SANS DFIR
DIGITAL FORENSICS & INCIDENT RESPONSE

Hunt Evil POSTER

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DFPS_FOR508_v4.11_0624

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dfir.sans.org

Find Evil – Know Normal

Knowing what's normal on a Windows host helps cut through the noise to quickly locate potential malware.
Use the information below as a reference to know what's normal in Windows and to focus your attention on the outliers.

System

Image Path: N/A for **`system.exe`** – Not generated from an executable image
Parent Process: None
Number of Instances: One
User Account: Local System
Start Time: At boot time
Description: The **`System`** process is responsible for most kernel-mode threads. Modules run under **`System`** are primarily drivers (.sys files), but also include several important DLLs as well as the kernel executable, **`ntoskrnl.exe`**.

smss.exe

Image Path: `%SystemRoot%\System32\smss.exe`
Parent Process: System
Number of Instances: One master instance and another child instance per session. Children exit after creating their session.
User Account: Local System
Start Time: Within seconds of boot time for the master instance
Description: The Session Manager process is responsible for creating new sessions. The first instance creates a child instance for each new session. Once the child instance initializes the new session by starting the Windows subsystem (**`csrss.exe`**) and **`wininit.exe`** for Session 0 or **`winlogon.exe`** for Session 1 and higher, the child instance exits.

wininit.exe

Image Path: `%SystemRoot%\System32\wininit.exe`
Parent Process: Created by an instance of **`smss.exe`** that exits, typically appearing as an orphan process.
Number of Instances: One
User Account: Local System
Start Time: Within seconds of boot time
Description: **`wininit.exe`** starts key background processes within Session 0. It starts the Service Control Manager (**`services.exe`**), the Local Security Authority process (**`lsass.exe`**), and **`lsaiso.exe`** for systems with Credential Guard enabled. Note that prior to Windows 10, the Local Session Manager process (**`lsm.exe`**) was also started by wininit.exe. As of Windows 10, that functionality has moved to a service DLL (lsm.dll) hosted by **`svchost.exe`**.

RuntimeBroker.exe

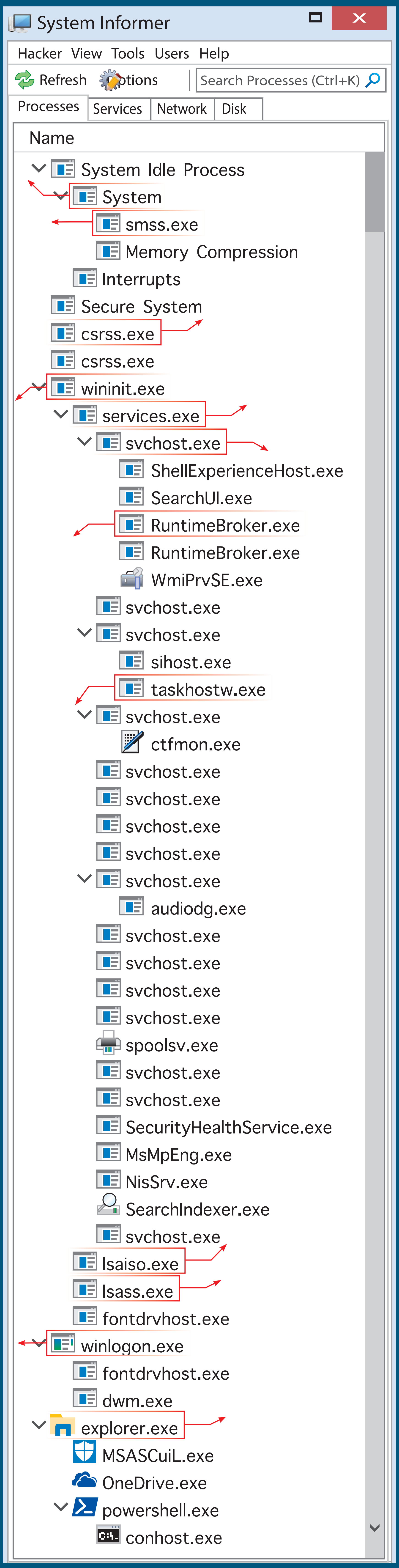
Image Path: `%SystemRoot%\System32\RuntimeBroker.exe`
Parent Process: **`svchost.exe`**
Number of Instances: One or more
User Account: Typically the logged-on user(s)
Start Time: Start times vary greatly
Description: **`RuntimeBroker.exe`** acts as a proxy between the constrained Universal Windows Platform (UWP) apps (formerly called Modern or Metro apps) and the full Windows API. UWP apps have limited capability to interface with hardware and the file system. Broker processes such as **`RuntimeBroker.exe`** are therefore used to provide the necessary level of access for UWP apps. Generally, there will be one **`RuntimeBroker.exe`** for each UWP app. For example, starting **`Calculator.exe`** will cause a corresponding **`RuntimeBroker.exe`** process to initiate.

taskhostw.exe

Image Path: `%SystemRoot%\System32\taskhostw.exe`
Parent Process: **`svchost.exe`**
Number of Instances: One or more **`taskhostw.exe`** processes are normal.
User Account: Task processes can be owned by logged-on users and/or by local service accounts.
Start Time: Start times vary greatly
Description: The generic host process for Windows Scheduled Tasks. Upon initialization, **`taskhostw.exe`** runs a continuous loop listening for trigger events. Example trigger events that can initiate a task include a defined time schedule, user logon, system startup, idle CPU time, a Windows log event, or workstation lock/unlock. There are more than 200 tasks pre-configured on a default installation of Windows 11 Enterprise (though not all are enabled). All executable files (DLLs & EXEs) used by the default Windows 10+ scheduled tasks are signed by Microsoft. This process replaced the older **`taskhost.exe`** and **`taskhostex.exe`** processes.

winlogon.exe

Image Path: `%SystemRoot%\System32\winlogon.exe`
Parent Process: Created by an instance of **`smss.exe`** that exits, typically appearing as an orphan process.
Number of Instances: One or more
User Account: Local System
Start Time: Within seconds of boot time for the first instance (for Session 1). Start times for additional instances occur as new sessions are created, typically through Remote Desktop or Fast User Switching logons.
Description: Winlogon handles interactive user logons and logoffs. It launches **`LogonUI.exe`**, which uses a credential provider to gather credentials from the user, ultimately passing the credentials to **`lsass.exe`** for validation. Once the user is authenticated, **`winlogon.exe`** loads the user's **`NTUSER.DAT`** into **`HKCU`** and starts the user's shell (usually **`explorer.exe`**) via **`userinit.exe`**. **`dwm.exe`** and **`fontdrvhost.exe`** are common children of this process and are responsible for display management.



```
System Idle Process
  System
    smss.exe
    Memory Compression
  Interrupts
Secure System
csrss.exe
csrss.exe
wininit.exe
  services.exe
    svchost.exe
      ShellExperienceHost.exe
      SearchUI.exe
      RuntimeBroker.exe
      RuntimeBroker.exe
      WmiPrvSE.exe
    svchost.exe
    svchost.exe
      sihost.exe
      taskhostw.exe
    svchost.exe
      ctfmon.exe
    svchost.exe
    svchost.exe
    svchost.exe
    svchost.exe
    svchost.exe
      audiodg.exe
    svchost.exe
    svchost.exe
    svchost.exe
    svchost.exe
    spoolsv.exe
    svchost.exe
    svchost.exe
    SecurityHealthService.exe
    MsMpEng.exe
    NisSrv.exe
    SearchIndexer.exe
    svchost.exe
  lsaiso.exe
  lsass.exe
  fontdrvhost.exe
winlogon.exe
  fontdrvhost.exe
  dwm.exe
explorer.exe
  MSASCuiL.exe
  OneDrive.exe
  powershell.exe
    conhost.exe
```

Process listing from Windows 10 Enterprise

csrss.exe

Image Path: `%SystemRoot%\System32\csrss.exe`
Parent Process: Created by an instance of **`smss.exe`** that exits, typically appearing as an orphan process.
Number of Instances: Two or more
User Account: Local System
Start Time: Within seconds of boot time for the first two instances (for Session 0 and 1). Start times for additional instances occur as new sessions are created, although often only Sessions 0 and 1 are created.
Description: The Client/Server Run-Time Subsystem is the user-mode process for the Windows subsystem. Its duties include managing processes and threads, importing many of the DLLs that provide the Windows API, and facilitating shutdown of the GUI during system shutdown. An instance of **`csrss.exe`** will run for each session. Session 0 is for services and Session 1 for the local console session. Additional sessions are created through the use of Remote Desktop and/or Fast User Switching. Each new session results in a new instance of **`csrss.exe`**.

services.exe

Image Path: `%SystemRoot%\System32\services.exe`
Parent Process: **`wininit.exe`**
Number of Instances: One
User Account: Local System
Start Time: Within seconds of boot time
Description: Implements the Unified Background Process Manager (UBPM), which is responsible for background activities such as services and scheduled tasks. **`Services.exe`** also implements the Service Control Manager (SCM), which specifically handles the loading of services and device drivers marked for auto-start. In addition, once a user has successfully logged on interactively, the SCM (**`services.exe`**) considers the boot successful and sets the Last Known Good control set (**`HKLM\SYSTEM\Select\LastKnownGood`**) to the value of the CurrentControlSet.

svchost.exe

Image Path: `%SystemRoot%\system32\svchost.exe`
Parent Process: **`services.exe`** (most often)
Number of Instances: Many (generally at least 10 and often more than 50)
User Account: Varies between Local System, Network Service, or Local Service accounts. Windows 10+ also has "per-user services" running under a user account context with Medium integrity level.
Start Time: Typically close to boot time. However, services can be started after boot (e.g., at logon), resulting in new instances of **`svchost.exe`** long after boot time.
Description: Generic host process for Windows services. It is used for running service DLLs. Windows differentiates multiple instances of **`svchost.exe`**, using the "**`-k`**" parameter pointing to Service Host Groups within the registry. Typical "**`-k`**" parameters include DcomLaunch, RPCSS, LocalService, netsvcs, NetworkService, UnistackSvcGroup, and more. The "**`-s`**" parameter identifies the service, such as LanmanServer, WinRM, or Winmgmt. "**`-p`**" signifies policy enforcement. Malware authors often take advantage of the ubiquitous nature of **`svchost.exe`** and use it either to host a malicious DLL as a service, or to blend in using a malicious process named **`svchost.exe`** or similar spelling. In Windows 10 version 1703, Microsoft changed the default grouping of similar services for systems with more than 3.5 GB of RAM. In such cases, most services will now run under their own instance of **`svchost.exe`** resulting in more than 50 instances of **`svchost.exe`**.

lsaiso.exe

Image Path: `%SystemRoot%\System32\lsaiso.exe`
Parent Process: **`wininit.exe`**
Number of Instances: Zero or one
User Account: Local System
Start Time: Within seconds of boot time
Description: When Virtualization-based Security (VBS) is enabled (used with Credential Guard), the functionality of **`lsass.exe`** is split between two processes—itself and **`lsaiso.exe`**. Most of the functionality stays within **`lsass.exe`**, but the important role of safely storing account credentials moves to **`lsaiso.exe`**. It provides safe storage by running in a context that is isolated from other processes through hardware virtualization technology. When remote authentication is required, **`lsass.exe`** proxies the requests using an RPC channel with **`lsaiso.exe`** in order to authenticate the user to the remote service. Note that if VBS is not enabled, **`lsaiso.exe`** should not be running on the system.

lsass.exe

Image Path: `%SystemRoot%\System32\lsass.exe`
Parent Process: **`wininit.exe`**
Number of Instances: One
User Account: Local System
Start Time: Within seconds of boot time
Description: The Local Security Authentication Subsystem Service process is responsible for authenticating users by calling an appropriate authentication package specified in **`HKLM\SYSTEM\CurrentControlSet\Control\Lsa`**. Typically, this will be Kerberos for domain accounts or MSV1_0 for local accounts. In addition to authenticating users, **`lsass.exe`** is also responsible for implementing the local security policy (such as password policies and audit policies) and for writing events to the security event log. Only one instance of this process should occur and it should rarely have child processes (Encrypting File System is a known exception).

explorer.exe

Image Path: `%SystemRoot%\explorer.exe`
Parent Process: Created by an instance of **`userinit.exe`** that exits, typically appearing as an orphan process.
Number of Instances: One or more per interactively logged-on user
User Account: Logged-on user(s)
Start Time: First instance starts when the owner's interactive logon begins
Description: At its core, Explorer provides users access to files. Functionally, though, it is both a file browser via Windows Explorer (though still **`explorer.exe`**) and a user interface providing features such as the user's Desktop, the Start Menu, the Taskbar, the Control Panel, and application launching via file extension associations and shortcut files. **`Explorer.exe`** is the default user interface specified in the Registry value **`HKLM\SOFTWARE\Microsoft\Windows NT\CurrentVersion\Winlogon\Shell`**, though Windows can alternatively function with another interface such as **`cmd.exe`** or **`powershell.exe`**. Notice that the legitimate **`explorer.exe`** resides in the **`%SystemRoot%`** directory rather than **`%SystemRoot%\System32`**. Multiple instances per user can occur, such as when the option "Launch folder windows in a separate process" is enabled.

Hunt Evil: Lateral Movement

During incident response and threat hunting, it is critical to understand how attackers move around your network. Lateral movement is an inescapable requirement for attackers to stealthily move from system to system and accomplish their objectives. Every adversary, including the most skilled, will use some form of lateral movement technique described here during a breach. Understanding lateral movement tools and techniques allows responders to hunt more efficiently, quickly perform incident response scoping, and better anticipate future attacker activity.

Tools and techniques to hunt the artifacts described below are detailed in the SANS DFIR course FOR508: Advanced Digital Forensics, Incident Response, and Threat Hunting

Additional Event Logs

Process-tracking events, Sysmon, and similar logging capabilities are not listed here for the sake of brevity. However, this type of enhanced logging can provide significant visibility of an intruder's lateral movement, given that the logs are not overwritten or otherwise deleted.

Additional FileSystem Artifacts

Deep-dive analysis techniques such as file carving, volume shadow analysis, and NTFS log file analysis can be instrumental in recovering many of these artifacts (including the recovery of registry and event log files and records).

Additional References

SANS DFIR FOR508 course: **http://sans.org/FOR508**

ATT&CK Lateral Movement: **http://for508.com/attck-lm**

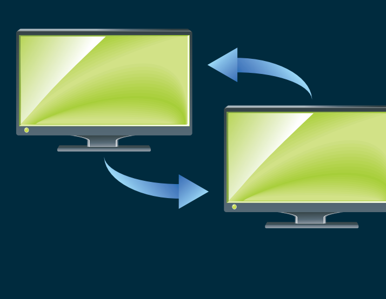
JPCERT Lateral Movement: **http://for508.com/jpcert-lm**

Artifacts in Memory Analysis

Artifacts in memory provide additional capabilities to track tools used to accomplish lateral movement. Evidence of execution can be identified via running processes like **rdpclip.exe**, **mstsc.exe**, and **wsmprovhost.exe**. Command-line extraction from processes like **conhost.exe** can provide valuable insight into how tools were used. Network connections and associated ports can be powerful indicators of lateral movement (e.g., port 445 for SMB traffic and port 3389 for RDP). MUP devices and named pipe usage can also be identified via memory forensics.

REMOTE ACCESS

Remote Desktop



SOURCE

EVENT LOGS

- `security.evtx`
  - **4648** – Logon specifying alternate credentials - if NLA enabled on destination
    - Current logged-on User Name
    - Alternate User Name
    - Destination Host Name/IP
    - Process Name
- `Microsoft-Windows-TerminalServices-RDPClient%4Operational.evtx`
  - **1024**
    - Destination Host Name
  - **1102**
    - Destination IP Address

REGISTRY

- Remote desktop destinations are tracked per-user
  - `NTUSER\Software\Microsoft\Terminal Server Client\Servers`
- ShimCache – `SYSTEM`
  - `mstsc.exe` Remote Desktop Client
- BAM/DAM – `SYSTEM` – Last Time Executed
  - `mstsc.exe` Remote Desktop Client
- `AmCache.hve` – First Time Executed
  - `mstsc.exe`
- UserAssist – `NTUSER.DAT`
  - `mstsc.exe` Remote Desktop Client execution
  - Last Time Executed
  - Number of Times Executed
- RecentApps – `NTUSER.DAT`
  - `mstsc.exe` Remote Desktop Client execution
  - Last Time Executed
  - Number of Times Executed
  - RecentItems subkey tracks connection destinations and times

FILE SYSTEM

- Jumplists – `C:\Users\<Username>\AppData\Roaming\Microsoft\Windows\Recent\AutomaticDestinations\`
  - `{MSTSC-APPID}-automaticDestinations-ms`
  - Tracks remote desktop connection destination and times
- Prefetch – `C:\Windows\Prefetch\`
  - `mstsc.exe-{hash}.pf`
- Bitmap Cache – `C:\Users\<Username>\AppData\Local\Microsoft\Terminal Server Client\Cache`
  - `bcache##.bmc`
  - `cache####.bin`
- Default.rdp file – `C:\Users\<Username>\Documents\`

DESTINATION

EVENT LOGS

- **Security Event Log** – `security.evtx`
  - **4624** Logon Type 10
    - Source IP/Logon User Name
  - **4778/4779**
    - IP Address of Source/Source System Name
    - Logon User Name
- `Microsoft-Windows-RemoteDesktopServices-RdpCoreTS%4Operational.evtx`
  - **131** – Connection Attempts
    - Source IP
  - **98** – Successful Connections
- `Microsoft-Windows-TerminalServices-RemoteConnectionManager%4Operational.evtx`
  - **1149**
    - Source IP/Logon User Name
      - Blank user name may indicate use of Sticky Keys
- `Microsoft-Windows-TerminalServices-LocalSessionManager%4Operational.evtx`
  - **21, 22, 25**
    - Source IP/Logon User Name
  - **41**
    - Logon User Name

REGISTRY

- ShimCache – `SYSTEM`
  - `rdpclip.exe`
  - `tstheme.exe`
- `AmCache.hve` – First Time Executed
  - `rdpclip.exe`
  - `tstheme.exe`

FILE SYSTEM

- Prefetch – `C:\Windows\Prefetch\`
  - `rdpclip.exe-{hash}.pf`
  - `tstheme.exe-{hash}.pf`

Map Network Shares (net.exe) to C$ or Admin$

```
net use z: \\host\c$ /user:domain\username <password>
```

SOURCE

EVENT LOGS

- `security.evtx`
  - **4648** – Logon specifying alternate credentials
    - Current logged-on User Name
    - Alternate User Name
    - Destination Host Name/IP
    - Process Name
- `Microsoft-Windows-SmbClient%4Security.evtx`
  - **31001** – Failed logon to destination
    - Destination Host Name
    - User Name for failed logon
    - Reason code for failed destination logon (e.g., bad password)

REGISTRY

- MountPoints2 – Remotely mapped shares
  - `NTUSER\Software\Microsoft\Windows\CurrentVersion\Explorer\MountPoints2`
- Shellbags – `USRCLASS.DAT`
  - Remote folders accessed inside an interactive session via Explorer by attackers
- ShimCache – `SYSTEM`
  - `net.exe`
  - `net1.exe`
- BAM/DAM – `NTUSER.DAT` – Last Time Executed
  - `net.exe`
  - `net1.exe`
- `AmCache.hve` – First Time Executed
  - `net.exe`
  - `net1.exe`

FILE SYSTEM

- **Prefetch** – `C:\Windows\Prefetch\`
  - `net.exe-{hash}.pf`
  - `net1.exe-{hash}.pf`
- User Profile Artifacts
  - Review shortcut files and jumplists for remote files accessed by attackers, if they had interactive access (RDP)

DESTINATION

EVENT LOGS

- **Security Event Log** – `security.evtx`
  - **4624** Logon Type 3
    - Source IP/Logon User Name
  - **4672**
    - Logon User Name
    - Logon by user with administrative rights
    - Requirement for accessing default shares such as `C$` and `ADMIN$`
  - **4776** – NTLM if authenticating to Local System
    - Source Host Name/Logon User Name
  - **4768** – TGT Granted
    - Source Host Name/Logon User Name
    - Available only on domain controller
  - **4769** – Service Ticket Granted if authenticating to Domain Controller
    - Destination Host Name/Logon User Name
    - Source IP
    - Available only on domain controller
  - **5140**
    - Share Access
  - **5145**
    - Auditing of shared files – NOISY!

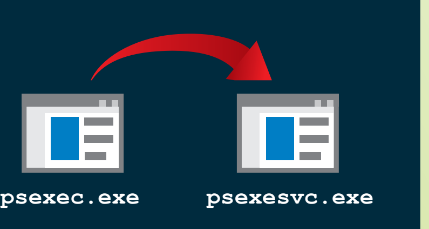
REGISTRY

FILE SYSTEM

- File Creation
  - Attacker's files (malware) copied to destination system
  - Look for Modified Time before Creation Time
  - Creation Time is time of file copy
- User Access Logging (Servers only)
  - `C:\Windows\System32\LogFiles\Sum`
    - User Name
    - Source IP Address
    - First and Last Access Time

REMOTE EXECUTION

PsExec



```
psexec.exe \\host -accepteula -d -c c:\temp\evil.exe
```

SOURCE

EVENT LOGS

- `security.evtx`
  - **4648** – Logon specifying alternate credentials
    - Current logged-on User Name
    - Alternate User Name
    - Destination Host Name/IP
    - Process Name

REGISTRY

- `NTUSER.DAT`
  - `Software\SysInternals\PsExec\EulaAccepted`
- ShimCache – `SYSTEM`
  - `psexec.exe`
- BAM/DAM – `SYSTEM` – Last Time Executed
  - `psexec.exe`
- `AmCache.hve` – First Time Executed
  - `psexec.exe`

FILE SYSTEM

- Prefetch – `C:\Windows\Prefetch\`
  - `psexec.exe-{hash}.pf`
  - Possible references to other files accessed by psexec.exe, such as executables copied to target system with the "-c" option
- File Creation
  - `psexec.exe` file downloaded and created on local host as the file is not native to Windows

DESTINATION

EVENT LOGS

- `security.evtx`
  - **4648** Logon specifying alternate credentials
    - Connecting User Name
    - Process Name
  - **4624** Logon Type 3 (and Type 2 if "`-u`" Alternate Credentials are used)
    - Source IP/Logon User Name
  - **4672**
    - Logon User Name
    - Logon by a user with administrative rights
    - Requirement for access default shares such as `C$` and `ADMIN$`
  - **5140** – Share Access
    - `ADMIN$` share used by PsExec
- `system.evtx`
  - **7045**
    - Service Install

REGISTRY

- New service creation configured in `SYSTEM\CurrentControlSet\Services\PSEXESVC`
  - "`-r`" option can allow attacker to rename service
- ShimCache – `SYSTEM`
  - `psexesvc.exe`
- `AmCache.hve` First Time Executed
  - `psexesvc.exe`

FILE SYSTEM

- Prefetch – `C:\Windows\Prefetch\`
  - `psexesvc.exe-{hash}.pf`
  - `evil.exe-{hash}.pf`
- File Creation
  - User profile directory structure created unless "`-e`" option used
  - `psexesvc.exe` will be placed in ADMIN$ (\Windows) by default, as well as other executables (evil.exe) pushed by PsExec
- User Access Logging (Servers only)
  - `C:\Windows\System32\LogFiles\Sum`
    - User Name
    - Source IP Address
    - First and Last Access Time

Scheduled Tasks

```
at \\host 13:00 "c:\temp\evil.exe"
schtasks /CREATE /TN taskname /TR c:\temp\evil.exe /SC once /RU "SYSTEM" /ST 13:00 /S host /U username
```

SOURCE

EVENT LOGS

- `security.evtx`
  - **4648** – Logon specifying alternate credentials
    - Current logged-on User Name
    - Alternate User Name
    - Destination Host Name/IP
    - Process Name

REGISTRY

- ShimCache – `SYSTEM`
  - `at.exe`
  - `schtasks.exe`
- BAM/DAM – `SYSTEM` – Last Time Executed
  - `at.exe`
  - `schtasks.exe`
- `AmCache.hve` - First Time Executed
  - `at.exe`
  - `schtasks.exe`

FILE SYSTEM

- Prefetch – `C:\Windows\Prefetch\`
  - `at.exe-{hash}.pf`
  - `schtasks.exe-{hash}.pf`

DESTINATION

EVENT LOGS

- `security.evtx`
  - **4624** Logon Type 3
    - Source IP/Logon User Name
  - **4672**
    - Logon User Name
    - Logon by a user with administrative rights
    - Requirement for accessing default shares such as `C$` and `ADMIN$`
  - **4698** – Scheduled task created
  - **4702** – Scheduled task updated
  - **4699** – Scheduled task deleted
  - **4700/4701** – Scheduled task enabled/disabled
- `Microsoft-Windows-Task Scheduler%4Operational.evtx`
  - **106** – Scheduled task created
  - **140** – Scheduled task updated
  - **141** – Scheduled task deleted
  - **200/201** – Scheduled task executed/completed

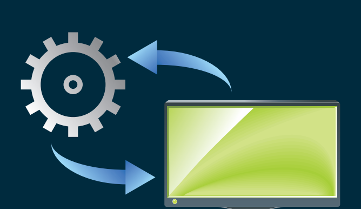
REGISTRY

- `SOFTWARE`
  - `Microsoft\Windows NT\CurrentVersion\Schedule\TaskCache\Tasks`
  - `Microsoft\Windows NT\CurrentVersion\Schedule\TaskCache\Tree\`
- ShimCache – `SYSTEM`
  - `evil.exe`
- `AmCache.hve` – First Time Executed
  - `evil.exe`

FILE SYSTEM

- File Creation
  - `evil.exe`
  - Job files created in `C:\Windows\Tasks`
  - XML task files created in `C:\Windows\System32\Tasks` `C:\Windows\SysWOW64\Tasks`
    - Author tag can identify:
      - Source system name
      - Creator username
- Prefetch – `C:\Windows\Prefetch\`
  - `evil.exe-{hash}.pf`

Services



```
sc \\host create servicename binpath= "c:\temp\evil.exe"
sc \\host start servicename
```

SOURCE

EVENT LOGS

REGISTRY

- ShimCache – `SYSTEM`
  - `sc.exe`
- BAM/DAM – `SYSTEM` – Last Time Executed
  - `sc.exe`
- `AmCache.hve` – First Time Executed
  - `sc.exe`

FILE SYSTEM

- Prefetch – `C:\Windows\Prefetch\`
  - `sc.exe-{hash}.pf`

DESTINATION

EVENT LOGS

- `security.evtx`
  - **4624** Logon Type 3
    - Source IP/Logon User Name
  - **4697**
    - Security records service install, if enabled
    - Enabling non-default Security events such as ID 4697 are particularly useful if only the Security logs are forwarded to a centralized log server
- `system.evtx`
  - **7034** – Service crashed unexpectedly
  - **7035** – Service sent a Start/Stop control
  - **7036** – Service started or stopped
  - **7040** – Start type changed (`Boot | On Request | Disabled`)
  - **7045** – A service was installed on the system

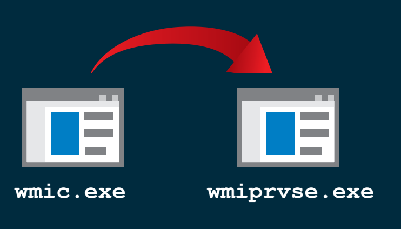
REGISTRY

- `SYSTEM`
  - `\CurrentControlSet\Services\`
  - New service creation
- ShimCache – `SYSTEM`
  - `evil.exe`
  - ShimCache records existence of malicious service executable, unless implemented as a service DLL
- `AmCache.hve` – First Time Executed
  - `evil.exe`

FILE SYSTEM

- File Creation
  - `evil.exe` or `evil.dll` malicious service executable or service DLL
- Prefetch – `C:\Windows\Prefetch\`
  - `evil.exe-{hash}.pf`

WMI/WMIC



```
wmic /node:host process call create "C:\temp\evil.exe"
Invoke-WmiMethod -Computer host -Class Win32_Process -Name create -Argument "c:\temp\evil.exe"
```

SOURCE

EVENT LOGS

- `security.evtx`
  - **4648** – Logon specifying alternate credentials
    - Current logged-on User Name
    - Alternate User Name
    - Destination Host Name/IP
    - Process Name

REGISTRY

- ShimCache – `SYSTEM`
  - `wmic.exe`
- BAM/DAM – `SYSTEM` – Last Time Executed
  - `wmic.exe`
- `AmCache.hve` – First Time Executed
  - `wmic.exe`

FILE SYSTEM

- Prefetch – `C:\Windows\Prefetch\`
  - `wmic.exe-{hash}.pf`

DESTINATION

EVENT LOGS

- `security.evtx`
  - **4624** Logon Type 3
    - Source IP/Logon User Name
  - **4672**
    - Logon User Name
    - Logon by an a user with administrative rights
- `Microsoft-Windows-WMI-Activity%4Operational.evtx`
  - **5857**
    - Indicates time of wmiprvse execution and path to provider DLL – attackers sometimes install malicious WMI provider DLLs
  - **5860, 5861**
    - Registration of Temporary (5860) and Permanent (5861) Event Consumers. Typically used for persistence, but can be used for remote execution.

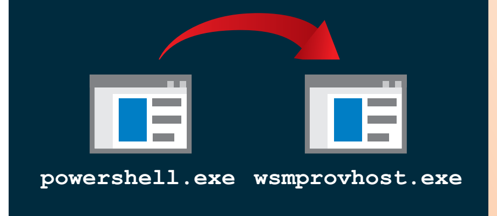
REGISTRY

- ShimCache – `SYSTEM`
  - `scrcons.exe`
  - `mofcomp.exe`
  - `wmiprvse.exe`
  - `evil.exe`
- `AmCache.hve` – First Time Executed
  - `scrcons.exe`
  - `mofcomp.exe`
  - `wmiprvse.exe`
  - `evil.exe`

FILE SYSTEM

- File Creation
  - `evil.exe`
  - `evil.mof` – .mof files can be used to manage the WMI Repository
- Prefetch – `C:\Windows\Prefetch\`
  - `scrcons.exe-{hash}.pf`
  - `mofcomp.exe-{hash}.pf`
  - `wmiprvse.exe-{hash}.pf`
  - `evil.exe-{hash}.pf`
- Unauthorized changes to the WMI Repository in `C:\Windows\System32\wbem\Repository`

PowerShell Remoting



```
Enter-PSSession -ComputerName host
Invoke-Command -ComputerName host -ScriptBlock {Start-Process c:\temp\evil.exe}
```

SOURCE

EVENT LOGS

- `security.evtx`
  - **4648** – Logon specifying alternate credentials
    - Current logged-on User Name
    - Alternate User Name
    - Destination Host Name/IP
    - Process Name
- `Microsoft-Windows-WinRM%4Operational.evtx`
  - **161** – Remote Authentication Error
  - **6** – WSMan Session initialize
    - Session created
    - Destination Host Name or IP
    - Current logged-on User Name
  - **8, 15, 16, 33** – WSMan Session deinitialization
    - Closing of WSMan session
    - Current logged-on User Name
- `Microsoft-Windows-PowerShell%4Operational.evtx`
  - **40961, 40962**
    - Records the local initiation of powershell.exe and associated user account
  - **8193** & **8194**
    - Session created
  - **8197** – Connect
    - Session closed

REGISTRY

- ShimCache – `SYSTEM`
  - `powershell.exe`
- BAM/DAM – `SYSTEM` – Last Time Executed
  - `powershell.exe`
- `AmCache.hve` – First Time Executed
  - `powershell.exe`

FILE SYSTEM

- Prefetch – `C:\Windows\Prefetch\`
  - `powershell.exe-{hash}.pf`
  - PowerShell scripts (.ps1 files) that run within 10 seconds of powershell.exe launching will be tracked in powershell.exe prefetch file
- Command history `C:\Users\<Username>\AppData\Roaming\Microsoft\Windows\PowerShell\PSReadline\ConsoleHost_history.txt`
  - With PS v5+, a history file with previous 4096 commands is maintained per user

DESTINATION

EVENT LOGS

- `security.evtx`
  - **4624** – Logon Type 3
    - Source IP/Logon User Name
  - **4672**
    - Logon User Name
    - Logon by an a user with administrative rights
- `Microsoft-Windows-PowerShell%4Operational.evtx`
  - **4103, 4104** – Script Block logging
    - Logs suspicious scripts by default in PS v5
    - Logs all scripts if configured
  - **53504** – Records the authenticating user
- `Windows PowerShell.evtx`
  - **400/403** "ServerRemoteHost" indicates start/end of Remoting session
  - **800** Includes partial script code
- `Microsoft-Windows-WinRM%4Operational.evtx`
  - **91** – Session creation
  - **142** – WSMan Operation Failure
  - **169** – Records the authenticating user

REGISTRY

- ShimCache – `SYSTEM`
  - `wsmprovhost.exe`
  - `evil.exe`
- `SOFTWARE`
  - `Microsoft\PowerShell\1\ShellIds\Microsoft.PowerShell\ExecutionPolicy`
    - Attacker may change execution policy to a less restrictive setting, such as "bypass"
- `AmCache.hve` – First Time Executed
  - `wsmprovhost.exe`
  - `evil.exe`

FILE SYSTEM

- File Creation
  - `evil.exe`
  - With `Enter-PSSession`, a user profile directory may be created
- Prefetch – `C:\Windows\Prefetch\`
  - `evil.exe-{hash].pf`
  - `wsmprovhost.exe-{hash].pf`

Evidence of Program Execution

UserAssist

Description:
UserAssist records metadata on GUI-based program executions.

Location:
NTUSER.DAT HIVE
`NTUSER.DAT\Software\Microsoft\Windows\CurrentVersion\Explorer\UserAssist\{GUID}\Count`

Interpretation:
- GUIDs identify type of execution (Win7+)
  - **CEBFF5CD** Executable File Execution
  - **F4E57C4B** Shortcut File Execution
- Values are ROT-13 Encoded
- Application path, last run time, run count, focus time and focus count

BAM/DAM

Description:
Windows Background/Desktop Activity Moderator (BAM/DAM) is maintained by the Windows power management sub-system. (Available in Win10+)

Location:
Win10
`SYSTEM\CurrentControlSet\Services\bam\UserSettings\{SID}`
`SYSTEM\CurrentControlSet\Services\dam\UserSettings\{SID}`

Interpretation:
- Provides full path of file executed and last execution date/time
- Typically up to one week of data available
- "State" key used in Win10 1809+

System Resource Usage Monitor (SRUM)

Description:
SRUM records 30 to 60 days of historical system performance including applications run, user accounts responsible, network connections, and bytes sent/received per application per hour.

Location:
Win8+
`C:\Windows\System32\SRU\SRUDB.dat`

Interpretation:
- SRUDB.dat is an Extensible Storage Engine database
- Three tables in SRUDB.dat are particularly important:
  - {973F5D5C-1D90-4944-BE8E-24B94231A174} = Network Data Usage
  - {d10ca2fe-6fcf-4f6d-848e-b2e99266fa89} = Application Resource Usage
  - {DD6636C4-8929-4683-974E-22C046A43763} = Network Connectivity Usage

ShimCache

Description:
The Windows Application Compatibility Database is used by Windows to identify possible application compatibility challenges with executables. It tracks the executable file path and binary last modified time.

Location:
XP: `SYSTEM\CurrentControlSet\Control\Session Manager\AppCompatibility`
Win7+: `SYSTEM\CurrentControlSet\Control\Session Manager\AppCompatCache`

Interpretation:
Any executable present in the file system could be found in this key. Data can be particularly useful to identify the presence of malware on devices where other application execution data is missing (such as Windows servers).
- Full path of executable
- Windows 7+ contains up to 1,024 entries (96 entries in WinXP)
- Post-WinXP no execution time is available
- Executables can be preemptively added to the database prior to execution. The existence of an executable in this key does not prove actual execution.

Jump Lists

Description:
Windows Jump Lists allow user access to frequently or recently used items quickly via the task bar. First introduced in Windows 7, they can identify applications in use and a wealth of metadata about items accessed via those applications.

Location:
`%USERPROFILE%\AppData\Roaming\Microsoft\Windows\Recent\AutomaticDestinations`

Interpretation:
- Each jump list file is named according to an application identifier (AppID).
  List of Jump List IDs
  -> **https://dfir.to/EZJumpList**
- Automatic Jump List Creation Time = First time an item added to the jump list. Typically, the first time an object was opened by the application.
- Automatic Jump List Modification Time = Last time item added to the jump list. Typically, the last time the application opened an object.

Prefetch

Description:
Prefetch increases performance of a system by pre-loading code pages of commonly used applications. It monitors all files and directories referenced for each application or process and maps them into a .pf file. It provides evidence that an application was executed.
- Limited to 128 files on XP and Win7
- Up to 1024 files on Win8+

Location:
`C:\Windows\Prefetch`
- Naming format: `(exename)-(hash).pf`

`SYSTEM\CurrentControlSet\Control\Session Manager\Memory Management\PrefetchParameters`
- EnablePrefetcher value
  (0 = disabled; 3 = application launch and boot enabled)

Interpretation:
- Date/Time file by that name and path was first executed
  - Creation date of .pf file (~-10 seconds)
- Date/Time file by that name and path was last executed
  - Last modification date of .pf file (~-10 seconds)
- Each .pf file includes embedded data, including the last eight execution times (only one time available pre-Win8), total number of times executed, and device and file handles used by the program

Amcache.hve

Description:
Amcache tracks installed applications, programs executed (or present), drivers loaded, and more. What sets this artifact apart is it also tracks the SHA1 hash for executables and drivers. (Available in Win7+)

Location:
`C:\Windows\AppCompat\Programs\Amcache.hve`

Interpretation:
- A complete registry hive, with multiple sub-keys
- Full path, file size, file modification time, compilation time, and publisher metadata
- SHA1 hash of executables and drivers
- Amcache should be used as an indication of executable and driver presence on the system, but not to prove actual execution