Fight crime.
Unravel incidents... one byte at a time.

Analysis of Diskette Image and Compromised Systems

GIAC Certified Forensic Analyst Practical Assignment
Version 1.5

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Abstract

This paper was written to meet the requirements for the SANS GIAC Certified Forensic Analyst practical assignment Version 1.5.

Part 1 is a scenario about a company, Ballard Industries, which manufactures fuel cells. The company has noticed their competitor, Rift, Inc., has been receiving orders for the same fuel cell, which was once unique to Ballard. The thought is that somehow Rift has received company proprietary information from Ballard. One day, an employee, Robert John Leszczynski, Jr., was "caught" leaving the company R&D lab with a diskette, which is against company policy. A full investigation ensued, which I cover in the remained of my paper.

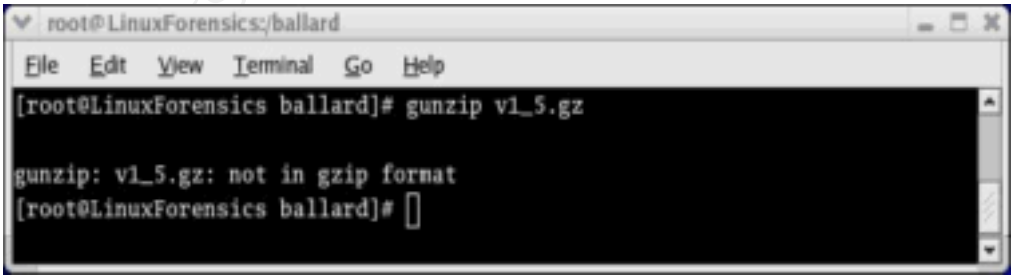
Part 2 Option 1, is about an actual investigation I conducted within my company. It was discovered that a commercially available key logger was installed on two manager's systems. An investigation on these two systems took place as well as an investigation on someone suspected of installing the key logger. A lot of correlation took place between the analysis of the three systems.

Part 1 – Analyze an Unknown Image

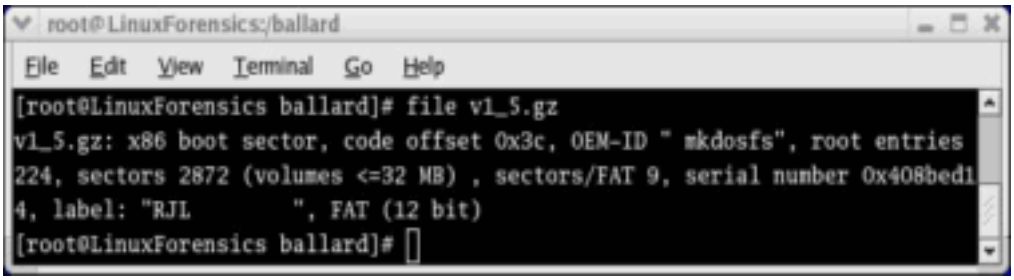
I downloaded the forensic image from (http://www.giac.org/gcfa/v1_5.gz) to my linux forensics workstation. I saved the image in the /ballard directory. The chain of custody provided in this assignment is:

- Tag# fl-260404-RJL1
- 3.5 inch TDK floppy disk
- MD5: d7641eb4da871d980adbe4d371eda2ad fl-260404-RJL1.img
- fl-260404-RJL1.img.gz

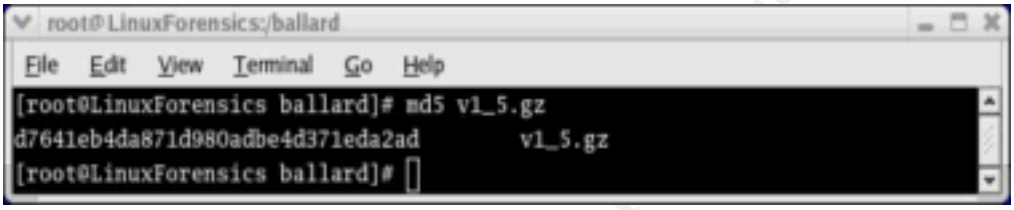
After downloaded the forensic image, I attempted to uncompress it.



As shown above from the error message generated, this file is not in gzip format, even though it is named with a .gz extension. I needed to determine what this file type was. I ran the following to determine it is a FAT12 file.

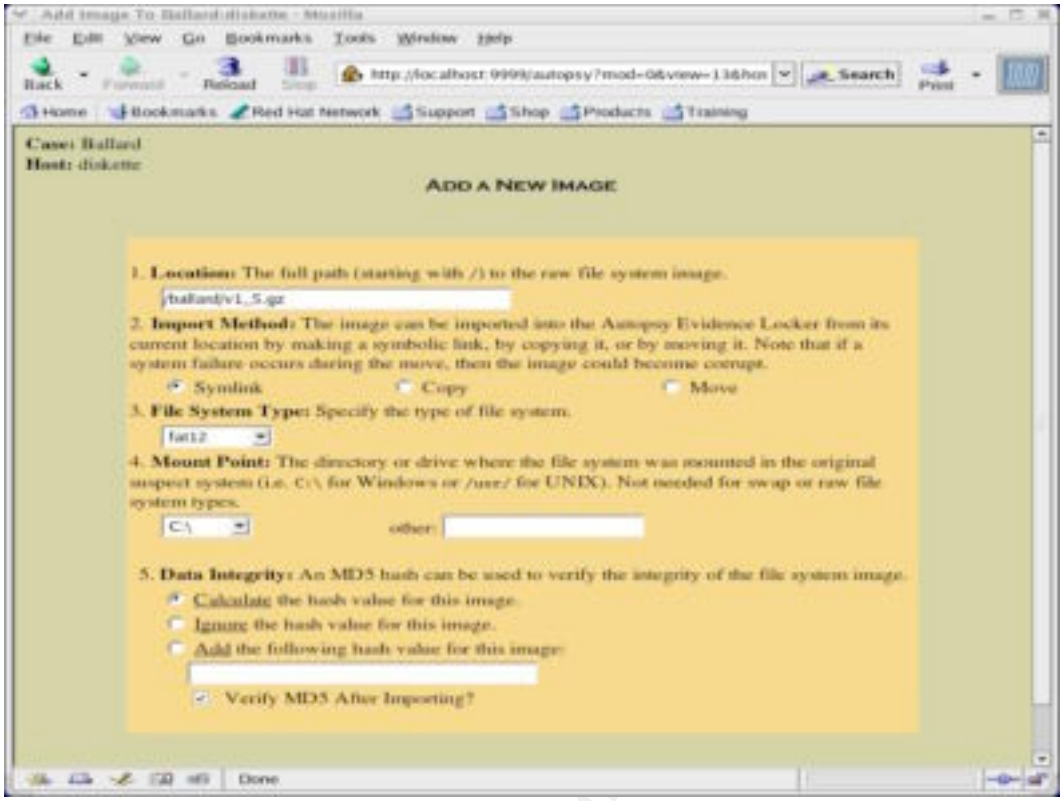


Now that I determine that the file really isn't compressed and is a FAT12 format, I had another problem. This file name is not the same as that specified in the chain of custody provided. I ran an md5 on the file. The md5 checksum is the same as that provided in the chain of custody.

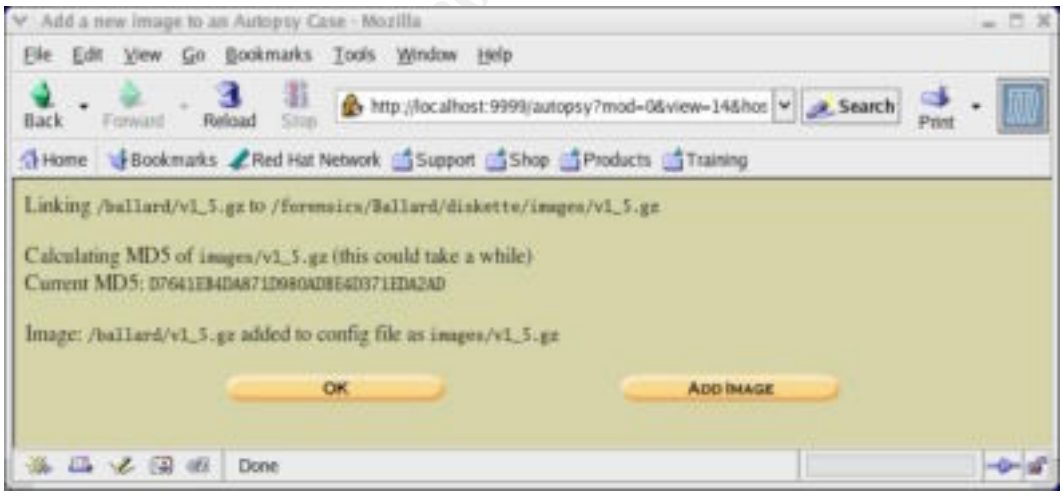


If I encountered this problem in a real-world investigation, I would report the problem to the person before myself who had the evidence. "If the information collected during an investigation should be used in legal proceedings, the prosecution is responsible for proving that what is presented in court is what was originally collected" (Mandia 92). It could be argued in this case that the evidence has been tampered with since the file names are not the same. Since the MD5 checksums are the same, it may be possible the evidence won't be thrown out. Regardless, in a real-world investigation, it is crucial that the chain of custody is maintained.

After downloading the image and verifying the MD5 checksums, I was ready to use Autopsy (http://www.sleuthkit.org/autopsy/desc.php). The first step was to create a new case. I called the case "Ballard." I then loaded the v1_5.gz image into Autopsy. I selected the file type as FAT12 and the mount point as C:. Autopsy doesn't have a value for A:.



For item 5 on this screen, I selected the option for an MD5 value be taken after the image is imported. This verifies the integrity of the image after Autopsy has loaded it.



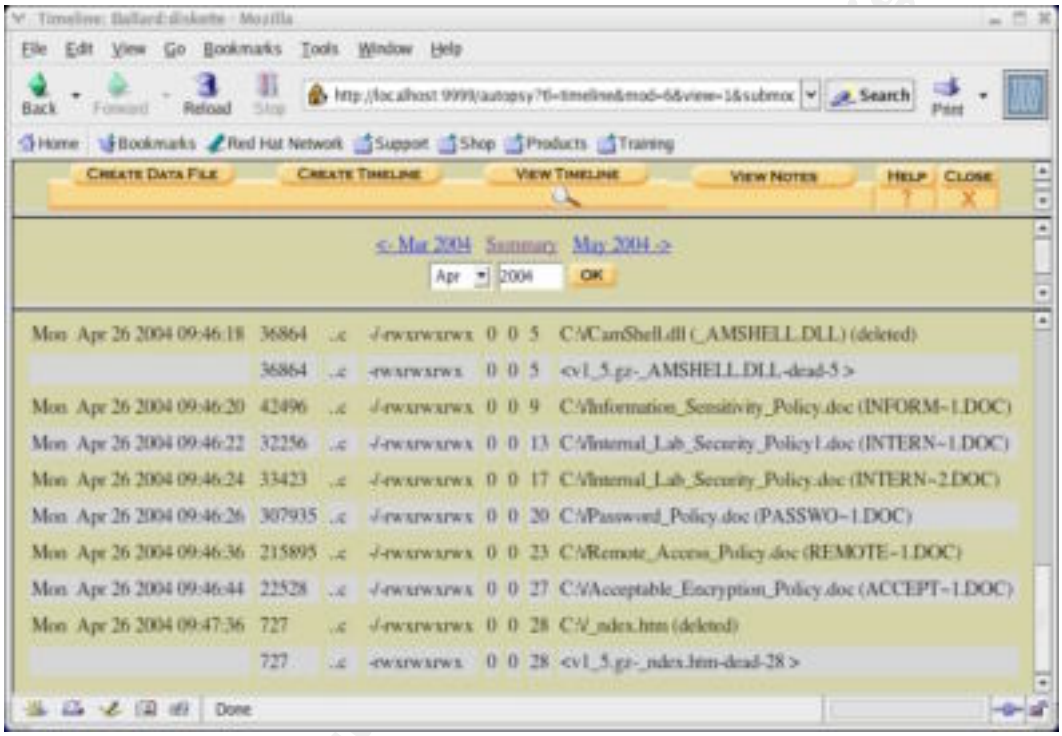
As seen above, the MD5 value calculated after Autopsy loaded the image is the same as the MD5 value from the chain of custody form.

The next step in my analysis of the image was to create a timeline within Autopsy with the following steps:

- Create Data File
  - Select: C:\ /ballard/v1_5.gz

- Select all data types
- Select to create an MD5

- Create
  - Starting date: not selected
  - Ending date: not selected
- View Timeline
  - The earliest event found was February 3, 2001. The file “CamShell.dll” was deleted.
  - Selected Summary. I noticed most of the events occurred on April 2004.



In the above screen shot, on April 26, 2004 starting at 9:46:18, is the list of the files listed created, as indicated by the “c” before the permissions settings.

The files in the image were:

- Camshell.dll
  - 36864 bytes at create time on April 26, 2004, 09:46:18
- V1_5.gz-_AMSHELL.DLL-dead-5
  - 36864 bytes at create time on April 26, 2004, 09:46:18
- Information_Sensitivity_Policy.doc
  - 42496 bytes at create time on April 26, 2004, 09:46:20
- Internal_Lab_Security_Policy1.doc
  - 32256 bytes at create time on April 26, 2004, 09:46:22
- Internal_Lab_Security_Policy.doc
  - 33423 bytes at create time on April 26, 2004, 09:46:24
- Password_Policy.doc
  - 307935 bytes at create time on April 26, 2004, 09:46:26

- Remote_Access_Policy.doc
  - 215895 bytes at create time on April 26, 2004, 09:46:36
- Acceptable_Encryption_Policy.doc
  - 22528 bytes at create time on April 26, 2004, 09:46:44
- _ndex.htm
  - 727 bytes at create time on April 26, 2004, 09:47:36
- v1_5.gz-_ndex.htm-dead-28
  - 727 bytes at create time on April 26, 2004, 09:47:36

I then selected "File Type" within Autopsy. This sorts the files based on what type of file they are. Plus, it gives me the inode number associated with each file.

An "Extension Mismatch" was found with CamShell.dll. Autopsy indicated this file is really an HTML document, but has a .dll extension. The six documents found in the image were indicated by Autopsy as in fact being documents and listed all of them under the "documents Category." The remaining file _ndex.html was listed under the "text Category" as being an HTML file.

The next step was going to the "File Analysis" section of Autopsy. I individually selected each file and selected "Strings Display." After viewing the output of running strings on each file, I extracted each file from the image. I did this by going to the "Meta Data" section of Autopsy. I typed in the inode number for each file and extracted it. The steps in this paragraph are straight forward once in Autopsy. To get to this section in Autopsy, you select your case, then the image. After selecting the image, the window that comes up shows the image you have selected and at the bottom you'll see an option for timeline. On this window, just click ok to open the image. The next window has the options indicated by quotes in this paragraph across the top of the Autopsy window.

The results of running strings and extracting the files are combined below:

- Camshell.dll
  - First several lines of the file contained HTML code for Macromedia (http://sdc.shockwave.com/shockwave/download/download.cgi?) shockwave.
  - The rest of the file appeared to be an actual .dll file. A .dll stands for dynamic link library. This is used by and associated with programs that run under the Windows operating system. I gathered the following information to help in my search for the program this .dll file was associated with.
    - Twisted Pear Productions produced the .dll
    - http://www.camouflage.freeserve.co.uk I tried to visit this website, but the name won't resolve.
    - Documents\VB\Programs\Camouflage\Shell\ Camouflage.vbp The .vbp file extension suggests this is some sort of Microsoft Visual Basic program.
    - Copyright 2000-2001
    - Product Version 1.01.0001
    - OriginalFilename Camshell.dll

- Information_Sensitivity_Policy
  - Nothing suspicious in strings display; saw normal document headers and footers
  - Opened the file in OpenOffice.org Writer (http://www.openoffice.org/) without any problems
  - Read through the document thoroughly to look for any clues; didn't see any
- Internal_Lab_Security_Policy1
  - Nothing suspicious in strings display; saw normal document headers and footers
  - Opened the file in OpenOffice.org Writer without any problems
  - Read through the document thoroughly to look for any clues; didn't see any
- Internal_Lab_Security_Policy
  - Strings display showed data after the normal document footer; couldn't read the data
  - Opened the file in OpenOffice.org Writer without any problems
  - Read through the document thoroughly to look for any clues; didn't see any
- Password_Policy
  - Strings display showed data after the normal document footer; couldn't read the data
  - Opened the file in OpenOffice.org Writer without any problems
  - Read through the document thoroughly to look for any clues; didn't see any
- Remote_Access_Policy
  - Strings display showed data after the normal document footer; couldn't read the data
  - Opened the file in OpenOffice.org Writer without any problems
  - Read through the document thoroughly to look for any clues; didn't see any
- Acceptable_Encryption_Policy
  - Nothing suspicious in strings display; saw normal document headers and footers
  - Opened the file in OpenOffice.org Writer without any problems
  - Read through the document thoroughly to look for any clues; didn't see any
- _ndex.html
  - Strings display showed HTML code for Macromedia shockwave
  - No suspicious data after the HTML code

At this point I had enough information from the camshell.dll file to start my search on the Internet. Based on the information above, I was going with the assumption that whatever program uses the camshell.dll file was used to embed the data at the end of the Internal Lab Security Policy, Password Policy, and Remote Access Policy documents.

A Google search for camshell.dll produced 1 hit. The website found, (http://www.tranceaddict.com/forums/archive/topic/79627-1.html), discusses a program called "Camouflage" that hides MP3's within other files. It didn't mention hiding documents within documents, though. I decided to pursue this avenue. I found a site, (http://scifi.pages.at/yoda9k/cf/info.htm), to download Camouflage 1.0.

I downloaded Camouflage 1.0 and extracted it. After viewing the "camouflage.txt" file, I realized this isn't the Camouflage associated with the camshell.dll file from the diskette image. There is no mention of "Twisted Pear Productions."

I downloaded Camouflage 1.04 from (http://www.zcu.cz/ftp/pub/win/simtelnet/win95/secfile/camou104.zip). I read the Readme.txt file that was included in the zip file. It listed the website: http://www.camouflage.freeserve.co.uk, the same one that was listed in the camshell.dll file from the diskette image.

Using a separate test PC that is isolated on the network, I installed Camouflage 1.04. Prior to this, I searched the Internet for the source code of Camouflage 1.04. I could not find the source. This would have been the ideal way of analyzing what Camouflage 1.04 does. Another method for analyzing what Camouflage 1.04 does is to reverse engineer the program.

Upon installing it, I discovered Camouflage 1.04 includes a file called "CamouflageShell.dll." No camshell.dll. I viewed the contents of CamouflageShell.dll. Its file version is 1.00. I uninstalled Camouflage 1.04 from the test PC and verified it was completely removed.

I downloaded Camouflage 1.21 from (http://camouflage.unfiction.com/Download.html). I installed this on the test PC. As with Camouflage 1.04, I searched the Internet for the source code of Camouflage 1.21. I could not find the source. Again, this would have been the ideal method for analyzing what Camouflage 1.21 does.

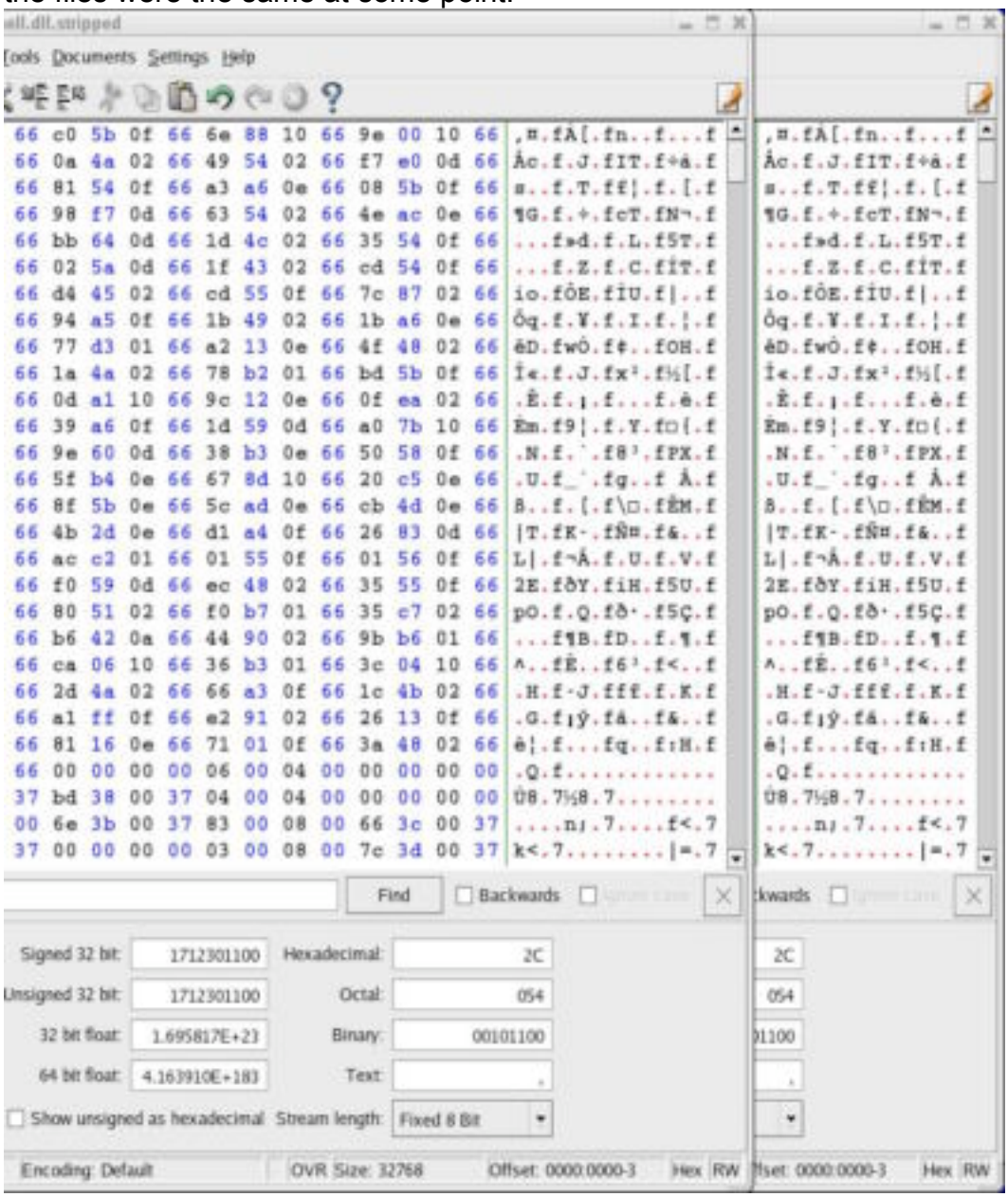
Upon installing it, I discovered Camouflage 1.21 includes a file called "CamShell.dll" located in the c:\Program Files\Camouflage directory. I viewed the contents of CamShell.dll. Its file version is 1.01.001, which is the same as the camshell.dll file found on the diskette image.

The next step in my analysis was to verify if the camshell.dll file from the diskette image came from Camouflage 1.21. From this point, I'll refer to the camshell.dll from the diskette image as "camshell.dll.img." I'll refer to the camshell.dll from the installation of Camouflage 1.21 as "camshell.dll.orig."

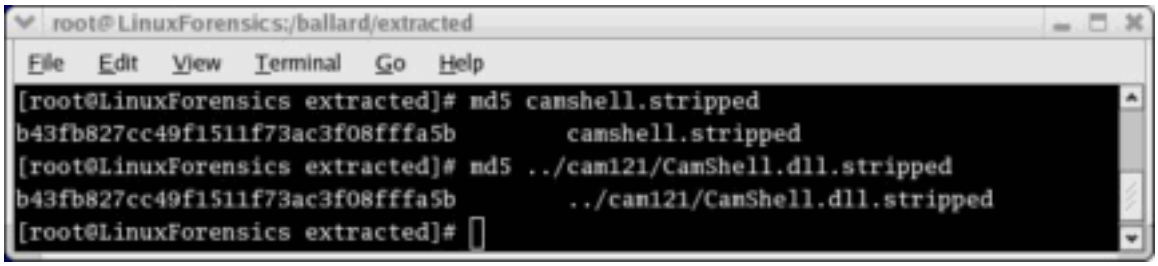
I opened each one in a hex editor on the forensics workstation. Right away I noticed differences. Camshell.dll.img has HTML code at the beginning of it. Camshell.dll.orig has a message stating, "This program cannot be run in DOS mode." Camshell.dll.img does not include this message anywhere. This message is often found in Windows programs that cannot be run from within a DOS window.

Further comparison I found a lot of similarities. Both files included the reference to Twisted Pear Productions and the URL http://www.camouflage.freeserve.co.uk. They also included the same path

Documents\VB\Programs\Camouflage\Shell. I didn't do an MD5 comparison, because I knew the MD5 values would be different as the Camshell.dll.orig included the reference to DOS mode that the Camshell.dll.img did not contain. However, because of the similarities I found, using a hex editor I discovered the starting point where both files have exact data. I wanted to test my theory that the files were the same at some point.



I cut out all data above this point and saved each camshell.dll. Then I ran an MD5 comparison of the two.



As you can see, the MD5 checksums are exact, showing that the files from the point where I extracted the data within the hex editor to the end are identical matches. The likelihood these two files are different is nearly zero, since I personally verified portions of their contents match and the MD5 sums match, which is highly unlikely for any two different files.

I did have to strip out data to the point where both of the camshell.dll files matched. This is because camshell.dll.img was partially overwritten with HTML code that appears to have come from _ndex.html. I used the same process as above to compare the contents of the _ndex.html and the beginning contents of the camshell.dll.img. I found where the files matched, cut out the remaining data in the camshell.dll.img. An MD5 comparison showed the checksums as being exact.

A theory is the suspect attempted to overwrite the camshell.dll.img file with the _ndex.html file. The entire camshell.dll.img file was not overwritten as the _ndex.html file is significantly smaller. The timeline doesn't clearly show this is what occurred. However, it is important to note that an MD5 comparison showed an exact match.

During my search for Camouflage, I came across the website (http://guillermito2.net/stegano/camouflage/) where the author talks about breaking into files created by Camouflage. It was from this page that I learned about tools to break into Camouflage files.

I downloaded the tool SetecAstronomy.pl (http://packetstormsecurity.nl/crypt/stego/camouflage/), which "…is a Perl script that can search files to identify where data has been hidden…" with Camouflage. If it detects such data, it displays how many hidden files are contained in the nonhidden file. "If a password was used to "protect" the hidden data, the password is printed out."

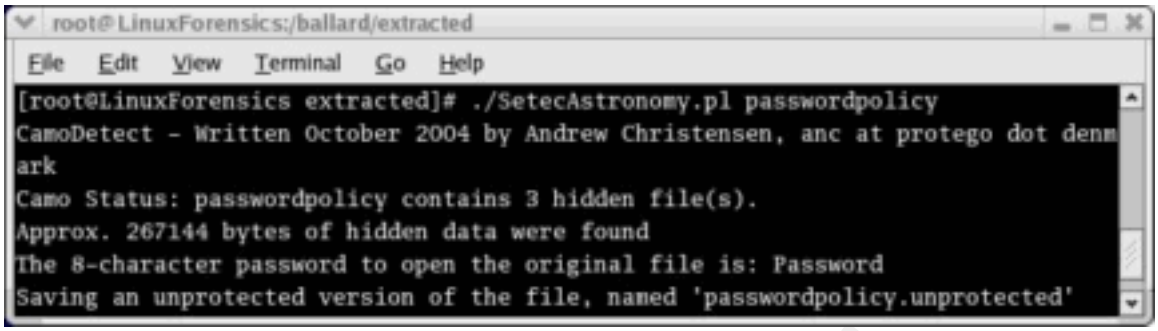
I ran the tool against the documents I found via the "strings display" in Autopsy that contained data after the document footer.

The document Internal_Lab_Security_Policy.doc included one hidden file. There was no Camouflage password to extract the hidden file. If there was a password, SetecAstronomy.pl would have indicated this and displayed what the password was.

The document Remote_Access_Policy.doc included one hidden file. The Camouflage password was "Remote."

The document Password_Policy.doc included three hidden files. The Camouflage password was "Password." The screen shot below shows the output of SetecAstronomy.pl ran against Password_Policy.doc. When

Password_Policy.doc was extracted from the image, it was saved as passwordpolicy.



Since I had great certainty that camshell.dll on the diskette image came from Camouflage 1.21, I used Camouflage 1.21 on the test PC to extract the hidden files.

After copying the 3 documents to the test PC and verifying their MD5 with the MD5 of each document on the forensics workstation, I proceeded to use Camouflage to extract the hidden files.

I right-clicked on Password_Policy.doc. I chose “Uncamouflage.” A box came up where I typed in the password, Password, which was discovered by the SetecAstronomy perl script. This extracted the following 2 .jpg’s: PEM-fuel-cell-large.jpg, which was a picture of the design of a PEM Fuel Cell, and Hydrocarbon%20fuel%20cell%20page2.jpg, which was a picture of some chemical makeup and text describing it. A .gif was extracted: pem_fuelcell.gif, which was a picture of the flow of chemical reactions to produce electricity.

Uncamouflage of Internal_Lab_Security_Policy.doc yielded: Opportunity.txt The contents of this file were:

I am willing to provide you with more information for a price. I have included a sample of our Client Authorized Table database. I have also provided you with our latest schematics not yet available. They are available as we discussed - "First Name".
My price is 5 million.

Robert J. Leszczynski

Uncamouflage of Remote_Access_Policy.doc yielded a Microsoft Access Database file: CAT.mdb. I opened the extracted file in Microsoft Access. According to the table name, this is a list of clients and their contact information. Furthermore, it included each of the client’s account login name and account password.

Mr. Leszczynski attempted to steal company proprietary information from Ballard Industries. This information included design pictures of the PEM Fuel Cell, a client database, and a text file indicating his willingness to sell the information for 5 million. He was not successful in stealing the information. According to the timeline of the image, it shows Mr. Leszczynski creating the files

on April 26, 2004. The last file was created at 09:46:18. The diskette was seized on April 26, 2004 at approximately 4:45pm. This suggests that April 26, 2004, was the first day Mr. Leszczynski attempted to leave the R&D lab with the diskette containing the camouflaged files with company proprietary information.

I would suggest the Systems Administrators search every machine to determine if Mr. Leszczynski installed Camouflage on other machines. The default installation of Camouflage installs it to the Program Files\Camouflage directory. The Administrators could also search for the Camouflage executable if Mr. Leszczynski installed it in a non-default directory. Another recommendation is they search the systems for files that may include camouflaged files. One way to determine this is to look for unusually large Microsoft Word documents, as was the case with the documents on the diskette image.

The evidence does not support that Camouflage was run from the diskette. When I installed Camouflage onto a test PC, it installs the following files: Camouflage.exe, CamShell.dll, Readme.txt, and Uninst.isu. The timeline from the diskette does not show any other files from Camouflage as having ever been on the diskette other than CamShell.dll. I performed a test to camouflage a document with Camouflage, to see how the program works, as I couldn't locate the source code for Camouflage.

I right-clicked on the test file I wanted to camouflage. I chose: Camouflage. The next window showed the file I wanted to camouflage. The window after that prompted me to input the path and filename, document1, I wanted to camouflage my test file into. The next window prompted me for the path and filename I wanted to call the new file that included the test file and document1. The final window prompted me to input a password, which is an option. It is possible to camouflage without inputting a password.

I tested this with camouflaging to a diskette. It operates in the same manner as camouflaging files on a hard drive. It doesn't appear that Camouflage copies the CamShell.dll file to a diskette when camouflaging to a diskette.

A full forensic investigation on Mr. Leszczynski's workstation in the R&D lab is needed. I would look for Camouflage as being installed. I would also compare timelines on the workstation with those on the diskette image. It is necessary to gather all possible evidence. The forensic investigation I performed on the diskette image from the diskette found in Mr. Leszczynski's possession only proves that the diskette contained company proprietary information. Granted, there is a text document with Mr. Leszczynski's name on it. However, there is no proof Mr. Leszczynski knew about this camouflaged information on the diskette. It is possible that Mr. Leszczynski is being setup by another company employee. The scope of the investigation may increase if no malicious activity is detected on Mr. Leszczynski's workstation.

Once it is proved who intentionally was trying to steal company proprietary information, The Economic Espionage Act of 1996 (http://www.usdoj.gov/criminal/cybercrime/ipmanual/08ipma.htm#VIII.B.) is applicable with this case. 18 U.S.C. § 1832 specifically applies. This provision makes it illegal for someone to attempt to or actually sell trade secrets to another

entity where the money gained will not be benefiting the owner of the trade secrets.

The evidence gathered in this investigation clearly shows this was the intent. First, I gathered .jpg images of company proprietary information regarding the fuel cells. Second, I gathered a text document stating the intent to sell the trade secrets for 5 million.

Another thing to note is this provision states it is illegal to receive such trade secret information if you know it was stolen. Therefore, the scope of this investigation increases even further beyond everyone who works in and has access to the R&D lab. It is important for law enforcement to find whom this stolen information intended to be delivered to.

The penalty for violating this law is imprisonment "for up to 10 years and fined $250,000 or both." The penalty is even more severe if it is discovered that Ballard's competitor, Rift, Inc., knew that the information they were receiving was stolen. In that case, Rift, Inc., if found guilty, could be fined "$5 million for violating 18 U.S.C. § 1832."

Other violations include violating Ballard's internal security policies for taking information out of the R&D lab. The penalty for violating Ballard's internal security policies is any disciplinary action up to termination of employment.

As I discussed earlier, there may be a problem with this investigation and upholding the evidence in court, since the chain of custody form does not match the diskette image name I received. In that case, it is important going forward as the investigation broadens that mistakes such as this are not repeated. Plus, the investigators need to keep in mind that the analysis of this diskette image may be thrown out of court and therefore need to find other evidence to support the notion that company proprietary information was stolen.

Part 2 – Option 1 – Perform Forensic Analysis on a system

My company was working on remediation efforts for a security incident that was declared two weeks earlier for virus activity. I declared a security incident for virus activity that was identified. This was detected in the IDS (Intrusion Detection System) and firewall logs. Declaring a security incident mobilized the necessary personnel, in this case the desktop support group, and communicated with IT management the steps undertaken for containment and clean up. The exposure was small with approximately 2% of the total workstations in my company's environment were infected. The environment is complex with hundreds of remote sites. All of the remote sites connect into the data center via frame relay for access to Company apps and Internet access.

The desktop technicians performing the virus clean up efforts ran the virus removal tools, which included McAfee VirusScan (http://www.mcafeesecurity.com/us/products/mcafee/antivirus/category.htm) and Trend Micro Housecall (http://housecall.trendmicro.com/). In addition, the technicians ran a spyware/adware removal tool, Ad-Aware (http://www.lavasoft.com/software/adaware/). These tools were installed, if not installed already, on the infected systems, which all run Microsoft Windows 2000.

On October 18, 2004, at 8:03am, one of the desktop technicians who was working on the virus clean up efforts contacted me. The technician discovered a non-standard directory in the \winnt\system32 directory, using the tools mentioned above.

I activated the Incident Response Plan. The IR Plan was developed and approved by IT senior management over a year ago. The first step of the IR Plan is the Determination Phase, in which the IR coordinator determines if malicious activity has occurred. In this case, I gathered as much detail as possible from the desktop technician as to what was discovered. The second step of the IR plan is the Initial Response Phase in which I notified management. Due to the size of the Company, the IR Plan calls for the 24x7 NOC to coordinate calling all needed individuals and schedule a conference call. The 24x7 NOC is utilized because they have off-hours contact information for everyone in the IT department. Instead of utilizing them for just off-hours security incidents, it is less confusing to use them for all security incidents.

A conference call with the VP of IT Operations, the Manger of Desktop Support, the team lead for the desktop support, and the desktop support technician was conducted. In this meeting, the first thing I stated is that all virus clean up efforts on the system that contained the non-standard directory needs to stop right away to preserve the system's state and prevent the further destruction of evidence.. Furthermore, as I didn't have enough detail yet as to what we were dealing with, I requested that all desktop support efforts for the remote location stop, including the virus clean up and any other desktop maintenance. I gathered further information from the desktop technician, including hostname, current IP address, system owner, and phone number. I also asked the desktop

technician everything he did to the system, so I could gather insight as to how the evidence has been touched on this system.

This directory was "PAL." A Google search shows this directory and the contents belonging to a commercially available key logger, Key Log Pro (http://www.keylogpro.com). At this point, the technician contacted me, on October 18, 2004, at 8:00am.

On October 19, 2004 I contacted the end user affected to interview her about the incident. She said that she had strong reasons to believe someone in her office had installed the key logger. She said in the previous week, she and her manager had received an email from this particular individual (referred to as "suspect individual" for the rest of this paper), which contained a password she and her manager use to password protect Excel documents. She stated there is no reason the suspect individual should know this password.

I started out running forensics on the victim's machine (victimpc1) and then decided to run forensics on her manager's machine (victimpc2) as well. I expanded the scope of the investigation to include her manager's machine, since he had received the email as well with the password used to protect Excel documents. This was a challenge as the office location for both individuals is over 1,000 miles away from the office where I work. Plus, the network connection between us is a 128k frame relay.

Due to the bandwidth constraints and the time constraints to determine who installed the key logger, imaging the victim's machine remotely was not an option. Also, having the hands-on initial response on the console was not possible. An ideal environment is to have physical access to the compromised system where I can use the system console and the local cdrom drive to run various forensic tools. I describe throughout the remainder of this document steps I took to compensate for this challenge of gathering evidence on remote systems while maintaining forensic soundness.

Analysis of victimpc1

I gathered information from the victim as to what her machine name was and what the current IP address was. The company uses DHCP for addressing workstations. I wanted to verify I was connecting to victimpc1, the name I'm choosing to use for the purposes of this paper.

As local administrator on the victim's machine, I ran the following trusted utilities from my Incident Response CD. The IR CD was in my laptop drive, shared to victimpc1. Once I was logged into victimpc1, I connected to the IR CD share, which then enabled me to run the trusted commands. If the system were located at the company location where I am, I would have imaged the machine to preserve system state. Given both victim machines were located in a remote location accessible only via a 64k frame-relay link, imaging the systems over the network was not an option. Plus, there aren't any IT personnel located at this remote location who could have imaged the machine to another hard drive and sent the 2nd hard drive to me for analysis.

From victimpc1:

C:\ net use o: \\laptop\IRCD

Furthermore, I used netcat (http://netcat.sourceforge.net/) to tunnel the output from the trusted commands. A netcat listener was setup on the forensic workstation to gather the data.

nc –l –p 31337 > /incident1/victimpc1/mtime (listener on the forensic workstation to receive the command for collecting Modification time)

dir /t:w /a /s /o:d | nc 10.10.10.10 31337 –w 3 (command for collecting Modification time on victimpc1 and piping the output to the forensic workstation)

For each command I ran on victimpc1, I stopped the previous listener, started a new one with the input redirected to a file name corresponding with the command to be run on victimpc1.

- dir /t:w /a /s /o:d collects file system timestamps for Modification Times
- dir /t:a /a /s /o:d collects file system timestamps for Access Times
- dir /t:c /a /s /o:d collects file system timestamps for Creation Times
    - MAC times = Modification, Access and Creation Times

It was important to collect MAC times before running any other commands to ensure that other investigative tools didn't change the MAC times before I had a chance to analyze the timeline. MAC times were gathered starting at the \winnt\System32\PAL and all sub directories and files.

- fport (http://www.foundstone.com/resources/proddesc/fport.htm). This utility shows the running process and the port it is using. Result: No suspicious processes were shown.

```
FPort v1.33 - TCP/IP Process to Port Mapper
Copyright 2000 by Foundstone, Inc.
http://www.foundstone.com

Pid   Process          Port  Proto Path
416   svchost      ->  135   TCP   C:\WINNT\system32\svchost.exe
8     System       ->  139   TCP
8     System       ->  445   TCP
736   residentagent  ->  1029  TCP   C:\Program Files\LANDesk\Shared
Files\residentagent.exe
880   MSTask       ->  1030  TCP   C:\WINNT\system32\MSTask.exe
8     System       ->  1033  TCP
8     System       ->  1303  TCP
8     System       ->  1350  TCP
1136  wuser32      ->  1761  TCP   C:\LDClient\wuser32.exe
1136  wuser32      ->  1762  TCP   C:\LDClient\wuser32.exe
1760  aim          ->  5180  TCP   C:\Program Files\AIM95\aim.exe
1892  DWRCS        ->  6129  TCP   C:\WINNT\SYSTEM32\DWRCS.EXE
736   residentagent  ->  9594  TCP   C:\Program Files\LANDesk\Shared
Files\residentagent.exe
680   tmcsvc       ->  33354 TCP   C:\LDClient\tmcsvc.exe
```

```
1448  MsgSys          ->  38292 TCP   C:\WINNT\system32\MsgSys.EXE

8     System          ->  137   UDP
8     System          ->  138   UDP
8     System          ->  445   UDP
232   lsass           ->  1044  UDP   C:\WINNT\system32\lsass.exe
1760  aim             ->  1083  UDP   C:\Program Files\AIM95\aim.exe
736   residentagent   ->  9595  UDP   C:\Program Files\LANDesk\Shared
Files\residentagent.exe
680   tmcsvc          ->  33354 UDP   C:\LDClient\tmcsvc.exe
680   tmcsvc          ->  33355 UDP   C:\LDClient\tmcsvc.exe
1448  MsgSys          ->  38037 UDP   C:\WINNT\system32\MsgSys.EXE
632   pds             ->  38293 UDP   C:\WINNT\system32\cba\pds.exe
528   cvpnd           ->  62515 UDP   C:\Program Files\vpn\cvpnd.exe
528   cvpnd           ->  62517 UDP   C:\Program Files\vpn\cvpnd.exe
528   cvpnd           ->  62519 UDP   C:\Program Files\vpn\cvpnd.exe
528   cvpnd           ->  62521 UDP   C:\Program Files\vpn\cvpnd.exe
528   cvpnd           ->  62523 UDP   C:\Program Files\vpn\cvpnd.exe
528   cvpnd           ->  62524 UDP   C:\Program Files\vpn\cvpnd.exe
```

- netstat -- This command shows the open source port and destination port connections. The purpose of running this command is to determine if the key logger or another malicious process has an open connection to another system. For example, the key logger may not only be producing log files on the local hard drive, but may also be piping the output to another system. Result: The results of running this command did not support the above stated possibilities. The only ports I saw open were Windows NetBIOS port 139 and port 445.
- pslist (http://www.sysinternals.com/ntw2k/freeware/pslist.shtml). This utility shows the running processes on the system. Result: No suspicious processes were discovered.

```
PsList 1.26 - Process Information Lister
Copyright (C) 1999-2004 Mark Russinovich
Sysinternals - www.sysinternals.com

Process information for victimpc1:

Name                             Pid Pri Thd  Hnd      VM      WS    Priv
Idle                               0   0   1    0       0      16       0
  System                           8   8  36  206    1676      92      24
    SMSS                         148  11   6   33    5256      84    1076
      WINLOGON                   168  13  17  417   38112    2168    5992
        services                 220   9  37  749   49552    7612    8720
          svchost                416   8   9  362   24596    2348    1640
          SPOOLSV                452   8  12  181   35372    1652    3236
          Ati2evxx               504   8   2   33   12892     360     268
          Avsynmgr               516   8   4  100   27260     484    1264
            VSStat               824   8   2   66   26044    1108    1300
              vshwin32           896   8   7  172   60208     520    7240
            Avconsol             988   8   2   63   29068     424    1536
          cvpnd                  528   8   4  143   31704    1336    2016
          svchost                548   8  30  602   48792    3032    8632
          LocalSch               596   8   6  137   26976     884    1136
          PDS                    632   8   5  138   32772     224    1616
```

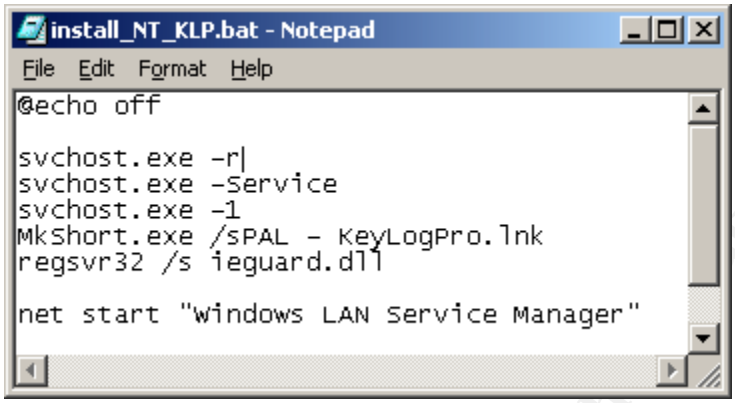
```
          QIPCLNT                668    8   2   39   12364     260     328
          tmcsvc                 680    8  10   70   30004     364    3424
          KodakCCS               696    8   3   62   23416     156     832
          residentAgent.e        736    8   5  147   28676     164    1360
          NetCfgSv               756    8   3   81   17328     492     600
          ptssvc                 836    8   3   99   17936     364     620
          regsvc                 872    8   2   29    9704     172     276
          mstask                 880    8   8  134   26832    3512    1436
          ScsiAccess             912    8   2   27   11176     176     276
          sp_SWIns               940    8   3   81   22776     508     720
          stisvc                 968    8   4   56   12684     180     484
          svchost               1056    8   3   54   26204     420     800
          winmgmt               1088    8   4  237   29496    1132    2212
          mspmspsv              1100    8   2   52   12160     100     496
          svchost               1116    8   6  176   28936     752    4040
          wuser32               1136    8  16  216   49792     476    2408
            MSGSYS              1448    8  13  158   37516     436    1676
          svchost               1176    8   6  691   27908    1008    3700
          MCSHIELD              1360   13  16  116   38280    4228    5880
          DWRCS                 1892    8  10  162   39084    5960    5368
        LSASS                    232    9  15  337   27332    1908    2392
        SoftMon                 1572    8   3   25   17376     680     508
      csrss                      172   13  10  531   20224    1620    1364
mcagent                          436    8   3  109   33368    1172    1512
explorer                         440    8   8  372   64636    9300    7964
atiptaxx                        1372    8   2   83   25084     652     896
point32                         1472    8   3   56   18284     448     688
hpcmpmgr                        1480    8   3  173   36084     516    2008
hpwuSchd                        1492    8   1   21   13984     252     244
cthi                            1616    8   4  164   32576    1132    2128
HXIUL                           1620    8   5  279   37188     792    4412
hpotdd01                        1640    8   4  108   32392    1428    1580
yeqffet                         1692    8   4  183   39020     732    1940
ViewMgr                         1712    8   2  136   28088    2676    1312
TBPS                            1716    8   7  214   45356    2228    2660
  PIB                           1784   24   2   72   29308     296    1308
rundll32                        1724    8   3  103   32624    3532    5460
WToolsA                         1748    8   7  167   50388    2068    2604
  WSup                          1700    8   3  110   42128    1328    2136
aim                             1760    8  10  399   84732    6140   16100
AccessMgr                       1852    8   3  151   81864    1600    7728
CMD                             2032    8   1   23   11348    1044     332
  pslist                        1676   13   2   86   15592    1432     732
```

- psloggedon (http://www.sysinternals.com/ntw2k/freeware/psloggedon.shtml). This utility shows who is logged on locally and who is logged on via resource shares. Result: I saw myself logged on as local administrator.
- psservice (http://www.sysinternals.com/ntw2k/freeware/psservice.shtml). This utility is a "local and remote services viewer/controller". Result: Looking through the output initially didn't show anything out of the ordinary. However, a little further into the investigation shows the service "Windows LAN Service Manager" is the service the key logger creates and runs under. I discovered that when I analyzed the files in the PAL directory.

```
SERVICE_NAME: Windows LAN Service Manager
DISPLAY_NAME: Windows LAN Service Manager
```

```
(null)
      TYPE           : 110 WIN32_OWN_PROCESS INTERACTIVE_PROCESS
      STATE          : 4  RUNNING
                           (STOPPABLE,NOT_PAUSABLE,IGNORES_SHUTDOWN)
      WIN32_EXIT_CODE     : 0  (0x0)
      SERVICE_EXIT_CODE : 0  (0x0)
      CHECKPOINT     : 0x0
      WAIT_HINT      : 0x0
```

The installation file, install_NT_KLP.bat (below) shows the "Windows Lan Service Manager" service being linked to Key Log Pro.



- dumpel (http://www.microsoft.com/windows2000/techinfo/reskit/tools/existing/dumpel-o.asp). This is a Microsoft tool for dumping Windows events into a file. I used it to dump the security, application and system logs. Result: I found instances of the suspect individual logged into the victim system. More investigation needed to determine if the access was legitimate or malicious, since the suspect individual performs IT duties.

An MD5 checksum was taken of all of the output and redirected into a file called: victimpc1md5. Then all of the output and victimpc1md5 files were tar'd up. Then an MD5 checksum was taken of the tar'd file and redirected into a file called: victimpc1tarmd5. The tar'd file and victimpc1tarmd5 file were saved to a CD-R. The CD-R was labeled, dated, and signed with my signature.

From the MAC times I was able to start putting together a time line of the PAL directory and all contents within the PAL directory. Under the PAL directory, the KLP directory was created on 07/07/2003 at 05:05pm. This gives us the starting time for when Key Log Pro was installed on victimpc1. The KLP directory contains the key logger installation and executable files. The output files from Key Log Pro are located in PAL\KLP\log\victimuser directory. According to MAC times, on 08/27/2003 at 01:06pm, I found 10 of the output text files from Key Log Pro accessed at the same time. This suggests some sort of bulk copy as so many files were accessed at the exact time.

After obtaining the MAC times for everything under the PAL directory, I zipped the PAL directory and copied it to my forensics workstation. I wanted to see if I could make a correlation between the output files of the key logger with

the password the victim and her manager use for password protecting Excel documents. I performed a grep <password name> on the output files from the key logger that capture the key strokes. These files were located in PAL\KLP\log\victimuser directory. I found the password in several Key Log Pro output files.

I went back to look at the Windows Security Events log that I obtained through the "dumpel" command described above. I attempted to correlate any logins with the time the PAL directory was created. No such correlation was possible. The events in the Windows Security Events log did not go back that far. Therefore, no correlation existed between when the suspect was logged in on victimpc1 and when the PAL directory was created or when the apparent bulk copy occurred.

Analysis of victimpc2

I performed the same forensics analysis on the manager's system, victimpc2. I gathered information from the victim as to what his machine name was and what the current IP address was. The company uses DHCP for addressing workstations. I wanted to verify I was connecting to victimpc2. I found Key Log Pro installed on his machine as well.

As with the analysis of victimpc1, I used the same process for running trusted commands from the Incident Response CD and using netcat to pipe the output to the forensic workstation.

- dir /t:w /a /s /o:d collects file system timestamps for Modification Times
- dir /t:a /a /s /o:d collects file system timestamps for Access Times
- dir /t:c /a /s /o:d collects file system timestamps for Creation Times

- fport (http://www.foundstone.com/resources/proddesc/fport.htm). Result: No suspicious processes were shown.

```
FPort v1.33 - TCP/IP Process to Port Mapper
Copyright 2000 by Foundstone, Inc.
http://www.foundstone.com

Pid   Process          Port  Proto Path
416   svchost      ->  135   TCP   C:\WINNT\system32\svchost.exe
8     System       ->  139   TCP
8     System       ->  445   TCP
692   residentagent  ->  1053  TCP   C:\Program Files\LANDesk\Shared
Files\residentagent.exe
776   MSTask       ->  1057  TCP   C:\WINNT\system32\MSTask.exe
8     System       ->  1069  TCP
1672  aim          ->  1188  TCP   C:\PROGRA~1\AIM95\aim.exe
1672  aim          ->  1200  TCP   C:\PROGRA~1\AIM95\aim.exe
8     System       ->  1440  TCP
8     System       ->  1512  TCP
1024  wuser32      ->  1761  TCP   C:\LDClient\wuser32.exe
1024  wuser32      ->  1762  TCP   C:\LDClient\wuser32.exe
1820  DWRCS        ->  6129  TCP   C:\WINNT\SYSTEM32\DWRCS.EXE
692   residentagent  ->  9594  TCP   C:\Program Files\LANDesk\Shared
Files\residentagent.exe
```

```
676   tmcsvc          ->  33354 TCP   C:\LDClient\tmcsvc.exe
1192  MsgSys          ->  38292 TCP   C:\WINNT\system32\MsgSys.EXE

8     System          ->  137   UDP
8     System          ->  138   UDP
8     System          ->  445   UDP
232   lsass           ->  500   UDP   C:\WINNT\system32\lsass.exe
232   lsass           ->  1029  UDP   C:\WINNT\system32\lsass.exe
184   winlogon        ->  1061  UDP   \??\C:\WINNT\system32\winlogon.exe
448   spoolsv         ->  1070  UDP   C:\WINNT\system32\spoolsv.exe
1384  Explorer        ->  1105  UDP   C:\WINNT\Explorer.EXE
1564  Weather         ->  1140  UDP
C:\PROGRA~1\AWS\WEATHE~1\Weather.exe
1672  aim             ->  1192  UDP   C:\PROGRA~1\AIM95\aim.exe
692   residentagent   ->  9595  UDP   C:\Program Files\LANDesk\Shared
Files\residentagent.exe
676   tmcsvc          ->  33354 UDP   C:\LDClient\tmcsvc.exe
676   tmcsvc          ->  33355 UDP   C:\LDClient\tmcsvc.exe
1192  MsgSys          ->  38037 UDP   C:\WINNT\system32\MsgSys.EXE
628   pds             ->  38293 UDP   C:\WINNT\system32\cba\pds.exe
552   cvpnd           ->  62515 UDP   C:\Program Files\vpn\cvpnd.exe
552   cvpnd           ->  62517 UDP   C:\Program Files\vpn\cvpnd.exe
552   cvpnd           ->  62519 UDP   C:\Program Files\vpn\cvpnd.exe
552   cvpnd           ->  62521 UDP   C:\Program Files\vpn\cvpnd.exe
552   cvpnd           ->  62523 UDP   C:\Program Files\vpn\cvpnd.exe
552   cvpnd           ->  62524 UDP   C:\Program Files\vpn\cvpnd.exe
```

- Netstat Result: As with the first pc, victimpc1, I did not see any open ports to suggest the key logger is piping its output to another system. No other open ports appeared suspicious.
- pslist (http://www.sysinternals.com/ntw2k/freeware/pslist.shtml). Result: No suspicious processes were discovered.

```
PsList 1.26 - Process Information Lister
Copyright (C) 1999-2004 Mark Russinovich
Sysinternals - www.sysinternals.com

Process information for victimpc2:

Name                             Pid Pri Thd  Hnd      VM      WS    Priv
Idle                               0   0   1    0       0      16       0
  System                           8   8  34  264    1676     212      24
    SMSS                         140  11   6   33    5256     376    1076
      CSRSS                      164  13  10  467   19744    1592    1364
      WINLOGON                   184  13  18  438   41488    1840    7192
        SERVICES                 212   9  36  605   34980    3124    2952
          svchost                416   8   8  318   22172    1796    1428
          SPOOLSV                448   8  13  160   27032    1208    2632
          PackethSvc             476   8   4  113   22924     208     968
          Ati2evxx               528   8   2   33   12892     372     264
          Avsynmgr               540   8   4   99   27272     616    1312
            VSStat               788   8   2   66   26056     940    1304
              vshwin32           984   8   7  172   60288    1208    7316
            Avconsol            1160   8   2   68   29108    1264    1548
          cvpnd                  552   8   4  143   31720    1080    1940
          svchost                568   8  28  459   38396    3240    3212
          LocalSch               588   8   5   56   15812     932     440
          PDS                    628   8   5  137   32776     224    1640
```

```
          QIPCLNT                664    8    2    39    12364      600      332
          tmcsvc                 676    8   10    70    30008      416     3436
          residentAgent.e        692    8    5   147    28680      392     1380
          regsvc                 756    8    2    29     9704      768      276
          mstask                 776    8    6   151    25116     1164     1132
          sp_SWIns               848    8    3    81    22776      724      724
          stisvc                 940    8    4    56    12684      844      484
          svchost                972    8    3    54    26216      492      880
          WinMgmt               1008    8    5   252    41244      300     3868
          wuser32               1024    8   16   217    49836      496     2440
            MSGSYS              1192    8   13   154    37520      444     1688
          MCSHIELD              1088   13   16   114    38344     5572     5780
          DNTUS26               1788    8    3    46    16108     1280      336
          DWRCS                 1820    8   10   159    36940     5904     3048
        LSASS                    232    9   15   358    28520     2016     2540
        SoftMon                 1072    8    3    30    18316     1592      660
explorer                        1384    8   14   388    42668     3772     5160
  CMD                            336    8    1    23    11348     1052      332
    pslist                      1704   13    2    76    15592     1408      696
  AccessMgr                     1276    8    3   143    78028     3940     6432
  atiptaxx                      1372    8    2    78    25016     1724     1004
  dpps2                         1532    8    1    30    20132     1468     2852
  loadqm                        1552    8    5   167    28588     2032     1680
  msnmsgr                       1560    8    4   178    41176     2612     5296
  Weather                       1564    8    9   326    92552     6736     5616
  MWSOEMON                      1640    8    1    26    14000      936      272
  rundll32                      1656    8    3   124    32008     4712     5408
  aim                           1672    8    9   348    73340     5748    14176
  aoltray                       1748    8    2    54    17152     1632      820
ssonsvr                         1436    8    1    15    10264      500      192
```

- psloggedon (http://www.sysinternals.com/ntw2k/freeware/psloggedon.shtml). Result: In addition to seeing myself logged in as local administrator, I saw the suspect individual's account logged in via a resource share. This doesn't necessarily indicate suspicious activity as one of the tasks performed by the suspect individual was backups.
- psservice (http://www.sysinternals.com/ntw2k/freeware/psservice.shtml). Result: As with victimpc1, I also saw the key logger service.

```
SERVICE_NAME: Windows LAN Service Manager
DISPLAY_NAME: Windows LAN Service Manager
(null)
      TYPE               : 110 WIN32_OWN_PROCESS INTERACTIVE_PROCESS
      STATE              : 4  RUNNING
                           (STOPPABLE,NOT_PAUSABLE,IGNORES_SHUTDOWN)
      WIN32_EXIT_CODE    : 0  (0x0)
      SERVICE_EXIT_CODE : 0  (0x0)
      CHECKPOINT         : 0x0
      WAIT_HINT          : 0x0
```

- dumpel (http://www.microsoft.com/windows2000/techinfo/reskit/tools/existing/dumpel-o.asp). Result: I found instances of the suspect individual logged into the victim system. More investigation was needed to determine if the

access was legitimate or malicious, since the suspect individual performs IT duties.

An MD5 checksum was taken of all of the output and redirected into a file called: victimpc2md5. Then all of the output and victimpc2md5 files were tar'd up. Then an MD5 checksum was taken of the tar'd file and redirected into a file called: victimpc2tarmd5. The tar'd file and victimpc2tarmd5 file were saved to a CD-R. The CD-R was labeled, dated, and signed with my signature.

As with victimpc1, from the MAC times I was able to start putting together a time line. Under the PAL directory, the KLP directory was created on 07/07/2003 at 04:43pm, about 22 minutes before it was created on victimpc1. This gives us the starting time for when Key Log Pro was installed on victimpc2. According to MAC times, on 06/14/2004 at 11:21am, I found 21 of the output text files from Key Log Pro accessed at the same time.

As with victimpc1, after obtaining the MAC times for everything under the PAL directory, I zipped the PAL directory and copied it down to my forensics workstation. I performed a grep <password name> on the output files from the key logger that capture the key strokes. These files were located in PAL\KLP\log\victimuser2 directory. I found the password used in password protecting Excel documents in several of the Key Log Pro output files.

I went back to look at the Windows Security Events log that I obtained through the "dumpel" command described above. I attempted to correlate any logins with the time the PAL directory was created. No such correlation was possible. The events in the Windows Security Events log did not go back that far, as with victimpc1.

Correlated results of victimpc1 and victimpc2

Key Log Pro was installed on both systems located in the same physical remote office, on the same date, and within 22 minutes of each other. A follow-up interview with the lady and her manager indicated some possibilities why they were targeted. The lady is a manager and her boss is a director. They both have access to the Company financial system and other Company proprietary systems and applications.

There was no indication the output files from the key logger were being directed to another system as indicated in the output from the netstat, fport, and pslist commands. Plus, these commands would have shown any backdoors, if they existed. No correlation existed when numerous key logger output files were accessed on victimpc1 and when they were accessed on victimpc2, meaning the apparent bulk copy commands did not occur on the same date or time.

Was not able to determine who installed Key Log Pro on either system. The Windows Events logs did not go back that far.

Investigation of suspectpc1

On October 22, 2004, a conference call was held between the victim, the manager, the IT VP, and myself. I reported my findings that I couldn't determine

who installed the key logger on victimpc1 and victimpc2. I stated that evidence might exist on the suspect's PC.

Management made the decision to place the suspect individual on administrative leave. The suspect individual's machine was shipped to me for forensics analysis. This machine was the suspect's workstation used for his job with our company. It was running Windows 2000 and connected to the company network via Ethernet. I instructed the manager to power off the suspect PC and on how to package the machine. He was to wrap it in bubble wrap and wrap tape around it such that the tape went around all 4 sides. "When the person closing the packaging seals the container, a signature across the seal will indicate that it has not been opened by anyone other than an authorized person" (Kruse II 11). I instructed the manager to write his name all across the tape.

In addition, the suspect individual's domain account was disabled, which also disables VPN access. All users in this remote office were instructed to change their domain account passwords.

Physical evidence collection

On October 25, 2004, at 11:32am I went to the shipping/receiving area to receive the package containing the suspect individual's PC (suspectpc1). I recorded the Airborne Express airbill number, which matched the number the manager gave me. Before moving the package, I took digital pictures of the box and of the surrounding area. Approximately 5 minutes later, I had the package in my office. I took more digital pictures of the box. At 11:40am I opened the box, witnessed by the VP involved with this incident and an IT manager. With the box open, I took digital pictures of the contents of the package. As I unpackaged the PC, I took more digital pictures. Once unpackaged, I contacted the manager and verified the system model and serial number.

- System: Dell OptiPlex GX1 with 3.5" floppy drive, PCI Ethernet card, PCI modem card
- Serial Number: abc123 (made-up for purposes of this paper)
- Evidence Tag Number: incident1-001

After recording the system and serial number, I opened the computer case. I took digital pictures of the case open and of the hard drive. I removed the hard drive.

- Hard drive: Maxtor model 8324OD3
- Serial Number: def456 (made-up for purposes of this paper)
- Evidence Tag Number: incident1-002

After recording the hard drive model and serial number, I burned the digital pictures to a CD-R. I labeled the CD-R, dated it, and signed it with my signature.

Imaging Suspect Hard Drive

I searched on the hard drive manufacturer's website for hard drive information.

(http://www.maxtor.com/portal/site/Maxtor/menuitem.5d2b41d3cef51dfe29dd10a191346068/?channelpath=/en_us/Support/Product%20Support/ATA%20Hard%20Drives/Desktop/DiamondMax%202160%20Ultra%20ATA). I needed to find the correct jumper settings to make this drive ATA slave. Once I changed the jumpers, I placed the drive in the forensics workstation. Changing the jumpers enables the forensics workstation to boot from its own primary hard drive, but also enables it to access the hard drive from suspectpc1.

A good way to image a hard drive and prevent data change is to use a hardware write blocker. This prevents any changes to the data as it is being imaged from one hard drive to another. A hardware write blocker was not available to use in this case, but another method for preventing changes to the data was utilized. This procedure – mounting read only – is described a little later.

Before this incident, as I was putting together a forensics procedure document, I tested various ways to image a hard drive. The environment I was attempting to create was booting a suspect system off of a Knoppix-STD 0.1 CD (http://www.knoppix-std.org/) and imaging to an externally attached USB hard drive. I was using the "dcfldd" command to image the internal hard drive to the USB hard drive. It would get about 170MB completed before it completely locked up the system. I attempted various things, but was not successful. I sent an email to the contact on the website for Knoppix-STD outlining the problems I was experiencing.

The forensics workstation is a Dell OptiPlex. The operation system is RedHat 8.0. Several forensics tools are installed on the system, which will be described throughout the investigation.

After booting up the forensics workstation with the hard drive from suspectpc1 installed, the next step was getting the Linux operating system on the forensics workstation to recognize the hard drive. This is performed by using the "mount" command, but first I needed to see how the hard drive was laid out, specifically the partitions.

```
# fdisk –l /dev/hdb
```

This showed only 1 partition.

Next I ran the "mount" command.

```
# mount –ro,noexec /dev/hdb1 /mnt/hdb1
```

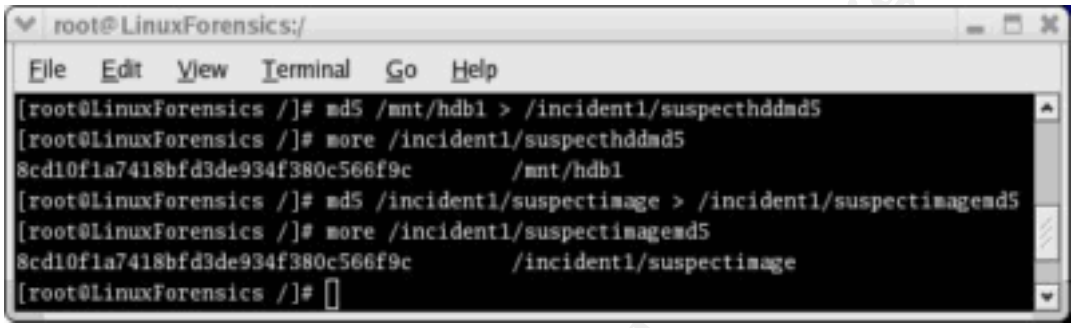
The –ro flags used with the "mount" command mounts the hard drive as read only. This was used to protect the data on the suspect hard drive. The "noexec" flag specifies that files won't be executed on the mount hard drive.

I performed an MD5 checksum on the mounted suspect hard drive. This was saved in the following file: /incident1/suspecthddmd5.

The final step was to actually image the suspect hard drive. This was performed with the following command:

dd if=/mnt/hdb1 of=/incident1/suspectimage

Once the imaging was complete, I performed an MD5 checksum of the suspectimage and saved it as: /incident1/suspectimagemd5. I tar'd the incident1 directory. Then an MD5 checksum was taken of the tar'd directory. The MD5 checksum of the suspectimagemd5 and of the tar'd directory were saved onto a floppy diskette, which remained in my possession at all times. Every day before I started working on suspectimagemd5, I took an MD5 checksum of the image and compared it with the MD5 checksum saved on the floppy. No discrepancies between the MD5 checksums ever came up during this investigation.



By this time, it was the end of the day. I placed the hard drive in an antistatic bag. I sealed the bag with packing tape and signed over the tape. The suspect hard drive was locked up for safe keeping until the end of the investigation.

Image Analysis

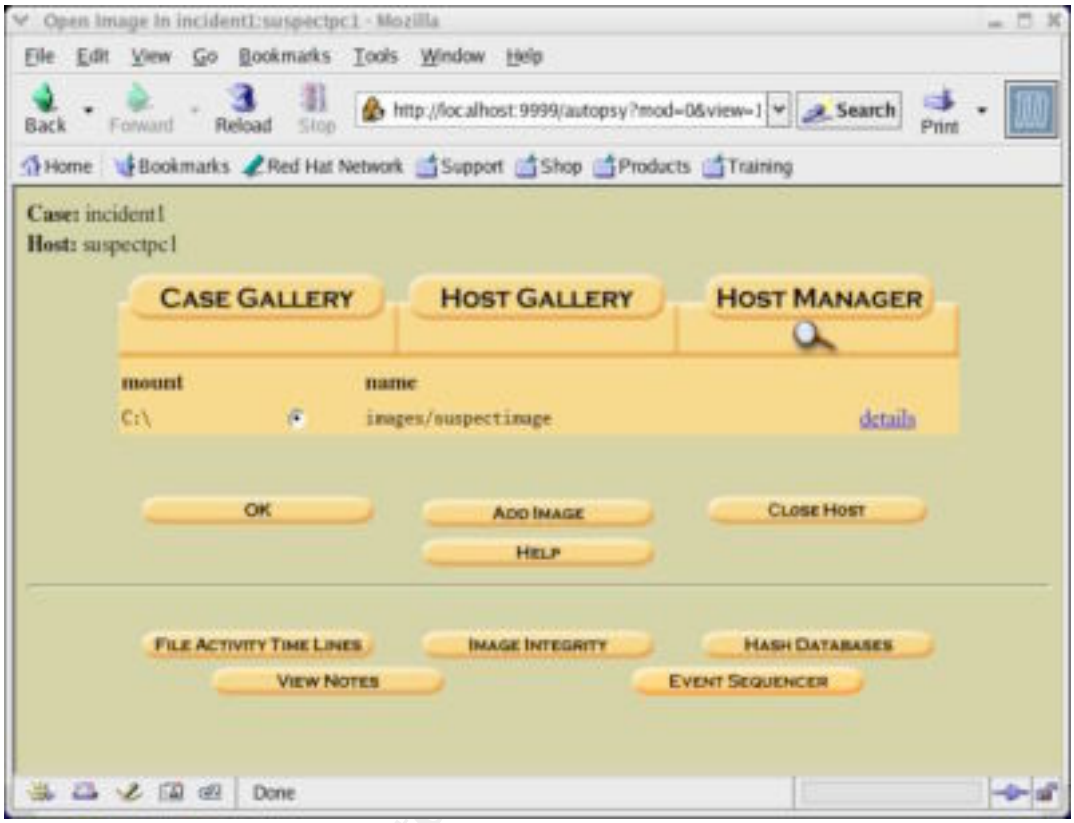
The overall goal of this analysis was to find any evidence linking the suspect to the key logger on the victimpc's. Since the suspect made it known that he knows the password the victim and her manager use for password protecting Excel documents, I was also searching for any evidence of how the suspect obtained that password.

On the forensics workstation, I used Autopsy Forensic Browser 2.01 (http://www.sleuthkit.org/autopsy/desc.php). To load the image from the suspect hard drive into Autopsy, I performed the following steps:

- Create New Case
  - Case Name: incident1
  - Investigator Names: Merlin Namuth
- Case Gallery
  - Select "incident1"
- Host Gallery
  - Add host
    - Host name: suspectpc1
- Host Manager
  - Add image
    - Location: /incident1/suspectimage
    - File System Type: ntfs
    - Mount Point: C:\

- Data Integrity: Calculate (This calculates the MD5 checksum, which then I compared with the MD5 checksum taken above. No discrepancies existed.)

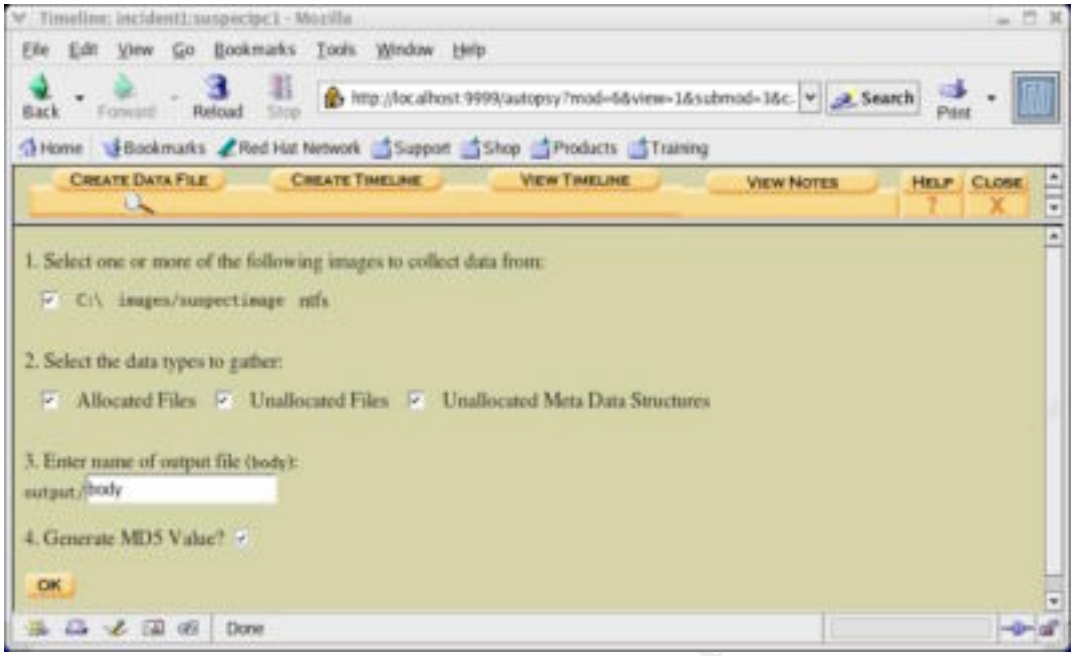
The following screen shot shows the Case: incident1 Host: suspectpc1 and the suspectimage is loaded into this case.



After the image was loaded, I stepped through Autopsy to a File Activity Time Line with the following steps:

- Create Data File
  - Select: C:\ images/suspectimage ntfs
  - Select all data types
  - Select to create an MD5

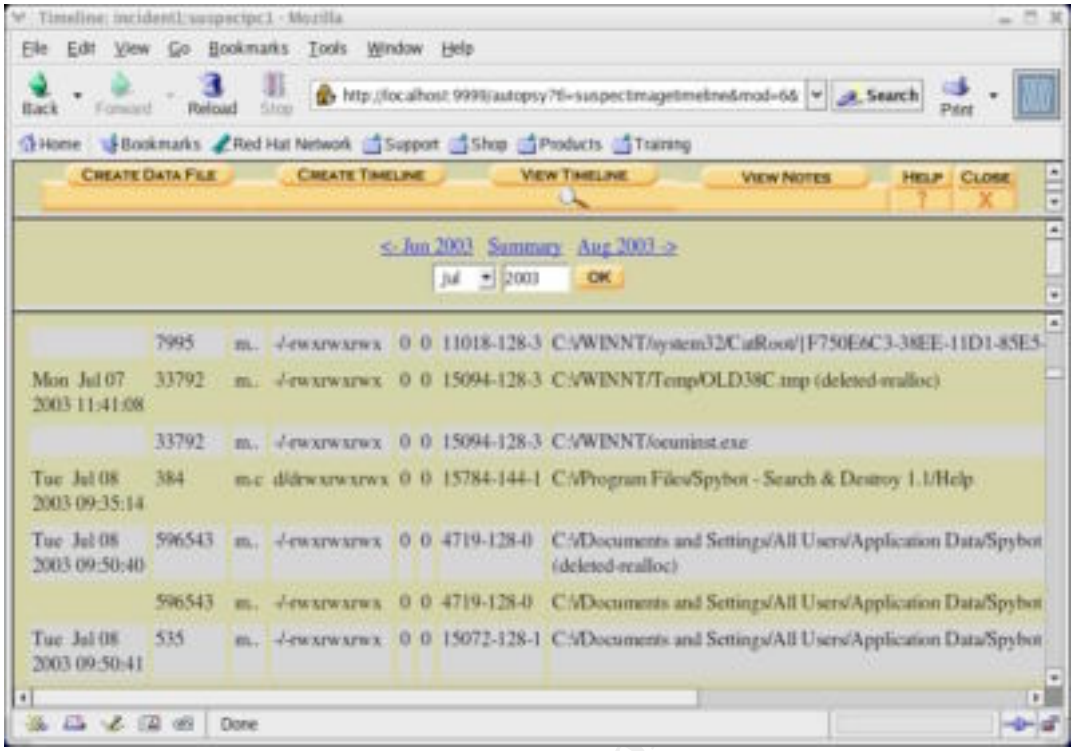
  The following screen shot shows this step.



- Create Timeline (This is creating the MAC times. On both of the victim machines I calculated the MAC times using command line syntax. In these steps I'm configuring Autopsy to calculate the MAC times for all files on the suspectimage.) The timeline is included in a separate document, Merlin_Namuth_GCFA_timeline.txt. The timeline is stripped down to meet the size requirements of this paper as the original size was 26MB
    - Starting date: July 1, 2003 (a few days prior to when the key logger was installed on victimpc1 and victimpc2)
    - Ending date: October 23, 2004 (the day the PC was seized and shipped to me for analysis)
- View Timeline
    - I searched on July 7, 2003 to see if I could find anything useful. July 7, 2003, is when the key logger was installed on victimpc1 and victimpc2

As shown in the following screen shot, no significant event occurred on July 7, 2003, that would correlate to when the key logger was installed on the victim machines. A significant event would include seeing the key logger installation file downloaded to suspectpc1. That would be indicated by a "c" for the create time. The screen shot below shows a Windows temp file that was deleted on July 7, 2003, indicating the file was deleted and the space the file utilized has been reallocated.

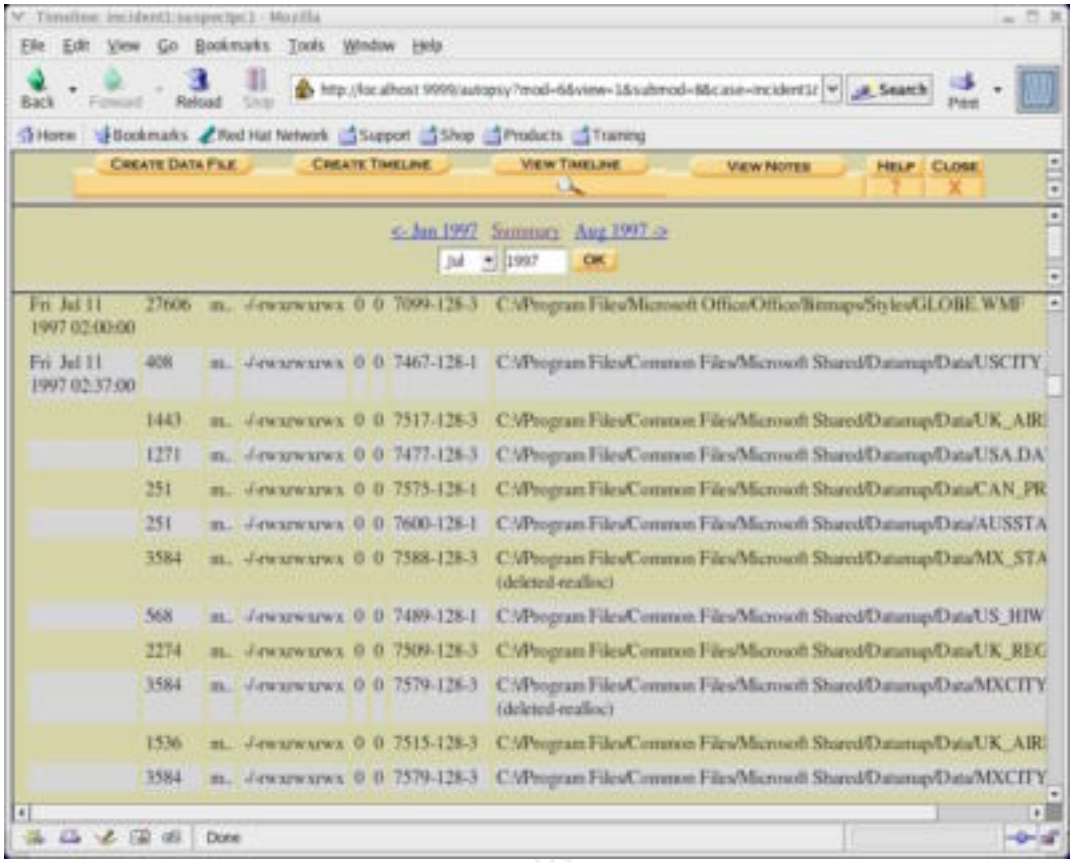
I viewed the time line going back 2 months to detect any activity associated to the key logger on victimpc1 and victimpc2. I didn't detect any such activity. This would be indicated by the key logger output files from victimpc1 and victimpc2 shown being created on suspectpc.



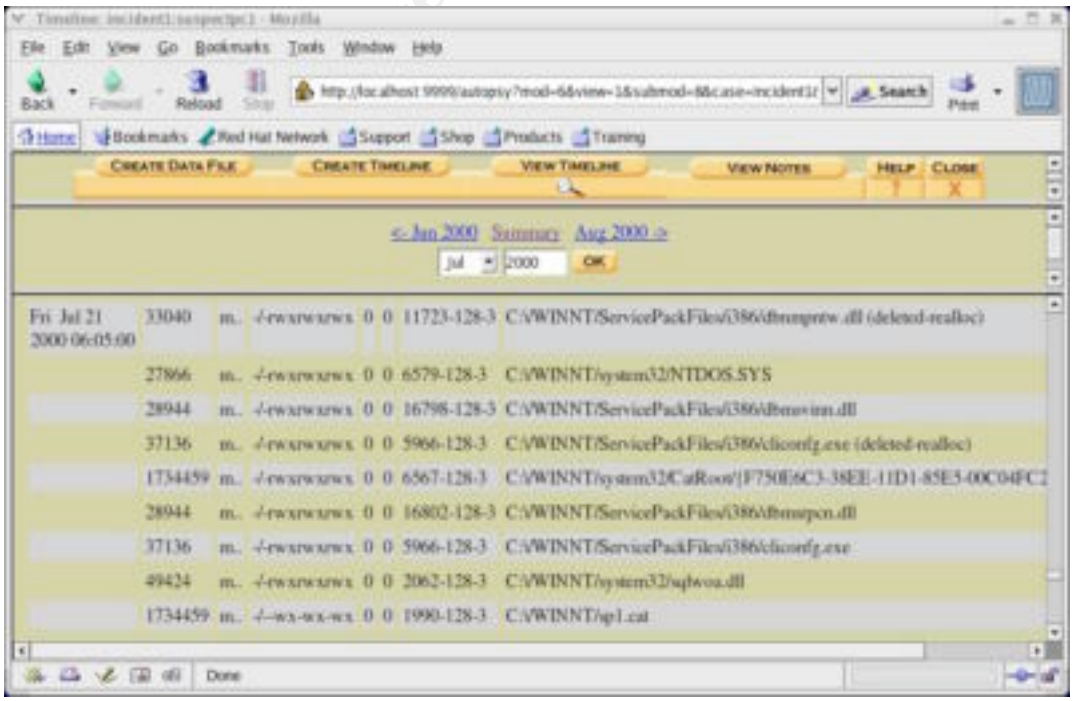
I analyzed the time line further to gain an understanding of major changes to the system, which might be helpful to the investigation.

From the screen above, I clicked on “Summary”. The resulting page shows the number of events broken down by month and day. I chose days that had a large number of events.

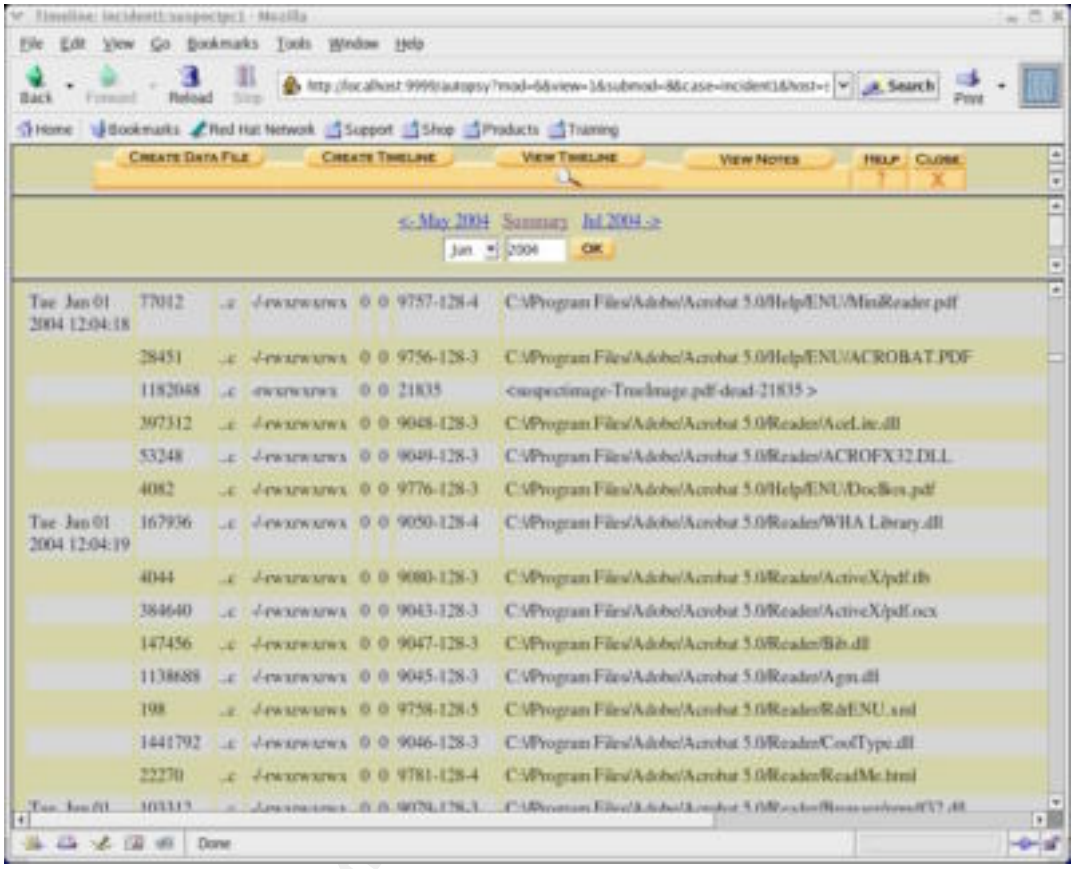
The earliest files were dated July 11, 1997.



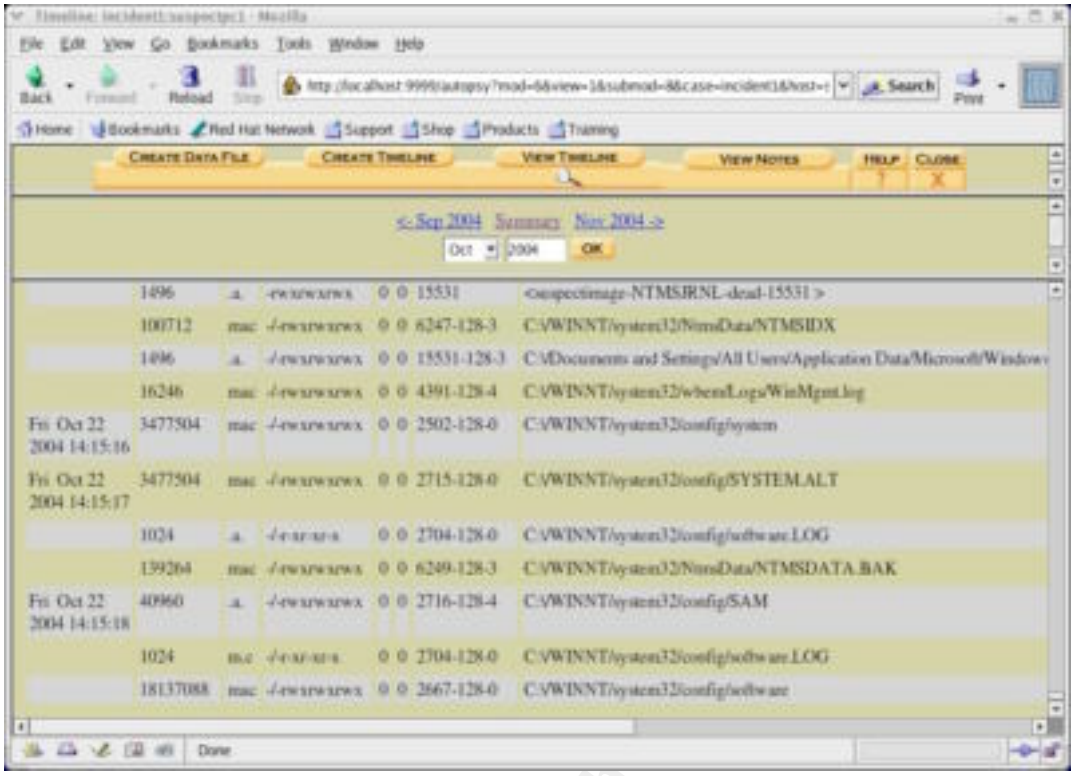
On July 21, 2000, the timeline shows Service Pack 1 installing by modifying files. The last file in the following screen shot is “sp1.cat,” which is a file included in Service Pack 1.



A large number significant number of file creates occurred on Jun 1, 2004. Several applications were removed and reinstalled. As shown below, the “c” indicates the creation of files and directories. The following screen shot shows the creation of files for Adobe Acrobat 5.0. Other applications included: Yahoo IM, AOL AIM, Spybot, and MSN messenger; not shown in this screen shot.



Last activity on the system was on October 22, 2004 at 14:15:18. October 22, 2004, is the day the suspect was put on administrative leave. This also indicates the last time any files on suspectpc1 were modified, accessed, and/or created, which is important to the integrity of the suspect hard drive and the image that was created from the suspect hard drive.



I conducted a string search on suspectimage. A string search is used to search for matches to what you are searching for. I performed the string search within Autopsy. It is called Keyword Search in autopsy. I searched on very specific words and phrases to determine if any correlation existed between suspectpc1 and the victim pc's.

The first word I searched for was "keylog." This result showed 20,718 occurrences of this word on the image. This search was too broad and needed to be more specific.

I searched for "klpf." This is the name of the executable file of the key logger installed on victimpc1 and victimpc2. The result showed 1 occurrence. This was found in Cluster 422742. I viewed the contents of that cluster and soon discovered other words associated with spyware and adware. This cluster contained a signature file for a spyware/adware removal tool. Therefore, the instance of finding klpf did not indicate that Key Log Pro was installed or had been installed on the suspect.

Victimpc1 and victimpc2 both had the same license key for Key Log Pro. I searched for the license string on the suspectimage. The result showed no occurrences.

The last string I searched for was the password the lady and her manager used for password protecting Excel documents. This password was supposed to be used between these 2 people and not shared with the suspect. I found 1 occurrence of this password on the suspectimage. This was found in Cluster 57412. This was contained in a configuration file for some sort of password cracking utility. The line in the configuration file this password was found read: "StartFrom = (password the lady and manager used)" Other key words in this

cluster included: BruteForce, MinPassLen_Value, MaxPassLen_Value. These are all words associated with a password cracking utility. I was unable to determine which password cracking utility was used based on just this configuration file.

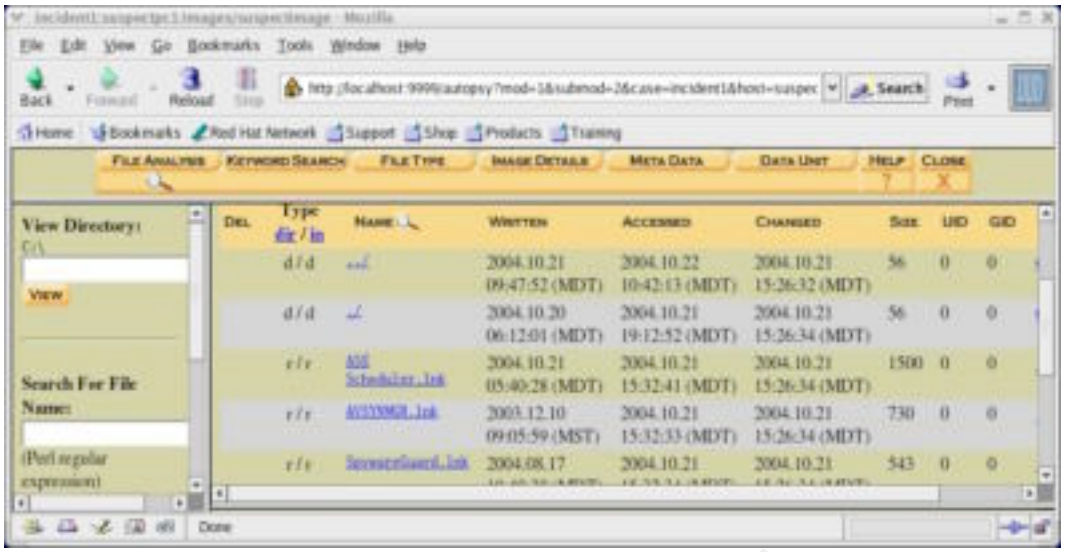
However, it was impossible to find and extract the program that uses this configuration file. This configuration file was located in a bad sector, which made it impossible to trace down the clusters containing the password cracking utility. The meta data for the cluster containing this configuration file pointed back to a special file in the ntfs file system called: $BadClus:$Bad. "This Metadata file contains a list of all the bad clusters on the volume." (http://linux-ntfs.sourceforge.net/ntfs/files/badclus.html).

Within Autopsy, I went to the File Analysis section. I proceeded down through the following files: \Documents and Settings\suspect\Local Settings\History\History.IE5 Within this directory I selected the file: index.dat. I then clicked on the link to export this file. I saved this under /incident1/suspectindex.dat I used pasco (http://www.foundstone.com/resources/proddesc/pasco.htm) to analyze this file. Paso is a forensics tool that enables you to view the information in the index.dat file. In this case, the index.dat file contains Internet Explorer history. I did not discover any suspicious URLs during my analysis. Suspicious URLs would include the URL for Key Log Pro and for password cracking utilities.

```
# pasco index.dat
```

I then proceeded down the following files: \Documents and Settings\Administrator\Local Settings\History\History.IE5. I exported the index.dat file from this directory. Again, I used pasco to view the contents of the index.dat file. I did not discover any suspicious URLs. I wanted to check the Internet history of the local administrator, just in case the suspect was browsing suspicious URLs while logged in at the local administrator. Suspicious URL's include the URL to download Key Log Pro and sites containing password cracking utilities.

I also viewed what programs startup when the pc starts. This is located in \Documents and Settings\suspect\Start Menu\ Programs\Startup. Nothing out of the ordinary was discovered. Suspicious programs starting up would include password cracking utilities.



I went to \RECYCLER. I clicked on each user SID and downloaded the INFO2 file for each user. The INFO2 file contains information about file(s) that was deleted.

I used a forensics tool, rifiuti (http://www.foundstone.com/resources/proddesc/rifiuti.htm), to view the contents of the INFO2 file for each user. I did not find any deleted files.

rifiuti INFO2

In Autopsy, I went to the \Documents and Settings\suspect\My Documents folder. I found a deleted file named users. Autopsy shows files that were deleted in red. I clicked on the file users. Autopsy automatically switches to "Deleted File Recovery Mode" since the file had been deleted. It showed the file had been deleted on April 20. 2004.

I then clicked on Export to extract this file.

I then opened the extracted file in OpenOffice.org Writer. The document contained a list of users matched up with system names. All of the users were located in the same location as the suspect. Since the suspect performed IT tasks, having this information is appropriate.

Conclusion

From the timeline I gathered some information as to the habits of the suspect. The suspect kept the system updated. From the timeline I found Windows service pack installs, antivirus updates, and Yahoo IM updates. In addition, the suspect used Spybot (http://beam.to/spybotsd), which is a spyware/adware removal tool. I saw frequent updates to Spybot, indicated by Spybot files being modified. I also saw a pop up blocker installed, Panicware (http://www.panicware.com/popupstopper-popupkiller.html?hop=welcome1). The suspect also frequented various technical websites.

All of the information gathered from the timeline mentioned above strongly indicates the suspect had a good understanding of how to maintain his Windows 2000 workstation.

There was no evidence of the key logger or the key logger output files from victimpc1 and victimpc2 currently on or having been on suspectpc1.

The only correlation from suspectpc1 and both victimpc1 and victimpc2 was the password cracking utility configuration file, on suspectpc1, containing a password known only to the owners of victimpc1 and victimpc2. It may be possible that the information and the password cracking utility may be recoverable using some 3rd party company who specializes in data recovery.

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