RED HAT :: BOSTON :: 2008

SUMMIT

JUNE 18–20, 2008

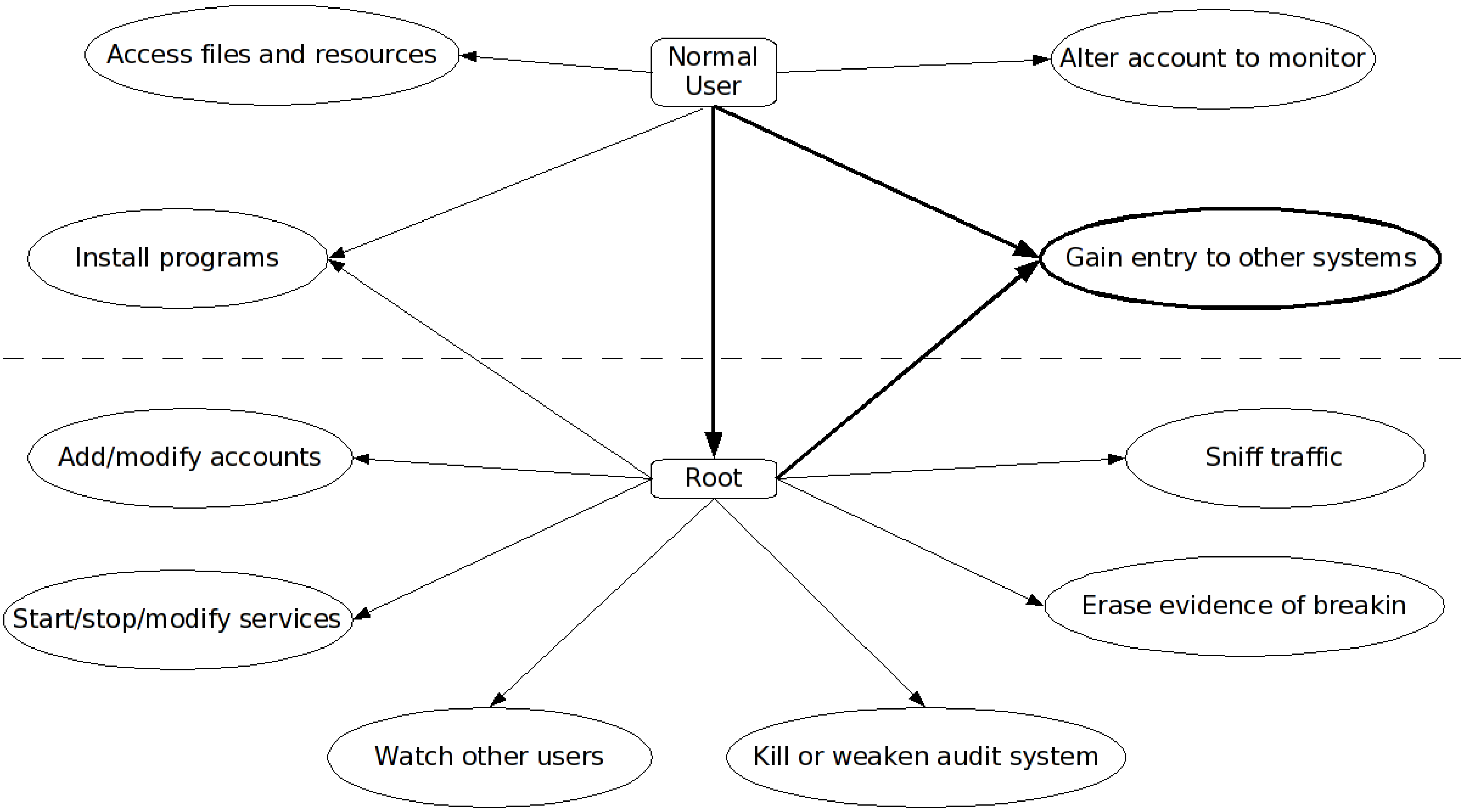
Hardening Red Hat Enterprise Linux 5

Steve Grubb, Red Hat

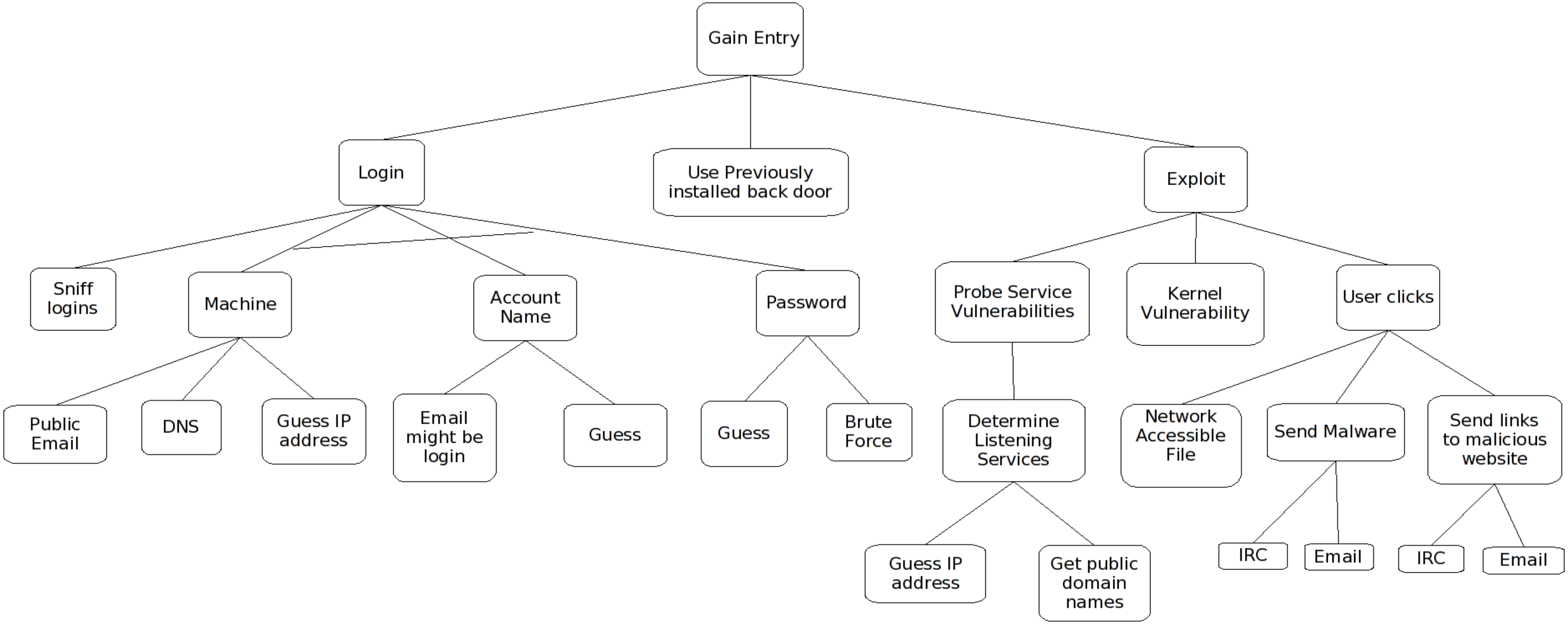
Hardening RHEL5

- Learn a little about some threats
- Go over some often missed configuration items
- Show how to make the system security better

Intrusion Goals


Normal User
Access files and resources
Alter account to monitor
Install programs
Gain entry to other systems
Root
Add/modify accounts
Sniff traffic
Start/stop/modify services
Erase evidence of breakin
Watch other users
Kill or weaken audit system

Network Intrusion Attack Tree



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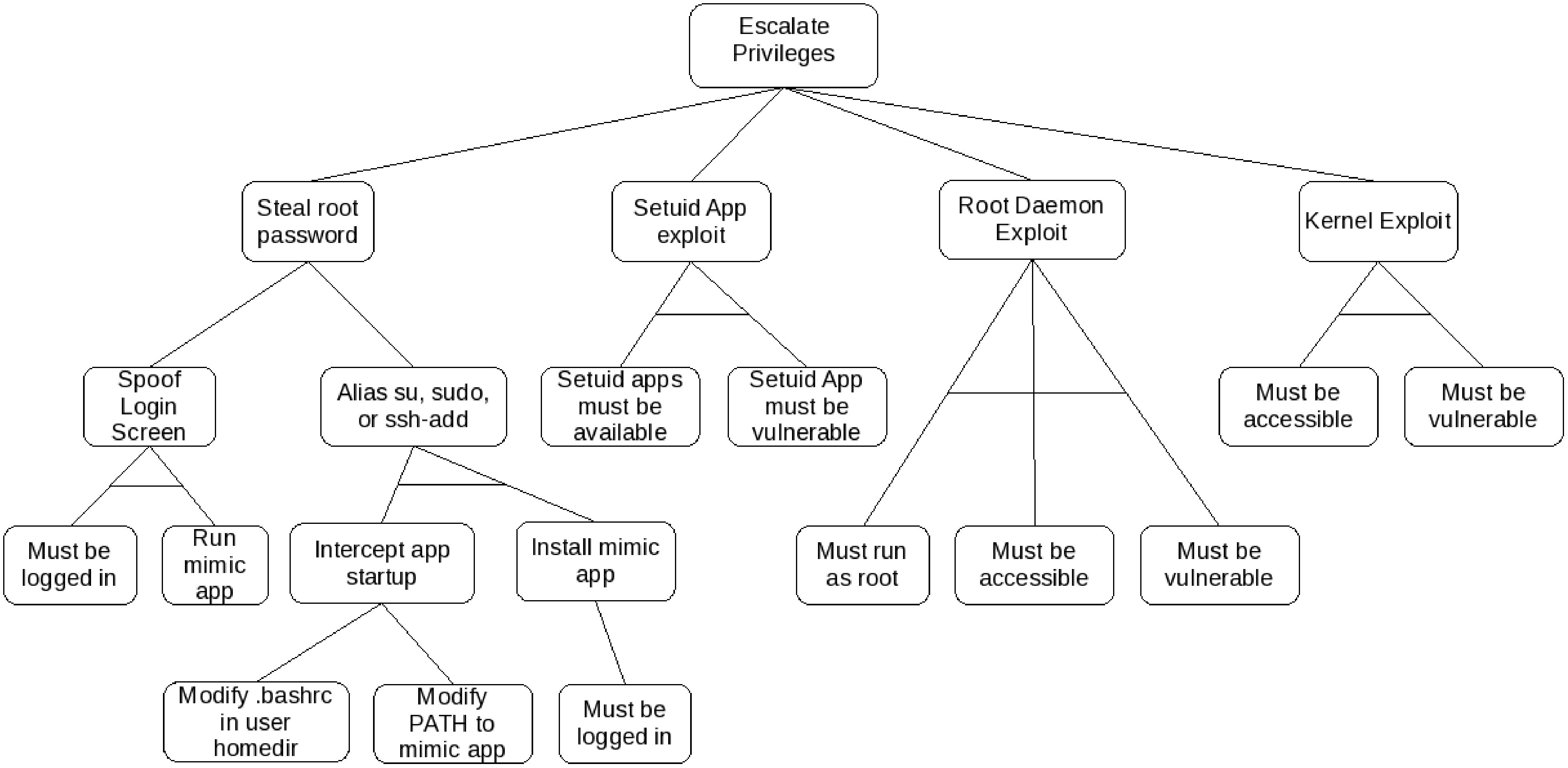
Privilege Escalation Attack Tree



System Update

Keep your system updated!

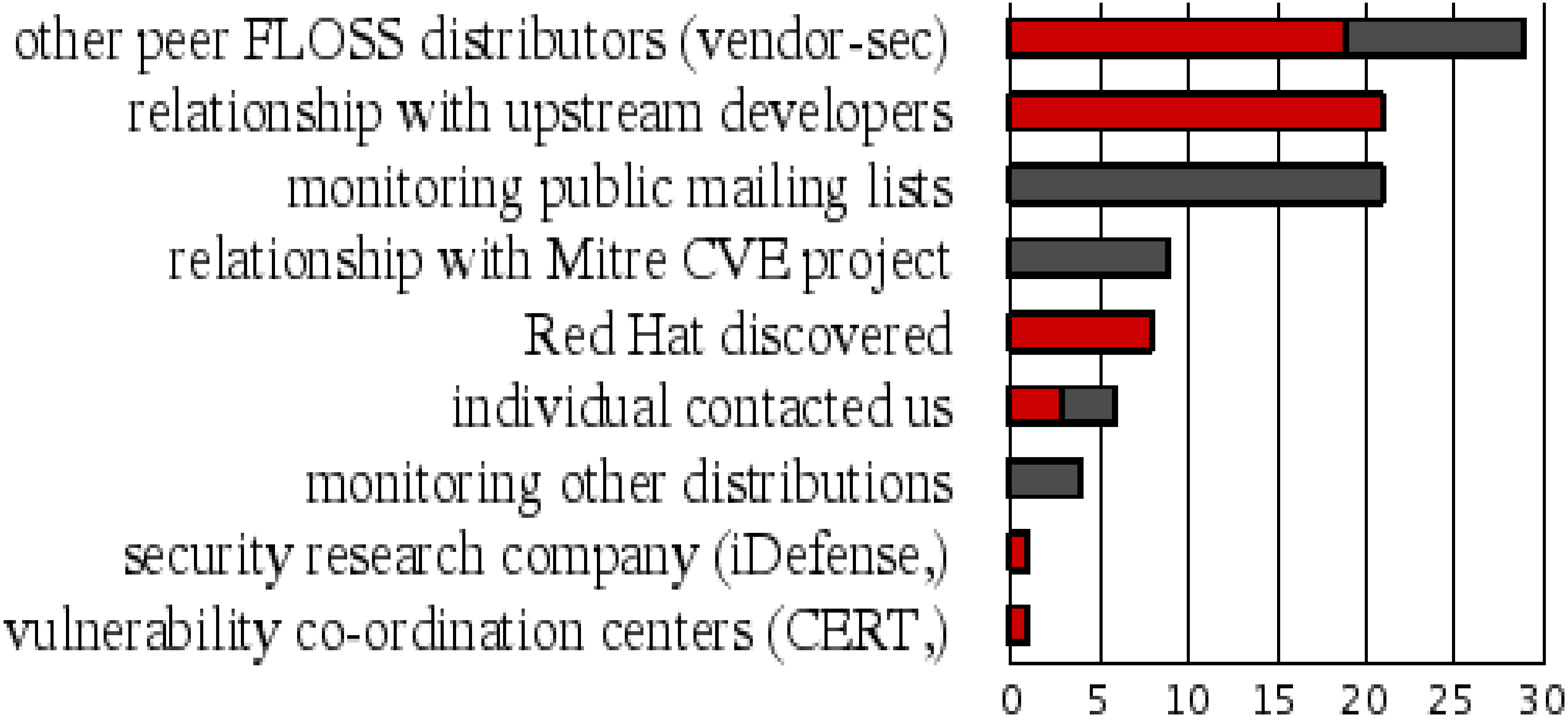
- If we know there is a problem, you should seriously consider taking the update

Some vulnerabilities can be mitigated by configuration

Some cannot

How Do We Find Vulnerabilities?

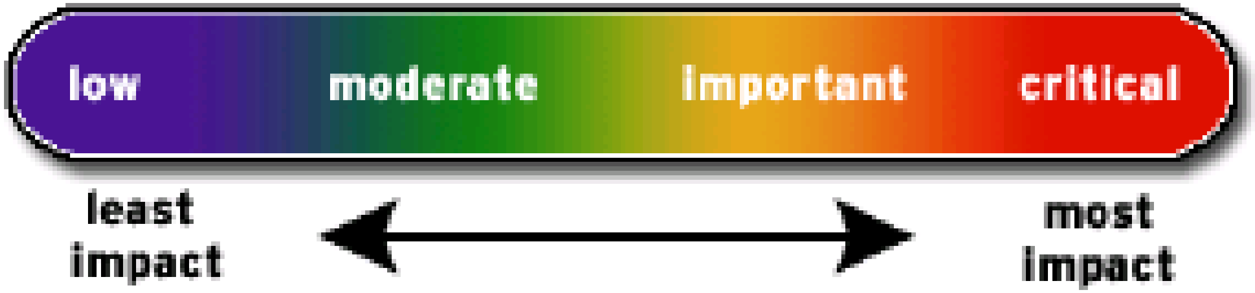
March 2005 – March 2007



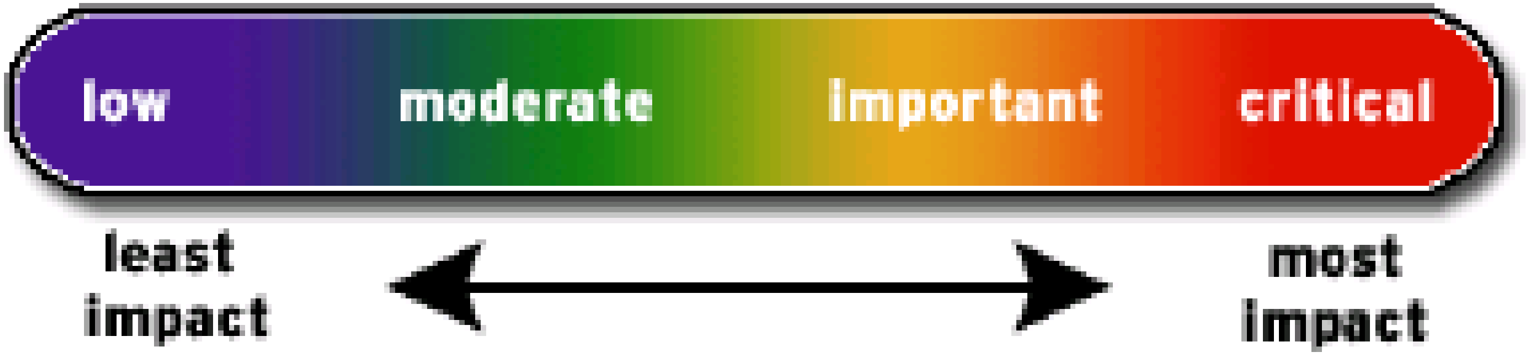
Setting a severity rating

Based on a technical assessment of the flaw, not the threat

- Unique to each Red Hat Enterprise Linux distribution
- Sets the priority through Engineering and QA
- Trend tracking (source, reported, public)



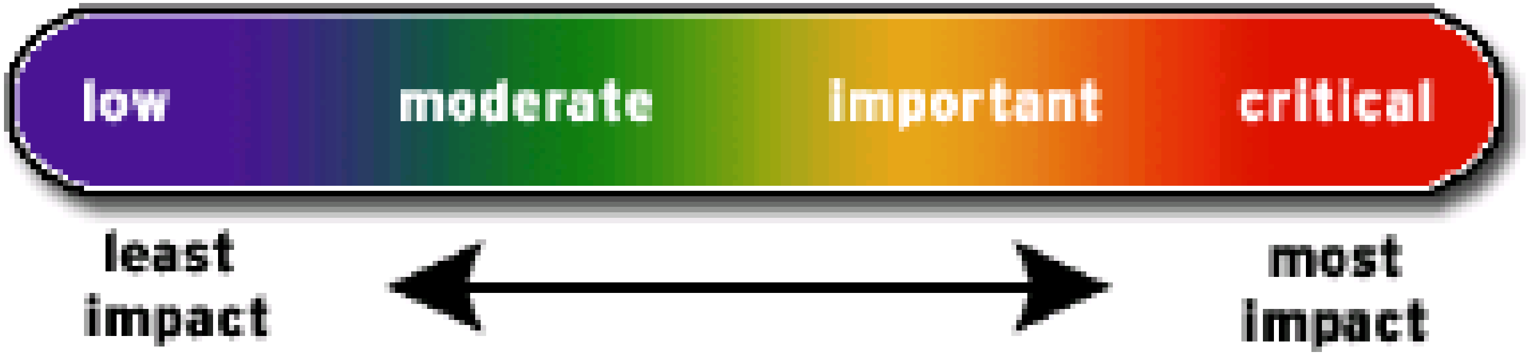
Severity Rating



Critical

> *"A vulnerability whose exploitation could allow the propagation of an Internet worm without user action."*

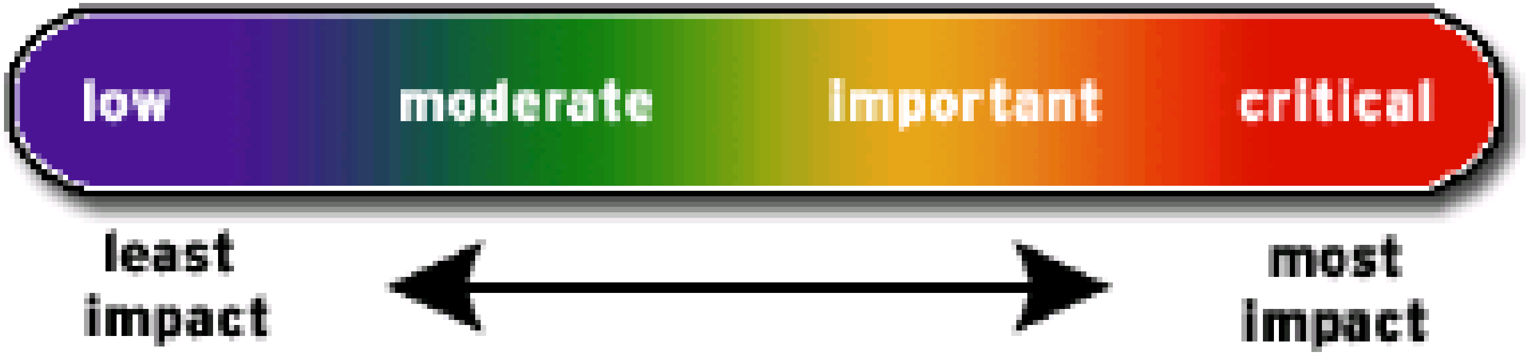
Severity Rating



Important

“easily compromise the Confidentiality, Integrity or Availability of resources”

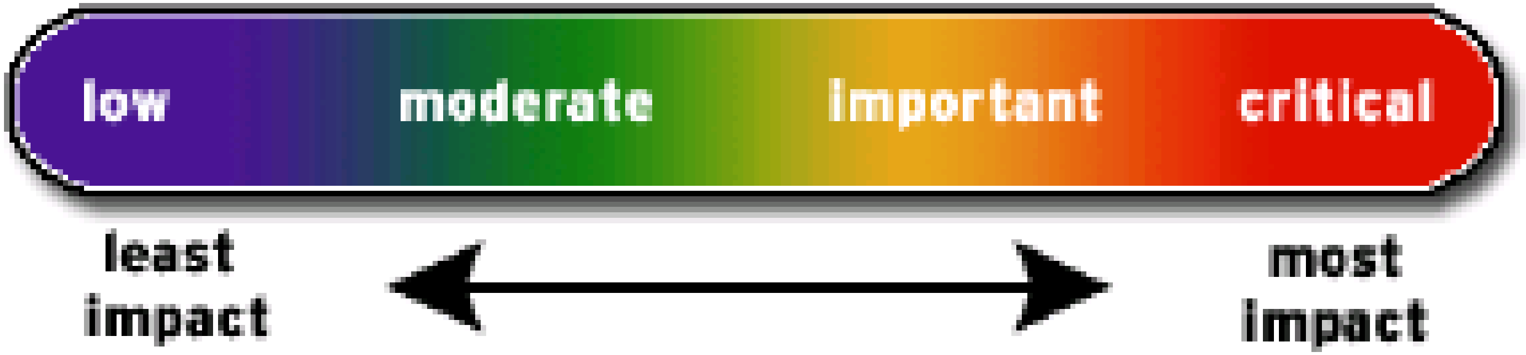
Severity Rating



Moderate

“harder or more unlikely to be exploitable”

Severity Rating



Low

> *“unlikely circumstances .. or where a successful exploit would lead to minimal consequences”*

Release Policy

- For critical vulnerabilities
  - Will be pushed immediately as embargo is lifted, or when passed QE
  - Will be pushed at any time or day
- For important vulnerabilities
  - May be held until reasonable time or day
- For moderate or low vulnerabilities
  - May be held until other issues come up in the same package, or the next Update release
- secalert @redhat.com - Address used for internal and external customers to ask security vulnerability related questions
  - Reporting new vulnerabilities
  - Asking how we addressed various vulnerabilities

Partitioning

Keep directories that users can write to on their own partition

- Prevents hard linking to setuid programs
- Allows precise control over mount options

```
$ ls -li test
13697075 -rwsr-x--- 1 root root 8666 2008-02-15 14:20 test

$ ln ./test test2

$ ls -li test2
13697075 -rwsr-x--- 2 root root 8666 2008-02-15 14:20 test2

$ make
gcc -g -W -Wall -Wundef test.c -o test

$ ls -li test
13697055 -rwsr-x--- 1 root root 8948 2008-02-17 15:53 test

$ ls -li test2
13697075 -rwsr-x--- 1 root root 8666 2008-02-15 14:20 test2
```

Partitioning

Allow minimal privileges via mount options

- Noexec on everything possible
- Nodev everywhere except / and chroot partitions
- Nosetuid everywhere except /
- Consider making /var/tmp link to /tmp, or maybe mount –bind option

A reasonable /etc/fstab:

```
LABEL=/               /               ext3    defaults                      1 1
LABEL=/tmp            /tmp            ext3    defaults,nosuid,noexec,nodev  1 2
LABEL=/var/log/audit  /var/log/audit  ext3    defaults,nosuid,noexec,nodev  1 2
LABEL=/home           /home           ext3    defaults,nosuid,nodev         1 2
LABEL=/var            /var            ext3    defaults,nosuid               1 2
LABEL=/boot           /boot           ext3    defaults,nosuid,noexec,nodev  1 2
/tmp                  /var/tmp        ext3    defaults,bind,nosuid,noexec,nodev  1 2
tmpfs                 /dev/shm        tmpfs   defaults                      0 0
devpts                /dev/pts        devpts  gid=5,mode=620                0 0
sysfs                 /sys            sysfs   defaults                      0 0
proc                  /proc           proc    defaults                      0 0
LABEL=SWAP-sda6       swap            swap    defaults                      0 0
```

Network Configuration

Strategy

- Minimize protocols being used
- Minimize addresses being listened to
- Minimize ports being listened on

Tools that help

- ifconfig – look at device and address mappings
- netstat – look at processes and their socket states
- route – look at the routing table
- nmap – scan the system from outside the firewall

Network Configuration

- IPv6
  - On by default
  - There are daemons that are IPv6 aware: sshd, apache, bind, xinetd, etc
  - Ip6tables has to be specifically setup
  - Could have service unexpectedly open to attack
- Detection
  - ifconfig | grep inet6
  - inet6 addr: fe80::21d:7eff:fe00:af5d/64 Scope:Link
  - inet6 addr: ::1/128 Scope:Host
- Disabling
  - Create a file /etc/modprobe.d/ipv6
  - Add this line inside: install ipv6 /bin/true

Network Configuration

Zeroconf

- On by default
- Used by avahi for local service discovery
  - Requires a hole in firewall to allow access
  - Advertises services to others

Detection

- route | grep link-local
- `link-local      *               255.255.0.0     U     0      0        0 eth2`

Disabling

- Edit /etc/sysconfig/network
- Add   NOZEROCONF=yes
- Then remove the avahi package and its dependencies

Network Configuration

Review Listening Daemons

- Default install is tuned for general use
- Probably a few things that are unnecessary

Detection

- netstat -tanp | grep LISTEN

Typical output:

```
[root ~]# netstat -tanp | grep LISTEN
tcp     0     0 127.0.0.1:8000     0.0.0.0:*       LISTEN      2256/nasd
tcp     0     0 127.0.0.1:3306     0.0.0.0:*       LISTEN      2166/mysqld
tcp     0     0 127.0.0.1:4690     0.0.0.0:*       LISTEN      2376/prelude-manage
tcp     0     0 127.0.0.1:631      0.0.0.0:*       LISTEN      2057/cupsd
tcp     0     0 127.0.0.1:25       0.0.0.0:*       LISTEN      2244/master
tcp     0     0 :::22              :::*            LISTEN      2068/sshd
```

Network Configuration

Disabling Listening Daemons

- Locate the pid in the netstat command
- cat /proc/<pid>/cmdline
- If not full path, run which or locate to find utility
- rpm -qf full-path-of-daemon
- rpm -e package
- If difficult to remove due to dependencies:
  - chkconfig <service> off

Network Configuration

/etc/sysctl.conf settings

```
# Don't reply to broadcasts. Prevents joining a smurf attack
net.ipv4.icmp_echo_ignore_broadcasts = 1

# Enable protection for bad icmp error messages
net.ipv4.icmp_ignore_bogus_error_responses = 1

# Enable syncookies for SYN flood attack protection
net.ipv4.tcp_syncookies = 1

#  Log spoofed, source routed, and redirect packets
net.ipv4.conf.all.log_martians = 1
net.ipv4.conf.default.log_martians = 1
```

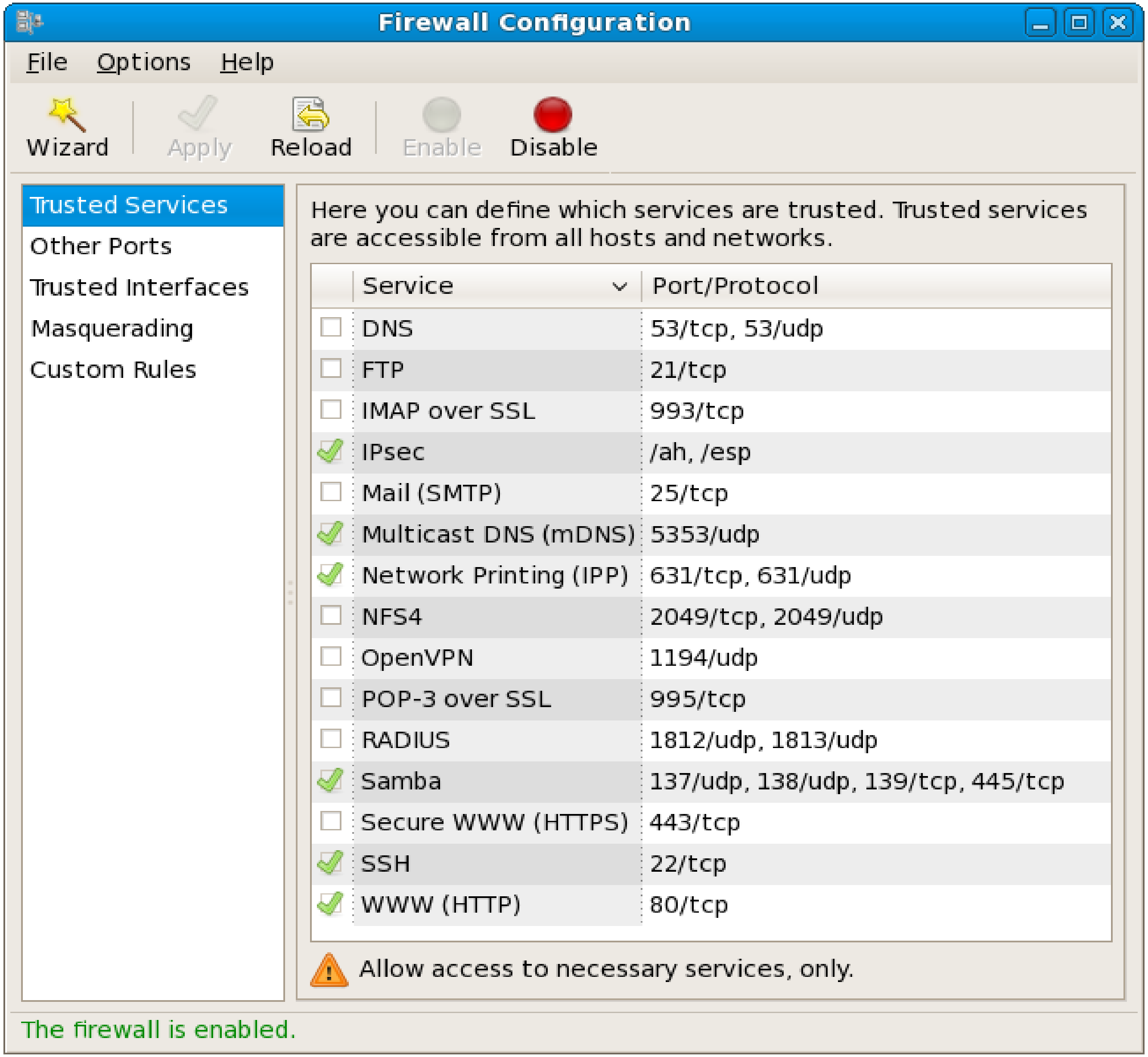
Network Configuration

```
# Don't allow source routed packets
net.ipv4.conf.all.accept_source_route = 0
net.ipv4.conf.default.accept_source_route = 0

# Turn on reverse path filtering
net.ipv4.conf.all.rp_filter = 1
net.ipv4.conf.default.rp_filter = 1

# Don't allow outsiders to alter the routing tables
net.ipv4.conf.all.accept_redirects = 0
net.ipv4.conf.default.accept_redirects = 0
net.ipv4.conf.all.secure_redirects = 0
net.ipv4.conf.default.secure_redirects = 0

# Don't pass traffic between networks or act as a router
net.ipv4.ip_forward = 0
net.ipv4.conf.all.send_redirects = 0
net.ipv4.conf.default.send_redirects = 0
```

Network Configuration

Iptables

- Default should be pretty good
- To see rules: service iptables status
- Use a GUI tool if not familiar with iptables rule syntax
- Use nmap from another machine to check effectiveness



Here you can define which services are trusted. Trusted services are accessible from all hosts and networks.

	Service	Port/Protocol
□	DNS	53/tcp, 53/udp
□	FTP	21/tcp
□	IMAP over SSL	993/tcp
☑	IPsec	/ah, /esp
□	Mail (SMTP)	25/tcp
☑	Multicast DNS (mDNS)	5353/udp
☑	Network Printing (IPP)	631/tcp, 631/udp
□	NFS4	2049/tcp, 2049/udp
□	OpenVPN	1194/udp
□	POP-3 over SSL	995/tcp
□	RADIUS	1812/udp, 1813/udp
☑	Samba	137/udp, 138/udp, 139/tcp, 445/tcp
□	Secure WWW (HTTPS)	443/tcp
☑	SSH	22/tcp
☑	WWW (HTTP)	80/tcp

⚠ Allow access to necessary services, only.

The firewall is enabled.

Network Configuration

tcp_wrappers

- Even if iptables is in use, configure this just in case
- Set /etc/hosts.deny to ALL: ALL
- Many daemons compiled with support
- Find by using: egrep libwrap /usr/bin/* /usr/sbin/* | sort
- For each program found, use its base name to set expected access rights (if there are any)
- Example: smbd: 192.168.1.

Unused Daemon Removal

Remove all daemons (and packages) not being used

- This reduces attack footprint and improves performance
- Many daemons listen on the network and could be accessible

Viewing

- chkconfig –list

Disabling

- rpm -qf /etc/rc.d/init.d/name

  rpm -e package-name
- OR   chkconfig <service> off

- Notes
  - Leave cpuspeed for speedshifting cpu and irqbalance for multicore CPU
  - Disable readahead, mcstransd, firstboot, (and NetworkManager for machines without wireless networking) since they are not needed.

System Time

Keep system time in sync

- You may need to correlate the time of disparate events across several machines to determine a chain of events
- Near impossible without common time base

Use ntp in cron job

- Create a file /etc/cron.daily/ntpdate containing the following crontab:

```
#!/bin/sh
/usr/sbin/ntpdate ntp-server
```

where ntp-server is the hostname or IP address of the site NTP server

Configure Remaining Daemons

At & cron

- Only allow root and people with verified need to run cron jobs
- Setup cron.allow and cron.deny
- Setup equivalents if you have 'at' installed

Sshd

- Enable only ssh2 protocol (this is default in RHEL5)
- If multi-homed, consider if it needs to listen on all addresses or just one
- Do not allow root logins
- Consider adding group permission for logins,   AllowGroups wheel

MySQL

- If database is used internally to machine, make it listen on localhost
- Change passwords

Configure Remaining Daemons

Bind

- Use chroot package
- Use ACLs
- Consider who the DNS server is used for (internal/external) and only serve DNS for those. Do not do both in one server instance.
- Do not allow zone transfers
- Do not do recursion

Apache

- Remove all unneeded modules
- Use mod_security to weed out injection attacks
- Set correct SE Linux Booleans to maintain functionality and protection

Configure Remaining Daemons

Init

- Disable interactive boot by editing /etc/sysconfig/init
- Make   PROMPT=no   to disable

- Also add password to single user mode. Edit /etc/inittab
- Add the following   ~~:S:wait:/sbin/sulogin

SE Linux

Leave enabled and in enforcing mode

- Does not affect daemons it doesn't know about - unless they are started in a confined domain, apache cgi-bin programs for example
- Provides a behavioral model that known applications should be following
- Can stop attacks before they become complete system breaches

Use targeted policy

- Strict and MLS should be used only if you need that kind of protection

Do boolean lockdown

- Review all booleans and set appropriately
- getsebool -a
- Generally, to secure the machine, look at things that are set to 'on' and change to 'off' if they do not apply

SE Linux Boolean Lockdown

```
[root ~]# getsebool -a | grep ' on'
allow_daemons_dump_core --> on
allow_daemons_use_tty --> on
allow_execmem --> on
allow_execstack --> on
allow_gadmin_exec_content --> on
allow_gssd_read_tmp --> on
allow_kerberos --> on
allow_mounton_anydir --> on
allow_postfix_local_write_mail_spool --> on
allow_staff_exec_content --> on
allow_sysadm_exec_content --> on
allow_unconfined_exec_content --> on
allow_unlabeled_packets --> on
allow_user_exec_content --> on
allow_xserver_execmem --> on
allow_zebra_write_config --> on
browser_confine_xguest --> on
httpd_builtin_scripting --> on
httpd_enable_cgi --> on
httpd_enable_homedirs --> on
httpd_tty_comm --> on
httpd_unified --> on
nfs_export_all_ro --> on
nfs_export_all_rw --> on
read_default_t --> on
samba_run_unconfined --> on
spamd_enable_home_dirs --> on
use_nfs_home_dirs --> on
user_ping --> on
```

Audit

Enable

- Install auditd
- chkconfig auditd on
- Audit daemon will turn on kernel auditing at boot and load rules

Setup correctly

- Add audit=1 to grub.conf kernel config line
- Have /var/log/audit on its own partition
- Edit /etc/audit/auditd.conf
- flush parameter should be set to sync or data
- max_log_file and num_logs need to be adjusted so that you get complete use of your partition
- space_left should be set to a number that gives the admin enough time to react to any alert message and perform some maintenance to free up disk space
- disk_full_action is triggered when no more room exists on the partition. All access should be terminated since no more audit capability exists.

Auditd

Set some defaults

- Place watches on critical files
  - Edit /etc/audit/audit.rules
  - -w /etc/shadow -p wa -k shadow
- Monitor important syscalls
  - -a exit,always -S open -S openat -F exit=-EPERM
- Auditd package has CAPP, LSPP, and NISPOM rules for samples
- Syscall rules are evaluated for every syscall of every program! Use judiciously

Review aureport output regularly

- Aureport gives system security summary report

Aureport system summary

```
Summary Report
======================
Range of time in logs: 07/22/2006 08:29:01.394 - 05/07/2007 16:12:29.832
Selected time for report: 05/01/2007 00:00:01 - 05/07/2007 16:12:29.832
Number of changes in configuration: 85
Number of changes to accounts, groups, or roles: 2
Number of logins: 25
Number of failed logins: 1
Number of authentications: 29
Number of failed authentications: 1
Number of users: 2
Number of terminals: 11
Number of host names: 3
Number of executables: 59
Number of files: 3
Number of AVC denials: 46
Number of MAC events: 21
Number of failed syscalls: 16
Number of anomaly events: 33
Number of responses to anomaly events: 0
Number of crypto events: 0
Number of process IDs: 4087
Number of events: 5885
```

Access Control

Do not allow root logins

- This messes up the audit system since root is a shared account
- Sshd and gdm have settings to disallow root login

pam_tally2

- This is used to lockout an account for consecutive failed login attempts

pam_access

- Used to forbid logins from certain locations, consoles, and accounts
- /etc/security/access.conf controls its config

pam_time

- Used to forbid logins during non-business hours
- /etc/security/time.conf controls its config

Access Control

pam_limits

- Used to limit maximum concurrent sessions and other user restrictions
- /etc/security/limits.conf controls its config

pam_loginuid

- Used for all entry point daemons to set the task's loginuid and session identifier
- Loginuid and session ID are inherited by all processes at fork
- Stored inside the task struct in the kernel
- Using require-auditd module option will forbid login if auditd is not running

Limit access to su command

- Edit /etc/pam.d/su
- Uncomment the line saying require wheel to allow uid change
- auth   required   pam_wheel.so use_uid

Disable Unused Devices

USB Mass Storage

- This can be used to transfer files in and out of the system
- Best to disable when possible by editing a file /etc/modprobe.d/no-usb
- Add this line inside: install usb-storage /bin/true

Wireless

- Disable in BIOS
- rm -rf /lib/modules/2.6.18*/kernel/drivers/net/wireless/*
- Must be run after each upgrade – working on something better

Firewire

- Check for /etc/modprobe.d/blacklist-firewire
- If not there, disable when possible by creating a file /etc/modprobe.d/no-firewire
- Add this line inside: install firewire_ohci /bin/true

Secure Physical Machine

Disable boot to anything except hard drive

- Do not allow booting from CD/DVD or USB devices

Disable any hardware unused

- Protects against device driver flaws should any ever be found

Lock BIOS

- After making sure to disallow USB booting, you don't want anyone to undo it

Set grub password

Integrity Checking

Amtu

- Abstract Machine Test utility
- Memory, network, disk, cpu security tests
- Can be run as cron job to repeatedly assure basic security assumptions
- Results sent to audit system

Aide

- File Integrity testing utility
- Configured by /etc/aide.conf
- --init snapshots the disksystem to /var/lib/aide/aide.db.new.gz
- Copy snapshot to immutable or safe location
- Rename snapshot to /var/lib/aide/aide.db.gz before doing comparison
- --check will compare current with snapshot for differences
- Summary sent to audit system

New Security Features since RHEL5 GA

NULL Pointer Dereference Protection

- MAP_FIXED flag to mmap syscall can be used to map page 0.
- vm.mmap_min_addr sysctl defaults to 64k
- SE Linux policy arbitrates access and CAP_SYS_RAWIO for DAC

SHA256 Password hashes

- Previously only md5 and des, now sha256 and sha512 have been added
- authconfig --passalgo=sha256 --update

Rsyslog

- Regex file splitting
- Execute commands
- TCP connection
- Database backend

TCG/TPM

- Tech preview in 5.2, supported in 5.3

Questions?

NSA guidance: http://www.nsa.gov/notices/notic00004.cfm?Address=/snac/os/redhat/rhel5-guide-i731.pdf

Email: sgrubb @redhat.com