Global Information Assurance Certification Paper

IRONICALLY, SOME TARGETS ARE HARDER THAN OTHERS

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Abstract

In this paper, a binary file of unknown purpose and functionality will be examined. This will be performed using commonly available tools and will seek to determine the purpose of the binary and the reason it was on the system. Any other details available about the binary will also be discussed.

In part 2 of this paper, a hard disk drive will be examined. This disk drive is taken from a computer in an unknown state, and the operating system's security may have been compromised. An image of the drive will be taken, and proved to be forensically sound. This image will then be examined using various tools, the goal being to discover as much information about the potential compromise as possible, hopefully including the identity of the intruder.

Part 3 will examine some legal aspects of a hypothetical scenario. This scenario involves a law enforcement official seeking assistance from the system administrator of an Internet Service Provider (ISP). The ISP network may have been used to attack a government network. This section of the paper will discuss what help the system administrator is allowed to give the law enforcement official. This discussion will focus on the law of New Zealand, as it stood on July 17TH, 2003.

In this assignment, the following conventions have been used.

Section headings are in Times New Roman (12) Bold Underline

The investigator's comments are in Times New Roman (12).

Commands entered into a command line or shell are in Arial (8) Bold

The computers responses to the command are in Arial(8)
Code listings are in Arial(8)
Document Listings are in Arial(8)

0.1 A blank line in
0.2 A continuous code or document listing

0.8 Indicates that for brevity, irrelevant or repititive lines have been omitted from the listing

The output from the Sysinternals Process Explorer is in Arial(6)

The printout of the Autopsy Time Line is in Arial(7)

Legal case names are in Times New Roman (12) Italic

Legislation is in Times New Roman (12) Underline

GCFA PART 1.

Analysis of an unknown binary

The following is an analysis of a binary of unknown functionality and purpose, which may be malicious. Accordingly, some security precautions are required, as will be later explained in more depth. Although the binary did not include an md5 checksum to assure us of its forensic accuracy, there is currently no reason to suspect that the file may be corrupted.

Binary Details

The details of the zip file containing the binary are as follows.

```
delta:> ls
total 8
drwxr-xr-x   2 michael  root         512 Jun 19 13:05 .
drwxr-xr-x   5 michael  root         512 Jun 19 12:42 ..
-rw-r--r--   1 michael  root        5687 Jun 17 14:28 binary_v1.3.zip
delta:>
```

AS CAN BE SEEN , THE NAME OF THE ZIP FILE I S "BINARY_V1.3.ZIP". THE FILE IS (APPROX) 6KB IN ITS COMPRESSED FORM. THE NAME OF THE COMPU TER ON WHICH THIS ST AGE OF THE INVESTIGATION IS BEING PERFORMED IS "DELTA." THIS MACHINE IS A SUNBLADE , RUNNING SOLARIS V 8. THE OWNER OF THE FILE IS "MICHAEL ", AS THIS IS THE USER WHO DOWNLOADED THE FILE (THIS CAN EASILY BE C ONFIRMED BY LOGGING INTO THE MACHINE AS ANOTHER USER , AND DOWNLOADING THE FILE AGAIN .) ACCORDINGLY , BOTH THE USER AND GROUP INFORMATIO N, AS WELL AS THE ATTR IBUTES OF THE ZIP FI LE CAN BE DISREGARDED . THE TIME STAMP ON THE FILE IS THE TIME TH AT THE ZIP FILE WAS DOWNLOADED AND WRITT EN TO THE DISK ON TH E LOCAL MACHINE . THIS ALSO HAS NO EVIDENTIAL VALUE , AS ALL THE TIME INF ORMATION HAS BEEN LO ST, DURING THE TRANSIT FROM THE MACHINE O N WHICH THE BINARY W AS FOUND .

USEFUL INFORMATION CA N BE GAINED FROM THE ZIP FILE HOWEVER .

```
delta:> zipinfo -l binary_v1.3.zip
Archive:  binary_v1.3.zip   5687 bytes   1 file
-rwxa--     2.0 fat    26793 b-     5567 defN 20-Feb-03 12:45 target2.exe
1 file, 26793 bytes uncompressed, 5567 bytes compressed:  79.2%
delta:>
```

This shows that the file's original size was 27kb. This high compression ration (27:6, approx 80% compression) suggests that the file may contain large amounts of text, which is more easily c ompressed than binary data.

This output also shows us that the file was zipped up from a “File Allocation System”. This is the file and directory system commonly used by Windows Operating System (OS). The file name is displayed as "target2.exe". The "exe" extension is used on DOS (Disk Operating System) systems to identify EXEcutable files. This accords with our hypothesis that the file was created in a Windows OS. Zipinfo displays the correct filename case, as stored in the file. As MS -DOS PKZIP always us es uppercase file names, this file may have been compressed from a Windows machine using the "Long File Name" system, which allows for lowercase file names.

The attributes on the stored file indicate that it is -Rwxa-- readable (always true), -rWxa-- writable, -rwXa-- executable (a guess based on the file name extension), and -rwxA-- archivable. The file is not a directory, hidden or a system file. The 2.0 indicates that the program used to zip the file was version 2.0 of that program. The defN indicates that the compression scheme used was "deflation", with a “Normal” compression ratio. Finally, the file was last modified at 12:45pm on Thursday the 20th of February, 2003. This is the DOS time, which is rounded to the nearest 2 seconds.

```
delta:> zipinfo -v binary_v1.3.zip
Archive:  binary_v1.3.zip   5687 bytes   1 file

End-of-central-directory record:
-------------------------------

  Actual offset of end-of-central-dir record:       5665 (00001621h)
  Expected offset of end-of-central-dir record:     5665 (00001621h)
  (based on the length of the central directory and its expected offset)

  This zipfile constitutes the sole disk of a single-part archive; its
  central directory contains 1 entry.  The central directory is 57
  (00000039h) bytes long, and its (expected) offset in bytes from the
  beginning of the zipfile is 5608 (000015E8h).

  There is no zipfile comment.

Central directory entry #0:
---------------------------

  target2.exe

  offset of local header from start of archive:     0 (00000000h) bytes
  file system or operating system of origin:        MS-DOS, OS/2 or NT FAT
  version of encoding software:                     2.0
  minimum file system compatibility required:       MS-DOS, OS/2 or NT FAT
  minimum software version required to extract:     2.0
  compression method:                               deflated
  compression sub-type (deflation):                 normal
  file security status:                             not encrypted
  extended local header:                            no
  file last modified on (DOS date/time):            2003 Feb 20 12:45:48
  32-bit CRC value (hex):                           d185fd18
  compressed size:                                  5567 bytes
  uncompressed size:                                26793 bytes
  length of filename:                               11 characters
  length of extra field:                            0 bytes
  length of file comment:                           0 characters
  disk number on which file begins:                 disk 1
  apparent file type:                               binary
  non-MSDOS external file attributes:               81FF00 hex
  MS-DOS file attributes (20 hex):                  arc

  There is no file comment.

delta:>
```

This file was apparently zipped up fro m a MS-DOS based system. MS-DOS does not store user information as part of a file's metadata. Accordingly, the zip file does not contain any information about the user or group who originally owned the binary in question.

Comments can be associated with t he entire zip file when compressing. This zip file

had no such comment. Comments can also be associated with individual files contained in the zip file. The "target2.exe" compressed file also had no comments.

List file

```
delta:> unzip -l binary_v1.3.zip
Archive:  binary_v1.3.zip
 Length   Date   Time    Name
 -----  ----   ----    ----
 26793  02-20-03  12:45   target2.exe
 -----                  -------
 26793                  1 file
```

Verbose listing of file

```
delta:> unzip -lv binary_v1.3.zip
Archive:  binary_v1.3.zip
 Length Method  Size  Ratio   Date   Time   CRC-32    Name
 ------ ------  ----  -----  ----   ----   ------    ----
 26793  Defl:N   5567  79%  02-20-03  12:45  d185fd18  target2.exe
 -----          -----  ---                          -------
 26793          5567  79%                          1 file
```

Test file

```
delta:> unzip -t binary_v1.3.zip
Archive:  binary_v1.3.zip
    testing: target2.exe            OK
No errors detected in compressed data of binary_v1.3.zip.
```

UNZIP FILE

```
DELTA:> UNZIP BINARY_V1.3.ZIP
ARCHIVE:  BINARY_V1.3.ZIP
  INFLATING: TARGET2.EXE
DELTA:> LS -AL
TOTAL 35
DRWXR-XR-X   2 MICHAEL  ROOT       512 JUN 27 10:13 .
DRWXR-XR-X   5 MICHAEL  ROOT       512 JUN 27 10:10 ..
-RW-R--R--   1 MICHAEL  ROOT      5687 JUN 20 14:48 BINARY_V1.3.ZIP
-RW-R--R--   1 MICHAEL  ROOT     26793 FEB 20 12:45 TARGET2.EXE
DELTA:>
```

FILE LAST MODIFIED

```
DELTA:> LS -AL
TOTAL 35
DRWXR-XR-X   2 MICHAEL  ROOT       512 JUN 27 10:13 .
DRWXR-XR-X   5 MICHAEL  ROOT       512 JUN 27 10:10 ..
-RW-R--R--   1 MICHAEL  ROOT      5687 JUN 20 14:48 BINARY_V1.3.ZIP
-RW-R--R--   1 MICHAEL  ROOT     26793 FEB 20 12:45 TARGET2.EXE
```

FILE LAST CHANGED (INODE INFORMATION)

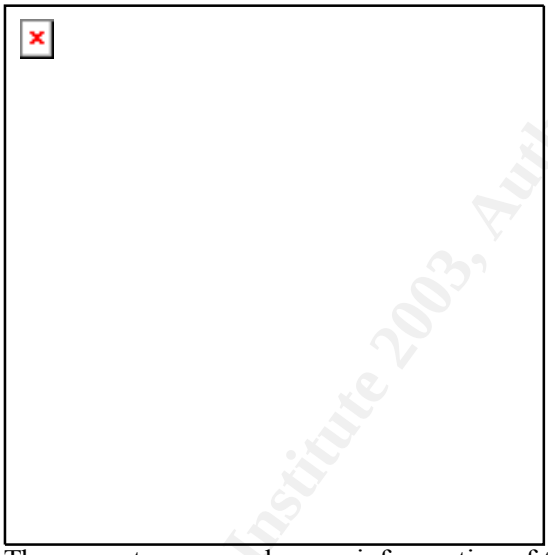
```
DELTA:> LS -ALC
TOTAL 35
DRWXR-XR-X   2 MICHAEL  ROOT       512 JUN 27 10:13 .
DRWXR-XR-X   5 MICHAEL  ROOT       512 JUN 27 10:10 ..
-RW-R--R--   1 MICHAEL  ROOT      5687 JUN 27 06:05 BINARY_V1.3.ZIP
-RW-R--R--   1 MICHAEL  ROOT     26793 JUN 27 10:13 TARGET2.EXE
```

FILE LAST ACCESSED

```
DELTA:> LS -ALU
TOTAL 35
DRWXR-XR-X   2 MICHAEL  ROOT       512 JUN 27 10:52 .
DRWXR-XR-X   5 MICHAEL  ROOT       512 JUN 27 10:52 ..
-RW-R--R--   1 MICHAEL  ROOT      5687 JUN 27 10:13 BINARY_V1.3.ZIP
-RW-R--R--   1 MICHAEL  ROOT     26793 FEB 20 12:45 TARGET2.EXE
DELTA:>
```

On a Unix system, three separate times are saved for each file. These times represent the time the file was last modified (M-Time), last accessed (A-Time), or had its metadata changed (C-Time). Collectively these are known as the MAC times. From the MAC times of this file once expanded, it was created on February 20th, at 12:45. The file's metadata was last changed at 10:13, June 27 (the time the file was extracted) but the file was last accessed also on Feb 20th at 12:45. It is likely that the file was created on the system in question on the 20th of February, and either never run, or run once immediately after it was created. The last changed time is of no use, as this includes the time the inode (portion of the disk drive) containing the file was modified. As the current inode on the test system did not contain any information about the file, it was updated when the file was extracted. 10:13 am was in fact the time the unzip command was run.

The file is 26,793b, as could be seen from the zip file. The md5 hash of the binary is "848903a92843895f3ba7fb77f02f9bf1", as shown in this screen-shot of the md5 hash being taken.



The current owner and group information of the binary are those that the file was extracted onto the test system using. In this case, that is "michael" and "root".

```
DELTA:> FILE TARGET2.EXE
TARGET2.EXE:  DOS EXECUTABLE (EXE)
DELTA:>
```

The unix "file" command (used to identify different file types) identifies the file as an MS-DOS type binary executable.

Program Description

EXECUTABLE FILES OFTE N CONTAIN READABLE T EXT, AS WELL AS BINARY D ATA. THIS TEXT CAN REVEAL USEFUL IN FORMATION ABOUT THE EXECUTABLE FILE , SUCH AS MENU OPTION S, HELP STRINGS , OR USAGE STATEMENTS . THESE STRINGS ARE DIS PLAYED USING THE "STRINGS " COMMAND . THE -A OPTION DISPLAYS AL L THE STRINGS IN THE FILE, INCLUDING THOSE OCCURING AT TH E BEGINNING AND END OF THE FILE .

```
DELTA:> STRINGS -A TARGET2.EXE
!THIS PROGRAM CANNOT BE RUN IN DOS MODE.
RICH
.TEXT
`.RDATA
@.DATA
.RSRC
HL@@
SUVW
D$,QPR
|4,3
D$ J'P
T$,J'RP
L$,J
T$,VRS
D$ J'P
T$,J'RP
|$ H
L$0H
L$ J'Q
D$"J
D$,J'PQ
SUVW
D$0QPR
D$$J'P
T$0J'RP
L$0J
T$0URV
D$$J'P
T$0J'RP
_^][
T$$H
D$ J'PQ
D$(H
L$(Q
H(@@
T$$QRJ
D$$PW
5 @@
5,@@
5 @@
5,@@
5 @@
5,@@
 H0A@
VPPP
5 @@
5,@@
IRQH
5H0@
SPHXD@
H|D@
SQHPD@
HTD@
|$,H`D@
D$|J
D$@SPS
D$TD
=D0@
5P0@
-T0@
T$|H
```

T$|RP
USSSP3
-@@
-;@@
_^]3
SUVW
D$(PQ
5D0@
-@@
-;@@
;EUI
X!XU\
X"IUV
X#TUP
IQH@A@
-@@
-;@@
_^]3
_^][
U WJ
HHA@
HPA@
5LD@
5PD@
5TD@
5XD@
T1H@D@
5TD@
5XD@
HT HT
H@D@
5LD@
5TD@
5XD@
5D@@
VWH?
HPA@
=@0@
HPA@
HPA@
U@H`B@
PH<B@
H(B@
T$(QR
HPA@
L$0PQ
=$0@
HPA@
PH0C@
5$0@
HPA@
HXC@
HXC@
H8C@
%|0@
%x0@
H '@
%P0@
%L0@
H(1@
SVW
= D@
SLEEP
HEAPALLOC
GETPROCESSHEAP
TERMINATEPROCESS
READFILE
PEEKNAMEDPIPE
CLOSEHANDLE
CREATEPROCESSA
CREATEPIPE
WRITEFILE
GETLASTERROR
LOCALALLOC

KERNEL32.DLL
StartServiceCtrlDispatcherA
SetServiceStatus
RegisterServiceCtrlHandlerA
CloseServiceHandle
ControlService
QueryServiceStatus
OpenServiceA
CreateServiceA
OpenSCManagerA
DeleteService
StartServiceA
ChangeServiceConfigA
QueryServiceConfigA
ADVAPI32.DLL
WSAIoctl
WSASocketA
WS2_32.DLL
MFC42.DLL
memmove
exit
fprintf
_iob
sprintf
perror
strstr
time
printf
MSVCRT.DLL
__dllonexit
_onexit
_exit
_XcptFilter
__p___initenv
__getmainargs
_initterm
__setusermatherr
_adjust_fdiv
__p__commode
__p__fmode
__set_app_type
_except_handler3
_controlfp
??0ios_base@std@@QAE@XZ
??1ios_base@std@@QAE@XZ
??0_Winit@std@@QAE@XZ
??1_Winit@std@@QAE@XZ
MSVCP60.DLL
ERROR 3
ERROR 2
ERROR 1
impossibile creare raw ICMP socket
RAW ICMP SendTo:
======================ICMP BackDoor V0.1 ======================
=========Code by Spoof. Enjoy Yourself!
Your PassWord:
loki
cmd.exe
Exit OK!
Local Partners Access
Error UnInstalling Service
Service UnInstalled Sucessfully
Error Installing Service
Service Installed Sucessfully
Create Service %s ok!
CreateService failed:%d
Service Stopped
Force Service Stopped Failed%d
The service is runnin g or starting!
Query service status failed!
Open service failed!
Service %s Already exists
Local Printer Manager Service
smsses.exe

OPEN SERVICE CONTROL MANAGE FAILED:%D
START SERVICE SUCCESSFULLY!
STARTING THE SERVICE FAILED!
STARTING THE SERVICE <%S>...
SUCCESSFULLY!
FAILED!
TRY TO CHANGE THE SERVICE'S START TYPE...
THE SERVICE IS DISABLED!
QUERY SERVICE CONFIG FAILED!
SMB2
SMB2
SMB2
SMBQ
SMBU
?????
SMB2
SMB2
SMB2
SMB/
DELTA:>

THE OUTPUT OF THE STR INGS COMMAND CLEARLY ALSO SHOWS THAT THI S IS AN MS-DOS BINARY. THE FIRST PART OF THE STRINGS OUTPUT IS F ROM THE "DOS STUB" – THE PORTION OF THE CODE THAT WILL BE EXECUTE D IF THE PROGRAM IS RUN IN DOS. HERE, THE PROGRAM WILL LIK ELY DISPLAY "THIS PROGRAM CANNOT B E RUN IN DOS MODE" AND THEN EXIT. THIS IS AN INDICATION THAT THE PROGRAM IS WRITTEN FOR WINDOWS. IN EITHER CASE, AS THE FILE IS NOT A UNIX BINARY, FURTHER ASSESSMENT WILL NEED TO BE CONDUCTED ON A WINDOWS BOX.

THE FOLLOWING STRINGS MAY GIVE US AN IDEA WHAT THIS PROGRAM W ILL DO WHEN EXECUTED.

Sleep
HeapAlloc
GetProcessHeap
This is standard Windows program functionali ty

TerminateProcess
This is a little suspicious. Generally programs only need to kill processes that they have started, so we might expect to see a fork or spawn call later on.

ReadFile
WriteFile
THE PROGRAM MAY HAVE THE ABILITY TO READ AND WRITE TO THE DISK DRIVE.

PEEKNAMEDPIPE
CLOSEHANDLE
CREATEPROCESSA
CREATEPIPE
These function calls are for creating a new process, and associating it with a data stream. This suggests network functionality.

GetLastError
LocalAlloc
KERNEL32.dll
More regular Windows sys tem calls.

StartServiceCtrlDispatcherA
SetServiceStatus
RegisterServiceCtrlHandlerA
CloseServiceHandle
ControlService

QueryServiceStatus
OpenServiceA
CreateServiceA
OpenSCManagerA
DeleteService
StartServiceA
ChangeServiceConfigA
QueryServiceConfigA

These calls are associated with service control. This allows programs to start and stop windows services, ie spawning other programs.

ADVAPI32.dll
WSAIoctl
WSASocketA
WS2_32.dll

THIS IS SOCKET FUNCTIONALITY, FOR COMMUNICATING WITH OTHER MACHINES.

MFC42.DLL
MEMMOVE
EXIT
FPRINTF
_IOB
SPRINTF
PERROR
STRSTR
TIME
PRINTF

These look like C functions, which may suggest that the program was written in C or a variant.

MSVCRT.dll
__dllonexit
_onexit
_exit
_XcptFilter
__p___initenv
__getmainargs
_initterm
__setusermatherr
_adjust_fdiv
__p__commode
__p__fmode
__set_app_type
_except_handler3
_controlfp

Some more Windows strings

??0Init@ios_base@std@@QAE@XZ
??1Init@ios_base@std@@QAE@XZ
??0_Winit@std@@QAE@XZ
??1_Winit@std@@QAE@XZ
MSVCP60.dll
ERROR 3
ERROR 2
ERROR 1

UNKNOWN WINDOWS FUNCTIONS

IMPOSSIBILE CREARE RAW ICMP SOCKET
RAW ICMP SENDTO:
========== ICMP BACKDOOR V0.1 ==========
=========CODE BY SPOOF. ENJOY YOURSELF!
YOUR PASSWORD:
LOKI
CMD.EXE

THIS SECTION APPEARS TO BE INTENDED TO BE READ. THESE STRINGS MAY BE STARTUP OR HELP MESSAGES. "ICMP BACKDOOR." THIS MIGHT BE WHAT THE PROGRAM IS – ALL THE

OTHER STRINGS WOULD BE APPROPRIATE IF THIS IS IN FACT WHAT IT DOES, BUT WE NEED MORE INFORMATION TO CONFIRM THIS HYPOTHESIS.

EXIT OK!
LOCAL PARTNERS ACCESS
ERROR UNINSTALLING SERVICE
SERVICE UNINSTALLED SUCESSFULLY
ERROR INSTALLING SERVICE
SERVICE INSTALLED SUCESSFULLY
CREATE SERVICE %S OK!
CREATESERVICE FAILED:%D
SERVICE STOPPED
FORCE SERVICE STOPPED FAILED%D
THE SERVICE IS RUNNING OR STARTING!
QUERY SERVICE STATUS FAILED!
OPEN SERVICE FAILED!
SERVICE %S ALREADY EXISTS
LOCAL PRINTER MANAGER SERVICE
SMSSES.EXE
OPEN SERVICE CONTROL MANAGE FAILED:%D
START SERVICE SUCCESSFULLY!
STARTING THE SERVICE FAILED!
STARTING THE SERVICE <%S>...
SUCCESSFULLY!
FAILED!
TRY TO CHANGE THE SERVICE'S START TYPE...
THE SERVICE IS DISABLED!
QUERY SERVICE CONFIG FAILED!

MORE SERVICE MANIPULATION STRINGS, STARTING THE "SERVICE CONTROL MANAGER" AND FOR CONTROLLING PROGRAMS.

QUICKVIEW PLUS IS A PROGRAM THAT PROVIDES INFORMATION ABOUT DIFFERENT FILE TYPES. EXAMINING THE BINARY IN THIS PROGRAM REVEALS THAT IT USES THE FOLLOWING WINDOWS SYSTEM DLL FILES.

kernel32.dll
advapi32.dll
ws2_32.dll
mfc42.dll
msvcrt.dll
msvcp60.dll

SOME OF THESE ARE STANDARD FUNCTIONS REQUIRED FOR A WINDOWS BINARY. A BINARY CAN BE COMPILED IN TWO WAYS – STATICALLY AND DYNAMICALLY. A STATICALLY COMPILED BINARY CONTAINS ALL THE FUNCTIONS IN ITS OWN FILE THAT IT NEEDS TO EXECUTE. A DYNAMICALLY LINKED BINARY REFERS TO AND CALLS OTHER SYSTEM FILES TO USE SOME OF THEIR SERVICES. CLEARLY THIS BINARY HAS BEEN COMPILED IN A DYNAMICALLY LINKED FASHION, AS IT REQUIRES OTHER SYSTEM FILES TO FUNCTION. MSVCRT.DLL CONTAINS STANDARD C LIBRARY FUNCTIONS SUCH AS PRINTF, MEMCPY, AND COS. OTHER REFERENCES FROM THE FILE PROVIDE MORE INFORMATION. WS2_32.DLL IS THE WINSOCK DYNAMIC LINK LIBRARY. THIS CONTAINS THE WINDOWS SOCKETS API USED BY INTERNET AND NETWORK APPLICATIONS TO HANDLE NETWORK CONNECTIONS. AN API IS AN "APPLICATION PROGRAMMING INTERFACE" I.E. A SET OF STANDARDS THAT DEFINE HOW PROGRAMMERS ACCESS CERTAIN FUNCTIONS WRITTEN BY OTHER PROGRAMMERS. CLEARLY THE PROGRAM IN INTENDED TO COMMUNICATE OVER THE NETWORK.

FROM THE STRINGS LISTING

impossibile creare raw ICMP socket
RAW ICMP SendTo:
========== Icmp BackDoor V0.1 ==========
========= Code by Spoof. Enjoy Yourself!
Your PassWord:

THE BINARY APPEARS TO BE AN ICMP BACKDOOR. THE STRING "IMPOSSIBILE CREARE RAW ICMP SOCKET" IS TRANSLATED BY GOOGLE TRANSLATION (FROM ITALIAN TO ENGLISH) AS "IMPOSSIBLE TO CREATE RAW ICMP SOCKET" (THIS WOULD TYPICALLY BE PHRASED "COULD NOT CREATE" IN AN ENGLISH PROGRAM). THIS IS CONSISTENT WITH THE ICMP HYPOTHESIS. THE PROGRAM ALSO CONTAINS VARIOUS OTHER STRINGS THAT APPEAR TO BE ERROR OR RESPONSE MESSAGES. SOME OF THE STRINGS INDICATE THAT THE PROGRAM IS STARTING OR STOPPING SERVICES, WHICH MAY MEAN THAT IT INCLUDES SOME TROJAN CONTROL OVER THE SYSTEM.

TO FURTHER ATTEMPT TO IDENTIFY WHAT THE PROGRAM DOES, IT WAS INSTALLED ON A WINDOWS MACHINE. THIS COMPUTER WAS RUNNING WINDOWS 2000 (PROFESSIONAL), AND WAS NOT PHYSICALLY CONNECTED TO ANY OTHER COMPUTERS. IT WAS RUNNING VMWARE 4.0.0 (BUILD 4460), WITH WINDOWS 2000 PROFESSIONAL INSTALLED AS THE "GUEST" OPERATING SYSTEM. FURTHER ANALYSIS OF THE BINARY WAS DONE UNDER THE VMWARE SYSTEM. THIS ALLOWED THE BINARY TO BE RUN WITHOUT FEAR OF COMPROMISING THE SYSTEM ITSELF. AFTER RUNNING THE BINARY IT WAS POSSIBLE TO EASILY RESTORE THE SYSTEM TO A KNOWN STATE BY "REVERT"ING THE VMWARE IMAGE TO ONE SAVED EARLIER. THIS ALLOWED FOR RELATIVELY FREE EXAMINATION OF THE BINARY. FIRST THE BINARY WAS RUN IN ITS DEFAULT MODE. WHEN EXECUTED, THE PROGRAM COMPLAINED ABOUT BEING UNABLE TO FIND A SYSTEM DYNAMIC LINK LIBRARY ("MSVCP60.DLL"). THIS SYSTEM BINARY WAS COPIED INTO THE VMWARE OPERATING SPACE VIA A FLOPPY DISK, AND THE UNKNOWN BINARY EXECUTED AGAIN. ONCE STARTED, THE PROGRAM PAUSED FOR 15 SECONDS, THEN RETURNED BACK TO THE OPERATING SYSTEM. IT DID NOT DISPLAY ANY ERROR MESSAGES, OR USER INFORMATION. IF RUN WITH A COMMAND LINE SWITCH (IE TARGET2.EXE /?, -I, -D ETC) THE PROGRAM IMMEDIATELY RETURNED TO THE OPERATING SYSTEM, WITHOUT PAUSING FOR THE 15 SECONDS.

PROGRAM EXECUTION

THE PROGRAM MAY EXPECT SOME PARAMETERS TO BE PASSED TO IT. THESE COULD INDICATE THE MODE THE PROGRAM SHOULD EXECUTE IN. THE PROGRAM SETS UP VARIOUS VARIABLES, AND THEN EXECUTES SOME SERVICE CONTROL FUNCTIONS. THIS SETS UP THE FUNCTIONALITY REQUIRED FOR THE PROGRAM TO CHECK TO SEE IF A CERTAIN SERVICE IS RUNNING ON THE COMPUTER. THE PROGRAM THEN MAKES SOME REGISTRY CALLS. SYSINTERNALS "REGISTRY MONITOR" SHOWS THESE REGISTRY CALLS AS BEING TO "HKLM (HKey Local Machine)\SOFTWARE\Microsoft\Windows NT\CurrentVersion\Winlogon", "LeakTrack", and "Diagnostics". Calls are also made to "CurrentControlSet\Control\Error Message Instrument", "Compatibility2", and "AppInit_DLLs". These may be standard calls made from a Windows application with these included DLL files. However, calls are also made to "Microsoft\Cryptography\RNG\Seed". These suspicious calls may indicate that the program is opening an encrypted communications channel.

FORENSIC DETAILS

SOME OF THE CALLS MADE BY THE PROGRAM RETURN FAIL RESULTS. THIS MAY INDICATE THAT THE PROGRAM NEEDS TO BE INSTALLED IN SOME FASHION BEFORE IT CAN BE RUN SUCCESSFULLY. THE PROGRAM CODE ITSELF ALSO CONTAINS CALLS THE THE PROGRAM

"\winnt\system32\smsses.exe". This string first occurs at the hexadecimal location 60f3. Unfortunately the Disassembler used in examining this binary, IDA Pro (Interactive DisAssembler version 4.5.0.762) would only disassemble the program to the hexadecimal location 5fff. This may be due to a limitation in the disassembler, or the program may contain some kind of "end of file" marker. It does contain the hex code 1A early on in the file. This is the code used in DOS files to indicate the end of file. The code is not unusual in this location however, as it marks the end of the "Dos-Stub", the portion of the program that executes when the program is run in DOS (here it displays "This program cannot be run in DOS mode"). Due to IDA Pro's failure to disassemble the complete binary, it was impossible to trace back into these strings to find out what they were used for. It is possible (although unlikely) that they were simply appended to the end of the executable to made disassembly more difficult. However, if that was the author's intention, then there would be far better ways to do this e.g. packing the executable in an encrypted fashion with a product such as NeoLite[i]. Alternatively it may be that the compiler used is simply not one IDA Pro recognises, and is unable to understand its internal format. It may be that IDA Pro does not disassemble this portion by default, and there is an option to perform a more complete analysis. Either way, this made understanding the binary's function more difficult.

The string refers to "\\winnt\system32\smsses.exe". This program does not appear to be a standard Windows executable, nor did it appear in any search engine results. This may be an executable that the binary drops when it is initially installed. The binary also references "\winnt\system32\reg.exe". This file also does not exist, but may be installed as part of the Windows Resource kit. The default version of the file is used to read and write the Windows Registry, but the version referred to by the binary might have other functionality. Without the binary being installed correctly, it is impossible to tell what purpose and outcome the files that the binary links to might have.

The binary was executed with a packet sniffer running. The computer used to execute the binary was a Windows 2000 machine, running Service Pack 2. The computer had the TCP/IP, "client for Microsoft networks", and "file and printer sharing for Microsoft Networks" network protocols installed. The packet sniffer used was ethereal (0.9.2) with the WinPCap 3.0 packet capture libraries installed. The network card used was the Asus P4PE motherboard on-board network card. The computer was connected by an ethernet cable, to a NetGear EN103(TP) hub. This hub was only connected to the investigation computer.

When the binary was executed, no network packets were detected. The binary may be searching for a local file that is not installed, or it may be acting in a "listener" mode, ie activate for 15 seconds, and fire off a shell if it detects certain incoming packet during that time. Alternatively, it might not include network functions at all, and just link to the Winsock files to confuse examiners.

The binary was then examined using "Process Explorer" from Sysinternals. This

PROGRAM WAS RUN , FOLLOWED BY THE BIN ARY. THIS SHOWED THAT THE BINARY EXECUTED , AND THEN EXITED , WITHOUT LEAVING ANY PROGRAMS RUNNING IN MEMORY. THE "HANDLES" LISTED FOR THE BINA RY WERE :

"
Process: target2.exe Pid: 632

Handle	Type	Access	Name
0x14	Directory	0x00000003	\KnownDlls
0x18	File	0x00100020	C: \Documents and Settings \Administrator\Desktop\binary_v1.3
0x20	Directory	0x000F000F	\Windows
0x28	Mutant	0x00000001	\NlsCacheMutant
0x30	Key	0x000F003F	HKLM
0x38	WindowStation	0x000F037F	\Windows\WindowStations \WinSta0
0x44	WindowStation	0x000F037F	\Windows\WindowStations \WinSta0
0x48	Desktop	0x000F01FF	\Default
0x4C	File	0x00100080	\Device\NamedPipe\

"

THE FINAL ENTRY HERE , "\DEVICE \NAMED PIPE" WAS DESCRIBED BY TH E PROGRAM AS "A DISK FILE , COMMUNICATIONS ENDP OINT, OR DRIVER INTERFACE " WITH 3 REFERENCES . THIS MAY BE A NETWORK LISTENER , AS NO SPECIFIC FILE WAS LISTED .

THE DLL VIEW FROM THE SAME PROGRAM SHOWED :

Process: target2.exe Pid: 632

Base	Size	MM	Description	Version	Time	Path
0x240000	0x16000	*			8/05/2001 12:00 p.m.	C: \WINNT\system 32\unicode.nls
0x260000	0x2F000	*			8/05/2001 12:00 p.m.	C: \WINNT\system 32\locale.nls
0x290000	0x41000	*			8/05/2001 12:00 p.m.	C: \WINNT\system 32\sortkey.nls
0x2E0000	0x4000	*			8/05/2001 12:00 p.m.	C: \WINNT\system 32\sorttbls.nls
0x300000	0x2000	*			8/05/2001 12:00 p.m.	C: \WINNT\system 32\ctype.nls
0x400000	0x6000				20/02/2003 12:45 p.m.	C: \Documents and Settings \Administrator\Desktop\binary_v1.3\target2.exe
0x6C370000	0xF2000		MFC DLL Shared Library - Retail Version	6.00.8665.0000	8/05/2001 12:00 p.m.	C: \WINNT\system 32\mfc42.dll
0x75020000	0x8000		Windows Socket 2.0 Helper for Windows NT	5.00.2134.0001	8/05/2001 12:00 p.m.	C: \WINNT\system 32\ws2help.dll
0x75030000	0x13000		Windows Socket 2.0 32 -Bit DLL	5.00.2195.2780	8/05/2001 12:00 p.m.	C: \WINNT\system 32\ws2_32.dll
0x76080000	0x61000		Microsoft (R) C++ Runtime Library	6.00.8972.0000	23/08/2001 5:00 p.m.	C: \Documents and Settings \Administrator\Desktop\binary_v1.3\msvcp60.dll
0x77D40000	0x70000		Remote Procedure Call Ru ntime	5.00.2195.2832	8/05/2001 12:00 p.m.	C: \WINNT\system 32\rpcrt4.dll
0x77DB0000	0x5B000		Advanced Windows 32 Base API	5.00.2195.2867	8/05/2001 12:00 p.m.	C: \WINNT\system 32\advapi32.dll
0x77E10000	0x64000		Windows 2000 USER API Client DLL	5.00.2195.2821	8/05/2001 12:00 p.m.	C: \WINNT\system 32\user32.dll
0x77E80000	0xB5000		Windows NT BASE API Client DLL	5.00.2195.2778	8/05/2001 12:00 p.m.	C: \WINNT\system 32\kernel32.dll
0x77F40000	0x3C000		GDI Client DLL	5.00.2195.2778	8/05/2001 12:00 p.m.	C: \WINNT\system 32\gdi32.dll
0x77F80000	0x7B000		NT Layer DLL	5.00.2195.2779	8 /05/2001 12:00 p.m.	C: \WINNT\system 32\ntdll.dll
0x78000000	0x46000		Microsoft (R) C Runtime Library	6.01.8924.0000	8/05/2001 12:00 p.m.	C: \WINNT\system 32\msvcrt.dll

The windows socket functionality shows that the binary uses net work services. There is no keyboard hook call, so the program is probably not looking for user input. The only functions seem to be standard windows functions, C functions, and socket functions, as well as possible remote procedure calls.

THERE IS NO REAS ON TO SUSPECT THAT T HE BINARY IS ANYTHIN G OTHER THAN WHAT IT CLAIMS TO BE - AN ICMP BACKDOOR . THE INTERNAL FUNCTION ALITY SUPPORTS THIS HYPOTHESIS , AS DOES THE LIST OF OTHER SYSTEM DLLS THAT THE BINARY US ES. THE BINARY REFERS TO "CMD .EXE". WHAT THE BINARY M AY DO IS , OPEN A REVERSE COMM AND SHELL , TUNNELED THROUGH ICMP PACKETS . THE TIMING FUNCTIONS IN THE BINARY AND THE SERVICE CALLS CO ULD POTENTIALLY ALLO W THE BINARY TO EXEC UTE THE SHELL AT A KNOWN TIME , ALLOWING A REMOTE A TTACKER ACCESS TO TH E SYSTEM . THE SHELL WOULD HAVE THEN BEEN OPENE D FROM INSIDE THE NE TWORK , AND BE RUNNING THRO UGH ICMP (WHICH IS NOT TYPICAL LY USED FOR TELNET TYPE COMMANDS) SO IT MAY BE ALLOWE D THROUGH THE FIREWALL WHERE OTHER PROGRAM S WOULD BE BLOCKED .

THE BINARY ALSO CONTA INS A STRING (IN UNICODE) REFERRING TO "\\199.107.97.191 \C$". THIS MAY BE THE SITE THAT THE BINARY TRIE S TO CONNEC T TO WITH THE REVERSE SHE LL. THE BINARY DOES CONTA IN SOME CODE FOR OPE NING FILES , SO IT MAY USE THESE FIL ES TO ALLOW IT TO CO NNECT TO OTHER SITES , AND JUS T USE THIS IP

ADDRESS AS A DEFAULT , OR A "RED HERRING ."

IT ALSO REFERS TO "YOUR PASS WORD." IT MAY BE DESIGNED TO PREVENT USE OF THE BINARY WITHOUT A CER TAIN PASSWORD . THIS STRING IS FOUND CLOSE TO THE STRING "LOKI", WHICH MAY BE THE RE QUIRED PASSWORD , OR MAY SIMPLY REFER TO THE ORIGINAL PROGRAM .

LOKI IS ANOTHER ICMP BACKDOOR PROGRAM , NAMED AFTER THE NORSE GOD OF TRICKERY AND DECEPTI ON. THE FOLLOWING DESCRIP TION IS TAKEN FROM "PHRACK" MAGAZINE[ii].

"THE CONCEPT OF THE LOKI PROJECT IS SIMPLE: ARBITRARY INFOR MATION TUNNELING IN THE DATA PORTION OF ICMP_ECHO AND ICMP_ECHOREPLY PACKETS. LOKI EXPLOITS THE COVERT CHANNEL THAT EXISTS INSIDE OF ICMP_ECHO TRAFFIC. THIS CHANNEL EXISTS BECAUSE NETWORK DEVICES DO NOT FILTER THE CONTENTS OF ICMP_ECHO TRAFFIC. THEY SIMPLY PASS THEM, DROP THEM, OR RETURN THEM. THE TROJAN PACKETS THEMSELVES ARE MASQUERADED AS COMMO N ICMP_ECHO TRAFFIC. WE CAN ENCAPSULATE (TUNNEL) ANY INFORMATION WE WANT. FROM HERE ON OUT, LOKI TRAFFIC WILL REFER TO ICMP_ECHO TRAFFIC THAT TUNNELS INFORMATION. (ASTUTE READERS WILL NOTE THAT LOKI IS SIMPLY A FORM OF STEGANOGRAPHY)."

THE BINARY RUNS FOR 15 SECONDS , WITHOUT SENDING OUT ANY NETWORK DATA . IT MAY BE WAITING FOR A CER TAIN NETWORK INPUT , (A PING PACKET OR SIM ILAR, PERHAPS CONTAINING THE PASSW ORD) TO ACTIVATE THE REV ERSE ICMP SHELL . THIS HYPOTHESIS IS UNLIKELY, AS NO LISTENING CON NECTIONS SHOW UP UND ER "NETSTAT -A". TRACING INTO THE BINARY USING IDA PRO, THE START PROCEDURE CALLS THE "MAIN" PROCEDURE . THIS SETS UP SOME VARIABL ES, AND THEN CALLS TH E "START SERVICE CTRL DISPATCHER A" FUNCTION OF ADVAPI32.DLL. THIS FUNCTION THEN CA LLS "WAIT NAMED PIPE W" FROM THE KERNEL 32.DLL. THIS FUNCTION WAITS U NTIL A TIME -OUT OCCURS , OR THE NAMED PIPE IS AVAILABLE FO R A CONNECTION . THE BINARY IS NOT WAI TING FOR A NETWORK CONNECTION , BUT RATHER A RESPON SE FROM THE LOCAL MA CHINE . IT APPEARS TO TRY TO SET UP A CONNECTION TO A SERVICE , WAIT 15 SECONDS FOR THAT SE RVICE TO CONNECT , AND THEN FAIL BACK T O THE OPERATING SYST EM. THIS MAY BE DUE TO TH E FACT THAT THE BINARY WAS NOT F ULLY INSTALLED ON TH E INVESTIGATION COMP UTER .

The IP address listed (199.107.97.191) is listed in SamSpade.org as belonging to

Azusa Pacific University
PO Box 7000
Azusa, CA 91702-7000
UNITED STATES

This program may have been written by a student at that university. In circumstances different from those in which this binary was encountered, more information could be gathered by contacting the appropriate people at that university to obtain further information about the user in control of that IP address.

Another string in the binary also identifies it as being written by "Spoof." Searching through various sites did not reveal any other code written by this author. There is also a string in the code "Hello from MFC." This may represent a cracker group, or it could refer to the Microsoft Foundation Classes. This is a group of classes used in programming that could have been including when the program was compiled. The string might simply show which compiler was used to compile the binary.

Binary footprints

This binary uses other system files. These system files are commonly used by other applications, and so their existence on the system alone should not be considered suspicious. The binary refers to the \winnt\system32\smsses.exe and \winnt\system32\reg.exe files. These files do not exist in a standard windows installation. Although their existence on a system would be suspicious, (reg.exe would not be a cause for concern if the resource kit had been installed) the binary could be modified to use files with other names or locations. As no more information about these files is available, they alone cannot be used to identify the binary.

Ultimately, the binary (in this form) can only reliably be detected through searching for a file with the md5sum 848903a92843895f3ba7fb77f02f9bf1. If the binary had been hex edited to use other executables, then this test would also fail, the MD5 being dependent on every byte in the file. Possibly a script could be constructed that would extract the first portion of the program that does not contain modifiable strings, and run an md5sum on that extracted portion, but that is outside the focus of this analysis.

Program Identification

THE SPECIFIC PROGRAM CODE FOR THIS PROGRA M WAS NOT ABLE TO BE LOCATED ON THE INTERNET. A SEARCH FOR "CODE BY SPOOF" DID NOT RETURN ANY USABLE RESULTS, USING ANY OF THE MAJOR SEA RCH ENGINES (GOOGLE, ALTAVISTA, YAHOO AND INFOSEEK.) ALTHOUGH SEARCHING FO R "COMMENT-LIKE" STRINGS CAN OFTEN H AVE GOOD RESULTS, THESE STRINGS ARE AL SO VERY EASY FOR AN INE XPERIENCED PROGRAMME R TO CHANGE. THE CURRENT BINARY MA Y BE A MODIFIED FORM OF ANOTHER PROGRAM THAT IS MORE AVAILABLE. A SEARCH FOR "\WINNT\SYSTEM32\SMSSES.EXE" ALSO DID NOT YIELD ANY USEFUL RESULTS. SEARCHING FOR "\SYSTEM32\REG.EXE" RETURNED MANY RESULTS, BUT AS THIS IS A STANDARD MICROSOFT PROGRAM THI S IS NOT SURPRISING. NONE OF THE RESULTS APPEARED TO REFER TO ANY KIND OF MALICIO US INSTALLATION OR U SE. A SEARCH FOR THE ITALIAN ERROR MESSAGE "IMPOSSIBILE CREARE R AW ICMP SOCKET" RETURNED A SINGLE PAGE[iii]*. THIS CONTAINED THE CL OSEST SOURCE CODE AV AILABLE YET, ALTHOUGH NOT EXACTLY THE SAME. THIS PROGRAM USES SOM E OF THE SAME SYSTEM DLL FILES, SUCH AS WS2_32.DLL, AND APPEARS TO HAVE SIMILAR FUNCTIONALI TY TO THE UNKNOWN BI NARY.*

THIS PAGE WAS TRANSLATED BY WWW.GOOGLE.COM, AND BY WWW.T-MAIL.COM. NEITHER OF THESE GAVE THE BE ST TRANSLATION IN AL L AREAS, SO A COMBINATION OF THE TWO TRANSLATIONS APPEARS BELOW. FOR READABILITY THE W HITESPACE FROM THE O RIGINAL CODE HAS BEEN MODIFI ED. PORTIONS OF THE C CODE HAVE ALSO BEEN TRANSLATED, WHICH MEANS THAT THE CODE WILL NOT COMPI LE AS WRITTEN. FOR EXAMPLE, A VARIABLE NAME THAT REQUIRES O NE WORD IN THE ORIGI NAL ITALIAN MAY HAVE BEEN TRANSLATED AS 3 ENGLISH WORDS, SEPARATED BY SPACES. AS C DOES NOT ALLOW SPAC ES IN VARIABLE NAMES, THIS WILL BREAK THE COMPILATION, BUT SERVES TO GIVE MORE OF AN IDEA WHAT THE CODE IS INTENDED TO DO.

"
----------[PREVIOUS]--[INDEX]--[NEXT]----------
==========
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```
==========================================================================
-[ 22 HACKiNG ]-----------------------------------------------------------

--[ UNDERC0VER W0RK - DASHIE EMPLOYED TIME : MANY HOURS TO READ TO THE MICROSUX DOCUMENTATION AND 10
MINUTEREN TO WRITE THE CODE...
INGESTED FOOD: HALF LITER OF SKIFOSA GATORADE TO THE RED ORANGE TONS OF ICE CREAM 1,5 LITERS OF COKE
LENGTHENED WITH THE FANTA.... WARM GOD THAT!!!
DEDICATED TO: MIKY, THE GIRL WHO HAS UPSET ME THE BENARES LIFE, ITS PUTS INTO EFFECT THEM BOY NONCHE' MY
PRECIOUS FRIEND \SPIRIT \, PERCHE' ITS VACCATE SUMMERY ME FAN ALWAYS TO SQUARTARE PIGPEN, PERCHE'
OTHERWISE WOULD BE FORGOTTEN ABOUT THE EXISTENCE OF UNIX THE FUSYS, IN ORDER TO HAVE ITSELF MADE TO COME
WANTS TO READ ALL THE TCP/IP ILLUSTRATED MICROSOFT, GOD BIT PARDONS THEM PERCHE' DOES NOT KNOW WHAT
THEY MAKE...

ECCOMI HERE! THE DARK ANNIHILATOR, THE ADAM OF THE OSCURITA ONE ', THE SALVATORE OF THE RETURNED INFERI E'!
EHEH... AFTER MONTHS OF GIROVAGARE IN PIU' THE DEEP RECESSES OF THE ABYSS THEY ARE MAGICALLY REAPPEARED
CARRYING WITH ME SOMETHING OF PRETTY... AN INTERESTING CUE FOR ALL THOSE THAT WILL HAVE READ THE ARTICLE OF
FUSYS ON THE ICMP TUNNELLING... IN LITTLE WORDS THIS E' A BOOKCASE, EXACTLY LIKE THAT PROPOSAL FROM FUSYS,
THAT IT SUPPLIES FUNCTIONS FOR THE ENCAPSULATION OF GIVE TO YOU IN PACKAGES ICMP. THE ONLY DIFFERENCE E'
THAT THE AFORESAID BOOKCASE E' RED-ADAPT IN ORDER TO BE
COMPILED ALSO UNDER WINSOZZZ. THE FREE WILL CONCURS TO YOU TO MAKE OF C IO' THAT YOU WANT, AND SICCOME OF
CUES VE IT HAS SOME THEY GIVE GIA' FUSYS TO YOU TO SUFFICIENZA, SAID THAT E' THE CASE YOU WATCH THE CODE AND
YOU TRY TO WRITE SOMETHING TO US...

ICMP_TUNNEL.H SNIP

/* COVERT TUNNELLING IN ICMP 0x00 ECHO REPLY MESSAGES

MANY THANKS TO FUSYS AND RICHARD STEVENS ^_^ DARK SCHNEIDER X1999 */
# INCLUDES < WINSOCK2.H >
# INCLUDES < WS2TCPIP.H >
# INCLUDES < STDIO.H >
# DEFINE ICMP_ECHOREPLY 0
# 8 DEFINE ICMP_ECHO

// DEFINITION OF SOME CONSTANTS
# DEFINE IP_HDR 20
# DEFINE ICMP_HDR 8
# DEFINE ICMP_MINLEN 8
# DEFINE MAXMESG 4096
# DEFINE MAXPACKET 5004
# DEFINE LAST 1
# DEFINE REPLY 1
# DEFINE ECHO_TAG 0xF001
# DEFINE ECHO_LAST 0xF002

// STRUCTURES AND VARIABLE
// LAUNCH A RIGHT PORKO LIBERATORIO D*IO... AFTER HOURS I HAVE FOUND LIKE MAKING
// TO REMOVE TO ME FROM THE BALLS THE FOTT UTA ICMP.DLL (WINSOCK CURSED)
// IP HEADER

STRUCT IP
{
 UNSIGNED CHAR HLEN:4;
 UNSIGNED CHAR VERSION:4;
 UNSIGNED CHAR TOS;
 UNSIGNED SHORT LUNGTOT;
 UNSIGNED SHORT ID;
 UNSIGNED SHORT FLAGS;
 UNSIGNED CHAR TTL;
 UNSIGNED CHAR PROTO;
 UNSIGNED SHORT CHECKSUM;
 UNSIGNED INT SOURCEIP;
 UNSIGNED INT DESTIP;
};


ICMP HEADER STRUCT ICMP
{
 TYPE BYTE;
 BYTE TAILS;
 USHORT CHECKSUM;
 USHORT ID;
 USHORT SEQ;
 ULONG GIVE TO YOU;
```

```
};

SOCKET SOCKFD;
U_INT ICMP_INIT = 1;
STRUCT SOCKADDR_IN CLISRC;

FUNCTION OF CHECKSUM USHORT CHECKSUM(USHORT *BUFFER, INT SIZE)
{
 UNSIGNED LONG CKSUM=0;
 WHILE (SIZE > 1)
   {
    CKSUM+=*BUFFER++;
    SIZE -=SIZEOF(USHORT);
   }
 IF(SIZE)
   {
    CKSUM + = * (UCHAR*)BUFFER;
   }
 CKSUM = (CKSUM > > 16) + (CKSUM & 0XFFFF);
 CKSUM + = (CKSUM >> 16);
 RETURN (USHORT)(~CKSUM);
}


// REIMPLEMENTO BCOPY AND BZERO... BUT PERCHE' CABBAGE WINDOWS
// DOES NOT MAKE AVAILABLE?
VOID BZERO (CHAR * PNT, INT DIM_PNT)
{
 MEMSET ((CHAR *)&PNT, 0, DIM_PNT);
};

VOID BCOPY (CHAR * SRC, CHAR * DEST, INT DIM_SRC)
{
 MEMMOVE((CHAR *)&DEST, (CHAR *)&SRC, DIM_SRC);
};

// MICRO$OFT SUCKS
// FUNCTIONS OF MANAGEME NT OF PACKAGES ICMP
// FANKULO TO THOSE CURSED STRONTIUMS THAT THEY ARE INVENTS ICMP .DLL
// THE UGLY BASTARDS TO YOU PIECES OF MERDA, THE COMPATIBILITA ' VE IS FICCATA IT ON
// FOR THE CULO?
// MICRO$OFT SUCKS

VOID ICMP_INIT (VOID)
{
 IF(ICMP_INIT)
   {
    IF((SOCKFD = SOCKET(AF_INET, SOCK_RAW, IPPROTO_ICMP)) == INVALID_SOCKET)
                    {
                     FPRINTF(STDERR, "IMPOSSIBLE TO CREATE RAW ICMP SOCKET");
                     EXIT(0);
                    }

   }
 ICMP_INIT = 0;
};

VOID ICMP_RESET (VOID)
{
 CLOSESOCKET (SOCKFD);
 ICMP_INIT = 1;
};

INT ICMP_SEND(CHAR *SEND_MESG, SIZE_T MESGLEN, ULONG DEST_IP, INT ECHO, INT LAST)
{
 INT TALKED NONSENSE;
 STRUCT TUNNEL
 {
  STRUCT ICMP ICMP;
  UCHAR DATA[MAXMESG];
 } ICMP_PK;
 INT ICMPLEN = SIZEOF(STRUCT ICMP);
 INT PACK_DIM;
 STRUCT SOCKADDR_IN DEST;
```

```
 INT DESTLEN;
 IF(MESGLEN > MAXMESG) RETURN(-1);
 IF(ICMP_INIT) ICMP_INIT();
 DESTLEN = SIZEOF(DEST);
 BZERO((CHAR *)&DEST, DESTLEN);
 DEST.SIN_FAMILY = AF_INET;
 DEST.SIN_ADDR.S_ADDR = DEST_IP;
 PACK_DIM = MESGLEN + SIZEOF(STRUCT ICMP);
 MEMSET(&ICMP_PK, 0, PACK_DIM);
 ICMP_PK.ICMP.TYPE = ICMP_ECHOREPLY;
 BCOPY(SEND_MESG, (CHAR *)&ICMP_PK.ICMP.DATI, MESGLEN);
 ICMP_PK.ICMP.CHECKSUM = CHECKSUM((USHORT *) &ICMP_PK.ICMP, (SIZEOF(STRUCT ICMP) + MESGLEN));
 IF(ECHO) ICMP_PK.ICMP.SEQ = ECHO_TAG;
 IF(LAST) ICMP_PK.ICMP.SEQ = ECHO_LAST;
 IF(SPARATO = SENDTO(SOCKFD, (CHAR *)&ICMP_PK, PACK_DIM, 0, (STRUCT SOCKADDR *)&DEST, DESTLEN) < 0)
  {
   PERROR("RAW ICMP SENDTO:");
   RETURN(-1);
  }
 ELSE IF(SPARATO! = PACK_DIM)
  {
   PERROR("DIMENSIONI WRONG PACKAGE IP: RETURN(-1);
                }
 RETURN(SPARATO);
};


INT ICMP_RECV(CHAR * RECV_MESG, SIZE_T MESGLEN, INT ECHO)
 {
 STRUCT RECV
 {
 STRUCT IP IP;
 STRUCT ICMP ICMP;
 CHAR DATA[MAXMESG];
} RCV_PK;
 INT PACK_DIM;
 INT RECEIVED;
 INT IPHDRLEN;
 INT CLILEN = SIZEOF(CLISRC);
 IF(ICMP_INIT) ICMP_INIT();
 WHILE(1)
 {
 PACK_DIM = MESGLEN + SIZEOF(STRUCT IP) + SIZEOF(STRUCT ICMP);
                MEMSET(&RCV_PK, 0, PACK_DIM);
                IF((ACCOLTO = RECVFROM(SOCKFD, (CHAR *)&RCV_PK, PACK_DIM, 0, (STRUCT SOCKADDR *) &CLISRC,
&CLILEN)) < 0) CONTINUOUS ONES;
                IPHDRLEN = RCV_PK.IP.HLEN < < 2;
                IF(ACCOLTO < (IPHDRLEN + ICMP_MINLEN)) CONTINUOUS;
                RECEIVED - = IPHDRLEN;
                IF(!ECHO)
                {
                 IF(!RCV_PK.ICMP.ID &&!RCV_PK.ICMP.CODE && RCV_PK.ICMP.TYPE == ICMP_ECHOREPLY &&
RCV_PK.ICMP.SEQ! = ECHO_TAG && RCV_PK.ICMP.SEQ! = ECHO_LAST)
BREAK;
                }
                IF(ECHO)
                {
                 IF(!RCV_PK.ICMP.ID &&!RCV_PK.ICMP.CODE && RCV_PK.ICMP.TYPE == ICMP_ECHOREPLY &&
(RCV_PK.ICMP.SEQ ==ECHO_TAG||RCV_PK.ICMP.SEQ == ECHO_LAST))
BREAK;
                }
               }
 IF(!ECHO)
                {
                 RECEIVED - = ICMP_HDR;
                 BCOPY((CHAR *)&RCV_PK.ICMP.DATI, RECV_MESG, RECEIVED);
                 RETURN(ACCOLTO);
                }
 IF(ECHO)
                {
                 IF(RCV_PK.ICMP.SEQ == ECHO_TAG)
                 {
                  RECEIVED - = ICMP_HDR;
                  BZERO(RECV_MESG, SIZEOF(RECV_MESG));
```

```
                    BCOPY((CHAR *)&RCV_PK.ICMP.DATI, RECV_MESG, RECEIVED);
                    RETURN(ACCOLTO);
                   }
                   RETURN(-666);
                  }
};

 HERE THE CODE OF THE BOOKCASE ENDS. IN ORDER TO WRITE PROGRAMS E' MOREOVER ABSOLUTELY NECESSARY TO
INSERT SOME LINES OF CODE IN THE MAIN: VOID MAIN(INT
ARGC, CHAR **ARGV)

{
 WSADATA WS;
 INT STATUS;
 INITIALIZATION OF THE WINSOCK IF(STATUS = WSASTARTUP(0X101, &WS)! = 0)
{
 FPRINTF(STDERR, "IMPOSSIBLE TO INIZIALIZZARE WINSOCK");
 EXIT(0);
}


 // THE TRUE CODE GOES US HERE AND JUST, BUT I MUST SAY THAT IT PASSES TO ME WANTS IT OF
 // WRITING IT AFTER THE MADONNE THAT I HAVE PULLED IN ORDE R TO MAKE TO TURN CODE ICMP...
 CLOSING AND DEALLOCAZIONE
  WSACLEANUP();
}

THIS E' WHICH HAD TO THE FA CT THAT THE WINSOCK HAS THE NECESSITA ' OF BEING
INIZIALIZZATE: IN PRACTICAL E' A PO' LIKE IF EYE HAD TO BE SAID TO THE SYSTEM
"THAT GIVES HERE IN THEN USE THE WINSOCK AND THEREFORE IT PREPARES ALL OF THE
SORT THE INTERFACES " OR ONE ROBA... I KNOW THAT NOT E' MUCH TECHNICIAN, BUT I
HAVE NOT FOUND NO DE FINITION RIGOROUS OF THE PERCHE' IS NECESSARY ONE EXPLICIT
DECLARATION OF INITIALIZATION... IMPERSCRUTABILI MYSTERIES OF MICIOSOFT MOTHER...
==========================================================================
----------[ EOF 13/22 ]----------
==========================================================================
----------[ PREVIOUS ]---[ INDEX ]---[ NEXT ]----------
"
```

THIS CODE IS NOT COMP LETE AS ORIGINALLY W RITTEN EITHER . FOR EXAMPLE , AT ONE POINT THE TRANSLATIO N READS " // THE TRUE CODE GOES US HERE ". THIS MAY INDICATE THAT TO AVOID HAVING "SCRIPT KIDDIES " USE HIS CODE , THE AUTHOR HAS DEL IBERATELY LEFT IT CRIPPLED . THIS MAY BE WHY SOME STRINGS APPEARING IN THE BINARY DO NOT APPEAR IN THIS CODE - THAT IT HAS BEEN CO MBINED WITH ANOTHER PROGRAM OF SIMILAR FUNCTIONALITY . ALSO, THIS PROGRAM CODE D OES NOT USE ALL THE SAME SYSTEM DLL FILES AS THE ORIGINAL FILE . NOR DOES IT APPEAR TO READ OR WRITE WINDO WS REGISTRY SETTINGS , OR FILES FROM THE H ARD DISK AS THE
ORIGINAL BINARY DID . THIS MAY MEAN THAT AL THOUGH THIS CODE HAS BEEN USED AS THE SHELL FOR THE COMMUN ICATIONS CHANNEL , THE AUTHOR OF THE B INARY HAS COMBINED IT WITH CODE FOR A WINDOWS BACK DOOR PRO GRAM.

THE WINDOWS SERVICE FUNCT IONALITY APPEARS TO BE QUITE SIMILAR TO A PROGRAM CALLED "HUC SERVICES TOOLS V0.4 BY LION, LION@CNHONKER .NET." THIS CODE CAN BE FOUND BY SEARCHIN G FOR "HSER.TXT" WITH GO OGLE . THE PAGE CONTAINING T HE CODE APPEARS TO HAVE
BEEN REMOVED , BUT (AS OF 06/07/03) THE GOOGLE CACHED COPY OF THE PAGE STILL EXISTS . IT MAY BE THAT THE AU THOR OF THE BINARY H AS COMBINED FUNCTION S FROM THESE PROGRAMS TO CR EATE THE ULTIMATE BI NARY. DUE TO THE NATURE OF THE COMBINATION CODE , WITH THE FULL SOURC E OF THE CURRENT BIN ARY BEING UNAVAILABLE , IT IS IMPOSSIBLE TO ACCURATELY DOWNLOAD AND COMPILE CODE TH AT RESULTS IN THE EXACT BINARY FOUND . HOWEVER WE CAN BE REA SONABLY CONFIDENT THAT WE HAVE IDENTIF IED SOURCE CODE THAT C ONTAINS MUCH THE SAM E FUNCTIONALITY

AS THE BINARY IN QUE STION.

Legal Implications

It is impossible to determine whether or not the binary was executed on the machine it was found on. The zip file downloaded was created locally with t he time and date that the download finished. This gives us no information about the time or date that the zip file or original binary were created. The zip file lists the modification time of the binary as being 12:45 on the 20th of February, 2003. The zip program used to compress the binary only stores the one time and date with the zip file. It is impossible to tell if the binary was created before that date, accessed (possibly executed) after that date, or even executed at all. The binary makes some Wind ows Registry calls. The Registry file from the machine on which the binary was found is unavailable. It is also impossible to tell whether the binary had been fully installed on the original system. If access to the system was available, checking whether t he "\winnt\system32\smsses.exe" file existed could give a clue as to whether the binary was fully installed, or simply copied onto the system. The binary requires such system DLLs as msvcp60.dll to run. If this file is unavailable to the binary then it pri nts an error message. If this file was not installed on the system that the binary was found on, then it could be assumed that the binary had not successfully executed there. What would have been helpful at this stage of the investigation would have been a full file listing (with file Modification, Creation and Access dates) from the system that the binary had been found on. With this extra information it may have been possible to determine whether, and when, the binary had been executed. With only the avai lable information however, this is impossible to determine.

Even if the binary had been successfully installed and executed on the system, this may not necessarily be illegal. This would depend on who had control over the system. If the owner of the syste m chosen to download, compile and execute the binary on their own system, then clearly this would be perfectly legal. If the binary was found on a staff member's computer within a company, then this still may not be illegal. In this instance the legality w ould depend on the policies in place at the company. If part of the employment contract that the employee had (read and then) signed contained a clause that no unapproved software was to be used on the company systems (and the binary was unapproved) then t his would breach the contract and may lead to liability for that employee. If the binary had been installed without the employee's knowledge, and it could be determined who had installed the binary, then potentially the person installing the binary could b e charged with an offence. This might breach privacy legislation, or anti "hacking" laws. This would depend on the location that the compromised system was located in, as well as the location from which the binary was installed (as this may have been done remotely.) Which jurisdiction's laws would apply would depend on the circumstances of the case, as well as the particular laws in question.

INTERVIEW QUESTIONS

IF GIVEN THE OPPORTUN ITY TO COMMUNICATE W ITH THE PERSON ALLEG ED TO HAVE

INSTALLED AND EXECUT ED THE BINARY IN QUES TION, THERE ARE SEVERAL L INES OF QUESTIONING THAT COU LD YIELD HELPFUL INF ORMATION . THE PARTICULAR LINE C HOSEN WOULD DEPEND ON THE RESPONSES GIVEN BY T HE SUSPECTED INSTALL ER OF THE SOFTWARE , AS WELL AS THEIR LE VEL OF COMPUTER COMP ETENCE .

APPROACH 1: TECHNICALLY NAIVE INV ESTIGATOR

ASSUMING ALL THE STAN DARD NAME , DATE ETC QUESTIONS HAVE BEEN ESTABLISHE D. ALSO, IT WOULD PROBABLY BE WISE TO FIND A SUBT LE WAY TO READ THE S USPECT THEIR "MIRANDA" RIGHTS , SO THAT THE RESULTS OF THE INTERVIEW C OULD POTENTIALLY BE USED IN COURT .

Q0 (SETTING THE SCENE). LOOK, I WAS WONDERING IF YO U COULD HELP US OUT WITH SOMETHING . WE KNOW THAT YOU 'RE GOOD WITH COMPUTE RS, AND WE NEED SOME HE LP. WE'VE FOUND THIS FILE O N A COMPUTER HERE , AND WE HAVE NO IDEA WHAT IT IS. I WAS JUST HOPING THAT YOU MIGHT HAVE A MINUTE TO HELP US OUT . CAN YOU GIVE US A HAN D?

Q1. WELL, WE DID A [DIR|LS] ON THE COMPUTER WHE RE THIS FILE IS . AND IT SHOWED US ALL THIS INFORMATION , BUT IT DOESN 'T REALLY MEAN MUCH T O ME . IT SAYS THESE TIMES AND DATES AND THESE O THER NUMBERS AND LET TERS AND STUFF . COULD YOU TALK US THROUGH WAS ALL THIS STUFFS ABOUT ?

Q2. THE NAME OF THE FILE THAT WE DON 'T KNOW ABOUT IS "TARGET2.EXE". DO YOU KNOW WHAT THIS MIGHT MEAN ? DOES ANYTHING THERE M AKE SENSE TO YOU ?

Q3. OH, OK IT'S AN EXECUTABLE FILE . WELL, WE DIDN 'T KNOW THAT , SO WE OPENED IT UP AND PRINTED IT OUT I N MICROSOFT WORD . JUST QUIETLY , IT PRINTED OUT A WH OLE LOT OF RUBBISH . BUT, THERE 'S ALSO SOME STUFF IN THERE THAT LOOKS LI KE IT MEAN SOMETHING , IF WE KNEW WHA T WE WERE LOOKING AT . FOR EXAMPLE , HERE IT SAYS "HELLO FROM MFC." THE ONLY MFC I KNOW OF IS THE MELBOURNE FOOTBALL CLUB , AND THEY DON 'T REALLY DO COMPUTER Y STUFF . DO YOU HAVE ANY IDEA WHO/WHAT MFC MIGHT BE ?

Q4. SOME MORE STUFF HERE GOES ON ABOUT SERVIC ES BEING STARTED , AND FAILURES AND STUFF . DO YOU HAVE ANY IDEA WHAT THAT MIGHT BE A BOUT?

Q5. OK, SO TOP OF YOUR HEAD , WHAT DO YOU THINK T HAT THIS PROGRAM MIG HT BE DOING?

Q6. WELL, IT MIGHT BE COMMUNI CATING WITH SOMEONE . THAT'S VERY HELPFUL . AND THERE 'S THESE NUMBERS IN THE PRI NTOUT AS WELL , 199.171 DOT SOMETHING . THEY LOOK KIND OF LIKE A TELEP HONE NUMBER TO ME . DO YOU HAVE ANY IDEA WHAT THEY MIGHT BE REFERRING TO ?

Q7. THAT'S VERY USEFUL . BECAUSE WHEN WE LOOKE D UP THAT IP IN THE FIREWALL LOG S, IT SEEMS THAT YOU WERE LOGGED IN A ND COMMUNICATING WIT H THE COMPROMISED COMPUTER THE LAST TI ME THE BINARY EXECUT ED. HOW DO YOU EXPLAIN TH AT?

APPROACH 2: TECHNICALLY COMPETENT INVESTIGATOR

Q0 (SETTING THE SCENE). WE'VE FOUND THIS BINARY ON THE SYSTEM . WE KNOW THAT IT WAS EXECUTED AT THIS TIME . WE KNOW THAT YOU WERE LOGGED IN AT THAT T IME, AND HAD ACCESS TO INSTAL L THE BINARY ON THE COMPUTER IN QUESTION . WE KNOW THAT YOU DID IT , WE JUST NEED TO KNO W HOW , SO THAT WE CAN PREV ENT IT HAPPENING AGA IN. THERE WILL BE NEGATIV E REPERCUSSIONS OF THI S INCIDENT , CERTAINLY . BUT, IF YOU HELP ME UNDERSTAND H OW OUR SYSTEMS AND P ROCEDURES ALLOWED IT TO HAPPEN , THEN I'LL GO TO BAT FOR YOU AND TRY TO HELP KEE P YOU OUT OF TROUBLE AS MUCH AS I CAN. OK?

Q1. HOW DID YOU GAIN THE LOGIN CREDENT IALS FOR THE COMPROM ISED MACHINE ?

Q2. HOW DID YOU GAIN PHYS ICAL ACCESS TO THE R OOM WHERE THE COMPRO MISED COMPUTER WAS LOCATED ?

Q3. WHEN DID YOU INSTALL THIS SOFTWARE ON THE COMPUTER IN QUESTIO N?

Q4. DID YOU COMPILE THIS BINARY ?

Q5. DID YOU WRITE THE SO URCE CODE ?

Q6. DO YOU STILL HAVE A C OPY OF THE SOURCE CO DE?

Q7. WHAT COMPILER DID YOU USE?

Q8. WHAT MACHINE WAS THE PROGRAM COMPILED ON ?

Q9. WHAT MACHINE WERE THE COMMUNICATIONS WITH ?

Q10. WHO CONTROLS THE MACH INE THAT THE BINARY WAS COMMUNICATING WI TH?

ADDITIONAL INFORMATION

POSSIBLE SOURCES FOR THE SOURCE CODE

ICMP TUNNELLING SOURCE CODE [iii]

WINDOWS SERVICE CONTROL SOURCE CODE [iv]

PROJECT LOKI OVERVIEW [ii]

PROJECT LOKI SOURCE CODE [v]

SAMSPADE LOOKUP ON 199.107.97.191 [vi]

GENERAL INFORMATION O N WINDOWS DLL FILES[vii]

MORE DETAILED INFORMA TION ON THE WINDOWS WINSOCK DLL FILE[viii]

GCFA PART 2 : OPTION 1

PERFORM FORENSIC ANALYSIS ON A SYSTEM

SYNOPSIS OF CASE FACTS

DURING RESEARCH INTO A NON-RELATED TOPIC , A CO-WORKER DISCOVERED A VULNERABILITY IN A COMMONLY USED LINUX SERVICE . TO FACILITATE RESEARC H INTO THIS VULNERABILITY , A COMPUTER WAS SET UP AS A TESTING UNIT . THE SUSPECTED VULNERABILITY WAS EX PLORED ON THIS MACHI NE. THE INTENTION WAS THA T HAVING GAINED ACCESS TO THE COMPUTER , THE OPPORTUNITY WO ULD BE TAKEN TO EXPL ORE AND GAIN FAMILARITY WITH OTHER "HACKER" TOOLS AND TRICKS , ON A SYSTEM WITH NO OPERATIONAL REQUIREM ENT. THIS POTENTIALLY COMP ROMISED MACHINE PRES ENTED AN IDEAL LEARNING EXPER IENCE. WHEN MY COLLEAGUE HAD FINISHED EXPLORING THE TEST SYSTEM, I TOOK THE OPPORTUNIT Y TO INVESTIGATE IT . DURING THE INITIAL RE SEARCH , I DELIBERATELY AVOIDED COMING INTO CONTACT WITH ANYTHING BEING DONE TO THE SYSTEM, SUCH THAT WHEN COMM ENCING THE INVESTIGA TION INTO THE SYSTEM I HAD NO INFORMATION ABOUT TH E COMPU TER OTHER THAN THE I NITIAL OPERATING SYS TEM INSTALLED . FOR THE REST OF THIS INVESTIGATION IT WIL L BE ASSUMED THAT NO THING IS KNOWN ABOUT THE ATTA CKER OR ATTACK USED , OTHER THAN THE FACT S FOUND FROM THE COMPUTER .

DESCRIBE THE SYSTEM (S) YOU WILL BE ANALYZI NG

THE COMPROMISED COMPU TER WAS ACQUIRED FRO M THE TEST LAB AT WO RK. THE SYSTEM HAD BEEN USED FOR TE STING PURPOSES , AND CONTINUES TO BE USED FOR THAT PURPO SE. THE SYSTEM WAS INSTAL LED WITH REDHAT LINUX (6.2). IT HAD A STANDARD (DISK SMITH ELECTRONICS) NE2000 COMPATIBLE NETWORK CARD, CONNECTED TO AN ETHERNET HUB . NO INFORMATION IS AVA ILABLE AS TO THE OTH ER SYSTEMS THAT MAY HAVE BEEN CONNECTED TO THE HUB AT THE SAME TIME AS THE POTENTIALLY COM PROMISED SYSTEM .

HARDWARE

Case #1. Tag #1

Computer Main Proces sing Unit, unmarked brand. Beige
Serial #: 11XX96

Pentium (1), 133 MGhz.
128 MB RAM.

ATAPI DiamondData CD-ROM (Read Only) drive. 40x.
Serial #: 9128D 3722XXXX02910 PCL 000
Seagate 1.6 GB HDD (Removed.)

Internal PCI Network Card

Internal PCI Video Card
Internal 3.5" High Density Floppy Disk Drive

15" LCD Visual Display Unit.

Keyboard, Mouse
Network Cable (1.5m)
Network Hub OfficeConnect Ethernet Hub 4C

Case #1. Tag #2

Hard Disk Drive from Suspect Computer.

Seagate ST31621A Hard Disk Drive . 1620 MB. Serial #: FJbSG9G

IMAGE MEDIA

TO OBTAIN THE IMAGE F ROM THE SUSPECT SYST EM, THE SUSPECT HARD DI SK DRIVE WAS EXTRACTED FROM THE C OMPUTER . A CLEAN COMPUTER WAS SET UP , AND THE HARD DISK DRIVE ZEROED OUT USI NG BCWIPE. THE IMAGING COMPUTER WAS P OWERED DOWN , AND THEN BOOTED INTO THE BIOS. FROM THE BIOS, THE BOOT ORDER WAS CHANGED SO THAT THE FLOPPY DISK (A) WAS THE FIRST BOOT DEVICE . A SYSTEM DISK (FROM A WINDOWS 98 OPERATING SYSTEM) WAS CREATED . THIS DISK INCLUDED TH E ENCASE FOR DOS EXECUTABLE (V4.13). THE IMAGING COMPUTER WAS POWERED DOWN AT THIS POINT , AND THE SUSPECT HARD DIS K DRIVE INSTALLED ON THE SECONDARY IDE CHANNEL . THE COMPUTER WAS BOOTED UP WITH THE FLOPPY D ISK IN THE DRIVE , TO PREVENT ANY READ S OR WRITES FROM THE S USPECT HARD DISK DRI VE. AFTER BOOTING FROM TH E SYSTEM FLOPPY, ENCASE WAS EXECUTED . THE "HASH" OPTION WAS CHOSEN B EFORE IMAGING THE SUSPECT DRIVE , TO GET A RESULT TO COMPARE THE IMAGED C OPY TO . THE RESULT FROM THIS OPERATION WAS S AVED TO THE FLOPPY D ISK (A).

Hard disk (0) was unlocked at this point to allow the image to be written to it. The "Acquire" option was then chosen. The hard drive to be acquired was HDD (1), and HDD (0) was the chosen target drive. This imaged th e suspect hard disk onto the forensic computer drive. Compression was not used when imaging, and the Hash option was not selected. Once the image acquisition had completed, an MD5 hash was taken of the image obtained, and also saved to the floppy disk. The se hash values were identical, comfirming the forensic integrity of the acquired image. At this stage I exited from the Encase tool, removed the floppy disk from the disk drive, and rebooted the computer into Windows for image analysis. Once in Windows, En Case for Windows was started, and a new case created. The Image files were moved into the \Program Files \Encase4 directory, so that EnCase could refer to them there. Encase was started, and a new case created. The image.e01 file was added to this case, and a hash performed. This hash accorded to the hashes obtained from DOS.

As the main investigation was to be performed under Redhat (9), the images now needed to be transferred to the RedHat system. It was also helpful to create a more transportable (and less writable) copy of the image than the original. For this purpose, the original EnCase acquire files were first independently MD5 summed. This was done using the md5sum.exe executable from CygWin. The output of this command was piped to a DOS text file, using the commands

"\DOCUME~1\ADMINI~1\DESKTOP\UTILS\MD5SUME:\IMG_1_2.E01 > C:\IMG_1_21.MD5"
"\DOCUME~1\ADMINI~1\DESKTOP\UTILS\MD5SUME:\IMG_1_2.E02 > C:\IMG_1_22.MD5"
"\DOCUME~1\ADMINI~1\DESKTOP\UTILS\MD5SUME:\IMG_1_2.E03 > C:\IMG_1_23.MD5"

RESPECTIVELY. THESE IMAGES WERE THEN BURNED ONTO CDS, ALONG WITH THE TEXT FILES CONTAINING THEIR MD5 SUMS. THIS ALLOWED FOR THE IMAGES TO BE COMPARED AFTER THEY WERE COPIED ONTO THE INVESTIGATION SYSTEM, BY RE-MD5 SUMMING THE COPIES ON THE HARD DRIVE, AND COMPARING THESE RESULTS WITH THE MD5 SUMS STORED ON THE CD. THIS ENSURED THAT THE DATA WAS THE SAME AS THAT FROM THE ORIGINAL HARD DISK DRIVE, AND THEREFORE ACCEPTABLE IN COURT ACCORDING TO THE "BEST EVIDENCE" RULE. AT THIS POINT THE FILES WERE COMBINED, USING "CAT IMG_1_2.E01 > COMPLETEIMAGE.IMG" ETC. THIS DONE, I ATTEMPTED TO MOUNT THE IMAGE USING THE LOOPBACK DEVICE. THIS ATTEMPT FAILED, AS THE IMAGE HAD BEEN OBTAINED FROM A DISK, RATHER THAN A SPECIFIC PARTITION. TO FIND THE START OF THE EXT 2 PARTITION ON THE DRIVE, THE IMAGE FILE WAS OPENED IN A HEX EDITOR. THIS WAS USED TO SEARCH FOR "LOST+FOUND", BEING AN EARLY ENTRY ON THE DRIVE. THIS FOUND, THE HEXIDECIMAL VALUE "53 EF" (THIS IS THE "MAGIC" NUMBER USED TO IDENTIFY THE FILE SYSTEM TYPE, AND THE BYTES ARE REVERSED FOR INTEL BIG-ENDIAN COMPUTERS) WAS SEARCHED FOR IN REVERSE. (HEX) 438 WAS SUBTRACTED FROM THIS NUMBER TO FIND THE START OF THE PARTITION. THIS VALUE WAS THEN USED IN THE MOUNT COMMAND, WITH "MOUNT -OFFSET 345381". THIS ALSO FAILED. FURTHER RESEARCH ON THIS FAILURE SHOWED THAT ENCASE USES A PROPRIETARY IMAGE FORMAT, RATHER THAN A FLAT /RAW IMAGE FORMAT. THE ENCASE IMAGE FORMAT IS INCOMPATIBLE WITH UNIX UTILITIES. THEREFORE, A "RAWER" DD IMAGE WAS REQUIRED.

ACCORDINGLY, THE SUSPECT HARD DISK WAS INSTALLED IN THE SECOND DRIVE BAY IN THE FORENSIC COMPUTER. WINDOWS TENDS TO WRITE TO DRIVES THAT IT DETECTS, SO THE IMAGE WAS NECESSARILY TAKEN THROUGH DOS. A BOOT FLOPPY DISK WOULD HAVE BEEN ANOTHER OPTION, ALTHOUGH A DOS VERSION OF THE DD TOOL COULD NOT BE LOCATED AT THE TIME OF ACQUISITION. THEREFORE THE IMAGE HAD TO BE TAKEN FROM LINUX. THE INVESTIGATIVE DRIVE WAS INSTALLED IN THE FIRST DRIVE BAY. THE COMPUTER WAS BOOTED INTO LINUX. THE SECOND IDE DRIVE APPEARED UNDER LINUX AS "HDC" AS IT WAS THE MASTER DRIVE ON THE SECONDARY IDE CONTROLLER. A DD IMAGE OF THE DRIVE WAS TAKEN, USING THE COMMAND
"dd if=/dev/hdc of=image.dd ibs=1 conv=notrunc,noerror".
This image was verified using by a comparison of "md5sum /dev/hdc" and "md5sum image.dd". The md5 sums also matched those obtained through the EnCase tool.

```
[root@localhost root]# md5sum /dev/hdc
172e559fa3ccd2835dcf267f74ca7d2f  /dev/hdc
[root@localhost root]# dd if=/dev/hdc of=RH_1_2.dd ibs=1 conv=notrunc,noerror
162369024 0+0 records in
3171270+0 records out
[root@localhost root]# md5sum RH_1_2.dd
```

172e559fa3ccd2835dcf267f74ca7d2f RH_1_2.dd

Although the dd image was made using the "root" user, it was then copied into the directory of the user "michael" for a nalysis. This properties of this image were altered using "chmod 604 RH_1_2.dd" to ensure that anyone (specifically "michael") could read this file. The resulting properties allowed only root to read and write the file, and anyone to read the file. Althoug h it might be a cause for concern on a multi -user system, on the standalone forensic system there was no risk in a world readable file containing this kind of information. User "michael" had no permission to write to this file, as it was owned by root. We could therefore be certain that none of the unix tools (as long as they were executed from the "michael" user account") would modify the data. At any stage an md5sum could be taken of the image to verify this, but the only one taken in this instance was as the final step of the analysis to prove that none of the tools had changed anything.

A slice of the file then needed to be copied out in order to mount the file, or examine it under Autopsy. To gather the partition information the command "/sbin/fdisk -lu" (List details, output information in sectors) was used.

```
[MICHAEL@LOCALHOST MORGUE]$ /SBIN/FDISK -LU RH_1_2.DD
YOU MUST SET CYLINDERS.
YOU CAN DO THIS FROM THE EXTRA FUNCTIONS MENU.

DISK RH_1_2.DD: 0 MB, 0 BYTES
64 HEADS, 63 SECTORS/TRACK, 0 CYLINDERS, TOTAL 0 SECTORS
UNITS = SECTORS OF 1 * 512 = 512 BYTES

   DEVICE BOOT   START     END   BLOCKS  ID SYSTEM
RH_1_2.DD1 *      63  3072383  1536160+  83 LINUX
RH_1_2.DD2     3072384  3169151    48384   5 EXTENDED
RH_1_2.DD5     3072447  3169151    48352+ 82 LINUX SWAP
YOU MUST SET CYLINDERS.
YOU CAN DO THIS FROM THE EXTRA FUNCTIONS MENU.
```

To extract the necessary section, dd was used. The start sector was sector 63 (being the first of the main Linux Partition), and the stop sector 3072383. Subtracting the start sector (63) from the stop sector (3072383) gives the number of sectors to copy (3072320).

```
[michael@localhost morgue]$ dd if=RH_1_2.dd of=RH_Partition_1.dd ibs=512 skip=63 count=3072320
3072320+0 records in
3072320+0 records out
```

This command left the RH_Partition_1.dd file containing only the valid ext2 partition, and therefore examinable under Autopsy. An md5sum of this new file was taken using the command "md5sum RH_Partition_1.dd > RH_Partition_1.md5". This md5 sum was also saved to a floppy disk to later compare with the file, ensuring that it had not been modified by any of the tools used. The file containing the single linux partition was then mounted for examination. This used the command "mount -t ext2 -o ro,loop,noexec,noatime /home/michael/temp/morgue/RH_Partition_1.dd /mnt/hack/root." This mounts the specified file (RH_Partition_1.dd) onto the directory listed (/mnt/hack/root). It treats it as being of the file system (" -t" is specify file system type) "ext2" - being the standard linux file system. This means that the file structure contained in the file can be examined, and treated like a live file system. The other options to the command, (specified with " -o), are Read Only ("ro"), mount using the LoopBack device ("loop" - this means treating a local file as an external file -system,)

do not allow any files from the file to be executed ("noexec"), and do not update the access times of any of the files when they are displayed ("noatime".) This ensures that the file will not be changed by an investigator exploring and running commands on the mounted file-system.

MEDIA ANALYSIS OF SYSTEM

THE FIRST STEP TO EXAMINING THE SYSTEM WAS TO MAKE SURE THAN NONE OF THE SYSTEM BINARIES HAD BEEN MODIFIED. THIS WAS NOT TO EXECUTE THEM, AS OF COURSE ALL TOOLS WERE USING KNOWN GOOD COPIED FROM A CD. HOWEVER, IF THE /BIN/LOGIN OR SIMILAR FILE HAD BEEN MODIFIED ON THE SYSTEM, THEN THIS WOULD BE EXTREMELY SUSPISCIOUS. CHECKING THE SYSTEM FILES WAS MADE EASIER BY THE OPERATING SYSTEM INVESTIGATED BEING REDHAT LINUX (6.2). THIS OPERATING SYSTEM USES THE RPM (OR REDHAT PACKAGE MANAGER) THAT INSTALLS PRECOMPILED EXECUTABLE FILES. ACCORDINGLY AN INVESTIGATOR CAN USE MD5 HASHES FROM A SYSTEM KNOWN TO BE FREE FROM COMPROMISE TO COMPARE WITH THE SUSPECT SYSTEM. THIS WOULD NOT BE THE CASE WHERE THE OPEN SOURCE SYSTEM HAD COMPILED THE EXECUTABLES ON THE MACHINE IN QUESTION, AS EACH DIFFERING COMPILIATION WOULD HAVE DIFFERING MD5 HASHES.

TO COMPARE THE SYSTEM BINARIES, A LIST OF KNOWN GOOD MD5 HASHS WAS DOWNLOADED FROM KNOWNGOODS[ix]. THIS FILE, LINUX-REDHAT-6.2-I386.TXT WAS LISTED AS HAVING THE MD5 HASH OF 5450D78784364D0B1A66476A5B2E81E7. THIS WAS COMPARED WITH THE MD5 SUM OF THE FILE ONCE COPIED ONTO THE INVESTIGATION MACHINE, AND FOUND TO BE IDENTICAL. POTENTIALLY A HACKER COULD HAVE COMPROMISED THE KNOWNGOODS.ORG WEBSITE, AND UPDATED BOTH THE FILE AND THE MD5-SUM LISTED, BUT WE HAVE NO INFORMATION TO THIS EFFECT. A TOOL TO COMPARE FILES WITH THEIR EXPECTED HASHES, "KG-REPORT-0.1.1" WAS THEN DOWNLOADED AND INSTALLED ONTO THE INVESTIGATION MACHINE. THE ONLY REQUIRED FILE FROM THIS TOOL WAS THE SCRIPT "CHECK-FILES.SH". THIS IS A SHELL SCRIPT THAT GOES THROUGH A SPECIFIED DIRECTORY (HERE THE MOUNTED VERSION OF THE DD COPY OF THE PARTITION FROM THE SUSPECT DRIVE) AND COMPARES THE MD5 RESULTS WITH THOSE FROM A SPECIFIED FILE. THE SCRIPT WAS FIRST VIEWED IN EMACS TO ENSURE THAT THERE WOULD BE NO UNEXPECTED FUNCTIONALITY, AND ALSO TO DISCOVER THE EXPECTED SYNTAX.

```
BEGIN SCRIPT"
#!/BIN/SH
# CHECKFILES.SH - CHECKS FOR MODIFIED FILES AND DISPLAYS A STATUS REPORT.
#
# COPYRIGHT (C) 2002 ANDREAS HOCHSTEGER <E9625392@STUDENT.TUWIEN.AC.AT>
#
# 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., 675 MASS AVE, CAMBRIDGE, MA 02139, USA.
```

```
IF [ "$#" -LT "1" -O "$#" -GT "2" ]; THEN
    ECHO "USAGE: $0 REFERENCE [PATH]"
    ECHO "  REFERENCE IS A FILE WITH CHECKSUMS FROM HTTP://WWW.KNOWNGOODS.ORG/"
    ECHO "  PATH IS THE PATH YOU WANT TO CHECK"
    EXIT 1
FI

FOR LIN `CAT $1 | GREP ",$2"`; DO
    F=`ECHO "$L" | AWK -F ',' '{PRINT \$2}'`
    MD5REF=`ECHO "$L" | AWK -F ',' '{PRINT \$3}'`
    ECHO -N "$F"
    IF [ -E $F ]; THEN
        MD5=`MD5SUM $F | AWK '{PRINT \$1}'`
        IF [ "$MD5REF" == "$MD5" ]; THEN
            STAT="OK      (MD5:$MD5)";
        ELSE
            STAT="ERROR   (MD5:$MD5, MD5REF:$MD5REF)";
        FI
    ELSE
        STAT="MISSING"
    FI
    ECHO "  $STAT";
DONE

EXIT 0
"
```

THIS SCRIPT WAS EXECUTED WITH THE COMMAND "./CHECK-FILES.SH ../LINUX-REDHAT-6.2-I386.TXT /MNT/HACK/ROOT". THIS SCRIPT RETURNED NO RESULTS. THE SCRIPT WAS THEN RUN USING THE COMMAND "./CHECK-FILES.SH ../LINUX-REDHAT-6.2-I386.TXT /" TO ENSURE THAT IT WAS ACTUALLY RETURNING VALID RESULTS. THIS RETURNED PAGES OF RESULTS, AS THE INVESTIGATIVE SYSTEM IS RUNNING REDHAT 9. AFTER THIS RESULT, WE KNOW THAT NONE OF THE STANDARD SYSTEM BINARIES HAD BEEN MODIFIED SINCE INSTALLATION.

IN ORDER TO CHECK THE SYSTEM FOR SETUID OR SETGID FILES, A FIND COMMAND WAS USED. THIS WAS TOLD TO LOOK FOR EITHER FILES WITH THE SETUID BIT SET (4000), OR THE SETGID BIT SET (2000). FIND WAS INSTRUCTED ONLY TO RETURN FILES OF TYPE "REGULAR FILE" TO AVOID DIRECTORIES OR LINKS ETC. THE -LS OPTION OUTPUTS THE RESULTS IN LS -DILS FORMAT.

```
[root@localhost hack]# find /mnt/hack/root/ \( -perm -004000 -o -perm -002000 \) -type f -ls
 65098   16 -rwxr-sr-x   1 root     mail        15280 Feb 22  2000 /mnt/hack/root/usr/lib/emacs/20.5/i386-redhat-linux-
gnu/movemail
144505   36 -rwsr-xr-x   1 root     root        35168 Feb 17  2000 /mnt/hack/root/usr/bin/chage
144512   36 -rwsr-xr-x   1 root     root        36756 Feb 17  2000 /mnt/hack/root/usr/bin/gpasswd
144543    8 -r-xr-sr-x   1 root     tty          6128 Mar  7  2000 /mnt/hack/root/usr/bin/wall
144676   36 -rwsr-xr-x   1 root     root        33288 Mar  2  2000 /mnt/hack/root/usr/bin/at
144973   76 -r-xr-sr-x   1 news     news        73144 Mar  3  2000 /mnt/hack/root/usr/bin/inews
145052   44 -r-sr-x---   1 root     news        43132 Mar  3  2000 /mnt/hack/root/usr/bin/innstart
145077   92 -r-sr-x---   1 uucp     news        89792 Mar  3  2000 /mnt/hack/root/usr/bin/rnews
145089   40 -r-sr-x---   1 root     news        40540 Mar  3  2000 /mnt/hack/root/usr/bin/startinnfeed
145245  524 -rws--x--x   2 root     root       531516 Feb  3  2000 /mnt/hack/root/usr/bin/suidperl
145245  524 -rws--x--x   2 root     root       531516 Feb  3  2000 /mnt/hack/root/usr/bin/sperl5.00503
145256   20 -r-sr-sr-x   1 root     lp          16872 Feb 15  2000 /mnt/hack/root/usr/bin/lpq
145257   20 -r-sr-sr-x   1 root     lp          18568 Feb 15  2000 /mnt/hack/root/usr/bin/lpr
145258   20 -r-sr-sr-x   1 root     lp          17208 Feb 15  2000 /mnt/hack/root/usr/bin/lprm
145274   36 -rwxr-sr-x   1 root     man         36192 Mar  1  2000 /mnt/hack/root/usr/bin/man
145312  172 -rwxr-sr-x   1 root     uucp       168080 Mar  8  2000 /mnt/hack/root/usr/bin/minicom
145369   48 -rwsr-xr-x   1 root     root        46600 Feb  4  2000 /mnt/hack/root/usr/bin/nwsfind
145459   12 -r-s--x--x   1 root     root        12244 Feb  8  2000 /mnt/hack/root/usr/bin/passwd
145508   12 -rwxr-sr-x   1 root     mail        11620 Feb  8  2000 /mnt/hack/root/usr/bin/lockfile
145510   80 -rwsr-sr-x   1 root     mail        76432 Feb  8  2000 /mnt/hack/root/usr/bin/procmail
145560   16 -rwsr-xr-x   1 root     root        14352 Mar  7  2000 /mnt/hack/root/usr/bin/rcp
145562   12 -rwsr-xr-x   1 root     root        10256 Mar  7  2000 /mnt/hack/root/usr/bin/rlogin
145563    8 -rwsr-xr-x   1 root     root         7436 Mar  7  2000 /mnt/hack/root/usr/bin/rsh
145634   24 -rwxr-sr-x   1 root     slocate     24272 Feb  4  2000 /mnt/hack/root/usr/bin/slocate
145730   16 -rws--x--x   1 root     root        14056 Mar  7  2000 /mnt/hack/root/usr/bin/chfn
```

```
145731   16 -rws--x--x   1 root     root        13832 Mar  7  2000 /mnt/hack/root/usr/bin/chsh
145748    8 -rws--x--x   1 root     root         5640 Mar  7  2000 /mnt/hack/root/usr/bin/newgrp
145759   12 -rwxr-sr-x   1 root     tty          8328 Mar  7  2000 /mnt/hack/root/usr/bin/write
145787  132 -r-sr-sr-x   1 uucp     uucp       127924 Mar  7  2000 /mnt/hack/root/usr/bin/cu
145788   96 -r-sr-xr-x   1 uucp     uucp        92852 Mar  7  2000 /mnt/hack/root/usr/bin/uucp
145790   40 -r-sr-sr-x   1 uucp     uucp        39364 Mar  7  2000 /mnt/hack/root/usr/bin/uuname
145792  104 -r-sr-xr-x   1 uucp     uucp       101024 Mar  7  2000 /mnt/hack/root/usr/bin/uustat
145794   96 -r-sr-xr-x   1 uucp     uucp        93920 Mar  7  2000 /mnt/hack/root/usr/bin/uux
145804   24 -rwsr-xr-x   1 root     root        21816 Feb  4  2000 /mnt/hack/root/usr/bin/crontab
 17020    8 -rwsr-xr-x   1 root     root         5896 Mar  9  2000 /mnt/hack/root/usr/sbin/usernetctl
 17826   28 -rwxr-sr-x   1 root     lp          25064 Feb 15  2000 /mnt/hack/root/usr/sbin/lpc
 18227  320 -rwsr-sr-x   1 root     root       320516 Feb 18  2000 /mnt/hack/root/usr/sbin/sendmail
 18256   20 -rwsr-xr-x   1 root     bin         16488 Feb  8  2000 /mnt/hack/root/usr/sbin/traceroute
 18294    8 -rwxr-sr-x   1 root     utmp         6096 Feb 25  2000 /mnt/hack/root/usr/sbin/utempter
 18319  224 -r-sr-sr-x   1 uucp     uucp       225008 Mar  7  2000 /mnt/hack/root/usr/sbin/uucico
 18322  108 -r-sr-sr-x   1 uucp     uucp       103164 Mar  7  2000 /mnt/hack/root/usr/sbin/uuxqt
 64144   36 -rwsr-xr-x   1 root     root        34751 Mar  1  2000 /mnt/hack/root/usr/libexec/pt_chown
145001   16 -rwsr-xr-x   1 root     root        14188 Mar  8  2000 /mnt/hack/root/bin/su
145142   20 -rwsr-xr-x   1 root     root        17968 Mar  7  2000 /mnt/hack/root/bin/ping
145325   60 -rwsr-xr-x   1 root     root        56208 Feb  4  2000 /mnt/hack/root/bin/mount
145326   28 -rwsr-xr-x   1 root     root        26608 Feb  4  2000 /mnt/hack/root/bin/umount
112774   48 -rwsr-sr-x   1 root     tty         45388 Mar  3  2000 /mnt/hack/root/sbin/dump
112776   72 -rwsr-sr-x   1 root     tty         67788 Mar  3  2000 /mnt/hack/root/sbin/restore
113164    4 -rwxr-sr-x   1 root     root         3860 Mar  9  2000 /mnt/hack/root/sbin/netreport
113170   28 -r-sr-xr-x   1 root     root        26126 Feb  6  2000 /mnt/hack/root/sbin/pwdb_chkpwd
113171   28 -r-sr-xr-x   1 root     root        27114 Feb  6  2000 /mnt/hack/root/sbin/unix_chkpwd
```

ALTHOUGH SOME OF THES E FILES LOOK SUSPISC IOUS , AND DID NOT RETURN A MAN PAGE ON THE INVESTIGATION MACHINE , THEY WERE ALL SIMPL Y FROM THE EARLIER V ERSION OF REDHAT . NONE OF THESE BINARIE S IS UNU SUAL FOR A REDHAT 6.2 INSTALLATION .

THE USER LIST COULD A LSO CONTAIN SIGNS OF AN INTRUSION . THIS IS CONTAINED IN "/ETC/PASSWD ." MALICIOUS INTRUDERS A PPARENTLY OFTEN LEAV E THEMSELVES ACCESS PRIVILEGES ON COMPRO MISED MACHINES , SO THAT THEY CAN GE T BACK IN T O THOSE MACHINES . THE PASSWD FILE WAS O BTAINED WITH THE COM MAND "CAT /MNT/HACK/ROOT/ETC/PASSWD".

```
root:x:0 0 :root:/root:/b in/bash
bin:x :1 :1 :b in :/b in:
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:/b in/sync
shutdown:x:6 :0 :shutdown:/sbin:/sb in/shutdown
halt:x :7 :0 :halt:/sb in:/sbin/halt
mail:x:8 :1 2 :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:1 2:100:games :/usr/games:
gopher:x:13 :30 :gopher:/usr/lib/gop her-data:
ftp :x:14 :50 :FTP User:/ho me/ftp :
nobody:x:99 :99 :Nobody:/:
xfs:x :43 :43 :X Font Server:/etc/X11/fs :/b in/false
named :x:25 :25 :Named :/var/named :/b in/false
postgres:x:26:26 :PostgreSQL Server:/var/lib/pgsq l:/bin/bash
wayne:x:500 :500 :wayne:/home/wayne:/bin/bash
wroot:x:0 :0 ::/root:/b in/bash
wruser:666 :666 ::/root:/b in/bash
wruser:x:666 :666 ::/root:bin/bash
```

Most of the users are as expected, until we get down to wroot. This user has a User Identifier (uid) of 0. The operating syst em uses the uid to control user access, to files and folders etc. UID 0 is that of root, which has full access to the system. A user having a uid of 0 is an extremely bad sign. Another curious sign is that the "wruser" has two entries in the passwd file. T he entries only differ by an "x" in the second

field. This "x" is used to indicate that the users password is stored in the "shadow" file. A user not having a shadowed password would be bad enough, but a double -up in the passwd file clearly shows us that s omething is amiss.

The system was next examined for unusual directory entries. A common trick is to create a directory containing malicious code, and to name this directory starting with a full stop ("."). This is the character Unix uses to define hidden directories, and if a directory starts with this character it will not be displayed using a default "ls" command. It can still be displayed by "ls -a", or using the "find" command. To find any hidden directories, the 'find /mnt/hack/root/ -name ".*"' command was used. This command was run as an "su" to root, to prevent access error messages.

```
[MICHAEL@LOCALHOST ROOT]$ SU
PASSWORD:
[ROOT@LOCALHOST ROOT]# FIND /MNT/HACK/ROOT/ -NAME ".*"
/MNT/HACK/ROOT/VAR/LIB/NEWS/.NEWS.DAILY
/MNT/HACK/ROOT/VAR/SPOOL/AT/.SEQ
/MNT/HACK/ROOT/TMP/.FONT-UNIX
/MNT/HACK/ROOT/TMP/..
/MNT/HACK/ROOT/TMP/../LRK4/PROCPS-1.01/PROC/.DEPEND
/MNT/HACK/ROOT/USR/DOC/BIND-8.2.2_P5/BOG/.CVSIGNORE
/MNT/HACK/ROOT/USR/DOC/PMAKE-2.1.34/TESTS/.PURIFY
/MNT/HACK/ROOT/USR/DOC/SAMBA-2.0.6/DOCS/YODLDOCS/.CVSIGNORE
/MNT/HACK/ROOT/USR/DOC/UCD-SNMP-4.1.1/LOCAL/.CVSIGNORE
/MNT/HACK/ROOT/USR/LIB/PERL5/5.00503/I386-LINUX/.PACKLIST
/MNT/HACK/ROOT/USR/LIB/PERL5/SITE_PERL/5.005/I386-LINUX/AUTO/MD5/.PACKLIST
/MNT/HACK/ROOT/USR/LIB/PERL5/SITE_PERL/5.005/I386-LINUX/AUTO/MOD_PERL/.PACKLIST
/MNT/HACK/ROOT/USR/LIB/LINUXCONF/INSTALL/GNOME/.DIRECTORY
/MNT/HACK/ROOT/USR/LIB/LINUXCONF/INSTALL/GNOME/.ORDER
/MNT/HACK/ROOT/USR/MAN/MAN1/..1.GZ
/MNT/HACK/ROOT/USR/BIN/.GITACTION
/MNT/HACK/ROOT/USR/SHARE/GIT/.GITRC.AIXTERM
/MNT/HACK/ROOT/USR/SHARE/GIT/.GITRC.COMMON
/MNT/HACK/ROOT/USR/SHARE/GIT/.GITRC.HFT
/MNT/HACK/ROOT/USR/SHARE/GIT/.GITRC.HPTERM
/MNT/HACK/ROOT/USR/SHARE/GIT/.GITRC.HP
/MNT/HACK/ROOT/USR/SHARE/GIT/.GITRC.IRIS-ANSI-NET
/MNT/HACK/ROOT/USR/SHARE/GIT/.GITRC.ANSI
/MNT/HACK/ROOT/USR/SHARE/GIT/.GITRC.IRIS-ANSI
/MNT/HACK/ROOT/USR/SHARE/GIT/.GITRC.LINUX
/MNT/HACK/ROOT/USR/SHARE/GIT/.GITRC.CONSOLE
/MNT/HACK/ROOT/USR/SHARE/GIT/.GITRC.MACH
/MNT/HACK/ROOT/USR/SHARE/GIT/.GITRC.MINIX
/MNT/HACK/ROOT/USR/SHARE/GIT/.GITRC.SUN-CMD
/MNT/HACK/ROOT/USR/SHARE/GIT/.GITRC.ETERM
/MNT/HACK/ROOT/USR/SHARE/GIT/.GITRC.GENERIC
/MNT/HACK/ROOT/USR/SHARE/GIT/.GITRC.PC3
/MNT/HACK/ROOT/USR/SHARE/GIT/.GITRC.SUN
/MNT/HACK/ROOT/USR/SHARE/GIT/.GITRC.THIX
/MNT/HACK/ROOT/USR/SHARE/GIT/.GITRC.VT102
/MNT/HACK/ROOT/USR/SHARE/GIT/.GITRC.VT420
/MNT/HACK/ROOT/USR/SHARE/GIT/.GITRC.SCREEN
/MNT/HACK/ROOT/USR/SHARE/GIT/.GITRC.VT100
/MNT/HACK/ROOT/USR/SHARE/GIT/.GITRC.VT125
/MNT/HACK/ROOT/USR/SHARE/GIT/.GITRC.VT200
/MNT/HACK/ROOT/USR/SHARE/GIT/.GITRC.VT201
/MNT/HACK/ROOT/USR/SHARE/GIT/.GITRC.VT220
/MNT/HACK/ROOT/USR/SHARE/GIT/.GITRC.VT240
/MNT/HACK/ROOT/USR/SHARE/GIT/.GITRC.VT300
/MNT/HACK/ROOT/USR/SHARE/GIT/.GITRC.VT320
/MNT/HACK/ROOT/USR/SHARE/GIT/.GITRC.VT400
/MNT/HACK/ROOT/USR/SHARE/GIT/.GITRC.XTERM-DEBIAN
/MNT/HACK/ROOT/USR/SHARE/GIT/.GITRC.DTTERM
/MNT/HACK/ROOT/USR/SHARE/GIT/.GITRC.RXVT
/MNT/HACK/ROOT/USR/SHARE/GIT/.GITRC.XTERM-COLOR
/MNT/HACK/ROOT/USR/SHARE/GIT/.GITRC.XTERMS
```

```
/MNT/HACK/ROOT/USR/SHARE/GIT/.GITRC.XTERM
/MNT/HACK/ROOT/ETC/.PWD.LOCK
/MNT/HACK/ROOT/ETC/SKEL/.EMACS
/MNT/HACK/ROOT/ETC/SKEL/.BASH_LOGOUT
/MNT/HACK/ROOT/ETC/SKEL/.BASH_PROFILE
/MNT/HACK/ROOT/ETC/SKEL/.BASHRC
/MNT/HACK/ROOT/ETC/SKEL/.SCREENRC
/MNT/HACK/ROOT/HOME/WAYNE/.EMACS
/MNT/HACK/ROOT/HOME/WAYNE/.BASH_LOGOUT
/MNT/HACK/ROOT/HOME/WAYNE/.BASH_PROFILE
/MNT/HACK/ROOT/HOME/WAYNE/.BASHRC
/MNT/HACK/ROOT/HOME/WAYNE/.SCREENRC
/MNT/HACK/ROOT/HOME/WAYNE/.BASH_HISTORY
/MNT/HACK/ROOT/LIB/MODULES/2.2.14-5.0/.RHKMVTAG
/MNT/HACK/ROOT/ROOT/.XDEFAULTS
/MNT/HACK/ROOT/ROOT/.BASH_LOGOUT
/MNT/HACK/ROOT/ROOT/.BASH_PROFILE
/MNT/HACK/ROOT/ROOT/.BASHRC
/MNT/HACK/ROOT/ROOT/.CSHRC
/MNT/HACK/ROOT/ROOT/.TCSHRC
/MNT/HACK/ROOT/ROOT/.BASH_HISTORY
[ROOT@LOCALHOST ROOT]#
```

THE EARLY "GIT" ENTRIES LOOKED SUSPICIOUS, BUT ARE IN FACT THE "GNU INTERACTIVE TOOLS" AND PERFECTLY LEGITIMATE. ANOTHER POSSIBLY SUSPECT ENTRY IS "SKEL" BUT THIS ALSO IS A STANDARD FILESET. THE DIRECTORY THAT IS NOT SO BENIGN IS THE "/TMP/..." DIRECTORY. THIS DIRECTORY NAME DOES NOT OCCUR IN ANY STANDARD LINUX INSTALLATION, BUT IS COMMONLY USED TO HIDE FILES BY AN INTRUDER. THE "/TMP" DIRECTORY CONTAINS THE FOLLOWING.

```
[ROOT@LOCALHOST TMP]# LS -AL
TOTAL 148
DRWXRWXRWT   6 ROOT    ROOT      4096 JUL  5 19:43 .
DRWXR-XR-X  17 ROOT    ROOT      4096 JUL  5 15:21 ..
DRWXR-XR-X   7 30      ROOT      4096 JUL  5 19:31 ...
DRWXR-XR-X   2 ROOT    ROOT      4096 JUL  3 14:18 FAKEIDENTD-1.2
DRWXRWXRWT   2 XFS     XFS       4096 JUL  5 14:04 .FONT-UNIX
-RW-------   1 ROOT    ROOT       456 JUL  2 14:09 FSTAB.OFC7U8
-RW-R--R--   1 ROOT    ROOT        24 JUL  5 12:20 IDENTDV
-RW-R--R--   1 ROOT    ROOT        63 JUL  5 17:27 IDENTDV
-RW-R--R--   1 ROOT    ROOT      5659 JUL  3 01:59 INSTALL.LOG
-RW-R--R--   1 ROOT    ROOT     95547 JUL  2 17:12 LAME1
DR-XR-XR-X   5 ROOT    ROOT      4096 JUL  5 15:24 LINUX_X86
-RW-R--R--   1 ROOT    ROOT      2239 JUL  2 14:12 UPGRADE.LOG
[ROOT@LOCALHOST TMP]#
```

FAKE IDENTD IS A STANDARD INSTALLATION OF THE FAKE IDENT SERVICE. ".FONT-UNIX" CONTAINS ONLY A SINGLE SYMBOLIC LINK. THE "LINUX_X86" DIRECTORY CONTAINS THE INSTALL FILES FOR "TRIPWIRE FOR SERVERS VERSION 3.0 FOR UNIX OPERATING SYSTEMS." THE "LAME1" FILE CONTAINS THE FOLLOWING.

```
[ROOT@LOCALHOST TMP]# HEAD -10 LAME1
15:51:08.116009 ETH0 < 192.168.210.7.32837 > 192.168.210.6.AUTH: S 4232921198:4232921198(0) WIN 5840 <MSS
1460,SACKOK,TIMESTAMP 432968 0,NOP,WSCALE 0>
(DF)
        4500 003C DB26 4000 4006 3A36 C0A8 D207
        C0A8 D206 8045 0071 FC4D 406E 0000 0000
        A002 16D0 B316 0000 0204 05B4 0402 080A
        0006 9B48 0000 0000 0103 0300
15:51:08.116154 ETH0 > 192.168.210.6.AUTH > 192.168.210.7.32837: S 4232627424:4232627424(0) ACK
4232921199 WIN 32120 <MSS 1460,SACKOK,TIMESTAMP 431310
432968,NOP,WSCALE 0> (DF)
        4500 003C 0963 4000 4006 0BFA C0A8 D206
        C0A8 D207 0071 8045 FC48 C4E0 FC4D 406F
        A012 7D78 F65E 0000 0204 05B4 0402 080A
        0006 94CE 0006 9B48 0103 0300

[ROOT@LOCALHOST TMP]# TAIL -10 LAME1
        5004 0000 D65B 0000
```

```
15:51:11.006448 eth0 < 192.168.210.7.32840 > 192.168.210.6.auth: F 31:31(0) ack 33 win 5840
<nop,nop,timestamp 433258 431597> (DF)
        4500 0034 ee4c 4000 4006 2718 c0a8 d207
        c0a8 d206 8048 0071 fc51 724e fc7c 36ef
        8011 16d0 e562 0000 0101 080a 0006 9c6a
        0006 95ed
15:51:11.006614 eth0 > 192.168.210.6.auth > 192.168.210.7.32840: R 4235998959:4235998959(0) win 0
        4500 0028 09fe 0000 ff06 8c72 c0a8 d206
        c0a8 d207 0071 8048 fc7c 36ef 0000 0000
        5004 0000 d65b 0000
[root@localhost tmp]#
```

This appears to be a 3 second packet trace file. The IP addresses used are non-routable, but may refer to the local machine which was not connected to the internet. To check this, the NIC configuration file was checked.

```
[root@localhost network-scripts]# cd /mnt/hack/root/etc/sysconfig/network-scripts
[root@localhost network-scripts]# cat ifcfg-eth0
DEVICE=eth0
BOOTPROTO=static
IPADDR=192.168.210.6
NETMASK=255.255.255.0
GATEWAY=192.168.210.33
[root@localhost network-scripts]#
```

This shows that the local address was in fact 192.168.210.6, which was referenced in the "lame1" file. All of the packets contained in the "lame1" file were between 192.168.210.6 and 192.168.210.7. Is it therefore likely that a sniffer of some sort was running, either on this system or the machine at the far end of the connections.

NB: In the following file listings, some files are shown as belonging to the user "michael". Unix uses the UID to identify who files belong to. On the investigation computer, user 500 was "michael". On the suspect computer, user 500 was "wayne". Therefore in the following file listings, files shown as belonging to "michael" actually belong to "wayne".

```
[root@localhost tmp]# cd "..."
[root@localhost ...]# ls -al
total 7948
drwxr-xr-x   7 30     root       4096 Jul  5 19:31 .
drwxrwxrwt   6 root   root       4096 Jul  5 19:43 ..
drwxr-xr-x   3 30     root       4096 Jul  5 19:35 adore
drwxrwxrwx   3 michael michael    4096 Jul  5 19:16 kis_client-0.9
-rw-r--r--   1 1001   1001     256000 Jul 20  2001 kis_client-0.9.tar
-rw-r--r--   1 1001   1001      28998 Jul 20  2001 kis_server-0.9.tar.gz
drwxr-xr-x   3 root   root       4096 Jul  5 18:47 knark-0.50
drwxr-xr-x   3 root   root       4096 Jul  5 18:37 knark-0.59
-rw-r--r--   1 michael michael   61440 Jul  5 18:45 knark.tar
drwxr-xr-x  18 root   root       4096 Jul  5 19:28 lrk4
-rw-r--r--   1 michael michael   92160 Jul  5 19:03 tools2.tar
-rw-r--r--   1 michael michael 3788800 Jul  5 19:26 tools3.tar
-rw-r--r--   1 michael michael   51200 Jul  5 19:30 tools4.tar
-rw-r--r--   1 michael michael 3788800 Jul  5 19:03 tools.tar
-rw-r--r--   1 1001   1001       4217 Jul 20  2001 usage.txt
[root@localhost ...]#
```

Adore and Knark are well known linux Loadable Kernel Module (LKM) rootkits. Further "google" research showed that "kis" is the "Kernel Intrusion System", an LKM rootkit, and "lrk4" is version 4 of the "Linux Root Kit." This program is another linux root kit, which replaces system binaries. Replaced files include ps, netstat, login and passwd. The earlier results from the known-goods reporting tool showed that all system binaries had the expected

MD5HASH. THIS MEANS THAT ALTH OUGH THIS PARTICULAR ROOTKIT MAY HAVE BE EN COPIED ONTO THE SYST EM, IT WAS NOT PROPERLY INSTALLED ON THAT SYSTEM. THE UNKNOWN TAR FILES WE RE NOW EXAMINED .

```
[ROOT@LOCALHOST ...]# TAR -TVF TOOLS.TAR |HEAD -10
DRWXR-XR-X ROOT/ROOT       0 1998-11-26 10:49:24 LRK4/
-RW-R--R-- ROOT/ROOT     716 1998-11-24 17:27:03 LRK4/MCONFIG
-RW-R--R-- ROOT/ROOT    4755 1998-11-26 08:51:53 LRK4/MAKEFILE
-RW-R--R-- ROOT/ROOT    9488 1998-11-26 19:01:22 LRK4/README
DRWXR-XR-X ROOT/ROOT       0 1998-11-26 09:28:23 LRK4/BIN/
-RW-R--R-- ROOT/ROOT    1661 1998-11-24 17:27:03 LRK4/BINDSHELL.C
DRWXR-R-- ROOT/ROOT        0 1998-11-26 09:28:24 LRK4/CHFN/
-RW-------- ROOT/ROOT  11493 1998-11-24 17:27:03 LRK4/CHFN/CHFN.C
-RW-------- ROOT/ROOT    109 1998-11-24 17:27:03 LRK4/CHFN/MAKEFILE
-RW-------- ROOT/ROOT   5283 1998-11-24 17:27:03 LRK4/CHFN/SETPWNAM.C
[ROOT@LOCALHOST ...]# TAR -TVF TOOLS.TAR |TAIL -10
-RW-R--R-- ROOT/ROOT    753 1998-11-24 17:27:16 LRK4/FINDUTILS/TESTSUITE/XARGS.SYSV/L2.XO
-RW-R--R-- ROOT/ROOT   1203 1998-11-24 17:27:17 LRK4/FINDUTILS/TESTSUITE/MAKEFILE.AM
-RW-R--R-- ROOT/ROOT   3634 1998-11-24 17:27:17 LRK4/FINDUTILS/TESTSUITE/MAKEFILE.IN
-RW-R--R-- ROOT/ROOT   3644 1998-11-24 17:27:17 LRK4/FINDUTILS/TESTSUITE/MAKEFILE
-RW-R--R-- ROOT/ROOT    462 1998-11-24 17:27:17 LRK4/FINDUTILS/CONFIG.LOG
-RW-R--R-- ROOT/ROOT   4535 1998-11-24 17:27:17 LRK4/FINDUTILS/MAKEFILE
-RW-R--R-- ROOT/ROOT   2370 1998-11-24 17:27:17 LRK4/FINDUTILS/CONFIG.CACHE
-RWXR-XR-X ROOT/ROOT   9519 1998-11-24 17:27:17 LRK4/FINDUTILS/CONFIG.STATUS
-RW-R--R-- ROOT/ROOT   5056 1998-11-24 17:27:17 LRK4/FINDUTILS/CONFIG.H
-RW-R--R-- ROOT/ROOT     29 1998-11-24 17:27:17 LRK4/FINDUTILS/STAMP-H

[ROOT@LOCALHOST ...]# TAR -TVF TOOLS.TAR |GREP -V LRK
[ROOT@LOCALHOST ...]#
```

This file contains the lrk4 program.

```
[root@localhost ...]# tar -tvf tools2.tar
-rw-r--r-- packet/packet 56295 2001-07-20 11:52:59 kis_client-0.9.tar.gz
-rw-r--r-- packet/packet 28998 2001-07-20 11:53:05 kis_server-0.9.tar.gz
-rw-r--r-- packet/packet  4217 2001-07-20 11:53:13 USAGE.TXT
[root@localhost ...]#
```

The tools2.tar file contains the com pressed installation files for "KIS".

```
[root@localhost ...]# tar -tvf tools3.tar |head -10
drwxr-xr-x root/root        0 1998-11-26 10:49:24 lrk4/
-rw-r--r-- root/root      716 1998-11-24 17:27:03 lrk4/MCONFIG
-rw-r--r-- root/root     4755 1998-11-26 08:51:53 lrk4/Makefile
-rw-r--r-- root/root     9488 1998-11-26 19:01:22 lrk4/README
drwxr-xr-x root/root        0 1998-11-26 09:28:23 lrk4/bin/
-rw-r--r-- root/root     1661 1998-11-24 17:27:03 lrk4/bindshell.c
drwxr--r-- root/root        0 1998-11-26 09:28:24 lrk4/chfn/
-rw------- root/root    11493 1998-11-24 17:27:03 lrk4/chfn/chfn.c
-rw------- root/root      109 1998-11-24 17:27:03 lrk4/chfn/Makefile
-rw------- root/root     5283 1998-11-24 17:27:03 lrk4/chfn/setpwnam.c
[root@localhost ...]# tar -tvf tools3.tar |tail -10
-rw-r--r-- root/root      753 1998-11-24 17:27:16 lrk4/findutils/testsuite/xargs.sysv/l2.xo
-rw-r--r-- root/root     1203 1998-11-24 17:27:17 lrk4/findutils/testsuite/Makefile.am
-rw-r--r-- root/root     3634 1998-11-24 17:27:17 lrk4/findutils/testsuite/Makefile.in
-rw-r--r-- root/root     3644 1998-11-24 17:27:17 lrk4/findutils/testsuite/Makefile
-rw-r--r-- root/root      462 1998-11-24 17:27:17 lrk4/findutils/config.log
-rw-r--r-- root/root     4535 1998-11-24 17:27:17 lrk4/findutils/Makefile
-rw-r--r-- root/root     2370 1998-11-24 17:27:17 lrk4/findutils/config.cache
-rwxr-xr-x root/root     9519 1998-11-24 17:27:17 lrk4/findutils/config.status
-rw-r--r-- root/root     5056 1998-11-24 17:27:17 lrk4/findutils/config.h
-rw-r--r-- root/root       29 1998-11-24 17:27:17 lrk4/findutils/stamp-h
[root@localhost ...]#
```

Tools3.tar appears to be the same as tools.tar. To make certain of this md5sums of both files were taken.

```
[root@localhost ...]# md5sum tools.tar
4d988511ea00a49e1450b7de490db614  tools.tar
```

```
[root@localhost ...]# md5sum tools3.tar
4d988511ea00a49e1450b7de490db614  tools3.tar
[root@localhost ...]#
```

These files are identical.

```
[root@localhost ...]# tar -tvf tools4.tar
drwxr-xr-x stealth/stealth   0 2000-12-24 05:03:29 adore/
drwxr-xr-x stealth/stealth   0 2000-12-24 05:03:29 adore/CVS/
-rw-r--r-- stealth/stealth   5 2000-12-24 05:03:29 adore/CVS/Root
-rw-r--r-- stealth/stealth   6 2000-12-24 05:03:29 adore/CVS/Repository
-rw-r--r-- stealth/stealth 616 2000-12-24 05:03:29 adore/CVS/Entries
-rw-r--r-- stealth/stealth  10 2000-12-24 05:03:29 adore/CVS/Tag
-rw-r--r-- stealth/stealth 1660 2000-06-26 07:03:05 adore/LICENSE
-rw-r--r-- stealth/stealth  738 2000-12-24 04:46:53 adore/Makefile.gen
-rw-r--r-- stealth/stealth 2632 2000-12-24 04:55:59 adore/README
-rw-r--r-- stealth/stealth   21 2000-12-24 04:55:59 adore/TODO
-rw-r--r-- stealth/stealth 10757 2000-12-24 04:55:59 adore/adore.c
-rw-r--r-- stealth/stealth  4179 2000-12-22 03:54:05 adore/ava.c
-rw-r--r-- stealth/stealth  1979 2000-12-24 04:57:23 adore/cleaner.c
-rwxr-xr-x stealth/stealth  2810 2000-12-24 04:57:23 adore/configure
-rw-r--r-- stealth/stealth  1904 2000-09-20 01:47:24 adore/dummy.c
-rw-r--r-- stealth/stealth  3262 2000-12-22 03:54:05 adore/libinvisible.c
-rw-r--r-- stealth/stealth  2527 2000-12-22 03:54:05 adore/libinvisible.h
-rwxr-xr-x stealth/stealth   199 2000-12-24 04:46:53 adore/startadore
[root@localhost ...]#
```

TOOLS4.TAR CONTAINS THE ADORE INSTALLATION FILES.

THE TIMES LISTED ON THE STANDARD "LS -AL" ARE THE TIMES THAT THE FILES WERE CREATED. HOWEVER, SOME COMPRESSION PROGRAMS STORE THE TIME THAT A FILE WAS CREATED IN THE COMPRESSED FILE, AND CAN EXTRACT THIS CREATION TIME WHEN THE FILE IS RESTORED. THIS IS THE EXPLANATION FOR THE MISLEADING FILE CREATION TIMES IN THE TEMP DIRECTORY.

```
-rw-r--r--   1 1001     1001        28998 Jul 20  2001 kis_server-0.9.tar.gz
```

The kis_server gzip file has a creation time of 2001, years before this system was installed. To gain a more accurate picture of the time the files were copied onto the system, the C time must be used. This represents the last time the metadata of the file was altered. This could include be a file being moved, “chmod”ed (change mode), or “chown”ed (change owner).

```
[root@localhost ...]# ls -lc
total 7940
drwxr-xr-x   3 30       root        4096 Jul  5 19:35 adore
drwxrwxrwx   3 michael  michael     4096 Jul  5 19:16 kis_client-0.9
-rw-r--r--   1 1001     1001      256000 Jul  5 19:14 kis_client-0.9.tar
-rw-r--r--   1 1001     1001       28998 Jul  5 19:05 kis_server-0.9.tar.gz
drwxr-xr-x   3 root     root        4096 Jul  5 18:47 knark-0.50
drwxr-xr-x   3 root     root        4096 Jul  5 18:37 knark-0.59
-rw-r--r--   1 michael  michael     61440 Jul  5 18:46 knark.tar
drwxr-xr-x  18 root     root        4096 Jul  5 19:28 lrk4
-rw-r--r--   1 michael  michael     92160 Jul  5 19:04 tools2.tar
-rw-r--r--   1 michael  michael   3788800 Jul  5 19:28 tools3.tar
-rw-r--r--   1 michael  michael     51200 Jul  5 19:31 tools4.tar
-rw-r--r--   1 michael  michael   3788800 Jul  5 19:04 tools.tar
-rw-r--r--   1 1001     1001        4217 Jul  5 19:05 USAGE.TXT
[root@localhost ...]#
```

ALL THE FILES WERE INSTALLED ONTO THE SYSTEM WITHIN AN HOUR OF 7PM, JULY 5TH. TO DISCOVER WHAT ELSE HAPPENED WITHIN THIS TIME PERIOD, THE SYSTEM LOGS WERE EXAMINED.

THE /VAR/LOG/MAILLOG CONTAINS THE FOLLOWING LINES

```
Jul  3 15:35:17 redhat6 sendmail[773]: NOQUEUE: Null connection from charlie [192.168.210.33]
Jul  3 15:35:17 redhat6 sendmail[775]: NOQUEUE: Authentication-Warning: localhost.localdomain: charlie
[192.168.210.33] didn't use HELO protocol
Jul  3 15:35:17 redhat6 sendmail[775]: PAA00775: lost input channel from charlie [192.168.210.33]
Jul  3 15:35:17 redhat6 sendmail[775]: PAA00775: from=nessus720696718@hotmail.com, size=0, class=0, pri=0,
nrcpts=0, proto=SMTP, relay=charlie
[192.168.210.33]
Jul  3 15:35:17 redhat6 sendmail[776]: NOQUEUE: Null connection from charlie [192.168.210.33]

Jul  3 15:35:28 redhat6 sendmail[822]: PAA00822: /tmp/nessus_test... Cannot mail directly to files
Jul  3 15:35:28 redhat6 sendmail[822]: PAA00822: lost input channel from charlie [192.168.210.33]

Jul  3 15:35:38 redhat6 sendmail[855]: PAA00855: from=<test_1@nessus.org>, size=0, class=0, pri=0, nrcpts=0,
proto=SMTP, relay=charlie [192.168.210.33]
Jul  3 15:35:42 redhat6 sendmail[866]: PAA00866: ruleset=check_rcpt, arg1=<test_2@nessus.org>, relay=charlie
[192.168.210.33], reject=550
<test_2@nessus.org>... Relaying denied
```

Clearly someone on 192.168.210.33 ran a Nessus [x] scan against this machine at 3:35pm on July 3rd. Nessus is a widely available tool that is used to test computers for security vulnerabilities and related issues.

The nessus scan also appears in the "/var/log/messages" file.

```
Jul  3 15:17:54 redhat6 login: FAILED LOGIN 1 FROM (null) FOR  root, User not known to the underlying
authentication module
Jul  3 15:17:59 redhat6 PAM_pwdb[615]: authentication failure; LOGIN(uid=0)-> root for login service
Jul  3 15:18:00 redhat6 login[615]: FAILED LOGIN 2 FROM (null) FOR root, Authentication failure
Jul  3 15:18:04 redhat6 PAM_pwdb[615]: (login) session opened for user root by LOGIN(uid=0)
Jul  3 15:18:39 redhat6 identd: cannot bind() server socket: Permission denied.
Jul  3 15:18:39 redhat6 inetd[478]: /sbin/identd (pid 659): exit status 255

Jul  3 15:18:41 redhat6 inetd[478]: /sbin/identd (pid 697): exit status 255
Jul  3 15:18:41 redhat6 inetd[478]: ident/tcp server failing (looping or being flooded), service terminated for 10 min
Jul  3 15:23:24 redhat6 inetd[478]: pid 704: exit signal 13
Jul  3 15:23:24 redhat6 inetd[478]: pid 706: exit signal 13
Jul  3 15:23:25 redhat6 ftpd[703]: getpeername (in.ftpd): Transport endpoint is not connected
Jul  3 15:23:25 redhat6 inetd[478]: pid 703: exit status 1
Jul  3 15:28:41 redhat6 inetd[478]: ident/tcp: bind: Address already in use
Jul  3 15:30:52 redhat6 ftpd[711]: lost connection to charlie [192.168.210.33]
Jul  3 15:30:52 redhat6 ftpd[711]: FTP session closed

Jul  3 03:35:13 redhat6 ftpd[753]: ANONYMOUS FTP LOGIN FROM charlie [192.168.210.33], nessus@nessus.org
Jul  3 03:35:13 redhat6 ftpd[753]: FTP session closed
```

Other suspiscious activity also appears in the "/var/log/messages" log file that records kernel messages

```
Jul  3 16:50:37 redhat6 PAM_pwdb[615]: authentication failure; LOGIN(uid=0) -> root for login service
Jul  3 16:50:38 redhat6 login[615]: FAILED LOGIN 1 FROM (null) FOR root, Authentication failure
Jul  3 16:50:50 redhat6 PAM_pwdb[615]: (login) session opened for user root by LOGIN(uid=0)


Jul  5 12:21:23 redhat6 inetd[477]: ident/tcp server failing (looping or being flooded), service terminated for 10 min
Jul  5 12:29:51 redhat6 identd: cannot bind() server socket: Address already in use.
Jul  5 12:33:44 redhat6 PAM_pwdb[614]: (login) session closed for user root
Jul  5 12:33:48 redhat6 PAM_pwdb[707]: get passwd; pwdb: request not recognized
Jul  5 12:33:49 redhat6 login[707]: FAILED LOGIN 1 FROM (null) FOR wroot, Authentication service cannot retrieve
authentication info.
Jul  5 12:34:01 redhat6 PAM_pwdb[707]: get passwd; pwdb: request not recognized
Jul  5 12:34:01 redhat6 login[707]: FAILED LOGIN 2 FROM (null) FOR wroot, Authentication service cannot retrieve
authentication info.
Jul  5 12:36:21 redhat6 PAM_pwdb[708]: get passwd; pwdb: request not recognized
Jul  5 12:36:22 redhat6 login[708]: FAILED LOGIN 1 FROM (null) FOR wroot, Authentication service cannot retrieve
authentication info.
```

```
Jul  5 12:36:39 redhat6 PAM_pwdb[708]: (login) session opened for user root by LOGIN(uid=0)
Jul  5 12:38:02 redhat6 PAM_pwdb[732]: (su) session opened for user wroot by root(uid=0)
Jul  5 12:38:31 redhat6 PAM_pwdb[732]: (su) session closed for user wroot
Jul  5 12:38:33 redhat6 PAM_pwdb[708]: (login) session closed for user root
Jul  5 12:38:39 redhat6 PAM_pwdb[745]: get passwd; pwdb: request not recognized
Jul  5 12:38:40 redhat6 login[745]: FAILED LOGIN 1 FROM (null) FOR wroot, Authentication service cannot retrieve
authentication info.
Jul  5 12:39:05 redhat6 pam_rhosts_auth[746]: denied to wayne@192.168.210.7 as wayne: access not allowed
Jul  5 12:39:07 redhat6 PAM_pwdb[746]: authentication failure; (uid=0) -> wayne for rlogin service
Jul  5 12:39:08 redhat6 in.rlogind[746]: PAM authentication failed for in.rlogind
Jul  5 12:39:13 redhat6 PAM_pwdb[747]: (login) session opened for user wayne by (uid=0)
Jul  5 12:39:42 redhat6 PAM_pwdb[747]: (login) session closed for user wayne
Jul  5 12:40:26 redhat6 pam_rhosts_auth[772]: denied to wayne@192.168.210.7 as wroot: access not allowed
Jul  5 12:40:27 redhat6 PAM_pwdb[772]: get passwd; pwdb: request not recognized
Jul  5 12:40:27 redhat6 in.rlogind[772]: PAM authentication failed for in.rlogind
Jul  5 12:41:13 redhat6 PAM_pwdb[773]: get passwd; pwdb: request not recognized
Jul  5 12:41:14 redhat6 login[773]: FAILED LOGIN 1 FROM 192.168.210.7 FOR wroot, Authentication failure
Jul  5 12:41:17 redhat6 login[773]: FAILED LOGIN 2 FROM 192.168.210.7 FOR , User not known to the underlying
authentication module
Jul  5 12:41:20 redhat6 login[773]: FAILED LOGIN 3 FROM 192.168.210.7 FOR , User not known to the underlying
authentication module
Jul  5 12:41:22 redhat6 PAM_pwdb[773]: check pass; user unknown
Jul  5 12:41:23 redhat6 login[773]: FAILED LOGIN SESSION FROM 192.168.210.7 FOR rew, User not known to the
underlying authentication module
Jul  5 12:41:52 redhat6 PAM_pwdb[768]: (login) session opened for user root by LOGIN(uid=0)

Jul  5 12:56:56 redhat6 inetd[477]: ident/tcp server failing (looping or being flooded), service terminated for 10 min
Jul  5 12:57:03 redhat6 identd: cannot bind() server socket: Address already in use.
Jul  5 12:59:49 redhat6 PAM_pwdb[958]: password for (wayne/500) changed by (root/0)
Jul  5 13:00:23 redhat6 PAM_pwdb[959]: password for (wroot/0) changed by ((null)/0)
Jul  5 13:00:34 redhat6 PAM_pwdb[882]: (login) session closed for user root
Jul  5 13:00:40 redhat6 PAM_pwdb[963]: (login) session opened for user wroot by LOGIN(uid=0)
Jul  5 13:02:29 redhat6 identd: cannot bind() server socket: Address already in use.
Jul  5 13:03:21 redhat6 PAM_pwdb[995]: password for (wroot/0) changed by ((null)/0)
Jul  5 13:04:31 redhat6 pam_rhosts_auth[996]: denied to wayne@192.168.210.7 as wroot: access not allowed
Jul  5 13:04:32 redhat6 PAM_pwdb[996]: authentication failure; (uid=0) -> wroot for rlogin service
Jul  5 13:04:32 redhat6 in.rlogind[996]: PAM authentication failed for in.rlogind
Jul  5 13:04:39 redhat6 login: FAILED LOGIN 1 FROM 192.168.210.7 FOR wroot, Authentication failure
Jul  5 13:04:50 redhat6 login: FAILED LOGIN 2 FROM 192.168.210.7 FOR wroot, Authentication failure
Jul  5 13:10:08 redhat6 pam_rhosts_auth[1002]: denied to wayne@192.168.210.7 as wroot: access not allowed
Jul  5 13:10:13 redhat6 in.rlogind[1002]: PAM authentication failed for in.rlogind
Jul  5 13:10:18 redhat6 login: FAILED LOGIN 1 FROM 192.168.210.7 FOR wroot, Authentication failure
Jul  5 13:10:25 redhat6 login: FAILED LOGIN 2 FROM 192.168.210.7 FOR root, Authentication failure
Jul  5 13:10:30 redhat6 PAM_pwdb[1003]: (login) session opened for user wayne by (uid=0)
Jul  5 13:10:51 redhat6 PAM_pwdb[1024]: (su) session opened for user wroot by wayne(uid=500)
Jul  5 13:11:39 redhat6 identd: cannot bind() server socket: Address already in use.
Jul  5 13:11:39 redhat6 identd: cannot bind() server socket: Address already in use.
Jul  5 13:11:46 redhat6 PAM_pwdb[1024]: (su) session closed for user wroot
Jul  5 13:11:51 redhat6 PAM_pwdb[1003]: (login) session closed for user wayne
Jul  5 13:12:38 redhat6 identd: cannot bind() server socket: Permission denied.

Jul  5 14:11:10 redhat6 PAM_pwdb[614]: check pass; user unknown
Jul  5 14:11:11 redhat6 login[614]: FAILED LOGIN 1 FROM (null) FOR rooty, User not known to the underlying
authentication module
Jul  5 14:11:16 redhat6 PAM_pwdb[614]: (login) session opened for user root by LOGIN(uid=0)
Jul  5 14:11:21 redhat6 identd: cannot bind() server socket: Address already in use.

Jul  5 18:42:51 redhat6 ftpd[1473]: PAM-listfile: Refused user root for service ftp
Jul  5 18:42:51 redhat6 PAM_pwdb[1473]: authentication failure; (uid=0) -> root for ftp service
Jul  5 18:42:52 redhat6 ftpd: 192.168.210.7: connected: IDLE
[1473]: failed login from 192.168.210.7 [192.168.210.7]
Jul  5 18:43:04 redhat6 PAM_pwdb[1473]: authentication failure; (uid=0) -> wruser for ftp service
Jul  5 18:43:05 redhat6 ftpd: 192.168.210.7: connected: IDLE
[1473]: failed login from 192.168.210.7 [192.168.210.7]
Jul  5 18:43:15 redhat6 ftpd: 192.168.210.7: wayne
[1473]: FTP LOGIN FROM 192.168.210.7 [192.168.210.7], wayne
Jul  5 18:45:21 redhat6 ftpd: 192.168.210.7: wayne: QUIT
[1473]: FTP session closed
Jul  5 19:01:10 redhat6 ftpd[1540]: failed login from 192.168.210.7 [192.168.210.7]
Jul  5 19:01:21 redhat6 ftpd[1540]: FTP LOGIN FROM 192.168.210.7 [192.168.210.7], wayne
Jul  5 19:17:16 redhat6 ftpd[1540]: FTP session closed
Jul  5 19:25:05 redhat6 ftpd[1834]: PAM-listfile: Refused user root for service ftp
Jul  5 19:25:05 redhat6 PAM_pwdb[1834]: authentication failure; (uid=0) -> root for ftp service
Jul  5 19:25:06 redhat6 ftpd: 192.168.210.7: connected: IDLE
```

```
[1834]: failed login from 192.168.210.7 [192.168.210.7]
Jul  5 19:25:14 redhat6 ftpd: 192.168.210.7: wayne
[1834]: FTP LOGIN FROM 192.168.210.7 [192.168.210.7], wayne
Jul  5 19:26:48 redhat6 ftpd: 192.168.210.7: wayne: QUIT
[1834]: FTP session closed
Jul  5 19:30:04 redhat6 ftpd[1842]: PAM-listfile: Refused user root for service ftp
Jul  5 19:30:04 redhat6 PAM_pwdb[1842]: authentication failure; (uid=0) -> root for ftp service
Jul  5 19:30:04 redhat6 ftpd: 192.168.210.7: connected: IDLE
[1842]: failed login from 192.168.210.7 [192.168.210.7]
Jul  5 19:30:12 redhat6 ftpd: 192.168.210.7: wayne
[1842]: FTP LOGIN FROM 192.168.210.7 [192.168.210.7], wayne
Jul  5 19:45:39 redhat6 ftpd: 192.168.210.7: wayne: IDLE
[1842]: User wayne timed out after 900 seconds at Sat Jul  5 19:45:39 2003
Jul  5 19:45:39 redhat6 ftpd: 192.168.210.7: wayne: IDLE
[1842]: FTP session closed
Jul  5 19:45:39 redhat6 inetd[477]: pid 1842: exit status 1
```

THE "/VAR/LOG/SECURE" FILE THAT DEALS WITH LOGIN FAILURES AND SUCH CONTAINS THE FOLLOWING

```
JUL  5 12:36:39 REDHAT6 LOGIN: ROOT LOGIN ON TTY1
JUL  5 12:39:04 REDHAT6 IN.RLOGIND[746]: CONNECT FROM 192.168.210.7
JUL  5 12:39:13 REDHAT6 LOGIN: LOGIN ON 0 BY WAYNE FROM 192.168.210.7
JUL  5 12:40:26 REDHAT6 IN.RLOGIND[772]: CONNECT FROM 192.168.210.7
JUL  5 12:41:52 REDHAT6 LOGIN: ROOT LOGIN ON TTY1
JUL  5 12:52:30 REDHAT6 LAST MESSAGE REPEATED 2 TIMES
JUL  5 13:00:40 REDHAT6 LOGIN: ROOT LOGIN ON TTY1
JUL  5 13:04:31 REDHAT6 IN.RLOGIND[996]: CONNECT FROM 192.168.210.7
JUL  5 13:10:08 REDHAT6 IN.RLOGIND[1002]: CONNECT FROM 192.168.210.7
JUL  5 13:10:30 REDHAT6 LOGIN: LOGIN ON 0 BY WAYNE FROM 192.168.210.7
JUL  5 13:16:36 REDHAT6 IN.RLOGIND[1089]: CONNECT FROM 192.168.210.7
JUL  5 13:18:01 REDHAT6 LOGIN: ROOT LOGIN ON TTY1
JUL  5 13:21:46 REDHAT6 IN.RLOGIND[1127]: CONNECT FROM 192.168.210.7
JUL  5 13:21:50 REDHAT6 LOGIN: LOGIN ON 0 BY WRUSER FROM 192.168.210.7
JUL  5 14:11:16 REDHAT6 LOGIN: ROOT LOGIN ON TTY1
JUL  5 14:14:16 REDHAT6 IN.RLOGIND[692]: CONNECT FROM 192.168.210.7
JUL  5 14:14:28 REDHAT6 LOGIN: LOGIN ON 0 BY WRUSER FROM 192.168.210.7
```

AND FINALLY, THE "/VAR/LOG/XFERLOG" FILE (WHICH RECORDS FILE TRANSFERS TO AND FROM THE SYSTEM) CONTAINS

```
SAT JUL  5 17:46:19 2003 1 192.168.210.7 15169 /TMP/KNARK.TAR.GZ B _ I R WAYNE FTP 0 * C
SAT JUL  5 18:45:17 2003 3 192.168.210.7 12856 /TMP/KNARK B _ I R WAYNE FTP 0 * C
SAT JUL  5 19:02:17 2003 4 192.168.210.7 87860 /TMP/TOOLS A _ I R WAYNE FTP 0 * C
SAT JUL  5 19:02:26 2003 1 192.168.210.7 87860 /TMP/TOOLS B _ I R WAYNE FTP 0 * C
SAT JUL  5 19:03:18 2003 34 192.168.210.7 900450 /TMP/TOOLS B _ I R WAYNE FTP 0 * C
SAT JUL  5 19:03:29 2003 1 192.168.210.7 87860 /TMP/TOOLS2 B _ I R WAYNE FTP 0 * C
SAT JUL  5 19:26:25 2003 36 192.168.210.7 900450 /TMP/TOOLS3.TAR.GZ A _ I R WAYNE FTP 0 * C
SAT JUL  5 19:26:31 2003 1 192.168.210.7 900450 /TMP/TOOLS3.TAR.GZ B _ I R WAYNE FTP 0 * C
SAT JUL  5 19:30:33 2003 1 192.168.210.7 9738 /TMP/TOOLS4.TAR.GZ A _ I R WAYNE FTP 0 * C
SAT JUL  5 19:30:39 2003 1 192.168.210.7 9738 /TMP/TOOLS4.TAR.GZ B _ I R WAYNE FTP 0 * C
```

Unfortunately, the system was seized in a powered down state. The system usually stores information about running processes in the "/proc" directory. This can be useful information for an investigator as it helps identify what the system was doing. The system was turned off however, which made it impossible to get any information from the /proc directory. In fact, the /proc directory was completely empty.

```
[root@localhost root]# cd /mnt/hack/root/var/proc
[root@localhost proc]# ls -al
total 8
drwxr-xr-x    2 root     root         4096 Jul  3 01:47 .
drwxr-xr-x   17 root     root         4096 Jul  5 15:21 ..
[root@localhost proc]#
```

ANOTHER OPTION WAS TO SEARCH FOR THE LOADABLE KERNEL MODULES FOUND ON THE

HARD DISK DRIVE . THIS WAS DONE USING T HE "CHKROOTKIT " PROGRAM . THIS PROGRA M RECOGNISES KNOWN ROO TKIT SIGNATURES , AND WARNS IF ANY HA VE BEEN INSTALLED . IT WAS EXECUTED WITH TH E COMMAND LINE "./CHKROOTKIT -R /MNT/HACK/ROOT/". IT DETECTED NO INSTALLED ROOTKITS . THIS MEANS THAT ANY R OOTKITS FOUND ON THE SYSTEM HAD SIMPLY BEEN COPIED THERE AND EXPANDED , RATHER THAN PROPERL Y INSTALLED . ALTHOUGH THE "/BOOT/SYSTEM .MAP" FILE WAS ALSO EXAMI NED , THIS FILE IS DIFFER ENT FROM MACHINE TO MACHINE . THERE WAS NO KNOWN GO OD COPY AVAILABLE , BUT NOTHING OUT OF PLACE COULD BE SEEN IN THI S FILE .

SYSTEM STARTUP FILES COU LD ALSO SHOW EVIDENC E OF A COMPROMISE . THESE ARE LOCATED IN THE "/ETC/INIT" AND "RC.D" DIRECTORIES . FILES SET TO START AUTOMATICALLY BEGIN WITH AN "S", AND FILES SET TO NO T START BEGIN WITH A "K". ALTHOUGH ALL THESE DI RECTORIES WERE EXA MINED , FOR BREVITY ONLY EX AMPLES ARE SHOWN .

```
[ROOT@LOCALHOST INIT .D]# CD ./ETC/INIT.D
[ROOT@LOCALHOST INIT.D]# LS -AL
TOTAL 188
DRWXR-XR-X   2 ROOT    ROOT       4096 JUL  3 14:18 .
DRWXR-XR-X  10 ROOT    ROOT       4096 JUL  2 14:09 ..
-RWXR-XR-X   1 ROOT    ROOT        525 MAR  4  2000 ANACRON
-RWXR-XR-X   1 ROOT    ROOT       1367 OCT 27  1999 APMD
-RWXR-XR-X   1 ROOT    ROOT        827 FEB 18  2000 ARPWATCH
-RWXR-XR-X   1 ROOT    ROOT        989 MAR  2  2000 ATD
-RWXR-XR-X   1 ROOT    ROOT       1031 FEB  4  2000 CROND
-RWXR-XR-X   1 ROOT    ROOT        405 JUL  3 14:18 FAKEIDENTD
-RWXR-XR-X   1 ROOT    ROOT       7349 JAN 21  2000 FUNCTIONS
-RWXR-XR-X   1 ROOT    ROOT       1261 MAR  1  2000 GPM
-RWXR-XR-X   1 ROOT    ROOT       3260 MAR  9  2000 HALT
-RWXR-XR-X   1 ROOT    ROOT        865 MAR  2  2000 HTTPD
-RWXR-XR-X   1 ROOT    ROOT       1151 FEB 23  2000 IDENTD
-RWXR-XR-X   1 ROOT    ROOT       1463 FEB  1  2000 INET
-RWXR-XR-X   1 ROOT    ROOT       1890 MAR  3  2000 INND
-RWXR-XR-X   1 ROOT    ROOT       2448 FEB 17  2000 IPCHAINS
-RWXR-XR-X   1 ROOT    ROOT       1065 MAR  9  2000 KDCROTATE
-RWXR-XR-X   1 ROOT    ROOT       1203 MAR  7  2000 KEYTABLE
-RWXR-XR-X   1 ROOT    ROOT        449 OCT  1  1999 KILLALL
-RWXR-XR-X   1 ROOT    ROOT       1179 MAR  5  2000 KUDZU
LRWXRWXRWX   1 ROOT    ROOT         43 JUL  2 14:11 LINUXCONF -> /USR/LIB/LINUXCONF/REDHAT/SCRIPTS/LINUXCONF
-RWXR-XR-X   1 ROOT    ROOT       1176 FEB 15  2000 LPD
-RWXR-XR-X   1 ROOT    ROOT       1104 FEB 25  2000 MARS-NWE
-RWXR-XR-X   1 ROOT    ROOT       1340 FEB 29  2000 NAMED
-RWXR-XR-X   1 ROOT    ROOT       3217 SEP 21  1999 NETFS
-RWXR-XR-X   1 ROOT    ROOT       5094 MAR  8  2000 NETWORK
-RWXR-XR-X   1 ROOT    ROOT       2257 FEB 10  2000 NFS
-RWXR-XR-X   1 ROOT    ROOT       1722 FEB 10  2000 NFSLOCK
-R-XR-XR-X   1 ROOT    ROOT       4481 MAR  8  2000 PCMCIA
-RWXR-XR-X   1 ROOT    ROOT       1086 FEB  8  2000 PORTMAP
-RWXR-XR-X   1 ROOT    ROOT       2431 FEB 13  2000 POSTGRESQL
-RWXR-XR-X   1 ROOT    ROOT       1542 FEB  5  2000 RANDOM
-RWXR-XR-X   1 ROOT    ROOT        780 FEB 10  2000 RSTATD
-RWXR-XR-X   1 ROOT    ROOT        976 FEB 10  2000 RUSERSD
-RWXR-XR-X   1 ROOT    ROOT        941 FEB 12  2000 RWALLD
-RWXR-XR-X   1 ROOT    ROOT        882 FEB  8  2000 RWHOD
-RWXR-XR-X   1 ROOT    ROOT       1549 FEB 18  2000 SENDMAIL
-RWXR-XR-X   1 ROOT    ROOT       1504 FEB  5  2000 SINGLE
-RWXR-XR-X   1 ROOT    ROOT       1177 FEB 26  2000 SMB
-RWXR-XR-X   1 ROOT    ROOT        851 FEB 28  2000 SNMPD
-RWXR-XR-X   1 ROOT    ROOT       1024 FEB  4  2000 SYSLOG
-RWXR-XR-X   1 ROOT    ROOT       1956 MAR  7  2000 XFS
-RWXR-XR-X   1 ROOT    ROOT       1712 FEB  6  2000 YPBIND
-RWXR-XR-X   1 ROOT    ROOT       1084 MAR  7  2000 YPPASSWDD
-RWXR-XR-X   1 ROOT    ROOT       1137 MAR  7  2000 YPSERV
[ROOT@LOCALHOST INIT.D]#
```

An interesting entry here is "fakeidentd" - the Fake Ident Daemon.

```
[root@localhost rc.d]# cd rc0.d/
[root@localhost rc0.d]# ls -al
total 8
drwxr-xr-x   2 root     root        4096 Jul  3 14:18 .
drwxr-xr-x  10 root     root        4096 Jul  2 14:09 ..
lrwxrwxrwx   1 root     root          19 Jul  3 01:55 K00linuxconf -> ../init.d/linuxconf
lrwxrwxrwx   1 root     root          14 Jul  3 01:53 K05innd -> ../init.d/innd
lrwxrwxrwx   1 root     root          18 Jul  3 01:49 K05keytable -> ../init.d/keytable
lrwxrwxrwx   1 root     root          13 Jul  3 01:49 K10xfs -> ../init.d/xfs
lrwxrwxrwx   1 root     root          13 Jul  3 01:52 K15gpm -> ../init.d/gpm
lrwxrwxrwx   1 root     root          15 Jul  3 01:49 K15httpd -> ../init.d/httpd
lrwxrwxrwx   1 root     root          13 Jul  3 01:57 K20nfs -> ../init.d/nfs
lrwxrwxrwx   1 root     root          16 Jul  3 01:58 K20rstatd -> ../init.d/rstatd
lrwxrwxrwx   1 root     root          17 Jul  3 01:58 K20rusersd -> ../init.d/rusersd
lrwxrwxrwx   1 root     root          16 Jul  3 01:58 K20rwalld -> ../init.d/rwalld
lrwxrwxrwx   1 root     root          15 Jul  3 01:58 K20rwhod -> ../init.d/rwhod
lrwxrwxrwx   1 root     root          18 Jul  3 01:58 K30sendmail -> ../init.d/sendmail
lrwxrwxrwx   1 root     root          19 Jul  3 01:59 K34yppasswdd -> ../init.d/yppasswdd
lrwxrwxrwx   1 root     root          13 Jul  3 01:58 K35smb -> ../init.d/smb
lrwxrwxrwx   1 root     root          27 Jul  3 14:18 K45fakeidentd -> /etc/rc.d/init.d/fakeidentd
lrwxrwxrwx   1 root     root          15 Jul  3 01:49 K45named -> ../init.d/named
lrwxrwxrwx   1 root     root          14 Jul  3 01:52 K50inet -> ../init.d/inet
lrwxrwxrwx   1 root     root          15 Jul  3 01:59 K50snmpd -> ../init.d/snmpd
lrwxrwxrwx   1 root     root          13 Jul  3 01:49 K60atd -> ../init.d/atd
lrwxrwxrwx   1 root     root          15 Jul  3 01:59 K60crond -> ../init.d/crond
lrwxrwxrwx   1 root     root          13 Jul  3 01:56 K60lpd -> ../init.d/lpd
lrwxrwxrwx   1 root     root          18 Jul  3 01:56 K60mars-nwe -> ../init.d/mars-nwe
lrwxrwxrwx   1 root     root          16 Jul  3 01:57 K65identd -> ../init.d/identd
lrwxrwxrwx   1 root     root          17 Jul  3 01:57 K70nfslock -> ../init.d/nfslock
lrwxrwxrwx   1 root     root          15 Jul  3 01:52 K75netfs -> ../init.d/netfs
lrwxrwxrwx   1 root     root          16 Jul  3 01:52 K80random -> ../init.d/random
lrwxrwxrwx   1 root     root          14 Jul  3 01:49 K84apmd -> ../init.d/apmd
lrwxrwxrwx   1 root     root          16 Jul  3 01:59 K84ypserv -> ../init.d/ypserv
lrwxrwxrwx   1 root     root          17 Jul  3 01:57 K89portmap -> ../init.d/portmap
lrwxrwxrwx   1 root     root          17 Jul  3 01:52 K90network -> ../init.d/network
lrwxrwxrwx   1 root     root          18 Jul  3 01:53 K92ipchains -> ../init.d/ipchains
lrwxrwxrwx   1 root     root          15 Jul  3 01:54 K95kudzu -> ../init.d/kudzu
lrwxrwxrwx   1 root     root          16 Jul  3 01:54 K96pcmcia -> ../init.d/pcmcia
lrwxrwxrwx   1 root     root          16 Jul  3 01:58 K99syslog -> ../init.d/syslog
lrwxrwxrwx   1 root     root          17 Jul  3 01:52 S00killall -> ../init.d/killall
lrwxrwxrwx   1 root     root          14 Jul  3 01:52 S01halt -> ../init.d/halt
[root@localhost rc0.d]# cd ..

[root@localhost rc.d]# cd rc6.d/
[root@localhost rc6.d]# ls -al
total 8
drwxr-xr-x   2 root     root        4096 Jul  3 14:18 .
drwxr-xr-x  10 root     root        4096 Jul  2 14:09 ..
lrwxrwxrwx   1 root     root          19 Jul  3 01:55 K00linuxconf -> ../init.d/linuxconf
lrwxrwxrwx   1 root     root          14 Jul  3 01:53 K05innd -> ../init.d/innd
lrwxrwxrwx   1 root     root          18 Jul  3 01:49 K05keytable -> ../init.d/keytable
lrwxrwxrwx   1 root     root          13 Jul  3 01:49 K10xfs -> ../init.d/xfs
lrwxrwxrwx   1 root     root          13 Jul  3 01:52 K15gpm -> ../init.d/gpm
lrwxrwxrwx   1 root     root          15 Jul  3 01:49 K15httpd -> ../init.d/httpd
lrwxrwxrwx   1 root     root          13 Jul  3 01:57 K20nfs -> ../init.d/nfs
lrwxrwxrwx   1 root     root          16 Jul  3 01:58 K20rstatd -> ../init.d/rstatd
lrwxrwxrwx   1 root     root          17 Jul  3 01:58 K20rusersd -> ../init.d/rusersd
lrwxrwxrwx   1 root     root          16 Jul  3 01:58 K20rwalld -> ../init.d/rwalld
lrwxrwxrwx   1 root     root          15 Jul  3 01:58 K20rwhod -> ../init.d/rwhod
lrwxrwxrwx   1 root     root          18 Jul  3 01:58 K30sendmail -> ../init.d/sendmail
lrwxrwxrwx   1 root     root          19 Jul  3 01:59 K34yppasswdd -> ../init.d/yppasswdd
lrwxrwxrwx   1 root     root          13 Jul  3 01:58 K35smb -> ../init.d/smb
lrwxrwxrwx   1 root     root          27 Jul  3 14:18 K45fakeidentd -> /etc/rc.d/init.d/fakeidentd
lrwxrwxrwx   1 root     root          15 Jul  3 01:49 K45named -> ../init.d/named
lrwxrwxrwx   1 root     root          14 Jul  3 01:52 K50inet -> ../init.d/inet
lrwxrwxrwx   1 root     root          15 Jul  3 01:59 K50snmpd -> ../init.d/snmpd
lrwxrwxrwx   1 root     root          13 Jul  3 01:49 K60atd -> ../init.d/atd
lrwxrwxrwx   1 root     root          15 Jul  3 01:59 K60crond -> ../init.d/crond
lrwxrwxrwx   1 root     root          13 Jul  3 01:56 K60lpd -> ../init.d/lpd
lrwxrwxrwx   1 root     root          18 Jul  3 01:56 K60mars-nwe -> ../init.d/mars-nwe
lrwxrwxrwx   1 root     root          16 Jul  3 01:57 K65identd -> ../init.d/identd
```

```
lrwxrwxrwx    1 root     root          17 Jul  3 01:57 K70nfslock -> ../init.d/nfslock
lrwxrwxrwx    1 root     root          15 Jul  3 01:52 K75netfs -> ../init.d/netfs
lrwxrwxrwx    1 root     root          16 Jul  3 01:52 K80random -> ../init.d/random
lrwxrwxrwx    1 root     root          14 Jul  3 01:49 K84apmd -> ../init.d/apmd
lrwxrwxrwx    1 root     root          16 Jul  3 01:59 K84ypserv -> ../init.d/ypserv
lrwxrwxrwx    1 root     root          17 Jul  3 01:57 K89portmap -> ../init.d/portmap
lrwxrwxrwx    1 root     root          17 Jul  3 01:52 K90network -> ../init.d/network
lrwxrwxrwx    1 root     root          18 Jul  3 01:53 K92ipchains -> ../init.d/ipchains
lrwxrwxrwx    1 root     root          15 Jul  3 01:54 K95kudzu -> ../init.d/kudzu
lrwxrwxrwx    1 root     root          16 Jul  3 01:54 K96pcmcia -> ../init.d/pcmcia
lrwxrwxrwx    1 root     root          16 Jul  3 01:58 K99syslog -> ../init.d/syslog
lrwxrwxrwx    1 root     root          17 Jul  3 01:52 S00killall -> ../init.d/killall
lrwxrwxrwx    1 root     root          14 Jul  3 01:52 S01reboot -> ../init.d/halt
[root@localhost rc6.d]# cd ..
[root@localhost rc.d]# ls -al
total 68
drwxr-xr-x   10 root     root        4096 Jul  2 14:09 .
drwxr-xr-x   29 root     root        4096 Jul  5 18:13 ..
drwxr-xr-x    2 root     root        4096 Jul  3 14:18 init.d
-rwxr-xr-x    1 root     root        2889 Nov  9  1999 rc
drwxr-xr-x    2 root     root        4096 Jul  3 14:18 rc0.d
drwxr-xr-x    2 root     root        4096 Jul  3 13:10 rc1.d
drwxr-xr-x    2 root     root        4096 Jul  3 14:18 rc2.d
drwxr-xr-x    2 root     root        4096 Jul  3 13:10 rc3.d
drwxr-xr-x    2 root     root        4096 Jul  3 13:10 rc4.d
drwxr-xr-x    2 root     root        4096 Jul  3 13:10 rc5.d
drwxr-xr-x    2 root     root        4096 Jul  3 14:18 rc6.d
-rwxr-xr-x    1 root     root         933 Oct  1  1999 rc.local
-r-xr-x---    1 news     news        2964 Mar  3  2000 rc.news
-rwxr-xr-x    1 root     root       13679 Feb 24  2000 rc.sysinit
[root@localhost rc.d]#
```

These are all much as you would expect on this type of system. The rc.local, news, and sysinit files were also exam ined, using "emacs rc.local", "emacs rc.news", or "emacs rc.sysinit" respectively. No anomalies were found in these files.

User's startup files were also examined at this point. Only one user had a home directory, "/home/wayne".

```
[ROOT@LOCALHOST WAYNE]# LS -AL
TOTAL 32
DRWX------   2 MICHAEL  MICHAEL     4096 JUL  5 12:39 .
DRWXR-XR-X   5 ROOT     ROOT        4096 FEB  7  1996 ..
-RW-------   1 MICHAEL  MICHAEL      19 JUL  5 13:11 .BASH_HISTORY
-RW-R--R--   1 MICHAEL  MICHAEL      24 JUL  3 01:59 .BASH_LOGOUT
-RW-R--R--   1 MICHAEL  MICHAEL     230 JUL  3 01:59 .BASH_PROFILE
-RW-R--R--   1 MICHAEL  MICHAEL     124 JUL  3 01:59 .BASHRC
-RWXR-XR-X   1 MICHAEL  MICHAEL     333 JUL  3 01:59 .EMACS
-RW-R--R--   1 MICHAEL  MICHAEL    3394 JUL  3 01:59 .SCREENRC

[ROOT@LOCALHOST WAYNE]# CAT .BASH_HISTORY
EXIT
SU WROOT
EXIT
[ROOT@LOCALHOST WAYNE]#
```

THE OTHER FILES (".BASH_LOGOUT", ".BASH_PROFILE", ".EMACS" AND ".SCREENRC") WERE UNMODIFIED FROM THE STANDARD REDHAT INSTALLATION. AS THE ".BASH_HISTORY" FILE ONLY CONTAINED THREE COMMANDS (EXIT, SU WROOT, AND EXIT) IT IS LIKELY THAT AFTER OBTAINING A LO GIN AND PASSWORD FOR WROOT THAT THE INTR UDER USED THIS ACCOUNT, RATHER THAN "WAYNE". AFTER OBTAINING THIS LOGIN/PASSWORD COMBINATION HE MAY IN FACT HAVE CLEANED OUT THE ".BASH_HISTORY" FILE TO COVER HIS T RACKS.

THE ONLY OTHER USER O N THE SYSTEM IS "ROOT". "/ROOT/.BASH_HISTORY" WAS NEXT EXAMINED. THIS FILE INCLUDING T HE FOLLOWING COMMAND S.

CHECKING THE SYSTEM INSTALLED SUCCESSFULLY

```
EXIT
MOUNT /DEV/FD0 /MNT/FLOPPY
DF -K
CD /MNT/FLOPPY
LS
CP */TMP/
CD /TMP
LS
```

ADDING SOME PACKAGES

```
PACKAGEADD
RPMADD
ADDPACKAGE
ADDRPM
CLEAR
LS
RPM
LS
```

Installing the fake ident service from an RPM

```
rpm -U fakeidentd*.rpm
```

Checking the fakeident service installed successfully

```
telnet localhost 113
/usr/sbin/identd -V
/usr/sbin/fakeidentd -version
```

Setting up network connectivity

```
reboot
ping 192.168.210.33
ifconfig
ping 192.168.210.33
ps -ef
ping 192.168.210.33

reboot
cd /etc
ls
vi inetd.conf
ping 192.168.210.7
```

Using TCPDump (likely to check the Fakeident service) and creating the lame1 file

```
man tcpdump
tcpdump -X > /tmp/lame1

cd /etc
ls
more hosts
vi hosts
more hosts.allow
wq
ping charlie
```

Installing a different version of fakeident, this time from the source code.

```
cd fakeidentd-1.2orig/
ls
make
make install
```

IT IS LIKELY THAT THE ROOT ACCOUNT IS COMPROMISED BY THIS TIME. HERE THE ROOT USER DIRECTLY EDITS THE "/ETC/PASSWD" AND "/ETC/SHADOW" FILES.

```
VI /ETC/SHADOW
EXIT
VI /ETC/PASSWD
EXIT
MORE /ETC/PASSWD
MAN PASSWD
MORE /ETC/PASSWD
VI /ETC/PASSWD
EXIT
```

REMOVING THE TRIPWIRE INSTALLATION DIRECTORY

```
RM JONTY
```

INSTALLING TRIPWIRE FROM A CD-ROM

```
SHOWMOUNT
MORE /ETC/FSTAB
MOUNT -T ISO9660 /DEV/CDROM /MNT/CDROM
MOUNT -T ISO9660 /DEV/CDROM /MNT/CDROM
CD /MNT/CDROM
LS
CP -R LINUX_x86 /TMP
CD /TMP
LS
CD LINUX*
LS
MORE RE*
LS
MORE INSTALL.CFG

./INSTALL.SH
LS
PWD
CD /MNT/CDROM
LD
LS
CD POL*
LS
CD LINUX*
LS
CD RED*
LS
CD 6.2
LS
PWD
CD /USR/LOCAL/BIN/TRIPWIRE
CD /USR/LOCAL
LS
CD TRIPWIRE
LS
CD TFS
LS
CD POLICY
LS
CP /MNT/CDROM/POLICYFILES/LINUX/REDHAT/6.2/TWPOL.TXT .
LS
CD ../BIN
```

Creating the tripwire files

```
./twadmin --create-polfile twpol.txt
./twadmin --create-polfile ../policy/twpol.txt
ls
```

Running tripwire (interactively)

```
./tripwire --init
./tripwire --check --interactive
umount /dev/cdrom
eject
```

RUNNING TRIPWIRE (NON-INTERACTIVELY)

```
CD TRIPWIRE/TFS
LS
CD BIN
LS
./TRIPWIRE --CHECK
/SBIN/IDENTD
```

It is likely that the intruder has again gained root access at this point. Here they install knark.

```
cd /tmp
ls
gunzip knark.tar.gz
ls
tar xvf knark.tar
ls
cd knar*
ls -al
more README
ls
```

```
mount /dev/fd0 /mnt/floppy
ls
cd README /mnt/floppy
cp README /mnt/floppy
cd /tmp
```

And move it from the original directory (/tmp) to the target directory (/tmp/.../)

```
umount /dev/fd0
cd knark*
ls
make
ls
pwd
cd ...
cd ..
ls
ls -al
cp kna* ...
ls
cp -r kn* /tmp/...
ls
rm kna*
ls
rm -r ka*
rm kna*
rm -r kna*
ls
cd ...
ls
cd ka*
cd kn*
ls
```

Knark install is attempted

```
insmod knark
make instmod knark
find /-name insmod
find / -name insmod
/sbin/insmod knark
/sbin/insmod /tmp/.../knark
make
```

Knark is apparently running at this time

```
cd /proc
ls
cd knark
ls -al
```

INSTALL ANOTHER VERSI ON OF KNARK

```
MV KNARK KNARK .TAR.GZ
GUNZIP *.G Z
LS
TAR XVFP *. TAR
LS
CD *.50
LS
MO RE RE*
MAKE
MAKE INSTALL
LS
```

RENAME THE TOOLS FILE S FOR UNZ IPPING , THEN UNZIP THEM .

```
MV TOOLS TOOLS .TAR.GZ
MV TOOLS2 TOOLS2.TAR.GZ
GUNZIP *.G Z
LS
TAR XVF T*. TAR
TAR XVF TOOLS. TAR
LS
TAR XVF TOOLS 2. TAR
LS
```

OPEN AN LRK 4 README FILE (USAGE).*

```
MO RE USAGE*
LS
CD LRK4
LS
MO RE README
 LS
```

Attempt to install "lrk4"

```
make
more Makefile
vi Makefile
ls
make
more linsniffer.c
 ls
make
vi l*.c
ls
cd ..
ls
more USAGE
more US*
```

ATTEMPT TO INSTALL "KIS"

```
LS
GUNZIP KIS_C*.GZ
LS
TAR XVF KIS *TAR
LS
CD KIS
CD KIS*
LS
MORE README
MORE README
MORE INSTALL
 LS
./CONFIGURE
FIND / -NAME G TK
```

Move more tools to "/tmp/...".

```
mv tool* .../
cd .../
ls
gunzip tools4.tar.gz
ls
tar xvf tools4.tar
ls
```

Install "adore".

```
cd adore
ls
more README
ls
configure
./configure
ls
more Makefile
 make
ls
make install
more README

ls
make clean; make
ls
ls -al
```

Start adore

```
./ava
./startadore
./ava h /tmp/.../
ls
more README
ls
./ava
./startadore
find / -name rmmod
echo $PATH
path=&PATH:/sbin
path=$PATH:/sbin
export PATH
./startadore
echo $PATH
PATH=$PATH:/sbin
export PATH
echo $PATH
./startadore
./ava
```

./ava h /tmp/.../
cd /tmp
ls -al
cd ...
./ava
ls

FINALLY, POWER DOWN THE SYST EM.

```
HALT
```

THE CRON (RUN REGULARLY) FILES COULD ALSO HI DE MALICIOUS FUNCTIO NALITY.

```
[MICHAEL@LOCALHOST ETC]$ LS -AL CRON*
-RW-R--R--   1 ROOT    ROOT        255 AUG 28  1999 CRONTAB

CRON.D:
TOTAL 12
DRWXR-XR-X   2 ROOT    ROOT       4096 FEB  4  2000 .
DRWXR-XR-X  29 ROOT    ROOT       4096 JUL  5 18:13 ..
-RW-R--R--   1 ROOT    ROOT         86 FEB 18  2000 KMOD

CRON.DAILY:
TOTAL 36
DRWXR-XR-X   2 ROOT    ROOT       4096 JUL  2 14:11 .
DRWXR-XR-X  29 ROOT    ROOT       4096 JUL  5 18:13 ..
-RWXR-XR-X   1 ROOT    ROOT        276 MAR  4  2000 0ANACRON
-RWXR-XR-X   1 ROOT    ROOT         77 MAR  3  2000 INN-CRON-EXPIRE
-RWXR-XR-X   1 ROOT    ROOT         53 MAR  3  2000 INN-CRON-RNEWS
-RWXR-XR-X   1 ROOT    ROOT         51 FEB 25  2000 LOGROTATE
-RWXR-XR-X   1 ROOT    ROOT        402 MAR  1  2000 MAKEWHATIS.CRON
-RWXR-XR-X   1 ROOT    ROOT        102 FEB  4  2000 SLOCATE.CRON
-RWXR-XR-X   1 ROOT    ROOT        104 FEB 15  2000 TMPWATCH

CRON.HOURLY:
TOTAL 12
DRWXR-XR-X   2 ROOT    ROOT       4096 AUG 28  1999 .
DRWXR-XR-X  29 ROOT    ROOT       4096 JUL  5 18:13 ..
-RWXR-XR-X   1 ROOT    ROOT         65 MAR  3  2000 INN-CRON-NNTPSEND

CRON.MONTHLY:
TOTAL 12
DRWXR-XR-X   2 ROOT    ROOT       4096 AUG 28  1999 .
DRWXR-XR-X  29 ROOT    ROOT       4096 JUL  5 18:13 ..
-RWXR-XR-X   1 ROOT    ROOT        278 MAR  4  2000 0ANACRON

CRON.WEEKLY:
TOTAL 16
DRWXR-XR-X   2 ROOT    ROOT       4096 JUL  2 14:11 .
DRWXR-XR-X  29 ROOT    ROOT       4096 JUL  5 18:13 ..
-RWXR-XR-X   1 ROOT    ROOT        277 MAR  4  2000 0ANACRON
-RWXR-XR-X   1 ROOT    ROOT        399 MAR  1  2000 MAKEWHATIS.CRON
[MICHAEL@LOCALHOST ETC]$
```

ALL THESE FILES ARE EXPEC TED VERSIONS .

TIME-LINE ANALYSIS

NOTE: DUE TO A DISCREPENCY BETWEEN THE TIMEZONE ON THE ANALYSIS COM PUTER AND THE DISK IMAGE , ALL TIMES LISTED AR E 12 HOURS SLOW . FOR THE LOCAL TIMES T HAT THE LISTED TIMES RELATE TO, ADD 12 HOURS TO EACH TIME .

eg. TimeLine listing
Sat Jul 05 2003 07:05:07 3788800 .a. -/-rw-r--r-- wayne   wayne   162927   /tmp/.../tools.tar

Vs.

Mount file listing

```
[root@localhost ...]# ls -lu
total 7940
drwxr-xr-x   3 30       root       4096 Jul  5 19:38 adore
drwxrwxrwx   3 michael  michael    4096 Jul  5 19:38 kis_client-0.9
-rw-r--r--   1 1001     1001     256000 Jul  5 19:15 kis_client-0.9.tar
-rw-r--r--   1 1001     1001      28998 Jul  5 19:05 kis_server-0.9.tar.gz
drwxr-xr-x   3 root     root       4096 Jul  5 19:38 knark-0.50
drwxr-xr-x   3 root     root       4096 Jul  5 19:38 knark-0.59
-rw-r--r--   1 michael  michael    61440 Jul  5 18:46 knark.tar
drwxr-xr-x  18 root     root       4096 Jul  5 19:38 lrk4
-rw-r--r--   1 michael  michael    92160 Jul  5 19:05 tools2.tar
-rw-r--r--   1 michael  michael  3788800 Jul  5 19:28 tools3.tar
-rw-r--r--   1 michael  michael    51200 Jul  5 19:31 tools4.tar
-rw-r--r--   1 michael  michael  3788800 Jul  5 19:05 tools.tar
-rw-r--r--   1 1001     1001       4217 Jul  5 19:14 USAGE.TXT
[root@localhost ...]#
```

THIS TIMELINE WAS CRE ATED FROM THE TIME R ANGE JAN 1ST, 2002 - JAN 1ST, 2004. SOME OF THE FILES ARE DIS PLAYED WITH THEIR OR IGINAL CREATION DATE S. THIS OCCURS WHERE THEY ARE COMPRESSE D ALONG WITH THEIR O RIGINAL DATES , AND THE PROGRAM USE D TO DECOMPRESS THEM ALSO EXTRACTS THE DATES AND USES THEM ON THE NEW SYSTEM . FOR EXAMPLE , THE TRIPWIRE FILES ARE LISTED AS BEING FROM MAY, WHICH IS KNOWN TO B E BEFORE THE SYSTEM WA S INSTALLED .

```
Tue May 14 2002 10:00:00  5554608 m.. -/-r-x----- root/wroot root     145959   /usr/local/tripwire/tfs/bin/tripwire
                           552231 m.. -/-r--r--r-- root/wroot root     145975   /usr/local/tripwire/tfs/documents/tfs_userguide.pdf
                             6355 m.. -/-r--r--r-- root/wroot root     145969   /usr/local/tripwire/tfs/man/man8/twagent.8
```

THE OPERATING SYSTEM INSTALLATION WAS STA RTED

```
TUE JUL 01 2003 22:53:36    237 M.C -/-RW-R--R-- ROOT/WROOT ROOT    48757  /BOOT/KERNEL.H
TUE JUL 01 2003 22:53:37   2635 .A. -/-RW-R--R-- ROOT/WROOT ROOT   114836  /VAR/LOG/DMESG
TUE JUL 01 2003 22:53:53   4096 M.C D/DRWX------ ROOT/WROOT ROOT   177690  /VAR/LIB/NFS/SM.BAK
               0 MAC C/CRW------- ROOT/WROOT ROOT    35342  /DEV/APM_BIOS
            4096 M.C D/DRWX------ ROOT/WROOT ROOT   177689  /VAR/LIB/NFS/SM
               0 MAC L/CRW------- ROOT/WROOT ROOT    35342  /ETC/RC.D/RC1.D/K83YPBIND (DELETED-REALLOC)
            4096 M.C D/DRWXR-XR-X ROOT/WROOT ROOT     1819  /VAR/LIB/NFS
TUE JUL 01 2003 22:53:55  56333 .A. -/-RW-R--R-- ROOT/WROOT ROOT   114837  /VAR/LOG/BOOT.LOG
TUE JUL 01 2003 22:53:59  14394 .A. -/-RW------- ROOT/WROOT ROOT   114838  /VAR/LOG/CRON
TUE JUL 01 2003 22:54:01      4 .A. -/-RW-R--R-- ROOT/WROOT ROOT    50470  /VAR/SPOOL/LPD/LPD.LOCK
            4096 M.C D/DRWXRWXR-X ROOT/WROOT DAEMON    49827  /VAR/SPOOL/LPD
TUE JUL 01 2003 22:54:12   4096 M.C D/DRWXR-XR-X ROOT/WROOT ROOT    96793  /USR/SHARE/FONTS/DEFAULT/GHOSTSCRIPT
            4096 M.C D/DRWXR-XR-X ROOT/WROOT ROOT    50327  /USR/SHARE/FONTS/DEFAULT/TYPE1
```

A delay caused the install to pause for 3 hours, possibly req uiring user input.

```
Wed Jul 02 2003 01:22:59      20 ma. l/lrwxrwxrwx root/wroot root     35347   /etc/rc.d/rc6.d/K83ypbind -> ../init.d/fakeidentd (deleted)
                              20 ma. l/lrwxrwxrwx root/wroot root     35367   /etc/rc.d/rc4.d/K25fakeidentd -> ../init.d/fakeidentdfs (deleted)
                              20 ma. l/lrwxrwxrwx root/wroot root     35347   /etc/rc.d/rc5.d/S80fakeidentd -> ../init.d/fakeidentdeytable (deleted)
                              20 ma. lrwxrwxrwx root/wroot root       35367   <RH_Partition_1.dd-dead-35367>
                              20 m.. lrwxrwxrwx root/wroot root       35365   <RH_Partition_1.dd-dead-35365>
                              20 ma. lrwxrwxrwx root/wroot root       35347   <RH_Partition_1.dd-dead-35347>
```

THE MAIN FILE INSTALL PROCESS BEGINS

```
WED JUL 02 2003 02:05:22   2239 .A. -/-RW-R--R-- ROOT/WROOT ROOT   162688  /TMP/UPGRADE.LOG
WED JUL 02 2003 02:06:27    161 ..C -/-RW-R--R-- ROOT/WROOT ROOT    80168  /ETC/HOSTS.ALLOW
             547 ..C -/-RW-R--R-- ROOT/WROOT ROOT    80174  /ETC/PROFILE
```

VARIOUS SYSTEM BINARI ES ARE INSTALLED

```
WED JUL 02 2003 02:11:15      6 ..C L/LRWXRWXRWX ROOT/WROOT ROOT   114051  /SBIN/SWAPOFF -> SWAPON B
            1606 ..C -/-RW-R--R-- ROOT/WROOT ROOT   145330  /USR/MAN/MAN8/UMOUNT.8.GZ
           26608 ..C -/-RWSR-XR-X ROOT/WROOT ROOT   145326  /BIN/UMOUNT
           12599 ..C -/-RW-R--R-- ROOT/WROOT ROOT   145327  /USR/MAN/MAN8/MOUNT.8.GZ
           56208 ..C -/-RWSR-XR-X ROOT/WROOT ROOT   145325  /BIN/MOUNT
            6200 ..C -/-RWXR-XR-X ROOT/WROOT ROOT   114048  /SBIN/SWAPON
```

The RedHat Package Manager is installed

```
Wed Jul 02 2003 02:11:36    4096 ..c d/drwxr-xr-x root/wroot root     50209   /etc/rpm
                             222 ..c -/-rwxr-xr-x root/wroot root     145555  /usr/bin/gendiff
                          886424 ..c -/-rwxr-xr-x root/wroot root     145541  /bin/rpm
Wed Jul 02 2003 02:11:37  695192 ..c -/-rwxr-xr-x root/wroot root     145556  /usr/bin/rpm2cpio
Wed Jul 02 2003 02:11:38    1288 ..c -/-rwxr-xr-x root/wroot root     176862  /usr/lib/rpm/brp-compress
                            1212 ..c -/-rwxr-xr-x root/wroot root     176872  /usr/lib/rpm/find-requires
```

OTHER DELAYS OCCUR DU RING THE INSTALL PRO CESS

```
WED JUL 02 2003 02:12:26    160 ..C -/-RW-R--R-- ROOT/WROOT ROOT    82665  /ETC/LILO.CONF.RPMSAVE
WED JUL 02 2003 02:12:27    160 M.C -/-RW-R--R-- ROOT/WROOT ROOT    82400  /ETC/LILO.CONF
                            160 M.C -/-RW-R--R-- ROOT/WROOT ROOT    82400  /USR/SHARE/LOCALE/SK/LC_MESSAGES/TIMECONFIG.MO-RPMDELETE
(DELETED-REALLOC)
WED JUL 02 2003 02:12:31  10240 M.C -/-RW------- ROOT/WROOT ROOT    50674  /BOOT/MAP
                          10240 M.C -/-RW------- ROOT/WROOT ROOT    50674  /BOOT/MAP~ (DELETED-REALLOC)
WED JUL 02 2003 02:14:33     34 ..C -/-RW-R--R-- ROOT/WROOT ROOT    82662  /ETC/CONF.MODULES~
                             51 M.C -/-RW-R--R-- ROOT/WROOT ROOT    82739  /ETC/CONF.MODULES
WED JUL 02 2003 02:14:58     95 M.C -/-RW-R--R-- ROOT/WROOT ROOT    98809  /ETC/SYSCONFIG/NETWORK-SCRIPTS/IFCFG-ETH0
                           4096 M.C D/DRWXR-XR-X ROOT/WROOT ROOT    97079  /ETC/SYSCONFIG/NETWORK-SCRIPTS
WED JUL 02 2003 02:38:03  26736 ..C -/-RWXR-XR-X ROOT/WROOT ROOT    18091  /USR/SBIN/IDENTD.ORIG
WED JUL 02 2003 03:43:06  18424 M.C -/-R--RW-R-- ROOT/WROOT MAN    177691  /VAR/CATMAN/CAT8/TCPDUMP.8.GZ
WED JUL 02 2003 03:51:58  18424 .A. -/-R--RW-R-- ROOT/WROOT MAN    177691  /VAR/CATMAN/CAT8/TCPDUMP.8.GZ
WED JUL 02 2003 04:00:32  16384 M.C D/DRWXR-XR-X ROOT/WROOT ROOT    160325  /USR/MAN/MAN1
WED JUL 02 2003 04:04:55  11092 M.C -/-RWXR-XR-X ROOT/WROOT ROOT    18728  /USR/SBIN/CIDENTD
                           3004 M.C -/-RWXR-XR-X ROOT/WROOT ROOT    162904  /USR/MAN/MAN1/CIDENTD.1
WED JUL 02 2003 05:12:13  95547 M.C -/-RW-R--R-- ROOT/WROOT ROOT    162903  /TMP/LAME1
WED JUL 02 2003 05:24:27     20 .A. LRWXRWXRWX ROOT/WROOT ROOT    35365  <RH_PARTITION_1.DD-DEAD-35365>
WED JUL 02 2003 05:26:20      0 MA. SRW-RW-RW- ROOT/WROOT ROOT    35360  <RH_PARTITION_1.DD-DEAD-35360>
                              0 MA. -/SRW-RW-RW- ROOT/WROOT ROOT    35360  /USR/LIB/LIBZ.SO.1.1.3-RPMDELETE (DELETED)
```

The "lame1" file is created, at the same size as the current version.

```
Wed Jul 02 2003 04:04:55    11092 m.c -/-rwxr-xr-x root/wroot root    18728  /usr/sbin/cidentd
                             3004 m.c -/-rwxr-xr-x root/wroot root    162904  /usr/man/man1/cidentd.1
Wed Jul 02 2003 05:12:13    95547 m.c -/-rw-r--r-- root/wroot root    162903  /tmp/lame1
Wed Jul 02 2003 05:24:27       20 .a. lrwxrwxrwx root/wroot root    35365  <RH_Partition_1.dd-dead-35365>
```

THE INSTALLATION PROC ESS CONTINUES

```
WED JUL 02 2003 13:47:08  16384 M.C D/DRWXR-XR-X ROOT/WROOT ROOT    11  /LOST+FOUND
                              0 MAC --------- ROOT/WROOT ROOT    1  <RH_PARTITION_1.DD-ALIVE-1>
WED JUL 02 2003 13:47:41   4096 MAC D/DRWXR-XR-X ROOT/WROOT ROOT    32065  /PROC
WED JUL 02 2003 13:47:44   5659 .A. -/-RW-R--R-- ROOT/WROOT ROOT    160322  /TMP/INSTALL.LOG
WED JUL 02 2003 13:48:00   9748 ..C -/-RW-R--R-- ROOT/WROOT ROOT    32069  /USR/LIB/LIBEFENCE.A
                           1574 ..C -/-RW-R--R-- ROOT/WROOT ROOT    16036  /USR/DOC/ELECTRICFENCE-2.1/README
                           5591 ..C -/-RW-R--R-- ROOT/WROOT ROOT    64133  /USR/MAN/MAN3/LIBEFENCE.3.GZ
                          17976 ..C -/-RW-R--R-- ROOT/WROOT ROOT    16035  /USR/DOC/ELECTRICFENCE-2.1/COPYING
                            940 ..C -/-RW-R--R-- ROOT/WROOT ROOT    16034  /USR/DOC/ELECTRICFENCE-2.1/CHANGES
                           4096 M.C D/DRWXR-XR-X ROOT/WROOT ROOT    16033  /USR/DOC/ELECTRICFENCE-2.1
                             50 ..C -/-RW-R--R-- ROOT/WROOT ROOT    64132  /USR/MAN/MAN3/EFENCE.3.GZ
```

THE MANUAL "MAN" PAGES ARE INSTALLED

```
WED JUL 02 2003 13:56:04   59568 ..C -/-RWXR-XR-X ROOT/WROOT ROOT    145264  /USR/BIN/SB
                           55504 ..C -/-RWXR-XR-X ROOT/WROOT ROOT    145263  /USR/BIN/RZ
                           16872 ..C -/-R-SR-SR-X ROOT/WROOT LP    145256  /USR/BIN/LPQ
                           59568 ..C -/-RWXR-XR-X ROOT/WROOT ROOT    145264  /USR/BIN/SZ
                            2239 ..C -/-RW-R--R-- ROOT/WROOT ROOT    162069  /USR/MAN/MAN1/LPRM.1.GZ
                            1176 ..C -/-RWXR-XR-X ROOT/WROOT ROOT    162065  /ETC/RC.D/INIT.D/LPD
                           59568 ..C -/-RWXR-XR-X ROOT/WROOT ROOT    145264  /USR/BIN/SX
                            3435 ..C -/-RW-R--R-- ROOT/WROOT ROOT    97938  /USR/MAN/MAN5/PRINTCAP.5.GZ
                           51696 ..C -/-RWXR--R-- ROOT/WROOT ROOT    17827  /USR/SBIN/LPD
                           25064 ..C -/-RWXR-SR-X ROOT/WROOT LP    17826  /USR/SBIN/LPC
                            3261 ..C -/-RW-R--R-- ROOT/WROOT ROOT    162068  /USR/MAN/MAN1/LPR.1.GZ
                            1875 ..C -/-RW-R--R-- ROOT/WROOT ROOT    145262  /USR/MAN/MAN8/PAC.8.GZ
```

The man pages are extracted

```
Wed Jul 02 2003 13:56:10       8 m.. l/lrwxrwxrwx root/wroot root    162082  /usr/man/man1/manpath.1.gz -> man.1.gz
                               3 m.. l/lrwxrwxrwx root/wroot root    145276  /usr/bin/manpath -> man
Wed Jul 02 2003 13:56:13    2873 ..c -/-rw-r--r-- root/wroot root    1761  /usr/doc/man-pages-1.28/COPYING
                            4096 m.c d/drwxr-xr-x root/wroot root    1760  /usr/doc/man-pages-1.28
                            1124 ..c -/-rw-r--r-- root/wroot root    1762  /usr/doc/man-pages-1.28/README
Wed Jul 02 2003 13:56:25    2840 ..c -/-rw-r--r-- root/wroot man    17860  /usr/man/man2/execve.2.gz
                            1850 ..c -/-rw-r--r-- root/wroot man    17958  /usr/man/man2/readv.2.gz
                            1878 ..c -/-rw-r--r-- root/wroot man    17896  /usr/man/man2/getsockname.2.gz
                            1504 ..c -/-rw-r--r-- root/wroot man    17839  /usr/man/man2/acct.2.gz
                              48 ..c -/-rw-r--r-- root/wroot man    17836  /usr/man/man2/_sysctl.2.gz
```

THE PLUGGABLE AUTHENTICATI ON MODULE IS INSTALLED

```
WED JUL 02 2003 13:59:40     250 M.C -/-RW-R--R-- ROOT/WROOT ROOT    82323  /ETC/PAM.D/PASSWD
                             372 M.. -/-RW------- ROOT/WROOT ROOT    82661  /ETC/GSHADOW-
                             437 M.C -/-RW-R--R-- ROOT/WROOT ROOT    80179  /ETC/PAM.D/LOGIN
                             446 M.. -/-RW------- ROOT/WROOT ROOT    80419  /ETC/GROUP-
                             443 M.C -/-RW-R--R-- ROOT/WROOT ROOT    82447  /ETC/PAM.D/RLOGIN
                             361 M.C -/-RW-R--R-- ROOT/WROOT ROOT    82658  /ETC/YP.CONF
                              32 M.C -/-RW-R--R-- ROOT/WROOT ROOT    82657  /ETC/SYSCONFIG/NETWORK
```

USER ACCOUNTS ARE SET UP

```
WED JUL 02 2003 13:59:43     333 MAC -/-RWXR-XR-X WAYNE    WAYNE     50450  /HOME/WAYNE/.EMACS
WED JUL 02 2003 13:59:44     230 M.C -/-RW-R--R-- WAYNE    WAYNE     50452  /HOME/WAYNE/.BASH_PROFILE
                446 ..C -/-RW------- ROOT/WROOT ROOT      80419  /ETC/GROUP-
                372 ..C -/-RW------- ROOT/WROOT ROOT      82661  /ETC/GSHADOW-
               3394 MAC -/-RW-R--R-- WAYNE    WAYNE     50454  /HOME/WAYNE/.SCREENRC
                124 M.C -/-RW-R--R-- WAYNE    WAYNE     50453  /HOME/WAYNE/.BASHRC
                382 M.C -/-R-------- ROOT/WROOT ROOT      82666  /ETC/GSHADOW
                459 M.C -/-RW-R--R-- ROOT/WROOT ROOT      82648  /ETC/GROUP
                 24 M.C -/-RW-R--R-- WAYNE    WAYNE     50451  /HOME/WAYNE/.BASH_LOGOUT
                700 M.C -/-RW-R--R-- ROOT/WROOT ROOT      82664  /ETC/PASSWD.OLD
WED JUL 02 2003 13:59:45       0 M.C -/-RW-R--R-- ROOT/WROOT ROOT      82660  /ETC/SYSCONFIG/DESKTOP
                870 M.C -/-RW-R--R-- ROOT/WROOT ROOT      80178  /ETC/LOCALTIME
                 44 M.C -/-RW-R--R-- ROOT/WROOT ROOT      82103  /ETC/SYSCONFIG/CLOCK
WED JUL 02 2003 13:59:48      34 M.. -/-RW-R--R-- ROOT/WROOT ROOT      82662  /ETC/CONF.MODULES~
                 38 M.C -/-RW-R--R-- ROOT/WROOT ROOT      81639  /ETC/SYSCONFIG/PCMCIA
WED JUL 02 2003 14:00:03     160 M.. -/-RW-R--R-- ROOT/WROOT ROOT      82665  /ETC/LILO.CONF.RPMSAVE
WED JUL 02 2003 14:00:04     512 M.C -/-RW-R--R-- ROOT/WROOT ROOT      50456  /BOOT/BOOT.0300
```

THE INSTALLATION CONTINUES

```
WED JUL 02 2003 16:02:00       9 MAC -/-RW------- ROOT/WROOT ROOT     145916  /VAR/SPOOL/ANACRON/CRON.DAILY
                4096 M.C D/DRWXR-XR-X ROOT/WROOT ROOT     144586  /VAR/SPOOL/ANACRON
WED JUL 02 2003 16:02:01     380 MAC -/-RW-R--R-- ROOT/WROOT ROOT      98810  /VAR/LIB/LOGROTATE.STATUS
                4096 M.C D/DRWXR-XR-X ROOT/WROOT ROOT      96193  /VAR/LIB
WED JUL 02 2003 16:02:02    6057 .A. -/-RW-R--R-- ROOT/WROOT ROOT     160534  /USR/MAN/MAN1/TACK.1.GZ
                2145 .A. -/-RW-R--R-- ROOT/WROOT ROOT     160522  /USR/MAN/MAN1/MKTEMP.1.GZ
                1480 .A. -/-RW-R--R-- ROOT/WROOT ROOT     160533  /USR/MAN/MAN1/INFOTOCAP.1M.GZ
```

THE INSTALLATION COMPLETES

```
WED JUL 02 2003 16:04:42  261409 M.C -/-RW-R----- ROOT/WROOT SLOCATE  82741  /VAR/LIB/SLOCATE/SLOCATE.DB
              261409 M.C -/-RW-R----- ROOT/WROOT SLOCATE  82741  /VAR/LIB/SLOCATE/SLOCATE.DB.TMP (DELETED-REALLOC)
                4096 M.C D/DRWXR-X--- ROOT/WROOT SLOCATE  80600  /VAR/LIB/SLOCATE
```

THE FAKE IDENT SERVICE IS INSTALLED

```
THU JUL 03 2003 01:08:48     405 M.C -/-RWXR-XR-X ROOT/WROOT ROOT      66712  /TMP/FAKEIDENTD-1.2/FAKEIDENTD
               12412 M.C -/-RWXR-XR-X ROOT/WROOT ROOT      66711  /TMP/FAKEIDENTD-1.2/IDENTD.C
THU JUL 03 2003 01:08:49    1771 M.C -/-RWXR-XR-X ROOT/WROOT ROOT      66713  /TMP/FAKEIDENTD-1.2/MAKEFILE
               19027 .A. -/-RWXR-XR-X ROOT/WROOT ROOT      66714  /TMP/FAKEIDENTD-1.2/COPYING
THU JUL 03 2003 01:08:50    1761 MAC -/-RWXR-XR-X ROOT/WROOT ROOT      66717  /TMP/FAKEIDENTD-1.2/MAKEFILE~
                 246 MAC -/-RWXR-XR-X ROOT/WROOT ROOT      66715  /TMP/FAKEIDENTD-1.2/INSTALL
               19027 M.C -/-RWXR-XR-X ROOT/WROOT ROOT      66714  /TMP/FAKEIDENTD-1.2/COPYING
                1905 MAC -/-RWXR-XR-X ROOT/WROOT ROOT      66716  /TMP/FAKEIDENTD-1.2/README
THU JUL 03 2003 01:09:09    7086 .A. -/-RW-R--R-- ROOT/WROOT ROOT     145557  /USR/MAN/MAN8/RPM.8.GZ
                4096 M.C D/DRWXRWXR-X ROOT/WROOT MAN      176760  /VAR/CATMAN/CAT8
THU JUL 03 2003 01:09:12    8783 MAC -/-R--RW-R-- ROOT/WROOT MAN      178936  /VAR/CATMAN/CAT8/RPM.8.GZ
THU JUL 03 2003 01:10:44      20 ..CL/LRWXRWXRWX ROOT/WROOT ROOT      35367  /ETC/RC.D/RC4.D/K25FAKEIDENTD ->
./INIT.D/FAKEIDENTDFS (DELETED)
                4096 M.C D/DRWXR-XR-X ROOT/WROOT ROOT      32357  /ETC/RC.D/RC1.D
               49152 MAC -/-RW-R--R-- ROOT/WROOT ROOT     177697  /VAR/LIB/RPM/PROVIDESINDEX.RPM
               16384 MAC -/-RW-R--R-- ROOT/WROOT ROOT     177699  /VAR/LIB/RPM/CONFLICTSINDEX.RPM
               16384 MAC -/-RW-R--R-- ROOT/WROOT ROOT     177695  /VAR/LIB/RPM/NAMEINDEX.RPM
                4096 M.C D/DRWXR-XR-X ROOT/WROOT ROOT      32359  /ETC/RC.D/RC3.D
                4096 M.C D/DRWXR-XR-X ROOT/WROOT ROOT      16040  /USR/SBIN
                  20 ..C LRWXRWXRWX ROOT/WROOT ROOT      35365  <RH_PARTITION_1.DD-DEAD-35365>
               16384 MAC -/-RW-R--R-- ROOT/WROOT ROOT     177700  /VAR/LIB/RPM/GROUPINDEX.RPM
                  20 ..C LRWXRWXRWX ROOT/WROOT ROOT      35347  <RH_PARTITION_1.DD-DEAD-35347>
                4096 M.C D/DRWXR-XR-X ROOT/WROOT ROOT      32360  /ETC/RC.D/RC4.D
                  20 ..C LRWXRWXRWX ROOT/WROOT ROOT      35367  <RH_PARTITION_1.DD-DEAD-35367>
                  56 MAC -/-RW-R--R-- ROOT/WROOT ROOT      35366  /VAR/TMP/RPM-TMP.82031 (DELETED)
                4096 M.C D/DRWXRWXRWT ROOT/WROOT ROOT      32077  /VAR/TMP
             4136456 MAC -/-RW-R--R-- ROOT/WROOT ROOT     177694  /VAR/LIB/RPM/PACKAGES.RPM
               16384 MAC -/-RW-R--R-- ROOT/WROOT ROOT     177701  /VAR/LIB/RPM/TRIGGERINDEX.RPM
                  56 MAC -RW-R--R-- ROOT/WROOT ROOT      35366  <RH_PARTITION_1.DD-DEAD-35366>
                4096 M.C D/DRWXR-XR-X ROOT/WROOT ROOT      32361  /ETC/RC.D/RC5.D
               49152 MAC -/-RW-R--R-- ROOT/WROOT ROOT     177698  /VAR/LIB/RPM/REQUIREDBY.RPM
             1343488 MAC -/-RW-R--R-- ROOT/WROOT ROOT     177696  /VAR/LIB/RPM/FILEINDEX.RPM
                  20 ..CL/LRWXRWXRWX ROOT/WROOT ROOT      35347  /ETC/RC.D/RC5.D/S80FAKEIDENTD -> ../INIT.D/FAKEIDENTDEYTABLE
(DELETED)
                  20 ..CL/LRWXRWXRWX ROOT/WROOT ROOT      35347  /ETC/RC.D/RC6.D/K83YPBIND -> ../INIT.D/FAKEIDENTD (DELETED)
THU JUL 03 2003 01:12:38    4096 M.C D/DRWXR-XR-X ROOT/WROOT ROOT     112229  /SBIN
                3078 M.C -/-RW-R--R-- ROOT/WROOT ROOT      81436  /ETC/INETD.CONF
THU JUL 03 2003 01:39:44      96 M.C -/-RW-R--R-- ROOT/WROOT ROOT      82656  /ETC/HOSTS
THU JUL 03 2003 01:51:21       0 ..C SRW-RW-RW- ROOT/WROOT ROOT      35360  <RH_PARTITION_1.DD-DEAD-35360>
                   0 ..C -/SRW-RW-RW- ROOT/WROOT ROOT      35360  /USR/LIB/LIBZ.SO.1.1.3-RPMDELETE (DELETED)
THU JUL 03 2003 02:18:55    1771 .A. -/-RWXR-XR-X ROOT/WROOT ROOT      66713  /TMP/FAKEIDENTD-1.2/MAKEFILE
               12412 .A. -/-RWXR-XR-X ROOT/WROOT ROOT      66711  /TMP/FAKEIDENTD-1.2/IDENTD.C
THU JUL 03 2003 02:18:57    4096 M.. D/DRWXR-XR-X ROOT/WROOT ROOT      66708  /TMP/FAKEIDENTD-1.2
                4096 M.. -/DRWXR-XR-X ROOT/WROOT ROOT      66708  /USR/MAN/MAN6/BANNER.6.GZ-RPMDELETE (DELETED-REALLOC)
THU JUL 03 2003 02:18:58   20113 M.C -/-RWXR-XR-X ROOT/WROOT ROOT     114842  /SBIN/IDENTD
```

```
27 M.C L/LRWXRWXRWX ROOT/WROOT ROOT 35346 /ETC/RC.D/RC5.D/K83YPBIND -> /ETC/RC.D/INIT.D/FAKEIDENTD
(DELETED-REALLOC)
405 M.C -/-RWXR-XR-X ROOT/WROOT ROOT 162686 /ETC/RC.D/INIT.D/FAKEIDENTD
20113 MAC -/-RWXR-XR-X ROOT/WROOT ROOT 66718 /TMP/FAKEIDENTD-1.2/IDENTD
405 .A. -/-RWXR-XR-X ROOT/WROOT ROOT 66712 /TMP/FAKEIDENTD-1.2/FAKEIDENTD
9 M.C -/-RW-R--R-- ROOT/WROOT ROOT 82742 /ETC/IDENTUSER
9 MAC -/-RW-R--R-- ROOT/WROOT ROOT 66719 /TMP/FAKEIDENTD-1.2/IDENTUSER
4096 M.C D/DRWXR-XR-X ROOT/WROOT ROOT 160653 /ETC/RC.D/RC0.D
4096 M.C D/DRWXR-XR-X ROOT/WROOT ROOT 32362 /ETC/RC.D/RC6.D
4096 M.C D/DRWXR-XR-X ROOT/WROOT ROOT 32358 /ETC/RC.D/RC2.D
27 M.C L/LRWXRWXRWX ROOT/WROOT ROOT 35346 /ETC/RC.D/RC3.D/S80FAKEIDENTD -> /ETC/RC.D/INIT.D/FAKEIDENTDNA
(DELETED-REALLOC)
4096 M.C D/DRWXR-XR-X ROOT/WROOT ROOT 160652 /ETC/RC.D/INIT.D
27 M.C L/LRWXRWXRWX ROOT/WROOT ROOT 162687 /ETC/RC.D/RC0.D/K45FAKEIDENTD -> /ETC/RC.D/INIT.D/FAKEIDENTD
27 M.C L/LRWXRWXRWX ROOT/WROOT ROOT 35346 /ETC/RC.D/RC6.D/K45FAKEIDENTD -> /ETC/RC.D/INIT.D/FAKEIDENTD
M.C 35345 /ETC/RC.D/RC2.D/S45FAKEIDENTD -> /ETC/RC.D/INIT.D/FAKEIDENTDN Ã‘
27 M.C L/LRWXRWXRWX ROOT/WROOT ROOT 35345 /ETC/RC.D/RC4.D/K83YPBIND -> /ETC/RC.D/INIT.D/FAKEIDENTD
(DELETED-REALLOC)
```

USER "WAYNE "'S SETTINGS ARE MODIF IED

```
SAT JUL 05 2003 01:10:31 124 .A. -/-RW-R--R-- WAYNE WAYNE 50453 /HOME/WAYNE/.BASHRC
230 .A. -/-RW-R--R-- WAYNE WAYNE 50452 /HOME/WAYNE/.BASH_PROFILE
19 .A. -/-RW------- WAYNE WAYNE 50690 /VAR/SPOOL/MQUEUE/QFPAA00987 (DELETED-REALLOC)
19 .A. -/-RW------- WAYNE WAYNE 50690 /HOME/WAYNE/.BASH_HISTORY
194394 .A. -/-RW-R--R-- ROOT/WROOT ROOT 50690 /VAR/LOCK/SUBSYS/XFS (DELETED-REALLOC)
SAT JUL 05 2003 01:11:27 4096 M.C D/DRWXR-X--- ROOT/WROOT ROOT 96198 /ROOT
SAT JUL 05 2003 01:11:51 19 M.C -/-RW------- WAYNE WAYNE 50690 /HOME/WAYNE/.BASH_HISTORY
19 M.C -/-RW------- WAYNE WAYNE 50690 /VAR/SPOOL/MQUEUE/QFPAA00987 (DELETED-REALLOC)
24 .A. -/-RW-R--R-- WAYNE WAYNE 50451 /HOME/WAYNE/.BASH_LOGOUT
194394 M.C -/-RW-R--R-- ROOT/WROOT ROOT 50690 /VAR/LOCK/SUBSYS/XFS (DELETED-REALLOC)
```

Someone accesses and modifies the passwd and shadow files (possibly using vi or a similar editor – "shadow~" and "passwd~" are created)

```
Sat Jul 05 2003 01:15:35 717 m.. -/-r------- root/wroot root 82321 /etc/shadow-
Sat Jul 05 2003 01:17:47 24 .a. -/-rw-r--r-- root/wroot root 98337 /root/.bash_logout
Sat Jul 05 2003 01:19:54 799 m.. -/-rw-r--r-- root/wroot root 80509 /etc/passwd-
Sat Jul 05 2003 01:20:34 775 m.c -/-r------- root/wroot root 82745 /etc/shadow
799 .ac -/-rw-r--r-- root/wroot root 80509 /etc/passwd-
799 m.c -/-rw-r--r-- root/wroot root 82655 /etc/passwd
717 ..c -/-r------- root/wroot root 82321 /etc/shadow-
Sat Jul 05 2003 02:03:34 8 m.c -/-rw-r--r-- root/wroot root 82667 /etc/HOSTNAME
```

TRIPWIRE IS INSTALLED

```
SAT JUL 05 2003 03:23:57 14031 M.C -/-R--R--R-- ROOT/WROOT ROOT 2583 /TMP/LINUX_X86/LICENSE.TXT
29648 M.C -/-R--R--R-- ROOT/WROOT ROOT 2585 /TMP/LINUX_X86/RELEASE_NOTES
3778320 .A. -/-RXR-XR-X ROOT/WROOT ROOT 145926 /TMP/LINUX_X86/BIN/SIGGEN
8337 M.C -/-R--R--R-- ROOT/WROOT ROOT 2584 /TMP/LINUX_X86/README
```

Various files including "lame1" are accessed.

```
Sat Jul 05 2003 06:12:09 3460 .a. -/-rw-r--r-- root/wroot root 97239 /lib/modules/2.2.14-5.0/fs/nls_iso8859-1.o
45405 .a. -/-rw-r--r-- root/wroot root 97214 /lib/modules/2.2.14-5.0/fs/fat.o
5172 .a. -/-rw-r--r-- root/wroot root 97223 /lib/modules/2.2.14-5.0/fs/nls_cp437.o
15741 .a. -/-rw-r--r-- root/wroot root 97256 /lib/modules/2.2.14-5.0/fs/vfat.o
28633 .a. -/-rw-r--r-- root/wroot root 82668 /lib/modules/2.2.14-5.0/modules.dep
Sat Jul 05 2003 06:12:46 95547 .a. -/-rw-r--r-- root/wroot root 162903 /tmp/lame1
Sat Jul 05 2003 06:13:08 63 .a. -/-rw-r--r-- root/wroot root 162683 /tmp/identdV
Sat Jul 05 2003 06:13:25 90 mac -/-rw-r--r-- root/wroot root 82766 /etc/mtab
4096 m.c d/drwxr-xr-x root/wroot root 80161 /etc
90 mac -/-rw-r--r-- root/wroot root 82766 /etc/mtab.tmp (deleted-realloc)
```

THE KNARK ROOTKIT IS EXTRACTED .

```
SAT JUL 05 2003 06:23:21 14975 MAC -/-RWXR-XR-X ROOT/WROOT ROOT 66729 /TMP/.../KNARK-0.59/REXEC
1644 MAC -/-RW-R--R-- ROOT/WROOT ROOT 2604 /TMP/.../KNARK-0.59/SRC/ROOTME.O
3530 MAC -/-RW-R--R-- ROOT/WROOT ROOT 2600 /TMP/.../KNARK-0.59/SRC/REXEC.C
4096 M.C D/DRWXR-XR-X ROOT/WROOT ROOT 2592 /TMP/.../KNARK-0.59/SRC
```

The tools.tar and tools2.tar files are copied onto the system .

```
Sat Jul 05 2003 06:47:39 1427 .a. -/-rw-r--r-- root/wroot root 178933 /tmp/.../knark-0.50/Makefile
Sat Jul 05 2003 07:03:18 3788800 m.. -/-rw-r--r-- wayne wayne 162927 /tmp/.../tools.tar
Sat Jul 05 2003 07:03:29 92160 m.. -/-rw-r--r-- wayne wayne 162920 /tmp/.../tools2.tar
Sat Jul 05 2003 07:04:24 92160 ..c -/-rw-r--r-- wayne wayne 162920 /tmp/.../tools2.tar
3788800 ..c -/-rw-r--r-- wayne wayne 162927 /tmp/.../tools.tar
```

The files are extracted (from the lack of time between the completion of the "kis"

extraction, and "tools2.tar" being extracted, these were likely done with a single command, .)

```
Sat Jul 05 2003 07:05:07  3788800 .a. -/-rw-r--r-- wayne    wayne    162927   /tmp/.../tools.tar
Sat Jul 05 2003 07:05:24     4217 ..c -/-rw-r--r-- 1001     1001     162970   /tmp/.../USAGE.TXT
                            28998 .ac -/-rw-r--r-- 1001     1001     162969   /tmp/.../kis_server-0.9.tar.gz
                            92160 .a. -/-rw-r--r-- wayne    wayne    162920   /tmp/.../tools2.tar
```

LRK IS EXTRACTED FROM TOOLS2.TAR

```
SAT JUL 05 2003 07:12:03   18571 MAC -/-RWXR-XR-X ROOT/WROOT ROOT    130940  /TMP/.../LRK4/FIX
SAT JUL 05 2003 07:12:04   13496 MAC -/-RWXR-XR-X ROOT/WROOT ROOT    130941  /TMP/.../LRK4/Z2
SAT JUL 05 2003 07:12:05   15608 MAC -/-RWXR-XR-X ROOT/WROOT ROOT    130942  /TMP/.../LRK4/WTED
SAT JUL 05 2003 07:12:21       0 MAC -/-RW------- ROOT/WROOT ROOT    130944  /TMP/.../LRK4/.LINSNIFFER.C.SWX (DELETED)
```

The kis tar file is extracted

```
Sat Jul 05 2003 07:14:45  256000 ..c -/-rw-r--r-- 1001     1001     162971   /tmp/.../kis_client-0.9.tar
Sat Jul 05 2003 07:15:01   17992 .a. -/-rw-r--r-- wayne    wayne    179003   /tmp/.../kis_client-0.9/COPYING
                               0 .a. -/-rw-rw-r-- wayne    wayne    179002   /tmp/.../kis_client-0.9/AUTHORS
                             528 .a. -/-rw-rw-r-- wayne    wayne    179012   /tmp/.../kis_client-0.9/config.h.in
```

TOOLS3.TAR IS UPLOADED ONTO THE SYSTEM .

```
SAT JUL 05 2003 07:26:31 3788800 M.. -/-RW-R--R-- WAYNE   WAYNE    162968  /TMP/../TOOLS3.TAR
```

TOOLS3.TAR IS CHANGED , POSSIBLY MOVED INTO THE CURRENT DIRECTO RY, AND THEN EXTRACTED .

```
SAT JUL 05 2003 07:28:29 3788800 ..C -/-RW-R--R-- WAYNE   WAYNE    162968  /TMP/../TOOLS3.TAR
SAT JUL 05 2003 07:28:41    1732 .A. -/-RW------- ROOT/WROOT ROOT  178982  /TMP/../LRK4/NET-TOOLS-1.32-ALPHA/LIB/IPX_GR.C
                            6240 .A. -/-RW-R--R-- ROOT/WROOT ROOT  50711   /TMP/.../LRK4/FILEUTILS-3.13/INTL/CAT-COMPAT.C
```

THE TIMELINE ONLY REF LECTS THE MOST RECEN T TIME CHANGE FOR EA CH FILE . THE SECURE AND XFERLOG W ERE UPDATED WITH EAC H UPLOAD , AND THIS IS SIMPLY THE MOST RECENT . HERE THE SECURE AND X FERLOG ARE UPDATED , FROM THE UPLOAD OF TOOLS4.TAR .

```
SAT JUL 05 2003 07:29:59   31062 M.C -/-RW------- ROOT/WROOT ROOT  114780  /VAR/LOG/SECURE
SAT JUL 05 2003 07:30:39     863 M.C -/-RW------- ROOT/WROOT ROOT  114834  /VAR/LOG/XFERLOG
                           51200 M.. -/-RW-R--R-- WAYNE   WAYNE    162973  /TMP/.../TOOLS4.TAR
SAT JUL 05 2003 07:31:15   51200 ..C -/-RW-R--R-- WAYNE   WAYNE    162973  /TMP/.../TOOLS4.TAR
```

Tools4.tar is extracted. Although the tar access appears fourth in this list, they all occur in the same second.

```
Sat Jul 05 2003 07:31:30     616 .ac -/-rw-r--r-- wayne    wayne    146101   /tmp/.../adore/CVS/Entries
                             199 ..c -/-rwxr-xr-x wayne    wayne    82822    /tmp/.../adore/startadore
                               6 .ac -/-rw-r--r-- wayne    wayne    146100   /tmp/.../adore/CVS/Repository
                           51200 .a. -/-rw-r--r-- wayne    wayne    162973   /tmp/.../tools4.tar
                            4179 ..c -/-rw-r--r-- wayne    wayne    82816    /tmp/.../adore/ava.c
                            4096 ..c d/drwxr-xr-x wayne    wayne    146098   /tmp/.../adore/CVS
                            1979 ..c -/-rw-r--r-- wayne    wayne    82817    /tmp/.../adore/cleaner.c
                              21 .ac -/-rw-r--r-- wayne    wayne    82814    /tmp/.../adore/TODO
                            4096 m.. d/drwxr-xr-x 30       root     162678   /tmp/...
                             738 .ac -/-rw-r--r-- wayne    wayne    82812    /tmp/.../adore/Makefile.gen
                            2527 ..c -/-rw-r--r-- wayne    wayne    82821    /tmp/.../adore/libinvisible.h
                            2810 ..c -/-rwxr-xr-x wayne    wayne    82818    /tmp/.../adore/configure
                              10 .ac -/-rw-r--r-- wayne    wayne    146102   /tmp/.../adore/CVS/Tag
                            1904 .ac -/-rw-r--r-- wayne    wayne    82819    /tmp/.../adore/dummy.c
                            2632 ..c -/-rw-r--r-- wayne    wayne    82813    /tmp/.../adore/README
                               5 .ac -/-rw-r--r-- wayne    wayne    146099   /tmp/.../adore/CVS/Root
                           10757 ..c -/-rw-r--r-- wayne    wayne    82815    /tmp/.../adore/adore.c
                            1660 .ac -/-rw-r--r-- wayne    wayne    82811    /tmp/.../adore/LICENSE
                            3262 ..c -/-rw-r--r-- wayne    wayne    82820    /tmp/.../adore/libinvisible.c
                            4096 m.. l/drwxr-xr-x 30       root     162678   /etc/rc.d/rc0.d/K83ypbind (deleted-realloc)
```

THE ADORE ROOTKIT IS COMP ILED

```
SAT JUL 05 2003 07:32:46     516 M.C -/-RW-R--R-- ROOT/WROOT ROOT  82823  /TMP/.../ADORE/MAKEFILE
                            2810 .A. -/-RWXR-XR-X WAYNE   WAYNE    82818  /TMP/.../ADORE/CONFIGURE
SAT JUL 05 2003 07:35:08   10757 .A. -/-RW-R--R-- WAYNE   WAYNE    82815  /TMP/.../ADORE/ADORE.C
                             516 .A. -/-RW-R--R-- ROOT/WROOT ROOT  82823  /TMP/.../ADORE/MAKEFILE
SAT JUL 05 2003 07:35:13    5132 M.C -/-RW-R--R-- ROOT/WROOT ROOT  82824  /TMP/.../ADORE/ADORE.O
                            4179 .A. -/-RW-R--R-- WAYNE   WAYNE    82816  /TMP/.../ADORE/AVA.C
```

And cleans up after itself

```
Sat Jul 05 2003 07:35:16       0 ..c -rw------ root/wroot root     162978   <RH_Partition_1.dd-dead-162978>
                               0 ..c -rw------ root/wroot root     162977   <RH_Partition_1.dd-dead-162977>
                            1979 .a. -/-rw-r--r-- wayne    wayne    82817    /tmp/.../adore/cleaner.c
                            1572 .ac -rw-r--r-- root/wroot root     162976   <RH_Partition_1.dd-dead-162976>
                               0 .ac -/-rw-r--r-- root/wroot root     162979   /tmp/cc4EAwgS.ld (deleted)
                            3516 .ac -/-rw-r--r-- root/wroot root     162975   /tmp/cchVZpX0.o (deleted)
                           14755 m.c -/-rwxr-xr-x root/wroot root     82825    /tmp/.../adore/ava
                               0 ..c -/-rw------- root/wroot root     162977   /tmp/cc4cOvd4.c (deleted)
                            3516 .ac -rw-r--r-- root/wroot root     162975   <RH_Partition_1.dd-dead-162975>
                            1572 .ac -/-rw-r--r-- root/wroot root     162976   /tmp/ccw7Y6RP.o (deleted)
                            4096 m.c d/drwxr-xr-x 30       root     82810    /tmp/.../adore
                            1084 m.c -/-rw-r--r-- root/wroot root     82826    /tmp/.../adore/cleaner.o
                            1002 mac -/-rw------- root/wroot root     162974   /tmp/ccgkurtN.s (deleted)
                               0 .ac -rw-r--r-- root/wroot root     162979   <RH_Partition_1.dd-dead-162979>
                            1002 mac -rw------- root/wroot root     162974   <RH_Partition_1.dd-dead-162974>
                               0 ..c -/-rw------- root/wroot root     162978   /tmp/ccOSSJfY.o (deleted)
```

THE ADORE README FILE IS ACCESSED .

```
SAT JUL 05 2003 07:37:54    2632 .A. -/-RW-R--R-- WAYNE    WAYNE    82813    /TMP/.../ADORE/README
```

THE ENTIRE "/TMP/.../" DIRECTORY IS ACCESSED, POSSIBLY THROUGH A "FIND ." OR SIMILAR COMMAND .

```
SAT JUL 05 2003 07:38:41    4096 .A. D/DRWXR-XR-X WAYNE    WAYNE    146098   /TMP/../ADORE/CVS
                            4096 .A. D/DRWXR-XR-X ROOT/WROOT ROOT    50717    /TMP/.../LRK4/CRON3.0PL1
                            4096 .A. D/DRWXR-XR-X ROOT/WROOT ROOT    146071   /TMP/../LRK4/FINDUTILS/TESTSUITE/XARGS.SYSV
                            4096 .A. -/DRWXR--R-- ROOT/WROOT ROOT    82743    /ETC/MTAB~ (DELETED-REALLOC)
                            4096 .A. D/DRWXR-XR-X ROOT/WROOT ROOT    146042   /TMP/../LRK4/FINDUTILS/TESTSUITE
                            4096 .A. D/DRWXR-XR-X ROOT/WROOT ROOT    66730    /TMP/.../LRK4/FILEUTILS-3.13/SRC
                            4096 .A. D/DRWXRWXRWX WAYNE    WAYNE    146087   /TMP/.../KIS_CLIENT-0.9/SRC
                            4096 .A. D/DRWXR-XR-X ROOT/WROOT ROOT    66740    /TMP/.../LRK4/PROCPS-1.01
                            4096 .A. D/DRWXR--R-- ROOT/WROOT ROOT    145990   /TMP/.../LRK4/RSHD
                            4096 .A. D/DRWXR-XR-X ROOT/WROOT ROOT    145993   /TMP/../LRK4/SHADOW-961025
                            4096 .A. D/DRWXR-XR-X ROOT/WROOT ROOT    130850   /TMP/../LRK4
                            4096 .A. D/DRWXR--R-- ROOT/WROOT ROOT    145918   /TMP/.../LRK4/CHFN
                            4096 .A. D/DRWXR--R-- ROOT/WROOT ROOT    82743    /TMP/.../LRK4/INETD
```

CRON IS UPDATED .

```
SAT JUL 05 2003 07:40:00    14394 M.C -/-RW------- ROOT/WROOT ROOT    114838   /VAR/LOG/CRON
```

ADORE IS STARTED.

```
SAT JUL 05 2003 07:40:55      199 .A. -/-RWXR-XR-X WAYNE    WAYNE    82822    /TMP/.../ADORE/STARTADORE
                             1084 .A. -/-RW-R--R-- ROOT/WROOT ROOT    82826    /TMP/.../ADORE/CLEANER.O
                             5132 .A. -/-RW-R--R-- ROOT/WROOT ROOT    82824    /TMP/.../ADORE/ADORE.O
```

THE ADORE "AVA" FUNCTION IS USED , WHICH ACCESSES THE "/TMP/.../" DIRECTORY , POSSIBLY TO HIDE IT FROM THE USER , WHICH IS PART OF ADORE'S FUNCTIONALITY .

```
SAT JUL 05 2003 07:41:15    14755 .A. -/-RWXR-XR-X ROOT/WROOT ROOT    82825    /TMP/.../ADORE/AVA
                             4096 ..CL/DRWXR-XR-X 30       ROOT     162678   /ETC/RC.D/RC0.D/K83YPBIND (DELETED-REALLOC)
                             4096 ..CD/DRWXR-XR-X 30       ROOT     162678   /TMP/...
SAT JUL 05 2003 07:41:41    4096 .A. L/DRWXR-XR-X 30       ROOT     162678   /ETC/RC.D/RC0.D/K83YPBIND (DELETED-REALLOC)
                             4096 .A. D/DRWXR-XR-X 30       ROOT     162678   /TMP/...
```

TRIPWIRE IS EXECUTED , AND ACCESSES MULTIPLE FILES .

```
SAT JUL 05 2003 07:44:12  5554608 .A. -/-R-X------ ROOT/WROOT ROOT    145959   /USR/LOCAL/TRIPWIRE/TFS/BIN/TRIPWIRE
SAT JUL 05 2003 07:44:14  3778320 .A. -/-R-X------ ROOT/WROOT ROOT    145958   /USR/LOCAL/TRIPWIRE/TFS/BIN/SIGGEN
SAT JUL 05 2003 07:44:17  4971792 .A. -/-R-X------ ROOT/WROOT ROOT    145960   /USR/LOCAL/TRIPWIRE/TFS/BIN/TWADMIN
SAT JUL 05 2003 07:44:19       14 .A. L/LRWXRWXRWX ROOT/WROOT ROOT    145269   /USR/BIN/MAIL -> ../../BIN/MAIL
                             4096 .A. D/DRWXR-X--- ROOT/WROOT ROOT    145955   /USR/LOCAL/TRIPWIRE/TFS/DB
                            16384 .A. D/DRWXR-XR-X ROOT/WROOT ROOT    144293   /USR/BIN
                               12 .A. L/LRWXRWXRWX ROOT/WROOT ROOT    144294   /USR/BIN/X11 -> ../X11R6/BIN
                          4494064 .A. -/-R-X------ ROOT/WROOT ROOT    145961   /USR/LOCAL/TRIPWIRE/TFS/BIN/TWPRINT
                             6125 .A. -/-RWXR-XR-X ROOT/WROOT ROOT    145700   /USR/BIN/RNMAIL
                             4586 .A. -/-RW-R----- ROOT/WROOT ROOT    145979   /USR/LOCAL/TRIPWIRE/TFS/BIN/TW.CFG
                            12642 .A. -/-RWXR-XR-X ROOT/WROOT ROOT    145699   /USR/BIN/PNEWS
                              931 .A. -/-RW-R----- ROOT/WROOT ROOT    145976   /USR/LOCAL/TRIPWIRE/TFS/KEY/SITE.KEY
                             4096 .A. D/DRWXR-X--- ROOT/WROOT ROOT    145956   /USR/LOCAL/TRIPWIRE/TFS/KEY
                             8287 .A. -/-RW-R--R-- ROOT/WROOT ROOT    178943   /USR/LOCAL/TRIPWIRE/TFS/POLICY/TW.POL
                                4 .A. L/LRWXRWXRWX ROOT/WROOT ROOT    145004   /USR/BIN/[ -> TEST
                             4096 .A. D/DRWXR-XR-X ROOT/WROOT ROOT    64136    /USR/LOCAL/BIN
                              931 .A. -/-RW-R----- ROOT/WROOT ROOT    145977   /USR/LOCAL/TRIPWIRE/TFS/KEY/REDHAT6-LOCAL.KEY
                             1260 .A. -/-RWXR-XR-X ROOT/WROOT ROOT    144907   /USR/BIN/.GITACTION
```

The Tripwire report is created.

```
Sat Jul 05 2003 07:49:10       96 .a. -/-rw-r--r-- root/wroot root     82656    /etc/hosts
                             4096 m.c d/drwxr-x--- root/wroot root     145954   /usr/local/tripwire/tfs/report
                             8238 .a. -/-rw-r--r-- root/wroot root     146103   /usr/local/tripwire/tfs/report/redhat6-20030705-194328.twr
Sat Jul 05 2003 07:49:11     8238 m.c -/-rw-r--r-- root/wroot root     146103   /usr/local/tripwire/tfs/report/redhat6-20030705-194328.twr
```

```
THE SYSTEM IS SHUTDOWN.
Sat Jul 05 2003 07:49:31      5 mac -/-rw-r--r-- root/wroot root    18729  /var/run/shutdown.pid (deleted)
              25968 .a. -/-rwxr-xr-x root/wroot root    112446  /sbin/init
              14128 .a. -/-rwxr-xr-x root/wroot root    112452  /sbin/shutdown
                  5 mac -rw-r--r-- root/wroot root    18729  <RH_Partition_1.dd-dead-18729>
                  0 m.c f/frw------- root/wroot root    32307  /dev/initctl
Sat Jul 05 2003 07:49:32     60 .a. -/-rw------- root/wroot root    82669  /etc/ioctl.save
                  0 .a. f/frw------- root/wroot root    32307  /dev/initctl
               1756 .a. -/-rw-r--r-- root/wroot root    81443  /etc/inittab

Sat Jul 05 2003 07:50:01    229248 m.c -/-rw-rw-r-- root/wroot utmp    113169  /var/log/wtmp
              340663 .a. -/-rwxr-xr-x root/wroot root    144301  /lib/ld-2.1.3.so
               75600 .a. -/-rwxr-xr-x root/wroot root    144569  /bin/grep
                6096 .a. -/-r-xr-xr-x root/wroot root    114744  /sbin/quotaon
                 456 .a. -/-rw-r--r-- root/wroot root    82375  /etc/fstab
                8128 .a. -/-rwxr-xr-x root/wroot root    112447  /sbin/killall5
                   6 .a. l/lrwxrwxrwx root /wroot root    114051  /sbin/swapoff -> swapon B
             4101324 .a. -/-rwxr-xr-x root/wroot root    144308  /lib/libc-2.1.3.so
                3260 .a. -/-rwxr-xr-x root/wroot root    161660  /etc/rc.d/init.d/halt
              527442 .a. -/-rwxr-xr-x root/wroot root    144319  /lib/libm-2.1.3.so
                   7 .a. l/lrwxrwxrwx root /wroot root    114743  /sbin/quotaoff -> quotaon
               56208 .a. -/-rwsr-xr-x root/wroot root    145325  /bin/mount
                  13 .a. l/lrwxrwxrwx root /wroot root    144309  /lib/libc.so.6 -> libc-2.1.3.so
              148848 .a. -/-rwxr-xr-x root/wroot root    144861  /bin/gawk-3.0.4
                  11 .a. l/lrwxrwxrwx root /wroot root    144302  /lib/ld-linux.so.2 -> ld-2.1.3.so
                   4 .a. l/lrwxrwxrwx root /wroot root    144873  /bin/awk -> gawkH B
               12247 .a. -/-rw-r--r-- root/wroot root    82738  /etc/ld.so.cache
                  13 .a. l/lrwxrwxrwx root /wroot root    144320  /lib/libm.so.6 -> libm-2.1.3.so
                6896 .a. -/-rwxr-xr-x root/wroot root    112445  /sbin/halt
              148848 .a. -/-rwxr-xr-x root/wroot root    144861  /bin/gawk
                6200 .a. -/-rwxr-xr-x root/wroot root    114048  /sbin/swapon
```

Recover Deleted Files

The search for deleted files was conducted in Autopsy Forensic Browser, version 1.62. The dd image file was still listed in the Autopsy "fsmorgue" file from earlier investigation. Autopsy was started, using the command "./autopsy 8888 localhost &". The "File Browsing" option was selected once Autopsy was started. The RH_Partition_1.dd file was then selected, being the extract of partition 1 from the dd of the entire drive. "Begin analysis" was then chosen. From this file browser window, "All Deleted Files" was chosen. This lists all deleted files on the system, along with their MAC times, sizes, UID and GID, and the inode they occupy (or occupied if it has been reallocated.) No suspect deleted files were found on the system, although a directory, "/jonty" was found. This directory turned out to contain files for "Tripwire for Servers 3.0".

String Search

Various groups of keywords were searched for. The Encase tool was used for this search, as it has a user friendly ability to search for multiple key words at once.

"hacker speak", ("r00t*", "h4x0r", "0wn*", "l33t", "gr33t*", "greet*", 666, 12345, 31337)
These are terms commonly used by malicious intruders. Vowels (and other letters) are commonly replaced by numbers. This may be to obfuscate the writing, so that people uninitiated into the practise will be unable to read the text. This is a rather weak explanation as the numbers are chosen to resemble their letter counterparts. They also have the advantage of being able to bypass some content checkers, that check for known text strings. “Greet” is commonly used in exploit code and viruses to

acknowledge other "black-hat" computer intruders. The number 666 is a biblical reference to the devil, and commonly used as a port number (or 6666 – being an ephemeral port ie one over 1024), but this would also be detected by the "666" string search. 12345 is another such number, used self conciously as it is so predictable. 31337 is more numbers replace by letters. The 3 is the letter "e", the 1 is an "L", and the 7 is a "t". The word eleet is a deliberate misspelling of "elite", being a skilled member of a small group of computer coders.

profanity, ("fuck", "shit")
Profanity is commonly used in malicious code, and infrequently used in open-source or production code. It is therefore useful and indicitive of a computer being misused.

intrusion terms ("rootkit", "hack", "sniff", "adore", "LKM", "backdoor")
These are terms commonly associated with computer intrusion tools. The tools often contain README files that de scribe their funtionality, and will likely contain these terms.

"r00t" was found in the lrk4 README file, as well as tools and tools3.tar (and various unallocated clusters.) These tools had already been located through a hidden directory search.

"0WN" WAS FOUND IN (/USR/LIB/) LIBSP.A, LIBSPGROVE.A, LIBSTYLE.A, (/USR/MAN/MAN1/) CREATE_SEQUENCE.L.GZ, (/usr/info/) *MAKE.INFO-5.GZ*, (/usr/man/man1/) *YPWHICH.1.GZ*, and (/usr/doc/wu-ftpd-2.6.0) CONTRIBUTORS. These are all usual system files.

"l33t" was found in unallocated clusters, that appear to have previously been part of the "bitchX" irc tool. This tool was not installed on the computer, and may have been installed previously and the hard disk since reformatted.

Although "gr33t" was not found, "greet" was found in 562 places, and not further investigated.

"666" was found in 19,243 places, and not further investigated.

"12345" was found in 4,953 pla ces, and not further investigated.

"fuck" was found in (/usr/share/emacs/20.5/etc/) yow.lines, (/tmp/.../knark-0.59/src/) knarc.c, modhide.c, (/usr/lib/ispell/) americanmed+.hash, americanxlg.hash, britishmed+.hash, britishxlg.hash, (/tmp/linux_x86/libkit/TWagent-libkit/) config.a, (/usr/share/emacs/20.5/lisp/play) doctor.elc (along with a surprising amount of other profanity), (/tmp/.../lrk4/) linsniffer.c, (/tmp/.../) knark.tar, tools.tar, tools3.tar, (/tmp/.../knark-0.50/src/) modhide.c, and (/usr/bin/f ilter/) filter_innd.pl

"shit" triggered in many of the same places as "fuck", although also triggered on "hashit", "Matsushita", "Yamashita", "RefreshItems", "BashIt", and "HIShitpos", all of which occurred multiple times.

"rootkit" occurred in many "/tm p/.../" files.

"hack" occurred in (/usr/doc/cvs -1.10.7/) BUGS, FAQ, NEWS, README, TODO, and cvs.ps. It occurred in over 4000 other places also, and may be unsuitable for a search term due to its generic nature and various usage.

"sniff" was found in many places, including system files and /tmp/.../, as were "adore" and "LKM".

"backdoor" was found in (/usr/share/emacs/20.5/lisp/progmodes/) cperl -mode.elc, (/tmp/lrk4/) README, (/tmp/.../lrk4/inted/) inetd.c, (/tmp/.../adore/) adore.c, libinvisible.c, (/tmp /.../) tools.tar, tools3.tar, and tools4.tar, (/usr/bin/filter/) filter_innd.pl, and (/var/lib/rpm/packages.rpm).

CONCLUSIONS

HYPOTHESIS : THE INTRUDER SCANNED THE SYSTEM USING THE PORT SCANNING TOOL "NESSUS." THE INTRUDER THEN GAI NED ACCESS TO THE MA CHINE. THIS PROBABLY OCCURRED THROUGH A F LAW DISCOVERED BY TH E NESSUS TOOL, POSSIBLY IN THE "FAKEIDENT" PROGRAM (THE VERSION INSTALLE D ON THE COMPUTER IS 1.2, ALL VERSIONS PRIOR TO 1.5 ARE KNOWN TO BE VUL NERABLE TO A BUFFER OVERFLOW ATTACK [xi].)

IT IS ALSO POSSIBLE T HAT THE INTRUDER GUE SSED THE USER ("WAYNE")'S PASSWORD. THE INTRUDER EXPLOITED T HIS ACCESS TO GAIN R OOT ACCESS. THIS ROOT ACCESS WAS USED TO MODIFY THE PASSWD AN D SHADOW FILES, TO INCLUDE NEW USER ACCOUNTS. THESE ACCOUNTS WERE "WRUSER", WITH A UID AND GID OF 666, AND "WROOT" WITH A UID OF 0. THE "WRUSER" ACCOUNT OCCURED IN THE PASSWD FILE TWIC E, ONCE WITH AND ONCE WITHOUT THE "X" INDICATING A SHADOW ED PASSWORD. THIS MAY INDICATE THA T THE PASSWORD FILE WAS MAN UALLY, AND INCORRECTLY, EDITED. TESTS PERFORMED ON OT HER SYSTEMS SHOWED THAT A DOUBLE-UP OF A USER ACCOUNT OF THIS TYPE, WHERE THE "NON-SHADOWED" VERSION OCCURS
FIRST IN THE PASSWD FILE, LEFT THAT USER UNAB LE TO LOG IN. THIS MAY SHOW TH AT THE INTRUDER IS NOT OVER LY FAMILIAR WITH UNI X SYSTEM FILE STRUCT URES. THE INTRUDER THEN UPLOADED SEVERA L LINUX ROOT KITS. ALTHOUGH THESE WERE E XPANDED FROM THE ORIGINAL "TAR" ARCHIVES, ONLY ONE (ADORE) WAS SUCCESSFULLY EX ECUTED. THE INTRUDER ATTEMPTED T O INSTALL THE OTHERS, BUT THE COMPILE MAY HAVE FAILED. THE README FILE FOR "ADORE" WAS ACCESSED BEFORE THE PROGRAM WAS ITS ELF EXECUTED, WHICH MAY SHOW THAT THE INTRUDER IS UNFA MILIAR WITH THIS TOO L. THE "ADORE" ROOTKIT WAS NOT DETE CTED BY THE "CHKROOTKIT" PROGRAM WHICH CHECKS FOR IT SPECIFICALLY, WHICH MAY SHOW THAT THE PROGRAM WAS NOT SET UP TO RUN ON RE BOOT. AS THE COMPUTER WAS P OWERED DOWN WHEN SEI ZED, NO "PROC" INFORMATION WAS AVAILABLE TO TELL IF "ADORE" WAS RUNNING AT THE TIME.

FROM THIS, IT IS LIKEL Y THAT THE INTRUDER IS A NOVICE HACKER. NESSUS IS A NOISY TOO L, WHICH SHOWS MANY ENT RIES IN LOGS. A SOPHISTICATED HACKE R WOULD NOT USE SUCH A TOOL IN THIS WAY. SIMILARLY, THE TOOL AND TOOL 3 ARCHIVE FILES UPLOA DED BY THE INTRUDER CONTAINED T HE SAME INFORMAT ION. THIS WAS A WASTE OF T IME AND BANDWIDTH WHICH MAY SUGGEST THAT THE INT RUDER WAS USING SOME ONE ELSE'S TOOLS, OR JUST RANDOMLY DOW NLOADING THINGS THEY THOUGHT MIGHT WORK. AS SHOWN BY

ACCESSING THE "ADORE" README FILE ON THE COMPROMISED SYSTEM, THE INTRUDER IS NOT FAMILIAR WITH THESE TOOLS ALREADY. AT THE VERY LEAST, A SKILLED INTRUDER WOULD KNOW TO VIEW THE README FILE ON THEIR OWN SYSTEM, IF NOT HAVING IT PRINTED OUT ALREADY.

Legal Issues of Incident Handling

What, if any, information can you provide to the law enforcement officer over the phone during the initial contact?

THE FIRST ISSUE TO CONSIDER IN THIS SITUATION IS ONE OF CONTRACT LAW. THE DETAILS OF THE CONTRACT SIGNED BETWEEN THE INTERNET USER AND THE ISP MAY LIMIT THE INFORMATION THAT THE ISP IS ALLOWED TO KEEP, OR PUBLISH (NOTE, ANY COMMUNICATION TO A THIRD PARTY IS CONSIDERED PUBLICATION, AS HELD IN GODFREY V. DEMON INTERNET LTD., CASE NO. 1998 G NO. 30 (26 MARCH 1999), REPORTED AT: [2000] 3 W.L.R. 1020.) THIS WOULD DEPEND ON THE CONTRACT BETWEEN THE SUBSCRIBER AND THE ISP IN QUESTION, ABOUT WHICH NO INFORMATION IS AVAILABLE HERE. POTENTIALLY THIS COULD RAISE ISSUES SUCH AS THOSE IN A RECENT CASE IN WHICH AN ISP WAS ACCUSED OF BREACHING CONFIDENTIALITY CLAUSES IN A CONTRACT BY INTERCEPTING THEIR CLIENTS' EMAILS[xii]*. THE JUDGE IN THAT CASE DECLINED TO UPHOLD AN INTERIM INJUNCTION REQUIRING THE CLIENT TO CONTINUE DEALING WITH THE ISP, DUE TO THE ISP'S CONTRACTUAL BREACH. THE ISP ARGUED THAT THE CONTRACT EXPRESSLY AUTHORISED MONITORING, BUT THE JUDGE RULED THAT INTERCEPTING AND USING EMAILS IS SO FAR REMOVED FROM THE PRIMARY CONTRACT THAT IT COULD NOT BE CONSIDERED AN IMPLIED TERM OF THAT CONTRACT. THE CASE HERE IS SLIGHTLY DIFFERENT, AS THE THIRD PARTY IS A LAW ENFORCEMENT OFFICIAL.*

THE DISCLOSURE WILL ALSO BE LIMITED BY THE PRIVACY ACT 1993. THIS ACT REQUIRES ANYONE COLLECTING INFORMATION ABOUT SPECIFIC PEOPLE TO DETERMINE WHAT USES THAT INFORMATION WILL BE USED FOR, AND TO LIMIT THEMSELVES TO THOSE PURPOSES. IT SETS DOWN SOME INFORMATION PRIVACY PRINCIPLES THAT NEED TO BE APPLIED IN SOME CIRCUMSTANCES, BUT MOST OF THESE ARE NOT RELEVANT HERE. INFORMATION PRIVACY PRINCIPLE (IPP) 11 HOWEVER BEGINS

"
Limits on disclosure of personal information
An agency that holds personal information shall not disclose the information to a person or body or agency unless the agency believes, on reasonable
grounds -

(a) That the disclosure of the information is one of the purposes in connection with which the information was obtained or is directly related to the
purposes
in connection with which the information was obtained; or
(b) That the source of the information is a publicly available publication; or
(c) That the disclosure is to the individual concerned; or
(d) That the disclosure is authorised by the individual concerned; or
(e) That non-compliance is necessary -

(i) To avoid prejudice to the maintenance of the law by any public sector agency, including the prevention, investigation, prosecution, and punishment
of
offences; or
(ii) For the enforcement of the law imposing a pecuniary penalty; or
(iii) For the protection of the public revenue; or
(iv) For the conduct of proceedings before any court or Tribunal (being proceedings that have been commenced or are reasonably in contemplation); or
"

THIS IPP WOULD LIMIT THE DIS CLOSURE OF THIS PERS ONAL INFORMATION , BUT AS SUBSECTION (E)(1) IS MET , THE INFORMATION CAN BE DISCLOSED .

NOTABLE SECTIONS AN E XAMPLE "TERMS AND CONDITIONS " FROM A NEW ZEALAND ISP[xiii] *ARE*

"

3.2 Your use of the Services

You will, at all times during the term of this Agreement:

* Comply with, and ensure that anyone else who uses the Services complies with, these terms and conditions for paradise.net customers and such system operating procedures, instructions and acceptable use requirements as we may notify you of from time to time;
* Ensure your use of the Services does not interfere with or disrupt TelstraClear's Network;
* Not use the Services for any unlawful or offensive act;
* Not use the Services to publish or distribute any information, software or other material, which is unlawful or which a reasonable person would consider offensive, abusive or defamatory (flaming);
* Not use the Services to distribute multiple unsolicited electronic mail to large numbers of persons including, but not limited to, electronic mail advertisements (spamming);
* Not use the Services to gain or attempt to gain unauthorised access to any computer systems or in a manner which infringes the rights of any person;
* Take all reasonable care (in accordance with industry accepted standards of best practice) to prevent the spread of viruses, or contamination by virus, of any software or hardware operated by any other person on the Internet, our system included;
* Be responsible and liable for any use (authorised or unauthorised) of the Services by any other person (including any charges associated with that use).

"

"

9. Privacy

9.1 You agree that paradise.net can collect information about you and the ways in which you are using the Services. Paradise.net will obtain this information directly from you, from our customer records and from the records that are generated within our equipment when you use our Services.

9.2 You agree that paradise.net may hold this information about you and may pass it on to our employees, contractors, agents and business partners for a range of lawful purposes connected with our business operations, which include:

* providing you with Services;
* administering your account;
* looking at ways in which we can improve the Services;
* keeping you informed as to the products and services (both existing and new) that are available to you from TelstraClear.

"

"

9.7 Pursuant to Privacy Principle 11, we may disclose information about you to law enforcement authorities (such as the Police or the Department of Internal Affairs) if we think that it is necessary to help maintain the law.

"

THESE TERMS AND CONDI TIONS ARE RELATIVELY UNIFORM ACROSS THE INDUSTRY . AS S9.7 SPECIFICALLY A LLOWS THE ISP TO COMPLY WITH THE PRIVACY ACT (ALTHOUGH THIS WOULD BE UNNECESSARY ON THE PRESENT FACT S), ALL RELEVANT INFORM ATION CAN BE PROVIDED TO THE LAW ENFORCEMENT OFFICER DURING THE INITIAL C ALL .

NOTE ALSO THAT ALTHOU GH IT IS ILLEGAL TO HINDER AN OFF ICER DURING THE COUR SE OF HIS/HER INVESTIGATION , ONE IS NOT COMPELLE D TO OFFER ANY POSIT IVE HELP . THIS SITUATION WOULD OF C OURSE BE DIFFERENT I F THE OFFICER HAD AN APPLICABLE SEARCH WARRANT FOR THE LOGS IN QUESTION .

AN EXAMPLE OF THE LAC K OF LAW IN THIS AREA WAS RECENTLY DE MONSTRATED , IN A

CASENOTE FROM THE PRIVACY COMMISSIONER[xiv] *WHICH READS*

"

COMPLAINTS

IN ONE COMPLAINT AN INDIVIDUAL REQUESTED ACCESS TO THE IDENTITY OF A PERSON WHO HAD REPEATEDLY ANONYMOUSLY EMAILED HER. WHILE THERE ARE CLEAR PROCEDURES FOR DEALING WITH MALICIOUS TELEPHONE CALLS THE SAME CANNOT NECESSARILY ALWAYS BE SAID FOR HARASSING EMAILS. NORMALLY AN ISP WILL ACT IF THREATS ARE MADE (ALTHOUGH A NEW ACCOUNT CAN EASILY BE OPENED TO REPLACE ONE THAT HAS BEEN CLOSED). IN THIS CASE THE MESSAGES, ALTHOUGH NOT OVERTLY THREATENING, WERE UNWELCOME AS THEY CONTAINED ANONYMOUS STATEMENTS OF AFFECTION (WITH A DISCONCERTING FEATURE THAT SUGGESTED THE SENDER KNEW WHERE THE COMPLAINANT LIVED). ALTHOUGH THE MESSAGES WERE DIRECTED FROM A US "HOTMAIL" ACCOUNT, THE EMAIL HEADER REVEALED THE SENDER'S NEW ZEALAND ISP AND HENCE THE COMPLAINANT'S ACCESS REQUEST COULD BE REVIEWED. THE LEGAL ISSUES INCLUDED WHETHER THE SENDER'S IDENTITY COULD BE SAID TO BE "ABOUT" THE RECIPIENT (AND HENCE "PERSONAL INFORMATION" TO WHICH THERE IS A RIGHT OF ACCESS) AND, IF SO, WHETHER THAT COULD BE PROPERLY WITHHELD TO AVOID AN "UNWARRANTED DISCLOSURE OF THE AFFAIRS" OF THE SENDER. THE COMPLAINT REMAINS UNDER REVIEW.

"

This was a 2000 case, however the law in this area remains as it was then. The fact that a privacy commission complaint was required shows that no law applied directly to the situation. If a private citizen could request this information from an ISP, then a law enforcement officer could not be in a weaker position t o do so.

What must the law enforcement officer do to ensure you to preserve this evidence if there is a delay in obtaining any required legal authority?

What the law enforcement officer is required to do to ensure that you preserve the evidence will be covered by that law enforcement officer's internal policy and procedures. From the system administrator's point of view, assuming that they wish to co-operate, no legal authority is required for the officer to request that they store the relevant information in a more permanent fashion. In this regard the officer has no less rights than any member of the public, who could also call up and request logs to be saved. A law enforcement officer making the request would likely have more persuasive power however.

What legal authority, if any, does the law enforcement officer need to provide to you in order for you to send him your logs?

At present there is no law covering the officer requesting a copy of the logs. The Privacy Act (IPP 11) requires that informa tion about an individual only be released to a law enforcement officer, but that is clearly the case here. The Crimes Act 1961 requires a warrant for an officer to intercept "private communications" but these are narrowly defined. The Act reads

"

216B. Prohibition on use of listening devices–
(1) Subject to subsections (2) [[to (4)]], every one is liable to imprisonment for a term not exceeding 2 years who intentionally intercepts any private communication by means of a listening device.

"

THE ACT THEN CONTINUES

"

PART 11A - OBTAINING EVIDENCE BY LISTENING DEVICES

[INTERPRETATION
[312A. INTERPRETATION--
(1) IN THIS PART, UNLESS THE CONTEXT OTHERWISE REQUIRES,--

``INTERCEPT", IN RELATION TO A PRIVATE COMMUNICATION, INCLUDES HEAR, LISTEN TO, RECORD, MONITOR, OR ACQUIRE THE COMMUNICATION WHILE IT IS TAKING PLACE:
``LISTENING DEVICE"--
(A) MEANS ANY ELECTRONIC, MECHANICAL, OR ELECTROMAGNETIC INSTRUMENT, APPARATUS, EQUIPMENT, OR OTHER DEVICE THAT IS USED OR IS CAPABLE OF BEING USED TO INTERCEPT A PRIVATE COMMUNICATION; BUT

``PRIVATE COMMUNICATION"--
(A) MEANS ANY ORAL COMMUNICATION MADE UNDER CIRCUMSTANCES THAT MAY REASONABLY BE TAKEN TO INDICATE THAT ANY PARTY TO THE COMMUNICATION DESIRES IT TO BE CONFINED TO THE PARTIES TO THE COMMUNICATION; BUT
(B) DOES NOT INCLUDE SUCH A COMMUNICATION OCCURRING IN CIRCUMSTANCES IN WHICH ANY PARTY OUGHT REASONABLY TO EXPECT THAT THE COMMUNICATION MAY BE INTERCEPTED BY SOME OTHER PERSON NOT HAVING THE EXPRESS OR IMPLIED CONSENT OF ANY PARTY TO DO SO:
``

THE LOGS IN THE PRESENT CASE ARE NOT "ORAL COMMUNICATIONS" AND THEIR 'INTERCEPTION' IS THEREFORE NOT COVERED BY THE CRIMES ACT 1961. A RECENT AMENDMENT TO THE CRIMES ACT, THE CRIMES AMENDMENT ACT (NO. 6) 2003 WILL CHANGE THIS POSITION.

THE RELEVANT PORTION OF THIS ACT READS

"

"private communication -

(a) means a communication (whether in oral or written form or otherwise) made under circumstances that may reasonably be taken to indicate that any party to the communication desires it to be confined to the parties to the communication; but

(b) does not include such a communication occurring in circumstances in which any party ought reasonably to expect that the communication may be intercepted by some other person not having the express or implied consent of any party to do so."

"

However, this Act does not come into force until October 1, 2003. In the interim, the law remains as it was. Once the Amendment Act comes into force, the law enforcement agent will require a valid warrant to obtain the records in question.

The Telecommunications (Interception Capability) Bill will compel the ISP to keep the logs, so that they can be used by law enforcement. However this Bill is still before Parliament, and therefore has no legal standing.

Although it is irrelevant to the issue of the ISP giving out information it already possesses, communications providers are already required to assist in the deployment of interception or phone listening devices, under the Telecommunications (Residual Powers) Act 1987.

What other "investigative" activity are you permitted to conduct at this time?

As the system administrator is in control of the system, they effectively own the information. Accordingly, as long as you do not intrude on other users' privacy, you are permitted to perform any investigative activity you choose. This position may be limited by the contract between the system administrator and the ISP. This contract will define the terms of reference of the system administrator's job, and these may be breached by the system administrator pursuing an investigation using the company's information. A prudent system administrator would check with the CEO or other official in the company to obtain approval before any further investigation. The Crimes Amendment Act (no. 6) 2003 makes it illegal to gain unauthorised access to computer systems. However, it does not cover elevating access, simply gaining it originally. As the system administrator already has authorised access to the system,

they would not be breaching this law by exploring the system beyond what they are authorised to do. As mentioned however, this would likely breach the contract with the ISP and lead to disciplinary actions.

How would your actions change if your logs disclosed a hacker gained unauthorized access to your system at some point, created an account for him/her to use, and used THAT account to hack into the government system?

The only difference in this scenario is that the ISP is no longer covered by the terms and conditions that users sign up with. As the terms and conditions allow the ISP to release information to law enforcement agents anyway, this release of information would not be any different. The "hacker" might not have been physically in the country when they accessed the system. This would change the situation and raise issues of international criminal law, and jurisdictional issues. The resolution to these issues would depend on where the "hacker" was located, as New Zealand has different relationships (treaties, customary law etc) with different countries around the world.

From a practical point of view, some extra actions would be required from the system administrator. A "hacker" gained unauthorised access to the system he or she was administering. Clearly, the situation that allowed this must not be allowed to continue. The flaw that allowed the "hacker" access to the system must be located, and that service hardened to prevent re-entry (or others exploiting the same flaw.) As this entry might break the law, the evidentiary value of the evidence should not be compromised. Therefore, the system administrator's first action should be to back up the evidence, so as to preserve it for the (possible) later prosecution of the intruder. This accomplished, the system should be hardened to prevent the flaw being re-exploited, by the same individual or another.

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