Malware Sandbox Analysis

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Acknowledgement

- Special thanks to **Null** community for their extended support and co-operation.
- Special thanks to **ThoughtWorks** for the beautiful venue.
- Thanks to all the trainers who have devoted their precious time and countless hours to make it happen.

Advanced Malware Analysis Training

This presentation is part of our **Advanced Malware Analysis** Training program. Currently it is delivered only during our local meets for FREE of cost.

For complete details of this course, visit our Security Training page.

Who am I?

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Sandbox Overview

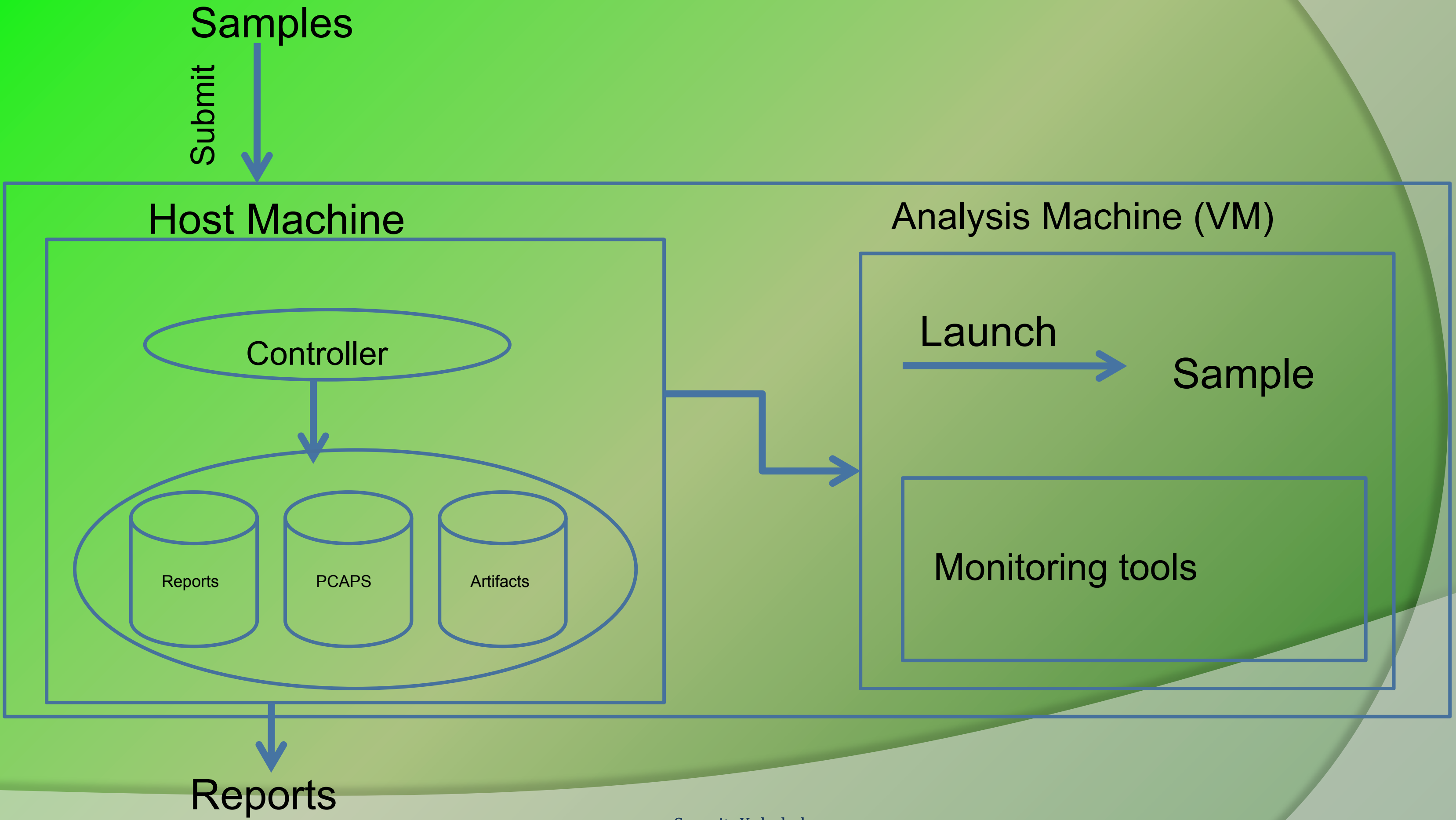
- Execute malware in a controlled/monitored environment
- Monitors file system, registry, process and network activity
- Outputs the results in multiple formats
- Examples of Sandboxes
  - Cuckoo Sandbox
  - ThreatExpert
  - Anubis
  - CWSandbox

Why Sandbox Analysis?

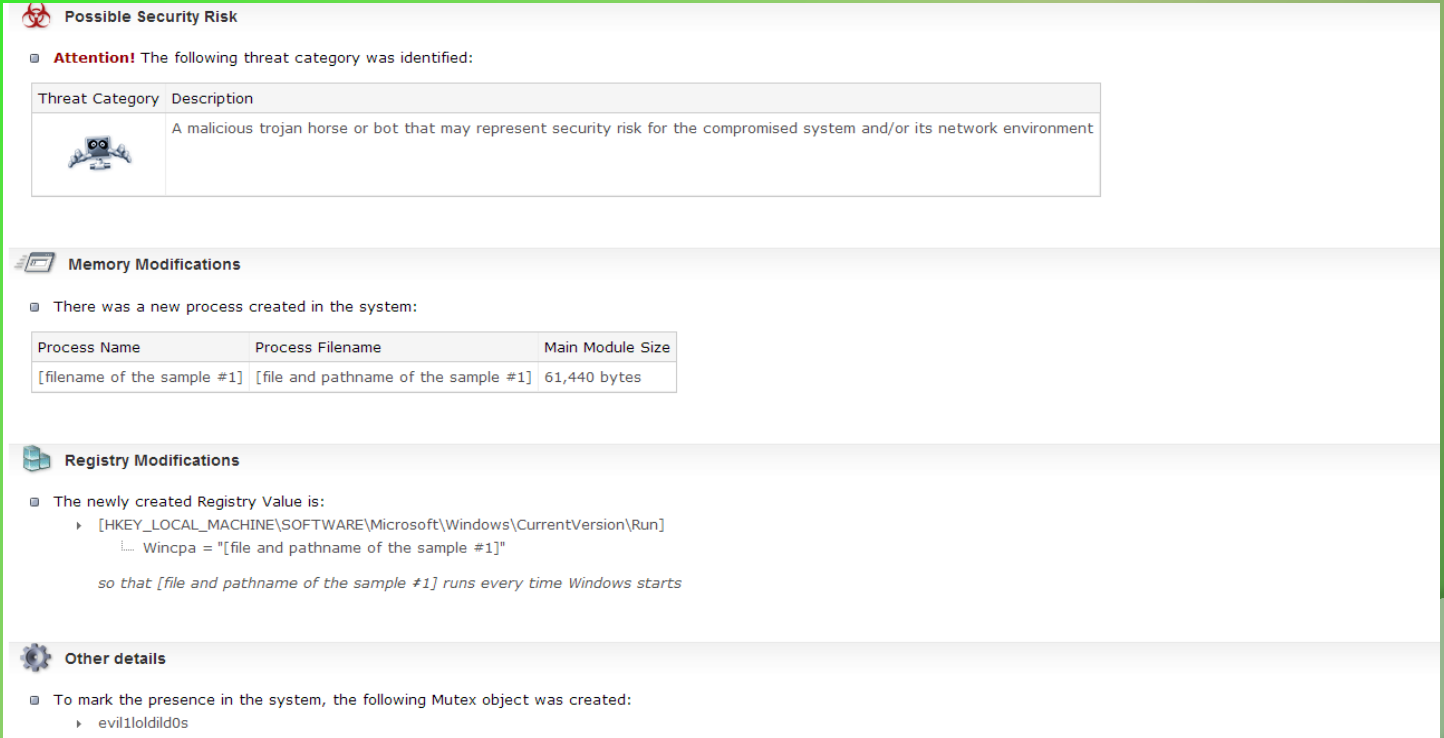
To determine:

- The nature and purpose of the malware
- Interaction with the file system
- Interaction with the registry
- Interaction with the network
- To determine identifiable patterns

Sandbox Architecture



Online Sandbox –ThreatExpert results



Possible Security Risk

- **Attention!** The following threat category was identified:

Threat Category	Description
	A malicious trojan horse or bot that may represent security risk for the compromised system and/or its network environment

Memory Modifications

- There was a new process created in the system:

Process Name	Process Filename	Main Module Size
[filename of the sample #1]	[file and pathname of the sample #1]	61,440 bytes

Registry Modifications

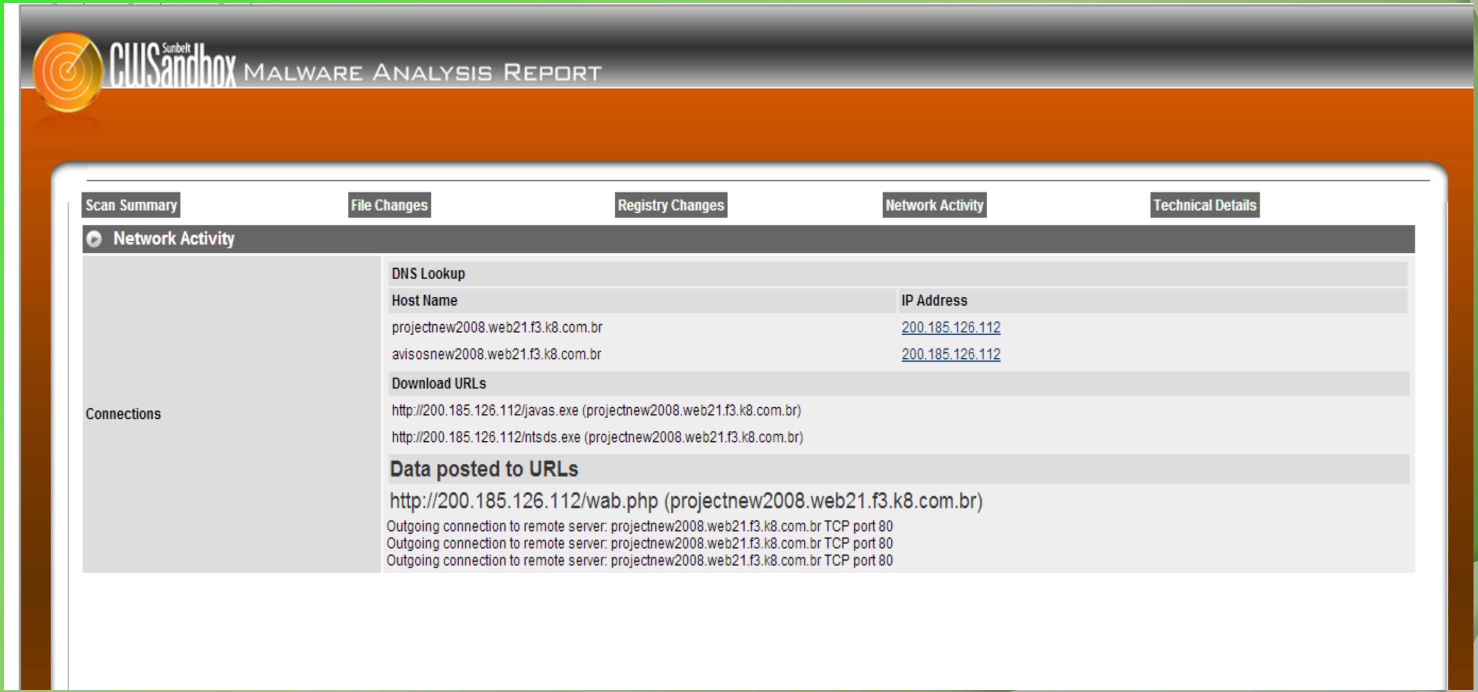
- The newly created Registry Value is:
  - [HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\Windows\CurrentVersion\Run]
    - Wincpa = "[file and pathname of the sample #1]"

  so that [file and pathname of the sample #1] runs every time Windows starts

Other details

- To mark the presence in the system, the following Mutex object was created:
  - evil1loldild0s

Online Sandbox –CWSandbox results



Network Activity

Connections

DNS Lookup

Host Name	IP Address
projectnew2008.web21.f3.k8.com.br	200.185.126.112
avisosnew2008.web21.f3.k8.com.br	200.185.126.112

Download URLs

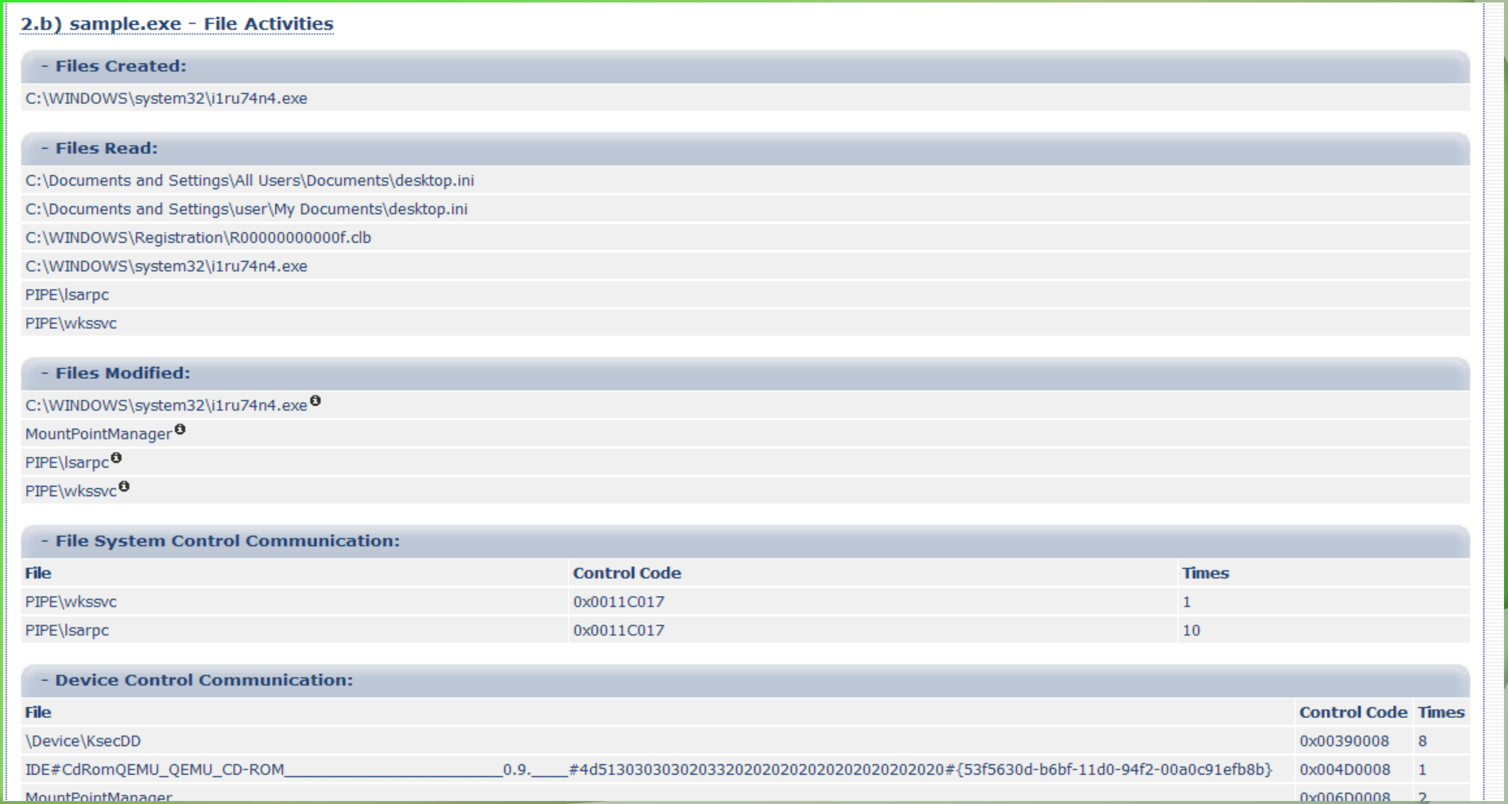
http://200.185.126.112/javas.exe (projectnew2008.web21.f3.k8.com.br)
http://200.185.126.112/ntsds.exe (projectnew2008.web21.f3.k8.com.br)

Data posted to URLs

http://200.185.126.112/wab.php (projectnew2008.web21.f3.k8.com.br)

```
Outgoing connection to remote server: projectnew2008.web21.f3.k8.com.br TCP port 80
Outgoing connection to remote server: projectnew2008.web21.f3.k8.com.br TCP port 80
Outgoing connection to remote server: projectnew2008.web21.f3.k8.com.br TCP port 80
```

Online Sandbox –Anubis results



2.b) sample.exe - File Activities

- Files Created:

C:\WINDOWS\system32\i1ru74n4.exe

- Files Read:

C:\Documents and Settings\All Users\Documents\desktop.ini

C:\Documents and Settings\user\My Documents\desktop.ini

C:\WINDOWS\Registration\R00000000000f.clb

C:\WINDOWS\system32\i1ru74n4.exe

PIPE\lsarpc

PIPE\wkssvc

- Files Modified:

C:\WINDOWS\system32\i1ru74n4.exe

MountPointManager

PIPE\lsarpc

PIPE\wkssvc

- File System Control Communication:

File	Control Code	Times
PIPE\wkssvc	0x0011C017	1
PIPE\lsarpc	0x0011C017	10

- Device Control Communication:

File	Control Code	Times
\Device\KsecDD	0x00390008	8
IDE#CdRomQEMU_QEMU_CD-ROM________________________0.9.____#4d51303030303320202020202020202020202020#{53f5630d-b6bf-11d0-94f2-00a0c91efb8b}	0x004D0008	1
MountPointManager	0x006D0008	2

Custom Sandbox – sandbox.py

- Automates static, dynamic and Memory analysis using open source tools
- Written in python
- Can be run in sandbox mode or internet mode
- In sandbox mode it can simulate internet services (this is the default mode)
- Allows you to set the timeout for the malware to run (default is 60 seconds)
- Stores final reports, pcaps, desktop screeshot , and malicious artifacts for later analysis

Sandbox.py (working)

- Takes sample as input
- Performs static analysis
- Reverts VM to clean snapshot
- Starts the VM
- Transfers the malware to VM
- Runs the monitoring tools (to monitor process, registry, file system, network activity)
- Executes the malware for the specified time

Sandbox.py (working contd)

- Stops the monitoring tools
- Suspends the VM
- Acquires the memory image
- Performs memory analysis using Volatility framework
- Stores the results (Final reports, destkop screenshot, pcaps and malicious artifacts for later analysis)

Sandbox.py Report

Static analysis results:

- File type (uses magic python module)
- Cryptographic hash (md5sum – uses hashlib python module)
- VirusTotal results (python script using VirusTotal's public api)
- Determines packers used by malware (uses yara-python)
- Determines the capabilities of the malware like IRC, P2P etc etc (uses yara-python module)

Sandbox.py report

Dynamic analysis results:

- Determines File system activity
- Determines Process activity
- Determines Registry activity
- Monitor Network activity
- Displays DNS summary
- Shows TCP conversations
- Displays HTTP requests & HTTP request tree

Sandbox.py report

Memory analysis results:

- uses Volatility advanced memory forensics framework
- displays process, hidden process in memory
- displays network connections, terminated network connections
- displays listening sockets
- determines api hooks, code injection and embedded executable in memory
- displays DLL's loaded by the process memory
- displays services in memory
- displays the registry keys (like run registry key)

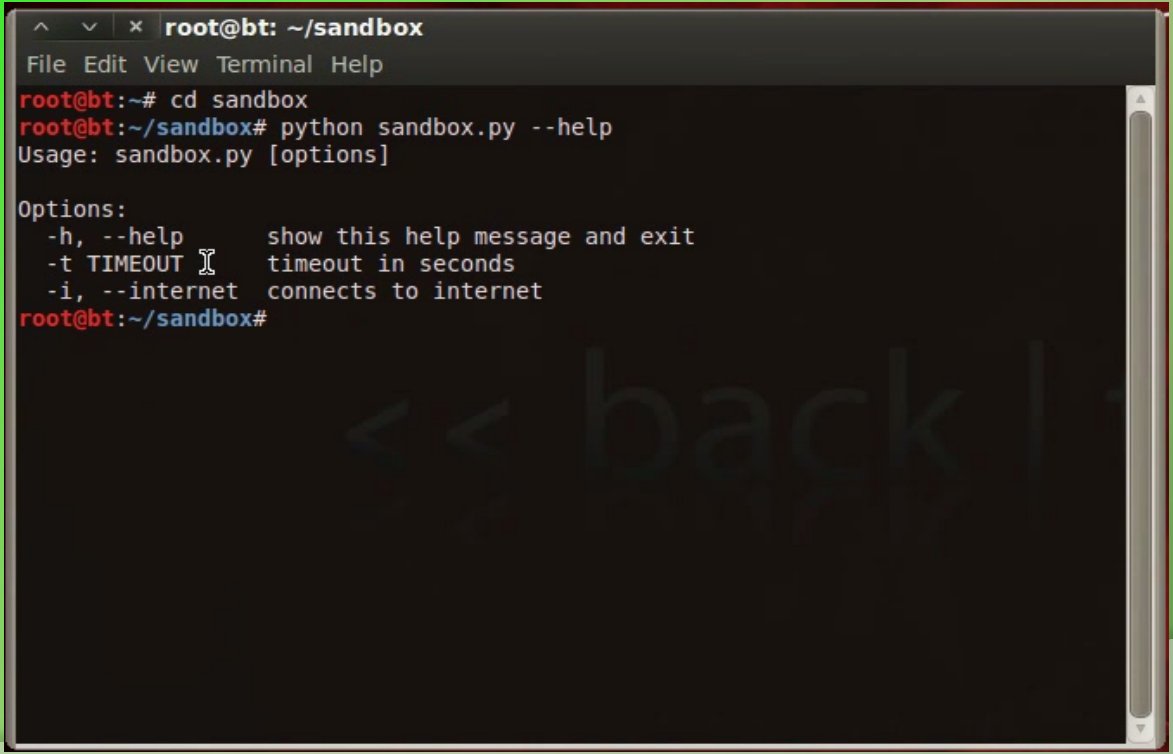
DEMO 1, 2 & 3

(SANDBOX ANALYSIS)

All Training Demo Videos are available at
http://securityxploded.com/security-training-videos.php

Sandbox.py – Help option

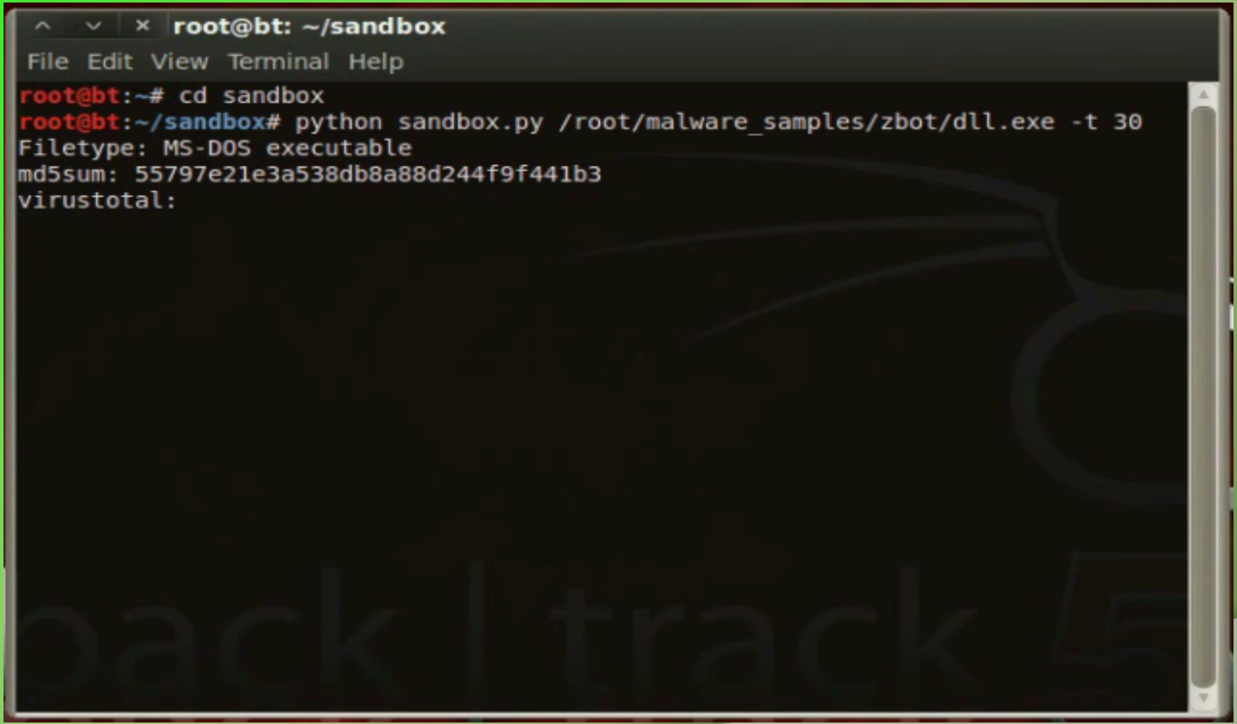
The below screenshot shows the sandbox.py help option



```
root@bt:~# cd sandbox
root@bt:~/sandbox# python sandbox.py --help
Usage: sandbox.py [options]

Options:
  -h, --help      show this help message and exit
  -t TIMEOUT      timeout in seconds
  -i, --internet  connects to internet
root@bt:~/sandbox#
```

Sandbox.py – Input

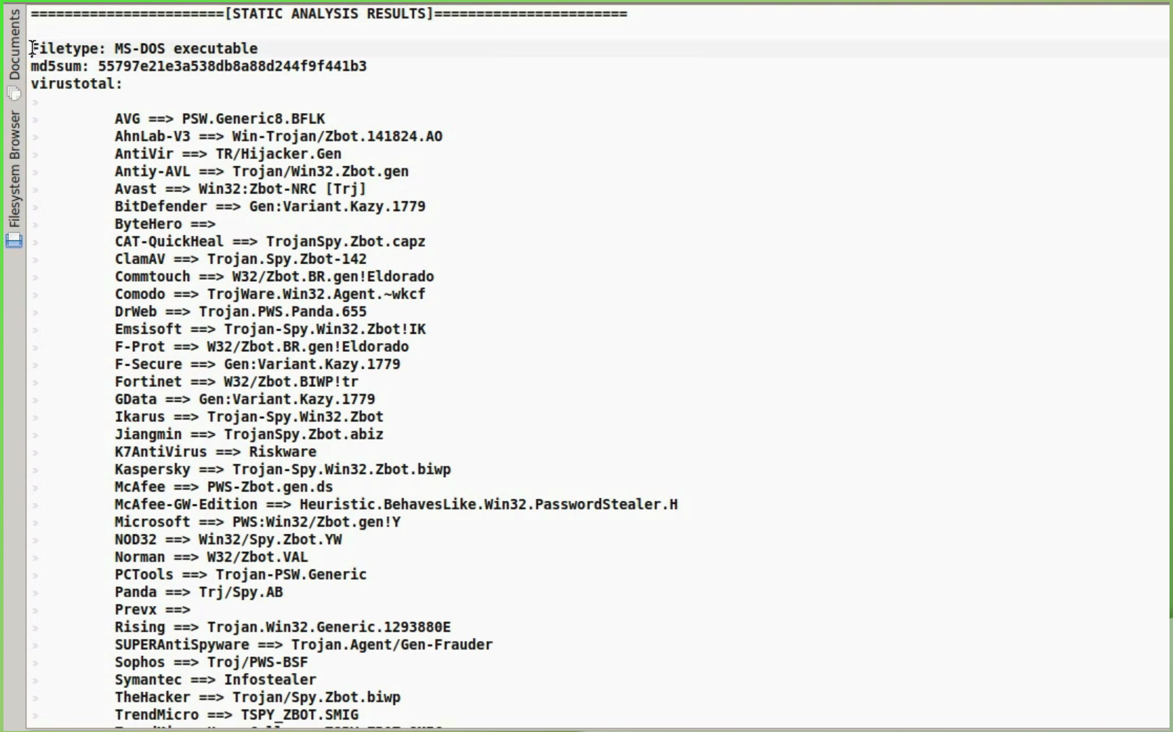
The below screenshot shows the sandbox.py taking sample as input to run it for 30 seconds



```
root@bt:~# cd sandbox
root@bt:~/sandbox# python sandbox.py /root/malware_samples/zbot/dll.exe -t 30
Filetype: MS-DOS executable
md5sum: 55797e21e3a538db8a88d244f9f441b3
virustotal:
```

Sandbox.py – Static Analysis

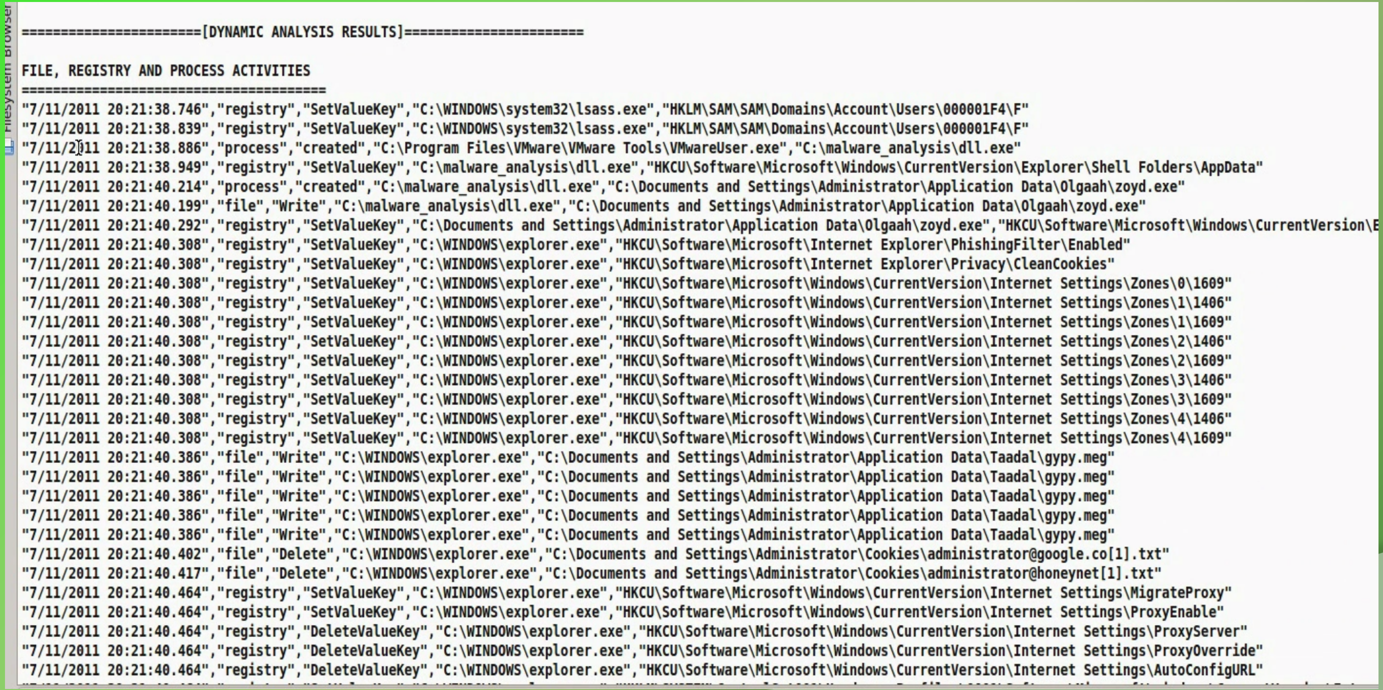
The below screenshot shows the static analysis results after executing the sample



```
=======================[STATIC ANALYSIS RESULTS]=======================

Filetype: MS-DOS executable
md5sum: 55797e21e3a538db8a88d244f9f441b3
virustotal:

          AVG ==> PSW.Generic8.BFLK
          AhnLab-V3 ==> Win-Trojan/Zbot.141824.AO
          AntiVir ==> TR/Hijacker.Gen
          Antiy-AVL ==> Trojan/Win32.Zbot.gen
          Avast ==> Win32:Zbot-NRC [Trj]
          BitDefender ==> Gen:Variant.Kazy.1779
          ByteHero ==>
          CAT-QuickHeal ==> TrojanSpy.Zbot.capz
          ClamAV ==> Trojan.Spy.Zbot-142
          Commtouch ==> W32/Zbot.BR.gen!Eldorado
          Comodo ==> TrojWare.Win32.Agent.~wkcf
          DrWeb ==> Trojan.PWS.Panda.655
          Emsisoft ==> Trojan-Spy.Win32.Zbot!IK
          F-Prot ==> W32/Zbot.BR.gen!Eldorado
          F-Secure ==> Gen:Variant.Kazy.1779
          Fortinet ==> W32/Zbot.BIWP!tr
          GData ==> Gen:Variant.Kazy.1779
          Ikarus ==> Trojan-Spy.Win32.Zbot
          Jiangmin ==> TrojanSpy.Zbot.abiz
          K7AntiVirus ==> Riskware
          Kaspersky ==> Trojan-Spy.Win32.Zbot.biwp
          McAfee ==> PWS-Zbot.gen.ds
          McAfee-GW-Edition ==> Heuristic.BehavesLike.Win32.PasswordStealer.H
          Microsoft ==> PWS:Win32/Zbot.gen!Y
          NOD32 ==> Win32/Spy.Zbot.YW
          Norman ==> W32/Zbot.VAL
          PCTools ==> Trojan-PSW.Generic
          Panda ==> Trj/Spy.AB
          Prevx ==>
          Rising ==> Trojan.Win32.Generic.1293880E
          SUPERAntiSpyware ==> Trojan.Agent/Gen-Frauder
          Sophos ==> Troj/PWS-BSF
          Symantec ==> Infostealer
          TheHacker ==> Trojan/Spy.Zbot.biwp
          TrendMicro ==> TSPY_ZBOT.SMIG
```

Sandbox.py – Dynamic Analysis

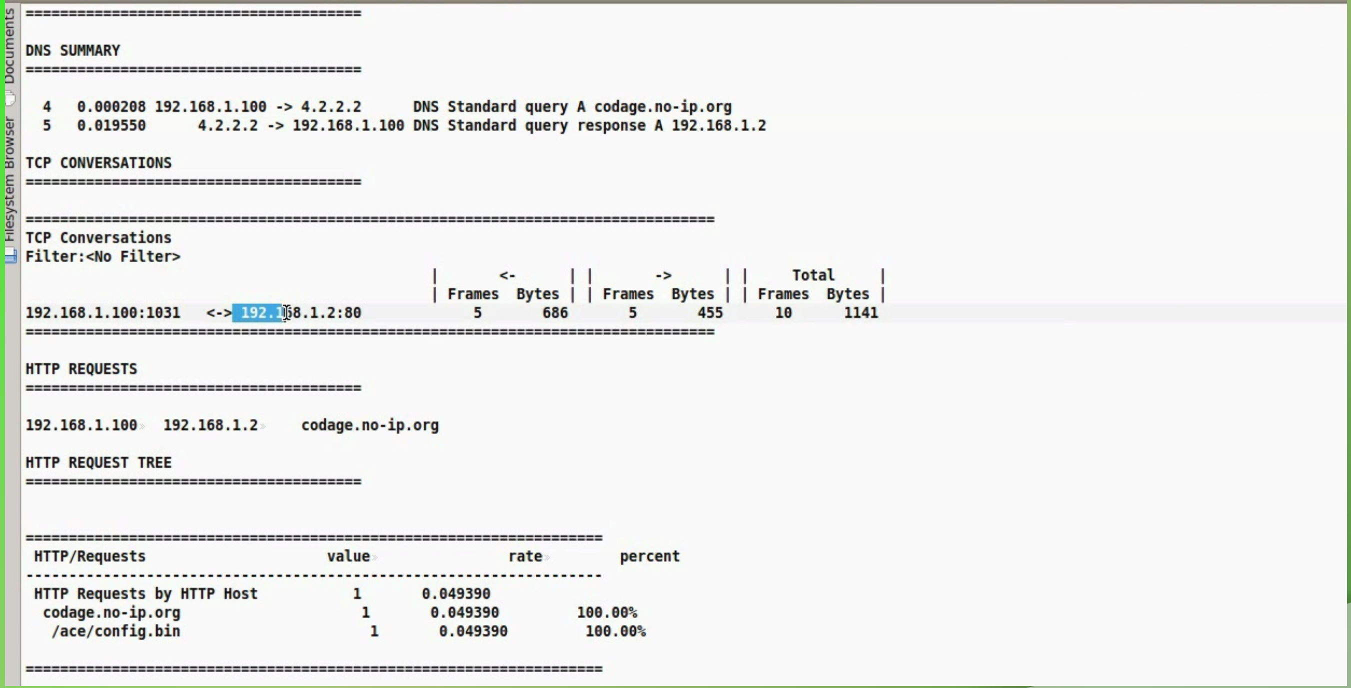
The below screenshot shows the dynamic analysis results after executing the sample



```
=======================[DYNAMIC ANALYSIS RESULTS]=======================

FILE, REGISTRY AND PROCESS ACTIVITIES
=======================================
"7/11/2011 20:21:38.746","registry","SetValueKey","C:\WINDOWS\system32\lsass.exe","HKLM\SAM\SAM\Domains\Account\Users\000001F4\F"
"7/11/2011 20:21:38.839","registry","SetValueKey","C:\WINDOWS\system32\lsass.exe","HKLM\SAM\SAM\Domains\Account\Users\000001F4\F"
"7/11/2011 20:21:38.886","process","created","C:\Program Files\VMware\VMware Tools\VMwareUser.exe","C:\malware_analysis\dll.exe"
"7/11/2011 20:21:38.949","registry","SetValueKey","C:\malware_analysis\dll.exe","HKCU\Software\Microsoft\Windows\CurrentVersion\Explorer\Shell Folders\AppData"
"7/11/2011 20:21:40.214","process","created","C:\malware_analysis\dll.exe","C:\Documents and Settings\Administrator\Application Data\Olgaah\zoyd.exe"
"7/11/2011 20:21:40.199","file","Write","C:\malware_analysis\dll.exe","C:\Documents and Settings\Administrator\Application Data\Olgaah\zoyd.exe"
"7/11/2011 20:21:40.292","registry","SetValueKey","C:\Documents and Settings\Administrator\Application Data\Olgaah\zoyd.exe","HKCU\Software\Microsoft\Windows\CurrentVersion\E
"7/11/2011 20:21:40.308","registry","SetValueKey","C:\WINDOWS\explorer.exe","HKCU\Software\Microsoft\Internet Explorer\PhishingFilter\Enabled"
"7/11/2011 20:21:40.308","registry","SetValueKey","C:\WINDOWS\explorer.exe","HKCU\Software\Microsoft\Internet Explorer\Privacy\CleanCookies"
"7/11/2011 20:21:40.308","registry","SetValueKey","C:\WINDOWS\explorer.exe","HKCU\Software\Microsoft\Windows\CurrentVersion\Internet Settings\Zones\0\1609"
"7/11/2011 20:21:40.308","registry","SetValueKey","C:\WINDOWS\explorer.exe","HKCU\Software\Microsoft\Windows\CurrentVersion\Internet Settings\Zones\1\1406"
"7/11/2011 20:21:40.308","registry","SetValueKey","C:\WINDOWS\explorer.exe","HKCU\Software\Microsoft\Windows\CurrentVersion\Internet Settings\Zones\1\1609"
"7/11/2011 20:21:40.308","registry","SetValueKey","C:\WINDOWS\explorer.exe","HKCU\Software\Microsoft\Windows\CurrentVersion\Internet Settings\Zones\2\1406"
"7/11/2011 20:21:40.308","registry","SetValueKey","C:\WINDOWS\explorer.exe","HKCU\Software\Microsoft\Windows\CurrentVersion\Internet Settings\Zones\2\1609"
"7/11/2011 20:21:40.308","registry","SetValueKey","C:\WINDOWS\explorer.exe","HKCU\Software\Microsoft\Windows\CurrentVersion\Internet Settings\Zones\3\1406"
"7/11/2011 20:21:40.308","registry","SetValueKey","C:\WINDOWS\explorer.exe","HKCU\Software\Microsoft\Windows\CurrentVersion\Internet Settings\Zones\3\1609"
"7/11/2011 20:21:40.308","registry","SetValueKey","C:\WINDOWS\explorer.exe","HKCU\Software\Microsoft\Windows\CurrentVersion\Internet Settings\Zones\4\1406"
"7/11/2011 20:21:40.308","registry","SetValueKey","C:\WINDOWS\explorer.exe","HKCU\Software\Microsoft\Windows\CurrentVersion\Internet Settings\Zones\4\1609"
"7/11/2011 20:21:40.386","file","Write","C:\WINDOWS\explorer.exe","C:\Documents and Settings\Administrator\Application Data\Taadal\gypy.meg"
"7/11/2011 20:21:40.386","file","Write","C:\WINDOWS\explorer.exe","C:\Documents and Settings\Administrator\Application Data\Taadal\gypy.meg"
"7/11/2011 20:21:40.386","file","Write","C:\WINDOWS\explorer.exe","C:\Documents and Settings\Administrator\Application Data\Taadal\gypy.meg"
"7/11/2011 20:21:40.386","file","Write","C:\WINDOWS\explorer.exe","C:\Documents and Settings\Administrator\Application Data\Taadal\gypy.meg"
"7/11/2011 20:21:40.386","file","Write","C:\WINDOWS\explorer.exe","C:\Documents and Settings\Administrator\Application Data\Taadal\gypy.meg"
"7/11/2011 20:21:40.402","file","Delete","C:\WINDOWS\explorer.exe","C:\Documents and Settings\Administrator\Cookies\administrator@google.co[1].txt"
"7/11/2011 20:21:40.417","file","Delete","C:\WINDOWS\explorer.exe","C:\Documents and Settings\Administrator\Cookies\administrator@honeynet[1].txt"
"7/11/2011 20:21:40.464","registry","SetValueKey","C:\WINDOWS\explorer.exe","HKCU\Software\Microsoft\Windows\CurrentVersion\Internet Settings\MigrateProxy"
"7/11/2011 20:21:40.464","registry","SetValueKey","C:\WINDOWS\explorer.exe","HKCU\Software\Microsoft\Windows\CurrentVersion\Internet Settings\ProxyEnable"
"7/11/2011 20:21:40.464","registry","DeleteValueKey","C:\WINDOWS\explorer.exe","HKCU\Software\Microsoft\Windows\CurrentVersion\Internet Settings\ProxyServer"
"7/11/2011 20:21:40.464","registry","DeleteValueKey","C:\WINDOWS\explorer.exe","HKCU\Software\Microsoft\Windows\CurrentVersion\Internet Settings\ProxyOverride"
"7/11/2011 20:21:40.464","registry","DeleteValueKey","C:\WINDOWS\explorer.exe","HKCU\Software\Microsoft\Windows\CurrentVersion\Internet Settings\AutoConfigURL"
```

Sandbox.py – Network Activity

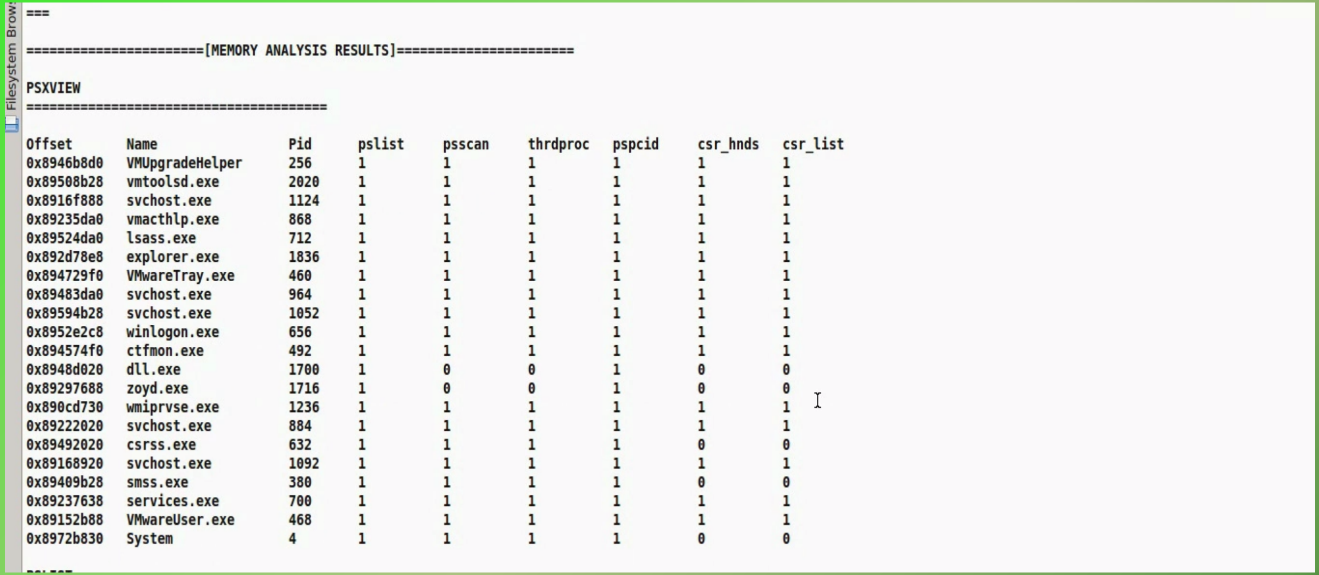
The below screenshot shows the network activity after executing the sample



```
=======================================

DNS SUMMARY
=======================================

  4   0.000208 192.168.1.100 -> 4.2.2.2      DNS Standard query A codage.no-ip.org
  5   0.019550      4.2.2.2 -> 192.168.1.100 DNS Standard query response A 192.168.1.2

TCP CONVERSATIONS
=======================================

================================================================================
TCP Conversations
Filter:<No Filter>
                                               |       <-      | |       ->      | |     Total     |
                                               | Frames  Bytes | | Frames  Bytes | | Frames  Bytes |
192.168.1.100:1031    <-> 192.168.1.2:80            5       686       5       455      10      1141
================================================================================

HTTP REQUESTS
=======================================

192.168.1.100   192.168.1.2     codage.no-ip.org

HTTP REQUEST TREE
=======================================


===================================================================
 HTTP/Requests                    value                rate         percent
-------------------------------------------------------------------
 HTTP Requests by HTTP Host          1       0.049390
  codage.no-ip.org                    1       0.049390         100.00%
   /ace/config.bin                     1       0.049390         100.00%

===================================================================
```

Sandbox.py – Memory Analysis

The below screenshot shows the memory analysis results after executing the sample



```
===

=====================[MEMORY ANALYSIS RESULTS]=====================

PSXVIEW
=======================================

Offset      Name              Pid     pslist    psscan    thrdproc  pspcid    csr_hnds  csr_list
0x8946b8d0  VMUpgradeHelper   256     1         1         1         1         1         1
0x89508b28  vmtoolsd.exe      2020    1         1         1         1         1         1
0x8916f888  svchost.exe       1124    1         1         1         1         1         1
0x89235da0  vmacthlp.exe      868     1         1         1         1         1         1
0x89524da0  lsass.exe         712     1         1         1         1         1         1
0x892d78e8  explorer.exe      1836    1         1         1         1         1         1
0x894729f0  VMwareTray.exe    460     1         1         1         1         1         1
0x89483da0  svchost.exe       964     1         1         1         1         1         1
0x89594b28  svchost.exe       1052    1         1         1         1         1         1
0x8952e2c8  winlogon.exe      656     1         1         1         1         1         1
0x894574f0  ctfmon.exe        492     1         1         1         1         1         1
0x8948d020  dll.exe           1700    1         0         0         1         0         0
0x89297688  zoyd.exe          1716    1         0         0         1         0         0
0x890cd730  wmiprvse.exe      1236    1         1         1         1         1         1
0x89222020  svchost.exe       884     1         1         1         1         1         1
0x89492020  csrss.exe         632     1         1         1         1         0         0
0x89168920  svchost.exe       1092    1         1         1         1         1         1
0x89409b28  smss.exe          380     1         1         1         1         0         0
0x89237638  services.exe      700     1         1         1         1         1         1
0x89152b88  VMwareUser.exe    468     1         1         1         1         1         1
0x8972b830  System            4       1         1         1         1         0         0
```

Reference

Complete Reference Guide for Advanced Malware Analysis Training

[Include links for all the Demos & Tools]

Thank You !

www.SecurityXploded.com