ROOTKITS
ANALYSIS AND DETECTION

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Rootkit

The name, root kit, suggests a component that allows obtaining root access in a computer system, its only purpose is to help an attacker into keeping a previously obtained root access.

DEFINITIONS

- **A collection of tools (programs) that a hacker uses to mask intrusion and obtain administrator-level access to a computer or computer network. ” Courtesy: SANS**

DEFINITIONS

- **A hacker security tool that captures passwords and message traffic to and from a computer. A collection of tools that allows a hacker to provide a backdoor into a system, collect information on other systems on the network, mask the fact that the system is compromised, and much more. Rootkit is a classic example of Trojan Horse software. Rootkit is available for a wide range of operating systems. Courtesy: NSA**

What does a Root Kit do?

- Hide Attacker Activities: Files, Processes and network connections
- Provide Unauthorized access
- Eavesdropping tools
- Clean Logs
- Hacking Tools
- Integrity Checkers deceivers

CLASSIFICATION

- Linux Root Kit
  - –User Mode
  - –Kernel Mode
- Windows Root Kit
  - –Kernel Mode

USER MODE ROOTKIT

- Replace specific system program used to extract information from the system
- Can include additional tools like sniffers and password crackers

Files usually substituted:

- File Hiding: du, find, sync, ls, df, lsof, netstat
- Hide PROCESSES: killall, pidof, ps, top, lsof
- SNIFFING & data acquisitions: ifconfig (hide the PROMISC flag), passwd

USER MODE ROOTKIT contd

Files usually substituted:

- Hide CONNECTIONS: netstat, tcpd, lsof, route, arp
- Execute tasks: crontab, reboot, halt, shutdown
- Hide LOGS: syslogd, tcpd
- Hide LOGINS: w, who, last. . . (no recording in utmp, wtmp, btmp, lastlog. . .)
- BACKDOORS: inetd, login, rlogin, rshd, telnetd, sshd, su, chfn, passwd, chsh, sudo

USER MODE ROOTKIT contd

Tools to Hide evidence

- addlen: tool to fit the trojaned file size to the original one.
- fix: changes the creation date and checksum (non-cryptographic) of any program.
- wted: has edit capabilities of wtmp and utmp log files.
- zap: zeroes out log files (utmp, wtmp, lastlog (Solaris), messages. . .) entries.
- zap2 (z2): erases log files entries: utmp, wtmp, lastlog. . .

USER MODE ROOTKIT contd

Disadvantages

- Too many binaries to replace thus prone to mistakes
- Verifications through checksums is easy and OS dependent.

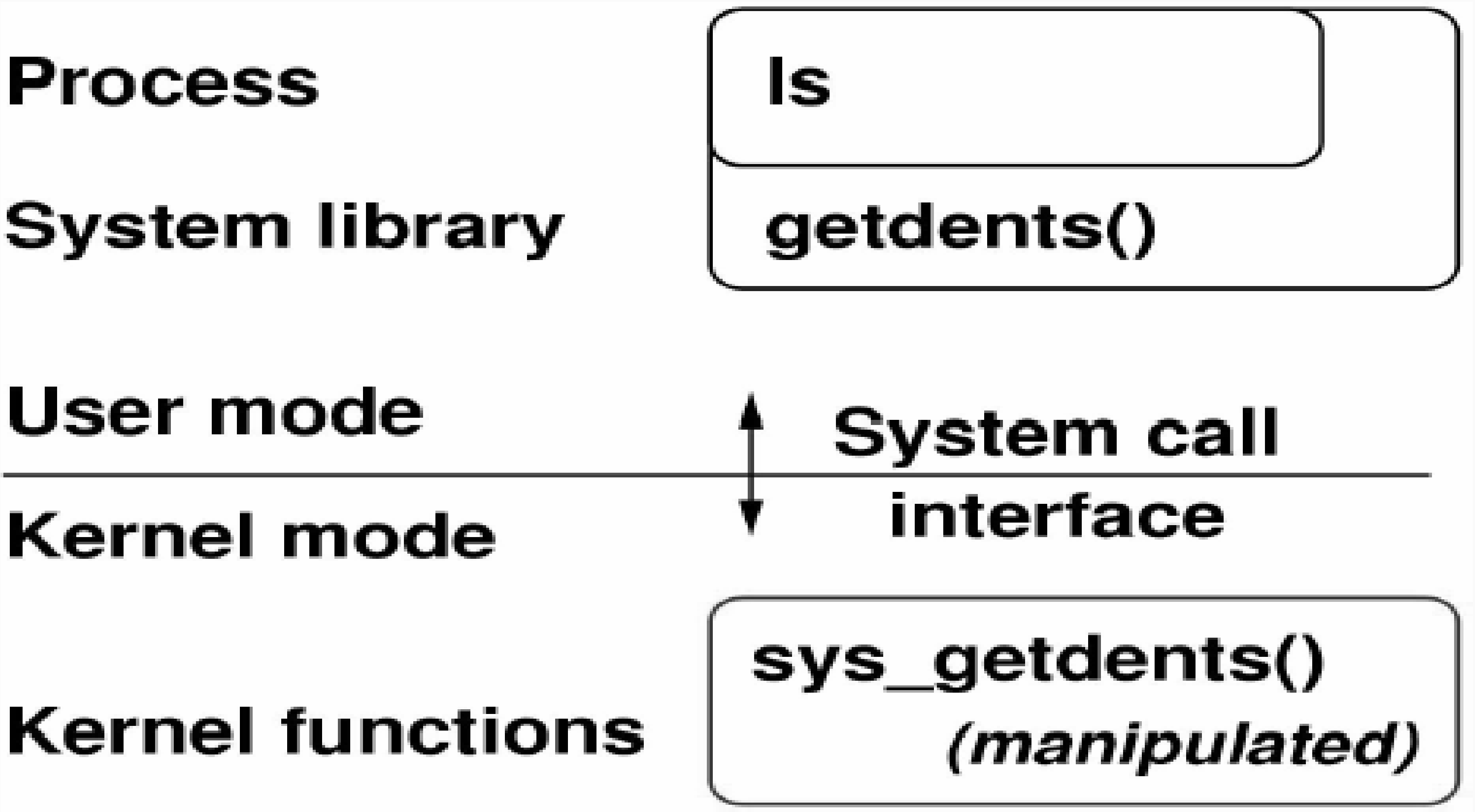
Some Famous Root Kits

- **T0rnkit**:
- **LRK, The Linux Rootkit**:
  - » There are many others coming up every day.

KERNEL MODE ROOT KIT

- User mode root kit requires various binaries to be manipulated, Kernel mode requires only altering the kernel
- The kernel rootkits provide all the user-mode rootkit features from a low level, and their hiding and deceive capabilities can trick all user-mode inspection tools.
- The goal of a kernel rootkit is placing the malicious code inside the kernel source by manipulating the kernel.

INTERCEPTING EXECUTION FLOW



Process

ls

System library

getdents()

User mode

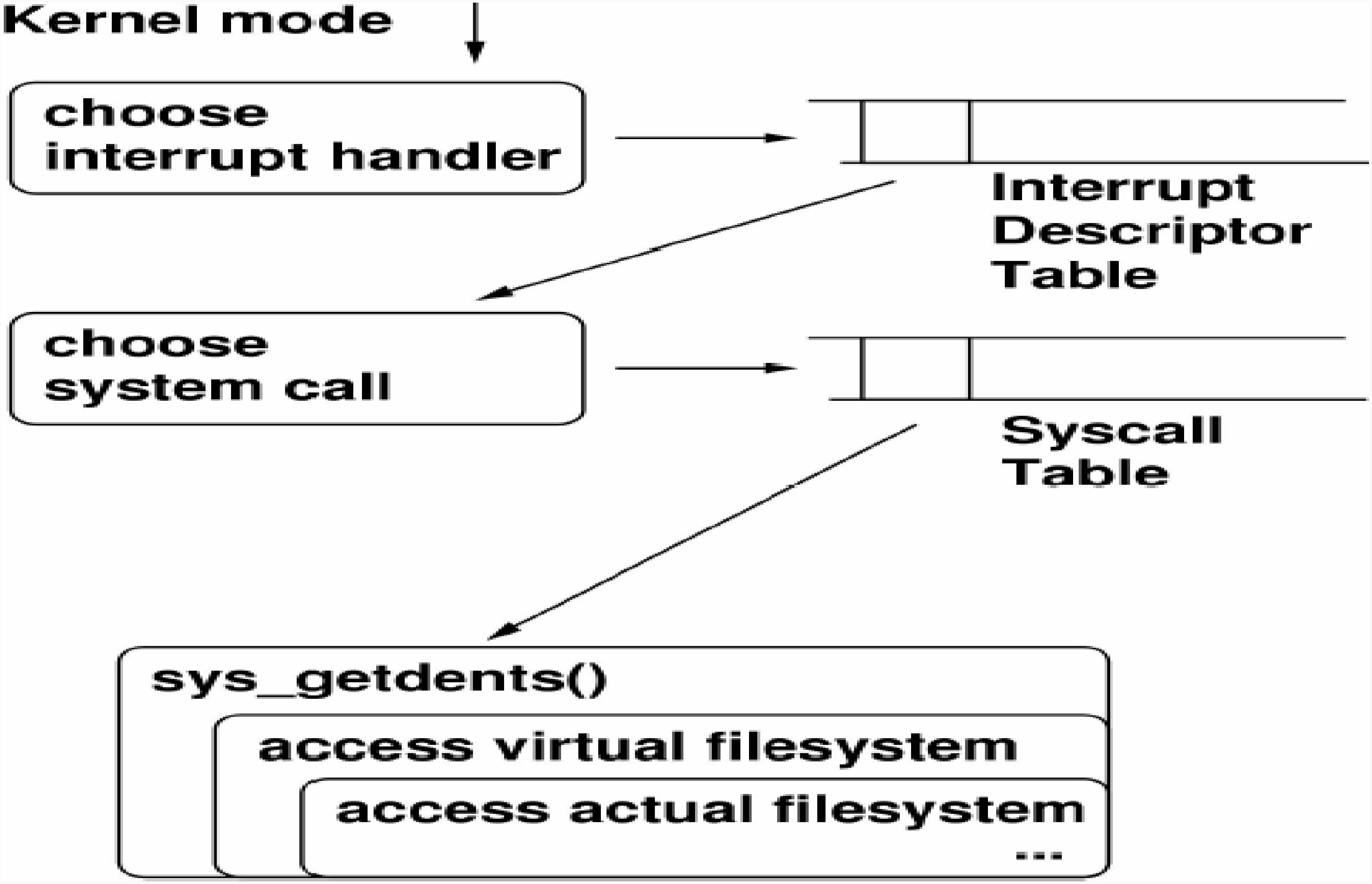
System call interface

Kernel mode

Kernel functions

sys_getdents()

(manipulated)



Kernel mode

choose interrupt handler

Interrupt Descriptor Table

choose system call

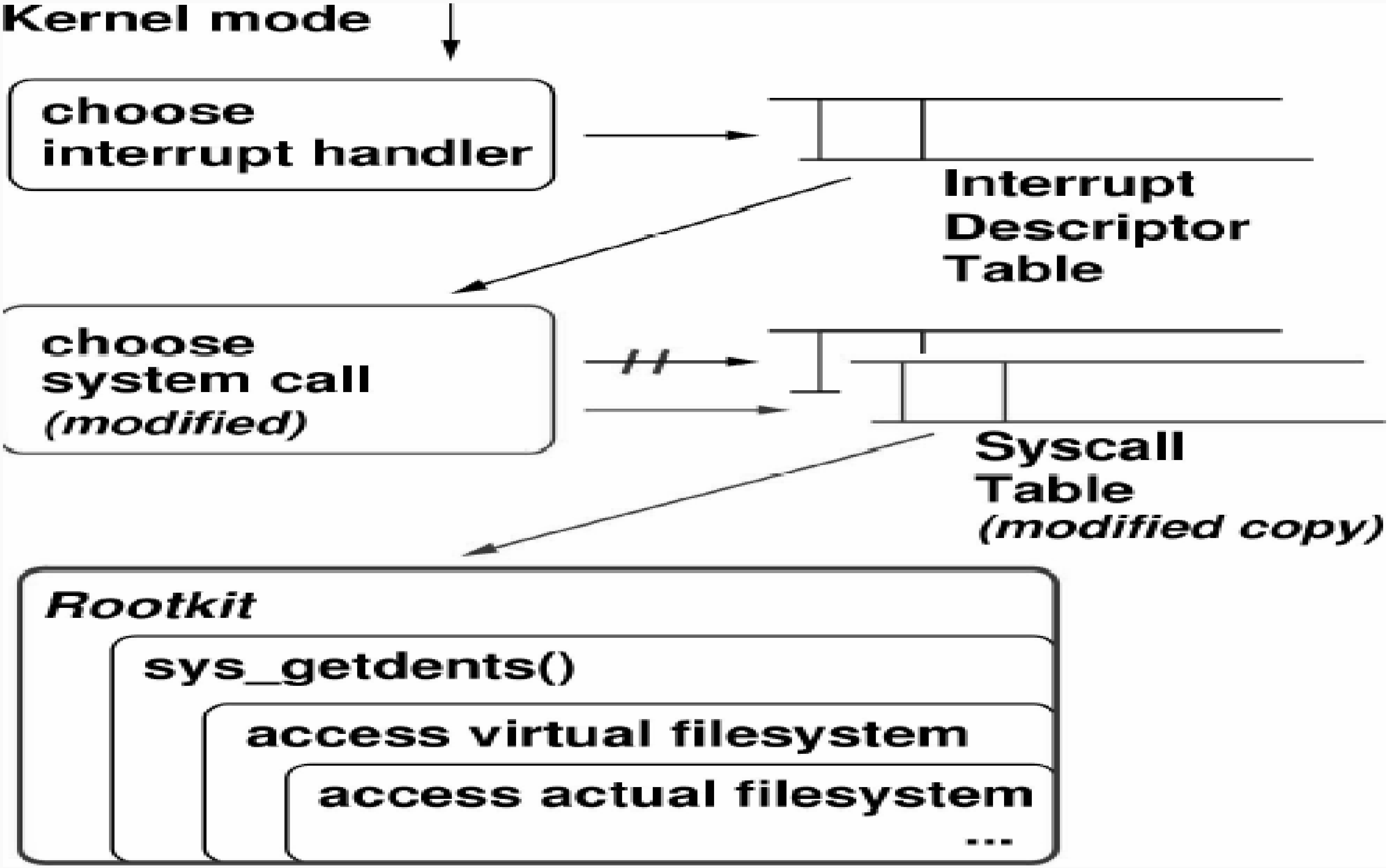
Syscall Table

sys_getdents()

access virtual filesystem

access actual filesystem

...



Kernel mode

choose
interrupt handler

Interrupt
Descriptor
Table

choose
system call
(modified)

Syscall
Table
(modified copy)

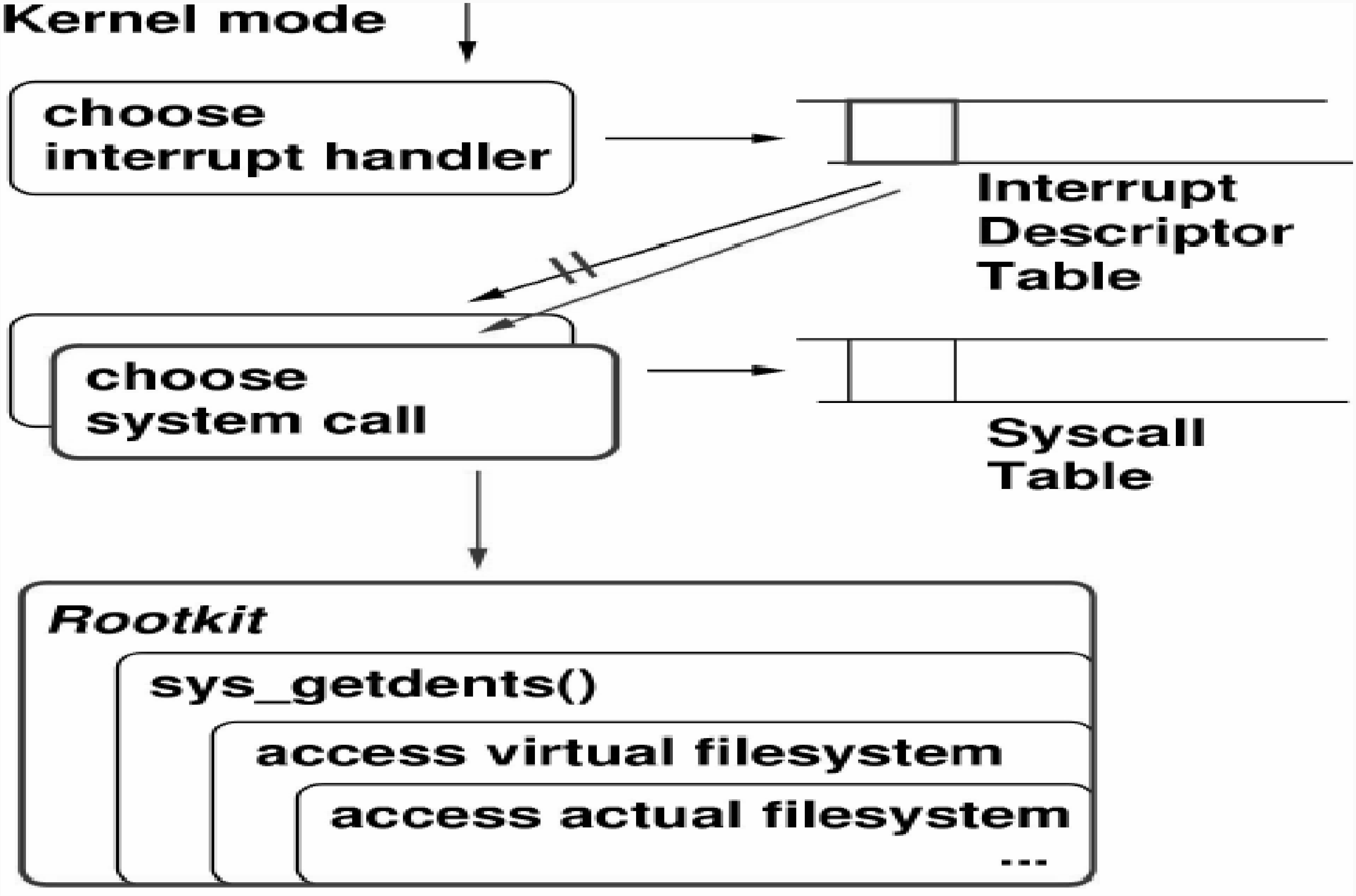
Rootkit

sys_getdents()

access virtual filesystem

access actual filesystem

...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choose interrupt handler
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Rootkit
sys_getdents()
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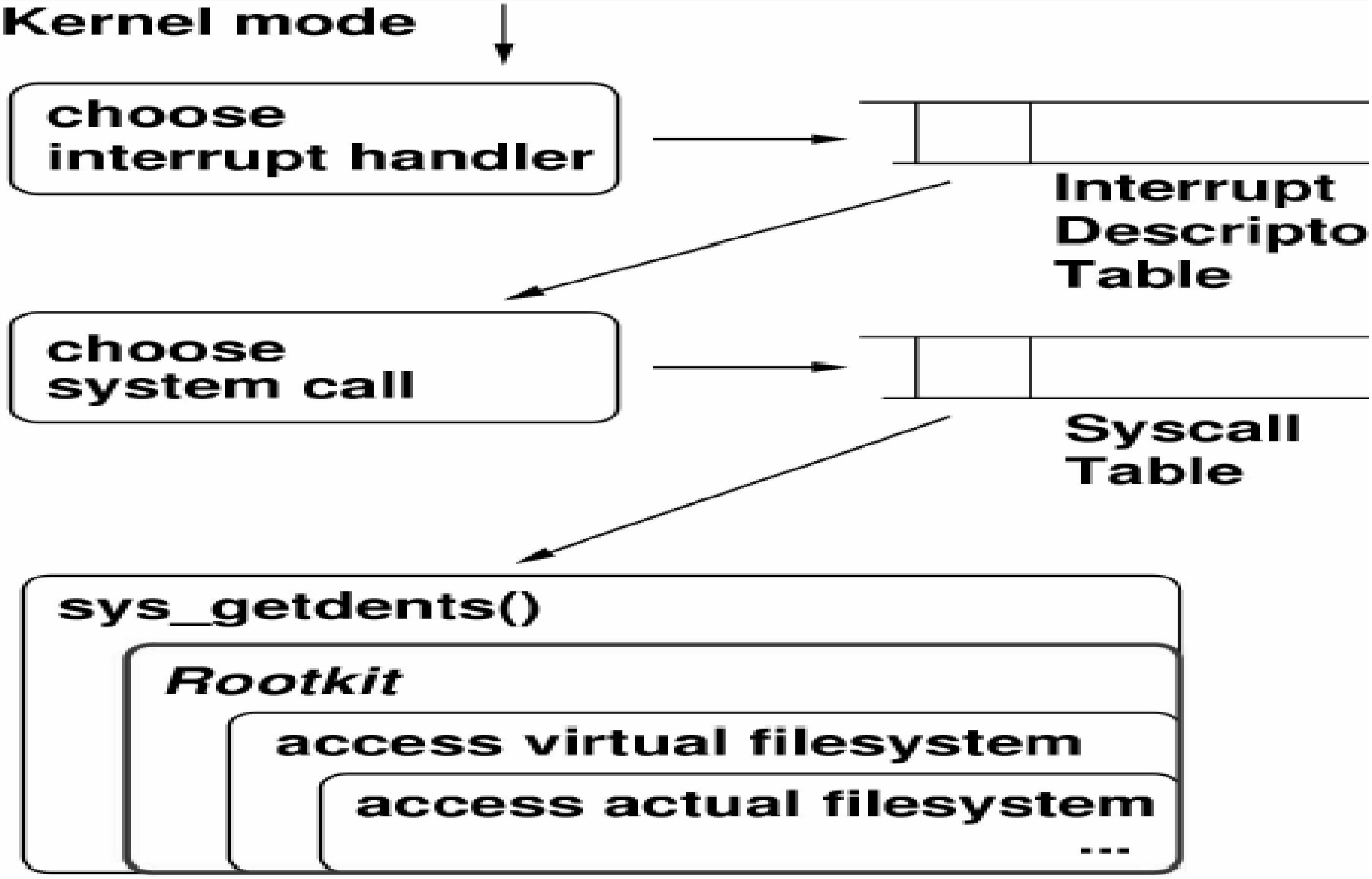

Kernel mode

choose interrupt handler

Interrupt Descripto Table

choose system call

Syscall Table

sys_getdents()

Rootkit

access virtual filesystem

access actual filesystem

...

ROOTKIT DETECTION

- Anomaly Search
  - Files
  - Network Usage
  - Scheduled and Booting Tasks
  - Accounts
  - Log and User Histroy entries

ROOTKIT DETECTION

- /proc psuedo file system
  - /proc/cmdline
  - /proc/kcore
  - /proc/kmsg
  - /proc/ksyms
  - /proc/modules
  - /proc/version/proc/sys

ROOTKIT DETECTION

- Suspicious files, directories and disk usage
  - System files in /tmp, /dev, font directories
  - Hard link count and directory size
  - Hard Link Count Analysis
  - Total Block Count Analysis
- MAC Times
  - Time Stamp Analysis

ROOTKIT DETECTION

- Logging system call traces: strace
- Detecting (and recovering) deleted executables and open files
- Network Connections
- Detecting Promiscuous NIC
- Integrity
- Checking Rootkit features

ROOTKIT DETECTION

- Tools
  - Saint Jude
  - Chrootkit
  - Rootkithunter
  - RkScan
  - The “Carbonite” LKM
  - Kstat
  - Exporting standard and debugging module symbols
  - Kernel memory scanning:
  - System Call table help:LKM or memory dump
  - Execution path analysis
  - CheckIDT
  - The kern_check tool
  - The check_ps tool

PROTECTING LINUX KERNEL

- OS Hardening
- Patching the kernel vulnerabilities
- Linux Bootstrap process analysis
- Kernel compilation without module support
- Kernel Hardening
- Restricted operations and capabilities
- “System.map” Protection
- System call table export

PROTECTING LINUX KERNEL

- LKM Protection
  - modlock (LKM Locking)
  - syscall_sentry LKM
  - Toby LKM
  - St. Michael;
  - LIDS