Hunting for Adversary's Schedule

After successfully getting thier foothold into their desired enterprise, **Do you think adversary want to *loose their access* becasue they accidentally hit CTRL + C?** Lets *schedule* some time to hunt one of adversaries favorite **Persistence** technique.

Today's Schedule

- [ ] A Window into Shcheduled Task
- [ ] Threat Hunting - Its quirks and features
- [ ] Lets Get to know the Data
- [ ] Detectioin Engineering
- [ ] What we learned - A recap

A Window INTO - Scheduled Task

What are scheduled tasks?

According to MSDN "A scheduled task is basically a codeunit that runs logic in a background session at a specific time."

Some main components Triggers, Actions, Principals, Settings, Registry Information and Data. Detailed objects available can be found at Task Schedule Objects

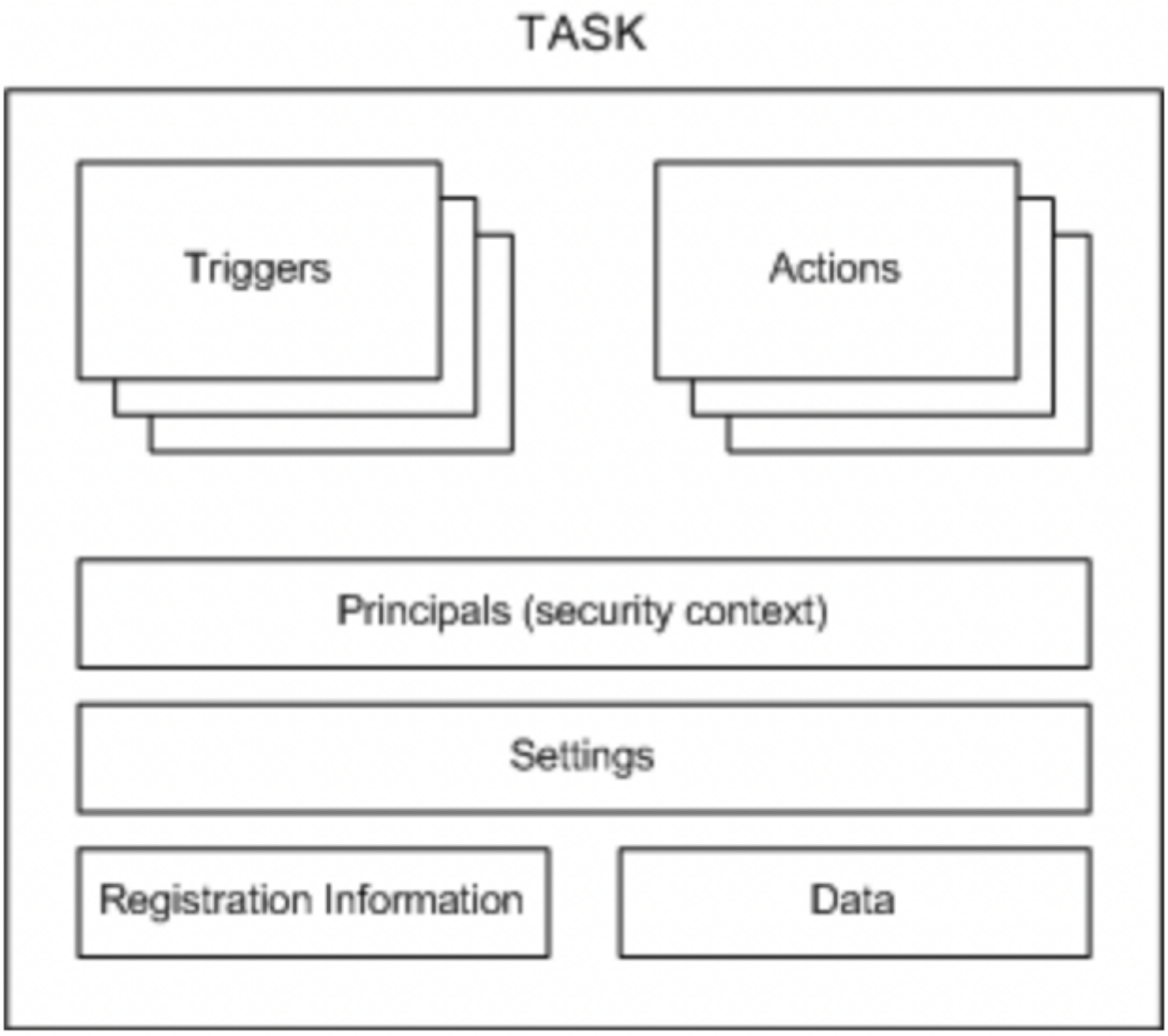


Image courtesy Microsoft Docs

Who can create scheduled taks?

To create/view/run/change scheduled tasks you **must be** an administrator or **member of the administrator's group** AND the task has **necessary permissions**. Additionally, you can grant users with SeBatchLogonRight permissions. Also, from MSDN " Schedule Task Wizard does not verify the password that you type for the user account that the process will run under. Make sure that you type the correct password."

Why attackers use scheduled tasks?

Scheduled Task is one of the common persistence techniques used in Intrusion operations and Red Teaming/Pentesting activities. Once a perpetrator/red teamer/pentester established their foothold, they want to **maintain** their access surviving reboots, network issues, and even pulling the cords.

Which stage of Mandiant Lifecycle/MITRE/Kill chain Scheduled task is used?

In Mandiant Lifecycle, scheduled tasks revolve around the cycle of Maintain Presence and Escalate Privileges. In MITRE lingo, it is spanned across three different Tactics (Persistence, Execution, Privilege Escalation) depending on what a perpetrator wants to achieve. For mighty Cyber Kill Chain, this can be in Exploitation, installation, and Command and Control.

Inspector Gadget - Threat Hunting

Image Courtesy Stickpng

Before we learn about Threat Hunting, lets define it

What is Threat Hunting?

Threat Hunting is a process of being proactive of unveiling unknow-knowns and unknown-unknowns to better our security posture

In Threat Hunting, hypothesis creation is generaly a first step to guide us in the process

Hypothesis Creation

"Hypotheses focus the research interest on the most important questions and thus generate a structure which then leads to the decision of which empiric tools to choose for research" 1(https://www.acad-write.org/mentor/how-to-write-a-hypothesis/). With this statement in mind, we will formulate our hypothesis using who, what, where, when, why and How. 2(https://youtu.be/vZgI00UcATw?t=26314).

In threat Hunting, we create Broad and Narrow Hypothesis (This is not a standard or a law but it provides a nice flow into starting our hunts). The Broad hypothesis can be used as our epic topic for the week/month. It is broad for a reason. The narrow hypothesis is what we want to hunt for today. You can think of the broad hypothesis as a Tactic and the narrow hypothesis as a tool/technique/procedure.

Broad Hypothesis

> Adversaries use persistence mechanisms to stay connected.

Narrow hypothesis

For creating our narrow hypothesis, let's answer some questions

1. Who - Inside Threats/Adversaries/pentesters/read teamers. (answers **who** is our **person of interest**)
2. What - Scheduled tasks (various persistence mechanisms, you can use MITRE to get known ones) (answers **what** we would like to **hunt**)
3. where - most of the artifacts be related to enpoint (EDR, sysmon, windows event logs) (answers **where** do find the **data** to prove/disprove our **hypothesis**)
4. When - We can hunt for all retained logs (answers the **timeframe** we will **focus** our hunt)
5. Why - To check for persistence in our environment (answers **why** are we **doing** this)
6. How - to identify a way of modeling our searches and interpret their results

with that in mind, our narrow hypothesis could be along the lines of

> Adversaries might ***create/change scheduled tasks*** on local/remote endpoints using GUI/command line tools to **execute** additional/new executables/hta files/js files for ***maintaining persistence*** in our environment.

Familiarize yourself with available data

Having a working hypothesis is great BUT we need some data to perform this hunt.

How to determine what data is required?

There are several answers to the question depending on Time, Team/org capabilities among other things. The easiest and most tested way is to take a look what our dear friends at MITRE did. we go to MITRE and check the section named "Detection" to give us the Data components required to hunt for.

We see that we may need

- command execution and their arguments
- file creation/modification events
- process and scheduled creation events.

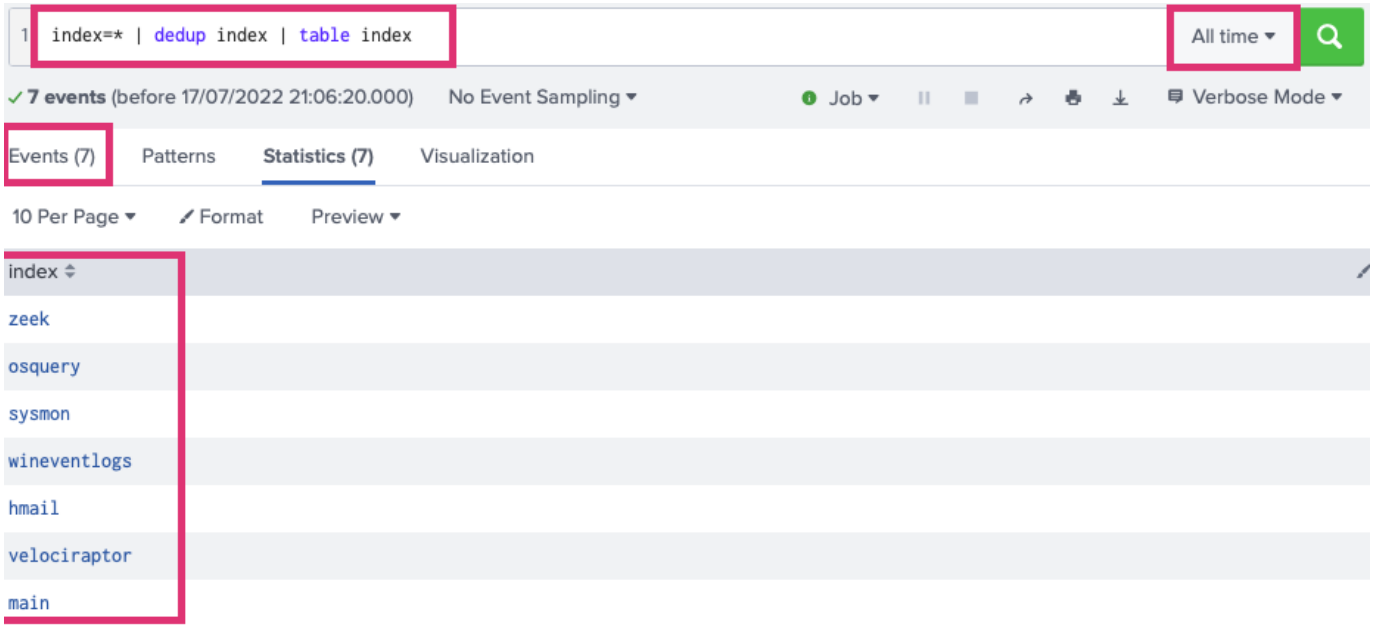
Let's check if we have any of those in our environment. using splunk.

query

```
index=* | dedup index | table index
```

Above query will

> query all indeces with wilcard *
>
> - deduplicate them using **dedup** command
>   - asking to present it in tabular form.



We can see endpoint (osquery, windows event logs, sysmon) logs that are required for our hypothesis. But we need specific ones like command line arguments, process creation events, etc. So our next step is to figure out if we have those events in sysmon and windows events and examine fields. For this, let's take look at a sample log for sysmon and windows events.

Sysmon sample log with query

```
index=sysmon
```

```
{ [-]
  @timestamp: 2022-03-12T22:52:54.263Z
  @version: 1
  agent: { [-]
    ephemeral_id: 89aebf72-73f7-4535-899b-ee8d39c57953
    hostname: files
    id: 9809b5ad-f9bd-4cd8-a7be-abb90a8a4c39
    name: files
    type: winlogbeat
    version: 7.16.2
  }
  ecs: { [-]
    version: 1.12.0
  }
  event: { [-]
    action: File created (rule: FileCreate)
    category: [ [-]
      file
    ]
    code: 11
    created: 2022-03-12T22:52:55.589Z
    kind: event
    module: sysmon
    provider: Microsoft-Windows-Sysmon
    type: [ [-]
      creation
    ]
  }
  file: { [-]
    directory: C:\Windows\ServiceProfiles\LocalService\AppData\Local
    extension: dat
    name: lastalive0.dat
    path: C:\Windows\ServiceProfiles\LocalService\AppData\Local\lastalive0.dat
  }
  host: { [-]
    architecture: x86_64
    hostname: files
    id: 2be492d7-af67-4e72-a1db-9c074112495c
    ip: [ [-]
      fe80::5bd:f44d:3be6:38a2
      172.16.50.110
      fe80::5efe:ac10:326e
    ]
    mac: [ [-]
      06:e5:dd:67:f2:a4
      00:00:00:00:00:00:00:e0
    ]
    name: files.magnumtempus.financial
    os: { [-]
      build: 14393.4770
      family: windows
      kernel: 10.0.14393.4770 (rs1_release.211101-1440)
      name: Windows Server 2016 Datacenter
      platform: windows
      type: windows
      version: 10.0
    }
  }
  log: { [-]
    level: information
  }
  message: File created:
RuleName: technique_id=T1047,technique_name=File System Permissions Weakness
UtcTime: 2022-03-12 22:52:54.263
ProcessGuid: {2BE492D7-E6DA-622C-1300-000000001702}
ProcessId: 992
Image: C:\Windows\System32\svchost.exe
TargetFilename: C:\Windows\ServiceProfiles\LocalService\AppData\Local\lastalive0.dat
CreationUtcTime: 2022-03-12 18:30:50.825
User: NT AUTHORITY\LOCAL SERVICE
  process: { [-]
    entity_id: {2BE492D7-E6DA-622C-1300-000000001702}
    executable: C:\Windows\System32\svchost.exe
    name: svchost.exe
    pid: 992
  }
  rule: { [-]
    name: technique_id=T1047,technique_name=File System Permissions Weakness
  }
  tags: [ [-]
    sysmon
    beats_input_codec_plain_applied
  ]
  winlog: { [-]
    api: wineventlog
    channel: Microsoft-Windows-Sysmon/Operational
    computer_name: files.magnumtempus.financial
    event_data: { [+]
    }
    event_id: 11
    opcode: Info
    process: { [+]
    }
    provider_guid: {5770385F-C22A-43E0-BF4C-06F5698FFBD9}
    provider_name: Microsoft-Windows-Sysmon
    record_id: 84363
    task: File created (rule: FileCreate)
```


Sysmon Tag/ Task Category

Sysmon ID

Log provider

Information related to hosts

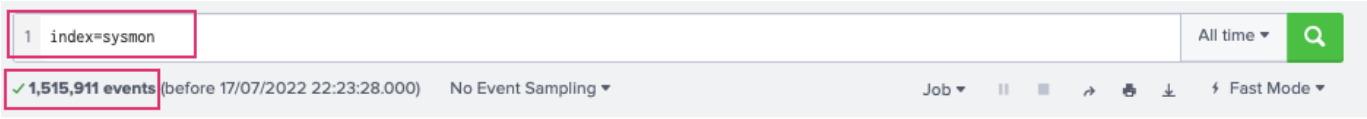
how we see in windows event logs

From sysmon config file

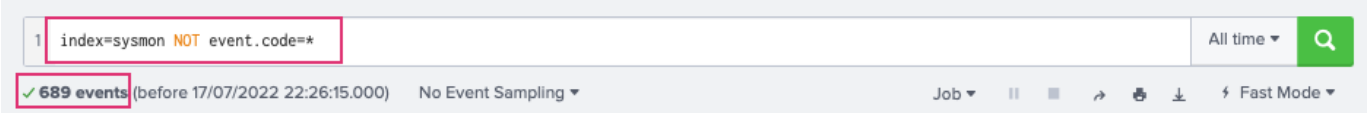
```
    }
    version: 2
  }
}
```


From the screenshot, we see event.action and event.code interesting as sysmon documentation states them as events.

One caveat in going with this method is that we do not know all sysmon logs will have same/similar fields. So, let see what field that may appear in all the logs and test it.



Total number of sysmon logs



Total number of logs without event id

99.999% of the logs have event id, so, it is good to work with this data. We can check the rest of the data for edge cases later in our threat hunting process if needed.

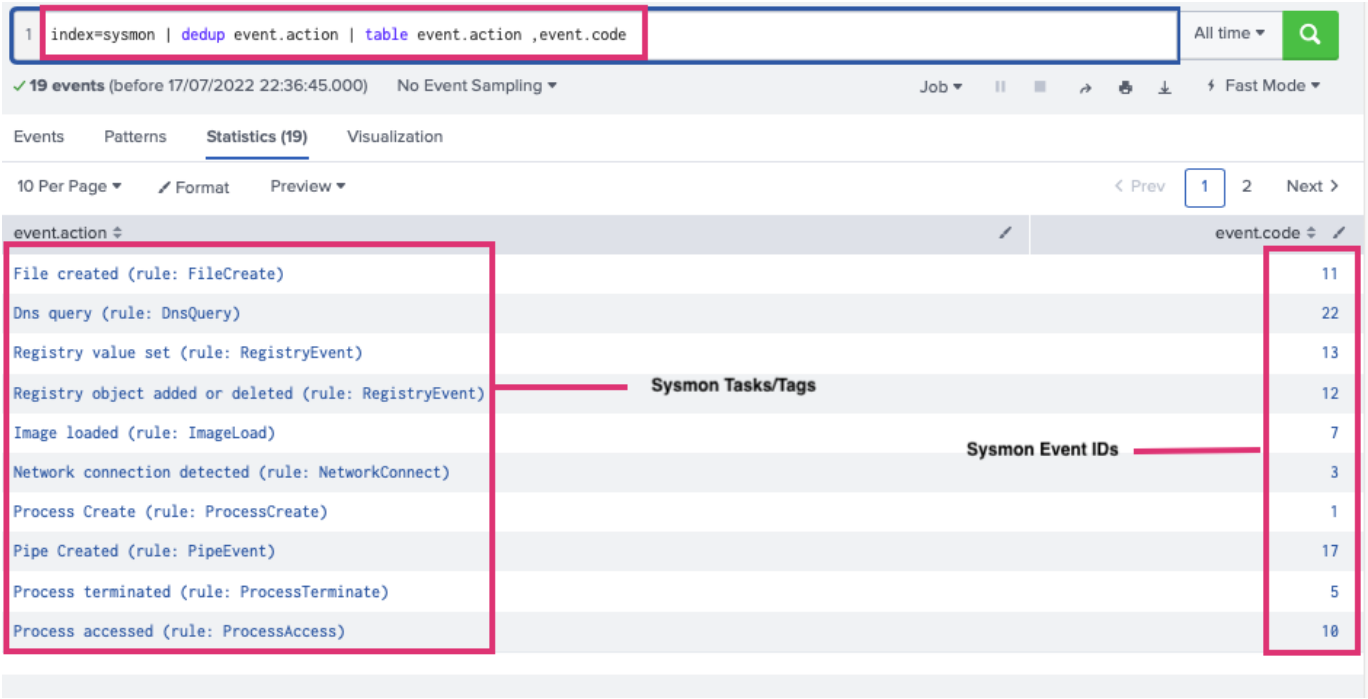
Now, lets check what types of events we have in sysmon

query

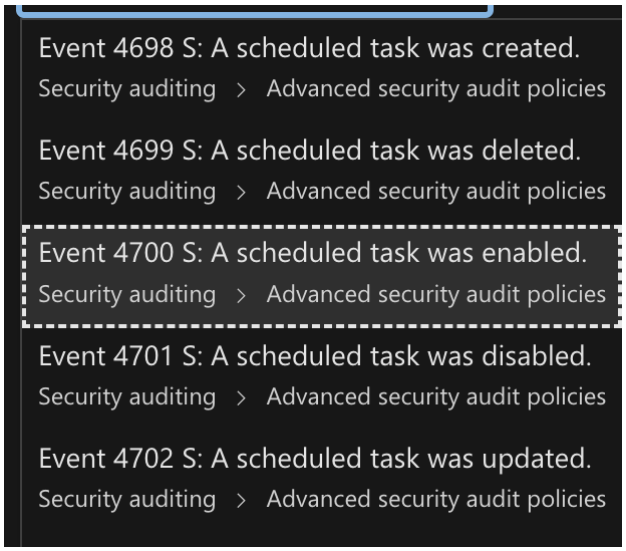
index=sysmon | dedup event.action | table event.action ,event.code

Above query will

- Use sysmon Index
  - Deduplicate even.action field
    - Presenting event.action and event.id in tabular form



There are several windows event IDs, let's see what is relevant to us by checking Microsoft's Auditing and searching for scheduled tasks in the sidebar, we will see events produced when a certain action is performed on/by scheduled tasks.



As we did with sysmon, let's check out sample windows event log to see what fields exist with the query

```
index=wineventlogs
```

These look similar to sysmon data we checked earlier with event IDs, event provider, message and other details.

Now that we know how our data looks like, lets check windows event logs related to scheduled tasks that we saw before.

query

> index=wineventlogs event.code IN (4698,4699,4700,4701,4702)

Above query will

> Search for windowseventlogs index

> - uses IN operator to check if event IDs 4698,4699,4700,4701,4702 present in event.code field. you can also do event.code=4698 event.code=4699 .... so on. Both will get you same results

No events. That's odd... isn't it?

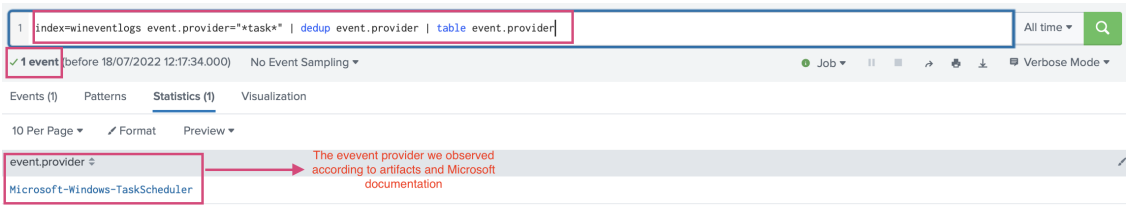
There is another channel that monitors scheduled task actions called "MicrosoftWindowsTaskScheduler/Operational". Let's check if we have that

query

> index=wineventlogs event.provider="*task*" | dedup event.provider | table event.provider

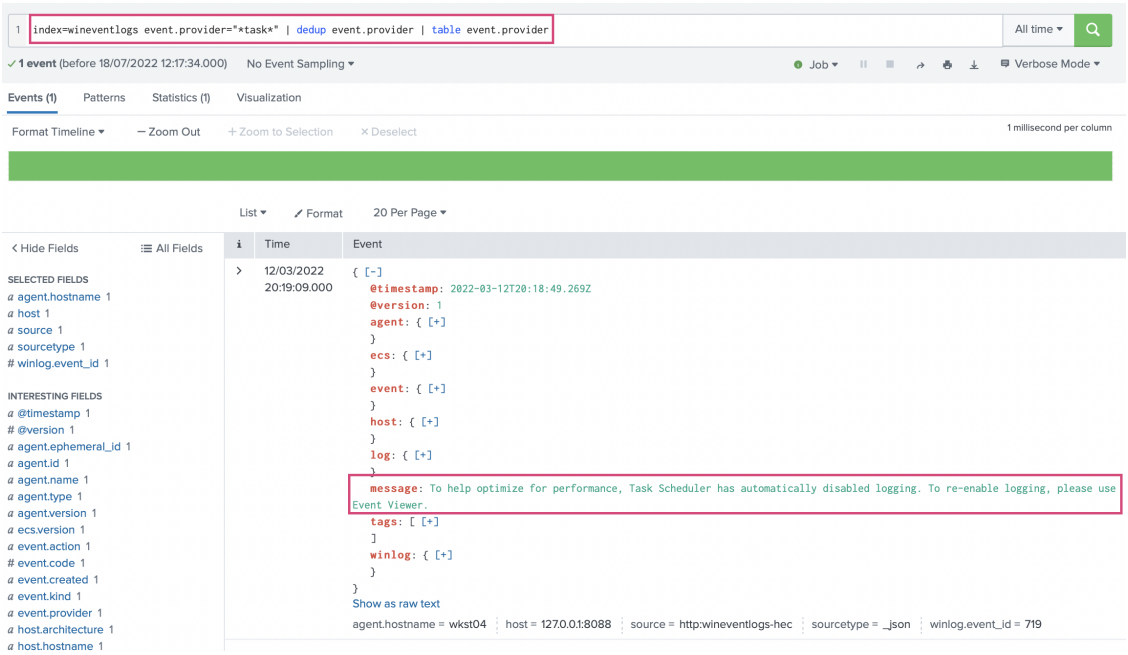
Above query will

> Search for windowseventlogs index
>
> - Check for a keyword task in event.provider feild.
>   - Deduplicates all the event.provider values (if we have more than one)
>   - Presets in a tabular form



We see "Microsoft-Windows-TaskScheduler/Operational" in the logs, but checking logs we observed a message

```
To help optimize for performance, Task Scheduler has automatically disabled logging. To re-enable logging, please use Event Viewer.
```



Which means, we cannot use windows event logs for this (at least for now). This is a very important step and we will circle back in ## Detection Coverage and Log Value section

Lets turn data into actionable queries and results

Based on our analysis, we determined that we cannot rely on windows event logs or "Microsoft-Windows-TaskScheduler/Operational" channel events.The best option here is sysmon data.

Ok great, but what should we search in sysmon data?

To answer that question we need to know the artifacts left behind when scheduled tasks are created. Without going into too many details, below we can see those artifacts. These you can get from past Incidents, DFIR analysts, Blog posts, MITRE references, research papers, etc.

1. Windows events 4698,4699,4700,4701,4702 we researched before
2. "Microsoft-Windows-TaskScheduler/Operational" channel logs
3. File creations in C:\Windows\System32\Tasks folder (sysmon event 11)with svchost.exe as creation process
4. Registry CreateKey (name of the Task), DeleteKey, SetValue (ID, Index, SD) (sysmon events 12,13,14)svchost.exe is the Image and TargetObject is the path
5. Image load events for taskschd.dll (sysmon event 7)
6. Commandline arguments

We will build our queries based on the available data and fields in it.

Referring to sysmon documentation, we can see event.code 11 is related to file creation event

query

> index=sysmon event.code=11

Above query will

> Search for sysmon index
>
> - Check for logs with event.code 11.

Process.executable and process.path seems to be the fields we can search to fit our 3rd point above. Let's construct a query

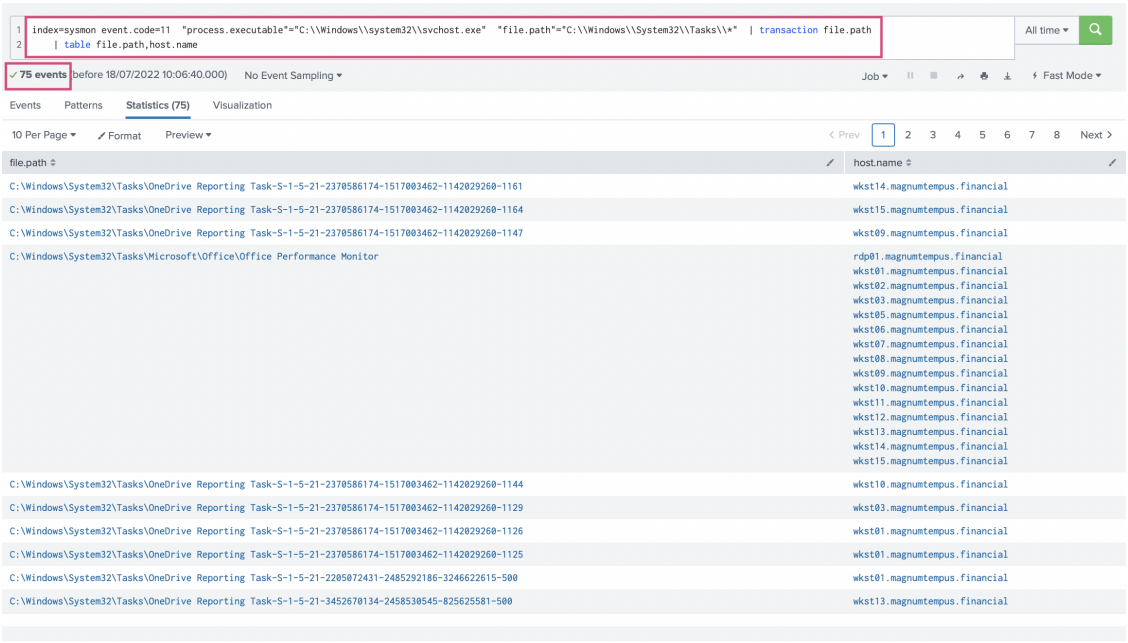
query

> index=sysmon event.code=11 "process.executable"="C:\Windows\system32\svchost.exe" "file.path"="C:\Windows\System32\Tasks*" | transaction file.path

```
| table file.path,host.name
```

Above query will

> Search for sysmon index
>
> - Check for logs with event.code 11.
>   - filter events that has svchost.exe as process
>   - filter events that are only created in C:\Windows\System32\Tasks* path
>   - stack results on file.path
>   - present them in tabular form



75 events are returned for our query and are easy to sift throught.

This is where the true fun of Threat Hunting begins.

We need to interpret the results to find that needle in the haystack.

In @UK*Daniel_Card words "***you don't need high privs to search the scheduled task history log.. but... there's a shit ton of ms/windows stuff in here so its hard to spot stuff..._**"**

For this, we need a good understanding of our environment's known-normal along with the normal behavior of the Operating System (OS) we are investigating. Also, one of the common themes we can take is

> "commonly observed events across multiple endpoints could be common OR something really bad is happening"

don't remember the person said it but experienced it first hand

This is not to say there won't be anything malicious in them BUT it will help us significantly reduce our dataset and gives a starting point. Some of the questions that help us in getting to this stage are

- Did we get the results we are expecting?
- What software do we install/approved on the system?
- Are there any anomalies in the data we received?
- How to narrow our investigation net?.

Let's say, CCleaner application is not approved in our environment but found in our results, we can follow up with the user or next steps according to our policies.

After filtering such results our refined query is

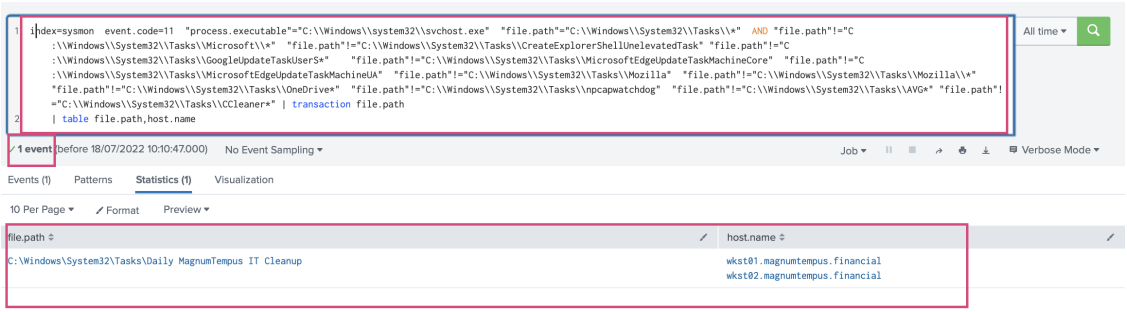
> index=sysmon event.code=11 "process.executable"="C:\Windows\system32\svchost.exe" AND "file.path"="C:\Windows\System32\Tasks\" *AND "file.path"!="C:|Windows|System32|Tasks|Microsoft|"* "file.path"!="C:\Windows\System32\Tasks\CreateExplorerShellUnelevatedTask" "file.path"!="C:\Windows\System32\Tasks\GoogleUpdateTaskUserS" *"file.path"!="C:|Windows|System32|Tasks|MicrosoftEdgeUpdateTaskMachineCore" "file.path"!="C:|Windows|System32|Tasks|MicrosoftEdgeUpdateTaskMachineUA" "file.path"!="C:|Windows|System32|Tasks|Mozilla" "file.path"!="C:|Windows|System32|Tasks|Mozilla|"* "file.path"!="C:\Windows\System32\Tasks\OneDrive" *"file.path"!="C:|Windows|System32|Tasks|npcapwatchdog" "file.path"!="C:|Windows|System32|Tasks|AVG"* "file.path"!="C:\Windows\System32\Tasks\CCleaner*" | transaction file.path

```
| table file.path,host.name
```

Above query will

Search for sysmon index

- Check for logs with event.code 11.
    - filter events that has svchost.exe as process
        - using AND operator to sepcify we want additional checks for file.path
            - Filtering some of the events from file.path based on our "commonly observed" methodology
                - stacking entries with file.path
                    - Present in tabular form



We are left with one task running on two computers. Great... But we will check for additional artifacts mentioned above to see if we can get to the same conclusion.

Let's check Registry events with event IDs found in sysmon documentation

query

```
index=sysmon "event.code" IN (12,13,14) "process.executable"="C:\Windows\system32\svchost.exe"
"registry.path"="HKLM\SOFTWARE\Microsoft\Windows NT\CurrentVersion\Schedule\TaskCache\Tree\*"
| transaction registry.path
| table registry.path,host.name
```

Above query will

Search for sysmon index

- Check for logs with event.code 12, 13, 14.
    - filter events that has svchost.exe as process
        - filter events with registry path
            - stacking entries with registy.path
                - Present in tabular form

```
index=sysmon "event.code" IN (12,13,14) "process.executable"="C:\\Windows\\system32\\svchost.exe" "registry.path"="HKLM\\SOFTWARE\\Microsoft\\Windows
    NT\\CurrentVersion\\Schedule\\TaskCache\\Tree\\*"
| transaction registry.path
| table registry.path,host.name
```

All time

439 events (before 18/07/2022 10:14:03.000) No Event Sampling Job Verbose Mode

Events (439) Patterns Statistics (439) Visualization

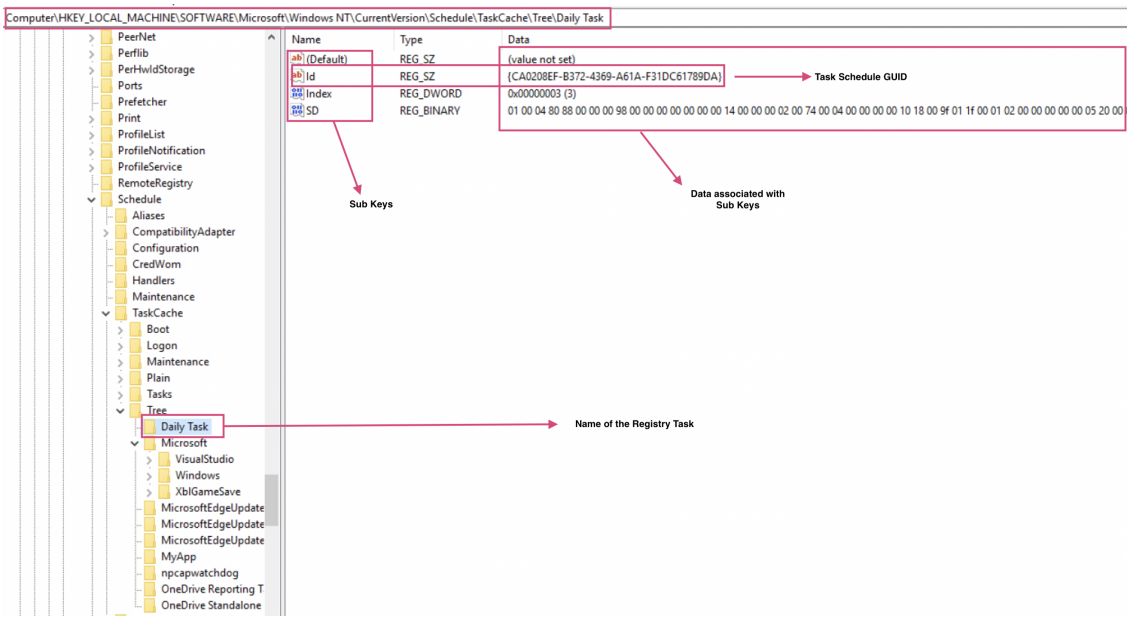
10 Per Page Format Preview Prev 1 2 3 4 5 6 7 8 ... Next

registry.path	host.name
HKLM\SOFTWARE\Microsoft\Windows NT\CurrentVersion\Schedule\TaskCache\Tree\Microsoft\Windows\UpdateOrchestrator\SD	dc.magnumtempus.financial dc02.magnumtempus.financial files.magnumtempus.financial rdp01.magnumtempus.financial wkst01.magnumtempus.financial wkst02.magnumtempus.financial wkst03 wkst03.magnumtempus.financial wkst04-1.magnumtempus.financial wkst04.magnumtempus.financial wkst05.magnumtempus.financial wkst06.magnumtempus.financial wkst07.magnumtempus.financial wkst08.magnumtempus.financial wkst09.magnumtempus.financial wkst10.magnumtempus.financial wkst11.magnumtempus.financial wkst12.magnumtempus.financial wkst13.magnumtempus.financial wkst14.magnumtempus.financial wkst15.magnumtempus.financial
HKLM\SOFTWARE\Microsoft\Windows NT\CurrentVersion\Schedule\TaskCache\Tree\Microsoft\Windows\UpdateOrchestrator	dc.magnumtempus.financial dc02.magnumtempus.financial files.magnumtempus.financial rdp01.magnumtempus.financial wkst01.magnumtempus.financial wkst02.magnumtempus.financial wkst03 wkst03.magnumtempus.financial wkst04-1.magnumtempus.financial wkst04.magnumtempus.financial wkst05.magnumtempus.financial wkst06.magnumtempus.financial wkst07.magnumtempus.financial wkst08.magnumtempus.financial wkst09.magnumtempus.financial wkst10.magnumtempus.financial

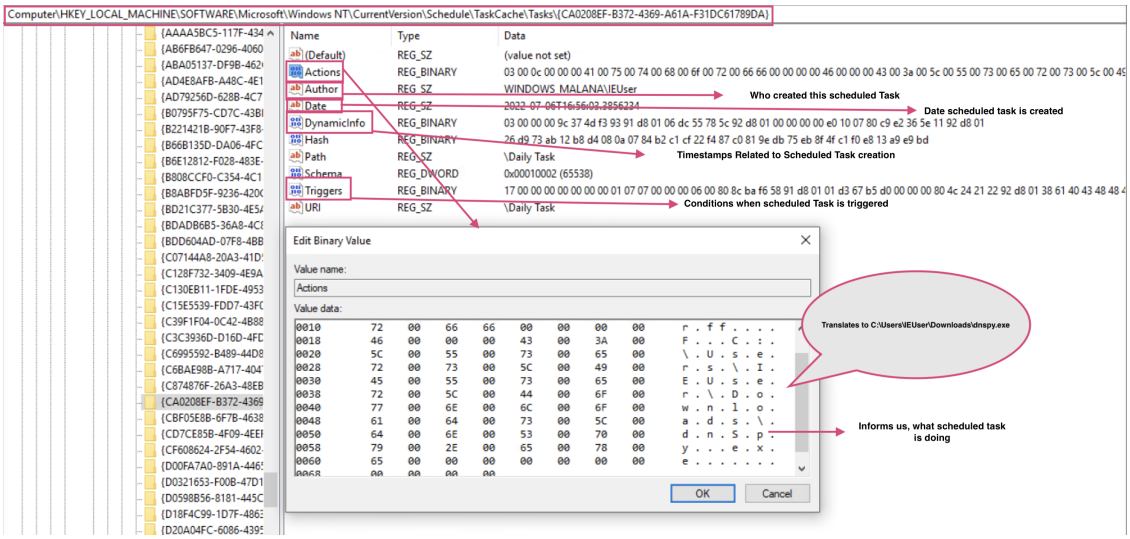
439 events. A little tough to sift through but still manageble. If you check the screenshot, we see path ending with SD.

By now, you unserstood that, majoority of Threat Hunting is research.

So, let's take a detour to see what these values are without going to much into the weeds. Scheduled Task registry "HKLM\SOFTWARE\Microsoft\Windows NT\CurrentVersion\Schedule\TaskCache\Tree" contains key/value pairs (keys and subkeys) and we create a task "Daily Task" in the below example, 4 Registry keys are created under "Daily Task" key, (Default), ID, Index, SD (you can check this by crearting a registry key and using RegEdit navigate to the path mentioned above.



Among these, ID field is important as it gives us a waypoint to navigate to it HKLM\SOFTWARE\Microsoft\Windows NT\CurrentVersion\Schedule\TaskCache\Task{CA0208EF-B372-4369-A61A-F31DC61789DA} (The last past if the GUID found in ID field). This will answer the question of "What's th4e scheduled Task is doing". Don't we see familiar names from the Task Schedule Objects.



Ok from this, we can deduce that to check the name of the scheduled task, we can filter out (Default), ID, Index and SD.

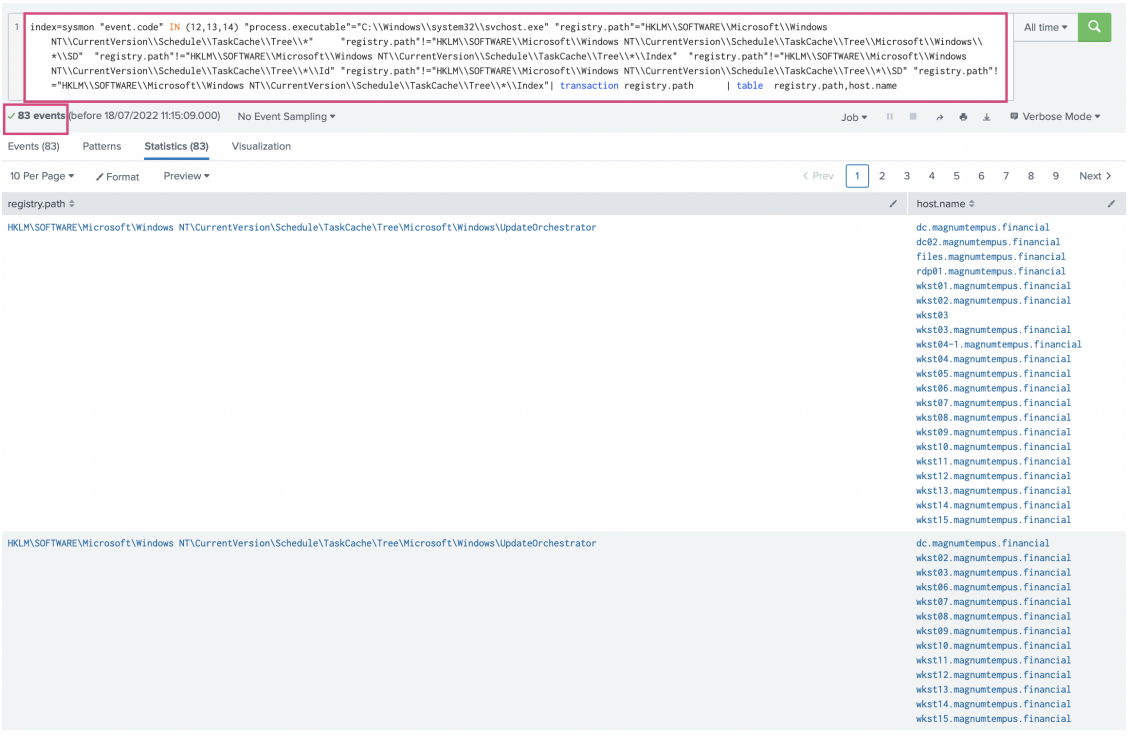
query

```
index=sysmon "event.code" IN (12,13,14) "process.executable"="C:\Windows\system32\svchost.exe"
"registry.path"="HKLM\SOFTWARE\Microsoft\Windows NT\CurrentVersion\Schedule\TaskCache\Tree\"
"registry.path"!="HKLM|SOFTWARE|Microsoft|Windows NT|CurrentVersion|Schedule|TaskCache|Tree|Microsoft|Windows|\SD"
"registry.path"!="HKLM\SOFTWARE\Microsoft\Windows NT\CurrentVersion\Schedule\TaskCache\Tree\|Index"
"registry.path"!="HKLM|SOFTWARE|Microsoft|Windows NT|CurrentVersion|Schedule|TaskCache|Tree|\Id"
"registry.path"!="HKLM\SOFTWARE\Microsoft\Windows NT\CurrentVersion\Schedule\TaskCache\Tree\|SD"
"registry.path"!="HKLM|SOFTWARE|Microsoft|Windows NT|CurrentVersion|Schedule|TaskCache|Tree|\Index"|
transaction registry.path | table registry.path,host.name
```

Above query will

Search for sysmon index

- Check for logs with event.code 12,13,14.
    - filter events that has svchost.exe as process
        - filtering some of the events from registry.path with sd, id, index subkeys
            - stacking entries with registry.path
                - Present in tabular form



Great, we have 83 events, better than 439 right?

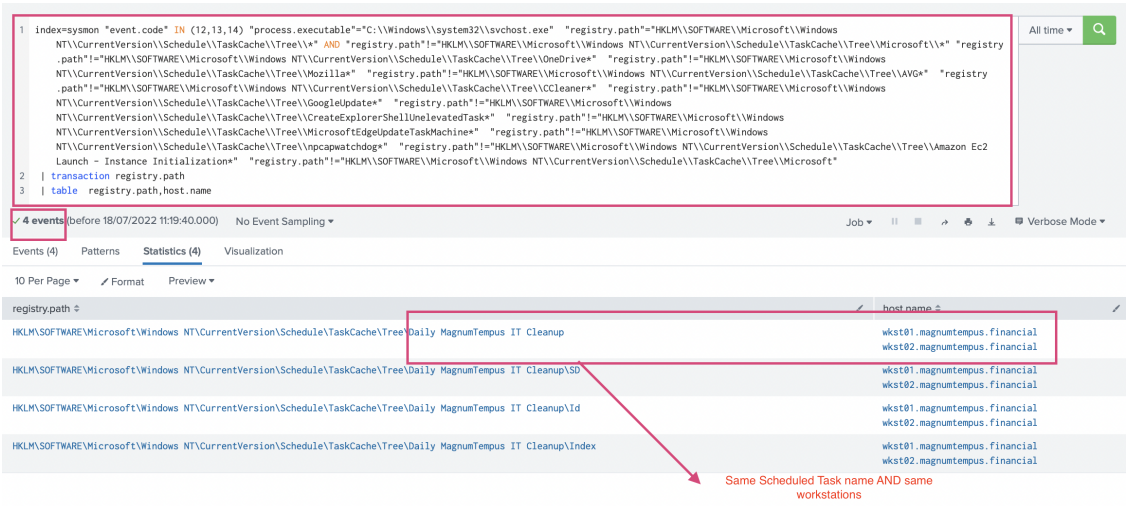
By following exact steps (common methodology & known-normal of the environment) from above, we reduced our results with

```
index=sysmon "event.code" IN (12,13,14) "process.executable"="C:\Windows\system32\svchost.exe"
"registry.path"="HKLM\SOFTWARE\Microsoft\Windows NT\CurrentVersion\Schedule\TaskCache\Tree\" AND
"registry.path"!="HKLM|SOFTWARE|Microsoft|Windows NT|CurrentVersion|Schedule|TaskCache|Tree|Microsoft|"
"registry.path"!="HKLM\SOFTWARE\Microsoft\Windows NT\CurrentVersion\Schedule\TaskCache\Tree\OneDrive"
"registry.path"!="HKLM|SOFTWARE|Microsoft|Windows NT|CurrentVersion|Schedule|TaskCache|Tree|Mozilla"
"registry.path"!="HKLM\SOFTWARE\Microsoft\Windows NT\CurrentVersion\Schedule\TaskCache\Tree\AVG"
"registry.path"!="HKLM|SOFTWARE|Microsoft|Windows NT|CurrentVersion|Schedule|TaskCache|Tree|CCleaner"
"registry.path"!="HKLM\SOFTWARE\Microsoft\Windows NT\CurrentVersion\Schedule\TaskCache\Tree\GoogleUpdate"
"registry.path"!="HKLM|SOFTWARE|Microsoft|Windows
NT|CurrentVersion|Schedule|TaskCache|Tree|CreateExplorerShellUnelevatedTask"
"registry.path"!="HKLM\SOFTWARE\Microsoft\Windows
NT\CurrentVersion\Schedule\TaskCache\Tree\MicrosoftEdgeUpdateTaskMachine"
"registry.path"!="HKLM|SOFTWARE|Microsoft|Windows NT|CurrentVersion|Schedule|TaskCache|Tree|npcapwatchdog"
"registry.path"!="HKLM\SOFTWARE\Microsoft\Windows NT\CurrentVersion\Schedule\TaskCache\Tree\Amazon Ec2
Launch - Instance Initialization*" "registry.path"!="HKLM\SOFTWARE\Microsoft\Windows
NT\CurrentVersion\Schedule\TaskCache\Tree\Microsoft"
| transaction registry.path
| table registry.path,host.name
```

Above query will

Search for sysmon index

- Check for logs with event.code 12,13,14.
    - filter events that has svchost.exe as process
        - using AND operator to sepcify we want additional checks for registry.path
            - Filtering some of the events from registry.path based on our "commonly observed" methodology
                - stacking entries with registry.path
                    - Present in tabular form



We got the same Task name on the same hosts.

By following above steps, we can say that a scheduled task named "Daily MagnumTempus IT Cleanup" is running on hosts wkst01.magnumtempus.financial and wkst02.magnumtempus.financial.

What is it doing though

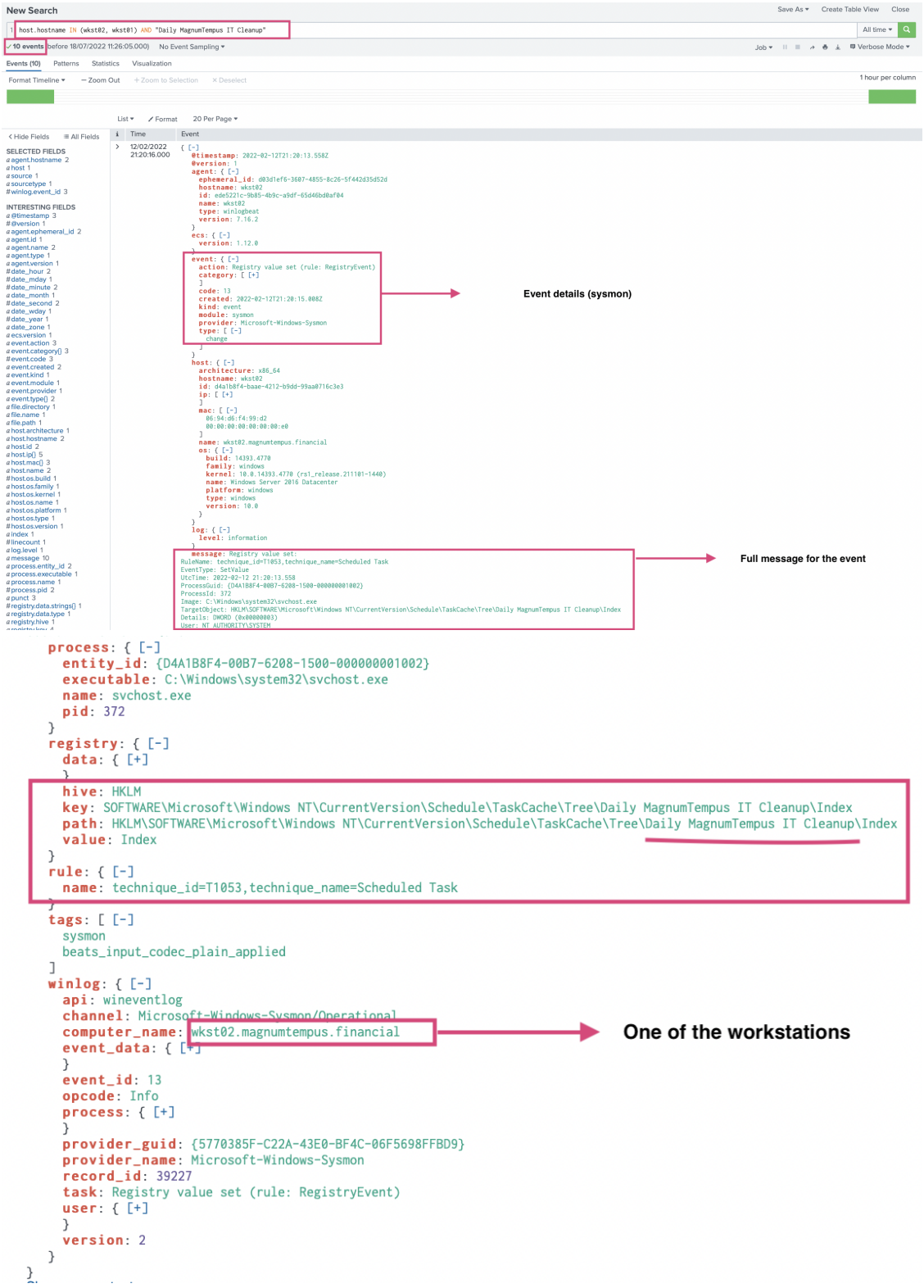
We now know the name of the scheduled task and the workstations, let's search for that name to see what other events we can see for this.

query

> host.hostname IN (wkst02, wkst01) AND "Daily MagnumTempus IT Cleanup"

Above query will

> Search for host.hotname for two workstations wkst01 and wkst01 we observed before
>
> - search for only evens with keyword "Daily MagnumTempus IT Cleanup"



We have 10 events BUT all of them are the ones we observed before AND no instances where we can see what it is doing.

Hmmm, strange.

We still have two more data components to check, Commandline arguments and process creation events.

There are several ways to create a scheduled task (GUI/Command tasks/Powershell/WMI). Though we will not be able to demostrate all the ways, you can check Scheduled Task creation by Schtasks, Scheduled Task using At, Scheduled Task using Powershell and Scheduled Task using WMI

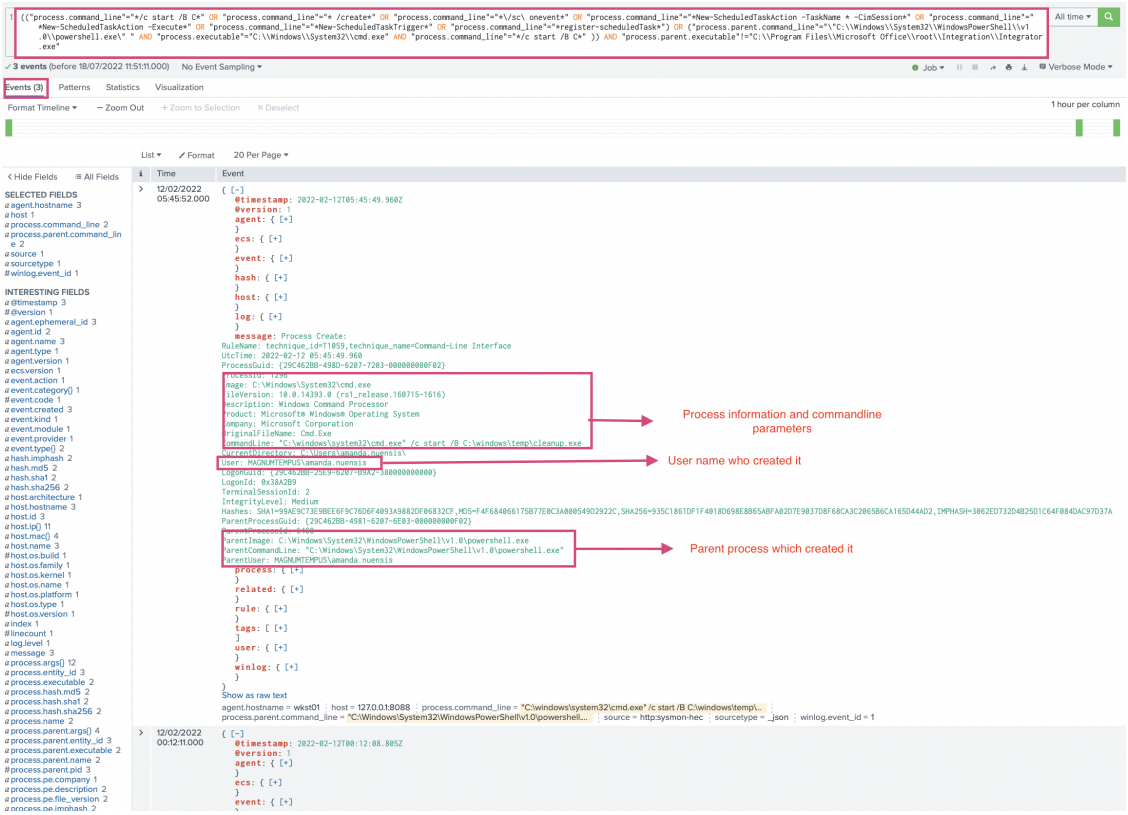
We will take some those events and search for keywords related to them. As we are checking for commadline arguments and process creation, we will check in the fileds process.command_line , process.executable and process.process.command_line

query:

```
((("process.command_line"="/c start /B C" OR "process.command_line"=" /create" OR "process.command_line"="/sc| onevent" OR "process.command_line"="New-ScheduledTaskAction -TaskName -CimSession" OR "process.command_line"="New-ScheduledTaskAction -Execute" OR "process.command_line"="New-ScheduledTaskTrigger" OR "process.command_line""register-scheduledTask") OR ("process.parent.command_line""C:|Windows|System32|WindowsPowerShell|v1.0|powershell.exe" " AND "process.executable"="C:|Windows|System32|cmd.exe" AND "process.command_line"="/c start /B C*" )) AND "process.parent.executable"!="C:\Program Files\Microsoft Office\root\Integration\Integrator.exe"
```

Above query will

> Search process.command_line for keywords related to scheduled task creation
>
> - filtering events with Integrator.exe in process.parent.executable (fun exercise, check what it is and what it's used for)



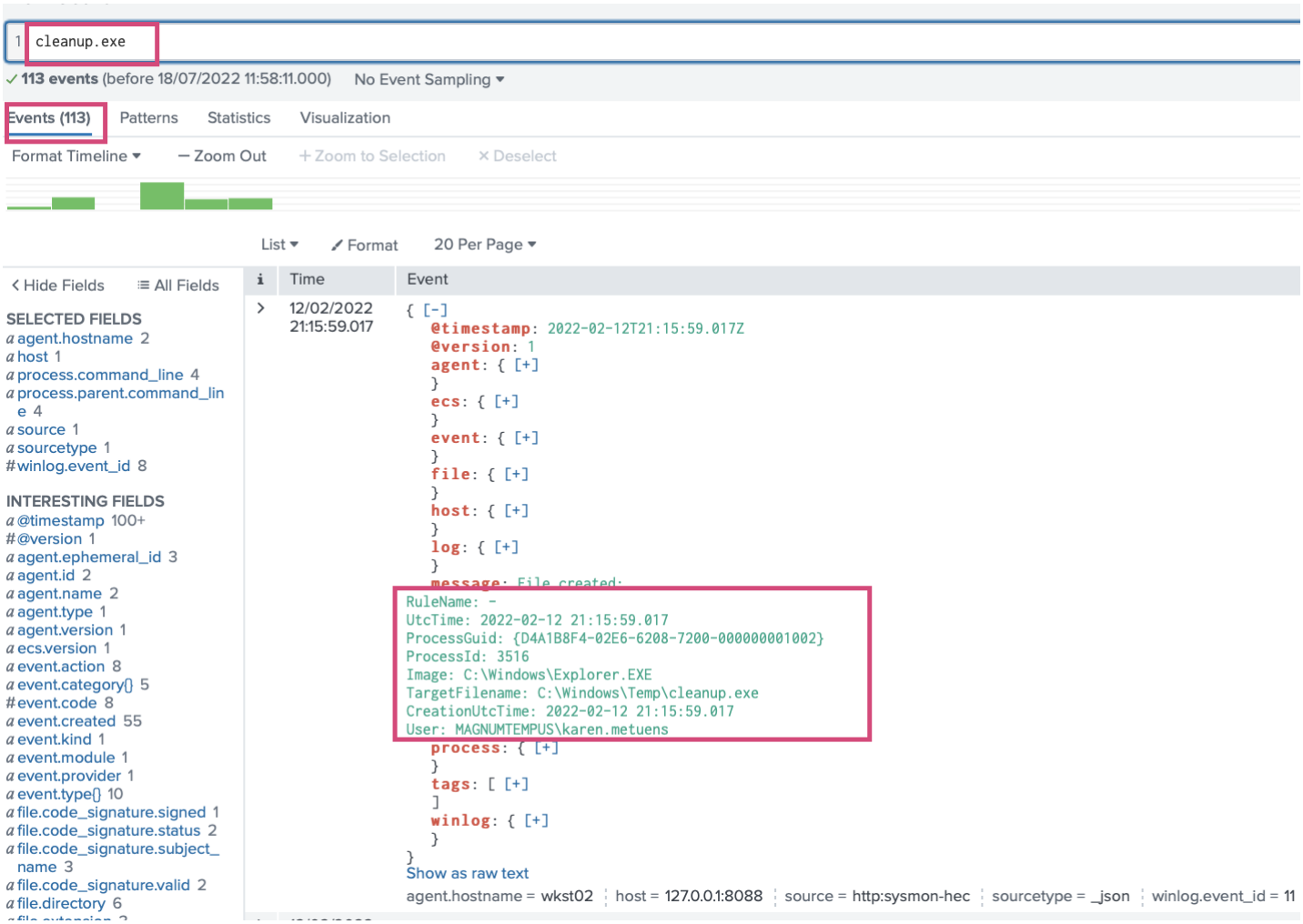
We see that an executable called cleanup.exe starting via cmd.exe from powershell.exe being parent process. It is running on one of the hosts that we deemed to be suspicious (wkst01) AND cleanup.exe is in tmp folder. ***A very strange combination in our org***.

Based on the Time this is executing, commandline arguments, process combination, folder location, AND workstation, we can with some degree of confidence say that this is malicious IF NOT at least suspicious. We can either start our IR collection process to determine other actions OR perform more log analysis to confirm.

Let's go a little further and see what this executable is doing by searching for the name cleanup.exe.

query

```
cleanup.exe
```



113 events. Great..

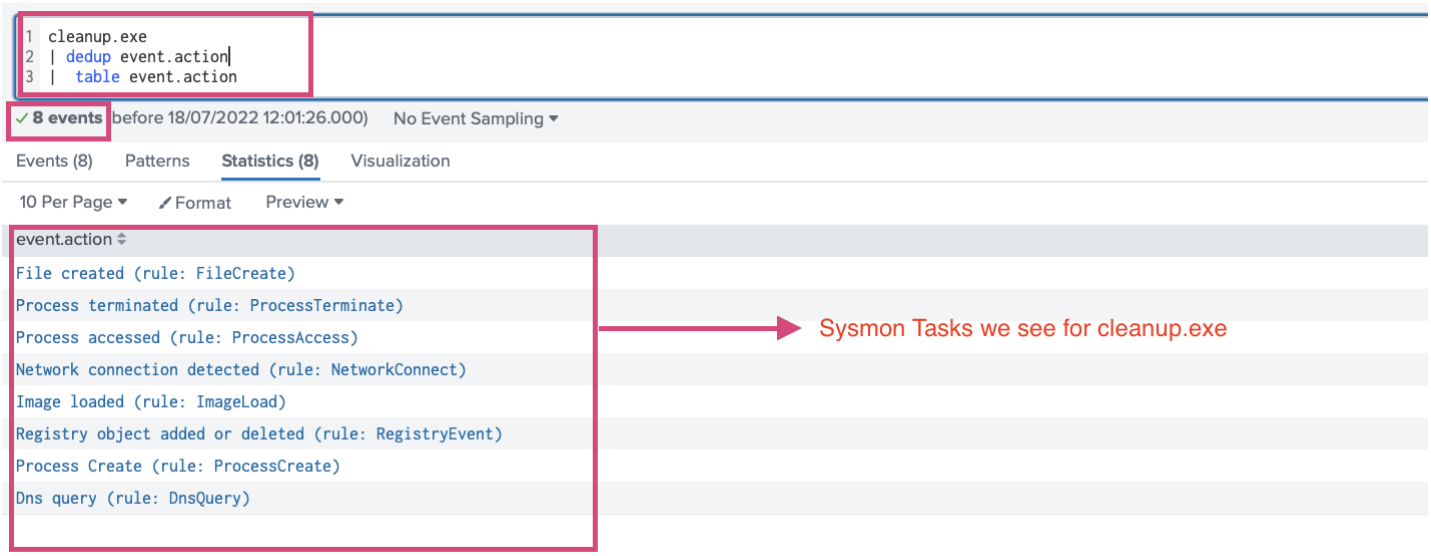
Let's see what events we see by checking event.action like we did before

query

```
cleanup.exe
| dedup event.action
| table event.action
```

Search for keyword cleanup.exe

- deduplicate tasks
    - present us in tabular form



There are some VERY interesting sysmon Tasks here.

Go on an adventure to see what they are doing.

Detection Engineering:

With the help of different gadgets, the inspector (we) have succeeded in unveiling a malicious scheduled task. While our DFIR folks have their little field trip, let's see how we can use the hunt to better our detections and visibility.

In detection engineering we should ask ourselves: detections releavance and security value, challenges in consuming/using the telemetry, and its impact on our visibility/coverage.
One of the sites we can check is strontic, especially for command-line utilities native to windows(if it is present in the site AND is native to windows). This gives me all the options that A tool can perform, its default path, Hash, signature, metadata, and get this, POSSIBLE MISUSE. That is so cool. We can check sigma rules, Malware IOCs, Atomic Red Team tests, and Yara rules

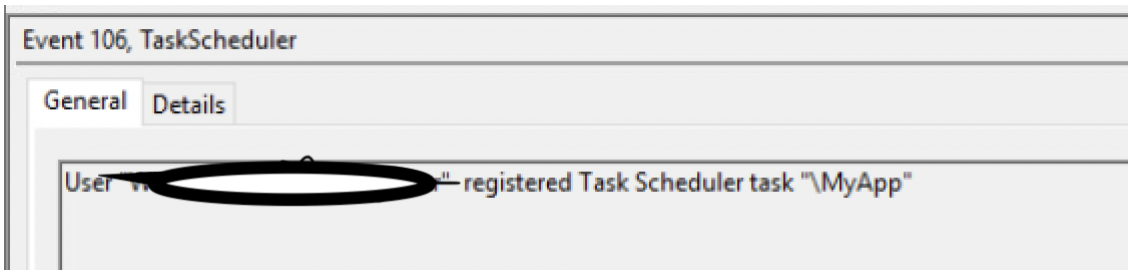
Depending on the maturity of the organization, you can use the site to create queries from known paths of misuse/attacks OR you can use it for testing your own detections.

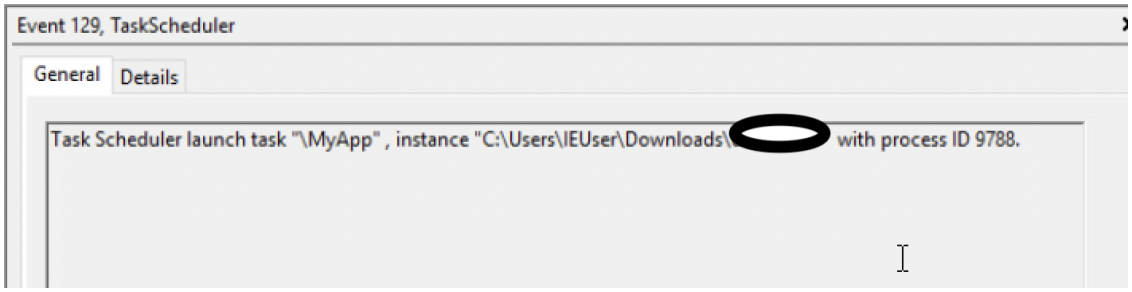
Detection Coverage and Log Value

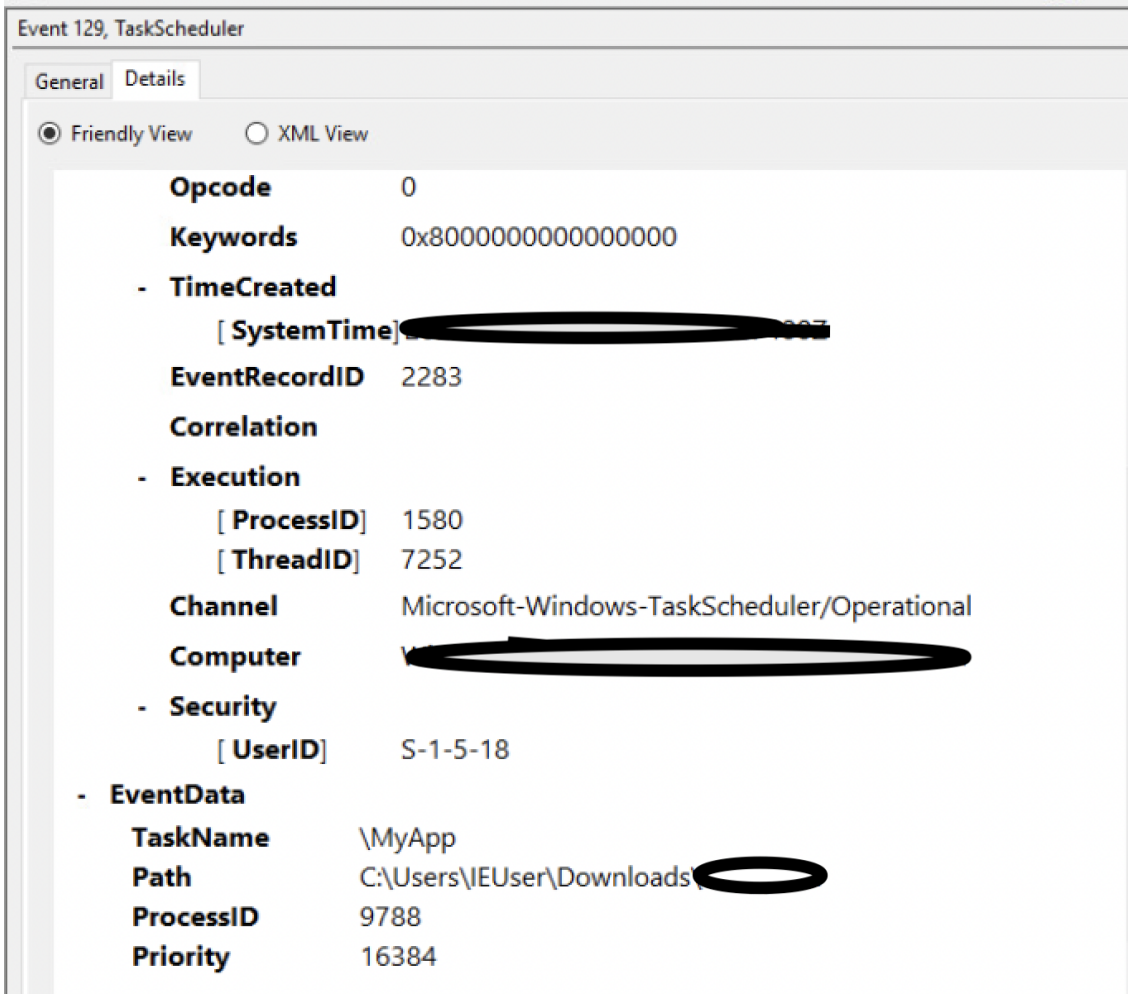
As we checked before, we do not have all the events where we can get information on Scheduled Tasks and their associated actions.

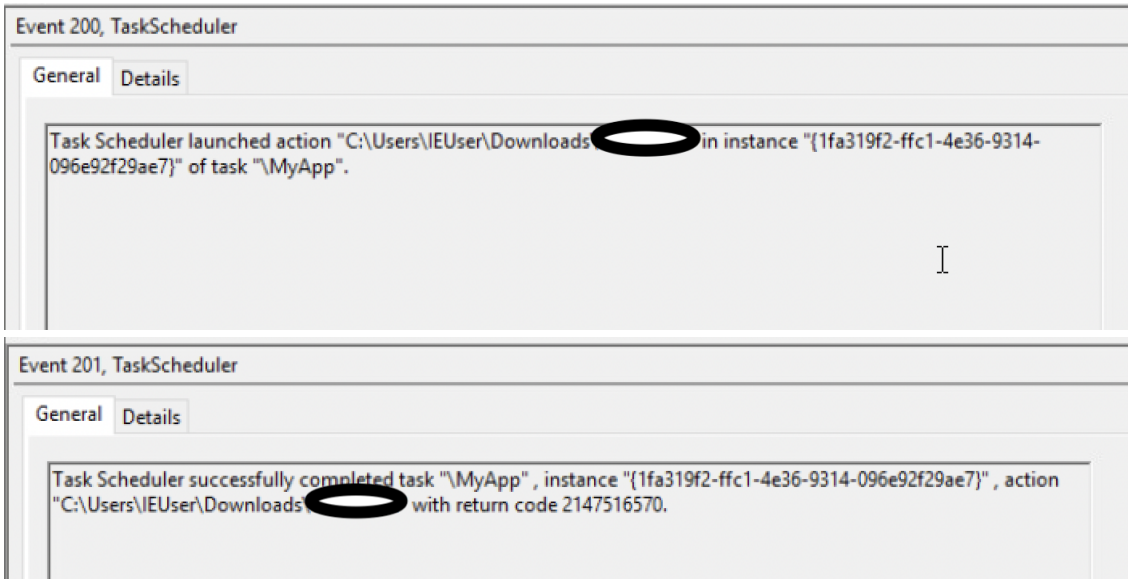
With our hunt, we identified that Windows event Logs (Security - 4698) and Microsoft-Windows-TaskSchedular/Operational.evtx are also helpful in performing hunts and creating detections. ***These must be explicitly collected and are not on by default***. This exercise can be viewed as a "visibility coverage gap" and helped us identify two more additional data sources for better detection coverage.

Below events would triger if we collected the above telemetry


Event 106, TaskScheduler
General
Details
registered Task Scheduler task "\MyApp"


Event 129, TaskScheduler
General
Details
Task Scheduler launch task "\MyApp" , instance "C:\Users\IEUser\Downloads\
with process ID 9788.


Event 129, TaskScheduler
General
Details
Friendly View
XML View
Opcode 0
Keywords 0x8000000000000000
- TimeCreated
[SystemTime]
EventRecordID 2283
Correlation
- Execution
[ProcessID] 1580
[ThreadID] 7252
Channel Microsoft-Windows-TaskScheduler/Operational
Computer
- Security
[UserID] S-1-5-18
- EventData
TaskName \MyApp
Path C:\Users\IEUser\Downloads\
ProcessID 9788
Priority 16384



Most of the time detection engineering is a reactive space (based on the attacks we observe) and covering all variations of existing tools/techniques OR creation of new ones is not possible. So, revisiting a rule after a specified amount of time is recommended. Some of the questions we want to answer are,

- is the rule/s still valid?
- Is there any new research in the space and will that be covered by our existing rules?
- Is it time to retire the rule? maybe the technique or tool is not valid and such.

Advanced Scheduled Task Techniques and some ideas

Hidden Scheduled Tasks

Hafnium hides tasks from the schtasks.exe executable and Task Scheduler. It does this by deleting the associated Security Descriptor registry value that is created automatically upon task creation.

> Security Descriptor registry value is used for determining the users allowed to run the task. This is a binding between the tasks we see when we query VS the tasks that are actually present. If we remove this key and its value, you will not see the task though it is present. This can only be performed by the SYSTEM user.

pro-tip

> So, now think about where this step can be performed in the kill chain or MITRE. Because if it needs a SYSTEM account to perform the action, you should be able to see one of the PRIVESC techniques before you can see that. In the contrast, if you see this, that means the perpetrator already performed PrivEsc.

query

> index=sysmon AND event.code=12 AND message="*DeleteKey*" AND "registry.path"="HKLM\SOFTWARE\Microsoft\Windows NT\CurrentVersion\Schedule\TaskCache\Tree*\SD"

Changing Scheduled Tasks with COM Handles

This technique is detailed in Misc-PowerShell-Stuff

Psuedo-code

Change in Scheduled task followed by registry delete/create of dafault key of the COM at HKCR:\CLSID{##HANDLER_found_in_scheduled_task}\InprocServer32

Some other use cases could be

1. Scheduled Tasks making unusual communications

2. Scheduled Tasks downloading powershell cradles
3. Scheduled Tasks executing binaries from odd folders
4. Scheudled Task changes (parameters and scripts/executable/events)
5. Monitoring Deleted Scheduled tasks by checking Event ID 141 (Microsoft-Windows-TaskScheduler/Operational log) and Event ID 4699 (Security)
6. Changes for schedules inside \Microsoft\Windows\ by unusual executable.

Some Known-attacks

1. APT28, Fancy Bear, Sofacy or STRONTIUM (Deleting Scheduled Tasks that can be retrived from Registry forensics)MITRE Groups
2. Scheduled Task invoking MSBUILD.exe
3. IcedID Malware - scheduling a task at logon
4. Exploiting Environment Variables in Scheduled Tasks for UAC Bypass
5. Trickbot
6. Fentanyl using Scheudled tasks to execute VB script

THREAT HUNTER TEMPLATE

Playbook Title: Hunting for Adversary's Schedule

Mitre Tactic: T1053

Mitre Sub Technique: T1053.005

Hypothesis:
Adversaries might create/change scheduled tasks on local/remote endpoints using GUI/command line tools to execute additional/new executables/hta files/js files for maintaining persistence in the environment

Proposed Detection Query:

> Query to leverage sysmon data to hunt for scheduled tasks

```
 index=sysmon AND event.code=11 AND "process.executable"="C:\\Windows\\system32\\svchost.exe" AND
"file.path"="C:\\Windows\\System32\\Tasks\\*"   "file.path"!="C:\\Windows\\System32\\Tasks\\Microsoft\\*"
"file.path"!="C:\\Windows\\System32\\Tasks\\CreateExplorerShellUnelevatedTask"
"file.path"!="C:\\Windows\\System32\\Tasks\\GoogleUpdateTaskUserS*"
"file.path"!="C:\\Windows\\System32\\Tasks\\MicrosoftEdgeUpdateTaskMachineCore"
"file.path"!="C:\\Windows\\System32\\Tasks\\MicrosoftEdgeUpdateTaskMachineUA"
"file.path"!="C:\\Windows\\System32\\Tasks\\Mozilla"  "file.path"!="C:\\Windows\\System32\\Tasks\\Mozilla\\*"
"file.path"!="C:\\Windows\\System32\\Tasks\\OneDrive*"  "file.path"!="C:\\Windows\\System32\\Tasks\\npcapwatchdog"
"file.path"!="C:\\Windows\\System32\\Tasks\\AVG*" "file.path"!="C:\\Windows\\System32\\Tasks\\CCleaner*" | transaction file.path
        | table file.path,host.name
> (("process.command_line"="*/c start /B C*" OR "process.command_line"="* /create*" OR "process.command_line"="*\/sc\ onevent*")
OR ("process.parent.command_line"="\"C:\\Windows\\System32\\WindowsPowerShell\\v1.0\\powershell.exe\" " AND
"process.executable"="C:\\Windows\\System32\\cmd.exe" AND "process.command_line"="*/c start /B C*" ))AND
"process.parent.executable"!="C:\\Program Files\\Microsoft Office\\root\\Integration\\Integrator.exe"
```

Simulation Details: Does not apply to us

Hunter Limitations/Observation Notes:
When searching for Scheduled tasks, we observed that we do not have all the data required, windows event logs, and "Microsoft-Windows-TaskScheduler/Operational" channel events. Also, we only see only one workstation wkst01 has cleanup.exe but no events for wkst02

Hunt Findings:
We observed a scheduled Task named "Daily MagnumTempus IT Cleanup" on computers wkst02 and wkst01

References:

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3. https://attack.mitre.org/techniques/T1053/
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5. https://strontic.github.io/xcyclopedia/
6. https://github.com/enigma0x3/Misc-PowerShell-Stuff/blob/master/Get-ScheduledTaskComHandler.ps1

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14. https://docs.microsoft.com/en-us/troubleshoot/windows-server/system-management-components/schedule-server-process
15. https://redcanary.com/threat-detection-report/https://blog.menasec.net/2019/03/threat-hunting-25-scheduled-tasks-for.html
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18. https://t.co/d54Gdkju5c
19. https://opencybersecurityalliance.org/huntbook-persistent-threat-discovery-kestrel/
20. @jaredcatkinson - A person to follow
21. https://www.ired.team/offensive-security/lateral-movement/wmi-via-newscheduledtask