboard. From here, you can get a basic overview of server status.
3. Look for machines listed under the "Host Problems" section.
 - Let's say we see a node, `e1000.chtc.wisc.edu`, listed under that section with the status message "Critical - Host Unreachable".
 - Click on that host to bring up information about it. From here, you can get a better overview of what's wrong with the machine. In this case, the machine is "Down" - offline for whatever reason. It might have crashed, it might be powered off, we don't know yet. All we know is that Icinga can't connect to it.
4. Great, now that we see a server is down, we need to check RT to see if a ticket already exists for this issue.
 - Log in to RT (`crt.cs.wisc.edu`) in a new tab.
 - Start a new search - select "New Search" under the "Tickets" tab at the top of the screen.
 - Enter the server name (`e1000`) in the "Subject" box, and make sure the relational selector is set to "Matches".
 - Click on "Add these terms and search".
5. At this point, you will either see (a) ticket(s) matching the server, or none at all. We want only want to have 1 ticket for managing each server, so it is important to not open new tickets when one already exists.
6. Let's say that you see several tickets that come up. First, check the ticket status.
 - If all tickets are "Resolved", then you are fine to re-open one. You will always re-open the most recent, or most-related ticket.
 - If there is an OPEN ticket related to the issue, then someone is already working on this issue and you can not continue creating a ticket.
 - If there are NO TICKETS matching, then you can create a new ticket.
7. If you want to re-open a closed ticket, first you will have to assign the ticket to yourself. Under the "People" Tab, choose your name from the "Owner" drop-down, and hit "Save Changes".
8. Then to re-open the ticket, hit "Re-Open" under the "Actions" tab.
 - You may now work on the ticket like you would any other.
9. If there are no tickets matching, you will need to create a new ticket.
 - At the top-right of the page next to the search bar is a ticket creation button. From the drop-down, select "htcondor-inf" - This will open the page to create a new ticket in the htcondor-inf queue.
 - In the right-most box labeled "Basics", put yourself in the "Owner" field and "CHTC" in the `inf_subgroup` field.

- In the left-most box, enter an appropriate subject ("e1000 down"), and a short-description if desired.
 - Click "Create" on the bottom of the page.
 - Assuming you made yourself the ticket owner, you will now see this ticket in your queue!
10. LASTLY, if you re-opened or created a new ticket, you need to acknowledge that you did so on Icinga so that other people won't create a duplicate ticket.
- Return to Icinga, and on the dashboard for that particular node, click on "Acknowledge" under the "Problem Handling" section.
 - enter a short message, (eg "Created a ticket - [your name]").
 - Hit "Acknowledge Problem" - And you're done!

Congratulations - you now know how to find problems on Icinga and create a ticket in order to fix it!

6 Checking for Errors

6.1 Monitoring with Icinga

6.1.1 Icinga Basics

6.1.2 Web Interface

6.1.3 Icinga CLI

6.2 Error Logs

6.3 Hardware Errors

7 Advanced Troubleshooting

TODO

8 Advanced Topics

8.1 Networking

8.1.1 Networking Basics

8.1.2 CHTC Network Structure

8.1.3 Troubleshooting Networking Issues

A Node Locations

A.1 B240

| Rack | A2 | A4 | C1 | C2 | C4 | E2 | E5 | E6 |
|------|------|---------|---------|------|------------|------|---------|---------|
| Node | c071 | mussel | e036 | c031 | atlas13 | e061 | atlas80 | atlas64 |
| | c061 | atlas18 | e027 | c032 | atlas14 | e060 | atlas81 | atlas65 |
| | c073 | atlas19 | e039 | c033 | atlas28 | e059 | atlas82 | atlas66 |
| | c074 | atlas20 | atlas17 | c011 | atlas15 | e058 | atlas83 | atlas67 |
| | c041 | e047 | atlas11 | c035 | starfish | e002 | atlas84 | atlas68 |
| | c076 | e035 | atlas12 | c037 | e013 | e025 | atlas85 | atlas69 |
| | c077 | e034 | atlas16 | c038 | e012 | e030 | atlas86 | atlas70 |
| | c078 | [[[| | c039 | e011 | e057 | atlas87 | atlas71 |
| | c064 | e006 | | c040 | spalding11 | e022 | atlas88 | atlas72 |
| | c080 | cobbler | | c021 | spalding10 | e040 | atlas89 | atlas73 |
| | c062 | e010 | | c022 | spalding09 | e023 | atlas90 | atlas74 |
| | c053 | e045 | | c023 | spalding08 | e018 | atlas91 | atlas75 |
| | c054 | e044 | | c024 | spalding07 | e016 | atlas92 | atlas76 |
| | c055 | [[[| | c025 | spalding06 | e026 | atlas93 | atlas77 |
| | c046 | e003 | | c026 | spalding05 | e028 | atlas95 | atlas78 |
| | c057 | | | c027 | c081 | e041 | atlas96 | atlas79 |
| | c058 | | | c028 | c082 | e038 | atlas97 | atlas08 |
| | c059 | | | c029 | c084 | e042 | atlas98 | atlas42 |
| | c060 | | | c030 | c085 | e046 | atlas99 | atlas62 |
| | e049 | | | c012 | c086 | e056 | | |
| | e050 | | | c013 | c088 | e052 | | |
| | e051 | | | c049 | c089 | e043 | | |
| | e054 | | | c015 | c090 | db1* | | |
| | e055 | | | c016 | | e460 | | |
| | e062 | | | c017 | | e461 | | |
| | e063 | | | c069 | | e462 | | |
| | e064 | | | c020 | | e463 | | |
| | e065 | | | c001 | | e464 | | |
| | e031 | | | c002 | | e465 | | |
| | | | | c004 | | | | |
| | | | | c070 | | | | |
| | | | | c065 | | | | |
| | | | | c007 | | | | |
| | | | | c008 | | | | |
| | | | | c009 | | | | |
| | | | | c010 | | | | |

| Rack | G1 | G2 | G5 | G6 |
|------|-----------|------|----------|---------|
| Node | satellite | e024 | [[[[]]]] | atlas45 |
| | e029 | e053 | atlas29 | atlas46 |
| | stress1 | e009 | atlas30 | atlas47 |
| | stress2 | e008 | atlas31 | atlas48 |
| | stress3 | e007 | atlas32 | atlas49 |
| | stress4 | e005 | atlas33 | atlas50 |
| | host-5 | e089 | atlas34 | atlas51 |
| | | e090 | atlas35 | atlas52 |
| | | e088 | atlas36 | atlas53 |
| | | e087 | atlas37 | atlas54 |
| | | e086 | atlas38 | atlas55 |
| | | e085 | atlas39 | atlas56 |
| | | e084 | atlas40 | atlas57 |
| | | e083 | atlas41 | atlas58 |
| | | e082 | atlas43 | atlas59 |
| | | e081 | | atlas60 |
| | | e080 | | atlas61 |
| | | e079 | | atlas63 |
| | | e078 | | |
| | | e077 | | |
| | | e076 | | |
| | | e075 | | |
| | | e074 | | |
| | | e073 | | |
| | | e072 | | |
| | | e071 | | |
| | | e072 | | |
| | | e069 | | |
| | | e068 | | |
| | | e067 | | |

A.2 2360/CSL

| Rack | GR 6 | GR 0 | GR 4 | GR 3 | 10 | GR 7 |
|------|---------|------|------|------|------|------|
| Node | atlas07 | e299 | e339 | e379 | e419 | e459 |
| | atlas04 | e298 | e338 | e378 | e418 | e458 |
| | atlas06 | e297 | e337 | e377 | e417 | e457 |
| | atlas05 | e296 | e336 | e376 | e416 | e456 |
| | atlas03 | e295 | e335 | e375 | e415 | e455 |
| | atlas02 | e294 | e334 | e374 | e414 | e454 |
| | mem2 | e293 | e333 | e373 | e413 | e453 |
| | mem1 | e292 | e332 | e372 | e412 | e452 |
| | gpu4 | e291 | e331 | e371 | e411 | e451 |
| | host-22 | e280 | e330 | e370 | e410 | e450 |
| | host-20 | e289 | e329 | e369 | e409 | e449 |
| | host-18 | e288 | e328 | e368 | e408 | e448 |
| | host-16 | e287 | e327 | e367 | e407 | e447 |
| | host-14 | e286 | e326 | e366 | e406 | e446 |
| | host-12 | e285 | e325 | e365 | e405 | e445 |
| | host-10 | e284 | e324 | e364 | e404 | e444 |
| | | e283 | e323 | e363 | e403 | e443 |
| | | e282 | e322 | e362 | e402 | e442 |
| | | e281 | e321 | e361 | e401 | e441 |
| | | e280 | e320 | e360 | e400 | e440 |
| | | e279 | e319 | e359 | e399 | e439 |
| | | e278 | e318 | e358 | e398 | e438 |
| | | e277 | e317 | e357 | e397 | e437 |
| | | e276 | e316 | e356 | e396 | e436 |
| | | e275 | e315 | e355 | e395 | e435 |
| | | e274 | e314 | e354 | e394 | e434 |
| | | e273 | e313 | e353 | e393 | e433 |
| | | e272 | e312 | e352 | e392 | e432 |
| | | e271 | e311 | e351 | e391 | e431 |
| | | e270 | e310 | e350 | e390 | e430 |
| | | e269 | e309 | e349 | e389 | e429 |
| | | e268 | e308 | e348 | e388 | e428 |
| | | e267 | e307 | e347 | e387 | e427 |
| | | e266 | e306 | e346 | e386 | e426 |
| | | e265 | e305 | e345 | e385 | e425 |
| | | e264 | e304 | e344 | e384 | e424 |
| | | e263 | e303 | e343 | e383 | e423 |
| | | e262 | e302 | e342 | e382 | e422 |
| | | e261 | e301 | e341 | e381 | e421 |
| | | e260 | e300 | e340 | e380 | e420 |

A.3 3370

| Rack | 1 | 4 | 5 | 6 | 7 | 8 | 9 | GR 5 |
|------|-------|-----------|------------------|------------|---------|----------|----------------|------------|
| Node | e198 | swamp-nas | osghost | host-6 | e222 | submit-4 | e116 | spalding-4 |
| | e197 | swamp05 | itb-data1 | pagesubmit | e220 | host-23 | e117 | spalding-1 |
| | e196 | swamp04 | itb-data2 | atlas21 | e219 | host-21 | nmi-0067 | spalding-2 |
| | e195 | swamp03 | itb-data3 | atlas22 | e215 | host-19 | e115 | spalding-3 |
| | e194 | swamp02 | itb-data4 | atlas27 | e214 | host-17 | gpu-1 | |
| | e193 | swamp01 | itb-data5 | atlas26 | e119 | host-15 | [??? | |
| | e192 | | itb-data6 | atlas25 | e212 | host-13 | atlas10 | |
| | e191 | | itb-host1 | atlas24 | e211 | host-11 | atlas09 | |
| | e190 | | itb-host2 | atlas23 | e210 | e238 | e111 | |
| | e189 | | itb-host3 | | e209 | e237 | matlab-build-5 | |
| | e188 | | vdt-bastion | | e208 | e236 | e113 | |
| | e187 | | vdt-centos5-test | | e207 | e235 | e112 | |
| | e186 | | vdt-debian6-test | | e206 | e234 | e246 | |
| | e185 | | vdt-debian7-test | | e205 | e233 | e245 | |
| | e184 | | | | e204 | e232 | e244 | |
| | e183 | | | | e203 | e231 | e243 | |
| | e182 | | | | e202 | e230 | e242 | |
| | e181 | | | | e201 | e229 | e241 | |
| | e180 | | | | e200 | e228 | e240 | |
| | e179 | | | | e199 | e227 | e239 | |
| | e178 | | | | host-24 | e226 | e259 | |
| | e177 | | | | | e225 | e258 | |
| | e176 | | | | | e224 | e256 | |
| | e175 | | | | | e223 | e255 | |
| | e174 | | | | | | e254 | |
| | e173 | | | | | | e253 | |
| | e172 | | | | | | e252 | |
| | e171 | | | | | | e251 | |
| | e170 | | | | | | e250 | |
| | e169 | | | | | | e249 | |
| | e168 | | | | | | e248 | |
| | e167 | | | | | | e247 | |
| | e166 | | | | | | | |
| | e165 | | | | | | | |
| | e164* | | | | | | | |
| | e163 | | | | | | | |
| | e162 | | | | | | | |
| | e161 | | | | | | | |
| | e160 | | | | | | | |
| | e159 | | | | | | | |
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| | e156 | | | | | | | |
| | e155 | | | | | | | |
| | e154 | | | | | | | |
| | e153 | | | | | | | |
| | e152 | | | | | | | |
| | e151 | | | | | | | |

A.4 WID Data Center

| Rack | A14 | A12 | B1 | B5 |
|------|------|----------------|----------------|------|
| Node | e093 | deepdivesubmit | wid-003 | e110 |
| | e094 | host-3 | [??? | e109 |
| | e095 | [??? | e019 | e108 |
| | e121 | [??? | e017 | e107 |
| | e122 | [??? | e020 | e106 |
| | e123 | host-7 | e033 | e105 |
| | e124 | submit-5 | e021 | e104 |
| | e125 | [??? | e014 | e103 |
| | e126 | quickstep | e015 | e102 |
| | e127 | wid-service-1 | matlab-build-1 | e101 |
| | e128 | e092 | e001 | e100 |
| | e129 | osg-ss-se | e091 | e099 |
| | e130 | [batlab] | [??? | e098 |
| | e131 | host-1 | [??? | e097 |
| | e132 | hypervisor0 | [??? | e096 |
| | e133 | | | |
| | e134 | | | |
| | e135 | | | |
| | e136 | | | |
| | e137 | | | |
| | e138 | | | |
| | e139 | | | |
| | e140 | | | |
| | e141 | | | |
| | e142 | | | |
| | e143 | | | |
| | e144 | | | |
| | e145 | | | |
| | e146 | | | |
| | e147 | | | |
| | e148 | | | |
| | e149 | | | |
| | e150 | | | |

| Rack | Z1-R11 | Z1-R10 | Z1-R8 | Z1-R7 | Z1-R5 | Z2-R11 | Z2-R10 | Z2-R8 | Z2-R7 | Z2-R5 |
|------|---------|---------|----------------|---------------|---------|---------|---------|---------|---------|---------|
| Node | aci-336 | aci-288 | aci-storage-7 | aci-service-1 | aci-144 | aci-096 | aci-048 | aci-192 | aci-240 | aci-344 |
| | aci-335 | aci-287 | aci-storage-8 | aci-service-2 | aci-143 | aci-095 | aci-047 | aci-191 | aci-239 | aci-343 |
| | aci-334 | aci-286 | aci-storage-9 | aci-service-3 | aci-142 | aci-094 | aci-046 | aci-190 | aci-238 | aci-342 |
| | aci-333 | aci-285 | aci-storage-10 | aci-storage-1 | aci-141 | aci-093 | aci-045 | aci-189 | aci-237 | aci-341 |
| | aci-332 | aci-284 | aci-storage-11 | aci-storage-2 | aci-140 | aci-092 | aci-044 | aci-188 | aci-236 | aci-340 |
| | aci-331 | aci-283 | aci-storage-12 | aci-storage-3 | aci-139 | aci-091 | aci-043 | aci-187 | aci-235 | aci-339 |
| | aci-330 | aci-282 | aci-storage-13 | aci-storage-4 | aci-138 | aci-090 | aci-042 | aci-186 | aci-234 | aci-338 |
| | aci-329 | aci-281 | aci-storage-14 | aci-storage-5 | aci-137 | aci-089 | aci-041 | aci-185 | aci-233 | aci-337 |
| | aci-328 | aci-280 | aci-storage-15 | aci-storage-6 | aci-136 | aci-088 | aci-040 | aci-184 | aci-232 | |
| | aci-327 | aci-279 | aci-storage-16 | | aci-135 | aci-087 | aci-039 | aci-183 | aci-231 | |
| | aci-326 | aci-278 | | | aci-134 | aci-086 | aci-038 | aci-182 | aci-230 | |
| | aci-325 | aci-277 | | | aci-133 | aci-085 | aci-037 | aci-181 | aci-229 | |
| | aci-324 | aci-276 | | | aci-132 | aci-084 | aci-036 | aci-180 | aci-228 | |
| | aci-323 | aci-275 | | | aci-131 | aci-083 | aci-035 | aci-179 | aci-227 | |
| | aci-322 | aci-274 | | | aci-130 | aci-082 | aci-034 | aci-178 | aci-226 | |
| | aci-321 | aci-273 | | | aci-129 | aci-081 | aci-033 | aci-177 | aci-225 | |
| | aci-320 | aci-272 | | | aci-128 | aci-080 | aci-032 | aci-176 | aci-224 | |
| | aci-319 | aci-271 | | | aci-127 | aci-079 | aci-031 | aci-175 | aci-223 | |
| | aci-318 | aci-270 | | | aci-126 | aci-078 | aci-030 | aci-174 | aci-222 | |
| | aci-317 | aci-269 | | | aci-125 | aci-077 | aci-029 | aci-173 | aci-221 | |
| | aci-316 | aci-268 | | | aci-124 | aci-076 | aci-028 | aci-172 | aci-220 | |
| | aci-315 | aci-267 | | | aci-123 | aci-075 | aci-027 | aci-171 | aci-219 | |
| | aci-314 | aci-266 | | | aci-122 | aci-074 | aci-026 | aci-170 | aci-218 | |
| | aci-313 | aci-265 | | | aci-121 | aci-073 | aci-025 | aci-169 | aci-217 | |
| | aci-312 | aci-264 | | | aci-120 | aci-072 | aci-024 | aci-168 | aci-216 | |
| | aci-311 | aci-263 | | | aci-119 | aci-071 | aci-023 | aci-167 | aci-215 | |
| | aci-310 | aci-262 | | | aci-118 | aci-070 | aci-022 | aci-166 | aci-214 | |
| | aci-309 | aci-261 | | | aci-117 | aci-069 | aci-021 | aci-165 | aci-213 | |
| | aci-308 | aci-260 | | | aci-116 | aci-068 | aci-020 | aci-164 | aci-212 | |
| | aci-307 | aci-259 | | | aci-115 | aci-067 | aci-019 | aci-163 | aci-211 | |
| | aci-306 | aci-258 | | | aci-114 | aci-066 | aci-018 | aci-162 | aci-210 | |
| | aci-305 | aci-257 | | | aci-113 | aci-065 | aci-017 | aci-161 | aci-209 | |
| | aci-304 | aci-256 | | | aci-112 | aci-064 | aci-016 | aci-160 | aci-208 | |
| | aci-303 | aci-255 | | | aci-111 | aci-063 | aci-015 | aci-159 | aci-207 | |
| | aci-302 | aci-254 | | | aci-110 | aci-062 | aci-014 | aci-158 | aci-206 | |
| | aci-301 | aci-253 | | | aci-109 | aci-061 | aci-013 | aci-157 | aci-205 | |
| | aci-300 | aci-252 | | | aci-108 | aci-060 | aci-012 | aci-156 | aci-204 | |
| | aci-299 | aci-251 | | | aci-107 | aci-059 | aci-011 | aci-155 | aci-203 | |
| | aci-298 | aci-250 | | | aci-106 | aci-058 | aci-010 | aci-154 | aci-202 | |
| | aci-297 | aci-249 | | | aci-105 | aci-057 | aci-009 | aci-153 | aci-201 | |
| | aci-296 | aci-248 | | | aci-104 | aci-056 | aci-008 | aci-152 | aci-200 | |
| | aci-295 | aci-247 | | | aci-103 | aci-055 | aci-007 | aci-151 | aci-199 | |
| | aci-294 | aci-246 | | | aci-102 | aci-054 | aci-006 | aci-150 | aci-198 | |
| | aci-293 | aci-245 | | | aci-101 | aci-053 | aci-005 | aci-149 | aci-197 | |
| | aci-292 | aci-244 | | | aci-100 | aci-052 | aci-004 | aci-148 | aci-196 | |
| | aci-291 | aci-243 | | | aci-099 | aci-051 | aci-003 | aci-147 | aci-195 | |
| | aci-290 | aci-242 | | | aci-098 | aci-050 | aci-002 | aci-146 | aci-194 | |
| | aci-289 | aci-241 | | | aci-097 | aci-049 | aci-001 | aci-145 | aci-193 | |

B List of Resources

TODO - A useful list of external resources.

- <http://pages.cs.wisc.edu/~van-lyse/> - Neil's CS Page contains tons of useful CHTC links.
- monitor0.chtc.wisc.edu - Our webpage for server monitoring. Contains links to Icinga, Grafana, Ganglia, and more.

C Glossary

TODO - Glossary of terms commonly used in this manual and in daily work.

- Cobbler - Cobbler is a frontend tool for configuring Linux network installs with PXE boot. Learn more: <http://cobbler.github.io/>
- Icinga - An open-source system monitoring tool with a web interface. Our Icinga server is at `monitor0.chtc.wisc.edu`. Learn more at: <https://www.icinga.org/>
- Puppet - Puppet is a tool for managing automatic configuration of systems. Our puppetmaster machine is `wid-service-1`. Learn more: <https://puppet.com/>
- RT (Request Tracker) - Ticket-tracking software. Access RT at: <https://crt.cs.wisc.edu/rt/>