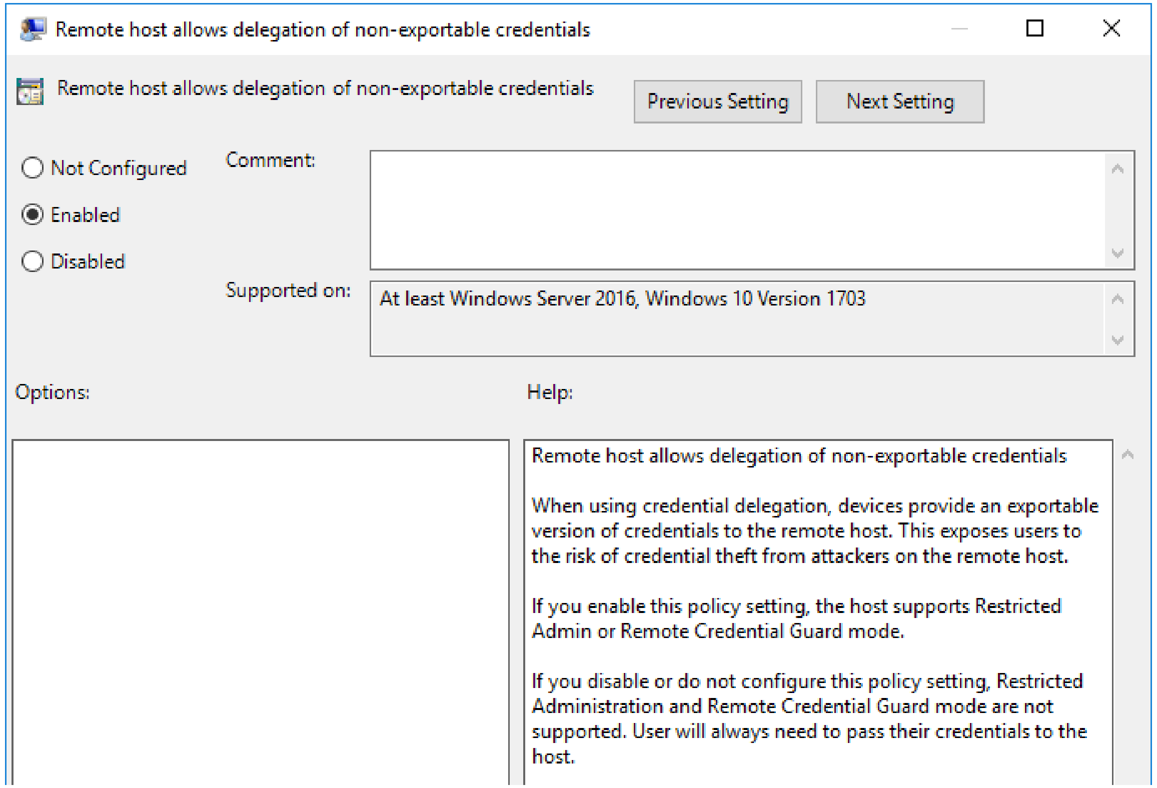
Securing Windows Active Directory

Additional Content

Securing RDP Connections

RDP Hosts

- Group Policy
  - Computer Configuration\Administrative Templates\System\Credentials Delegation - **Remote host allows delegation of nonexportable credentials**: Enabled
- Registry
  - HKLM\SYSTEM\CurrentControlSet\Control\Lsa – DisableRestrictedAdmin (DWORD): 0



Remote host allows delegation of non-exportable credentials

Remote host allows delegation of non-exportable credentials

○ Not Configured
● Enabled
○ Disabled

Comment:

Supported on: At least Windows Server 2016, Windows 10 Version 1703

Remote host allows delegation of non-exportable credentials

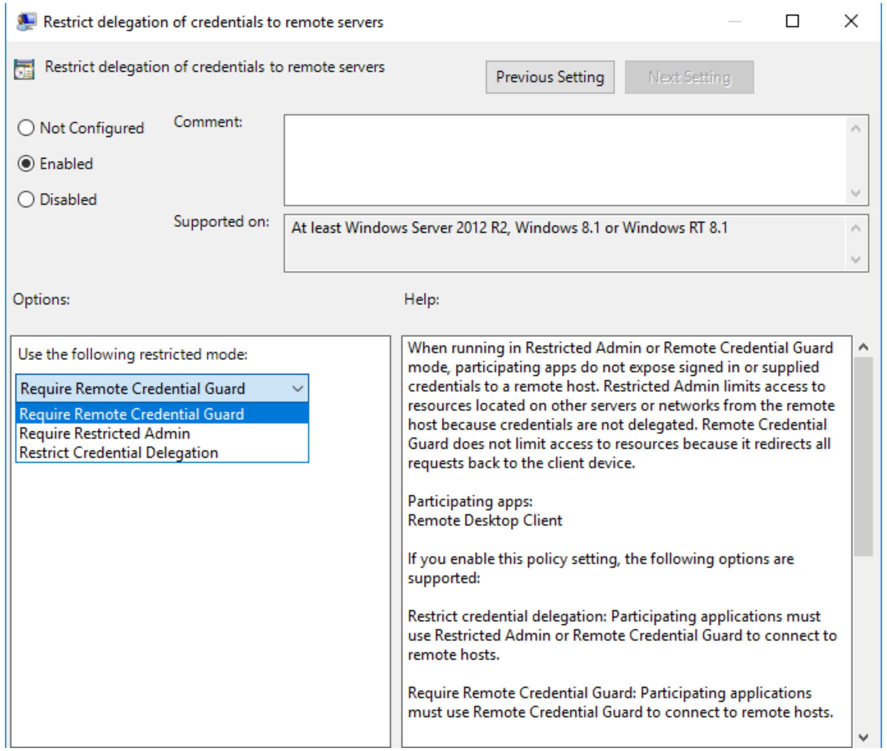
When using credential delegation, devices provide an exportable version of credentials to the remote host. This exposes users to the risk of credential theft from attackers on the remote host.

If you enable this policy setting, the host supports Restricted Admin or Remote Credential Guard mode.

If you disable or do not configure this policy setting, Restricted Administration and Remote Credential Guard mode are not supported. User will always need to pass their credentials to the host.

RDP Clients

- Command
  - mstsc.exe /remoteGuard
  - mstsc.exe / restrictedAdmin
- Group Policy
  - Computer Configuration\Administrative Templates\System\Credentials Delegation - **Restrict delegation of credentials to remote servers**:
    - Require Remote Credential Guard
    - Require Restricted Admin
    - Restrict Credential Delegation (Remote Credential Guard is preferred, but it uses Restricted Admin mode (if supported) when Remote Credential Guard can't be used)
- Registry
  - HKLM\Software\Policies\Microsoft\Windows\CredentialsDelegation –
    - RestrictedRemoteAdministration (DWORD): 1
    - RestrictedRemoteAdministrationType (DWORD)
      - 1 – Require Restricted Admin
      - 2 – Require Remote Credential Guard
      - 3 - Restrict Credential Delegation



Restrict delegation of credentials to remote servers

Restrict delegation of credentials to remote servers

○ Not Configured
● Enabled
○ Disabled

Comment:

Supported on: At least Windows Server 2012 R2, Windows 8.1 or Windows RT 8.1

Use the following restricted mode:

Require Remote Credential Guard

Require Remote Credential Guard
Require Restricted Admin
Restrict Credential Delegation

When running in Restricted Admin or Remote Credential Guard mode, participating apps do not expose signed in or supplied credentials to a remote host. Restricted Admin limits access to resources located on other servers or networks from the remote host because credentials are not delegated. Remote Credential Guard does not limit access to resources because it redirects all requests back to the client device.

Participating apps:
Remote Desktop Client

If you enable this policy setting, the following options are supported:

Restrict credential delegation: Participating applications must use Restricted Admin or Remote Credential Guard to connect to remote hosts.

Require Remote Credential Guard: Participating applications must use Remote Credential Guard to connect to remote hosts.

Comparing Connection Options

	Remote Desktop session	**w/ Remote Credential Guard**	**w/ Restricted Admin mode**
Credentials are sent to and stored on the remote host	Yes	No	No
Attacker can use credentials after disconnection	Yes	No	No
Connection to other resources from session host	Yes	During the remote session, you can connect to other systems using SSO	The Remote Desktop session connects to other resources as the ***remote host's identity***
Attacker can act on behalf of the user	Yes	An attacker can act on behalf of the user only when the session is ongoing	An attacker can't act on behalf of the user and any attack is local to the server

Remote Desktop connections and helpdesk support scenarios

- Remote Credential Guard not recommended for helpdesk scenarios.
- If an RDP session is initiated to an already compromised client, the attacker could use that open channel to create sessions on the user's behalf.
- For helpdesk support scenarios, RDP connections should only be initiated using the /RestrictedAdmin switch.

Anonymous Access of AD

Get the value of the dSHeuristics attribute.

- By default, anonymous LDAP operations to Active Directory, other than rootDSE searches and binds, are not permitted.
- If the dSHeuristics attribute is set to 0000002, anonymous clients can perform any operation against domain controllers that is permitted by the access control list (ACL).
- To get this value, run the following PowerShell command:

```
Get-ADObject -Identity "CN=Directory Service,CN=Windows
NT,CN=Services,CN=Configuration,DC=Litware,DC=com" -Properties dSHeuristics |
Select-Object dSHeuristics
```

Is Anonymous Logon a member of Pre-Windows 2000 Compatible Access?

- Members of the Pre-Windows 2000 Compatible Access group have Read access for all users and groups in the domain.
- This group is provided for backward compatibility for computers running Windows NT 4.0 and earlier.
- If the output of this command returns the DistinguishedName of the Pre-Windows 2000 Compatible Access group, Anonymous Logon is a member of the Pre-Windows 2000 Compatible Access security group

```
Get-ADObject -LDAPFilter '(&(objectSid=S-1-5-7)(ObjectClass=foreignSecurityPrincipal))' -Properties memberOf | Select-Object -ExpandProperty memberOf
```

DC Promo Option	Default members
Clean installation of Windows 2000	Everyone
Clean installation of Windows 2000 with “Permissions compatible with pre-Windows 2000 servers	Anonymous Logon, Everyone
Clean installation of Windows Server 2003 (and later)	Authenticated Users
Clean installation of Windows Server 2003 with “Permissions compatible with pre-Windows 2000 servers”	Anonymous Logon, Authenticated Users, Everyone

Does Everyone include Anonymous Logon?

- By Default, the Everyone SID is removed from the token created for anonymous connections.
  - Therefore, anonymous users can only access those resources for which the anonymous user has been explicitly given permission.
- If **EveryoneIncludesAnonymous** is set to “1”, anonymous users are able to access any resource for which the Everyone group has been given permissions.
  - GPO setting: **Network access: Let Everyone permissions apply to anonymous users**
- Query each DC to see if the registry value HKLM\SYSTEM\CurrentControlSet\Control\Lsa – EveryoneIncludesAnonymous is set to “1”

Remote Enumeration of SAM

Remote Enumeration of SAM

- **SAMRPC** protocol used to query a machine on a network:
  - Privileged accounts such as local or domain administrators
  - Enumerate groups and group memberships from the local SAM and AD.
- Can provide context and serve as a starting point for an attack.
- With Windows 10, Server 2016, SAM can do an access check against remote calls.
- Controlled by :
  - Network access: Restrict clients allowed to make remote calls to SAM
  - HKEY\System\CurrentControlSet\Control – LsaRestrictRemoteSam (SZ)
- By default, on domain members, only built-in Administrators are allowed SAM-R.

LDAP server signing requirements

LDAP server signing requirements

- Unsigned network traffic is susceptible to man-in-the-middle attacks
  - An intruder can capture packets between server and client and modify them before forwarding them to the client.

LDAP server signing requirements

- Domain controller: LDAP server signing requirements (LDAPServerIntegrity)
    - None (1)
        - Data signing is not required in order to bind with the server.
        - If the client requests data signing, the server supports it.
    - Require Signing (2)
        - LDAP simple binds not using TLS/SSL are rejected
        - LDAP data-signing option must be negotiated unless TLS/SSL is in use.
- Default: This policy is not defined, which has the same effect as None.

- Network security: LDAP client signing requirements (LDAPClientIntegrity)
    - None (0)
    - Negotiate signing (1)
    - Require signature (2)
- Default: Negotiate signing.

- This setting doesn't have any impact on LDAP simple bind through SSL (LDAP TCP/636).

LDAP server channel binding token

LDAP server channel binding token requirements

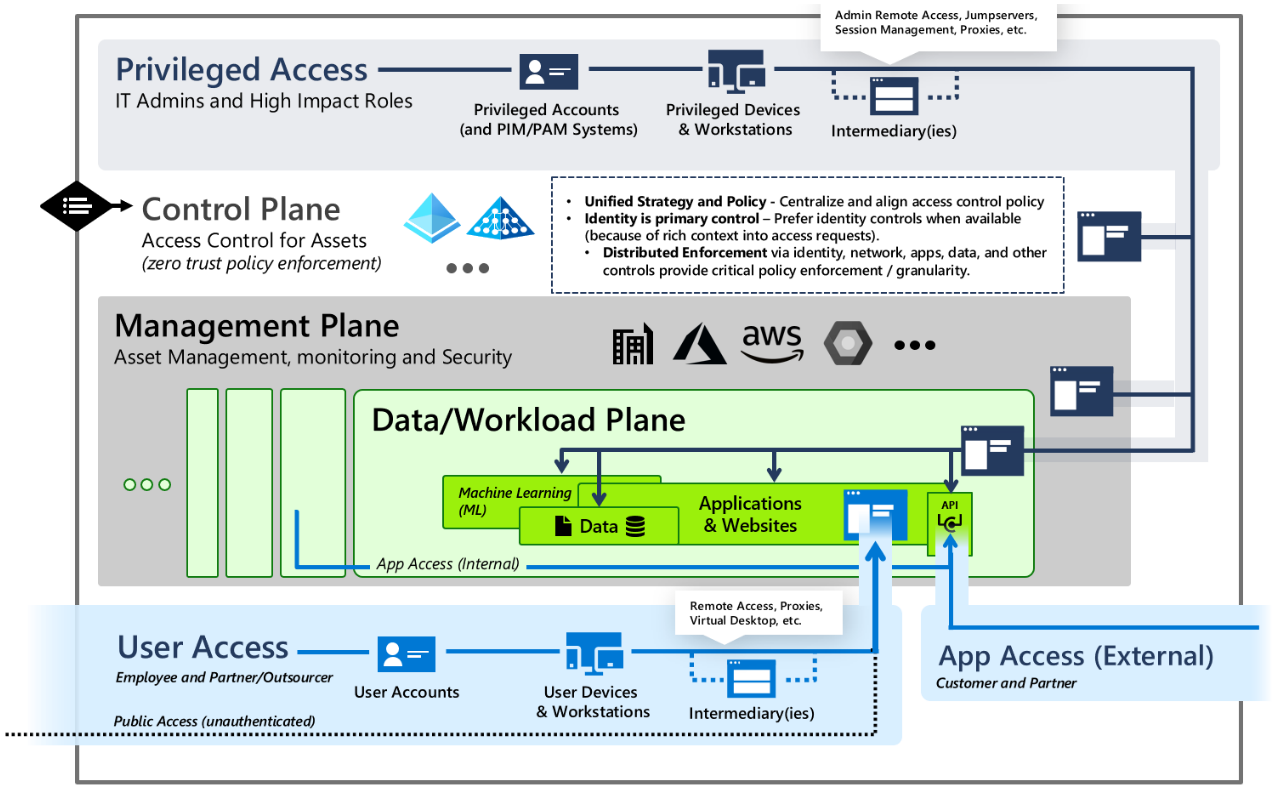
- Channel binding for LDAP binds the TLS tunnel and LDAP application layers together.
- Channel binding tokens help make LDAP authentication over SSL/TLS more secure against man-in-the-middle attacks.

- Domain controller: LDAP server channel binding token requirements (LdapEnforceChannelBinding)
  - Never (0)
  - When Supported (1)
  - Always (2)
- Default: This policy is not defined, which has the same effect as When Supported.

Enterprise Access Model

Enterprise Access Model

- Incorporates on-premises tiering with cloud services
- Tier 0 expanded to control plane – Access Control
- Tier 1 split
  - Management plane – IT management
  - Data/Workload plane – per-workload management
- Tier 2 split
  - User access – internal users + collaboration (B2B / B2C)
  - App access – API access


Admin Remote Access, Jumpservers, Session Management, Proxies, etc.
Privileged Access
IT Admins and High Impact Roles
Privileged Accounts (and PIM/PAM Systems)
Privileged Devices & Workstations
Intermediary(ies)
Control Plane
Access Control for Assets
(zero trust policy enforcement)
Management Plane
Asset Management, monitoring and Security
aws
Data/Workload Plane
Machine Learning (ML)
Data
Applications & Websites
API
App Access (Internal)
Remote Access, Proxies, Virtual Desktop, etc.
User Access
Employee and Partner/Outsourcer
User Accounts
User Devices & Workstations
Intermediary(ies)
Public Access (unauthenticated)
App Access (External)
Customer and Partner

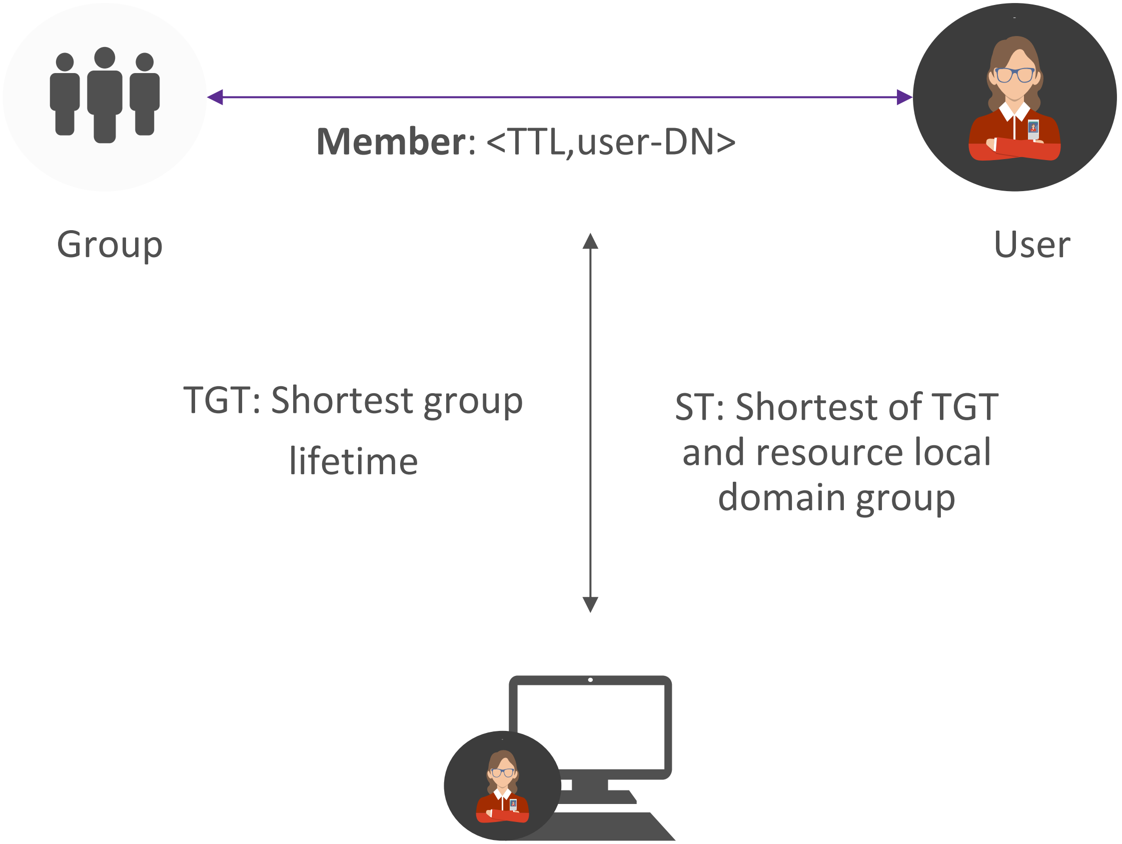
- **Unified Strategy and Policy** - Centralize and align access control policy
- **Identity is primary control** – Prefer identity controls when available (because of rich context into access requests).
  - **Distributed Enforcement** via identity, network, apps, data, and other controls provide critical policy enforcement / granularity.

Privileged Access Management Optional Feature

Windows Server 2016 FFL

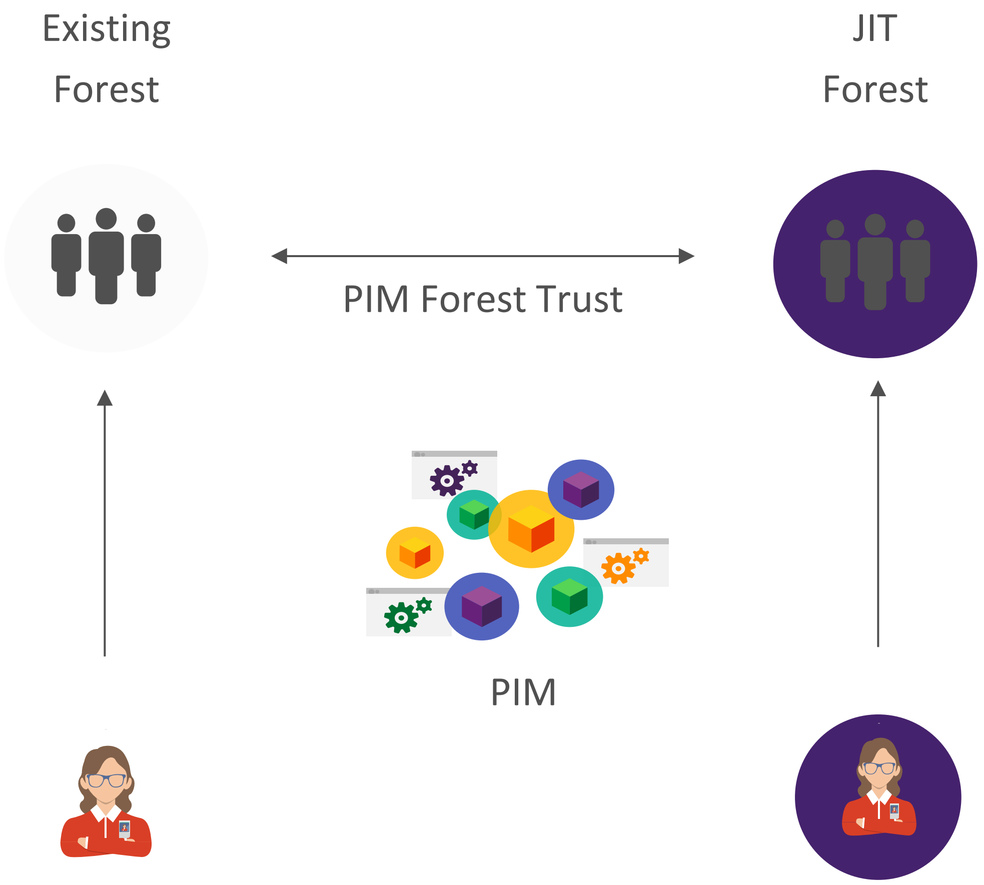
Time-limited Group Memberships

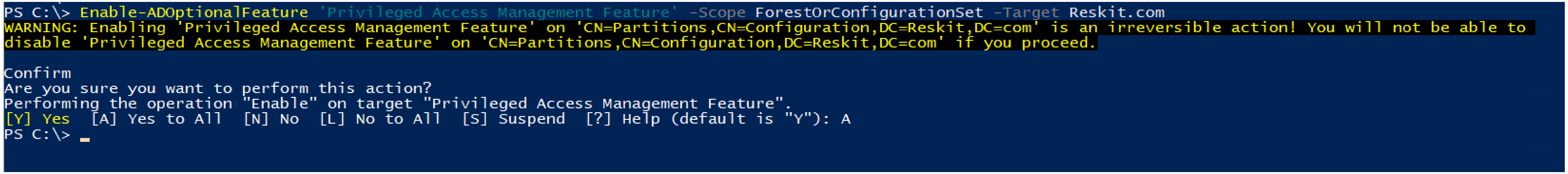
- Users can be added to a security group with time-to-live (TTL)
  - When the TTL expires, the user’s membership in that group disappears
- Kerberos token lifetime will be determined by TTL of the user’s memberships
  - TGT based on shortest group membership
  - Service ticket based on TGT and resource local domain group membership


Member: <TTL,user-DN>
Group
User
TGT: Shortest group lifetime
ST: Shortest of TGT and resource local domain group

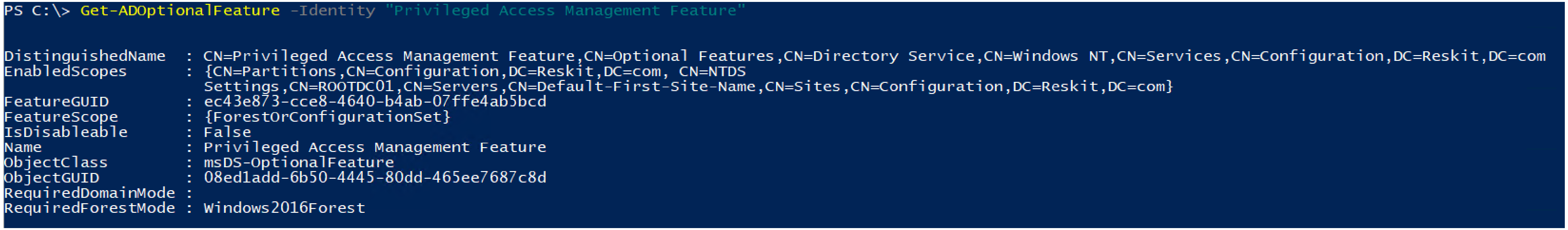
Just In Time Forest

- Create new Server 2016 forest
  - No need to change existing forest
  - Create new **PIM** trust to existing forest
- Add shadow principals in new forest
  - Shadow group which is new object class created in config NC. Unlike security group, the security identifier (SID) with a domain in another forest
  - Add shadow admin user
- Remove admins from existing groups

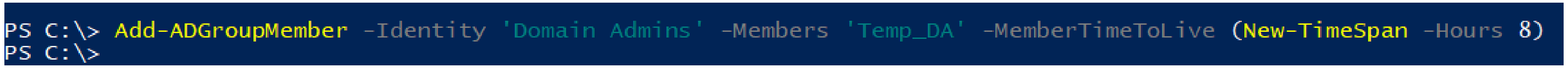




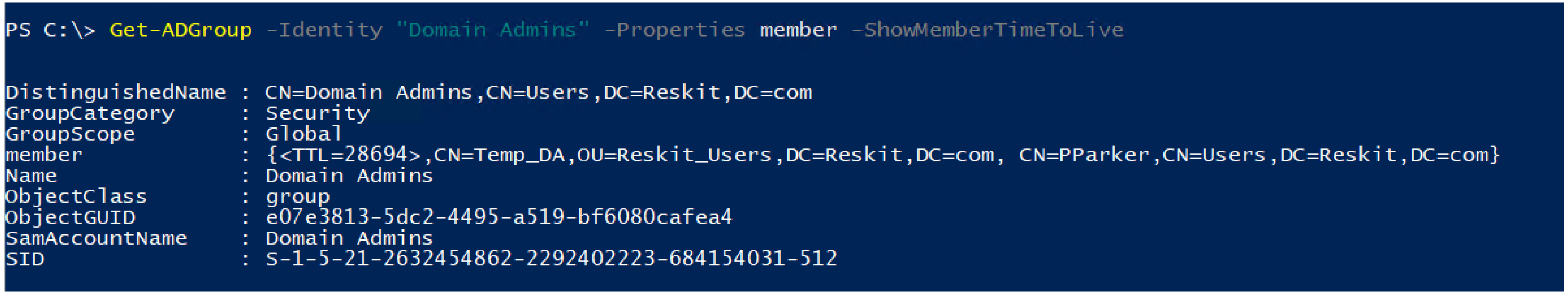
```
PS C:\> Enable-ADOptionalFeature 'Privileged Access Management Feature' -Scope ForestOrConfigurationSet -Target Reskit.com
WARNING: Enabling 'Privileged Access Management Feature' on 'CN=Partitions,CN=Configuration,DC=Reskit,DC=com' is an irreversible action! You will not be able to
disable 'Privileged Access Management Feature' on 'CN=Partitions,CN=Configuration,DC=Reskit,DC=com' if you proceed.

Confirm
Are you sure you want to perform this action?
Performing the operation "Enable" on target "Privileged Access Management Feature".
[Y] Yes  [A] Yes to All  [N] No  [L] No to All  [S] Suspend  [?] Help (default is "Y"): A
PS C:\> _
```



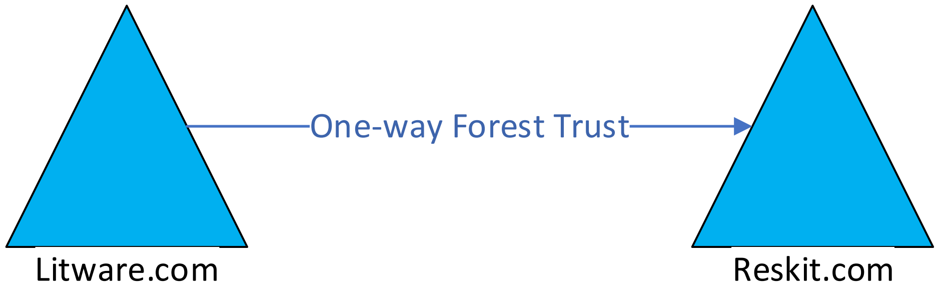
```
PS C:\> Get-ADOptionalFeature -Identity "Privileged Access Management Feature"


DistinguishedName  : CN=Privileged Access Management Feature,CN=Optional Features,CN=Directory Service,CN=Windows NT,CN=Services,CN=Configuration,DC=Reskit,DC=com
EnabledScopes      : {CN=Partitions,CN=Configuration,DC=Reskit,DC=com, CN=NTDS
                     Settings,CN=ROOTDC01,CN=Servers,CN=Default-First-Site-Name,CN=Sites,CN=Configuration,DC=Reskit,DC=com}
FeatureGUID        : ec43e873-cce8-4640-b4ab-07ffe4ab5bcd
FeatureScope       : {ForestOrConfigurationSet}
IsDisableable      : False
Name               : Privileged Access Management Feature
ObjectClass        : msDS-OptionalFeature
ObjectGUID         : 08ed1add-6b50-4445-80dd-465ee7687c8d
RequiredDomainMode :
RequiredForestMode : Windows2016Forest
```

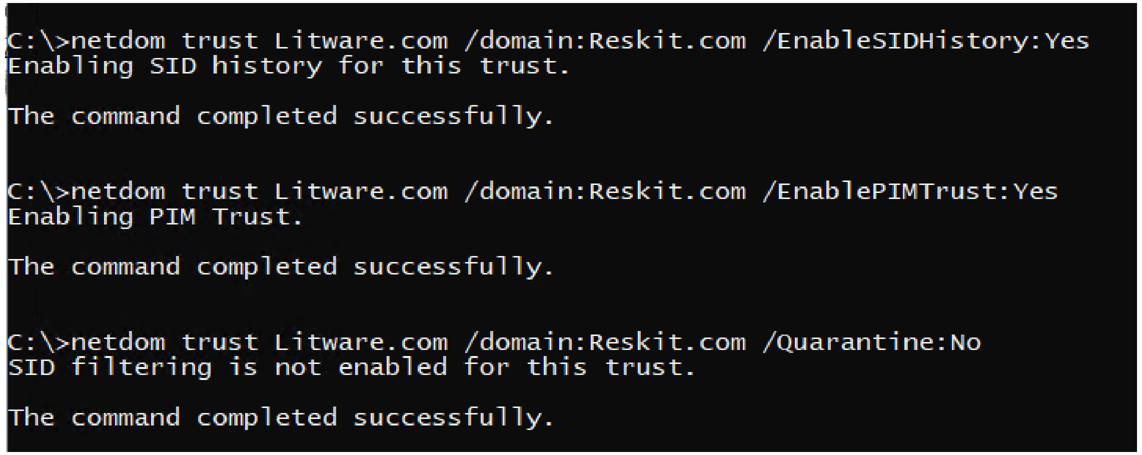


```
PS C:\> Add-ADGroupMember -Identity 'Domain Admins' -Members 'Temp_DA' -MemberTimeToLive (New-TimeSpan -Hours 8)
PS C:\>
```



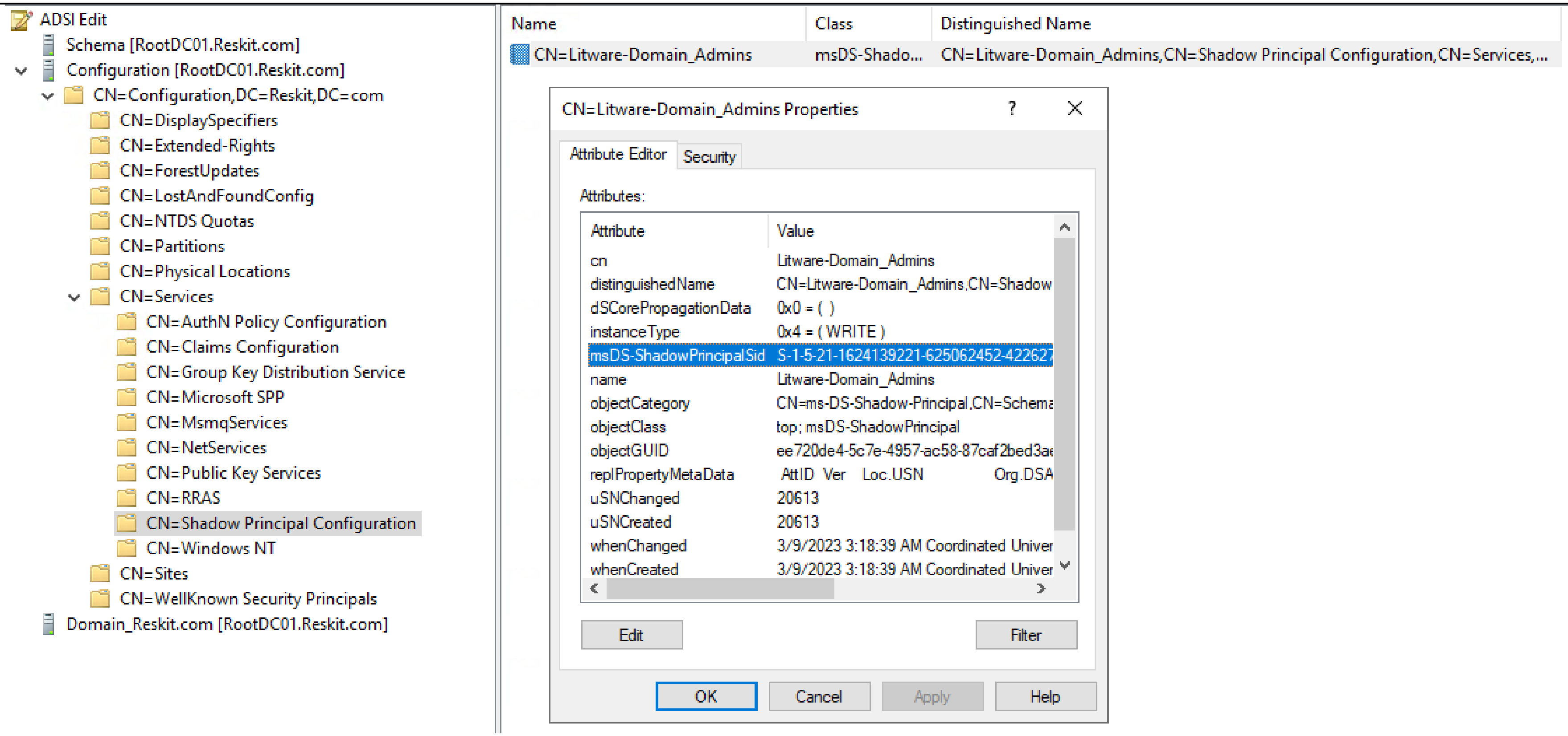
```
PS C:\> Get-ADGroup -Identity "Domain Admins" -Properties member -ShowMemberTimeToLive


DistinguishedName : CN=Domain Admins,CN=Users,DC=Reskit,DC=com
GroupCategory     : Security
GroupScope        : Global
member            : {<TTL=28694>,CN=Temp_DA,OU=Reskit_Users,DC=Reskit,DC=com, CN=PParker,CN=Users,DC=Reskit,DC=com}
Name              : Domain Admins
ObjectClass       : group
ObjectGUID        : e07e3813-5dc2-4495-a519-bf6080cafea4
SamAccountName    : Domain Admins
SID               : S-1-5-21-2632454862-2292402223-684154031-512
```





```
C:\>netdom trust Litware.com /domain:Reskit.com /EnableSIDHistory:Yes
Enabling SID history for this trust.

The command completed successfully.


C:\>netdom trust Litware.com /domain:Reskit.com /EnablePIMTrust:Yes
Enabling PIM Trust.

The command completed successfully.


C:\>netdom trust Litware.com /domain:Reskit.com /Quarantine:No
SID filtering is not enabled for this trust.

The command completed successfully.
```

```
$LitwareDomainAdminsSID = (Get-ADGroup -Identity "Domain Admins" -Properties ObjectSID -Server
RootDC02.Litware.com).ObjectSID.Value


New-ADObject -Type "msDS-ShadowPrincipal" `
             -Name "Litware-Domain_Admins" `
             -Path "CN=Shadow Principal Configuration,CN=Services,CN=Configuration,DC=Reskit,DC=com" `
             -OtherAttributes @{'msDS-ShadowPrincipalSid'= $LitwareDomainAdminsSID}
```



ADSI Edit
- Schema [RootDC01.Reskit.com]
- Configuration [RootDC01.Reskit.com]
  - CN=Configuration,DC=Reskit,DC=com
    - CN=DisplaySpecifiers
    - CN=Extended-Rights
    - CN=ForestUpdates
    - CN=LostAndFoundConfig
    - CN=NTDS Quotas
    - CN=Partitions
    - CN=Physical Locations
    - CN=Services
      - CN=AuthN Policy Configuration
      - CN=Claims Configuration
      - CN=Group Key Distribution Service
      - CN=Microsoft SPP
      - CN=MsmqServices
      - CN=NetServices
      - CN=Public Key Services
      - CN=RRAS
      - CN=Shadow Principal Configuration
      - CN=Windows NT
    - CN=Sites
    - CN=WellKnown Security Principals
- Domain_Reskit.com [RootDC01.Reskit.com]

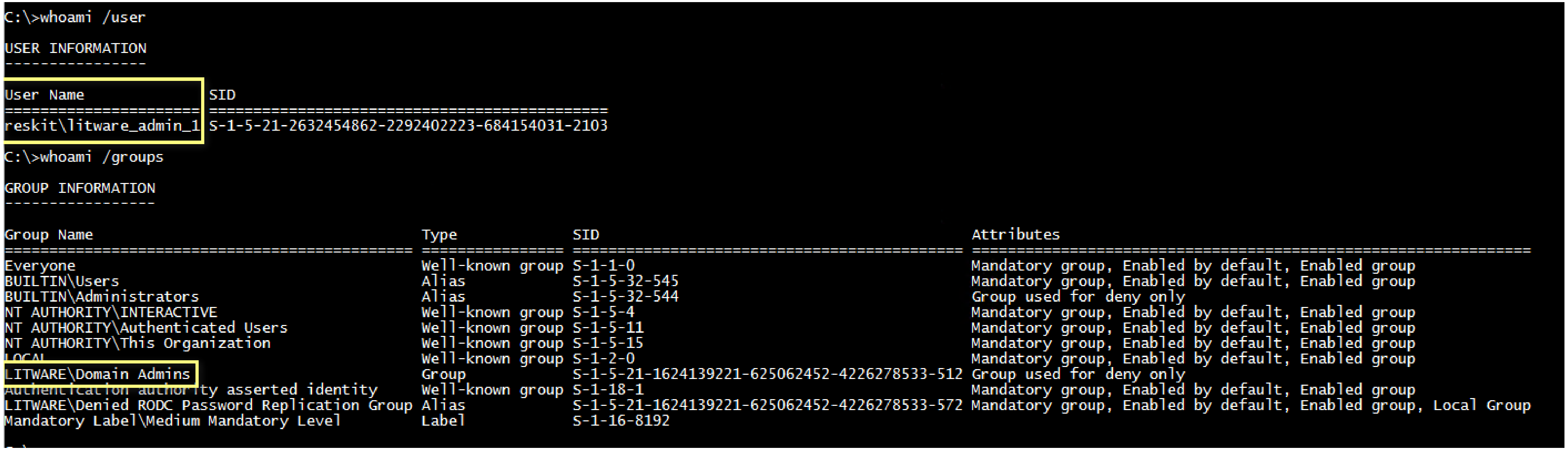
Name	Class	Distinguished Name
CN=Litware-Domain_Admins	msDS-Shado...	CN=Litware-Domain_Admins,CN=Shadow Principal Configuration,CN=Services,...

CN=Litware-Domain_Admins Properties

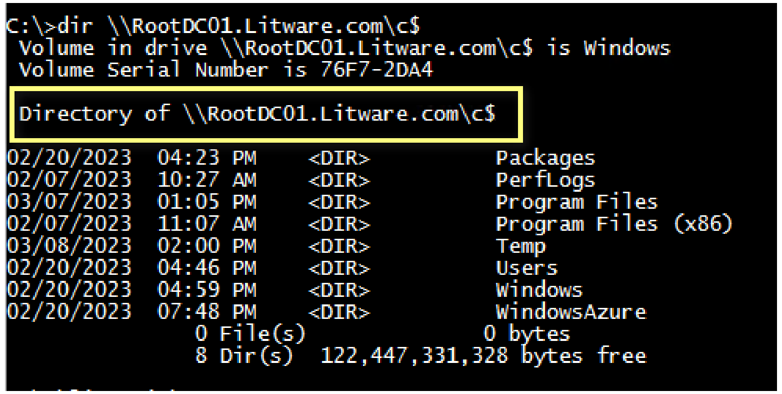
Attributes:

Attribute	Value
cn	Litware-Domain_Admins
distinguishedName	CN=Litware-Domain_Admins,CN=Shadow
dSCorePropagationData	0x0 = ( )
instanceType	0x4 = (WRITE)
msDS-ShadowPrincipalSid	S-1-5-21-1624139221-625062452-422627
name	Litware-Domain_Admins
objectCategory	CN=ms-DS-Shadow-Principal,CN=Schema
objectClass	top; msDS-ShadowPrincipal
objectGUID	ee720de4-5c7e-4957-ac58-87caf2bed3ae
replPropertyMetaData	AttID Ver Loc.USN Org.DSA
uSNChanged	20613
uSNCreated	20613
whenChanged	3/9/2023 3:18:39 AM Coordinated Univer
whenCreated	3/9/2023 3:18:39 AM Coordinated Univer

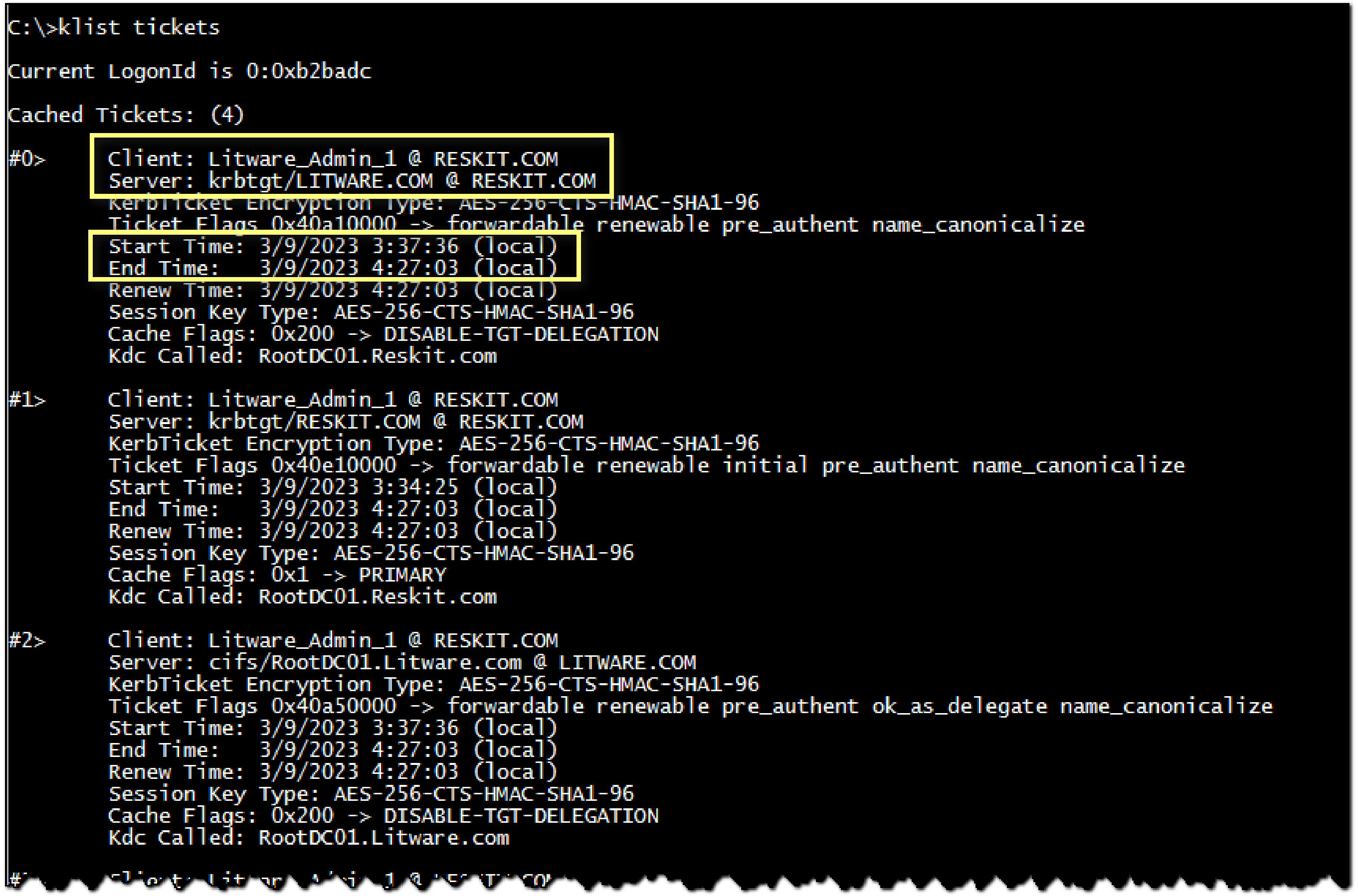
```
Set-ADObject -Identity "CN=Litware-Domain_Admins,CN=Shadow Principal
Configuration,CN=Services,CN=Configuration,DC=Reskit,DC=com" `

             -Add @{'member'="<TTL=3600,CN=Litware_Admin_1,OU=Reskit-Admins,DC=Reskit,DC=com>"}
```



```
C:\>whoami /user

USER INFORMATION
----------------

User Name              SID
====================== =============================================
reskit\litware_admin_1 S-1-5-21-2632454862-2292402223-684154031-2103

C:\>whoami /groups

GROUP INFORMATION
-----------------

Group Name                                     Type             SID                                           Attributes
============================================== ================ ============================================= ===============================================================
Everyone                                       Well-known group S-1-1-0                                       Mandatory group, Enabled by default, Enabled group
BUILTIN\Users                                  Alias            S-1-5-32-545                                  Mandatory group, Enabled by default, Enabled group
BUILTIN\Administrators                         Alias            S-1-5-32-544                                  Group used for deny only
NT AUTHORITY\INTERACTIVE                       Well-known group S-1-5-4                                       Mandatory group, Enabled by default, Enabled group
NT AUTHORITY\Authenticated Users               Well-known group S-1-5-11                                      Mandatory group, Enabled by default, Enabled group
NT AUTHORITY\This Organization                 Well-known group S-1-5-15                                      Mandatory group, Enabled by default, Enabled group
LOCAL                                          Well-known group S-1-2-0                                       Mandatory group, Enabled by default, Enabled group
LITWARE\Domain Admins                          Group            S-1-5-21-1624139221-625062452-4226278533-512 Group used for deny only
Authentication authority asserted identity     Well-known group S-1-18-1                                      Mandatory group, Enabled by default, Enabled group
LITWARE\Denied RODC Password Replication Group Alias            S-1-5-21-1624139221-625062452-4226278533-572 Mandatory group, Enabled by default, Enabled group, Local Group
Mandatory Label\Medium Mandatory Level         Label            S-1-16-8192
```



```
C:\>dir \\RootDC01.Litware.com\c$
 Volume in drive \\RootDC01.Litware.com\c$ is Windows
 Volume Serial Number is 76F7-2DA4

 Directory of \\RootDC01.Litware.com\c$

02/20/2023  04:23 PM    <DIR>          Packages
02/07/2023  10:27 AM    <DIR>          PerfLogs
03/07/2023  01:05 PM    <DIR>          Program Files
02/07/2023  11:07 AM    <DIR>          Program Files (x86)
03/08/2023  02:00 PM    <DIR>          Temp
02/20/2023  04:46 PM    <DIR>          Users
02/20/2023  04:59 PM    <DIR>          Windows
02/20/2023  07:48 PM    <DIR>          WindowsAzure
               0 File(s)              0 bytes
               8 Dir(s)  122,447,331,328 bytes free
```



```
C:\>klist tickets

Current LogonId is 0:0xb2badc

Cached Tickets: (4)

#0>     Client: Litware_Admin_1 @ RESKIT.COM
        Server: krbtgt/LITWARE.COM @ RESKIT.COM
        KerbTicket Encryption Type: AES-256-CTS-HMAC-SHA1-96
        Ticket Flags 0x40a10000 -> forwardable renewable pre_authent name_canonicalize
        Start Time: 3/9/2023 3:37:36 (local)
        End Time:   3/9/2023 4:27:03 (local)
        Renew Time: 3/9/2023 4:27:03 (local)
        Session Key Type: AES-256-CTS-HMAC-SHA1-96
        Cache Flags: 0x200 -> DISABLE-TGT-DELEGATION
        Kdc Called: RootDC01.Reskit.com

#1>     Client: Litware_Admin_1 @ RESKIT.COM
        Server: krbtgt/RESKIT.COM @ RESKIT.COM
        KerbTicket Encryption Type: AES-256-CTS-HMAC-SHA1-96
        Ticket Flags 0x40e10000 -> forwardable renewable initial pre_authent name_canonicalize
        Start Time: 3/9/2023 3:34:25 (local)
        End Time:   3/9/2023 4:27:03 (local)
        Renew Time: 3/9/2023 4:27:03 (local)
        Session Key Type: AES-256-CTS-HMAC-SHA1-96
        Cache Flags: 0x1 -> PRIMARY
        Kdc Called: RootDC01.Reskit.com

#2>     Client: Litware_Admin_1 @ RESKIT.COM
        Server: cifs/RootDC01.Litware.com @ LITWARE.COM
        KerbTicket Encryption Type: AES-256-CTS-HMAC-SHA1-96
        Ticket Flags 0x40a50000 -> forwardable renewable pre_authent ok_as_delegate name_canonicalize
        Start Time: 3/9/2023 3:37:36 (local)
        End Time:   3/9/2023 4:27:03 (local)
        Renew Time: 3/9/2023 4:27:03 (local)
        Session Key Type: AES-256-CTS-HMAC-SHA1-96
        Cache Flags: 0x200 -> DISABLE-TGT-DELEGATION
        Kdc Called: RootDC01.Litware.com

#3>     Client: Litware_Admin_1 @ RESKIT.COM
```

Windows Hello for Business

Windows Hello for Business

- User Friendly
  - Passwordless biometrics or PIN
  - SSO for on-premises and the cloud

- Enterprise Grade
  - Asymmetric key pair authentication model
  - Strong two-factor authentication
  - Multiple accounts per device
  - Deploy in the cloud, hybrid, or on-prem

Windows Hello for Business

- Replace Passwords with Keys
  - Unlocked through a user gesture of biometrics or PIN
  - FIDO2 Certified
  - Can leverage enterprise PKI for certificates

- Private Key is Never Shared
  - Keys are always generated in hardware by Trusted Platform Module [TPM]
  - Hardware bound keys are attested by Trusted Computing Group Protocols

Windows Hello for Business Adoption

10 Million

Monthly active Windows Hello for Business users

50K+

Enterprises have deployed Windows Hello for Business

>450K

Largest single enterprise deployment

Statistics, June 2022

Windows Hello for Business Deployment

Cloud

Key Trust

Hybrid

Cert Trust

Key Trust

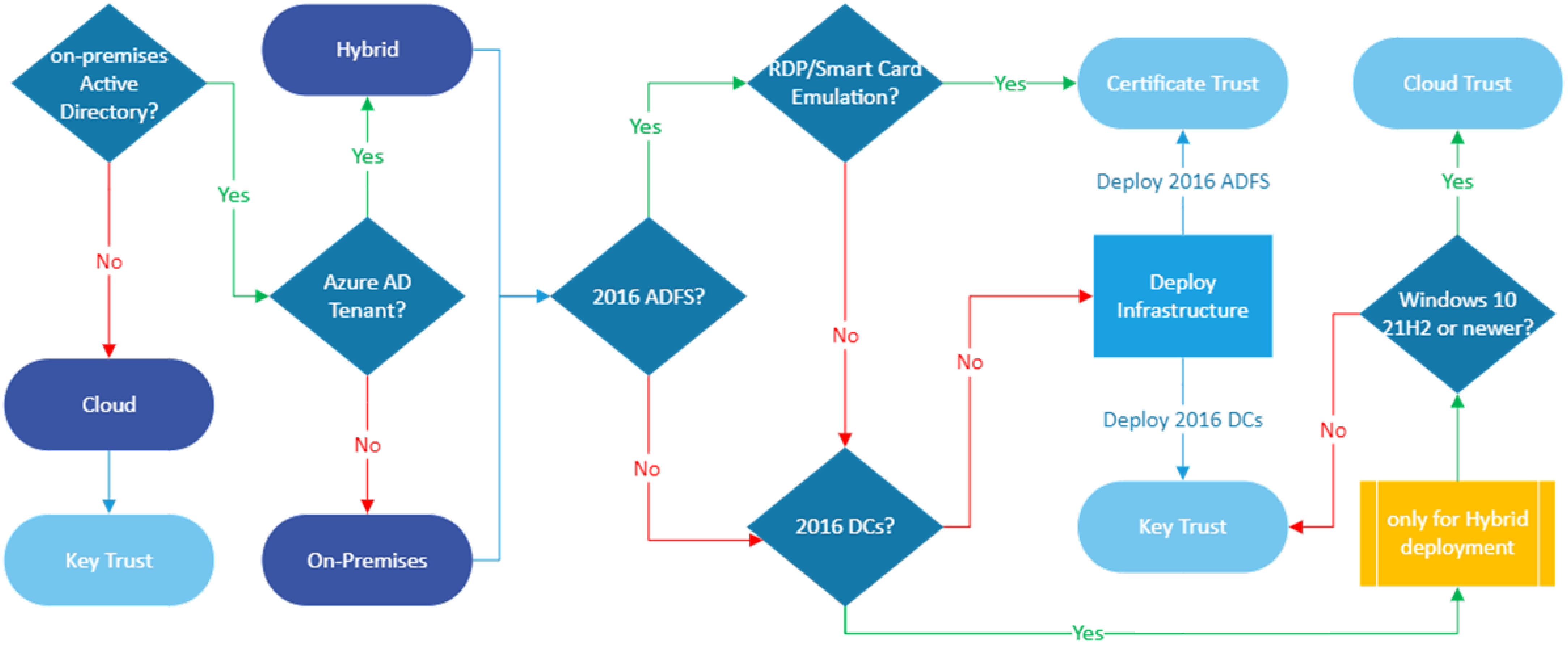
Cloud Trust
(Preview)

On-Premises

Cert Trust

Key Trust

WH4B - Choosing a Deployment Model



Key, Certificate and Cloud Trust: Security

Key Trust

- Authenticates using raw key to Azure AD
- Authenticates using raw key to Active Directory
- Does not require issuance of end user certificate from PKI
- Requires 2016 or later Domain Controllers

Cert Trust

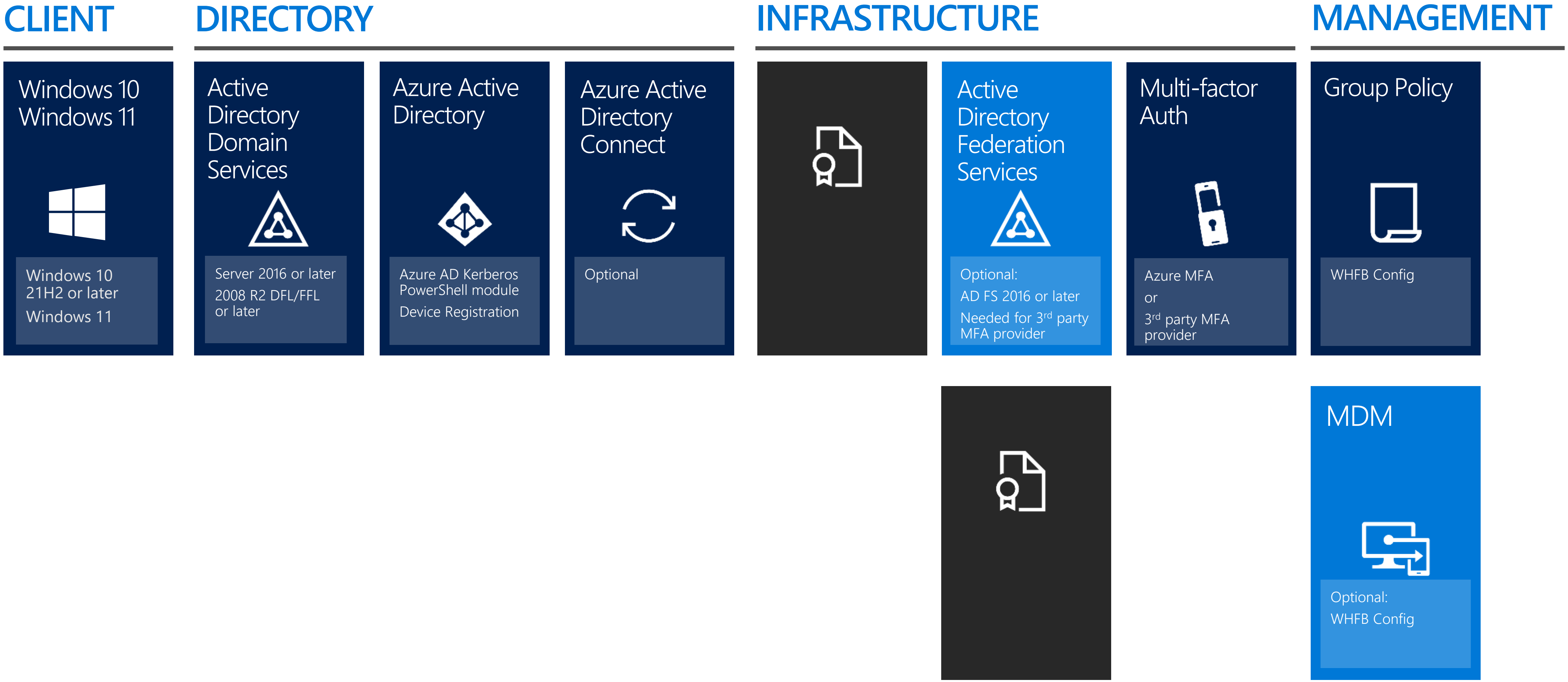
- Authenticates using raw key to Azure AD
- Authenticates using PKI user cert to Active Directory
- Requires issuance of end user certificate from PKI
- Requires 2012 or later Domain Controllers

Cloud Trust

- Authenticates using raw key to Azure AD
- Authenticates using TGT issued from Azure AD Kerberos to Active Directory
- Does not require issuance of any certificate
- Requires 2016 or later Domain Controllers

- All trusts use asymmetric key pairs
- All trusts use the same TPM hardware
- All trusts require the same strong proof-up [MFA] for enrollment

Hybrid Cloud Trust Components (Preview)



CLIENT

Windows 10
Windows 11

Windows 10
21H2 or later
Windows 11

DIRECTORY

Active Directory Domain Services

Server 2016 or later
2008 R2 DFL/FFL or later

Azure Active Directory

Azure AD Kerberos PowerShell module
Device Registration

Azure Active Directory Connect

Optional

INFRASTRUCTURE

Active Directory Federation Services

Optional:
AD FS 2016 or later
Needed for 3rd party MFA provider

Multi-factor Auth

Azure MFA
or
3rd party MFA provider

MANAGEMENT

Group Policy

WHFB Config

MDM

Optional:
WHFB Config

Hybrid Key Trust Components

CLIENT

Windows 10

DIRECTORY

Active Directory Domain Services

Server 2016 or later
2008 R2 DFL/FFL or later

Azure Active Directory

Device Registration
Key Registration

Azure Active Directory Connect

Directory Synchronization with write-back (ADP)

INFRASTRUCTURE

Active Directory Certificate Services

AD CS 2012 or later
KDC Certificate

Active Directory Federation Services

Optional:
AD FS 2016 or later
Needed for 3rd party MFA provider

Multi-factor Auth

Azure MFA
or
3rd party MFA provider

MANAGEMENT

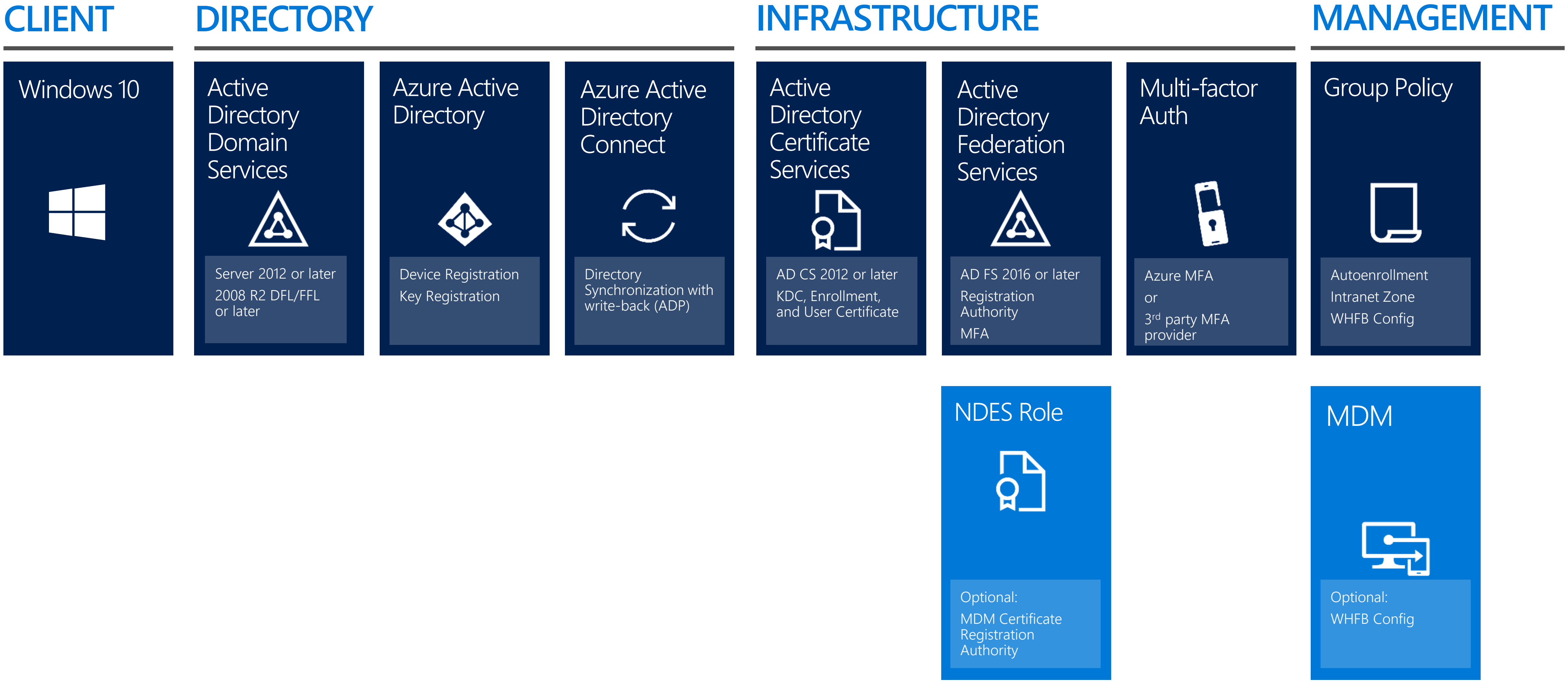
Group Policy

Autoenrollment
Intranet Zone
WHFB Config

MDM

Optional:
WHFB Config

Hybrid Certificate Trust Components



CLIENT

Windows 10

DIRECTORY

Active Directory Domain Services

Server 2012 or later

2008 R2 DFL/FFL or later

Azure Active Directory

Device Registration

Key Registration

Azure Active Directory Connect

Directory Synchronization with write-back (ADP)

INFRASTRUCTURE

Active Directory Certificate Services

AD CS 2012 or later

KDC, Enrollment, and User Certificate

Active Directory Federation Services

AD FS 2016 or later

Registration Authority

MFA

NDES Role

Optional:

MDM Certificate Registration Authority

Multi-factor Auth

Azure MFA

or

3rd party MFA provider

MANAGEMENT

Group Policy

Autoenrollment

Intranet Zone

WHFB Config

MDM

Optional:

WHFB Config

WH4B – Trust Types (Hybrid)

	Cloud Trust	Key Trust	Certificate Trust
AuthN factor to Azure AD	Keys	Keys	Keys
AuthN factor to AD DS	Kerberos	Keys	Certificate
Domain controller min version	Win Svr 2016 + KB3534307 Win Svr 2019 + KB4534321	Server 2016	Server 2012 R2
Client min version	Win 10 21H2 + KB5010415 Win 11 21H2 + KB5010414		
DFL/FFL min version	Server 2008 R2	Server 2008 R2	Server 2008 R2
DC cert requirement	No	Yes*	Yes*
Client cert requirement	No	No	Yes
AD DS Schema min version	Server 2016	Server 2016	Server 2016
Authentication Type Support	Federated and Managed (PHS / PTA)	Federated and Managed (PHS / PTA)	Federated only
AD FS Required	No	No	Yes (Server 2016+)
Device Writeback Required	No	No	Yes