DESIGNING, DEVELOPING AND RUNNING PURPLE TEAMING EXERCISES

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Adversary Simulations and Research

UNSW (ADFA) - Master of Cyber Security

Security Researcher

- *Vulnerabilities: Microsoft, Cisco, SAP*

Speaker & Trainer

- *Sessions: Black Hat USA, Def Con*

Open Source Software Projects

- *Petaq Purple Team C2 & Malware*
- *Viproy VoIP Penetration Testing Kit*

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Agenda

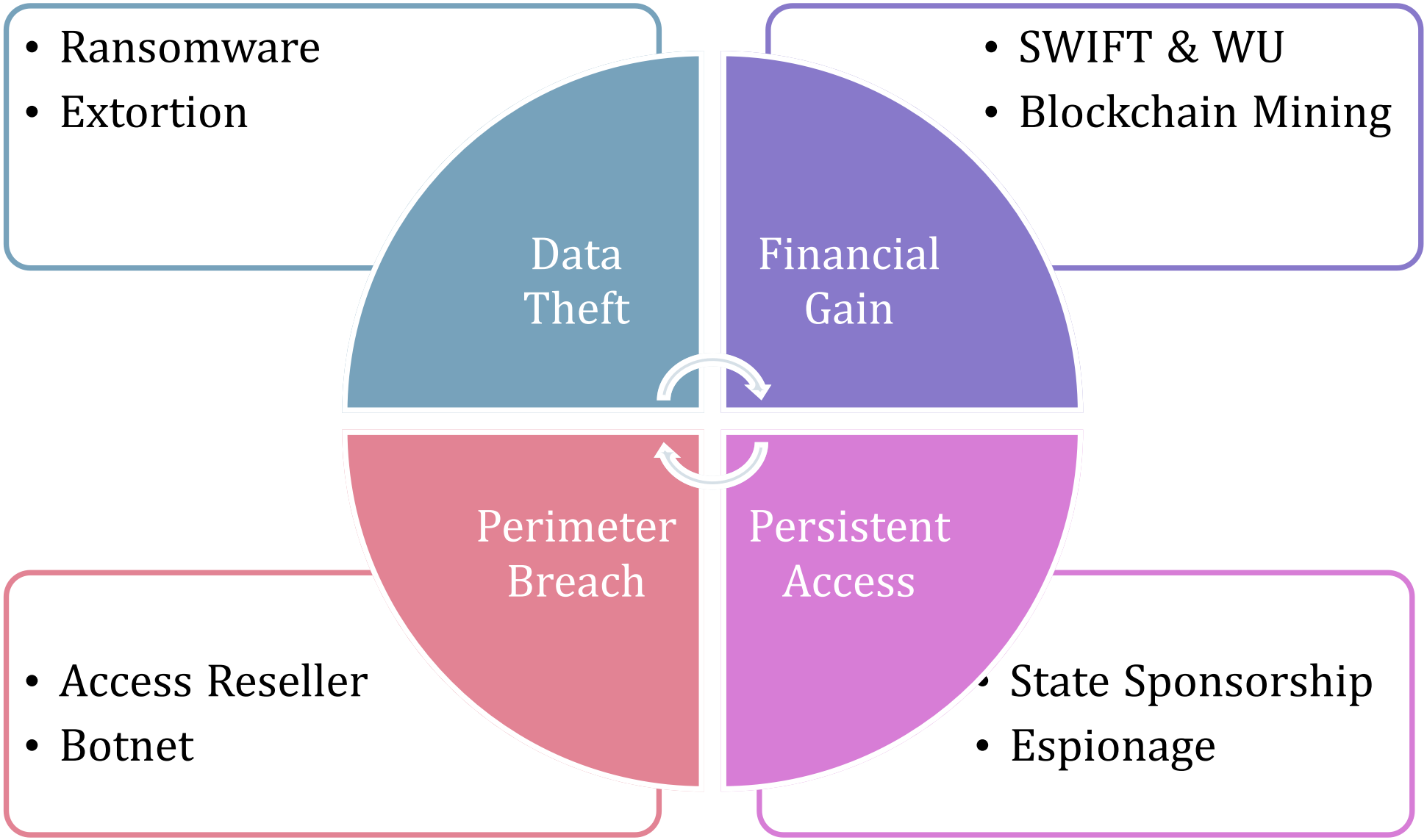
Threat Actors and Landscape

Adversary Simulations

Purple Team Exercises

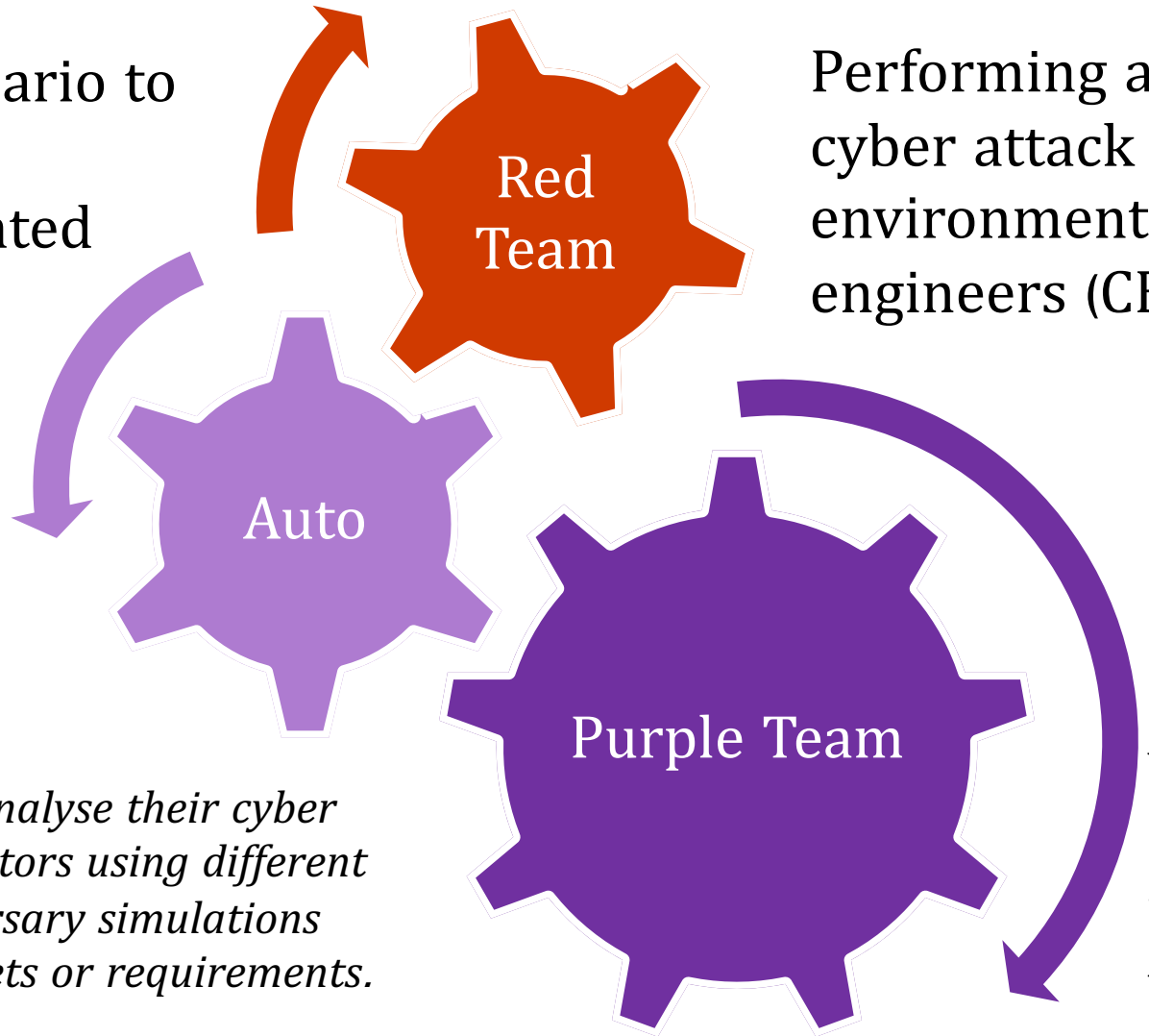
Scenario Run - Demo

Threat Actors and Motives



Adversary Simulation Types

Automating a scenario to assess the defence controls implemented (MITRE ATT&CK)



Performing a Threat Intelligence-Led cyber attack against the targeted environment with a team of engineers (CBEST, CORIE, ICAST)

Performing a cyber attack with blue team collaboration to improve people and defence together (MITRE ATT&CK)

Organisations desire to analyse their cyber defence against threat actors using different implementations of adversary simulations depending on their budgets or requirements.

What Are We Simulating, Again?

Because, the regulation said so? (CBEST, CORIE, ICAST, MITRE)

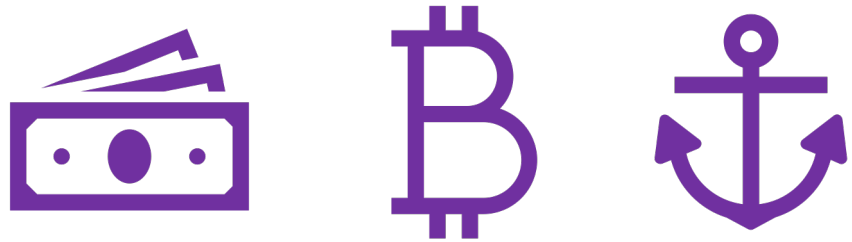
Security Breach Experienced

External/Internal Red Team Exercise

General Assessment of the Security Controls and Perimeter

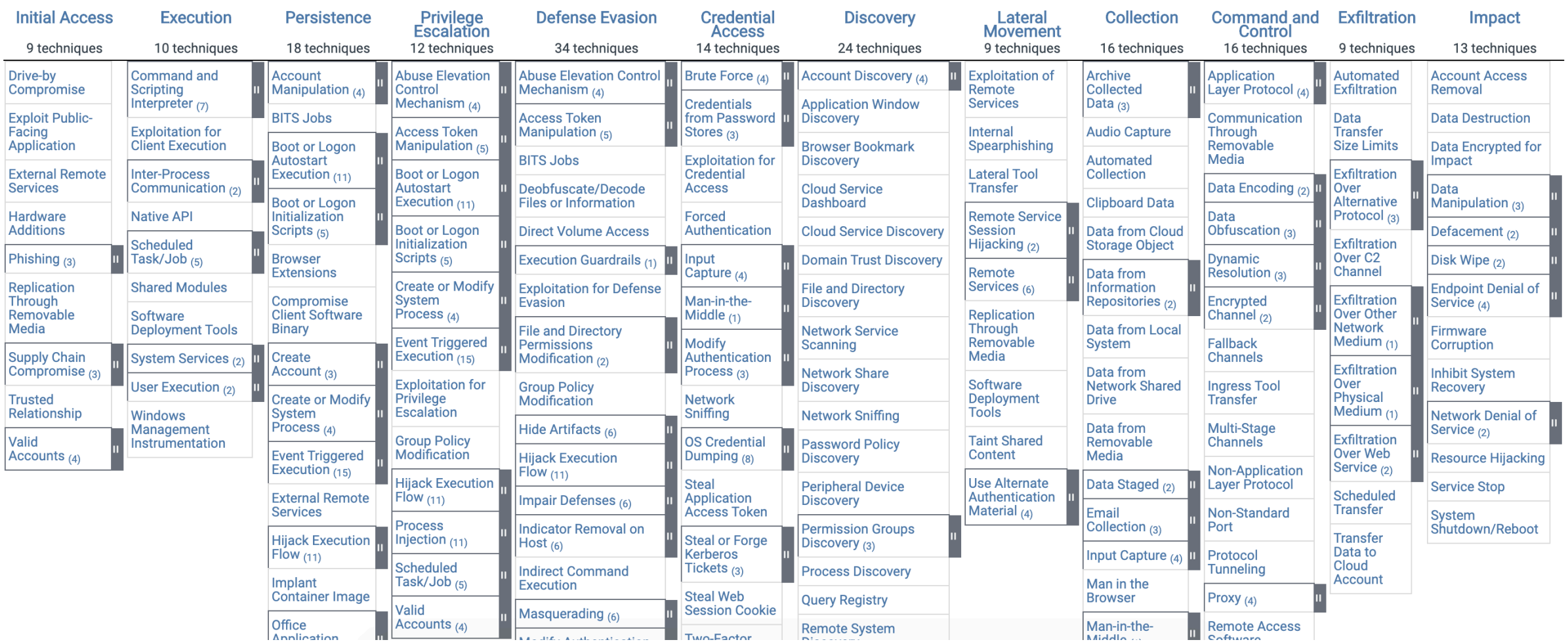
Threat Actor actively/potentially targeting the organisation

- *Ransomware & Extortion*
- *Blockchain Mining*
- *Long Term Access*



Coverage: Mitre Att&ck

Design



https://attack.mitre.org/

Essential Decisions

Uninformed vs Informed

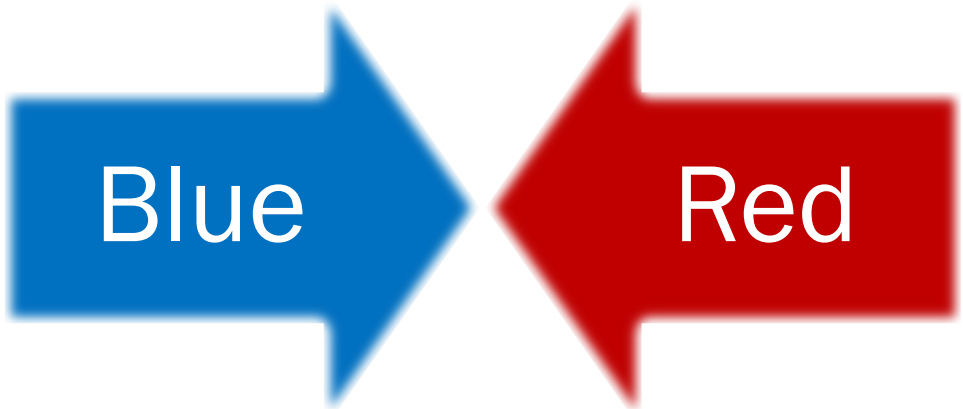
External Offensive Team vs Internal Offensive Team

Purple Team Exercise Types

- *Scenario Automation*
- *Capture the Flag (Red vs Blue)*
- *Assume Breach*

Team Structure

Threat Intelligence
Cyber Response
Cyber Detection
Security Awareness
Security Operations



Red Team
Offensive Security
Penetration Testing
External Provider

Consider Some Guest Players

Essential Requirements

Threat Intelligence Data and/or Simulation Scenario

Technical Requirements

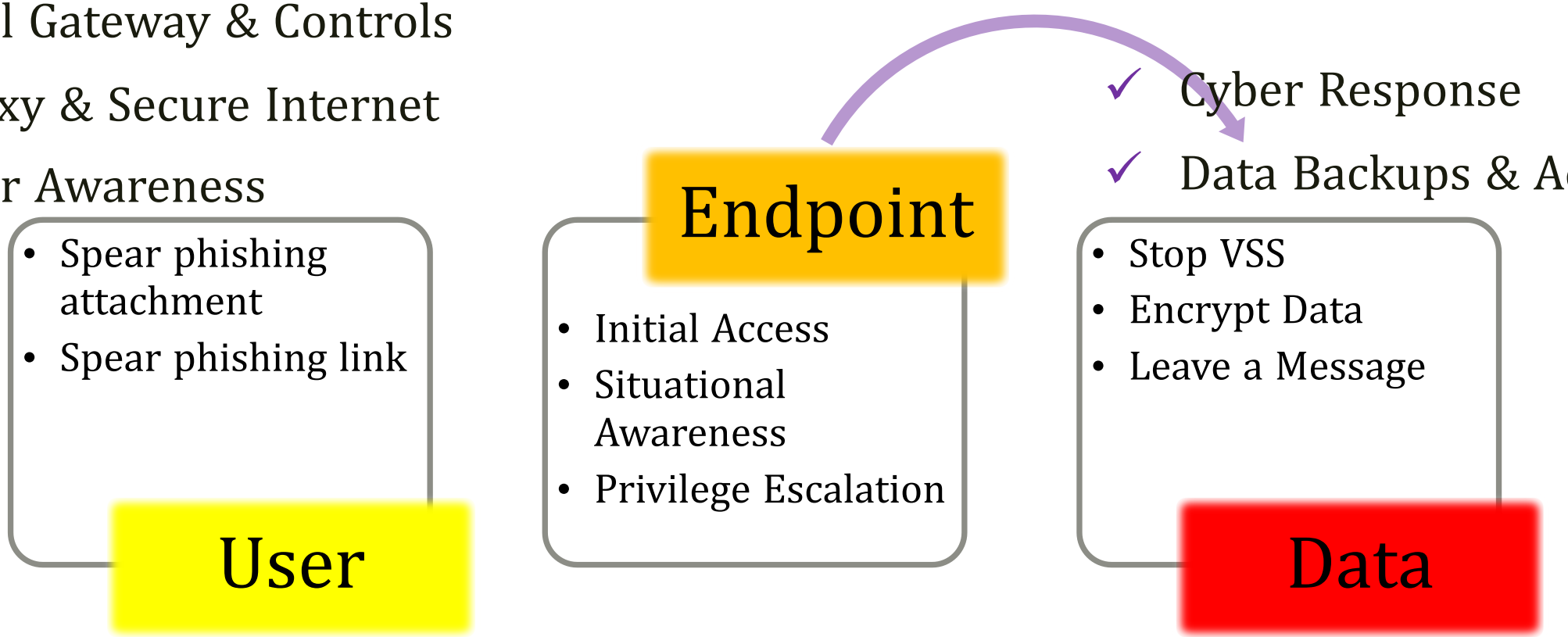
- *Accounts, Credentials*
- *Laptops, Servers*

Business Requirements

- *Resource Requirements*
- *Change Requests, Approvals*

Scenarios (Ransomware)

- ✓ Mail Gateway & Controls
- ✓ Proxy & Secure Internet
- ❑ User Awareness



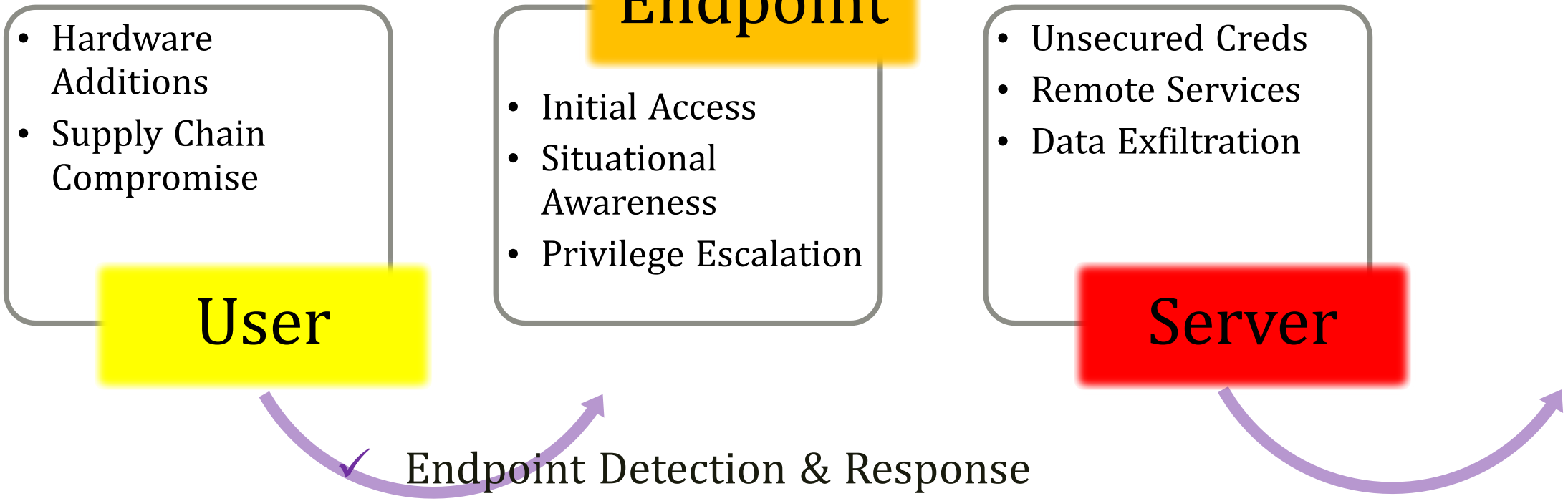
- ✓ Cyber Response
- ✓ Data Backups & Access

- ✓ Endpoint Detection & Response
- ✓ Vulnerability & Patch Management
- ✓ Command & Control Detection

Scenarios (Supply Chain)

- ✓ Physical Access
- ✓ Software & Inventory Management
- ✓ Hardware Monitoring & Detection

- ✓ Cyber Response
- ✓ Lateral Movement Detection
- ✓ Data Protection Services



- ✓ Endpoint Detection & Response
- ✓ Vulnerability & Patch Management
- ✓ Command & Control Detection

Scenarios (Assume Breach)

Design

- ✓ Endpoint Detection & Response
- ✓ Vulnerability & Patch Management
- ✓ Command & Control Detection

Endpoint

- Initial Access
- Situational Awareness
- Privilege Escalation

Server

- Unsecured Creds
- Remote Services
- Privilege Escalation
- Account Discovery

Finance

- Data Manipulation
- Fraud Attempt
- Create a Transfer
- Approve Transfers

- ✓ Cyber Response
- ✓ Financial Controls
- ✓ Fraud Controls

- ✓ Cyber Response
- ✓ Lateral Movement Detection

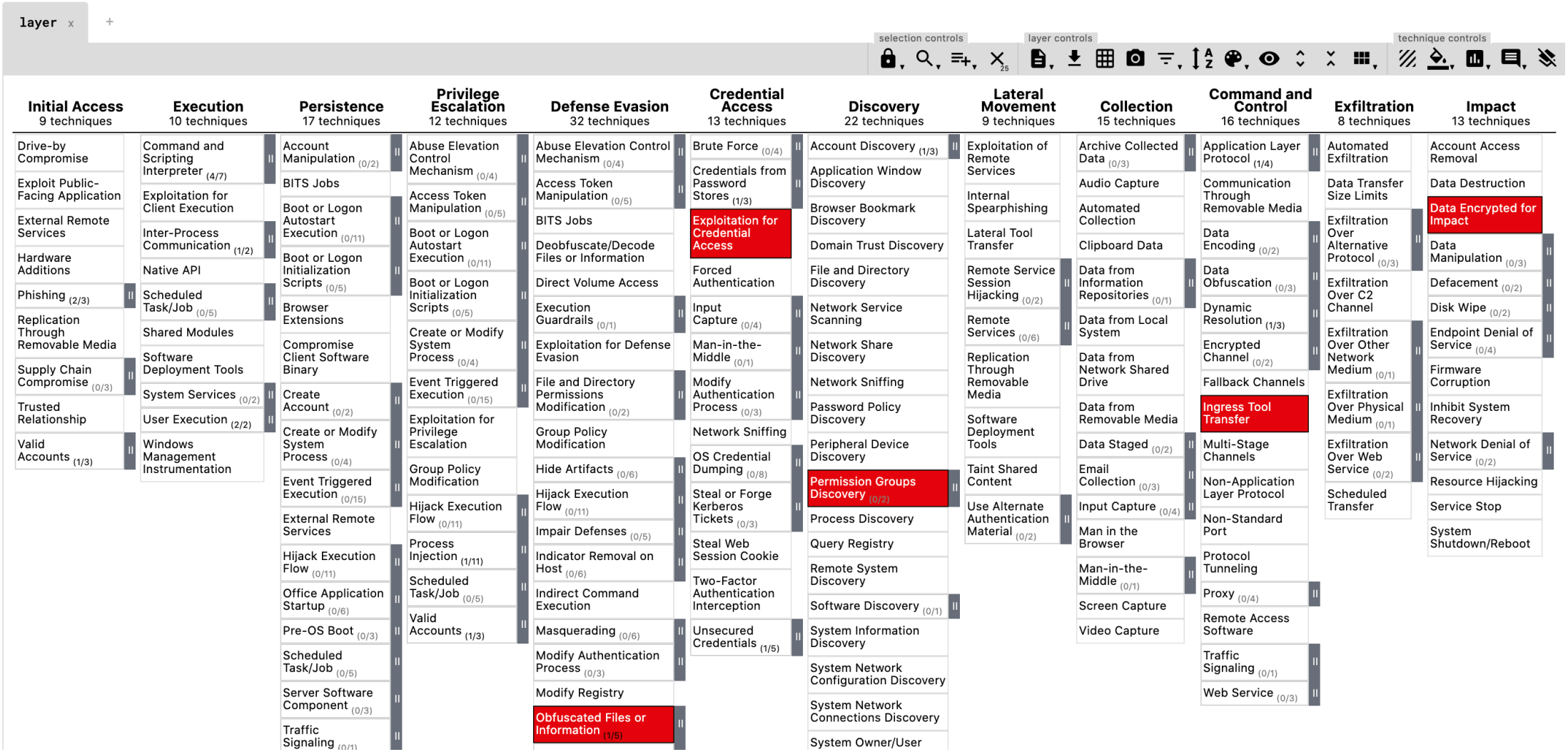
Scenario Automation

Since 2016, there are active researches on automating the adversary behaviours and tradecraft for continuous defence improvements. While MITRE teams lead the researches in this area [ref:1,2,3,4]; there are also other researchers [ref:5,6] proposing additional aspects of the automation.

- *Efficient ways of simulating the threat actors*
- *Planning and execution phases are as important as techniques*
- *Developing open source projects and tools to implement it*
- *Scenario runs to demonstrate the efficiency*
- *Demonstrating the Kill Chain similar approach to stop the attacks*

Coverage: Mitre Att&ck Navigator

Design



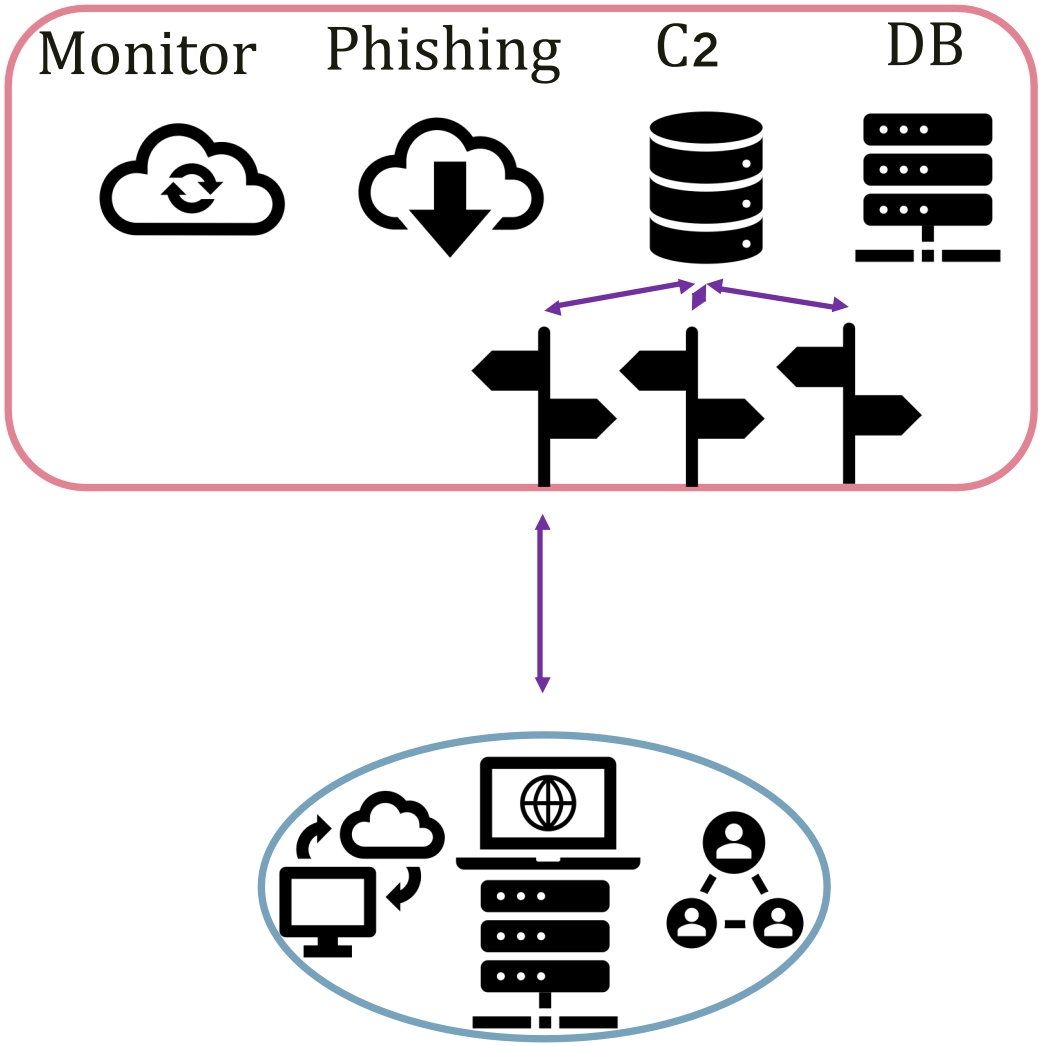
https://mitre-attack.github.io/attack-navigator/enterprise/

Platform

Development

Cloud Deployment

- *Provider Selection*
- *Services: Storage, DB, VM, OS*
- *Domains: Fronted, Aged, Classified*



Operational Security

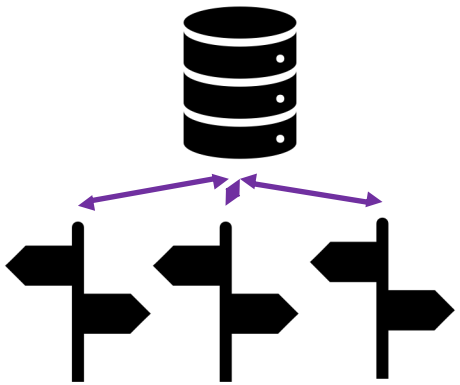
- *Real-Time Monitoring*
- *Encrypting Data in Transit and at Rest*
- *Implement Compliance Requirements*

Software: Command & Control

Development

Command & Control Service Selection

- *What does the threat actor use?*
- *What operating systems are targeted?*
- *Multi Instance: Long Term, Short Term, Interactive*
- *C2 Protocols, Cloud Native, Multi User, Logging…*



Safer C2 Choices

- *Cobalt Strike (Commercial, Favorite of Threat Actors and Red Teams)*
- *Covenant (C#, Open Source, Mostly Stable)*
- *SilentTrinity (.NET and Python, Open Source, Stable)*

Software: Command & Control

Development

C2 Matrix

- *Keeping a C2 List*
- *Filtering for C2 features*

If threat actor uses Metasploit or PS Empire, and you want to emulate it, then consider using that

MATRIX

ABOUT ASK DOCUMENTATION FEEDBACK GUI MATRIX

Information	Code + UI	Channels	Agents	Capabilities	Support

C2	Version Reviewed	Implementation
Apfell	1.3	Docker
Caldera	2	pip3
Cobalt Strike	2	binary
Covenant	0.3	Docker
Dali	POC	pip3
Empire	2.5	install.sh
EvilOSX	7.2.1	pip3
Faction C2	N/A	install.sh
FlyingAFalseFlag	POC	pip3
godoh	1.6	binary
ibombshell	0.0.3b	pip3
INNUENDO	1.7	install.sh
Koadic C3	0xA (10)	pip3
MacShellSwift	N/A	python
Metasploit	5.0.62	Ruby
Merlin	0.8.0	Binary
Nuages	POC	setup.sh
Octopus	v1.0 Beta	pip3

https://www.thec2matrix.com/matrix

Software: Scenario Automation

Development

Mitre Att&ck - Caldera (Apache License)

User Interface, Custom Implant (Sandcat),

https://github.com/mitre/caldera , https://www.youtube.com/watch?v=_mVGjqu03fg

Red Canary - Atomic Red team (MIT License)

A repository for Powershell/.NET/Command Scripts for Mitre Att&cK PoC

https://redcanary.com/atomic-red-team/, https://atomicredteam.io/testing

Mordor (GNU Public License)

Better Integration with Defense tools.

https://github.com/hunters-forge/Mordor

https://github.com/hunters-forge/ThreatHunter-Playbook

Software: Petaq C2

Development

Petaq Purple Team Command & Control Server (MIT License)

- *P'takh (petaQ) is a Klingon insult, meaning something like "weirdo"*
- *Protocols : HTTP(S), WebSocket, SMB Named Pipe, TCP, UDP*
- *Execution : CMD, .NET Assembly, Source, Shellcode Injection, PowerShell*
- *Features : WMI Lateral Movement, Nested Implant Linking, Encryption*
- *Scenario Based Automation and TTP Support*

Petaq is suitable to interactive and scenario based exercises, both

https://github.com/fozavci/petaqc2

Software: Support Environment

Development

Kill Chain

- *Spear phishing : GoPhish*
- *Initial Access, Evasion, Awareness : Unicorn, SharpShooter, Ghost Pack*
- *Active Directory : Bloodhound, Ping Castle, Rubeus, Kekeo*
- *Lateral Movement : SharpMove, SharpWMI, PSExec, ScShell*

Support Services for Deployment or Redirection

- *Cloud Services : S3, DynamoDB, Lambda, Azure Blob, Office 365 Tasks*
- *Proxies : Nginx, Apache, Haproxy*

Software: Operational Security

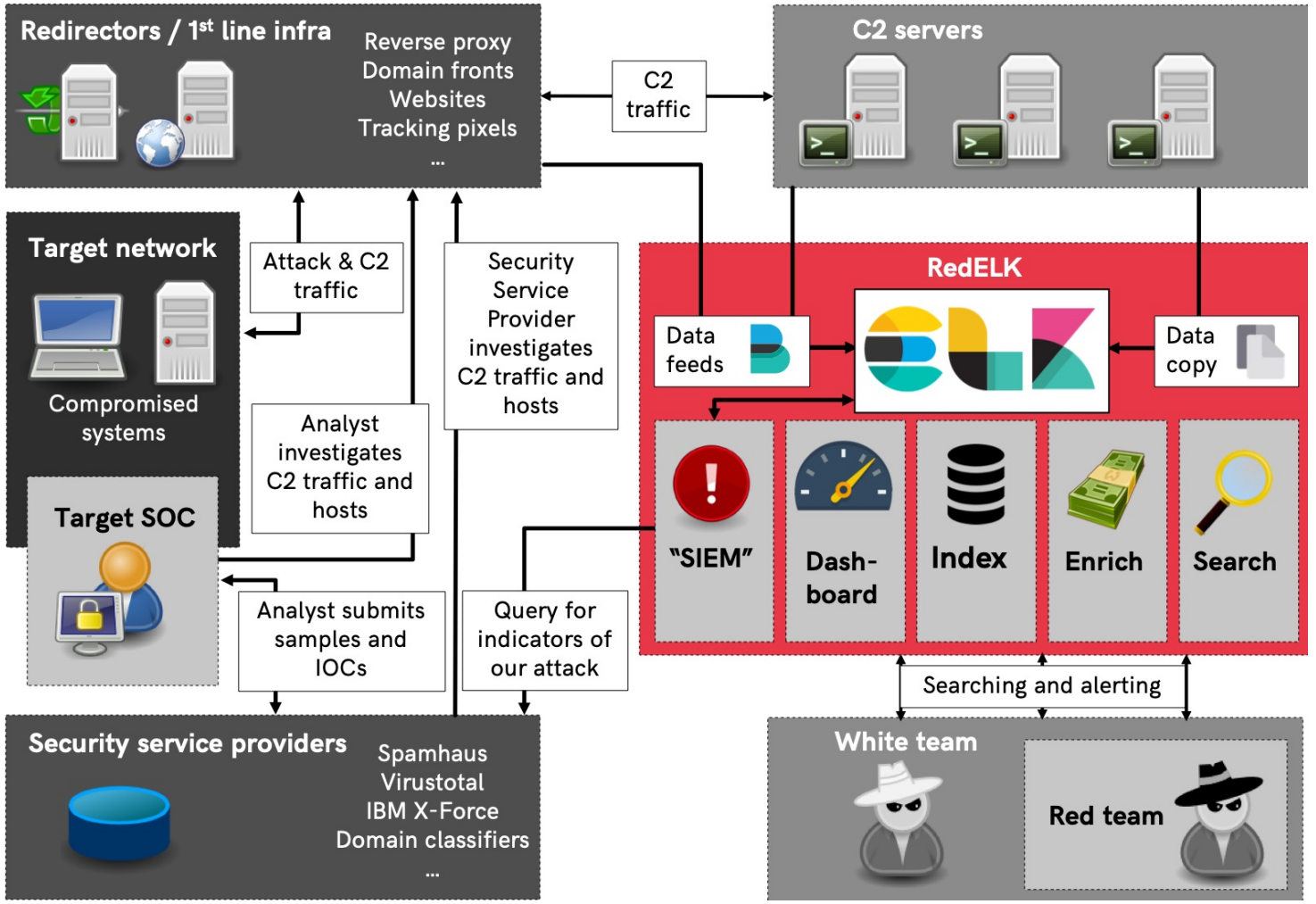
Development

RedELK

- *Open Source*
- *Processing C2 Logs*
- *Processing Proxy Logs*
- *Check IOC Websites/Feeds*

Benefits

- *Protect the Platform*
- *Observe the Blue Team*
- *Avoid Unwanted Victims*



https://github.com/outflanknl/RedELK

Planting the Flags

Development

Flags are useful to assess the team capabilities such as reverse engineering, malware analysis and utilising the security controls.

- *Phishing email (e.g. headers, content)*
- *Initial malware stages (e.g. command, dropper, stage1, stage2)*
- *C2 communications (e.g. profile, protocol)*
- *Persistency options (e.g. registry, file IOCs, services)*
- *Lateral movement (e.g. remote service, WMI query, creds)*
- *Data exfiltration (e.g. fake DLP flags, C2 channels, WebDAV)*

Use a Capture the Flag scoring website or application

Exercise Run Tips

Attacks take time to show up on SOC monitors and alerts.

- *Run the attacks or scenario, and give a grace period*
- *The exercise duration may be 2-3 days due to scope*

Use a CTF or reporting software to give a metric to all parties.

Assign a facilitator to the exercise.

- *Maintain the pressure like the real life exercise*
- *It's not a race, but a friendly competition*

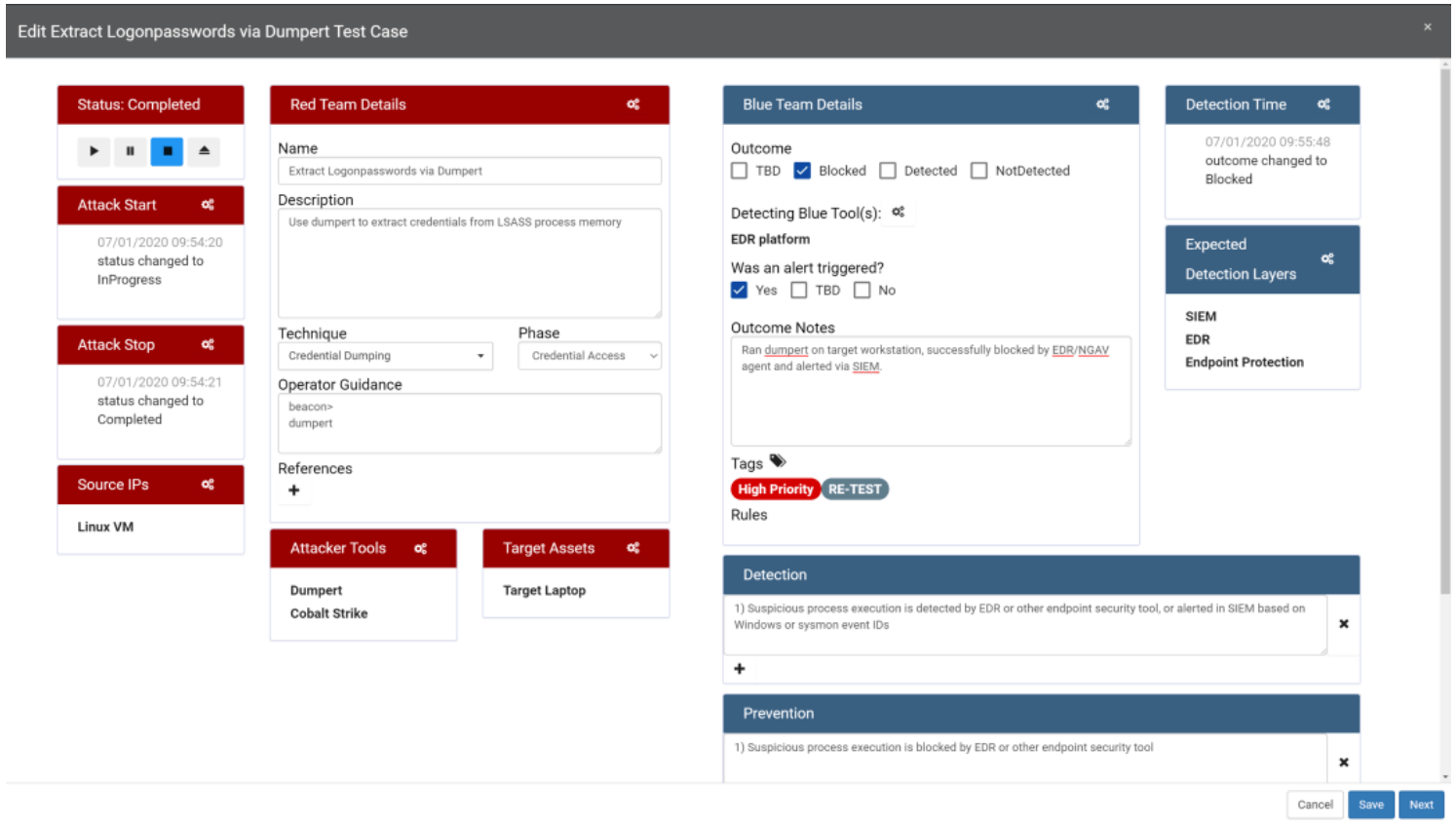
Blue team should receive all tradecraft, logs and IOCs

Vectr – Monitoring and Reporting

Run

Vectr is designed to provide metrics to the Red and Blue teams during the Purple Team exercises.

- *TTP Details*
- *Mitre Att&ck Mapping*
- *Detection/Prevention*
- *Response/Flags*



https://vectr.io/

Uplift the Game

Run

Add Variations to Command & Control

- *Cloud Native C2s (e.g. Serverless Apps, Direct DB Connections, JavaScript Everywhere)*
- *C2 Traffic Cloud to Cloud (e.g. Deploying the C2 in another tenant of target cloud)*
- *Domain Fronting (e.g. Leveraging Cloud Fronting services with Domain/SNI masking)*
- *Newest HTTP Protocols (e.g. Mobile push on HTTP/2 or HTTP/3, WebRTC, WebSocket)*

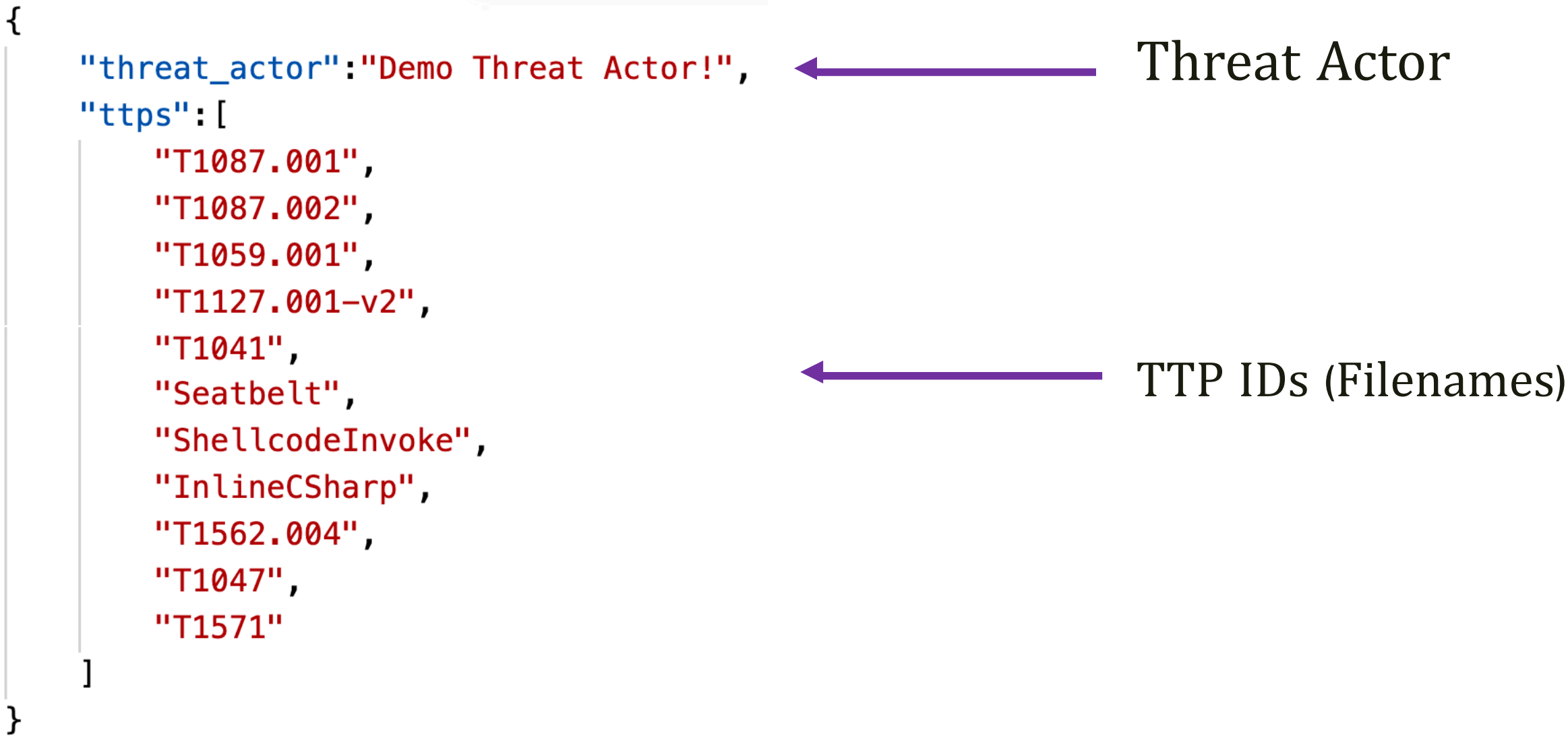
Improve Evasion Techniques

- *Reloading a clean NTDLL and remapping API Calls*
- *Protecting the processes with Parent ID spoofing, Microsoft Process Tags and Hollowing*
- *Disabling the EDR monitoring in Kernel Space*

Adjust the Pace of Exercise for the Scenario Requirement

DEMO

Running Scenarios Through Petaq



Preparing TTPs for Petaq

```
{
    "name": "Enumerate users and groups",
    "mitreid": "T1087.001",
    "description": "Getting the users and groups via net command.",
    "instructions": [
        "exec cmd /cnet users",
        "exec cmd /cnet groups"
    ]
}
```

Name

Mitre Att&ck ID

Description

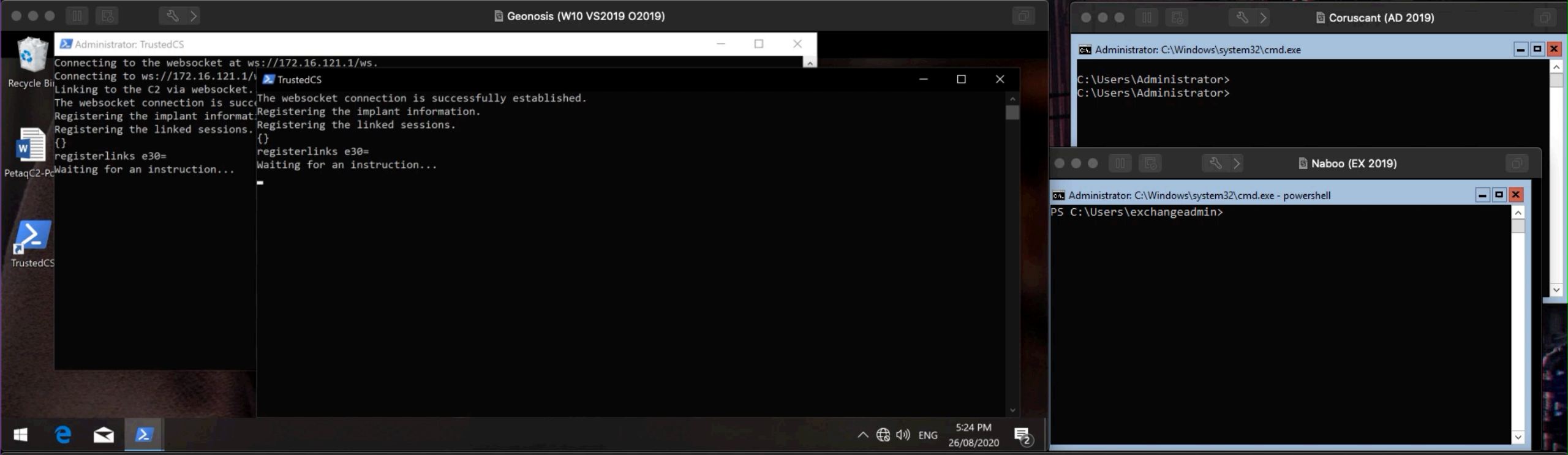
Instructions

Execute Process Command	Upload Download Link Sleep	Execute .NET Assembly .NET Source Code .NET Direct	Execute PowerShell via System Management	Execute Shellcode (Raw Assembly)	Lateral Movement (WMI)

Use real tradecraft such as PowerUp, Mimikatz, Seatbelt, SharpMove, WMI, SC, PSExec

Preparing TTPs for Petaq

```
{
    "na{
  {
      "name": "Non-Standard Port",
      "mitreid": "T1571",
      "description": "Adversaries may communicate using a protocol and port paring
      that are typically not associated. For example, HTTPS over port 8088[1] or port
}     587[2] as opposed to the traditional port 443. Adversaries may make changes to
      the standard port used by a protocol to bypass filtering or muddle analysis/
      parsing of network data.",
      "instructions": [
          "link tcp://10.0.0.2/8002"
      ]
  }
      }
```



dotnet

dotnet ⌘1 bash ⌘2

```
2020-8-26---17-20-38
Hosting environment: Development
Content root path: /Users/case/Documents/Research/PetProjects/petaq_videos/petaqc2_v0.2_auscert/petaqservice
Now listening on: https://0.0.0.0:443
Now listening on: http://0.0.0.0:80
Application started. Press Ctrl+C to shut down.
Petaq - Purple Team Simulation Kit
# Log file Logs/2020-8-26---17-20-38/WK4P9QQQ10JW1WN8N48E.txt created.
# Registering the implant...
Implant registration for WK4P9QQQ10JW1WN8N48E is done.
Links are adding to the implant...
# Log file Logs/2020-8-26---17-20-38/WNOVOD22XSS9LGWL1G7L.txt created.
# Registering the implant...
Implant registration for WNOVOD22XSS9LGWL1G7L is done.
Links are adding to the implant...
# list
Session ID              User Name              Hostname       IP Address      Status       Link URI
WNOVOD22XSS9LGWL1G7L    GALAXY\exchangeadmin   geonosis       172.16.121.137  connected    ws://172.16.121.1:80/ws
WK4P9QQQ10JW1WN8N48E    GALAXY\anakin          geonosis       172.16.121.137  connected    ws://172.16.121.1:80/ws
#
```

Conclusion

Various exercise types exist, find/develop a tailor fit exercise

- *Your adversary, your environment, your people, your software*

Benefits of Purple Team Exercises

- *Overall defence level for certain threats*
- *Security weaknesses or vulnerabilities*
- *Uplifting the existing skills sets and resources*
- *Measuring software and solution efficiency*

<u>Specialists first, software later…</u>

Research

1. Applebaum, A., Miller, D., Strom, B., Korban, C., & Wolf, R. (2016, December). Intelligent, automated red team emulation. In Proceedings of the 32nd Annual Conference on Computer Security Applications (pp. 363-373).
2. Applebaum, A., Miller, D., Strom, B., Foster, H., & Thomas, C. (2017, July). Analysis of automated adversary emulation techniques. In Proceedings of the Summer Simulation Multi-Conference (pp. 1-12).
3. Strom, B. E., Battaglia, J. A., Kemmerer, M. S., Kupersanin, W., Miller, D. P., Wampler, C., ... & Wolf, R. D. (2017). Finding cyber threats with ATT&CK-based analytics. The MITRE Corporation, Bedford, MA, Technical Report No. MTR170202.
4. Miller, D., Alford, R., Applebaum, A., Foster, H., Little, C., & Strom, B. (2018). Automated adversary emulation: A case for planning and acting with unknowns. MITRE: McLean, VA, USA.
5. Yoo, J. D., Park, E., Lee, G., Ahn, M. K., Kim, D., Seo, S., & Kim, H. K. (2020). Cyber Attack and Defense Emulation Agents. Applied Sciences, 10(6), 2140.
6. Klosa, C., Schoenborn, J. M., & Althoff, K. D. Evaluation of CEBRAS: A Case-based Reasoning Adversary Emulation System.

References

- *Petaq C2 (https://github.com/fozavci/petaqc2)*
- *Cobalt Strike (https://www.cobaltstrike.com)*
- *Covenant (https://github.com/cobbr/Covenant)*
- *SilentTrinity (https://github.com/byt3bl33d3r/SILENTTRINITY)*
- *Caldera (https://github.com/mitre/caldera)*
- *Ghost Pack (https://github.com/GhostPack/)*
- *GoPhish (https://getgophish.com/)*
- *SCShell (https://github.com/Mr-Un1k0d3r/SCShell)*
- *RedELK (https://github.com/outflanknl/RedELK)*

THANKS