SPECTEROPS

The Admin's Guide to Preventing SCCM Attacks

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What this talk is not about:

- SCCM fundamentals
- Attack path execution
- Attack path detection

What this talk is about:

- **SCCM attack path prevention**
- Step-by-step reference guide
- Potential pitfalls (and bypasses)
- War stories and real-world context

Who is this talk for?

- Defenders who want to better **understand SCCM attack paths** and which mitigations are best suited for their environments
- System administrators who want to **implement mitigations** for known SCCM attack paths
- Offensive security pros who want to understand misconfigurations, their **potential bypasses**, and how to better report issues to clients

Misconfiguration Manager

SCCM Attack Path Management Knowledge Base

- Co-authored with Duane Michael (@subat0mik)
- Step-by-step foundational, offensive, and defensive **write-ups** for known techniques
- A **taxonomy** to simplify and demystify concepts (à la Certified Pre-Owned)
- Based on MITRE ATT&CK
- PowerShell script to identify TAKEOVER and ELEVATE issues

Misconfiguration Manager Taxonomy

Because "Hierarchy takeover via NTLM coercion and relay to MSSQL on remote site database" doesn't roll off the tongue…

Attack Techniques

RECON

CRED

ELEVATE

TAKEOVER

EXEC

Defense Techniques

PREVENT

DETECT

CANARY

https://misconfigurationmanager.com

Hierarchy TAKEOVER

Gaining complete control of all client devices in the SCCM hierarchy

- How can attackers take over a hierarchy?
  - Obtain the **Full Administrator** role in **ANY** site
  - The site database is replicated to all sites
  - **Own one Primary Site, own them all**
- Why do we care?
  - Allows **arbitrary command execution** on all clients
  - Allows access to features like **CMPivot, Run Script**
  - Allows the ability to impact the availability of software

Hierarchy TAKEOVER

Key concepts

- Each site server's domain computer account must be:
  - Local admin on every site system role (i.e., every SCCM server)
  - Sysadmin in the site database
- Attackers can force this account to authenticate to an arbitrary IP address and use the creds to impersonate the site server to other SCCM servers, then grant themselves the Full Administrator role
- As defenders, if we can **prevent NTLM authentication with relayed credentials**, we prevent most known TAKEOVER and ELEVATE techniques

SCCM Hierarchy Takeover Attack Paths

TAKEOVER-1

NTLM coercion and relay to MSSQL on remote site database

TAKEOVER-2

NTLM coercion and relay to SMB on remote site database

TAKEOVER-3

NTLM coercion and relay to HTTP on ADCS

TAKEOVER-4

NTLM coercion and relay from CAS to origin primary site server

TAKEOVER-5

NTLM coercion and relay to AdminService on remote SMS Provider

TAKEOVER-6

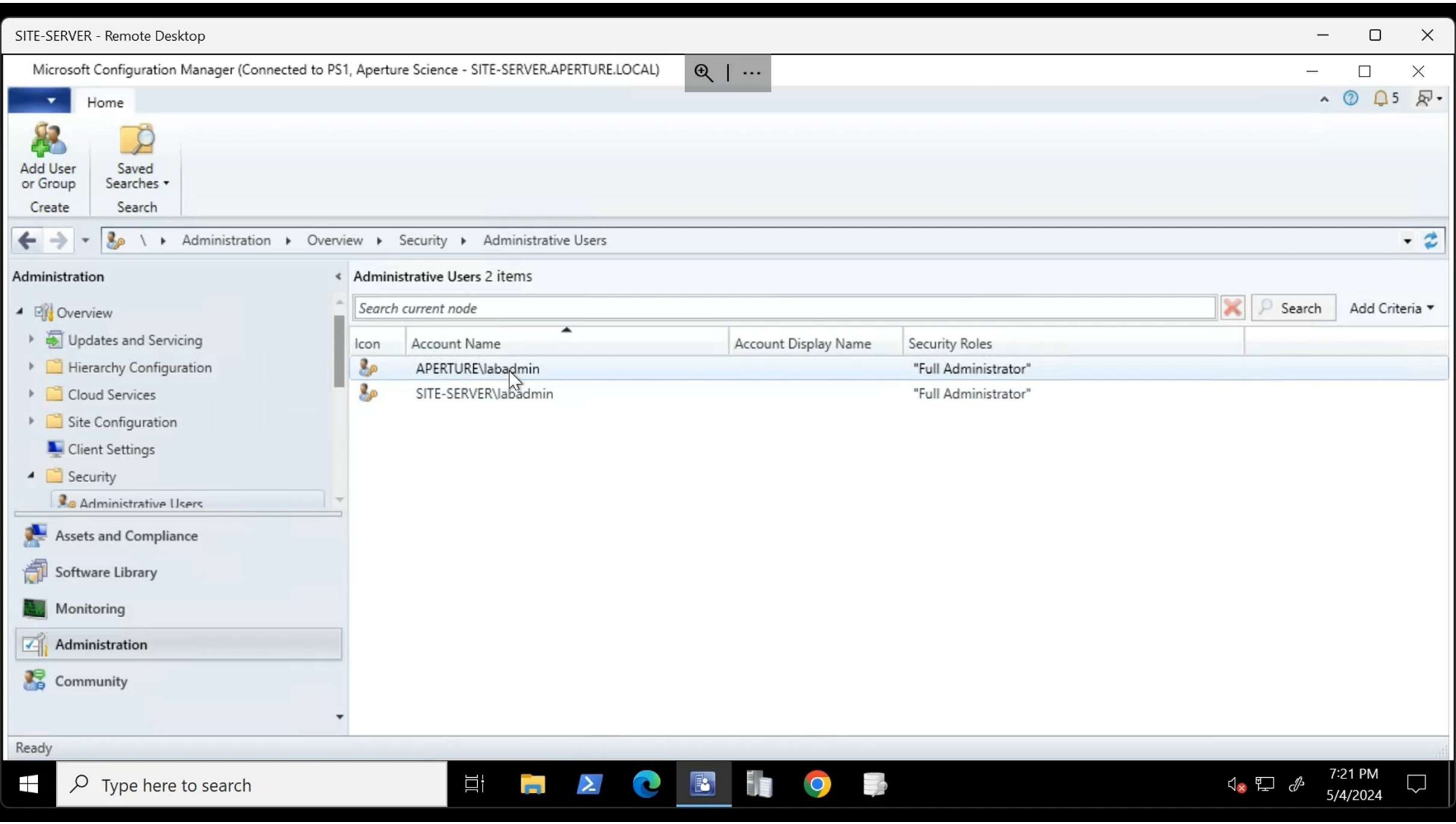
NTLM coercion and relay to SMB on remote SMS Provider

TAKEOVER-7

NTLM coercion and relay to SMB between primary and passive site servers

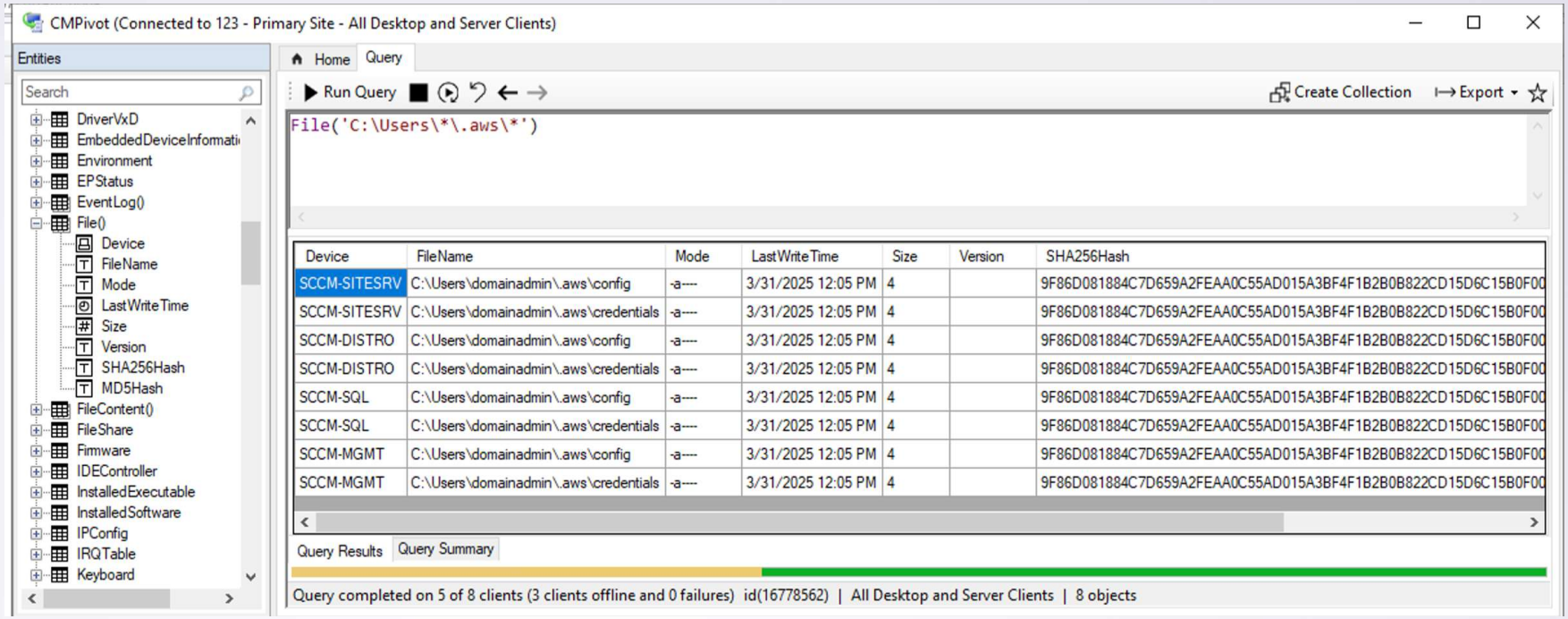
TAKEOVER-8

NTLM coercion and relay HTTP to LDAP on domain controller


SITE-SERVER - Remote Desktop
Microsoft Configuration Manager (Connected to PS1, Aperture Science - SITE-SERVER.APERTURE.LOCAL)
Home
Add User or Group
Create
Saved Searches
Search
Administration
Overview
Security
Administrative Users
Administration
Overview
Updates and Servicing
Hierarchy Configuration
Cloud Services
Site Configuration
Client Settings
Security
Administrative Users
Assets and Compliance
Software Library
Monitoring
Administration
Community
Administrative Users 2 items
Search current node
Search
Add Criteria
Icon
Account Name
Account Display Name
Security Roles
APERTURE\labadmin
"Full Administrator"
SITE-SERVER\labadmin
"Full Administrator"
Ready
Type here to search
7:21 PM
5/4/2024

Real World Examples

TAKEOVER



TAKEOVER Prevention

Just disable NTLM for the domain, it's easy!

- Just kidding, please don't do this
- This recommendation is common (Chris is guilty of making it) but it isn't feasible to just flip the switch in many organizations
- Careful monitoring must take place beforehand to identify clients that don't support Kerberos
- However, this fix doesn't account for Kerberos relay attacks

TAKEOVER Prevention

Security Features

- Signing
  - A digital signature of each message is attached to the message, preventing tampering
  - Uses a shared session key to hash message
- Channel binding (e.g., extended protection for authentication, or EPA)
  - Prevents MITM/spoofing attacks by binding authentication to the secure channel
  - Token from secure outer protocol (TLS) is embedded in each authentication message, preventing tampering
- Disable/block connectivity to protocols that don't support these features

https://support.microsoft.com/en-us/topic/kb5005413-mitigating-ntlm-relay-attacks-on-active-directory-certificate-services-ad-cs-3612b773-4043-4aa9-b23d-b87910cd3429

TAKEOVER/ELEVATE Prevention

Prevent Relayed Credentials from Authenticating Successfully

Technique	Codename
Require EPA on AD CS and site databases	PREVENT-14
Require SMB signing on site systems	PREVENT-12
Disable and uninstall WebClient on site servers	PREVENT-11
Block unnecessary connections to site systems	PREVENT-20
Require LDAP channel binding and signing	PREVENT-13

IMPORTANT: Implementing these settings **will** impact connectivity and/or performance and we have only personally tested them in a lab environment, so it is crucial to first audit and test these changes in your environment before implementing in production.

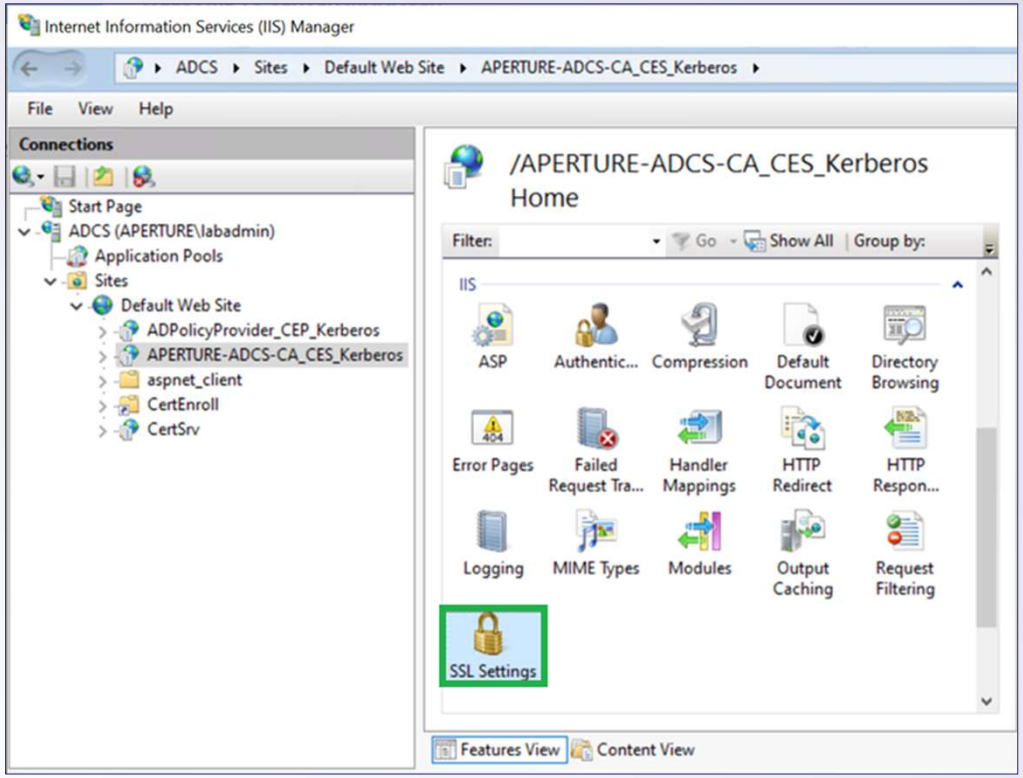
https://github.com/subat0mik/Misconfiguration-Manager/blob/main/defense-techniques/_defense-techniques-list.md

Require EPA on AD CS

PREVENT-14

On AD CS servers:

1. Open IIS Manager
2. Expand the connection, “Sites”, and “Default Web Site”
3. Click on “CertSrv” to configure the Certificate Authority Enrollment Service
4. Double-click “SSL Settings”



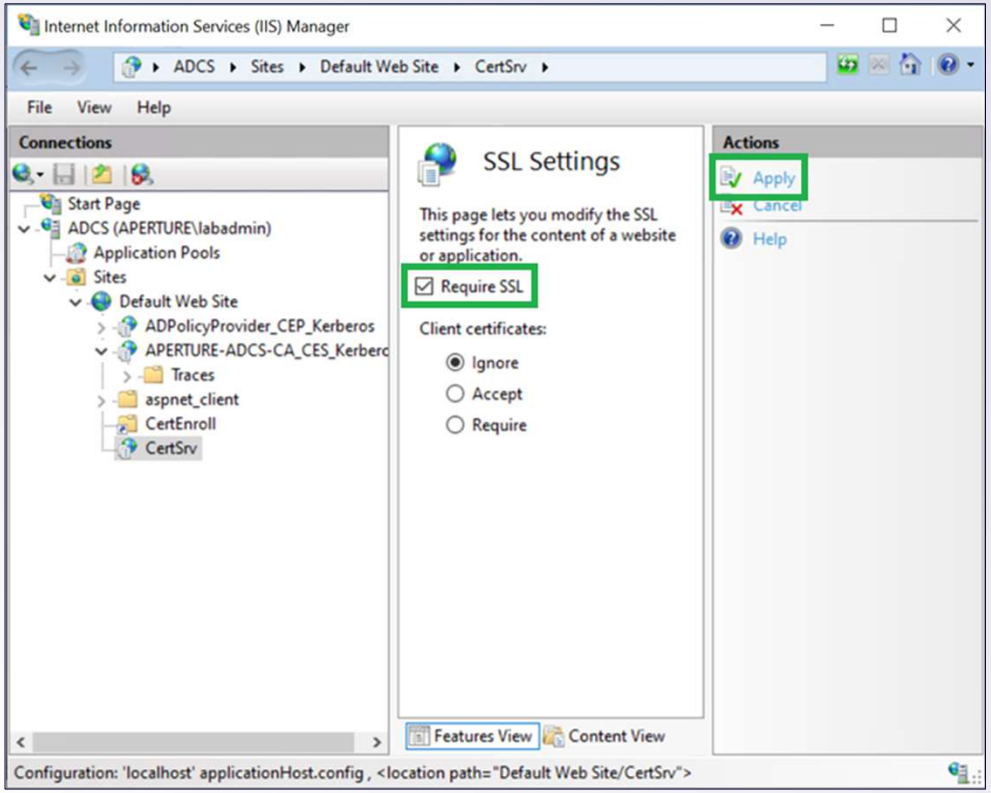
https://support.microsoft.com/en-us/topic/kb5005413-mitigating-ntlm-relay-attacks-on-active-directory-certificate-services-ad-cs-3612b773-4043-4aa9-b23d-b87910cd3429

Require EPA on AD CS

PREVENT-14

5. Check the box next to “Require SSL”
6. Click “Apply”

If this setting is not applied, relaying to HTTP instead of HTTPS will bypass EPA

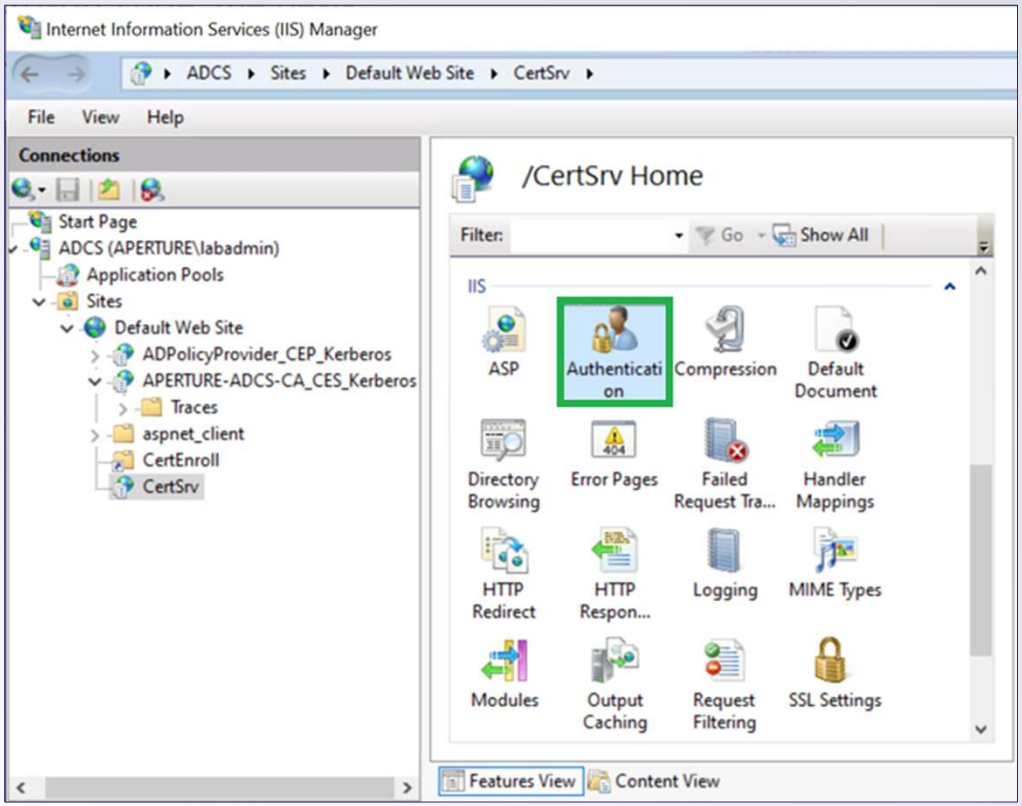


https://support.microsoft.com/en-us/topic/kb5005413-mitigating-ntlm-relay-attacks-on-active-directory-certificate-services-ad-cs-3612b773-4043-4aa9-b23d-b87910cd3429

Require EPA on AD CS

PREVENT-14

7. Click on the “CertSrv” site again
8. Double-click “Authentication”



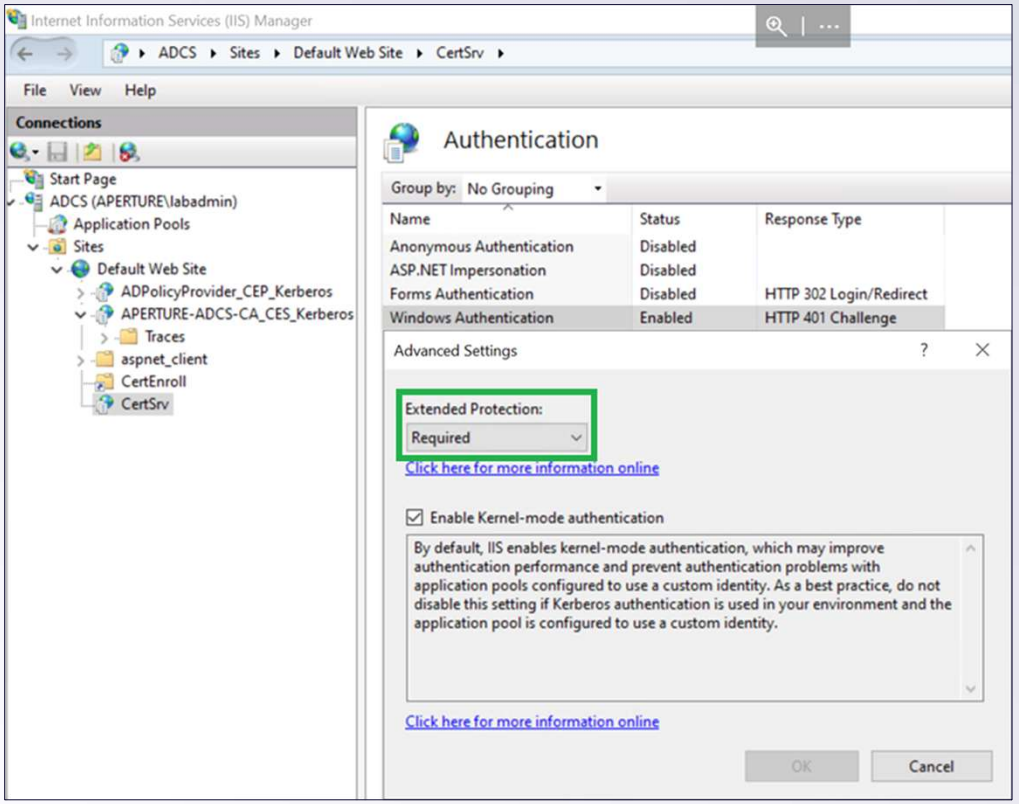
https://support.microsoft.com/en-us/topic/kb5005413-mitigating-ntlm-relay-attacks-on-active-directory-certificate-services-ad-cs-3612b773-4043-4aa9-b23d-b87910cd3429

Require EPA on AD CS

PREVENT-14

9. Right click “Windows Authentication”
10. Click “Advanced Settings”
11. Set “Extended Protection” to “Required”
12. Click “OK”

Setting to “Accept” will not prevent NTLM relay attacks if the coerced client doesn’t support channel binding

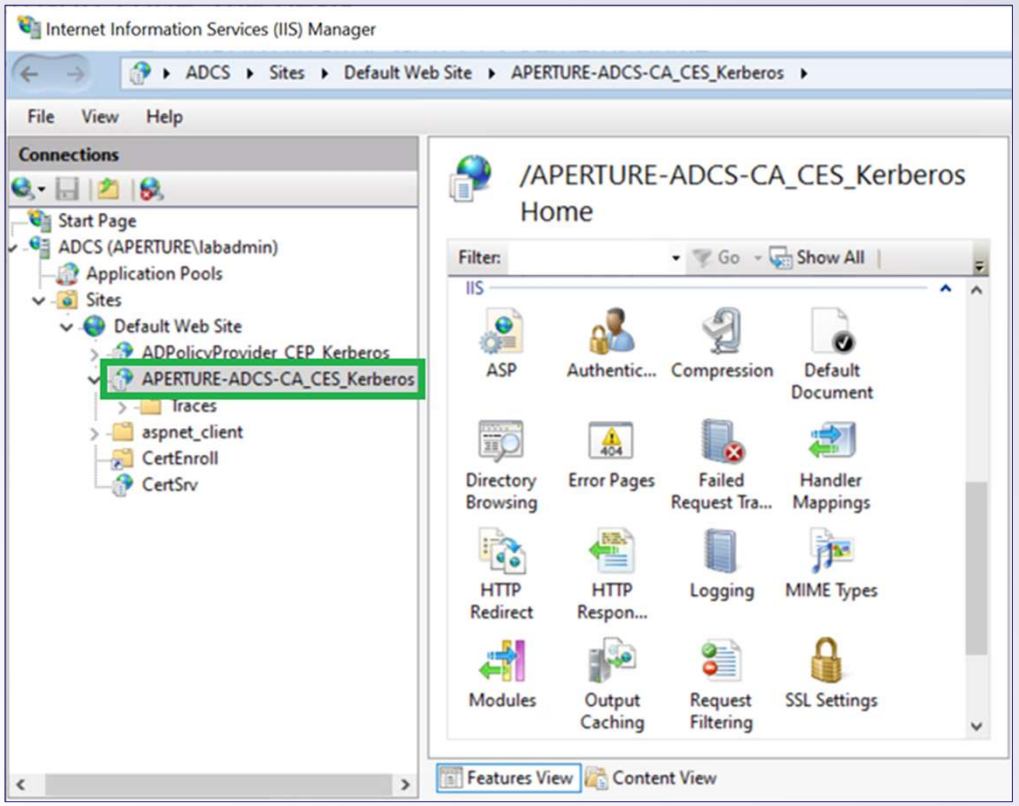


https://support.microsoft.com/en-us/topic/kb5005413-mitigating-ntlm-relay-attacks-on-active-directory-certificate-services-ad-cs-3612b773-4043-4aa9-b23d-b87910cd3429

Require EPA on AD CS

PREVENT-14

13. Repeat steps 3-12 for the Certificate Enrollment Web Service (“APERTURE-ADCS-CA_CES_Kerberos” in the example)



https://support.microsoft.com/en-us/topic/kb5005413-mitigating-ntlm-relay-attacks-on-active-directory-certificate-services-ad-cs-3612b773-4043-4aa9-b23d-b87910cd3429

Require EPA on AD CS

PREVENT-14

14. Append “<%windir%>\systemdata\CES\<CA>_CES_Kerberos\web.config”:

```
<binding name="TransportWithHeaderClientAuth">
    <security mode="Transport">
        <transport clientCredentialType="Windows">
        <extendedProtectionPolicy policyEnforcement="Always" />
        </transport>
        <message clientCredentialType="None" establishSecurityContext="false" negotiateServiceCredential="false" />
    </security>
    <readerQuotas maxStringContentLength="131072" />
</binding>
```

15. Restart the IIS service by issuing the “iisreset /restart” command

https://support.microsoft.com/en-us/topic/kb5005413-mitigating-ntlm-relay-attacks-on-active-directory-certificate-services-ad-cs-3612b773-4043-4aa9-b23d-b87910cd3429

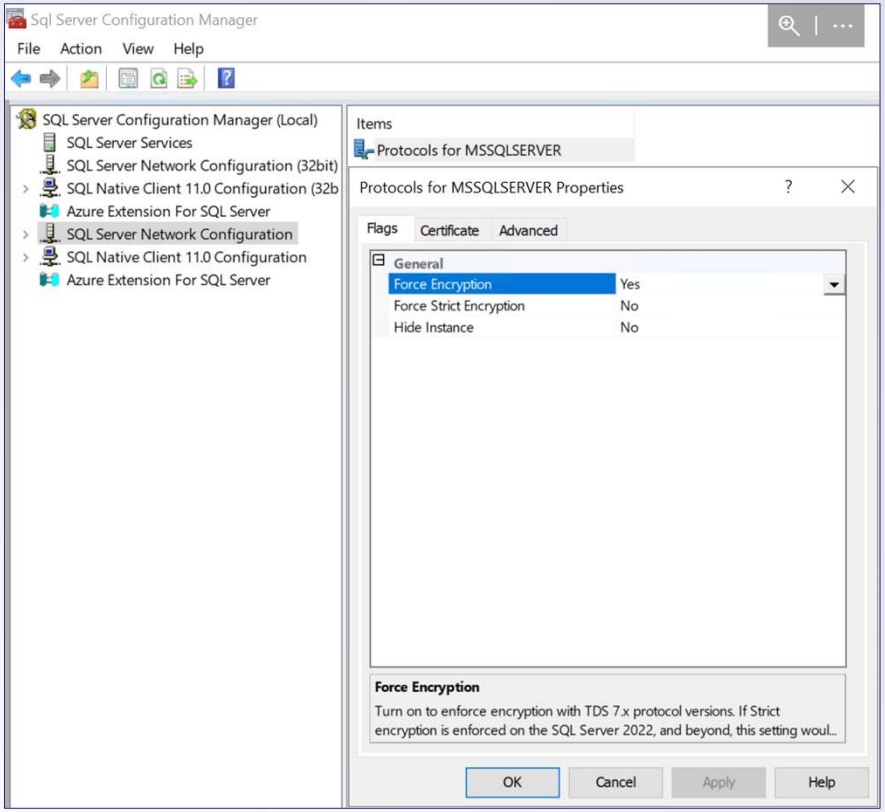
Require EPA on site databases

PREVENT-14

On site database servers:

1. Open Sql Server Configuration Manager
2. Click “Sql Server Network Configuration”
3. Right click “Protocols for MSSQLSERVER”, then click “Properties”
4. Set “Force Encryption” to “Yes”

If this setting is not configured, only service binding is enforced (not channel binding)



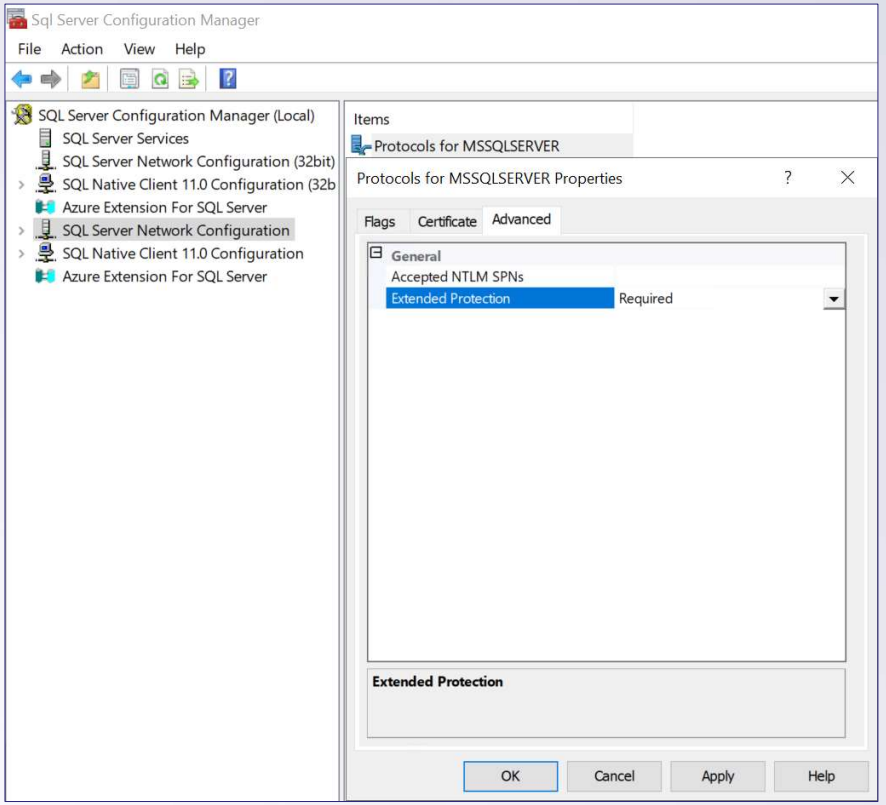
https://learn.microsoft.com/en-us/sql/database-engine/configure-windows/connect-to-the-database-engine-using-extended-protection?view=sql-server-ver16

Require EPA on site databases

PREVENT-14

5. Navigate to the “Advanced” tab
6. Set “Extended Protection” to “Required”
7. Click “Apply”, then “OK”
8. Restart the “SQL Server (MSSQLSERVER)” service

Setting to “Allowed” will not prevent NTLM relay attacks if the coerced client doesn’t support channel binding



https://learn.microsoft.com/en-us/sql/database-engine/configure-windows/connect-to-the-database-engine-using-extended-protection?view=sql-server-ver16

Require SMB Signing on Site Systems

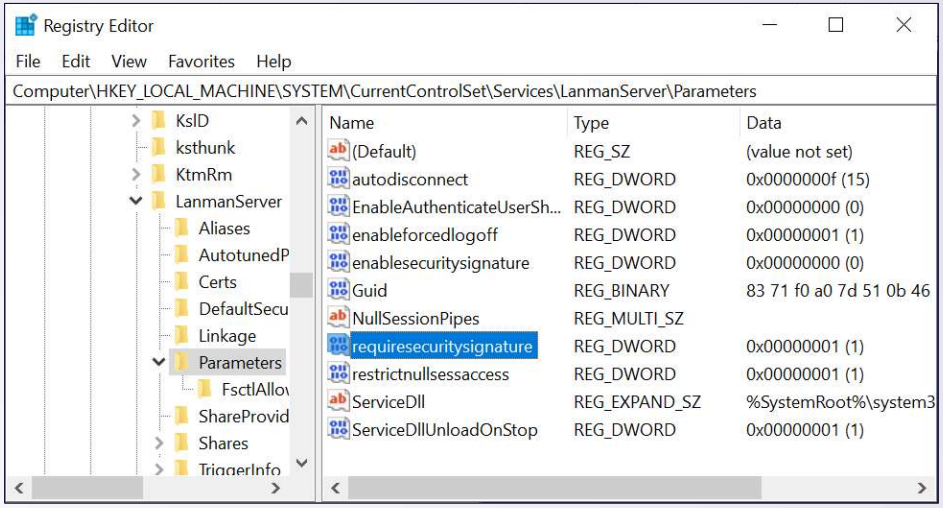
PREVENT-12

On every site system role:

1. Open regedit
2. Navigate to HKLM\System\CurrentControlSet\Services\LanManServer\Parameters\
3. Set “RequireSecuritySignature” to 1

Equivalent GPO: “Microsoft network client: Digitally sign communications (always)”

Configuring this setting “if client agrees” or “if server agrees” does not offer relay protection



https://learn.microsoft.com/en-us/troubleshoot/windows-server/networking/overview-server-message-block-signing

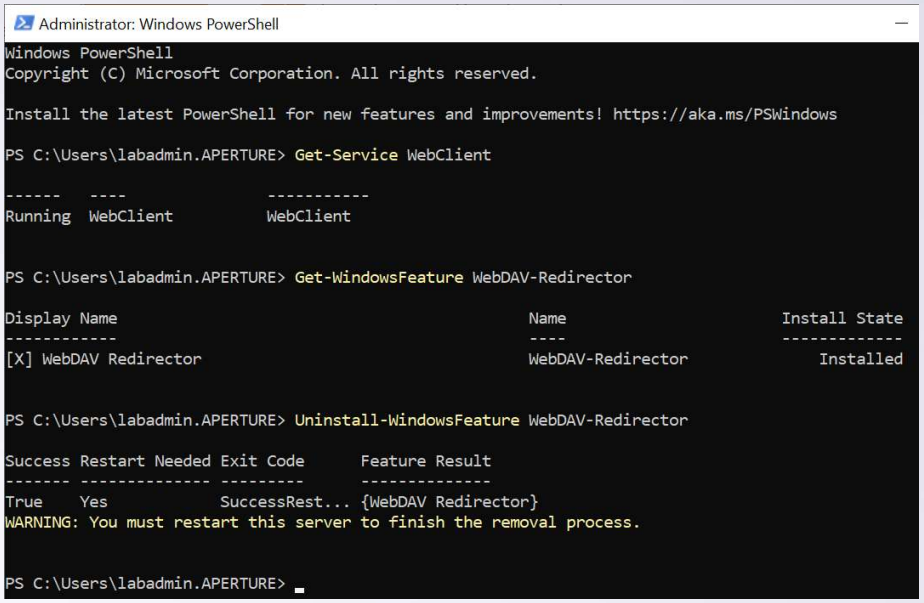
Disable and Uninstall WebClient on Site Servers

PREVENT-11

On every primary site server, central administration site server, and passive site server:

1. Open PowerShell (Administrator)
2. Execute the following command:
   - Uninstall-WindowsFeature -Name WebDAV-Redirector
3. At the next opportunity, restart the server to complete the change

If WebClient is installed but not running, it can potentially be triggered to start and be abused



https://learn.microsoft.com/en-us/windows-server/storage/file-server/smb-interception-defense?tabs=group-policy#disable-the-webdav-protocol

Block Unnecessary Connections to Site Systems

PREVENT-20

Site servers (including primary site, central administration site, and passive site servers):

- TCP/445 (SMB) - inbound **and outbound**

Site database servers:

- TCP/445 (SMB) - inbound
- TCP/1433 (MSSQL) - inbound

https://learn.microsoft.com/en-us/intune/configmgr/core/plan-design/hierarchy/ports

Block Unnecessary Connections to Site Systems

PREVENT-20

There is no support for relay protection on the SMS Provider AdminService!

It is imperative to restrict the following ports on SMS Providers (including site servers):

- TCP/443 (HTTPS) - inbound
- TCP/445 (SMB/WMI) - inbound

If necessary, move SMS Providers to a system without client-facing roles

Restricting connections to TCP/443 and TCP/445 isn't feasible when the server also hosts client-facing roles (e.g., management point, distribution point), so these ports are often open

https://learn.microsoft.com/en-us/intune/configmgr/core/plan-design/hierarchy/ports

Require LDAP Channel Binding and Signing

PREVENT-13

1. Configure Windows clients and domain controllers to negotiate channel binding **and** signing via GPO **when supported**
2. **Monitor events** to identify clients that may not comply with signing or channel binding requirements
3. **After handling outliers**, require LDAP channel binding **and** signing

If only channel binding is required, relay to LDAP with StartTLS is possible because TLS is established after NTLM authentication is complete

If only signing is required, relay to LDAPS is possible (pre-Windows Server 2025) because TLS traffic is signed

Client Push Installation

Overview

- Deploys the client software remotely from the site server
- Copies files to the ADMIN$ share and executes the installer
- Uses configured credentials and the **site server's domain computer account**, which must be a **local admin** to install the client software
- Can be initiated manually or automatically when new devices are discovered (e.g., in a certain domain/subnet)

Automatic Site-wide Client Push Installation Abuse

ELEVATE-2

- Attackers can register a fake device record in SCCM by sending requests to a management point
- This will **cause the site server to authenticate to an arbitrary IP address specified for the fake device**
- Incoming NTLM authentication can be **cracked or relayed** to other workstations or SCCM servers (where the site server has admin privileges by default)

https://medium.com/specter-ops-posts/coercing-ntlm-authentication-from-sccm-e6e23ea8260a

ELEVATE-2 Prevention

Disable Automatic Client Push Installation and Fallback to NTLM

Technique	Codename
Disable automatic site-wide client push installation	PREVENT-3
Patch site server with KB15599094	PREVENT-1
Disable Fallback to NTLM	PREVENT-2
Require PKI certificates for client authentication	PREVENT-8

None of these prevent Kerberos relay if an SCCM admin initiates a manual client push installation

Use another method of client installation instead of client push installation. Choose an option that "pulls" the client installer from a server hosting the files instead of using a privileged account to "push" the client installer to the device, for example software update or GPO-based installation.

https://github.com/subat0mik/Misconfiguration-Manager/blob/main/defense-techniques/_defense-techniques-list.md

Other Potential Solutions to Prevent TAKEOVER

Don't try this at home!... or do, and tell us what happened

Microsoft hasn't provided an official response supporting any of these ideas:

- Add all site servers to the "Protected Users" group
  - Prevents site servers from using NTLM for authentication
- Restrict outbound NTLM from site servers to only necessary systems
- Restrict inbound NTLM to site databases and SMS Providers to only necessary systems

These solutions do not prevent Kerberos relay

To their credit, Microsoft did add official support for EPA to the site database, so hopefully we'll make progress on these as well!

CRED Attacks

Machine Policy Secrets

Downloaded from Management Points

- Network Access Accounts (NAA)
  - Domain accounts used by systems that are not joined to AD to download content from software distribution points
- Task Sequences
  - Step-by-step instructions executed by clients, often for operating system deployment or complicated software installations/setup
- Collection Variables
  - Environment variables defined for a device collection to access

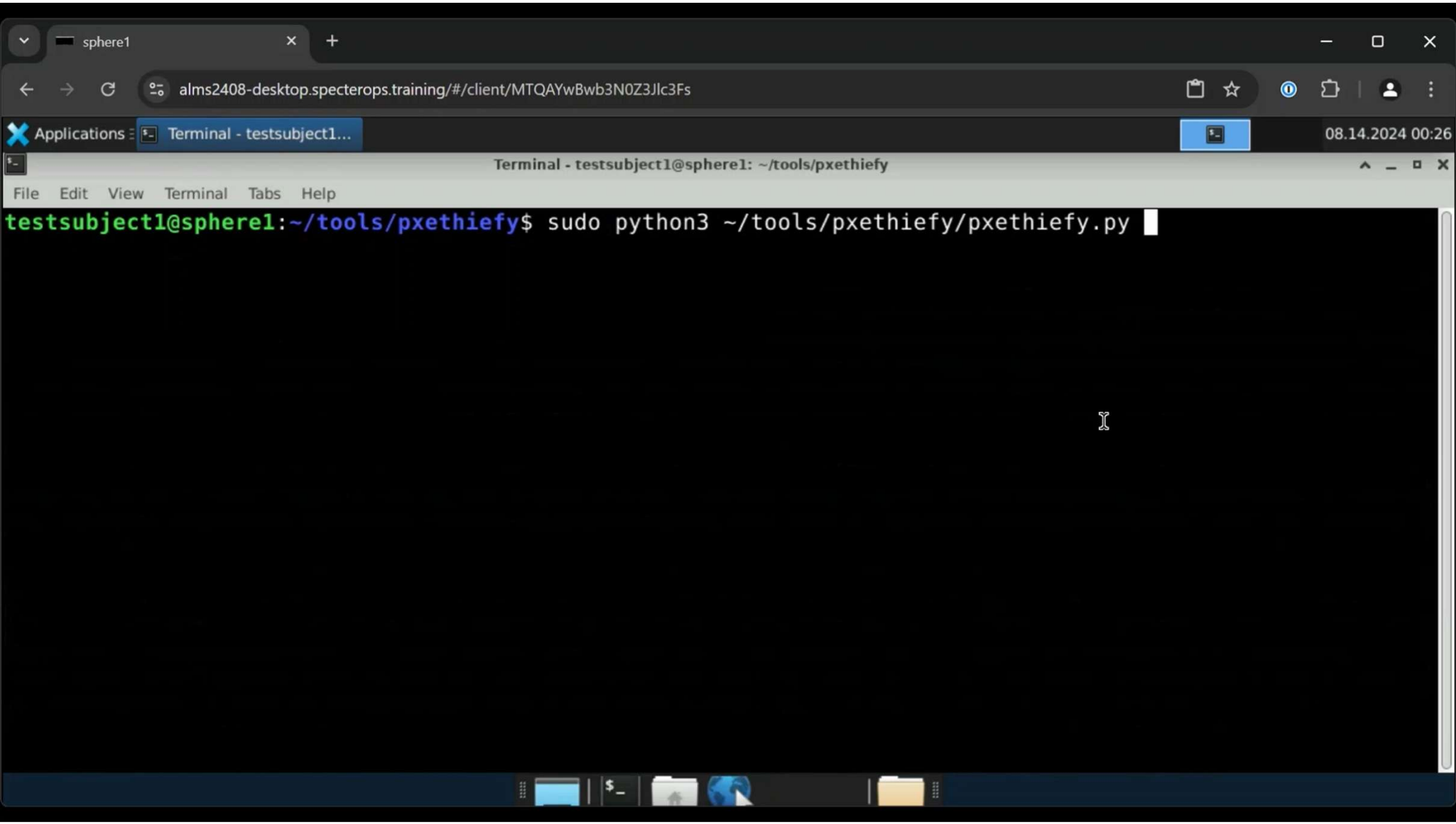
https://learn.microsoft.com/en-us/intune/configmgr/core/plan-design/hierarchy/accounts

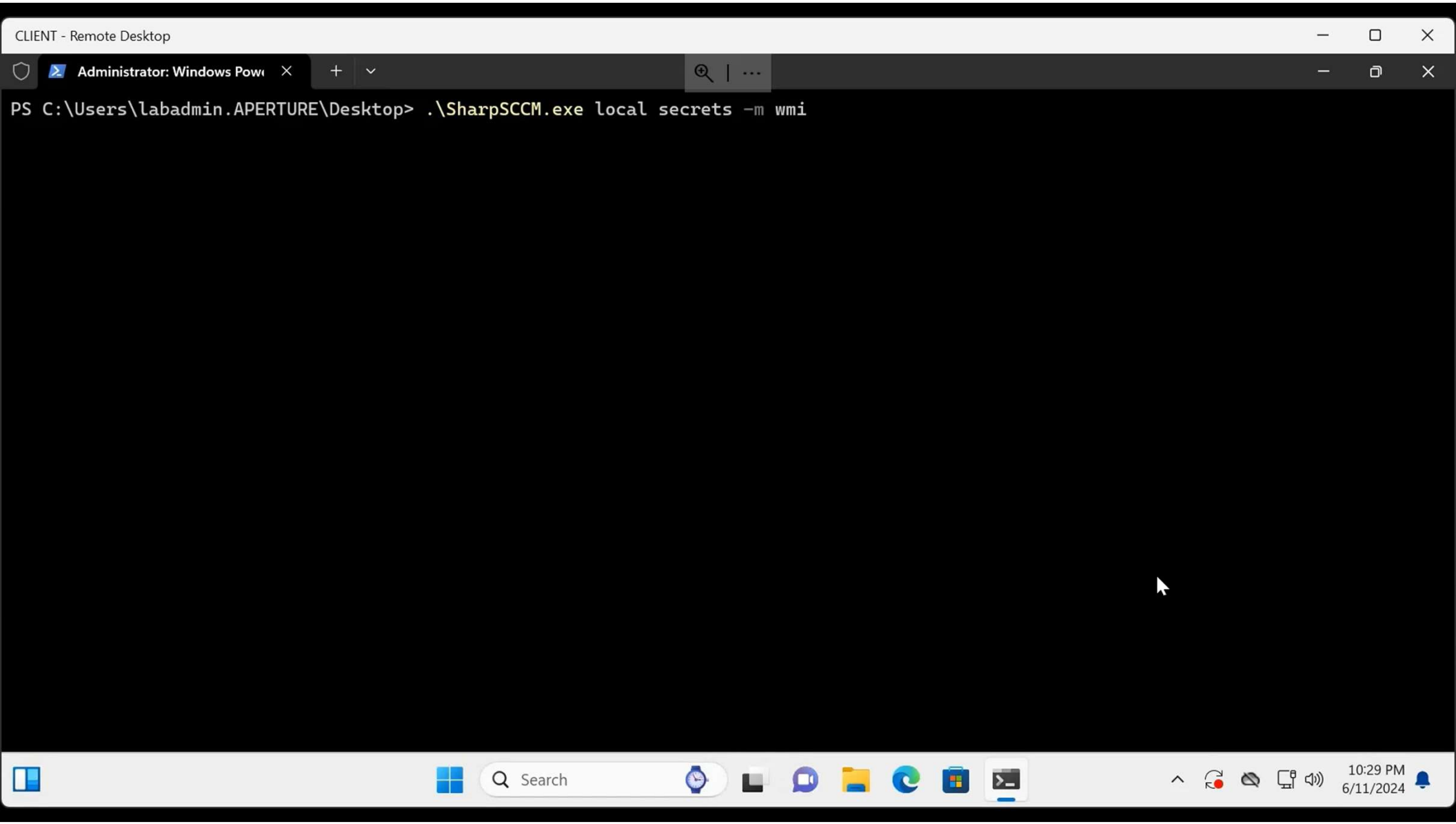
Machine Policy Secrets

Downloaded from Management Points

- May contain obfuscated domain join credentials, local admin credentials, RunAs credentials
- Can be requested from a management point and deobfuscated
- Credentials are stored on clients as DPAPI blobs protected by the system's masterkey
- Retrievable via WMI as a privileged user
- Remain in CIM repository after client is uninstalled or account rotation
  - C:\Windows\System32\Wbem\Repository\OBJECTS.DATA

https://subat0mik.medium.com/the-phantom-credentials-of-sccm-why-the-naa-wont-die-332ac7aa1ab9


sphere1
alms2408-desktop.specterops.training/#/client/MTQAYwBwb3N0Z3Jlc3Fs
Applications
Terminal - testsubject1...
08.14.2024 00:26
Terminal - testsubject1@sphere1: ~/tools/pxethiefy
File Edit View Terminal Tabs Help
testsubject1@sphere1:~/tools/pxethiefy$ sudo python3 ~/tools/pxethiefy/pxethiefy.py


CLIENT - Remote Desktop
Administrator: Windows Pow
PS C:\Users\labadmin.APERTURE\Desktop> .\SharpSCCM.exe local secrets -m wmi
Search
10:29 PM
6/11/2024

Real World Examples

Overprivileged Policy Secrets

- Domain join account in PXE boot task sequence Owns all computers in the domain
- Remember to change ownership and remove rights assignments from accounts that do not require them

Creds in PXE boot task sequences can be retrieved remotely if there is no PXE password or a weak one

https://github.com/subat0mik/Misconfiguration-Manager/blob/main/defense-techniques/PREVENT/PREVENT-17/prevent-17_description.md

CRED Prevention

Protect Secrets Stored in Machine Policies

Technique	Codename
*Configure Enhanced HTTP	PREVENT-4
Disable network access accounts	PREVENT-3 and PREVENT-15
**Enforce the principle of least privilege for accounts	PREVENT-10
Configure a strong PXE boot password	PREVENT-6
Restrict permissions to join machines to AD	PREVENT-16

*Configuring PKI certificates for client authentication (PREVENT-8) would be ideal but involves a lot of overhead compared to EHTTP

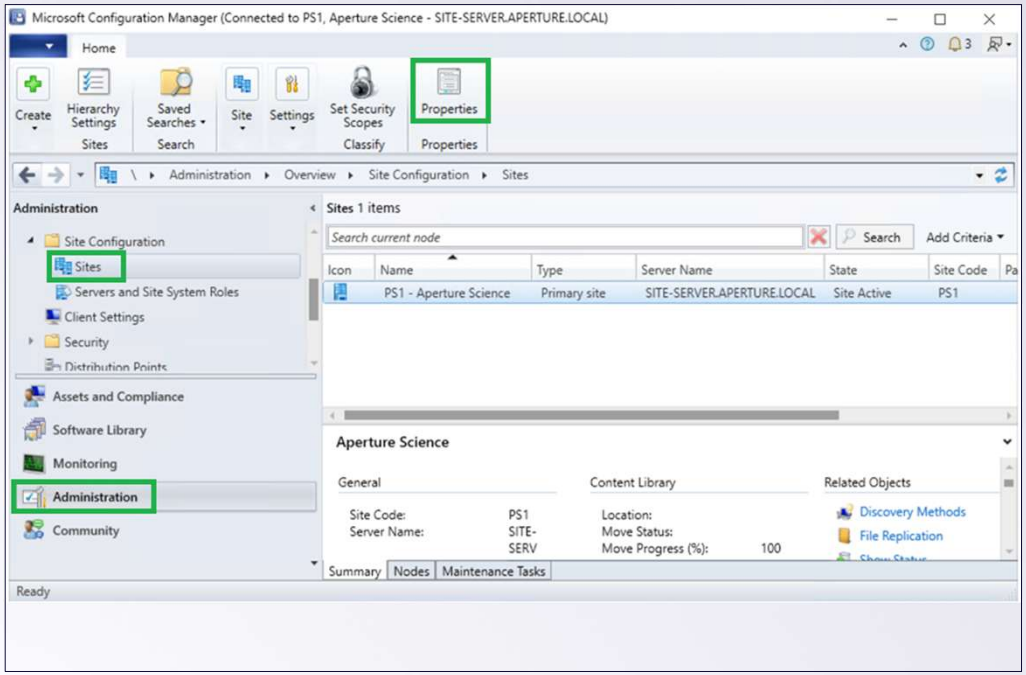
**If you must have an NAA, disable interactive logon and restrict to read-only access to distribution point network shares

https://github.com/subat0mik/Misconfiguration-Manager/blob/main/defense-techniques/_defense-techniques-list.md

Configure Enhanced HTTP

PREVENT-4

1. Open the Configuration Manager Console
2. Navigate to Administration > Site Configuration > Sites, then click the site
3. Click “Properties”



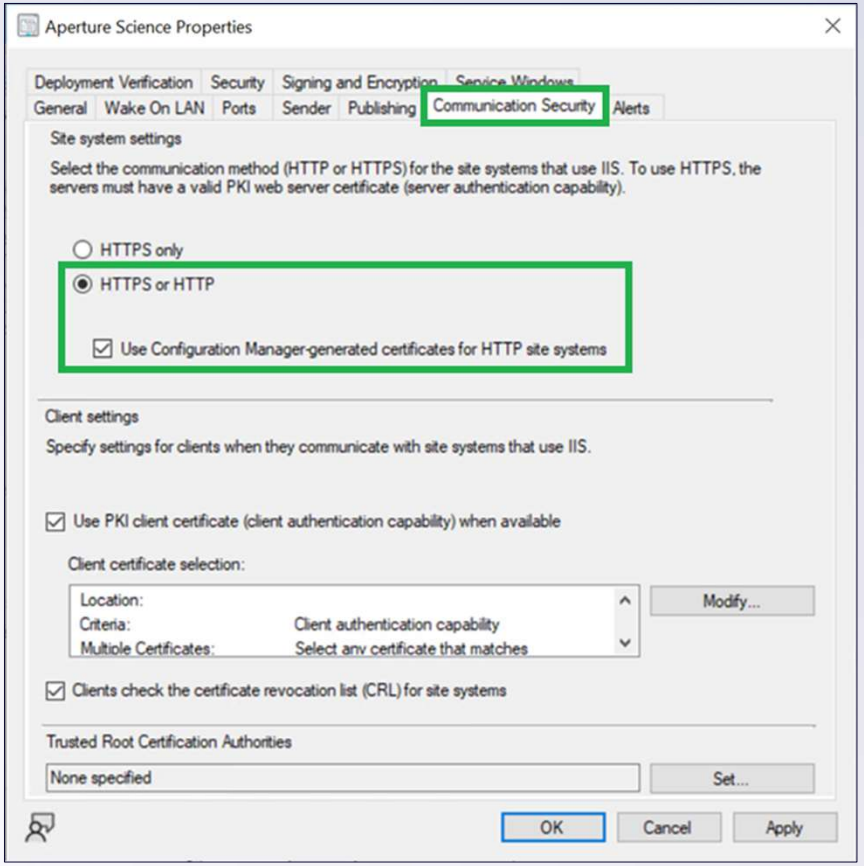
https://learn.microsoft.com/en-us/intune/configmgr/core/plan-design/hierarchy/enhanced-http

Configure Enhanced HTTP

PREVENT-4

4. Click the “Communication Security” tab
5. Select “HTTPS or (E)HTTP”
6. Check the box next to “Use Configuration Manager-generated certificates for HTTP site systems”
7. Click “Apply”, then “OK”

Enhanced HTTP does not prevent registration of fake device records to download machine policy secrets or coerce automatic client push

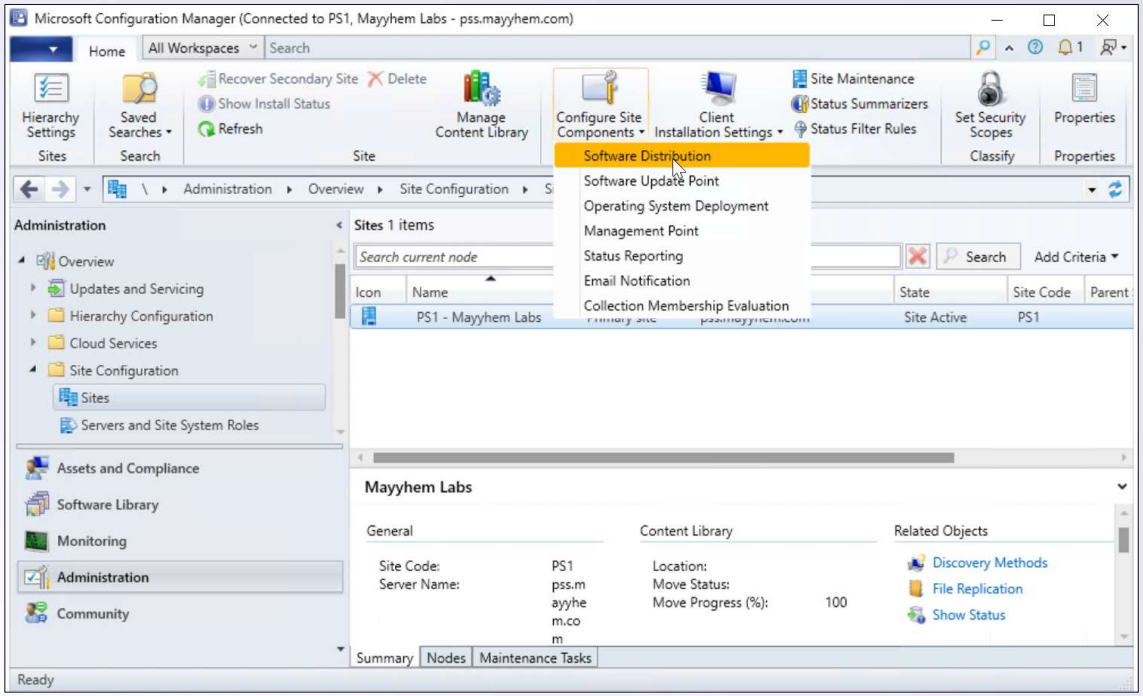


https://learn.microsoft.com/en-us/intune/configmgr/core/plan-design/hierarchy/enhanced-http

Disable Network Access Accounts

PREVENT-3

1. Open the Configuration Manager Console
2. Navigate to Administration > Site Configuration > Sites, then click the site
3. Click “Configure Site Components”, then “Software Distribution”

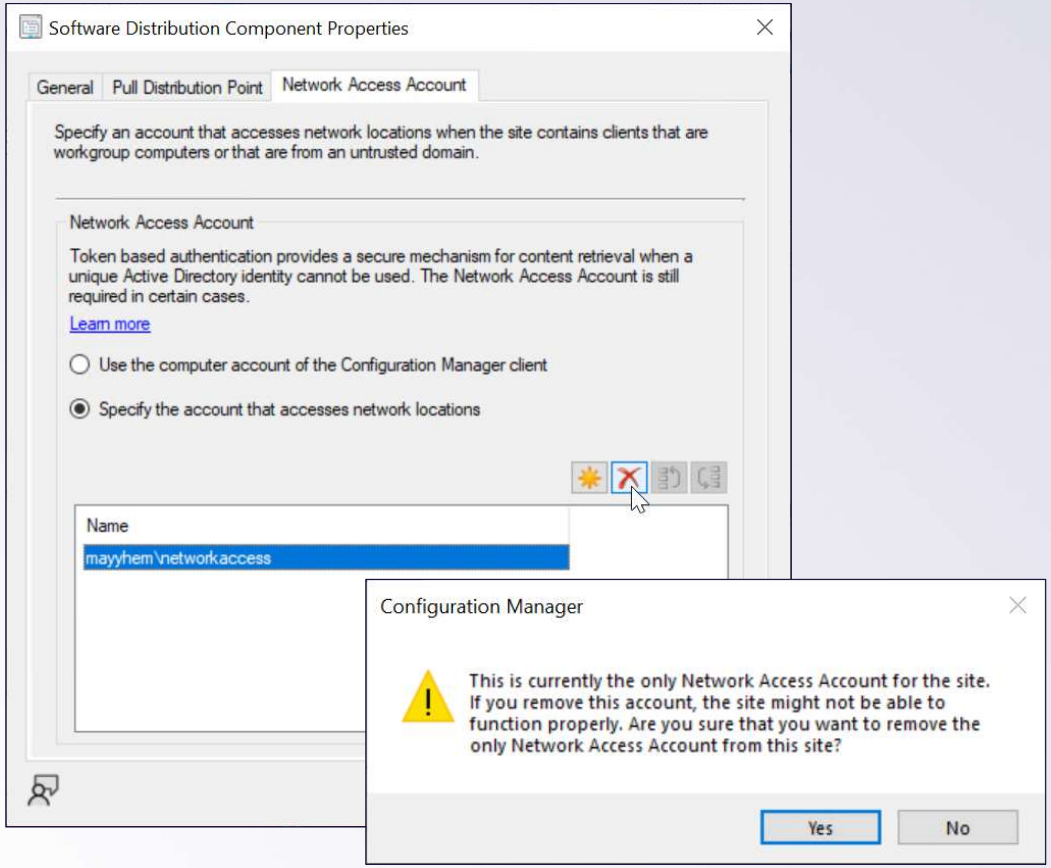


https://learn.microsoft.com/en-us/intune/configmgr/core/plan-design/hierarchy/accounts#actions-that-require-the-network-access-account

Disable Network Access Accounts

PREVENT-3

4. Click the “Network Access Account” tab
5. Select each account and click the big red X
6. When prompted to delete the only NAA, say “Yes”
7. Click “Apply”, then “OK”



https://learn.microsoft.com/en-us/intune/configmgr/core/plan-design/hierarchy/accounts#actions-that-require-the-network-access-account

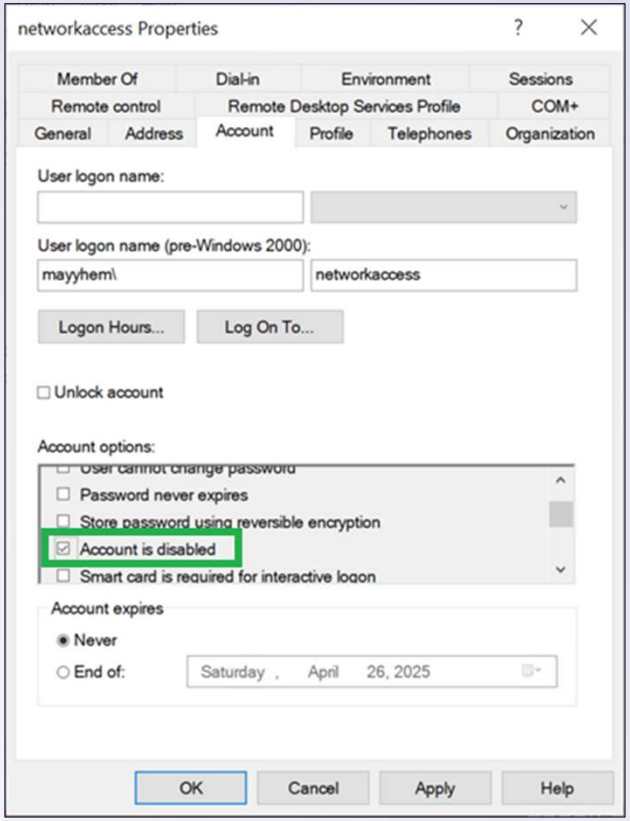
Disable Network Access Accounts

PREVENT-15

8. Open Active Directory Users and Computers
9. Open the “Properties” window for the NAA
10. Click the “Account” tab, check the box next to “Account is disabled”
11. Click “Apply”, then “OK”
12. Rejoice

Alternatively, rotate the password after removing the NAA from SCCM by selecting “Reset Password” in ADUC

If the NAA is removed from SCCM but not disabled or the password rotated, the WMI repository on client devices will still contain valid credentials

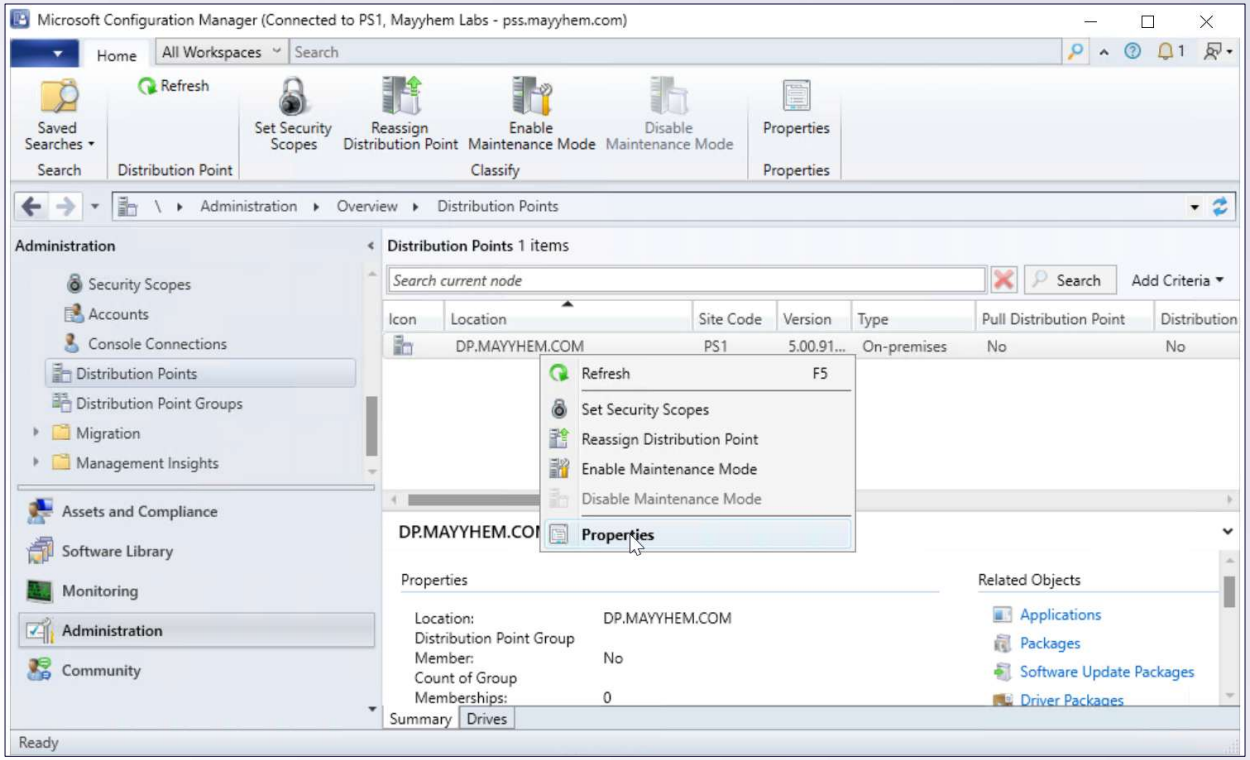


https://learn.microsoft.com/en-us/intune/configmgr/core/plan-design/hierarchy/accounts#actions-that-require-the-network-access-account

Configure a Strong PXE Boot Password

PREVENT-6

1. Open the Configuration Manager Console
2. Navigate to Administration > Distribution Points
3. Right click on each distribution point and select “Properties”

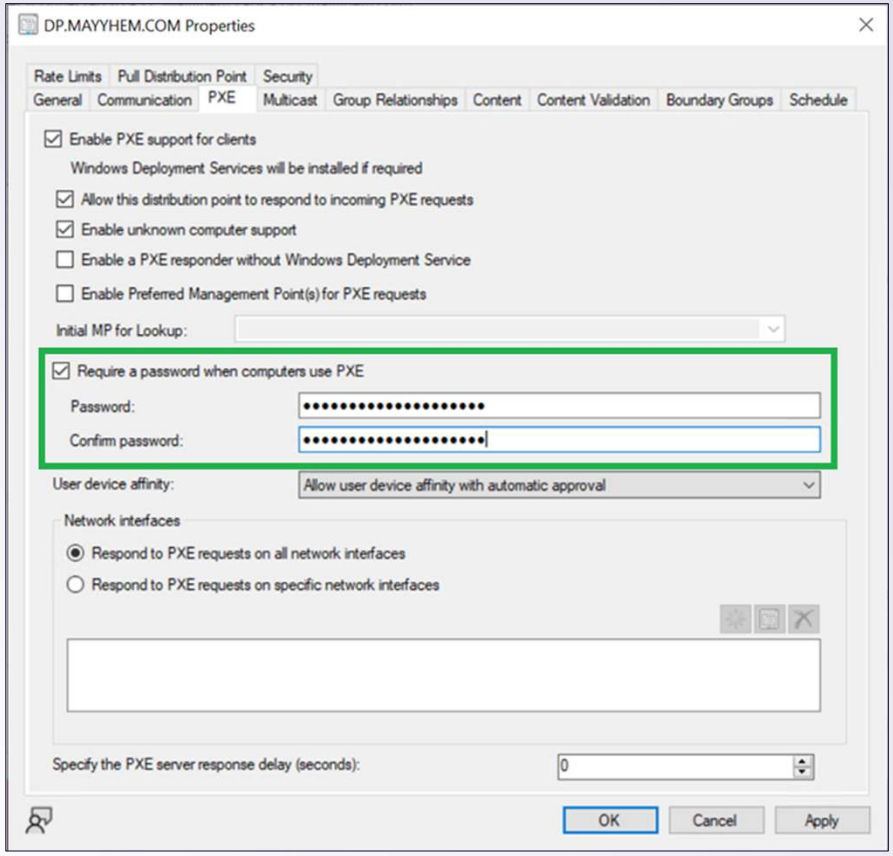


Configure a Strong PXE Boot Password

PREVENT-6

4. Click on the “PXE” tab
5. Check the box next to “Require a password when computers use PXE”
6. Enter a strong passphrase
7. Click “Apply”, then “OK”

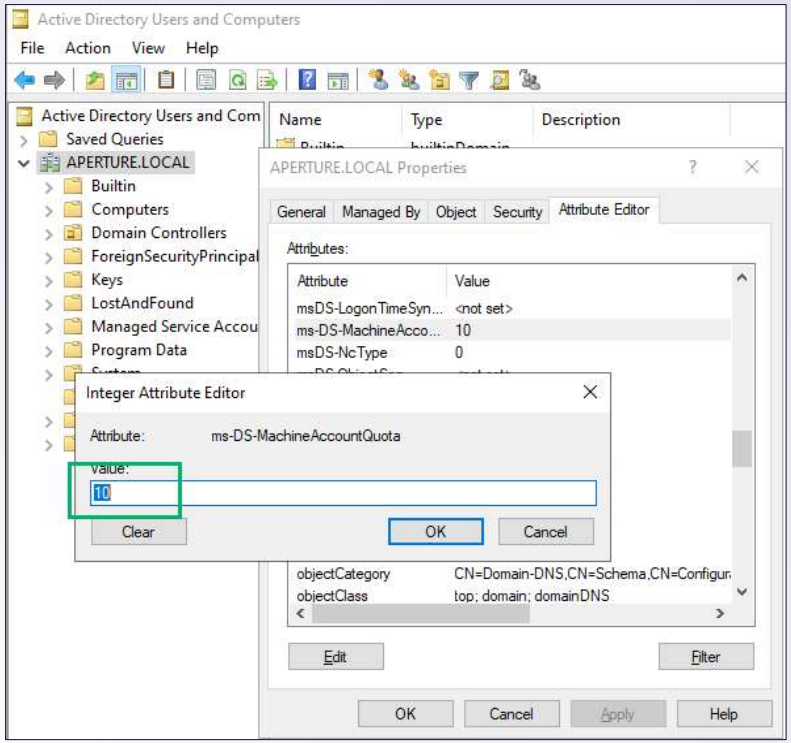
If an **uncrackable** password is not set, task sequences that may contain creds (and the distribution point’s cert, if using PKI) can still be dumped remotely



Restrict Permission to Join Machines to AD

PREVENT-16: Machine Account Quota

1. Open ADUC on a DC
2. Right click the domain object and select "Properties"
3. Select the "Attribute Editor" tab
4. Find the "ms-DS-MachineAccountQuota" attribute
5. Set the attribute to 0



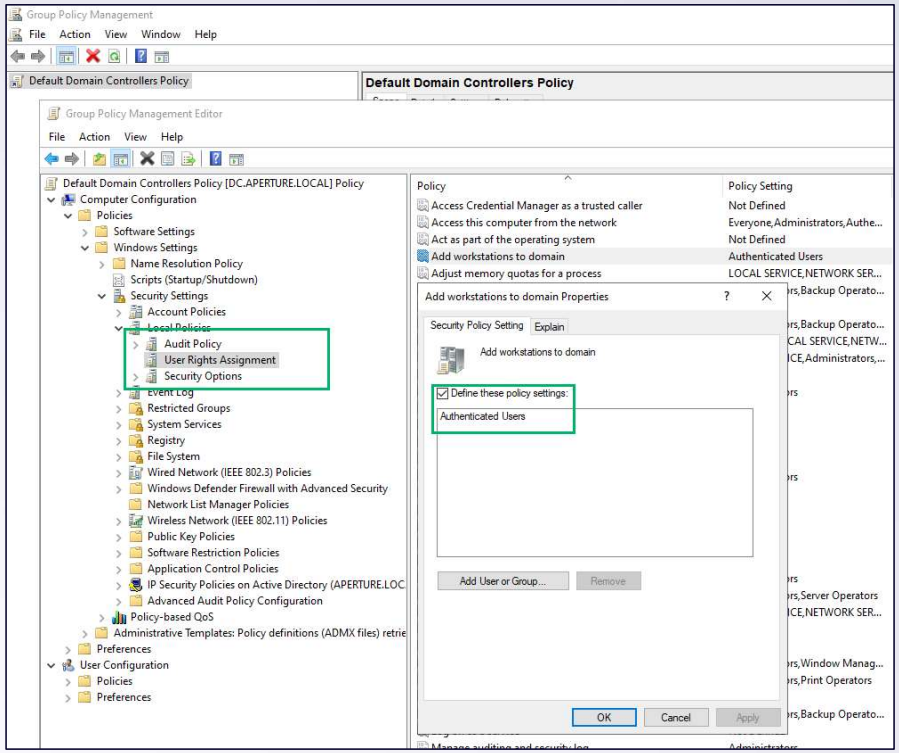
https://learn.microsoft.com/en-us/windows/win32/adschema/a-ms-ds-machineaccountquota

Restrict Permission to Join Machines to AD

PREVENT-16: User Rights Assignment

1. Open Group Policy Management
2. Right click “Default Domain Controllers Policy” and select “Edit”
3. Navigate to "User Rights Assignment“
4. Right click "Add workstations to domain" and select "Edit"
5. Remove "Authenticated Users“, then click “Apply” and “OK”

Attackers can still impersonate a client device to fetch secret policies from a management point with local admin on any domain-joined computer



https://learn.microsoft.com/en-us/previous-versions/windows/it-pro/windows-10/security/threat-protection/security-policy-settings/add-workstations-to-domain

Wrapping It Up

What should I look at next?

- Misconfiguration Manager repo →
  - **Slides for this talk**
  - MisconfigurationManager.ps1 PowerShell script
  - DETECT and CANARY techniques
  - RESOURCES.md
- New NTLM relay edges in BloodHound
- Josh Prager's detection guidance SO-CON talk, "**Detecting Configuration Manager Attack Paths**"
- #sccm channel in BloodHound Slack → (https://ghst.ly/BHSlack)

Thank you!

Any questions?

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