ballarat 2012
linux.conf.au
16 - 20 January 2012

# Time to harden up

## SELinux is no longer an option

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# SELinux

- Overview
- How to use it
- Retrofit



NOT

# Code

```
/* selinuxfs pseudo filesystem for exporting the security policy API.
Based on the proc code and the fs/nfsd/nfsctl.c code. */

#include "flask.h"
#include "avc.h"
#include "avc_ss.h"
#include "security.h"
#include "objsec.h"
#include "conditional.h"

/* Policy capability filenames */
static char *policycap_names[] = {
"network_peer_controls",
"open_perms"
};
```



NOT


http://www.flickr.com/potos/wwarby/5109439137/

# Real


MUSIC TELEVISION®

# First ?

OFF

# Why?

# Install Notes

# Tivoli Asset Management for IT

Tivoli Asset Management for IT > Installing Tivoli Asset Management for IT > Installing Software Knowledge Base Toolkit, version 1.2 > Installation requirements for version 1.2

Tivoli. Software Knowledge Base Toolkit, Version 1.2

## Setting SELinux to permissive mode when installing the content management server on Red Hat Enterprise Linux 5

Red Hat Enterprise Linux® 5 enables SELinux by default which interferes with the installation process of Software Knowledge Base Toolkit. To ensure the proper installation and usage of the toolkit, the SELinux setting must be changed from the *enforcing* mode to either *permissive* or *disabled* mode.

**Procedure**

- If you want to disable SELinux only for the installation process, use the setenforce 0 command to set the SELinux to permissive mode.

  **Note:** SELinux will be fully enabled again the next time the system is restarted or if when the setenforce 1 command is entered on the command line.

- If you want to permanently disable SELinux, go to the SELinux configuration file that is located in the `/etc/selinux/` directory and set the value of the **SELINUX** attribute to *permissive* or *disabled*.

  **Note:** Note that in the case of server installation, the SELinux enforcing mode cannot be set back to its default value on Red Hat Enterprise Linux 5 because then the server will stop working correctly.



# Permissive
# !=
# ON

# Permissive

# =

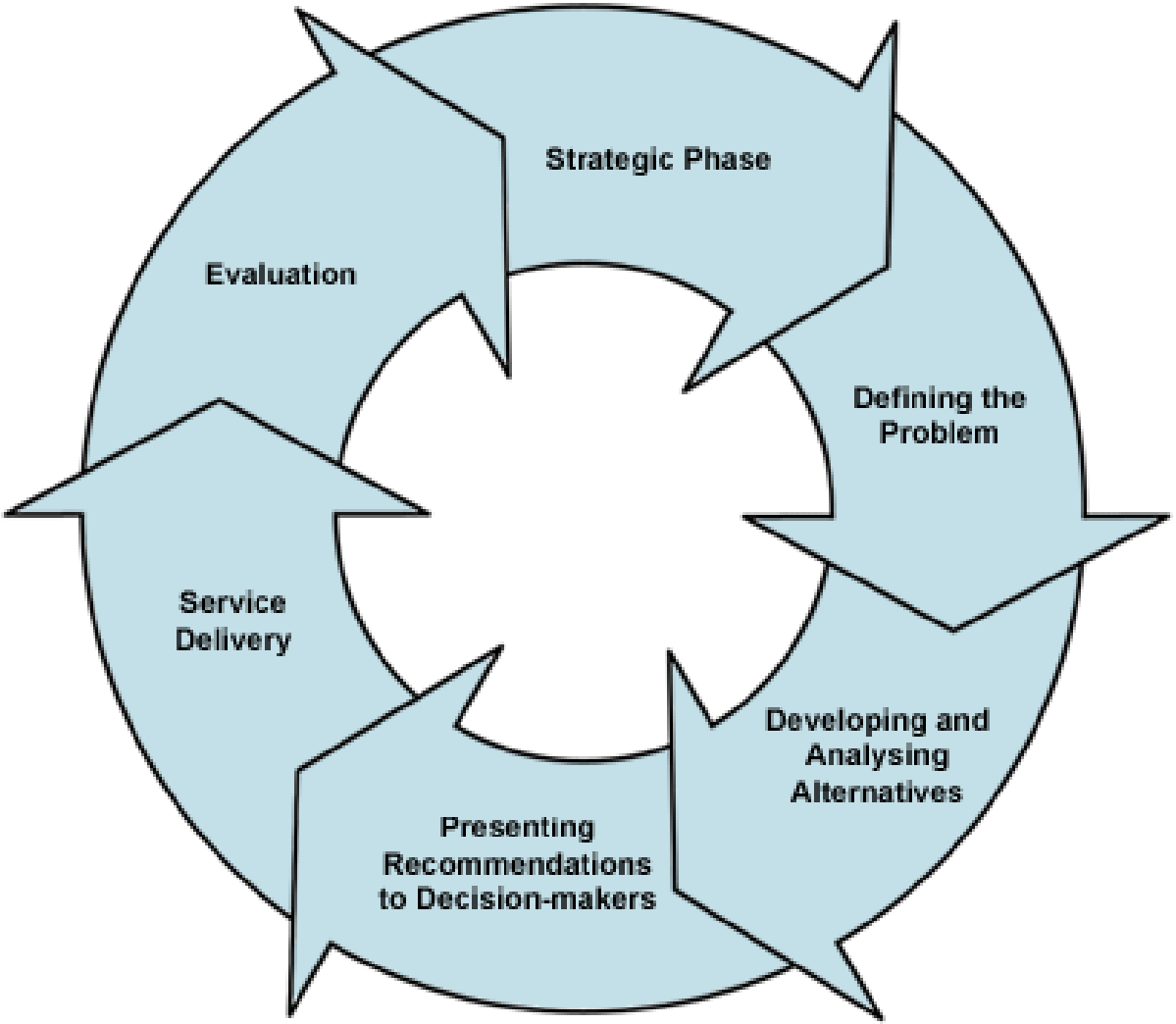
# Testing

# Enabled

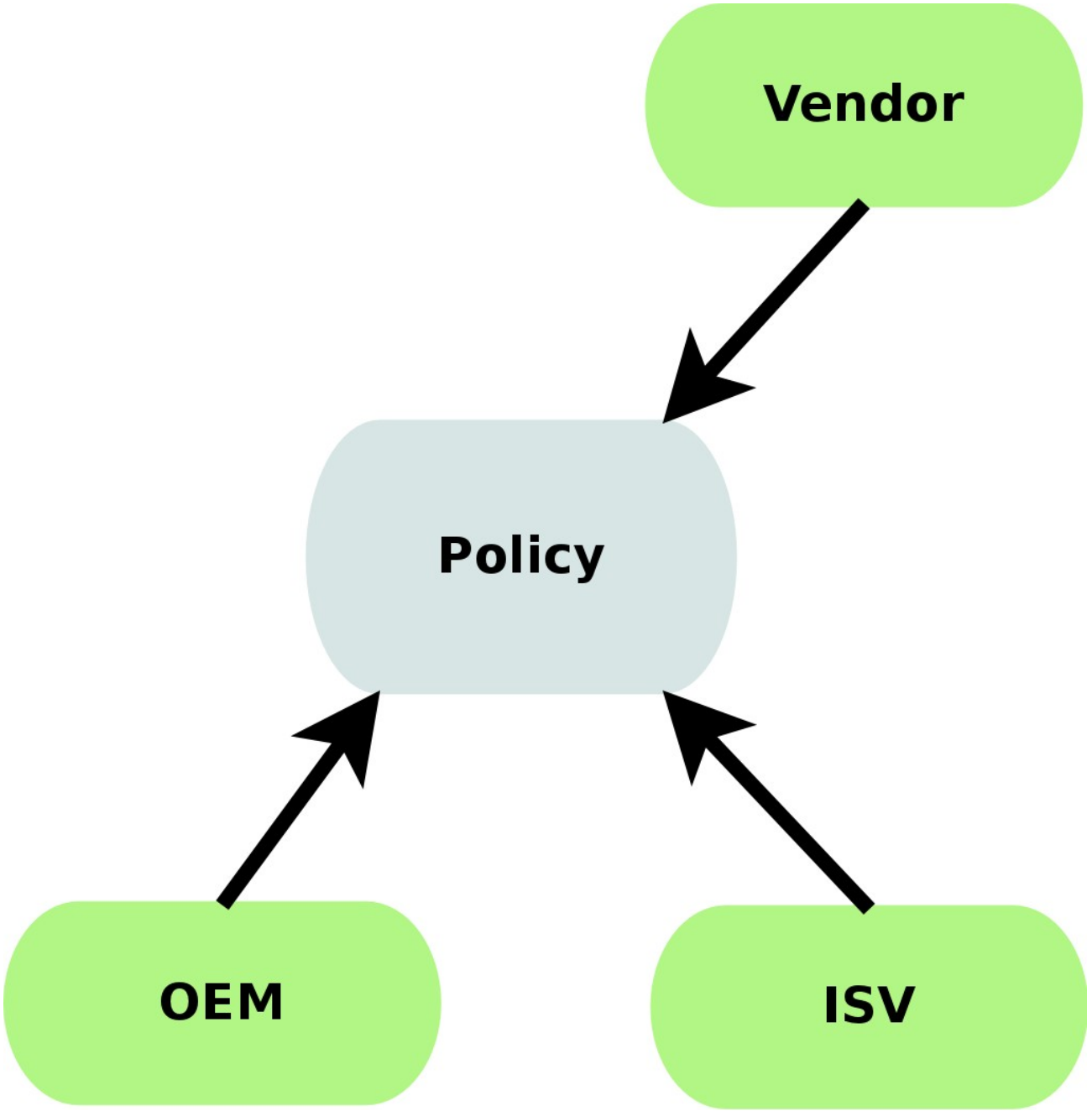
# Enabled
# &
# Enforcing

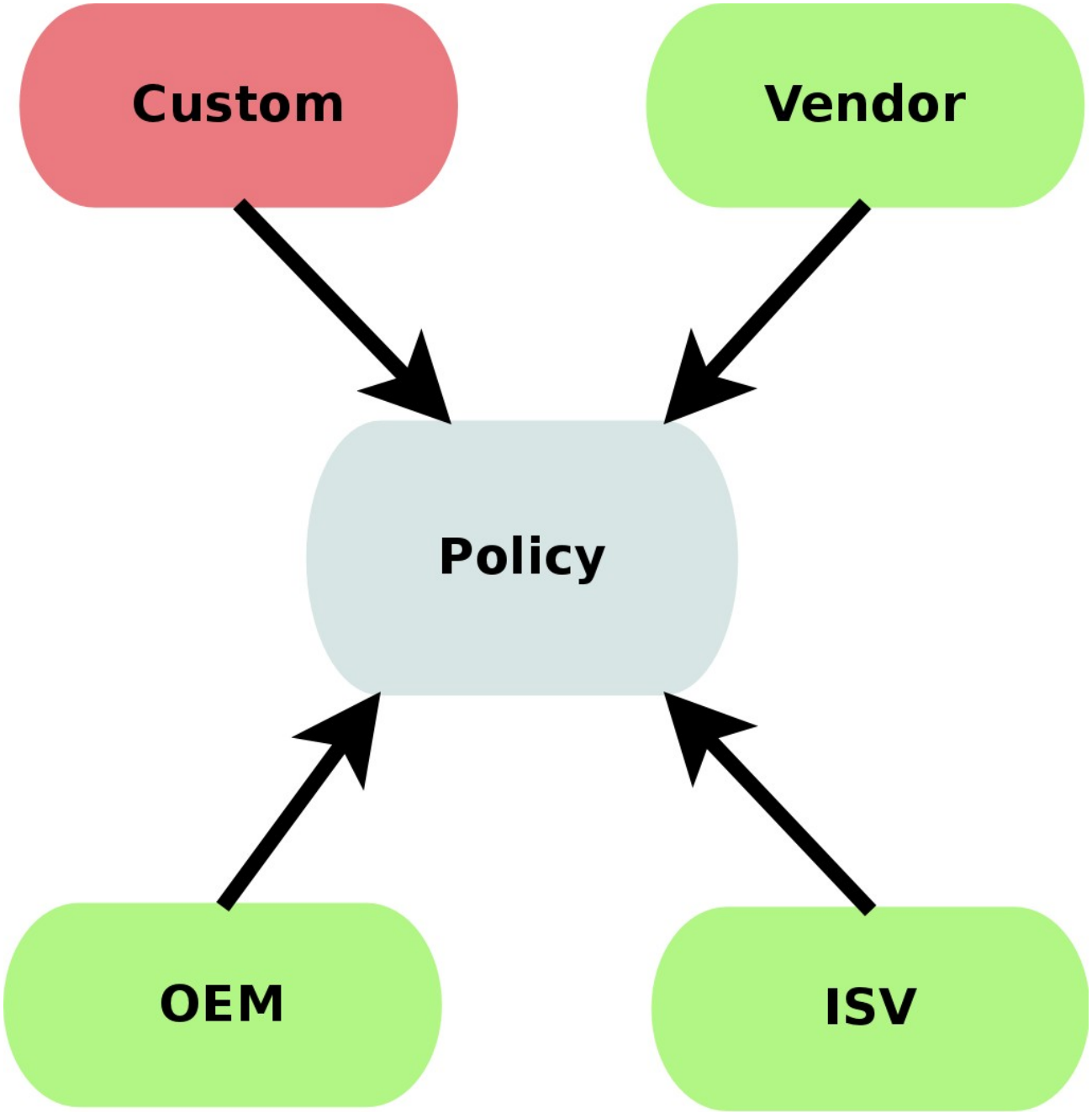

Dilbert © Scott Adams

# Policy




http://www.population.govt.nz/tools-and-resources/policy-development-cycle.aspx


Vendor
Policy
OEM
ISV


Custom
Vendor
Policy
OEM
ISV

# What

# A brief history

- Created by the United States National Security Agency (NSA) as set of patches to the Linux kernel using Linux Security Modules (LSM)
- Released by the NSA under the GNU General Public License (GPL) in 2000
- Adopted by the upstream Linux kernel in 2003
  - Red Hat Enterprise Linux since RHEL 4
  - Debian from etch
  - Ubuntu from 8.04



# What is SELinux?

- MAC vs. DAC
- Labeling
- Type Enforcement
- Policy



# MAC vs. DAC

- Typical Unix/Linux: Discretionary Access Control (DAC)
  - User ownership
  - Group ownership
  - Permissions
- If I want, I have the ability (discretion) to `chmod +rwx` my home directory. Nothing will stop me, and in a DAC system, nothing will stop others from getting in.



# MAC vs. DAC

- In DAC systems, `root` is omnipotent.




# MAC vs. DAC

- SELinux system: Mandatory Access Control (MAC)
- On MAC systems, policy is set centrally and fixed
- Even if you change the DAC settings on your home directory, if a mandatory system policy is in place which prevents another user or process from accessing it, you're generally safe.



# MAC vs. DAC

- MAC can be incredibly fine grained. Policies can be set to determine access between:
  - Users
  - Files
  - Directories
  - Memory
  - Sockets
  - tcp/udp ports
  - etc...



# Labeling

- Different components of the system - files, directories, running processes, sockets, ports, users and so on – are assigned different labels for their security context.



# Labeling

- For example, in the Apache web server, you'll see the following labels:
  - /usr/sbin/httpd has the context system_u:object_r:httpd_exec_t:s0
  - /etc/httpd/ has the context system_u:object_r:httpd_config_t:s0
  - /var/www/html/ has the context system_u:object_r:httpd_sys_content_t:s0
  - /var/log/httpd/ has the context system_u:object_r:httpd_log_t:s0



# Labeling

- For example, in the Apache web server, you'll see the following labels:
  - /usr/lib64/httpd/modules/ has the context system_u:object_r:httpd_modules_t:s0
  - /etc/rc.d/init.d/httpd has the context system_u:object_r:httpd_initrc_exec_t:s0
  - ...etc



# Labeling

- When httpd is run, it has the label unconfined_u:system_r:httpd_t:s0
- The http ports (80, 443, 488, 8008, 8009, 8443) are labeled http_port_t



# Labeling

- These labels are used to enforce policies.



# Labeling

- There are other fields in the SELinux context
  - system_u:object_r:httpd_exec_t:s0
  - User (root, unconfined_u, user_u, system_u)
    - Not the same as Linux user! There are usually a very limited number of SELinux users, and typically all regular Linux users will run as the same SELinux user
    - User files and processes will typically be labeled unconfined_u
    - System files and processes will often be labeled system_u
  - SELinux User is not used in targeted policy



# Type Enforcement

- Type enforcement is just a definition of how types interact.
- Processes running with httpd_t context should probably be able to access the configuration files labeled with httpd_config_t
- Processes running with httpd_t context should probably not be able to access files with type shadow_t!



# Policy

- Policy is just the rule set that defines how these labeled objects interact
- The default policy in RHEL 6 is the targeted policy.
  - Unless covered by a targeted policy, processes run unconfined.
  - Hundreds of apps covered by policy.
- The MLS/MCS policies are far more fine grained
  - If not explicitly allowed, everything is denied.



# Why

# Where


Dilbert © Scott Adams



# Why Not?

# How

# Turn it on

```
# setenforce –help
usage:  setenforce [ Enforcing | Permissive | 1 | 0 ]
# setenforce 1
```



# Check it is on

```
# getenforce
Enforcing
# cat /etc/selinux/config

# This file controls the state of SELinux on the system.
# SELINUX= can take one of these three values:
#     enforcing - SELinux security policy is enforced.
#     permissive - SELinux prints warnings instead of enforcing.
#     disabled - No SELinux policy is loaded.
SELINUX=enforcing
# SELINUXTYPE= can take one of these two values:
#     targeted - Targeted processes are protected,
#     mls - Multi Level Security protection.
SELINUXTYPE=targeted
```



# Relabel your filesystem

```
# fixfiles onboot
System will relabel on next boot

# ls -l /.autorelabel
-rw-r--r--. 1 root root 0 Jan 12 18:18 /.autorelabel

# reboot
```



# Viewing labels

- Many utilities support the -Z argument
- For example
  - ls -Z
  - cp -Z
  - ps -Z
  - id -Z



# Creating labels

- SELinux aware apps
  - chcon
  - restorecon
  - semanage fcontext
    - See /etc/selinux/targeted/contexts/files/file_contexts
  - RPMs
- Users creating files
  - New files inherit context
  - Moved files maintain context



# What does it mean if I get an SELinux error?

- When you see an SELinux denial, it means that something is wrong.
- It can mean that the labeling is wrong
- The policy needs to be tweaked
- There's a bug in the app or the policy
- You've been or are being broken into!



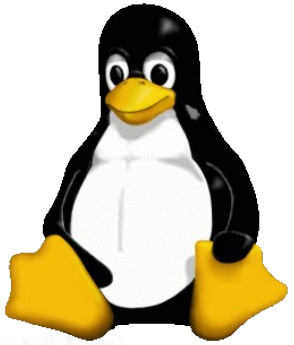
# Permissive

# =

# Testing

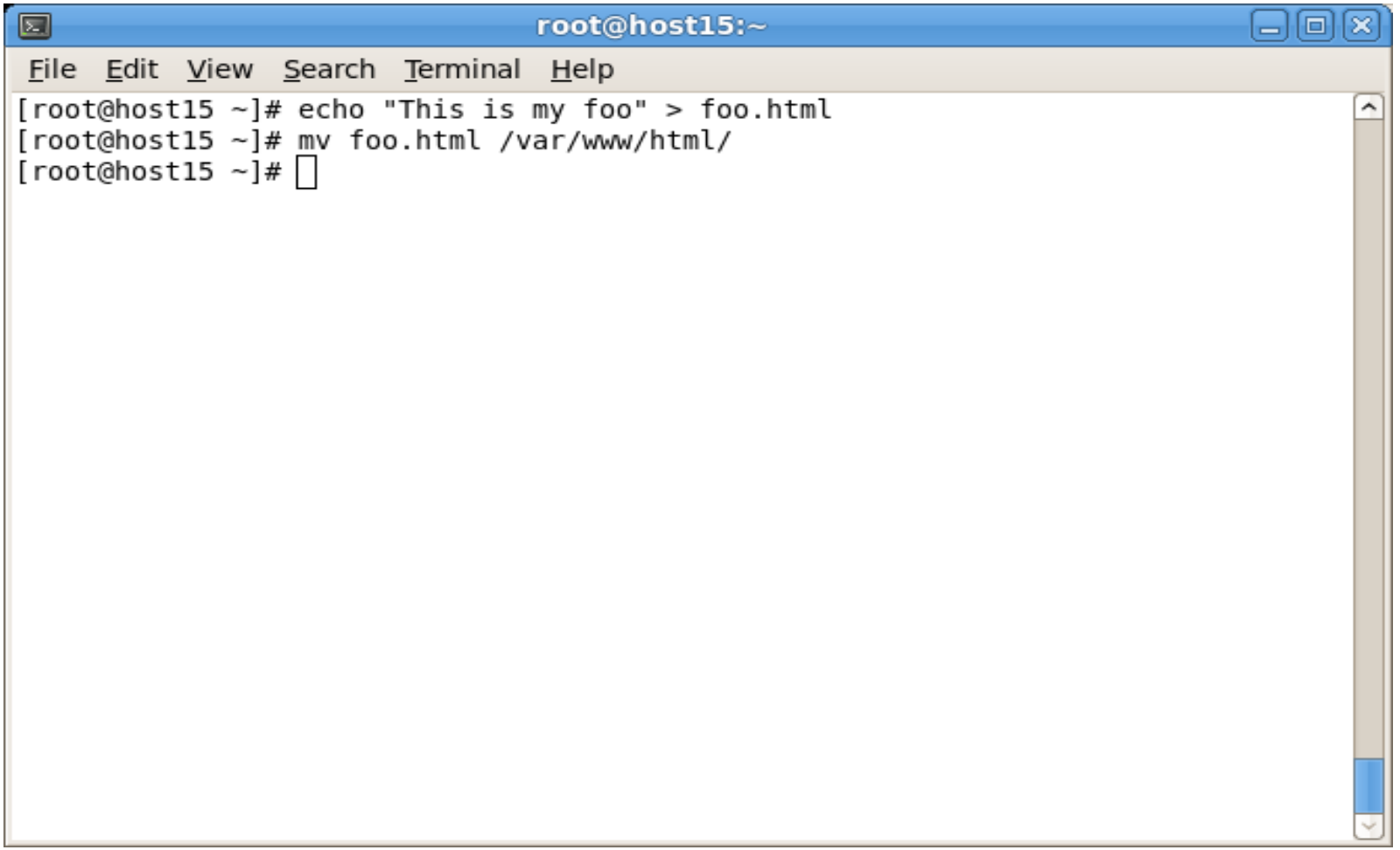
http://www.theanimalangel.org/whiteboys.jpg

# THE REAL WORLD

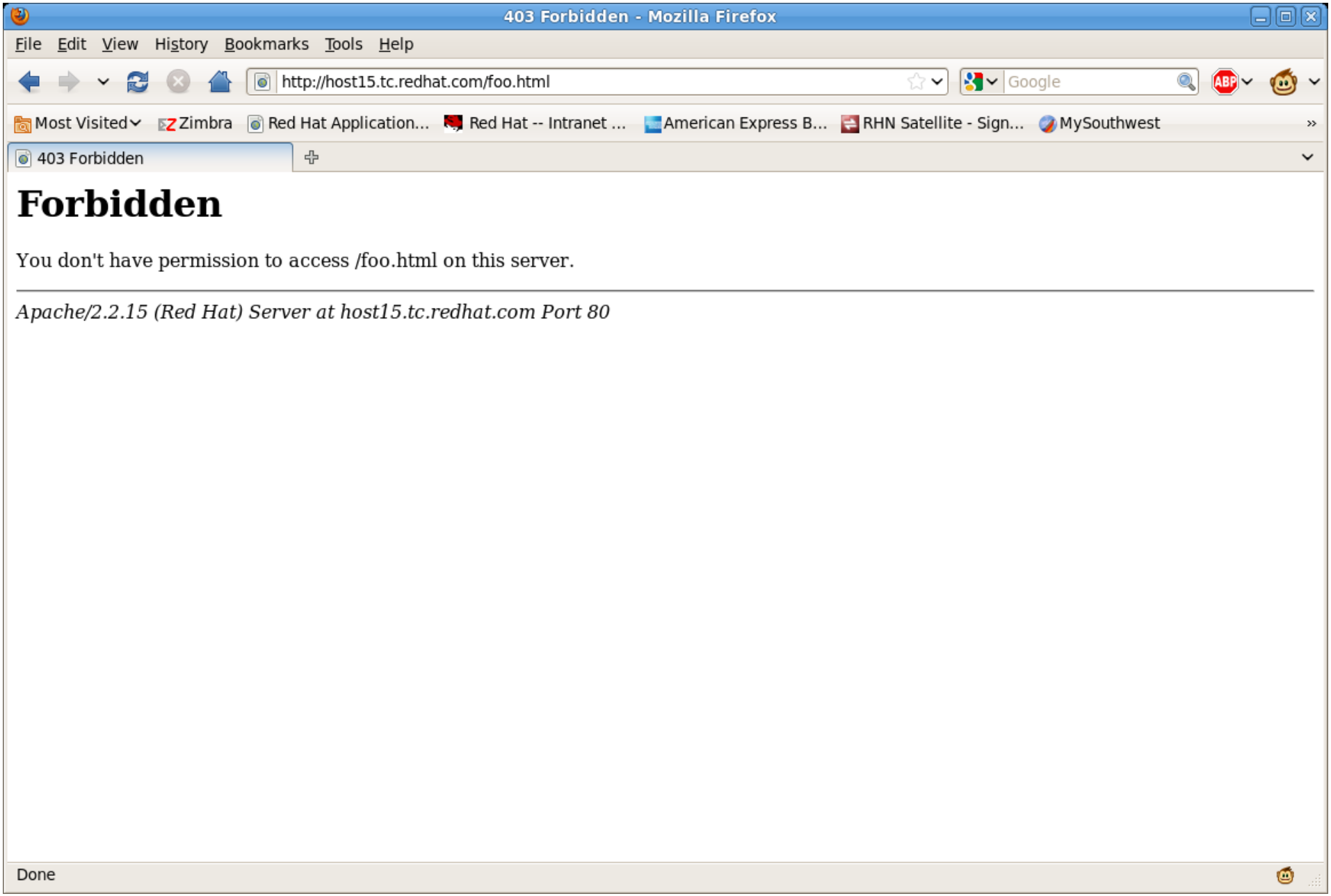


# Apache vs. SELinux

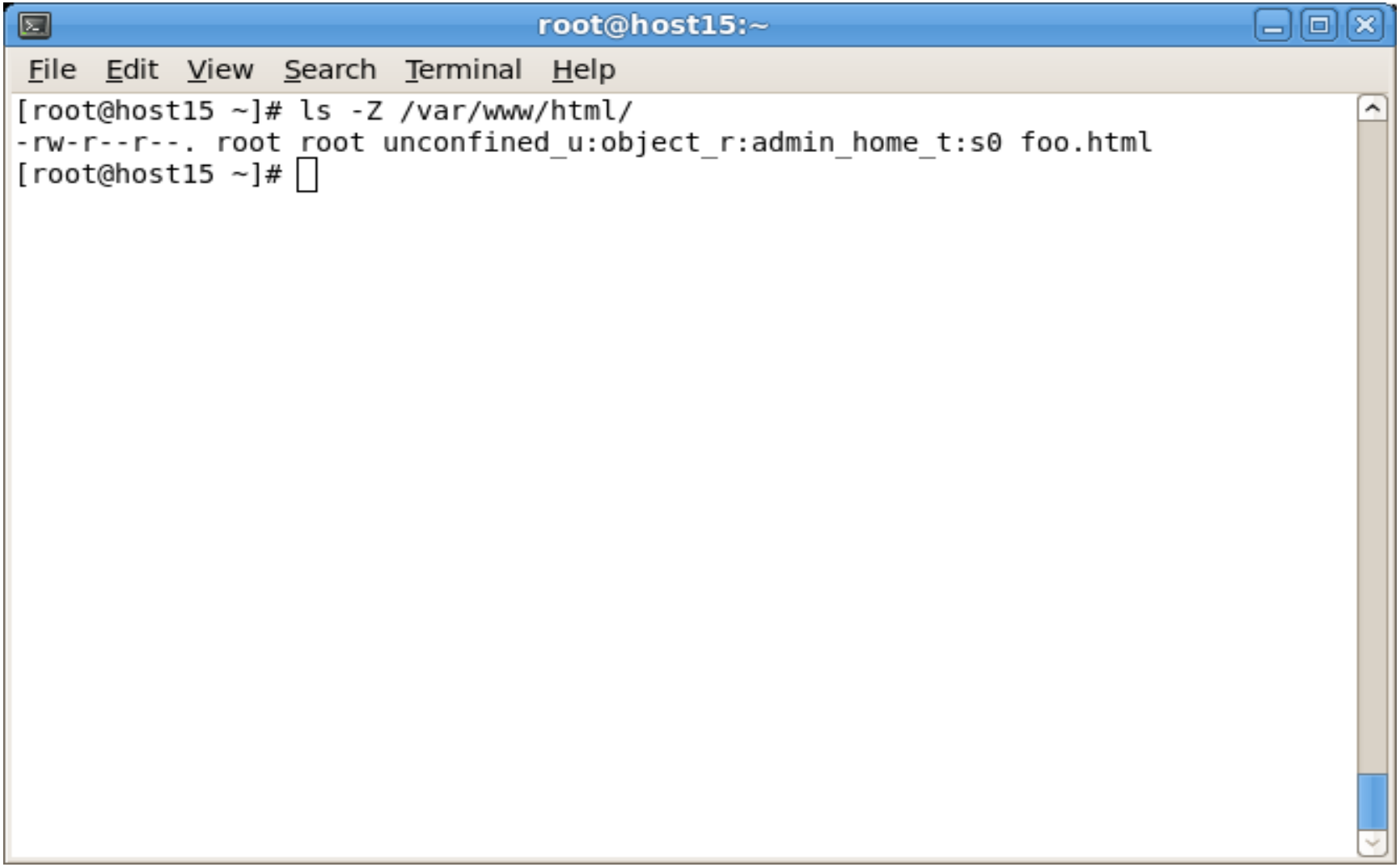
- Create content and move it







403 Forbidden - Mozilla Firefox
File Edit View History Bookmarks Tools Help
http://host15.tc.redhat.com/foo.html
Google
Most Visited
Zimbra
Red Hat Application...
Red Hat -- Intranet ...
American Express B...
RHN Satellite - Sign...
MySouthwest
403 Forbidden
Forbidden
You don't have permission to access /foo.html on this server.
Apache/2.2.15 (Red Hat) Server at host15.tc.redhat.com Port 80
Done

# Move vs copy


root@host15:~
File Edit View Search Terminal Help
[root@host15 ~]# ls -Z /var/www/html/
-rw-r--r--. root root unconfined_u:object_r:admin_home_t:s0 foo.html
[root@host15 ~]#

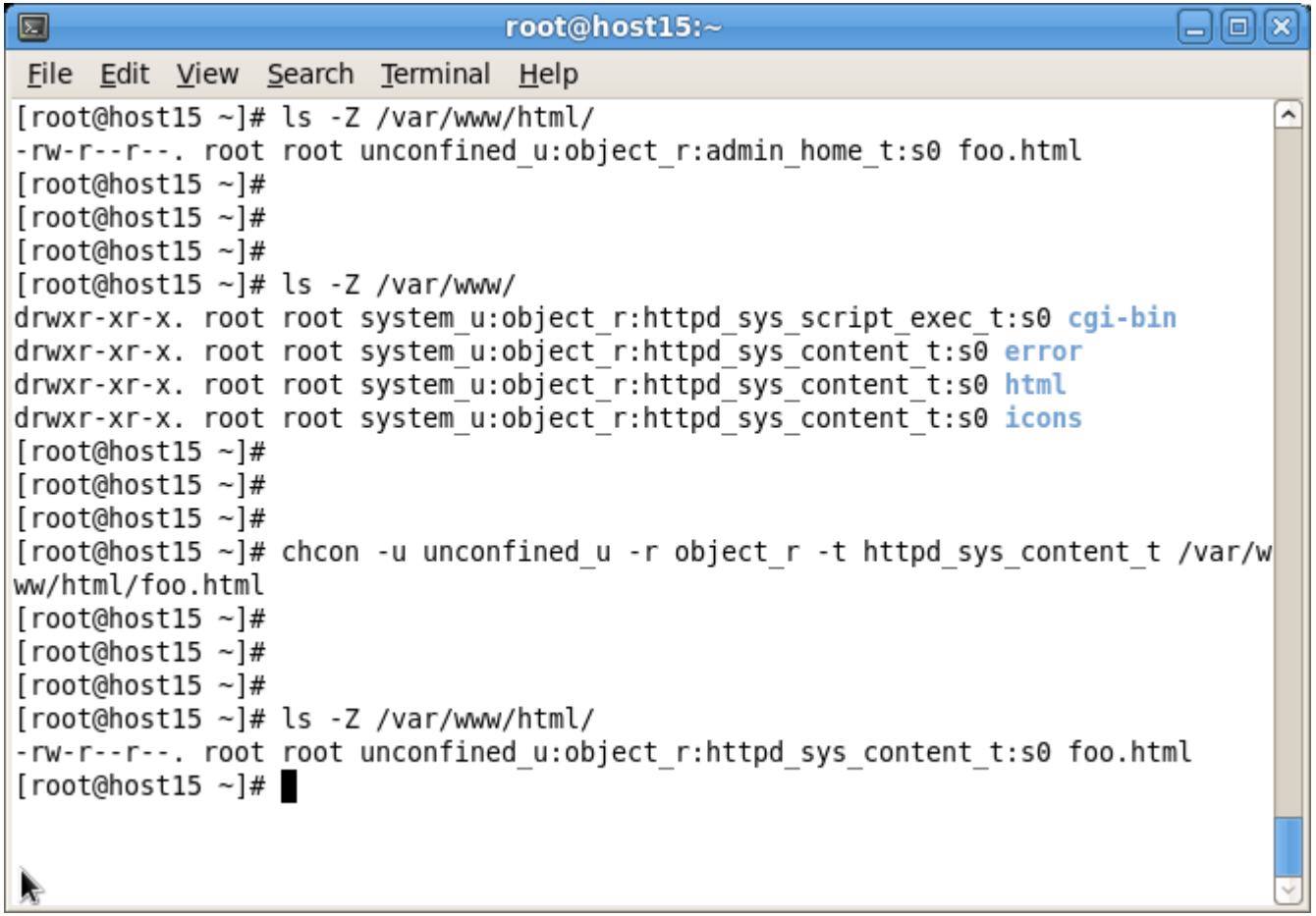
# Apache vs. SELinux

- We need to change the context

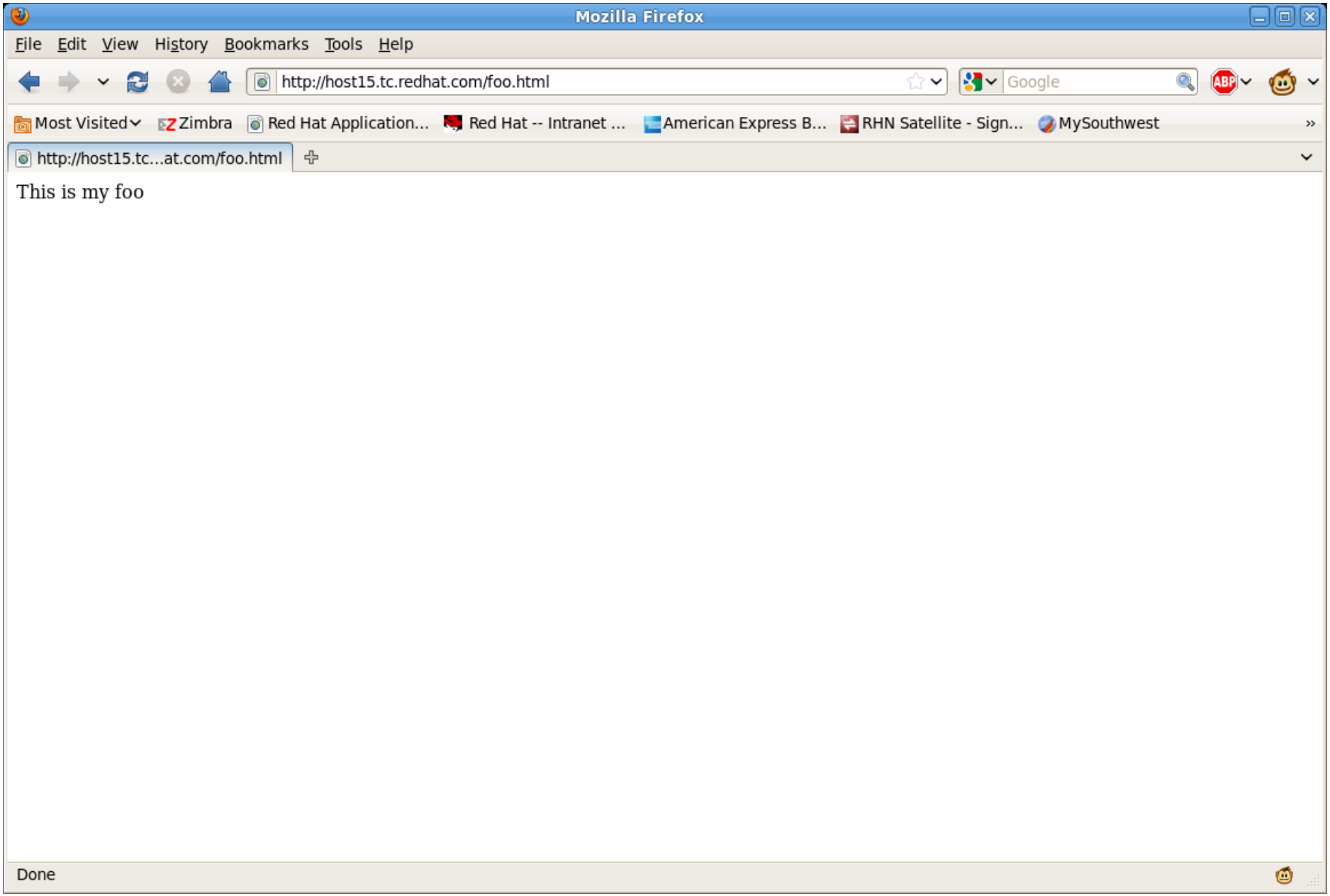


# Apache vs. SELinux

- Hardest way - figure out the context and use chcon



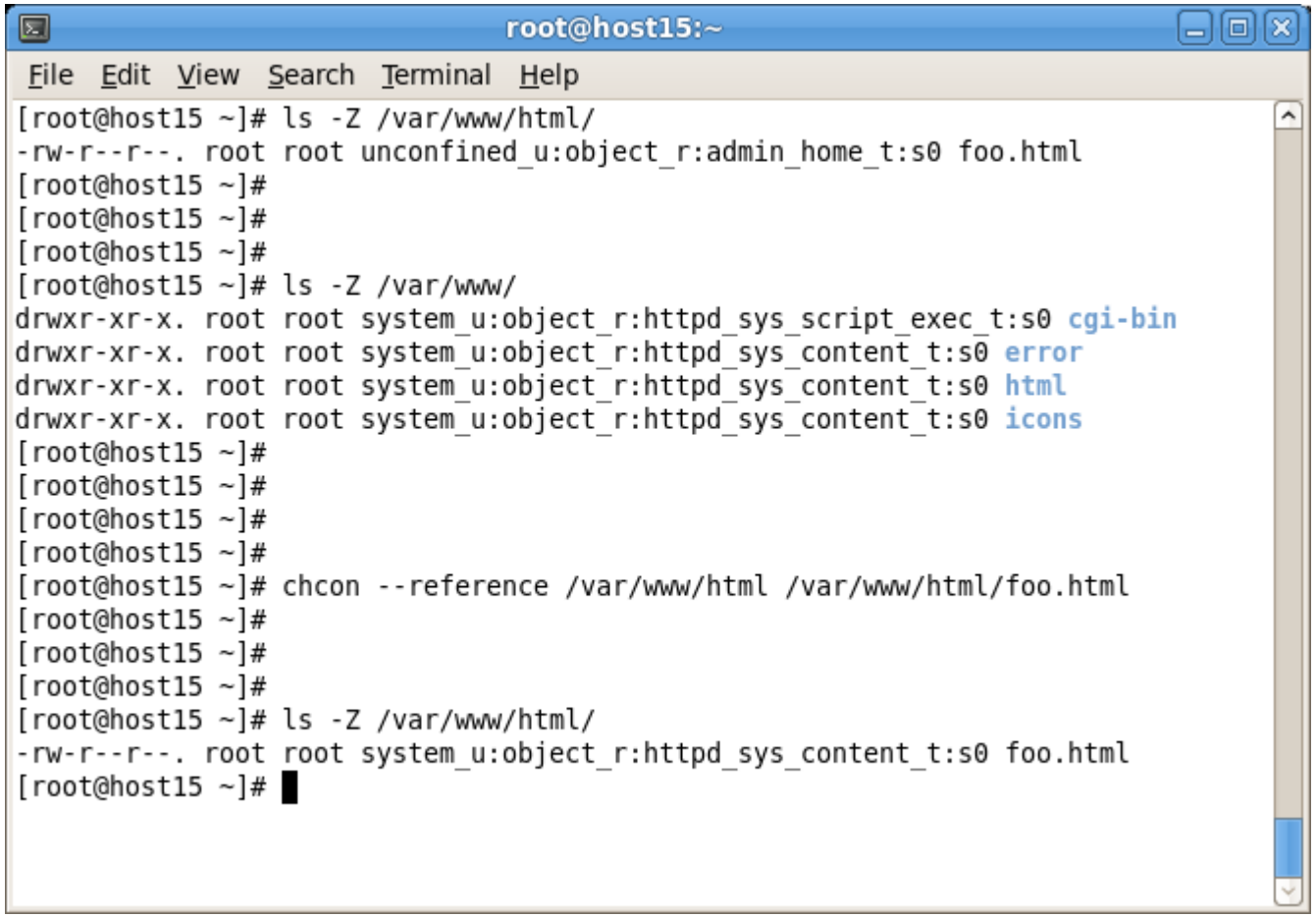




Mozilla Firefox
File Edit View History Bookmarks Tools Help
http://host15.tc.redhat.com/foo.html
Google
Most Visited
Zimbra
Red Hat Application...
Red Hat -- Intranet ...
American Express B...
RHN Satellite - Sign...
MySouthwest
http://host15.tc...at.com/foo.html
This is my foo
Done



# Apache vs. SELinux

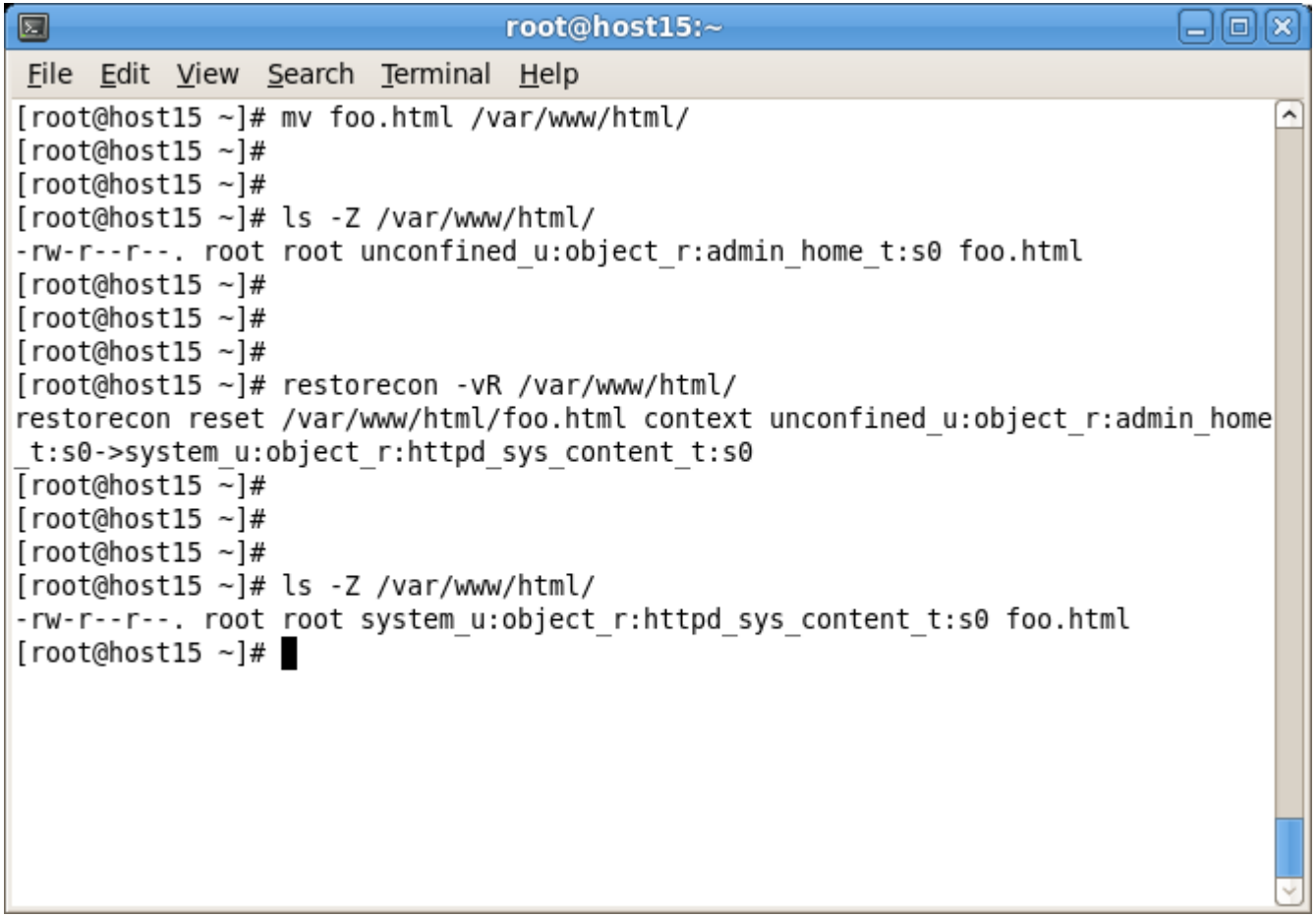
- Easier way - use chcon --reference






# Apache vs. SELinux

- Easiest way - restorecon

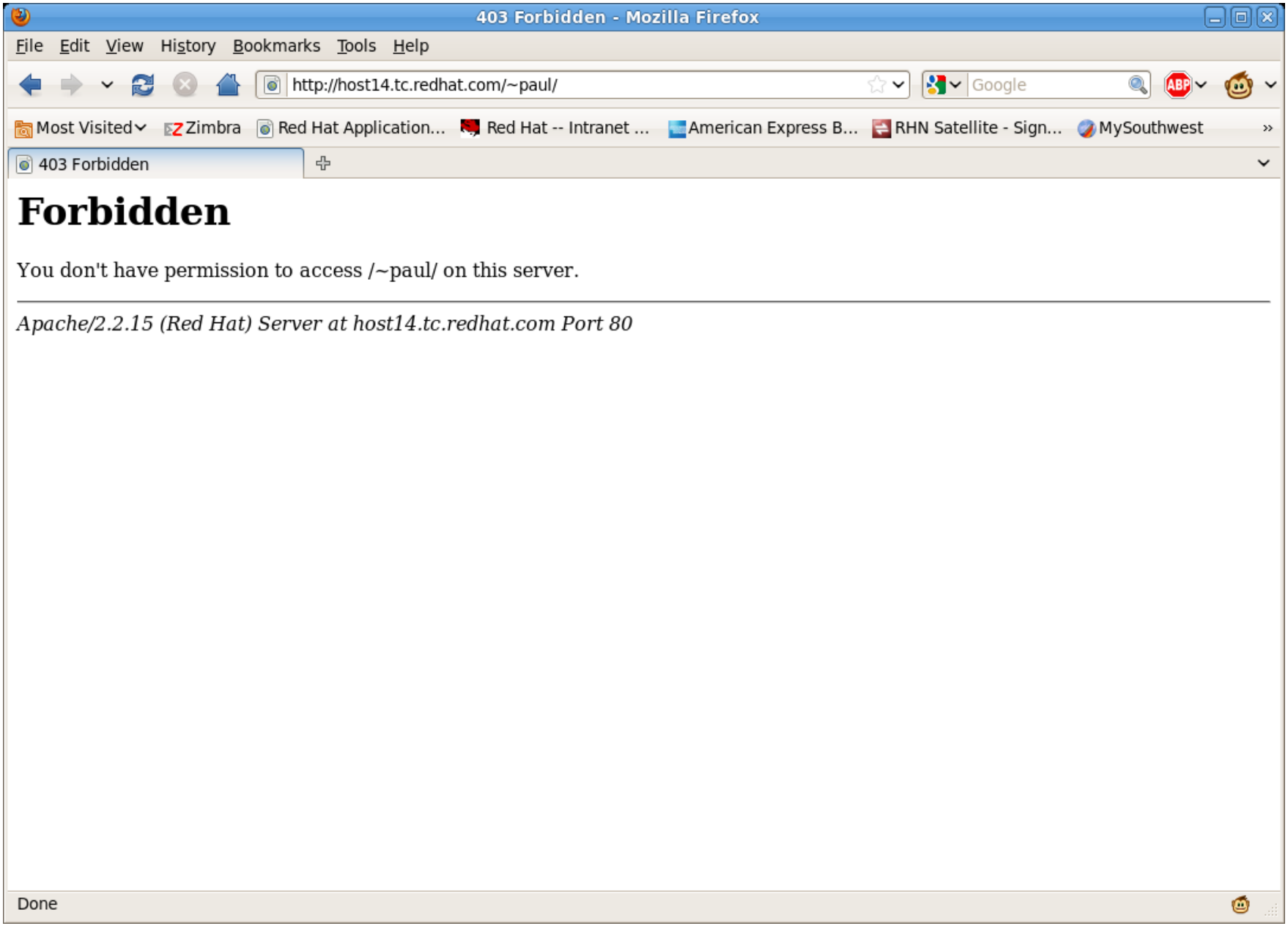





# Apache and public_html

- Allowing Apache to access Paul's home directory so we can access http://host15.tc.redhat.com/~paul
  - Fix httpd.conf
  - Set permissions to allow httpd to access /home/paul
  - Reload Apache
  - As Paul, create index.html
  - Fire up the browser

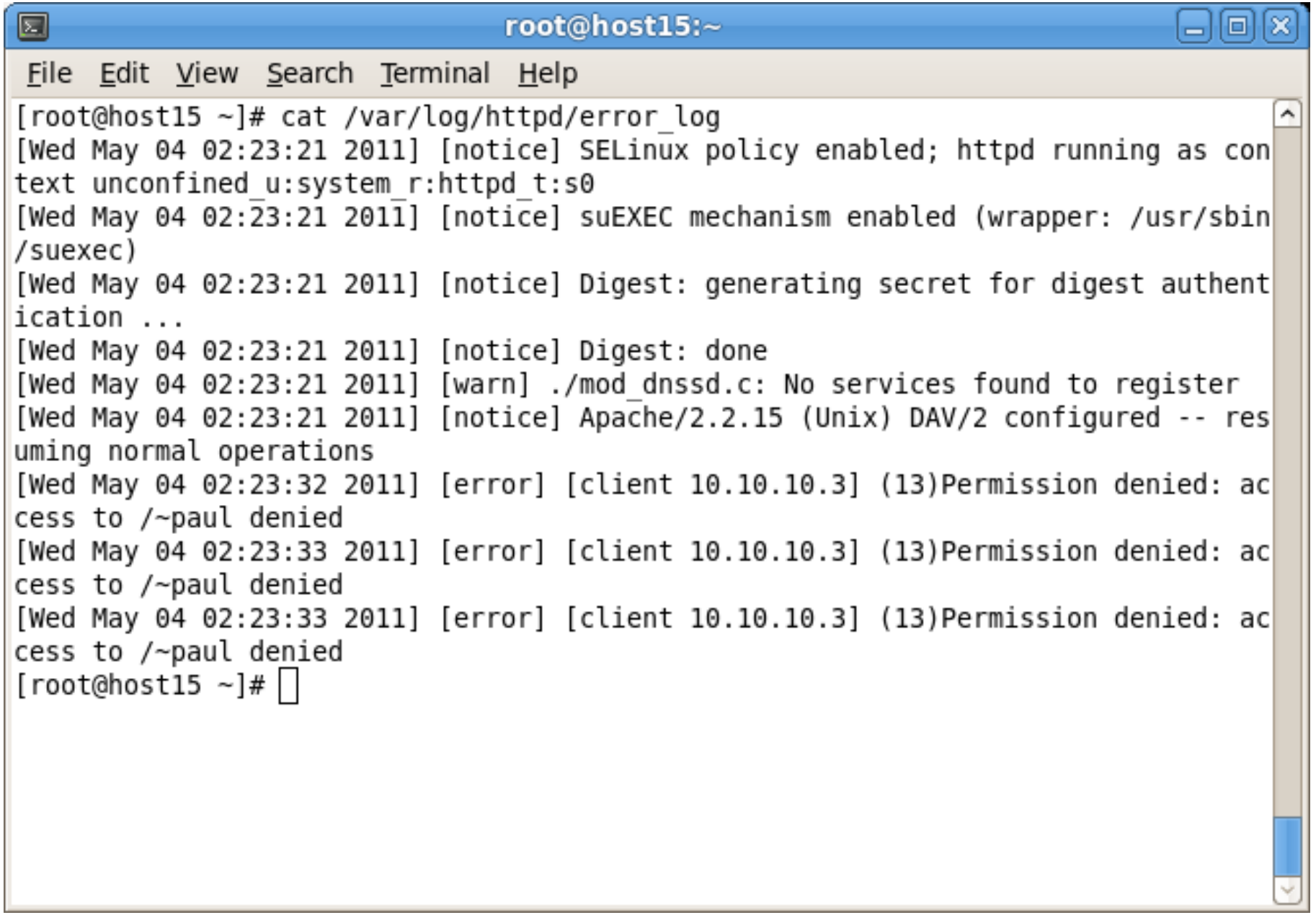



403 Forbidden - Mozilla Firefox
File Edit View History Bookmarks Tools Help
http://host14.tc.redhat.com/~paul/
Google
Most Visited
Zimbra
Red Hat Application...
Red Hat -- Intranet ...
American Express B...
RHN Satellite - Sign...
MySouthwest
403 Forbidden
Forbidden
You don't have permission to access /~paul/ on this server.
Apache/2.2.15 (Red Hat) Server at host14.tc.redhat.com Port 80
Done

# Things to check

- /var/log/httpd/access.log
- /var/log/httpd/error.log




root@host15:~
File Edit View Search Terminal Help
[root@host15 ~]# cat /var/log/httpd/error_log
[Wed May 04 02:23:21 2011] [notice] SELinux policy enabled; httpd running as con
text unconfined_u:system_r:httpd_t:s0
[Wed May 04 02:23:21 2011] [notice] suEXEC mechanism enabled (wrapper: /usr/sbin
/suexec)
[Wed May 04 02:23:21 2011] [notice] Digest: generating secret for digest authent
ication ...
[Wed May 04 02:23:21 2011] [notice] Digest: done
[Wed May 04 02:23:21 2011] [warn] ./mod_dnssd.c: No services found to register
[Wed May 04 02:23:21 2011] [notice] Apache/2.2.15 (Unix) DAV/2 configured -- res
uming normal operations
[Wed May 04 02:23:32 2011] [error] [client 10.10.10.3] (13)Permission denied: ac
cess to /~paul denied
[Wed May 04 02:23:33 2011] [error] [client 10.10.10.3] (13)Permission denied: ac
cess to /~paul denied
[Wed May 04 02:23:33 2011] [error] [client 10.10.10.3] (13)Permission denied: ac
cess to /~paul denied
[root@host15 ~]#



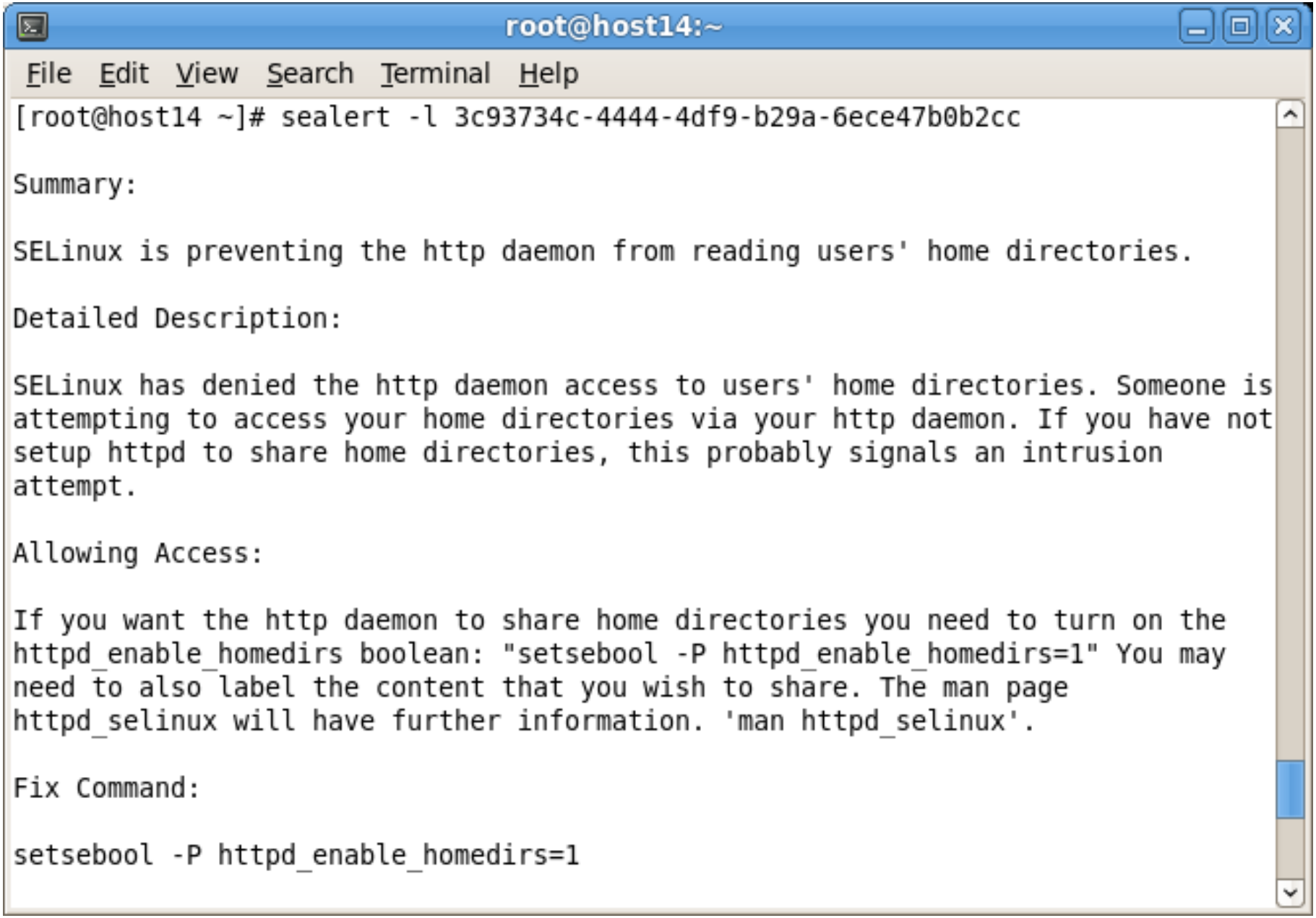
# Things to check

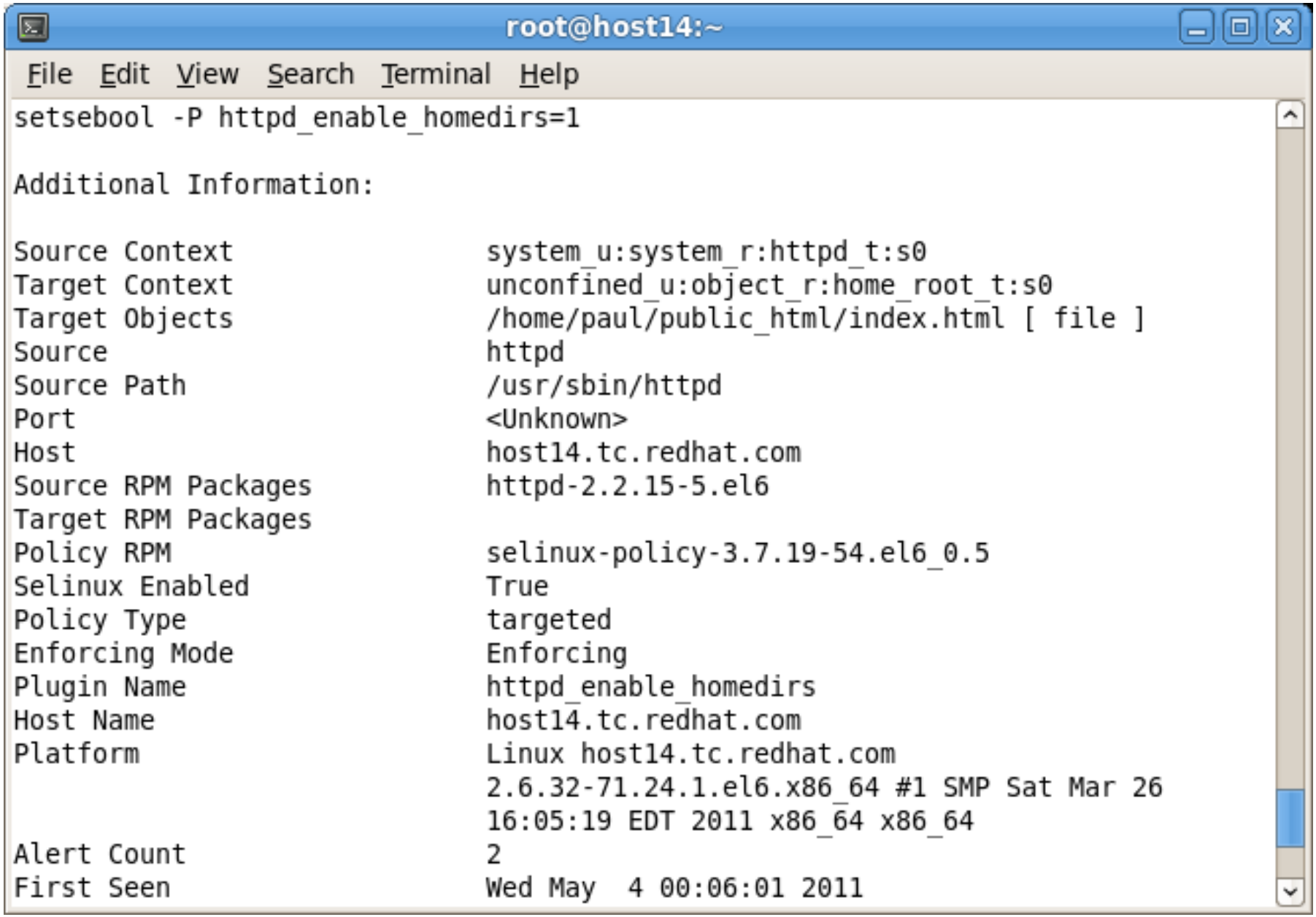
- /var/log/messages

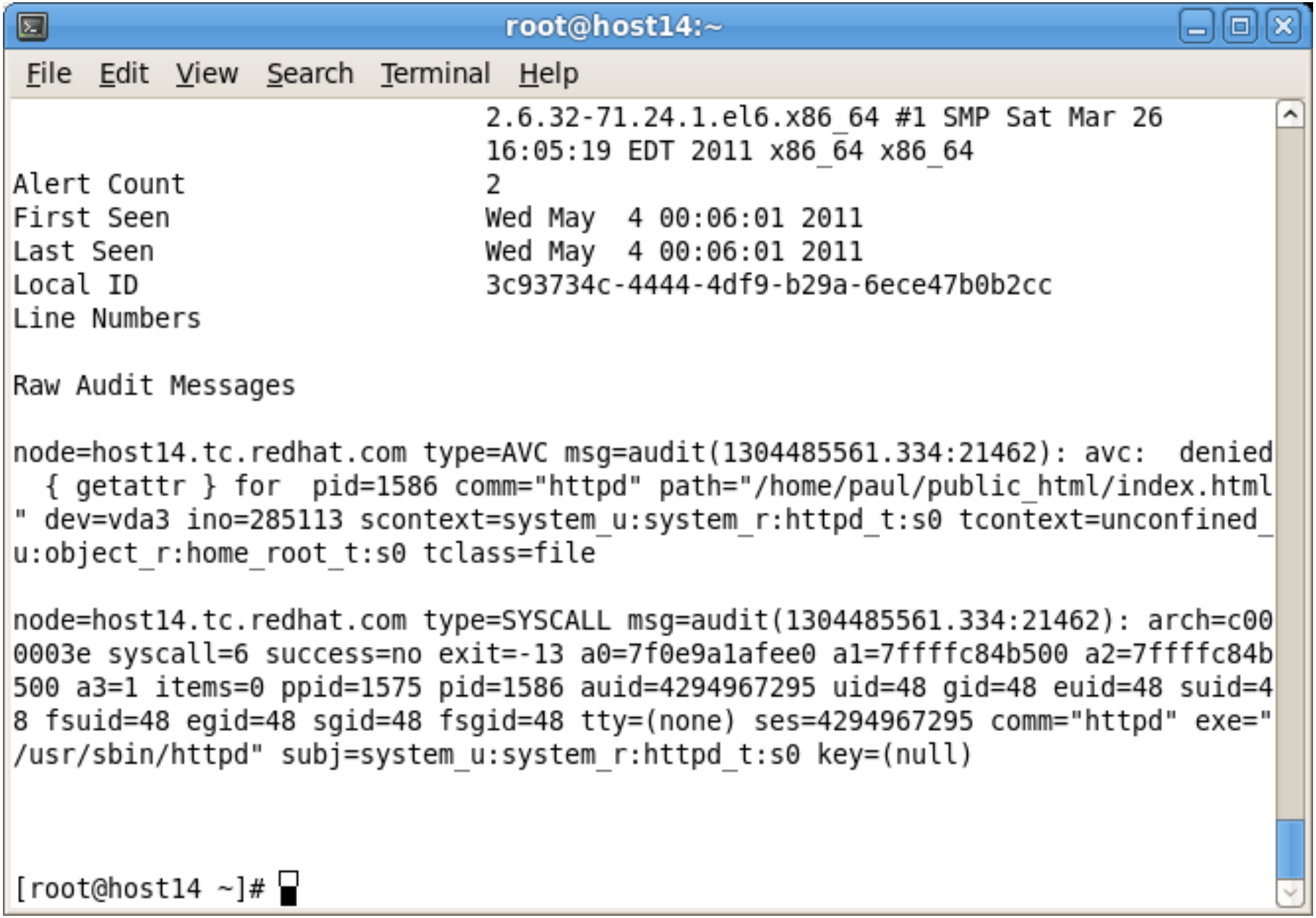


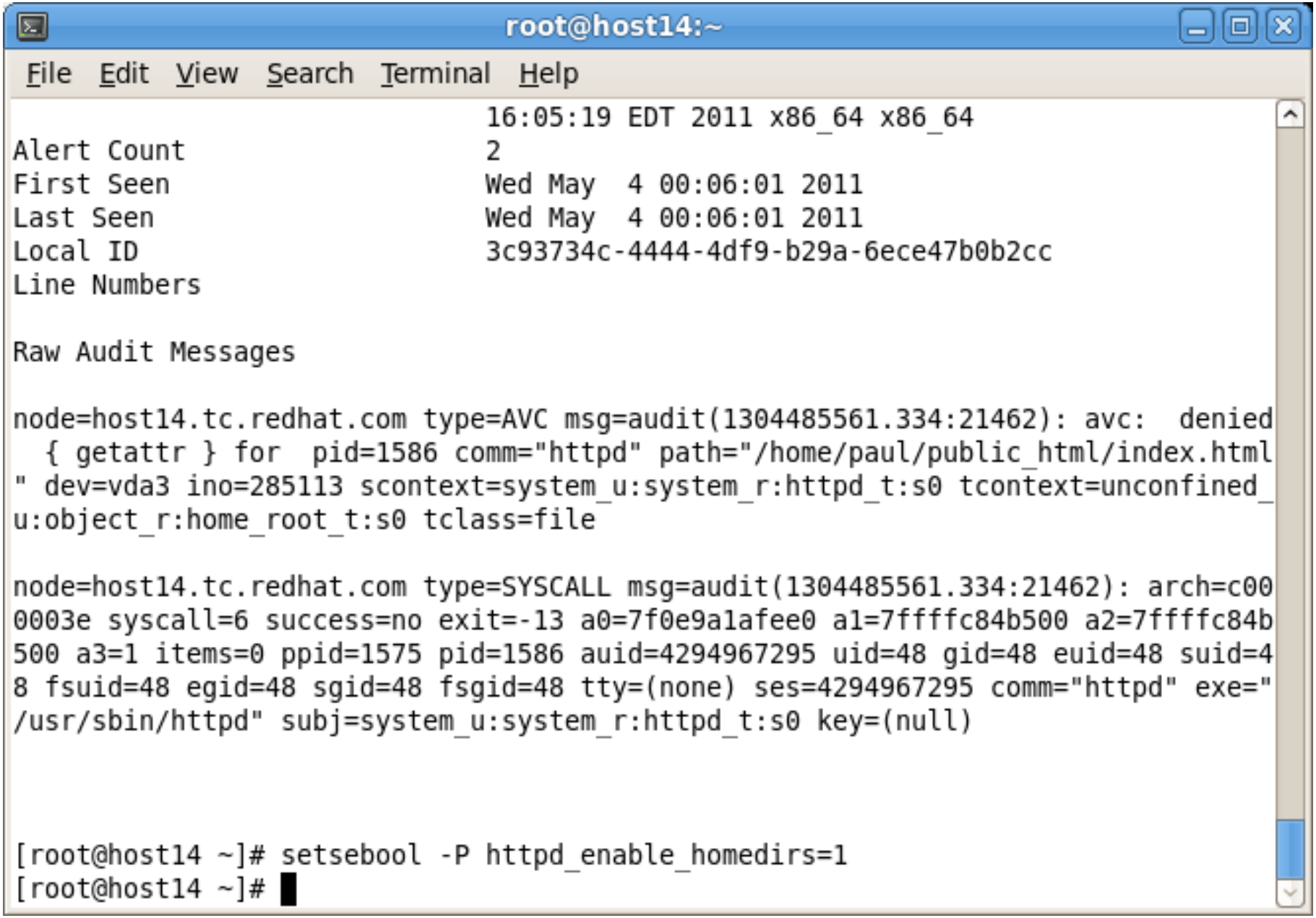

root@host14:~
File Edit View Search Terminal Help
May 4 00:06:03 host14 setroubleshoot: SELinux is preventing the http daemon fro
m reading users' home directories. For complete SELinux messages. run sealert -l
3c93734c-4444-4df9-b29a-6ece47b0b2cc
May 4 00:06:03 host14 setroubleshoot: SELinux is preventing the http daemon fro
m reading users' home directories. For complete SELinux messages. run sealert -l
3c93734c-4444-4df9-b29a-6ece47b0b2cc



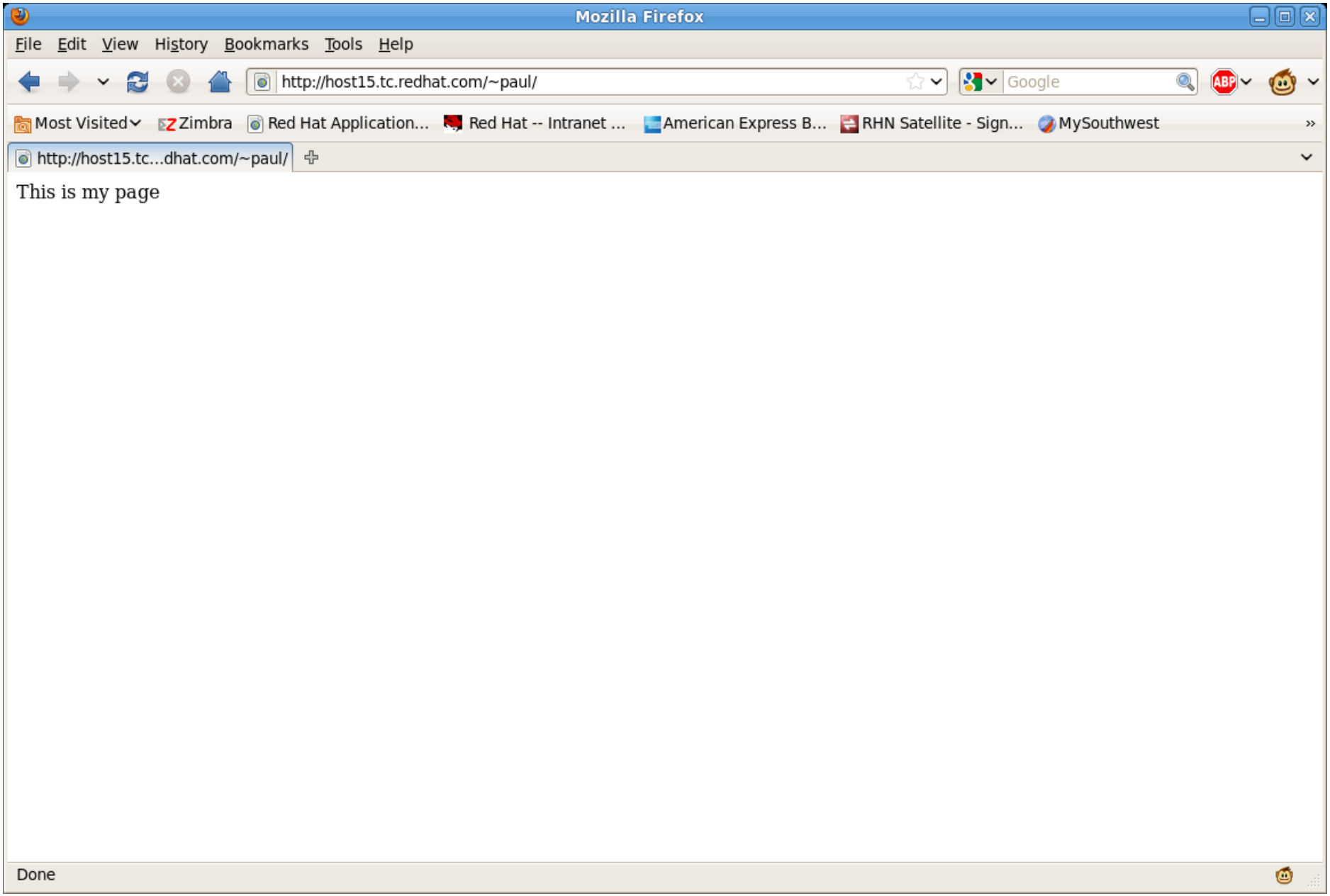

root@host14:~
File Edit View Search Terminal Help
[root@host14 ~]# sealert -l 3c93734c-4444-4df9-b29a-6ece47b0b2cc
Summary:
SELinux is preventing the http daemon from reading users' home directories.
Detailed Description:
SELinux has denied the http daemon access to users' home directories. Someone is attempting to access your home directories via your http daemon. If you have not setup httpd to share home directories, this probably signals an intrusion attempt.
Allowing Access:
If you want the http daemon to share home directories you need to turn on the httpd_enable_homedirs boolean: "setsebool -P httpd_enable_homedirs=1" You may need to also label the content that you wish to share. The man page httpd_selinux will have further information. 'man httpd_selinux'.
Fix Command:
setsebool -P httpd_enable_homedirs=1


root@host14:~
File Edit View Search Terminal Help
setsebool -P httpd_enable_homedirs=1
Additional Information:
Source Context system_u:system_r:httpd_t:s0
Target Context unconfined_u:object_r:home_root_t:s0
Target Objects /home/paul/public_html/index.html [ file ]
Source httpd
Source Path /usr/sbin/httpd
Port <Unknown>
Host host14.tc.redhat.com
Source RPM Packages httpd-2.2.15-5.el6
Target RPM Packages
Policy RPM selinux-policy-3.7.19-54.el6_0.5
Selinux Enabled True
Policy Type targeted
Enforcing Mode Enforcing
Plugin Name httpd_enable_homedirs
Host Name host14.tc.redhat.com
Platform Linux host14.tc.redhat.com
2.6.32-71.24.1.el6.x86_64 #1 SMP Sat Mar 26
16:05:19 EDT 2011 x86_64 x86_64
Alert Count 2
First Seen Wed May 4 00:06:01 2011


root@host14:~
File Edit View Search Terminal Help
2.6.32-71.24.1.el6.x86_64 #1 SMP Sat Mar 26
16:05:19 EDT 2011 x86_64 x86_64
Alert Count 2
First Seen Wed May 4 00:06:01 2011
Last Seen Wed May 4 00:06:01 2011
Local ID 3c93734c-4444-4df9-b29a-6ece47b0b2cc
Line Numbers
Raw Audit Messages
node=host14.tc.redhat.com type=AVC msg=audit(1304485561.334:21462): avc: denied
{ getattr } for pid=1586 comm="httpd" path="/home/paul/public_html/index.html
" dev=vda3 ino=285113 scontext=system_u:system_r:httpd_t:s0 tcontext=unconfined_
u:object_r:home_root_t:s0 tclass=file
node=host14.tc.redhat.com type=SYSCALL msg=audit(1304485561.334:21462): arch=c00
0003e syscall=6 success=no exit=-13 a0=7f0e9a1afee0 a1=7ffffc84b500 a2=7ffffc84b
500 a3=1 items=0 ppid=1575 pid=1586 auid=4294967295 uid=48 gid=48 euid=48 suid=4
8 fsuid=48 egid=48 sgid=48 fsgid=48 tty=(none) ses=4294967295 comm="httpd" exe="
/usr/sbin/httpd" subj=system_u:system_r:httpd_t:s0 key=(null)
[root@host14 ~]#


root@host14:~
File Edit View Search Terminal Help
16:05:19 EDT 2011 x86_64 x86_64
Alert Count 2
First Seen Wed May 4 00:06:01 2011
Last Seen Wed May 4 00:06:01 2011
Local ID 3c93734c-4444-4df9-b29a-6ece47b0b2cc
Line Numbers
Raw Audit Messages
node=host14.tc.redhat.com type=AVC msg=audit(1304485561.334:21462): avc: denied { getattr } for pid=1586 comm="httpd" path="/home/paul/public_html/index.html" dev=vda3 ino=285113 scontext=system_u:system_r:httpd_t:s0 tcontext=unconfined_u:object_r:home_root_t:s0 tclass=file
node=host14.tc.redhat.com type=SYSCALL msg=audit(1304485561.334:21462): arch=c0000003e syscall=6 success=no exit=-13 a0=7f0e9a1afee0 a1=7ffffc84b500 a2=7ffffc84b500 a3=1 items=0 ppid=1575 pid=1586 auid=4294967295 uid=48 gid=48 euid=48 suid=48 fsuid=48 egid=48 sgid=48 fsgid=48 tty=(none) ses=4294967295 comm="httpd" exe="/usr/sbin/httpd" subj=system_u:system_r:httpd_t:s0 key=(null)
[root@host14 ~]# setsebool -P httpd_enable_homedirs=1
[root@host14 ~]#



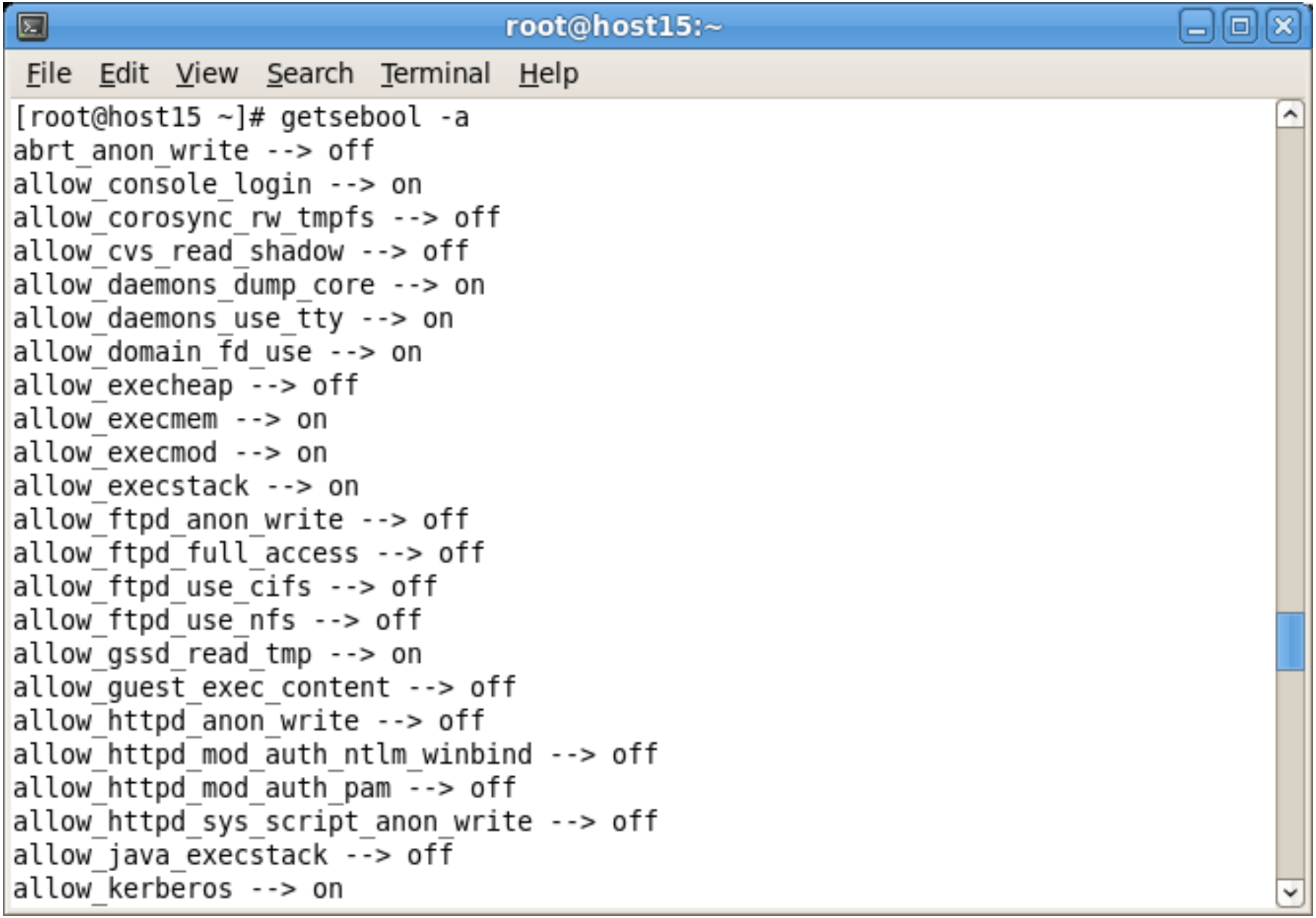

Mozilla Firefox
File Edit View History Bookmarks Tools Help
http://host15.tc.redhat.com/~paul/
Google
Most Visited
Zimbra
Red Hat Application...
Red Hat -- Intranet ...
American Express B...
RHN Satellite - Sign...
MySouthwest
http://host15.tc...dhat.com/~paul/
This is my page
Done

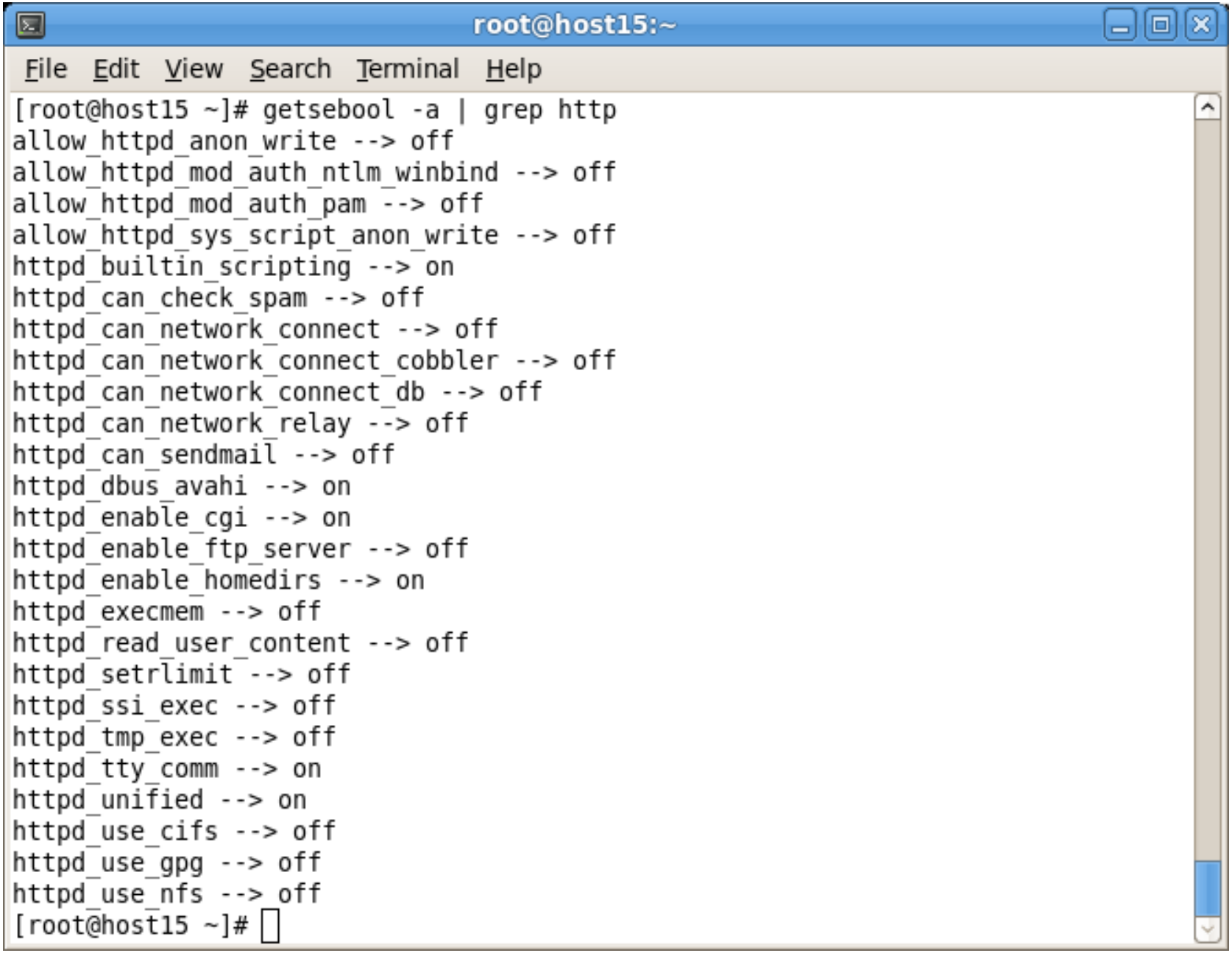


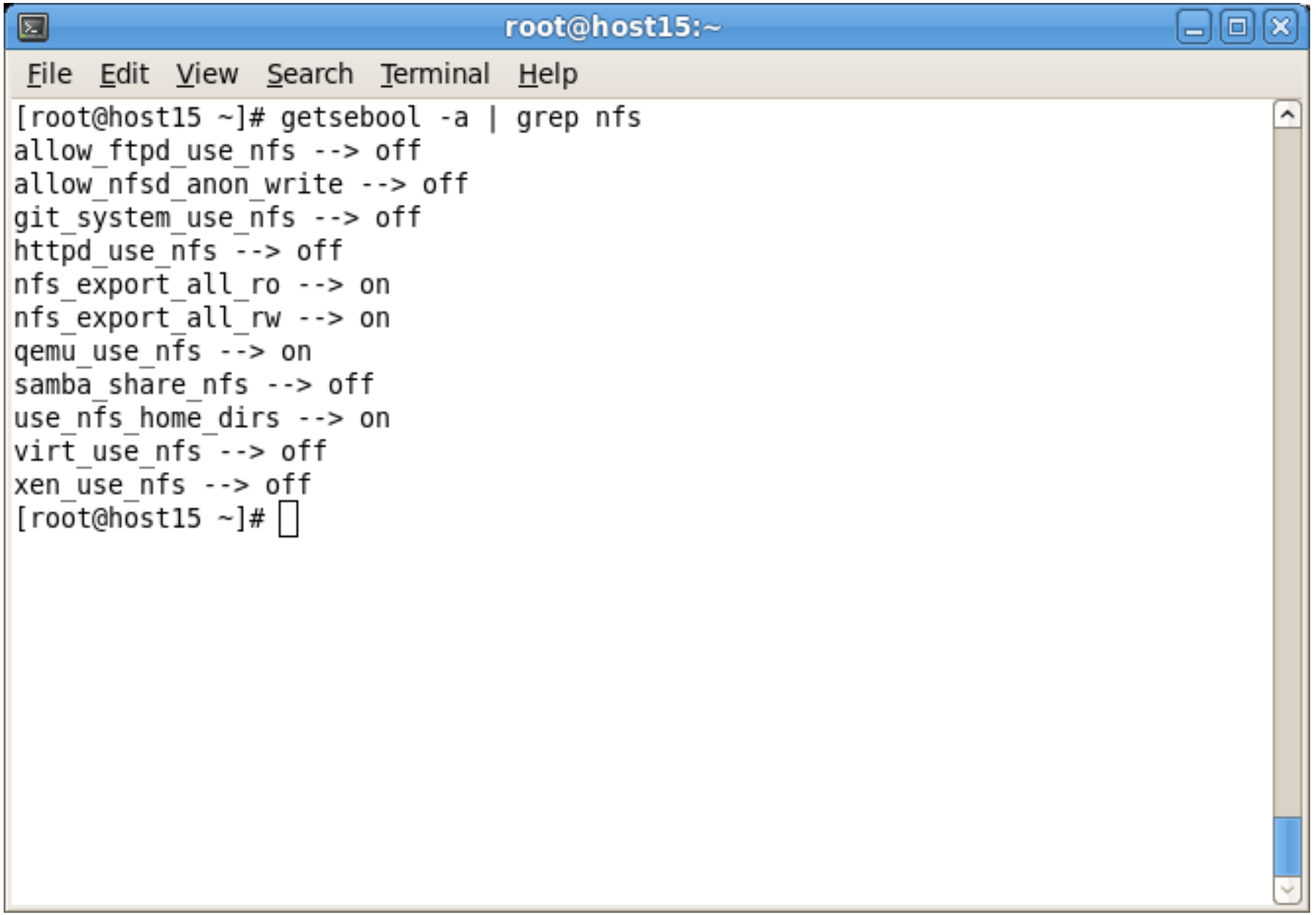
# Booleans

- Booleans just turn something on or off
  - getsebool
  - setsebool



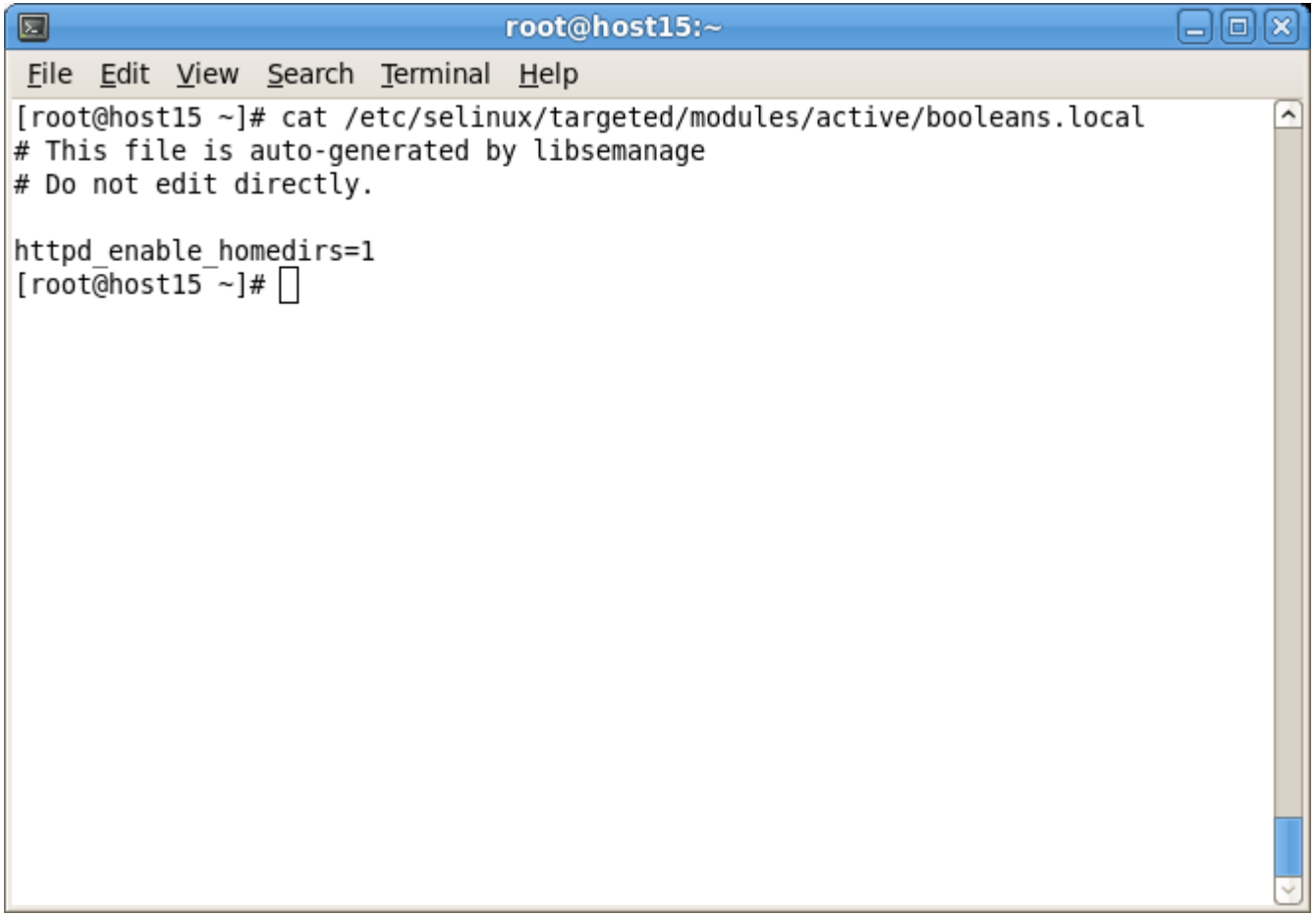

root@host15:~
File Edit View Search Terminal Help
[root@host15 ~]# getsebool -a
abrt_anon_write --> off
allow_console_login --> on
allow_corosync_rw_tmpfs --> off
allow_cvs_read_shadow --> off
allow_daemons_dump_core --> on
allow_daemons_use_tty --> on
allow_domain_fd_use --> on
allow_execheap --> off
allow_execmem --> on
allow_execmod --> on
allow_execstack --> on
allow_ftpd_anon_write --> off
allow_ftpd_full_access --> off
allow_ftpd_use_cifs --> off
allow_ftpd_use_nfs --> off
allow_gssd_read_tmp --> on
allow_guest_exec_content --> off
allow_httpd_anon_write --> off
allow_httpd_mod_auth_ntlm_winbind --> off
allow_httpd_mod_auth_pam --> off
allow_httpd_sys_script_anon_write --> off
allow_java_execstack --> off
allow_kerberos --> on


root@host15:~
File Edit View Search Terminal Help
[root@host15 ~]# getsebool -a | grep http
allow_httpd_anon_write --> off
allow_httpd_mod_auth_ntlm_winbind --> off
allow_httpd_mod_auth_pam --> off
allow_httpd_sys_script_anon_write --> off
httpd_builtin_scripting --> on
httpd_can_check_spam --> off
httpd_can_network_connect --> off
httpd_can_network_connect_cobbler --> off
httpd_can_network_connect_db --> off
httpd_can_network_relay --> off
httpd_can_sendmail --> off
httpd_dbus_avahi --> on
httpd_enable_cgi --> on
httpd_enable_ftp_server --> off
httpd_enable_homedirs --> on
httpd_execmem --> off
httpd_read_user_content --> off
httpd_setrlimit --> off
httpd_ssi_exec --> off
httpd_tmp_exec --> off
httpd_tty_comm --> on
httpd_unified --> on
httpd_use_cifs --> off
httpd_use_gpg --> off
httpd_use_nfs --> off
[root@host15 ~]#


root@host15:~
File Edit View Search Terminal Help
[root@host15 ~]# getsebool -a | grep nfs
allow_ftpd_use_nfs --> off
allow_nfsd_anon_write --> off
git_system_use_nfs --> off
httpd_use_nfs --> off
nfs_export_all_ro --> on
nfs_export_all_rw --> on
qemu_use_nfs --> on
samba_share_nfs --> off
use_nfs_home_dirs --> on
virt_use_nfs --> off
xen_use_nfs --> off
[root@host15 ~]#

# How can I see what booleans have been set?

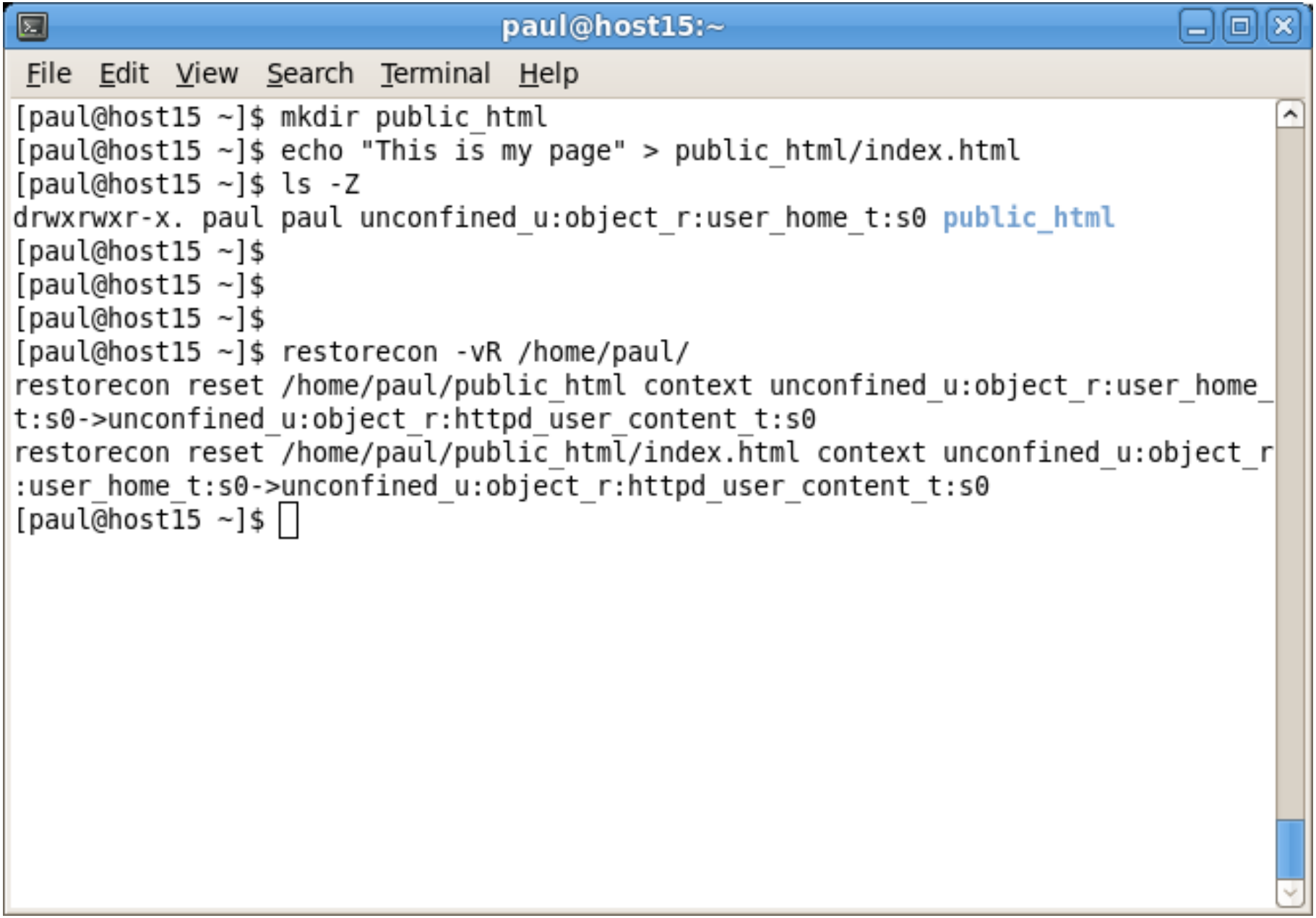
- /etc/selinux/targeted/modules/active/booleans.local



# When in doubt...

- Restore labels

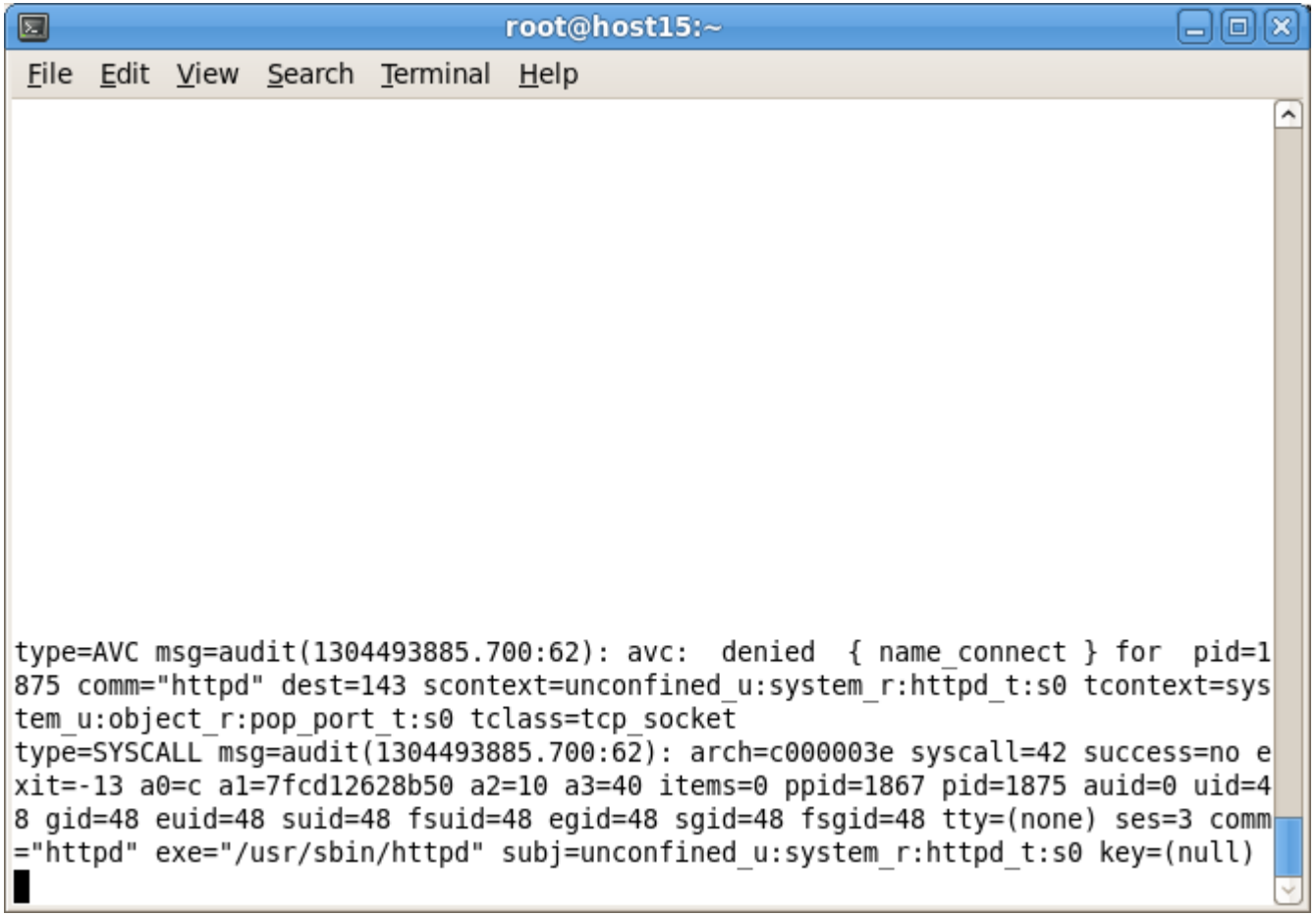



paul@host15:~
File Edit View Search Terminal Help
[paul@host15 ~]$ mkdir public_html
[paul@host15 ~]$ echo "This is my page" > public_html/index.html
[paul@host15 ~]$ ls -Z
drwxrwxr-x. paul paul unconfined_u:object_r:user_home_t:s0 public_html
[paul@host15 ~]$
[paul@host15 ~]$
[paul@host15 ~]$
[paul@host15 ~]$ restorecon -vR /home/paul/
restorecon reset /home/paul/public_html context unconfined_u:object_r:user_home_
t:s0->unconfined_u:object_r:httpd_user_content_t:s0
restorecon reset /home/paul/public_html/index.html context unconfined_u:object_r
:user_home_t:s0->unconfined_u:object_r:httpd_user_content_t:s0
[paul@host15 ~]$



# Install Audit

- /var/log/audit/audit.log






# setroubleshoot

- Provides tools to help diagnose SELinux problems
  - `yum install setroubleshoot-server`
- Analyse your audit.log
  - `sealert -a`



# Retrofit

- Apply SELinux to an existing webserver
  - Debain Lenny
  - 1.5 GB Xen Virtual Image
  - 96 MB Ram
  - Small Image designed for fast recover
  - Close to stateless



# Retrofit

- Initial preparation
  - Backup VM
  - Increase VM Size
  - Upgrade to Debian Squeeze
    - Post upgrade cleanups
    - Confirm websites still work as expected
  - Post upgrade backup
  - Install SELinux support plus auditd



# Install & Enable SELinux

```
# This pulls in a lot of additional packages
apt-get install selinux-basics selinux-policy-default auditd

# configure GRUB and PAM and to create /.autorelabel
selinux-activate

reboot

# check that everything has been setup correctly and to catch common
SELinux problems
check-selinux-installation
```



# Permissive = Tesing

```
debian:/var/log/audit# sestatus
SELinux status:                 enabled
SELinuxfs mount:                /selinux
Current mode:                   permissive
Mode from config file:          permissive
Policy version:                 24
Policy from config file:        default
```



# Deal with /var/log/audit/audit.log

```
Jan  6 12:23:43 debian kernel: [   74.427105] type=1400
audit(1325805811.932:7): avc:  denied  { getattr } for  pid=841
comm="apache2" path="/home/www/photos" dev=xvda2 ino=73097
scontext=system_u:system_r:httpd_t:s0
tcontext=unconfined_u:object_r:user_home_t:s0 tclass=dir
```

```
ls -lZ /var/www /home/www -d

drwxr-sr-x. 28 steve users unconfined_u:object_r:user_home_dir_t:s0 4096
Jun  6  2009 /home/www

drwxr-xr-x.  3 root  root  system_u:object_r:httpd_sys_content_t:s0 4096
May 13  2010 /var/www


chcon -R --reference /var/www /home/www
```



# Update the policy

```
semanage fcontext -a -t httpd_sys_content_t "/home/www(/.*)?"
semanage fcontext -a -t httpd_sys_script_exec_t "/home/www/cgi-bin(/.*)?"

restorecon -R /home/www

# Allow cgi-bin support
semanage boolean -m --on httpd_enable_cgi

# Allow access to our NFS mounted images
semanage boolean -m --on httpd_use_nfs
```



# The hardest part

Everything other than debugging SELinux



# Questions



# References

- SELinux Project Page

  http://selinuxproject.org/

- Red Hat Security-Enhanced Linux Docs

  http://docs.redhat.com/docs/en-US/Red_Hat_Enterprise_Linux/6/html/Security-Enhanced_Linux/index.html

- Running key services under SELinux

  http://docs.redhat.com/docs/en-US/Red_Hat_Enterprise_Linux/6/html/Managing_Confined_Services/index.html

- Tips on Apache and SELinux

  http://selinuxproject.org/page/ApacheRecipes

- SELinux and Debian

  http://wiki.debian.org/SELinux/Setup



# Images

- Real World Logo
  - http://judgmentalobserver.wordpress.com/2011/06/28/top-10-most-hated-real-world-cast-members/
  - http://judgmentalobserver.files.wordpress.com/2011/06/real-world-logo.jpg?w=510
- MTV Logo
  - http://tv.popcrunch.com/wp-content/uploads/2009/06/mtv_logo.jpg
- Tivoli Installer
  - http://publib.boulder.ibm.com/infocenter/tamit/v7r2m2/index.jsp?topic=%2Fcom.ibm.ins.doc%2Fskb_ins_t_selinuxsetting.html
- Ass
  - http://www.theanimalangel.org/whiteboys.jpg
- Tux
  - http://upload.wikimedia.org/wikipedia/commons/a/af/Tux.png
- Flames
  - http://www.flickr.com/photos/wwarby/5109439137/