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# Monitoring for Security Events Using Windows Management Instrumentation

Stephen Seigler

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## Summary

This paper was written to demonstrate a method of using Windows Management Instrumentation (WMI) and Windows Scripting Host (WSH) to interactively monitor a computer system for security events. It will cover monitoring the following aspects of security auditing:

- Event Log
- Registry
- Processes
- New User Creation
- CD/Floppy Access
- Scheduler Service

Conventional security auditing generally involves creating baselines of the aforementioned items, and periodically comparing the current status against the baseline. The WSH script included in the appendixes can be used to monitor each of these items interactively. This would have the benefit of reducing response time to a security event, by generating an alert when the event happens. Otherwise, the security event might not be discovered until the next manual audit.

## Example

Suppose a hacker is going to attempt to create a back door on your monitored system using the schedule service and netcat (nc.exe). This script would generate two alerts if they were successful. It would notify that a job has been scheduled, and then that an unapproved process is running. If they were unsuccessful, an alert would be generated about the failed attempt. If successful, without the script generating these alerts, the back door could potentially be accessible to the intruder until a manual audit showed the rogue process.

## Auditing

Network auditing is a very important but complex subject. There are many different opinions on determining what to audit, how to audit, and when to audit. The details of an audit policy will vary from one network to the next. Determining an audit policy is beyond the scope of this paper.

What is auditing? According to **Microsoft Windows NT 4.0 Security, Audit, and Control**,

Auditing is an important component of the Effective Security Monitoring controls. Auditing means measuring the system against a predefined system setting to ensure no changes have occurred. Changes may indicate possible security breaches. If no auditing is being conducted, then the Effective Security Monitoring controls will not be satisfied and thus confidentiality, integrity, and availability of data is at risk.

Auditing takes time and effort to implement and it uses a lot of resources; therefore, many corporations do not even turn on auditing on their Windows NT systems.

This script was written to help ease the burden of auditing, by reporting security events directly to a central location. In a large network, reviewing event logs alone is a monumental task.

### **General Statements**

This script was written specifically to monitor Windows NT4, SP6a systems. Some customization may be necessary to run it on Windows 2000 or later.

There are three scripts that complete this monitoring solution: SystemMonitor.vbs, ProcessList.vbs, and AdministrativeWorkstation.vbs. We will discuss what each script accomplishes and then look the SystemMonitor.vbs script in detail.

Monitored systems and the workstation that receives the alerts must be running Windows Scripting Host (WSH) and Windows Management Instrumentation (WMI). WMI may be downloaded from <http://www.microsoft.com/downloads/release.asp?ReleaseID=18490> WSH may be downloaded from <http://msdn.microsoft.com/downloads/default.asp?URL=/downloads/sample.asp?url=/msdn-files/027/001/733/msdncompositedoc.xml> These pages also contain the system requirements for these products.

To use this script, select the entire section Appendix A and paste into a text editor such as Notepad. Create a new folder for the script, and save the file as ASCII text with the name 'SystemMonitor.vbs' in the new folder.

If you intend to use this script to monitor processes, you must also create the ProcessList.vbs file in the same folder as the 'SystemMonitor.vbs' script. Select the entire section appendix B and paste into a text editor such as Notepad. Save the file as ASCII text with the name it as 'ProcessList.vbs'.

To receive pop-up alerts on the administrative workstation, you will need to run the 'Administrative.vbs' script. If this script is not running on the administrative workstation, events will be written to its event log without a pop-up notification. Select the entire section appendix C and paste into a text editor such as Notepad. Save the file as ASCII text with the name 'Administrative.vbs' in it.

If Notepad is used, make sure that word wrap is turned off, and it may be necessary to put quotation marks around the filename in the save as box to avoid the .txt extension being appended to the filename. If Wordpad is used, choose the save as text document option.

It is recommended that the SystemMonitor.vbs script be installed as a service on the system to be monitored with an automatic startup. This service must not run under the service account, or security events will not be sent to the administrative workstation. Please see Microsoft Knowledge Base article Q137890, HOWTO: Create a User-Defined Service. More information about this can be found in Appendix D.

The Administrative.vbs script may be installed as a service on the administrative workstation with an automatic startup. This service would need to be run under the system account, and allowed to interact with the desktop. Please see Microsoft Knowledge Base article Q137890, HOWTO: Create a User-Defined Service. More information about this can be found in Appendix D.

### **SystemMonitor.vbs**

This is the main script and runs on the system to be monitored. It can be used for monitoring the following security events.

### **Monitor the event log**

Harry Krimkowitz makes the following statements in his paper, **Mitigating Risks to the Insider Threat within your Organization.**

Finally, you should require system administrators to perform comprehensive information security audits. You should require that audit logs be stored and reviewed at least weekly. Of course, you must allocate your system administrators sufficient time and resources to adequately review these logs.

While these statements are very correct, this script can help by monitoring all failed security events, and successful security events that would be of interest. This would certainly reduce the amount of time and resources required reviewing the logs. It would also eliminate the time between when a security event is written to the logs, and when the log is reviewed. The following table contains a list of successful events that this script monitors.

Event ID: 517	The audit log was cleared
Event ID: 608	User Right Assigned
Event ID: 610	New Trusted Domain
Event ID: 611	Removing Trusted Domain
Event ID: 612	Audit Policy Change
Event ID: 624	User Account Created
Event ID: 625	User Account Type Change
Event ID: 626	User Account Enabled
Event ID: 631	Global Group Created
Event ID: 632	Global Group Member Added
Event ID: 635	Local Group Created
Event ID: 636	Local Group Member Added
Event ID: 639	Local Group Changed
Event ID: 640	General Account Database Change
Event ID: 641	Global Group Changed
Event ID: 642	User Account Changed
Event ID: 643	Domain Policy Changed
Event ID: 644	User Account Locked Out

This list may be modified in the script. Please refer to **Microsoft Knowledge Base article Q17407** for a complete list of security log events. The script may be configured to monitor all warning and error events.

NOTE: It is important to note that depending on your audit policy, these events may not be recorded.

**Monitor specific registry keys for changes or new entries**  
**Hacking Exposed, Third Edition**, p. 209 states:

A Backdoor Favorite: Windows Startup Receptacles

...attackers almost always place necessary Registry values under the standard Windows startup keys. These areas should be checked regularly for the presence of malicious or strange-looking commands.

- HKLM\Software\Microsoft\Windows\CurrentVersion\Run and RunOnce, RunOnceEx, RunServices (Win 9x only)

CERT makes the following statements in their article titled **Selecting audit events for Windows NT 4.0 registry keys** regarding the following registry keys.

These keys, their subkeys, and values determine logon and other authentication enforcement settings on the system, accessibility of

account information and the registry from other systems on the network, and dialup connections. In the case of domain controller systems, these settings apply to the entire NT domain and can affect related, trusted domains.

- SYSTEM\CurrentControlSet\Control\Lsa
- SYSTEM\CurrentControlSet\Control\SecurityProviders
- SOFTWARE\Microsoft\Windows NT\CurrentVersion\Winlogon

This script monitors these keys for changes interactively. If the keys that are monitored are changed in any way, an alert will be generated.

### **Monitor processes**

**Hacking Exposed, Third Edition**, p. 209 states:

...regular analysis of the Process List can be useful. For example, you could schedule regular AT jobs to look for remote.exe or nc.exe in the Process List and kill them.

When the script starts, it checks each process that is already running, and compares it against the list of approved processes in the ProcessList.txt file. After that, it checks every process that starts up. The ProcessList.txt file that contains the list of approved processes can be generated by running the ProcessList.vbs script in appendix B. (Please see the detailed description of the ProcessList.vbs script.) It can also generate alerts when an approved process is created. For example, regedt32.exe may be an approved process, but you may want to know whenever it is used. Nc.exe however, is not an approved process, and you would certainly want to know when it is started or running.

### **Monitor new user creation**

**Hacking Exposed, Third Edition**, p. 557-558 states the following regarding user accounts.

#### **Creating Rogue User Accounts**

Most every system administrator recognizes that superuser-equivalent accounts are critical resources to protect and audit. What is more difficult to track are inconspicuously named accounts that have superuser privileges. Malicious hackers will try to create such accounts without fail on conquered systems.

It is therefore a good practice to create a baseline list of all network user accounts and audit against it regularly. This script helps to get a head start on this by generating an alert when a new user account is created.

## **Monitor the CD-ROM and/or the floppy drive**

Dave Ashcroft makes the following statements in his paper, **Physical Security: The Often Overlooked Weakness**.

If your data is well protected from attack from the Internet, and your employees only have access to those parts of the databases that they need for their specific jobs, many would feel that they are adequately protected. However, one big problem is still often overlooked. This problem is a weakness in physical security.

He then proceeds to discuss controls related to physical security. By monitoring for CD-ROM and floppy access, this script will keep you better informed of access to your system. If someone is using the CD-ROM or floppy drive, physical access has been gained to the monitored system.

## **Monitor the Scheduler service**

**Hacking Exposed, Third Edition**, p. 194-196 demonstrates a method of using the schedule service to allow remote command execution.

When the scheduled command has executed, the job ID will vanish from the AT listing. If the command was entered correctly, the remote server is now running. Intruders can now gain a command shell on a remote system using the remote utility in client mode, as shown next.

This indicates that once the job has been run, there would now be no scheduled job, and no record of its existence. How would this scheduled job be detected? It is important that jobs be monitored as they are created, because a job scheduled by a hacker may only exist for a few minutes. This script can be configured to monitor scheduled job creation, and generate an alert when a job is scheduled.

## **Here's a breakdown of the SystemMonitor.vbs script.**

Here we specify that all variables must be declared and declare them.

```
'This line forces declaration of all variables  
Option Explicit
```

```
'Declare all variables
```

These are the variables used to control what the script monitors.

```
Dim AdministrativeAlert  
Dim MonitorEventLog  
Dim MonitorAllFailed  
Dim MonitorAllErrors
```

Dim MonitorAllWarnings  
Dim MonitorRegistry  
Dim MonitorCDROM  
Dim MonitorFloppy  
Dim MonitorScheduler  
Dim MonitorProcesses  
Dim MonitorServices  
Dim CDDriveLetter  
Dim ScanSpeed

### **Script Customization**

This section of the script sets the variables that the script uses to determine what to monitor.

This variable should be set to the name of the workstation that receives the alerts. This workstation must be running NT4, SP4 or later. The alerts will be written to the application log of this computer, and if the Administrative.vbs script is running on this workstation, it will generate a pop-up when an alert is received.

```
AdministrativeAlert = "computername"
```

These variables control whether the event log is monitored. If it is set to monitor the event log, the other variables control which types of events are monitored. This will analyze events as they are written to the event log. Unless MonitorAllFailed is set to 0, the script monitors all failed security events. It also monitors certain successful security events that would be of interest. The list of monitored successful security events may be modified in the script. Set MonitorAllFailed = 1 to monitor all failed security events. Set MonitorAllErrors = 1 to monitor all error events. Set MonitorAllWarnings = 1 to monitor all warning events. If the script is used to monitor all error and warning events, this may generate significant amounts of alerts, depending on your environment.

This script monitors the event log for Event ID: 624, User Account Created to report when a new user is created. Auditing 'User and Group Management' must be enabled for this event to be logged. MonitorEventLog must not be set to 0 for this script to report all new users created.

```
MonitorEventLog = 1  
MonitorAllFailed = 1  
MonitorAllErrors = 0  
MonitorAllWarnings = 0
```

This variable controls whether this script monitors the registry. This script will monitor all keys listed in the script below, which can be customized. It will monitor those keys for new entries, changes, and key or value deletion.



MonitorRegistry = 1

The keys that this script monitors for changes are listed below. This list can be customized in the script.

HKLM\SYSTEM\CurrentControlSet\Control\Lsa  
HKLM\SYSTEM\CurrentControlSet\Control\SecurityProviders  
HKLM\Software\Microsoft\Windows\CurrentVersion\Run  
HKLM\Software\Microsoft\Windows\CurrentVersion\RunOnce  
HKLM\SOFTWARE\Microsoft\Windows NT\CurrentVersion\Winlogon

This variable controls whether the script monitors the CD-ROM drive. This will log and generate an alert whenever a CD is put in the drive. Set CDDriveLetter to correspond with the drive letter of your CD-ROM drive. NOTE: This may cause the CD-ROM drive light to flash on and off, depending on the ScanSpeed chosen.

MonitorCDROM = 1  
CDDriveLetter = "X:"

This variable controls whether the script monitors the floppy disk drive. This will log and generate an alert whenever a floppy disk is put in the floppy drive. NOTE: This may cause the floppy disk drive light to flash on and off, depending on the ScanSpeed chosen.

MonitorFloppy = 1

This variable controls whether the script monitors the scheduler service. This will log and generate an alert whenever a job is scheduled.

MonitorScheduler = 1

This variable controls whether the script monitors processes. This will monitor for unauthorized processes. It will log and generate an alert whenever an unauthorized process is detected. If processes are to be monitored, the ProcessList.vbs script must be run in the same folder as this script to generate the ProcessList.txt file, which will list all currently running processes. The ProcessList.txt should be modified as necessary to add authorized processes.

MonitorProcesses = 1

The rate of scanning affects the monitoring of the CD-ROM, floppy, scheduler, and new processes and is set by the ScanSpeed variable set below. Note that short scan rates may incur significant processor overhead. However, processes with a lifespan shorter than the chosen ScanSpeed might not be detected. Use the Task Manager to monitor the system overhead being used by wscript.exe and winmgmt.exe processes. This

number should be experimented with to determine the optimum number for each installation.

```
ScanSpeed = 5
```

This next line displays a message box for five seconds, so that the user knows that the script is starting.

```
result = WshShell.Popup("Monitor script is starting. Please wait...", 5)
```

Here we determine the location of this script, and set filenames for use later in the script.

```
strScriptPath = Left(WScript.ScriptFullName, InStrRev(WScript.ScriptFullName, "\"))
strLogFileName = strScriptPath & "monitor.log"
strProcessFilePath = "ProcessList.txt"
```

Here we make sure that there is a file for logging to. If there isn't, it creates it.

```
If Not objFSO.fileexists(strLogFileName) Then
    Set objFile = objFSO.CreateTextFile(strLogFileName, True)
    objFile.Close
End If
```

This section requests that events that have one of the event codes in the list be sent to the EventSink\_OnObjectReady sub for processing. The codes listed here are the list of successful security events of interest listed above.

```
' Set up the event selection. EventSink_OnObjectReady will be called when
' one of the specified Win32_NTLogEvent occurs
strQuery = "SELECT * FROM __InstanceCreationEvent WHERE TargetInstance ISA
'Win32_NTLogEvent" & _
    "and TargetInstance.EventCode = 517 or TargetInstance.EventCode = 608" & _
    " or TargetInstance.EventCode = 610 or TargetInstance.EventCode = 611" & _
    " or TargetInstance.EventCode = 612 or TargetInstance.EventCode = 624" & _
    " or TargetInstance.EventCode = 625 or TargetInstance.EventCode = 631" & _
    " or TargetInstance.EventCode = 632 or TargetInstance.EventCode = 635" & _
    " or TargetInstance.EventCode = 636 or TargetInstance.EventCode = 639" & _
    " or TargetInstance.EventCode = 640 or TargetInstance.EventCode = 641" & _
    " or TargetInstance.EventCode = 642 or TargetInstance.EventCode = 643" & _
    " or TargetInstance.EventCode = 644"
```

Here depending on how the event log variables have been configured, strings are appended onto the query string.

```
If MonitorAllFailed = 1 Then
```

```
    strQuery = strQuery & " or TargetInstance.Type = 'audit failure'"  
End If
```

```
If MonitorAllWarnings = 1 Then  
    strQuery = strQuery & " or TargetInstance.Type = 'warning'"  
End If
```

```
If MonitorAllErrors = 1 Then  
    strQuery = strQuery & " or TargetInstance.Type = 'error'"  
End If
```

Here is where the actual list of registry keys to be monitored is declared. This list can be modified as necessary.

```
' Set up the registry key selection. RegistrySink_OnObjectReady will be called when  
' a change is detected at any of the keys listed below  
Registry.ExecNotificationQueryAsync RegistrySink, _  
"SELECT * FROM RegistryKeyChangeEvent " & _  
    "Where (hive = 'HKEY_LOCAL_MACHINE' And Keypath =  
'Software\\Microsoft\\Windows\\CurrentVersion\\Run') " & _  
    "OR (hive = 'HKEY_LOCAL_MACHINE' And Keypath =  
'Software\\Microsoft\\Windows\\CurrentVersion\\RunOnce') " & _  
    "OR (hive = 'HKEY_LOCAL_MACHINE' And Keypath = 'Software\\Microsoft\\Windows  
NT\\CurrentVersion\\Winlogon') " & _  
    "OR (hive = 'HKEY_LOCAL_MACHINE' And Keypath =  
'System\\CurrentControlSet\\Control\\Lsa') " & _  
    "OR (hive = 'HKEY_LOCAL_MACHINE' And Keypath =  
'System\\CurrentControlSet\\Control\\SecurityProviders')"
```

This is the function that performs all logging and alerting. It writes the message that is passed to it to the log file, and if the alert variable is true, logs it to the event log of the administrative workstation.

```
Public Function LogEntry(blankline, msg, alert)  
    Set Log = objFSO.OpenTextFile(strLogFileName, 8, False)  
  
    If blankline Then  
        Log.WriteBlankLines (1)  
        Log.WriteLine (Date & " at " & Time)  
        Log.WriteLine (msg)  
        Log.Close  
    Else  
        Log.WriteLine (Date & " at " & Time)  
        Log.WriteLine (msg)  
        Log.Close  
    End If
```

```
If alert Then
    WshShell.LogEvent 0, msg, AdministrativeAlert
End If
```

End Function

Here we log the fact that monitoring has started, and then display a message stating that system monitoring has started.

```
result = LogEntry(True, "System monitoring started.", False)
```

```
WScript.Echo "System monitoring in progress. To stop monitoring, click OK."
```

## Troubleshooting the scripts

Generally speaking, errors with the scripts will indicate that WMI and/or WSH are not installed, not installed correctly, or a WMI provider is not registered. To help determine where to start looking for the problem, use the customization section of the SystemMonitor.vbs script to disable monitoring everything except one thing. Then run the script. Keep enabling one item at a time, until you find what is causing the trouble. A WMI provider may need to be registered. For more information regarding WMI provider registration, please visit <http://search.microsoft.com/us/dev/default.asp> and search for 'register wmi provider'.

Error 2140: an internal Windows NT error occurred. If you receive this error message when you attempt to start the service, the application parameter is probably incorrect.

If you install the scripts as services, and the scripts do not appear to be working correctly, try executing them directly. Once you can run the scripts without errors and they work properly, then try them as services.

## Suggested Improvements

- Monitor ports. Write a routine that would create a baseline of all open ports, and then monitor for new ports that the system has open.
- Monitor new file creation. This would have to be implemented very carefully, or the alerts generated by this would be overwhelming. However, if a new executable was created in your inetpub\scripts folder, that would very likely be a security event.
- Create a user interface (UI). Depending on the volume of notifications that this script generates in an environment, it would possibly be advantageous to have a UI on the administrative workstation, instead of pop-up alerts.
- Log to ODBC database. Long term storage of security events reported to the administrative workstation would be best stored in an ODBC database. This would better facilitate queries, and generating reports.

- Add the ability to send alerts to multiple administrative workstations.

## References

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## Appendix A

'This line forces declaration of all variables  
Option Explicit

'Declare all variables  
Dim objFSO  
Dim objFile  
Dim objTextStream  
Dim WshShell

Dim strScriptPath  
Dim strLogFileName  
Dim strQuery  
Dim result  
Dim Log  
Dim msg

Dim AdministrativeAlert  
Dim MonitorEventLog  
Dim MonitorAllFailed  
Dim MonitorAllErrors  
Dim MonitorAllWarnings  
Dim MonitorRegistry  
Dim MonitorCDROM  
Dim MonitorFloppy  
Dim MonitorScheduler  
Dim MonitorProcesses  
Dim MonitorServices  
Dim CDDriveLetter  
Dim ScanSpeed

Dim EventsSink  
Dim RegistrySink  
Dim FloppySink  
Dim CDRomSink  
Dim TaskSink  
Dim ProcessSink

Dim Events  
Dim Registry  
Dim Service  
Dim ServiceSet  
Dim strProcessFilePath  
Dim aryProcessName(1000)  
Dim aryProcessExecutablePath(1000)  
Dim aryProcessAlert(1000)  
Dim varProcessApproved  
Dim varProcessPathNull  
Dim varCounter  
Dim varCounterProcess  
Dim strInputLine

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```
Dim strSplitString
Dim ProcessList
Dim Process
```

```
' This is the section used to customize this script. There are other places in the script for customization.
' To change the workstation that receives alerts, change the value of the next line.
' Alerts will be written to the application log of this computer.
AdministrativeAlert = "computername"
```

```
' Monitor the event logs. This will analyze events as they are written to the event log.
' It will only alert on event codes listed in the script below, which can be customized.
' Set MonitorAllFailed = 1 to monitor all failed security events.
' Set MonitorAllErrors = 1 to monitor all error events.
' Set MonitorAllWarnings = 1 to monitor all warning events.
' NOTE: This script will report all new users created, but not if MonitorEventLog is set to 0.
MonitorEventLog = 1
MonitorAllFailed = 1
MonitorAllErrors = 0
MonitorAllWarnings = 0
```

```
' Monitor the registry. This will monitor all keys listed in the script below, which can be customized.
' It will monitor those keys for new entries, changes, and key or value deletion.
MonitorRegistry = 1
```

```
' Monitor the CD-ROM drive. This will log and generate an alert whenever a CD is put in the drive.
' Set CDDriveLetter to correspond with the drive letter of your CD-ROM drive.
' NOTE: This may cause the CD-ROM drive light to flash on and off, depending on the ScanSpeed chosen.
MonitorCDROM = 1
CDDriveLetter = "X:"
```

```
' Monitor the floppy drive. This will log and generate an alert whenever a floppy disk is put in the floppy
drive.
' NOTE: This may cause the floppy disk drive light to flash on and off, depending on the ScanSpeed
chosen.
MonitorFloppy = 1
```

```
' Monitor scheduler service. This will log and generate an alert whenever a job is scheduled.
MonitorScheduler = 1
```

```
' Monitor processes. This will monitor for unauthorized processes. It will log and generate an alert
whenever an
' unauthorized process is detected. If you monitor processes, be sure to run the processlist.vbs script in
the same
' folder as this script to generate the processlist.txt file, which will list all currently running processes.
' The processlist.txt may be modified as necessary to add authorized processes
MonitorProcesses = 1
```

```
' The rate of scanning affects the monitoring of the CD-ROM, floppy, scheduler, and new processes and is
' set by the ScanSpeed variable set below. Note that short scan rates may incur significant processor
' overhead. However, processes with a lifespan shorter than the chosen ScanSpeed might not be
detected.
' Use the Task Manager to monitor the system overhead being used by wscript.exe and winmgmt.exe
processes.
```

' This number should be experimented with to determine the optimum number for each installation.  
ScanSpeed = 5

'Initialize variables  
varCounter = 0  
varCounterProcess = 0

Set objFSO = CreateObject("Scripting.FileSystemObject")  
Set WshShell = WScript.CreateObject("WScript.Shell")

result = WshShell.Popup("Monitor script is starting. Please wait...", 5)

' Get the path to this script  
strScriptPath = Left(WScript.ScriptFullName, InStrRev(WScript.ScriptFullName, "\"))  
strLogFileName = strScriptPath & "monitor.log"  
strProcessFilePath = "ProcessList.txt"

' Check to determine if the log file exists  
If Not objFSO.FileExists(strLogFileName) Then  
    Set objFile = objFSO.CreateTextFile(strLogFileName, True)  
    objFile.Close  
End If

' Connect to WMI and obtain an SWbemServices objects, used by multiple monitors  
Set Service = GetObject("WinMgmts:{impersonationLevel=impersonate, (security)}")

If MonitorEventLog = 1 Then

    ' Create the sink object that will receive the Events  
    Set EventsSink = WScript.CreateObject("WbemScripting.SWbemSink", "EventsSink\_")

    ' Connect to WMI and obtain an SWbemServices objects  
    Set Events = GetObject("WinMgmts:{impersonationLevel=impersonate, (security)}" & \_  
        "!//./root/cimv2")

    ' Set up the event selection. EventSink\_OnObjectReady will be called when  
    ' one of the specified Win32\_NTLogEvent occurs  
    strQuery = "SELECT \* FROM \_\_InstanceCreationEvent WHERE TargetInstance ISA  
'Win32\_NTLogEvent'" & \_  
        "and TargetInstance.EventCode = 517 or TargetInstance.EventCode = 608" & \_  
        " or TargetInstance.EventCode = 610 or TargetInstance.EventCode = 611" & \_  
        " or TargetInstance.EventCode = 612 or TargetInstance.EventCode = 624" & \_  
        " or TargetInstance.EventCode = 625 or TargetInstance.EventCode = 631" & \_  
        " or TargetInstance.EventCode = 632 or TargetInstance.EventCode = 635" & \_  
        " or TargetInstance.EventCode = 636 or TargetInstance.EventCode = 639" & \_  
        " or TargetInstance.EventCode = 640 or TargetInstance.EventCode = 641" & \_  
        " or TargetInstance.EventCode = 642 or TargetInstance.EventCode = 643" & \_  
        " or TargetInstance.EventCode = 644"

    If MonitorAllFailed = 1 Then  
        strQuery = strQuery & " or TargetInstance.Type = 'audit failure'"  
    End If



```

If MonitorAllWarnings = 1 Then
    strQuery = strQuery & " or TargetInstance.Type = 'warning'"
End If

If MonitorAllErrors = 1 Then
    strQuery = strQuery & " or TargetInstance.Type = 'error'"
End If

Events.ExecNotificationQueryAsync EventsSink, strQuery

End If

If MonitorRegistry = 1 Then

    ' Create the sink object that will receive registry change events.
    Set RegistrySink = WScript.CreateObject("WbemScripting.SWbemSink", "RegistrySink_")

    ' Connect to WMI and obtain an SWbemServices object
    Set Registry = GetObject("WinMgmts:{impersonationLevel=impersonate, (security)}" & _
        "!//./root/default")

    ' Set up the registry key selection. RegistrySink_OnObjectReady will be called when
    ' a change is detected at any of the keys listed below
    Registry.ExecNotificationQueryAsync RegistrySink, _
        "SELECT * FROM RegistryKeyChangeEvent " & _
        "Where (hive = 'HKEY_LOCAL_MACHINE' And Keypath =
'Software\\Microsoft\\Windows\\CurrentVersion\\Run') " & _
        "OR (hive = 'HKEY_LOCAL_MACHINE' And Keypath =
'Software\\Microsoft\\Windows\\CurrentVersion\\RunOnce') " & _
        "OR (hive = 'HKEY_LOCAL_MACHINE' And Keypath = 'Software\\Microsoft\\Windows
NT\\CurrentVersion\\Winlogon') " & _
        "OR (hive = 'HKEY_LOCAL_MACHINE' And Keypath = 'System\\CurrentControlSet\\Control\\Lsa') "
    & _
        "OR (hive = 'HKEY_LOCAL_MACHINE' And Keypath =
'System\\CurrentControlSet\\Control\\SecurityProviders')"

End If

If MonitorCDROM = 1 Then

    ' Create the sink object that will receive the CD-ROM events.
    Set CDRomSink = WScript.CreateObject("WbemScripting.SWbemSink", "CDRomSink_")

    ' CDRomSink_OnObjectReady will be called when a CD-ROM is put in the drive.
    Service.ExecNotificationQueryAsync CDRomSink, _
        "SELECT * FROM __InstanceModificationEvent WITHIN " & ScanSpeed & " WHERE TargetInstance
ISA 'Win32_LogicalDisk' " & _
        "and TargetInstance.Name="" & CDDriveLetter & "" and PreviousInstance.Size !=
TargetInstance.Size and TargetInstance.Size > 0"

End If

If MonitorFloppy = 1 Then

```

```

' Create the sink object that will receive the floppy events.
Set FloppySink = WScript.CreateObject("WbemScripting.SWbemSink", "FloppySink_")

' FloppySink_OnObjectReady will be called when a floppy disk is put in the drive.
Service.ExecNotificationQueryAsync FloppySink, _
  "SELECT * FROM __InstanceModificationEvent WITHIN " & ScanSpeed & " WHERE TargetInstance
ISA 'Win32_LogicalDisk' " & _
  "and TargetInstance.Name='A:' and PreviousInstance.Size != TargetInstance.Size and
TargetInstance.Size > 0"

End If

If MonitorScheduler = 1 Then

  ' Create the sink object that will receive the task scheduler events.
  Set TaskSink = WScript.CreateObject("WbemScripting.SWbemSink", "TaskSink_")

  ' TaskSink_OnObjectReady will be called when a job is scheduled.
  Service.ExecNotificationQueryAsync TaskSink, _
    "select * from __InstanceCreationEvent WITHIN " & ScanSpeed & " where targetinstance isa
'Win32_ScheduledJob'"

End If

If MonitorProcesses = 1 Then
' This section monitors processes as they are created.
'Initialize Variables
varCounterProcess = 0
varProcessApproved = 0

' Create the sink object that will receive the new process events.
Set ProcessSink = WScript.CreateObject("WbemScripting.SWbemSink", "ProcessSink_")

' Build known good process array from process list file
If objFSO.FileExists(strScriptPath & strProcessFilePath) Then
  Set objTextStream = objFSO.OpenTextFile(strScriptPath & strProcessFilePath)

  Do While Not objTextStream.AtEndOfStream
    strInputLine = LCase(objTextStream.ReadLine)
    If Len(Trim(strInputLine)) > 0 And Left(strInputLine, 1) <> ";" Then
      strSplitString = Split(strInputLine, "#")
      aryProcessName(varCounter) = strSplitString(0)
      aryProcessExecutablePath(varCounter) = strSplitString(1)
      aryProcessAlert(varCounter) = strSplitString(2)
      varCounter = varCounter + 1
    End If
  Loop
  objTextStream.Close

  ' Connect to WMI and obtain an SWbemServices object
  Set ProcessList = GetObject("WinMgmts:{impersonationLevel=impersonate,
(security)}").ExecQuery("select * from Win32_Process")

```

```

For Each Process In ProcessList
    Do Until varCounterProcess = varCounter
        If aryProcessName(varCounterProcess) = LCase(Process.Name) Then
            varProcessApproved = 1
            Exit Do
        End If
        varCounterProcess = varCounterProcess + 1
    Loop

    If varProcessApproved = 1 Then
        'Process is approved. Now check to see if an alert should still be generated
        If aryProcessAlert(varCounterProcess) = 1 Then
            msg = "An approved process has been created. " & Chr(10) & LCase(Process.Name) &
Chr(10) & Chr(13) & _
                "This process is listed in the ProcessList.txt file, but an alert has been requested
because the line that lists this" & _
                " process ends with a 1. To avoid this alert in the future, edit the ProcessList.txt file
and change the 1 to a 0."
            result = LogEntry(True, msg, True)
        End If
    Else
        'Process is not approved. Log and generate alert.
        msg = "An un-approved process has been created. " & Chr(10) & LCase(Process.Name) &
Chr(10) & Chr(13) & _
                "To avoid this alert in the future, add this process to the ProcessList.txt on the system
that generated this alert."
        result = LogEntry(True, msg, True)
    End If

    'Reinitialize Variables
    varCounterProcess = 0
    varProcessApproved = 0

    Next

    result = LogEntry(True, "All currently running processes have been checked.", False)

    Service.ExecNotificationQueryAsync ProcessSink, _
        "select * from __InstanceCreationEvent WITHIN " & ScanSpeed & " where targetinstance isa
'Win32_Process'"

    Else
        WScript.Echo ("ProcessList.txt does not exist. To monitor processes, please exit this script and
run the process.vbs file.")

    End If

End If

'This function performs all logging and alerting.
Public Function LogEntry(blankline, msg, alert)
    Set Log = objFSO.OpenTextFile(strLogFileName, 8, False)

```

```

If blankline Then
    Log.WriteBlankLines (1)
    Log.WriteLine (Date & " at " & Time)
    Log.WriteLine (msg)
    Log.Close
Else
    Log.WriteLine (Date & " at " & Time)
    Log.WriteLine (msg)
    Log.Close
End If

If alert Then
    WshShell.LogEvent 0, msg, AdministrativeAlert
End If

```

End Function

' This is the subroutine executed when a Win32\_NTLogEvent event matching the selection criteria occurs.

```

Sub EventsSink_OnObjectReady(objObject, objAsyncContext)
    msg = objObject.TargetInstance.Type & Chr(10) & Chr(13) & objObject.TargetInstance.Message
    result = LogEntry(True, msg, True)
End Sub

```

' This is the subroutine executed when a registry change is detected.

```

Sub RegistrySink_OnObjectReady(objObject, objAsyncContext)
    result = LogEntry(True, "Registry change detected at: " & objObject.hive & "\" & objObject.KeyPath,
True)
End Sub

```

'This is the subroutine executed when a floppy is inserted.

```

Sub FloppySink_OnObjectReady(objObject, objAsyncContext)
    result = LogEntry(True, "Floppy disk inserted!", True)
End Sub

```

'This is the subroutine executed when a CD-ROM is inserted.

```

Sub CDRomSink_OnObjectReady(objObject, objAsyncContext)
    result = LogEntry(True, "CD-ROM inserted!", True)
End Sub

```

' This is the subroutine executed when a new scheduled task is detected.

```

Sub TaskSink_OnObjectReady(objObject, objAsyncContext)
    result = LogEntry(True, "The command " & objObject.TargetInstance.Command & " has been
scheduled.", True)
End Sub

```

' This is the subroutine executed when a new Win32\_Process is detected.

```

Sub ProcessSink_OnObjectReady(objObject, objAsyncContext)
'Initialize Variables
varCounterProcess = 0
varProcessApproved = 0

varProcessPathNull = objObject.TargetInstance.ExecutablePath

```

```

If IsNull(varProcessPathNull) Then
    Do Until varCounterProcess = varCounter
        If aryProcessName(varCounterProcess) = LCase(objObject.TargetInstance.Name) Then
            varProcessApproved = 1
            Exit Do
        End If
        varCounterProcess = varCounterProcess + 1
    Loop
End If

If Not IsNull(varProcessPathNull) Then
    Do Until varCounterProcess = varCounter
        If LCase(aryProcessName(varCounterProcess)) = LCase(objObject.TargetInstance.Name) And
aryProcessExecutablePath(varCounterProcess) = LCase(objObject.TargetInstance.ExecutablePath) Then
            varProcessApproved = 1
            Exit Do
        End If
        varCounterProcess = varCounterProcess + 1
    Loop
End If

If varProcessApproved = 1 Then
    'Process is approved. Now check to see if an alert should still be generated
    If aryProcessAlert(varCounterProcess) = 1 Then
        msg = "An approved process has been created. " & Chr(10) &
LCase(objObject.TargetInstance.Name) & " " & _
            LCase(objObject.TargetInstance.ExecutablePath) & Chr(10) & Chr(13) & _
            "This process is listed in the ProcessList.txt file, but an alert has been requested because
the line that lists this" & _
            " process ends with a 1. To avoid this alert in the future, edit the ProcessList.txt file and
change the 1 to a 0."
        result = LogEntry(True, msg, True)
    End If
Else
    'Process is not approved. Log and generate alert.
    msg = "An un-approved process has been created. " & Chr(10) &
LCase(objObject.TargetInstance.Name) & " "" & _
            LCase(objObject.TargetInstance.ExecutablePath) & """" & Chr(10) & Chr(13) & _
            "To avoid this alert in the future, add this process to the ProcessList.txt on the system that
generated this alert."
    result = LogEntry(True, msg, True)
End If

End Sub

result = LogEntry(True, "System monitoring started.", False)

WScript.Echo "System monitoring in progress. To stop monitoring, click OK."

```

## Appendix B

'Every time that this script is run, it will create a new ProcessList.txt file.  
'Customizations that have been made to an existing ProcessList.txt file will be overwritten.

'This line forces us to declare all variables  
Option Explicit

'Declare all variables

```
Dim objTextStream
Dim objFSO
Dim objFile
Dim WshShell
Dim result
Dim strProcessFilePath
Dim strScriptPath
Dim strSplitString
Dim ProcessList
Dim process
```

```
Set objFSO = CreateObject("Scripting.FileSystemObject")
Set WshShell = WScript.CreateObject("WScript.Shell")
```

```
result = WshShell.Popup("Process list script is starting. Please wait...", 3)
```

```
'Get the path to this script
strScriptPath = Left(WScript.ScriptFullName, InStrRev(WScript.ScriptFullName, "\"))
strProcessFilePath = "ProcessList.txt"
```

'Check to see if a ProcessList.txt file already exists

```
If objFSO.FileExists(strScriptPath & strProcessFilePath) Then
    WScript.Echo ("ProcessList.txt file exists. Please delete or rename before running this script again!")
Else
    Set objFile = objFSO.CreateTextFile(strScriptPath & strProcessFilePath, True)
    objFile.Close
```

```
If objFSO.FileExists(strScriptPath & strProcessFilePath) Then
    Set objTextStream = objFSO.OpenTextFile(strScriptPath & strProcessFilePath, 8, False)
    objTextStream.WriteLine (";This list has been generated by the processlist.vbs script.")
    objTextStream.WriteLine (";Other processes may be added to this list as necessary.")
    objTextStream.WriteLine (";The number is necessary at the end of each line.")
    objTextStream.WriteLine (";A 0 indicates that no alert should be generated.")
    objTextStream.WriteLine (";A 1 indicates that an alert should be generated.")
    objTextStream.WriteLine (";Use a semi-colon to comment out a line.")
    objTextStream.WriteLine (1)
    objTextStream.Close
End If
```

' Connect to WMI and obtain an SWbemServices object

```

Set ProcessList = GetObject("WinMgmts:{impersonationLevel=impersonate,
(security)}").ExecQuery("select * from Win32_Process")

For Each process In ProcessList
    If objFSO.FileExists(strScriptPath & strProcessFilePath) Then
        Set objTextStream = objFSO.OpenTextFile(strScriptPath & strProcessFilePath, 8, False)
        objTextStream.WriteLine (LCase(process.Name) & "#" & LCase(process.ExecutablePath) & "#" &
"0")
        objTextStream.Close
    End If
Next

End If

WScript.Echo ("Process list script complete!")

```

## Appendix C

'This line forces declaration of all variables  
Option Explicit

'Declare all variables  
Dim WshShell  
Dim strQuery  
Dim NTEvent  
Dim Events  
Dim msg

Set WshShell = WScript.CreateObject("WScript.Shell")

' Set up the event selection  
strQuery = "SELECT \* FROM \_\_InstanceCreationEvent WHERE TargetInstance ISA 'Win32\_NTLogEvent'  
and TargetInstance.SourceName = 'WSH'"

' Connect to WMI and obtain an SWbemServices objects  
Set Events = GetObject("WinMgmts:{impersonationLevel=impersonate,  
(security)}").ExecNotificationQuery(strQuery)

```

Do
    Set NTEvent = Events.nextevent
    If Err <> 0 Then
        WScript.Echo Err.Number, Err.Description, Err.Source
        Exit Do
    ElseIf NTEvent.TargetInstance.Message <> Empty Then
        msg = "Alert from " & NTEvent.TargetInstance.ComputerName & Chr(10) &
NTEvent.TargetInstance.Message
        WScript.Echo msg
    Else
        WScript.Echo "Event received, but it did not contain a message."
    End If
Loop

```

WScript.Echo "finished"

## Appendix D

Microsoft Knowledge Base article Q137890, HOWTO: Create a User-Defined Service describes one value under the Parameters key called Application. You will need to create an additional value called AppParameters under the Parameters key. Both values need to be string values. You will need to customize the path information of each value.

SystemMonitor.vbs service parameters

Value Name: Application  
Data Type: REG\_SZ  
String: C:\winnt\system32\wscript.exe

Value Name: AppParameters  
Data Type: REG\_SZ  
String: C:\Monitor\SystemMonitor.vbs

Be sure to set the startup type to automatic, and assign a valid network user account and password for the service.

Administrative.vbs service parameters

Value Name: Application  
Data Type: REG\_SZ  
String: C:\winnt\system32\wscript.exe

Value Name: AppParameters  
Data Type: REG\_SZ  
String: C:\Monitor\administrative.vbs

Be sure to set the startup type to automatic, and select the checkbox to allow the service to interact with the desktop.

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SANS Norfolk 2019	Norfolk, VA	Mar 18, 2019 - Mar 23, 2019	Live Event
SANS Munich March 2019	Munich, Germany	Mar 18, 2019 - Mar 23, 2019	Live Event
SANS vLive - SEC401: Security Essentials Bootcamp Style	SEC401 - 201903,	Mar 19, 2019 - Apr 25, 2019	vLive
Community SANS Raleigh SEC401	Raleigh, NC	Apr 01, 2019 - Apr 06, 2019	Community SANS
SANS 2019 - SEC401: Security Essentials Bootcamp Style	Orlando, FL	Apr 01, 2019 - Apr 06, 2019	vLive
SANS 2019	Orlando, FL	Apr 01, 2019 - Apr 08, 2019	Live Event
SANS London April 2019	London, United Kingdom	Apr 08, 2019 - Apr 13, 2019	Live Event
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