Linux Hardening Techniques

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Agenda

1. What is Systems Hardening?
2. Basic Principles
3. Updates & Encryption
4. Monitoring
5. Services
6. Firewalls
7. Logging

What is System Hardening?

- A collection of tools, techniques, and best practices to reduce vulnerability in technology applications, systems, infrastructure, firmware, and other areas
- 3 major areas: OS vs Software vs Network
  - When have we done hardening in this class before?
  - This lecture is focusing mostly on OS and software level

Why Harden?

- Firewalls can only get us so far, what happens when at attack is inside the network?
  - If you have nothing protecting your systems you are in trouble
- We want some kind of secondary protection

A Few Cybersecurity Principles

- Zero Trust Security
  - Instead of assuming everything behind the firewall is safe, Zero Trust verifies each request as though it originates from an unsecure network
- Principle of Least Privilege
  - Only privileges needed to complete a task should be allowed
  - Users should not have domain administrator/root privileges
- Principle of Least Common Mechanism
  - Mechanisms used to access resources should not be shared in order to avoid the transmission of data.
  - Shared resources should not be used to access resources

The Threat Model

- A process by which potential threats can be identified and prioritized.
  - If you have a web server that feeds input to a mysql database, then protecting against mysql injections would be prioritized in your model.

2 considerations

- *nix like is a very broad grouping of systems
  - Some of this might not translate 1:1, but the theory remains the same
- IR and Hardening are 2 sides of the same coin
  - Usually the Exploitation/Installation signals the transition into IR

Systems Updates

- Running an outdated system is a bad idea
- Constantly upgrading to the bleeding edge might also cause issues
  - What issues can we think off?
- This is why we use a LTS based update system
  - Recall from the linux lecture we configured the machines to only do security updates

Hard Disk Encryption

- What is Encryption?
  - Turns readable text into cipher text
    - GPG is a common tool
- Full Disk Encryption might not work for all cases

System Monitoring

- Recall from the Services Lecture that linux had process and services
  - A process is an instance of a particular executable
  - A service is a process which runs in the background (daemons)
    - firewalld, named, systemd

System Monitoring

- systemd
  - system and service manager
- systemctl
  - control the state of the systemd system and service manager
  - systemctl enable, disable, start, stop <service>
- journalctl

System Monitoring

- ps aux
  - Very common command
  - ps → process status
  - a → running processes from all users
  - u → user or owner column in output
  - x → prints the processes those have not been executed from the terminal
- htop
  - A process viewer

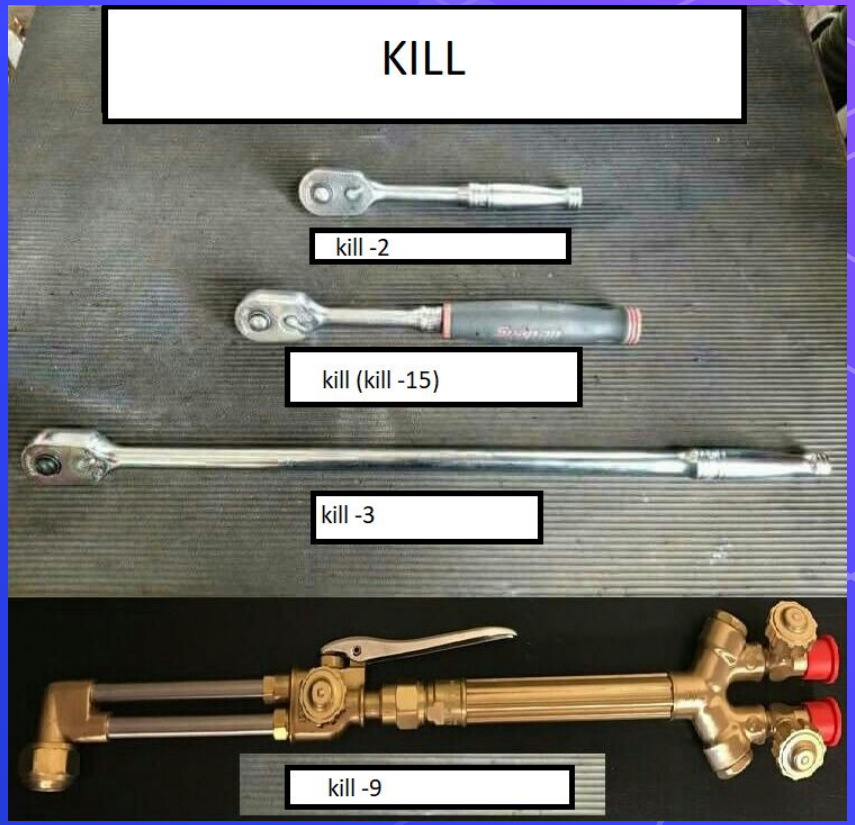
System Monitoring

- lsof - “list open files”
  - Because everything in linux is a byte stream, we can treat each stream as a file
  - Lets us monitor what each process is doing on our system

```
apache2 14746 www-data  mem       REG    8,5   229248  131156 /usr/lib/x86_64-linux-gnu/libapr-1.so.0.6.
apache2 14746 www-data  mem       REG    8,5   184152  133833 /usr/lib/x86_64-linux-gnu/libaprutil-1.so.
apache2 14746 www-data  mem       REG    8,5   465008  139929 /usr/lib/x86_64-linux-gnu/libpcre.so.3.13.
apache2 14746 www-data  mem       REG    8,5   191472  138874 /usr/lib/x86_64-linux-gnu/ld-2.31.so
apache2 14746 www-data    0r      CHR    1,3      0t0       6 /dev/null
apache2 14746 www-data    1w      CHR    1,3      0t0       6 /dev/null
apache2 14746 www-data    2w      REG    8,5      239  675232 /var/log/apache2/error.log
apache2 14746 www-data    3u     sock    0,8      0t0   25895 protocol: TCP
apache2 14746 www-data    4u     IPv6   25896    0t0     TCP *:http (LISTEN)
apache2 14746 www-data    5r     FIFO   0,12     0t0  316658 pipe
apache2 14746 www-data    6w     FIFO   0,12     0t0  316658 pipe
apache2 14746 www-data    7w      REG    8,5        0  656971 /var/log/apache2/other_vhosts_access.log
apache2 14746 www-data    8w      REG    8,5        0  661337 /var/log/apache2/access.log
```

Finding & Killing processes

- pgrep vs grep
  - ps aux | grep bash
- pkill vs kill
  - SIGKILL (kill -9)
- pkill / pgrep just kill by process name
  - kill 3782
  - pkill nautilus



In Class Activity

- Fun with killing and finding commands
- Going to be using ss and kill to find and kill a process

Break Time!

Please return in 10 mins

Securing Services

- Recall from the pentesting lecture: The Cron Service
- time-based job scheduler
- Remember the Cybersecurity Principles we talked about
  - /etc/cron.allow - If this file exists, it must contain the user's name for that user to be allowed to use cron jobs.
  - /etc/cron.deny - If the cron.allow file does not exist but the /etc/cron.deny file does exist then, to use cron jobs, users must not be listed in the /etc/cron.deny file.
- Used by attacker, therefore should be considered when defending a system

Securing Services

- Some services come with secure installation scripts
  - Recall from the Services lecture: mysql_secure_installation
- Other services have config files
  - /etc/ssh/sshd_config
    - PermitRootLogin
    - AllowList
- Services should handle unexpected input gracefully
  - SQL injections, Heartbleed, XSS

Securing Services

- The User Service
- Recall from the Linux HW: Linux Pluggable Authentication Modules (PAM)
  - configure methods to authenticate users
  - Allows authentication with LDAP
    - Why might we find this useful?

Securing Services

- Access Control Lists
  - a list of permissions associated with a system resource
- SELinux
  - set of kernel modifications and user-space tools
  - enforces mandatory access control policies that confine user programs and system services, as well as access to files and network resources
  - Recall the Principle of Least Privilege

In Class Activity

- Secure a SSH Server

Break Time!

Please return in 5 mins

Local firewalls

- When have we used these before?
  - The Services Lecture
- Recall the Principle of Least Common Mechanism
  - We don’t want to share anything except 1 service
  - Default deny all is great here

Local Firewalls

- How do we see what our machine is talking to on the network?
  - ss/netstat(deprecated)
    - What are the security considerations of using deprecated software on systems?
- PortSentry
  - Daemon that will watch unused ports for activity
  - What phases of the kill chain does this help us defend against?
- Fail2Ban

Logging

- Which logs have we looked at before?
  - Apache logs in Services Lecture
- Located in /var/log
  - auth.log (deb) or secure (rehl) for logins
  - faillog for failed logins
  - cron keeps a log of cronjobs
  - Other service will have their own logs

Logging

- We can also log changes to files
  - When would this be useful?
- This is where file integrity tools come in handy
  - Tripwire
  - OSSEC

Homework

- 4 Guided Activities
- On the LSHHW VM find and document 3 things that you have hardened
  - Document the issue
  - Document how you fixed it
  - Do a simple risk analysis on the issue

Further reading

- Saltzer and Schroeder's Design Principles
- CIS Security Benchmarks
- SELinux Docs
- LSOF cheat sheet