XFOCUS TEAM
from internet,for internet

Reliable enumerating the Windows processes in ring3

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X'CON 2004

Normal method of enumerating process

- Psapi
  - EnumProcesses()
- ToolHelp32
  - Process32First()
  - Process32Next()
- NtQuerySystemInformation()

SystemProcessInformation = 5

à ExpGetProcessInformation()

à Travel the ActiveProcessLinks

à Locate the EPROCESS

à Obtain the information of process

EPROCESS

- A snip of EPROCESS structure:

```
.....
DWORD      UniqueProcessId
LIST_ENTRY  ActiveProcessLinks
.....
Char        ImageFileName[16]
```

- A snip of ETHREAD structure:

```
.....
PEPROCESS  ThreadsProcess
.....
```

ActiveProcessLinks

```
kd> da poi(PsInitialSystemProcess) + 1fc
81a2fc5c  "System"
kd> da poi(poi(PsInitialSystemProcess)+a0) -a0 + 1fc
8132af5c  "SMSS.EXE"
kd> da poi(poi(poi(PsInitialSystemProcess)+a0)) -a0 + 1fc
8134af5c  "CSRSS.EXE"
kd> da poi(poi(poi(poi(PsInitialSystemProcess)+a0))) -a0 + 1fc
8119375c  "WINLOGON.EXE"
```

Hidden process detective flow

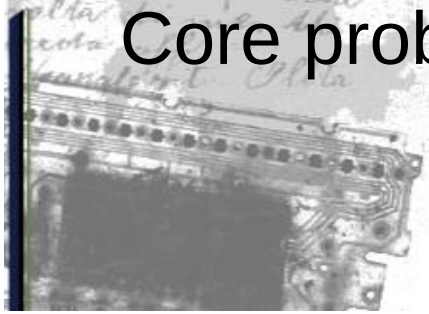
Locate all EPROCESS

Normal method of

Obtain the process information

Compare and find the hidden processes

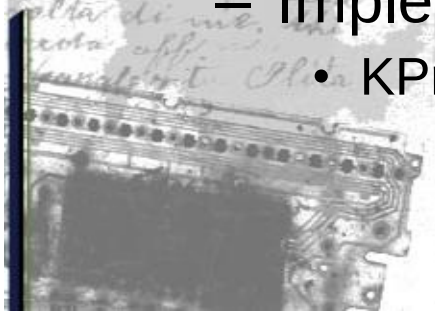
Core problem: Locating the EPROCESS



War between hidden and detective

- Hook NtQuerySystemInformation()
  - Hook SDT
  - SystemProcessInformation=5
    SystemHandleInformation=16
  - Implement:
    - Hacker Defender (holy_father@phreaker.net)

- Travel the ActiveProcessLinks directly and enumerate the processes
  - Can detective Hook NtQuerySystemInformation()
  - Implement：
    - KProcCheck (chewkeong@security.org.sg)



War between hidden and detective

- Unlink itself from ActiveProcessLinks
  - Implement:
    - FU_Rootkit (fuzen_op@yahoo.com)
- Utilize the thread schedule list detect the hidden processes
  - KiWaitInListHead、KiWaitOutListhead、KiDispatcherReadyListHead
  - Can detect Hook NtQuerySystemInformation()
  - Can detect unlink from ActiveProcessLinks
  - Can't implement on Windows XP and Windows 2003
  - Implement
    - Klister (joanna@mailsnare.net)
    - KProcCheck (chewkeong@security.org.sg)

War between hidden and detective

- Defeat processes detective method base on kernel schedule link
  - http://www.xfocus.net/articles/200404/693.html (Kinsephi@hotmail.com)

- Hook SwapContext()

  Original SwapContext() function:

```
__fastcall SwapContext
(
        PETHREAD SwapIn,
        PETHREAD SwapOut
)
```

Hook SwapContext()

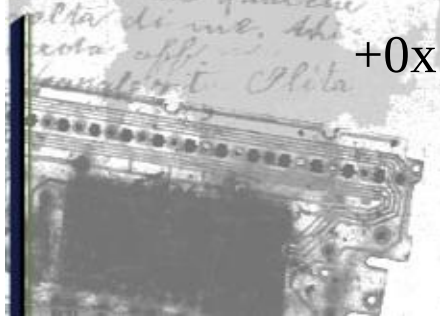
- Support Windows 2000/XP/2003
- CONTEXT SWAP level detective more reliable
- Can detect all know process hidden method
- SwapContext() is not Exported function
  - Reliable
  - May cause system crash
- Implement:
  - http://www.rootkit.com/newsread_print.php?newsid=170 (kkasslin@cc.hut.fi)

New finding in EPROCESS

- Windows NT 5.0、5.1
  - EPROCESS. SessionProcessLinks
    - Not include System和smss.exe
  - EPROCESS.Vm.WorkingSetExpansionLinks

- Windows NT 5.2
  - EPROCESS. MmProcessLinks

```
kd> dt _EPROCESS ImageFileName poi(MmProcessList)-238
   +0x154 ImageFileName : [16]  "Idle"
kd> dt _EPROCESS ImageFileName poi(poi(MmProcessList))-238
   +0x154 ImageFileName : [16]  "System"
```



Find first EPROCESS

- Export PsInitialSystemProcess Ntoskrnl.exe

```
kd> dt _EPROCESS ImageFileName
   poi(PsInitialSystemProcess)
   +0x1fc ImageFileName : [16]  "System“
```

- NtQuerySystemInformation()
  - SystemHandleInformation = 16
  - SYSTEM_HANDLE_INFORMATION.Object

Finding first EPROCESS

- Utilizing KPCR

```
kd> dt _KPCR PrcbData.CurrentThread ffdff000
   +0x120 PrcbData                 :
      +0x004 CurrentThread         : 0xff91e740
kd> dt _ETHREAD ThreadsProcess 0xff91e740
   +0x22c ThreadsProcess : 0xff9011c0
kd> dt _EPROCESS ImageFileName 0xff9011c0
   +0x1fc ImageFileName : [16]  "kd.exe"
```

Read kernel date-NT 5.0

- Read physical memory

```
RtlInitUnicodeString (
   &PhyMemString,
   L\\Device\\PhysicalMemory
);
ZwOpenSection (
   &hPhyMem, SECTION_MAP_READ,
   &PhyMemAttribs
);
MapAddress = MapViewOfFile (
   hPhyMem, FILE_MAP_READ, 0, ReadAddress,
   ReadLength + GetPageSize()
);
```

Read kernel date-NT 5.0

- Virtual address **à** Physical address

```
PVOID __stdcall LameGetPhysicalAddress( PVOID KernelAddress )
{
    PVOID PhysAddress = 0;

    if((DWORD)KernelAddress < 0x80000000L ||
      (DWORD)KernelAddress >= 0xA0000000L)
       (DWORD)PhysAddress= (DWORD)KernelAddress & 0x0FFFFFFF;
    else
       (DWORD)PhysAddress = (DWORD)KernelAddress & 0x1FFFFFFF;
    return PhysAddress;
}
```

– Flier Lu (flier_AT_nsfocus.com)
"Aintegrality of Windows NT system dispatch list"

Read kernel date-NT 5.1/5.2

- ZwSystemDebugControl()

```
NTSTATUS ZwSystemDebugControl (
    IN SYSDBG_COMMAND Command,
    IN PVOID InputBuffer,
    IN ULONG InputBufferLength,
    OUT PVOID OutputBuffer,
    IN ULONG OutputBufferLength,
    OUT PULONG ReturnLength
    );
```

Read kernel date-NT 5.1/5.2

```
typedef struct _MEMORY_CHUNKS {
    ULONG Address;
    PVOID Data;
    ULONG Length;
}MEMORY_CHUNKS, *PMEMORY_CHUNKS;
MEMORY_CHUNKS QueryBuff;

ZwSystemDebugControl (
    SysDbgReadKernelMemory,
    &QueryBuff,
    sizeof(MEMORY_CHUNKS),
    NULL,
    0,
    &ReturnLength
);
```

Obtain full patch of process image

- Windows NT 5.0

```
kd> dt _EPROCESS pImageFileName
    poi(poi(PsInitialSystemProcess)+a0)-a0
   +0x284 pImageFileName : 0x81363fb8  "\WINNT\system32\SMSS.EXE“
```

- Windows NT 5.1/5.2

```
lkd> dt _eprocess SeAuditProcessCreationInfo.ImageFileName->Name
    0ff894218
nt!_EPROCESS
   +0x1d4 SeAuditProcessCreationInfo                :
      +0x000 ImageFileName                          :
         +0x000 Name                                : _UNICODE_STRING
"\Device\HarddiskVolume1\WINDOWS\system32\cmd.exe"
```

Handling the process remains

- Can’t unlink the EPROCESS properly After process end
- Other members of EPROCESS are corrupted
  - Check validity
- MmProcessLinks can enumerate all the remains of EPROCESS

Reference

[1]Hacker Defender
Holy_Father(holy_father_AT_phreaker.net)
- http://rootkit.host.sk/

[2]KprocCheck Tan Chew Keong(chewkeong_AT_security.org.sg)
- http://www.security.org.sg/code/kproccheck.html

[3]FU_Rootkit fuzen_op(fuzen_op_AT_yahoo.com)
- https://www.rootkit.com/vault/fuzen_op/FU_Rootkit.zip

[4]Klister Joanna Rutkowska(joanna_AT_mailsnare.net)
- http://www.rootkit.com/vault/joanna/klister-0.4.zip

Reference

[5]绕过内核调度链表进程检测
SoBeIt(Kinsephi_AT_hotmail.com)

- http://www.xfocus.net/articles/200404/693.html

[6]Detecting Hidden Processes by Hooking the SwapContext Function kkasslin(kkasslin_AT_cc.hut.fi)

- http://www.rootkit.com/newsread_print.php?newsid=170

[7]Playing with Windows /dev/(k)mem crazylord (razylord_AT_thins.net)

- http://www.phrack.org/phrack/59/p59-0x10.txt

Reference

[8]自动验证 Windows NT 系统服务描述表的完整性 Flier Lu (flier_AT_nsfocus.com)

- http://www.nsfocus.net/index.php?act=magazine&do=view&mid=2119

[9]对Native API NtSystemDebugControl的分析 tombkeeper (tombkeeper_AT_xfocus.org)

- http://www.xfocus.net/articles/200408/721.html

[10]获取Windows 系统的内核变量 tombkeeper (tombkeeper_AT_xfocus.org)

- http://www.xfocus.net/articles/200408/724.html