Research and Development Document

ON

Azure Multifactor Authentication (MFA)

as

Internship Project

Celebal Summer Internship

By

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Under

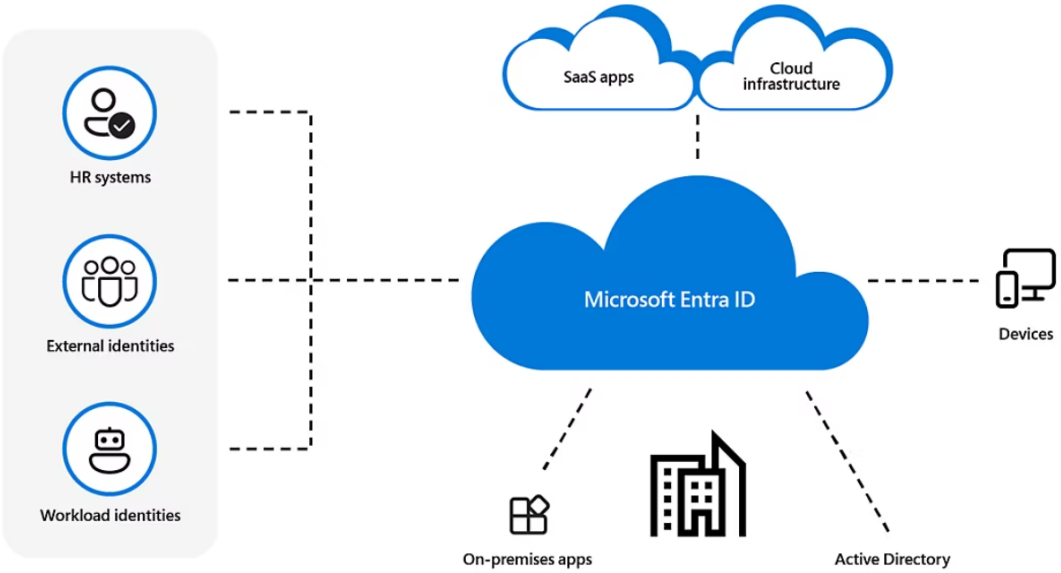
Celebal Summer Internship

in

Cloud Infra & Security

Azure Multifactor Authentication (MFA) is a security feature provided by **Microsoft Entra ID (formerly Azure Active Directory)** that requires users to verify their identity using more than one method of authentication. It adds an additional layer of protection to user sign-ins and transactions beyond just a username and password.

Microsoft Entra ID – also known as **Azure Active Directory (AD),** is a cloud-based identity and access management service that helps organizations secure and manage user identities and access to resources



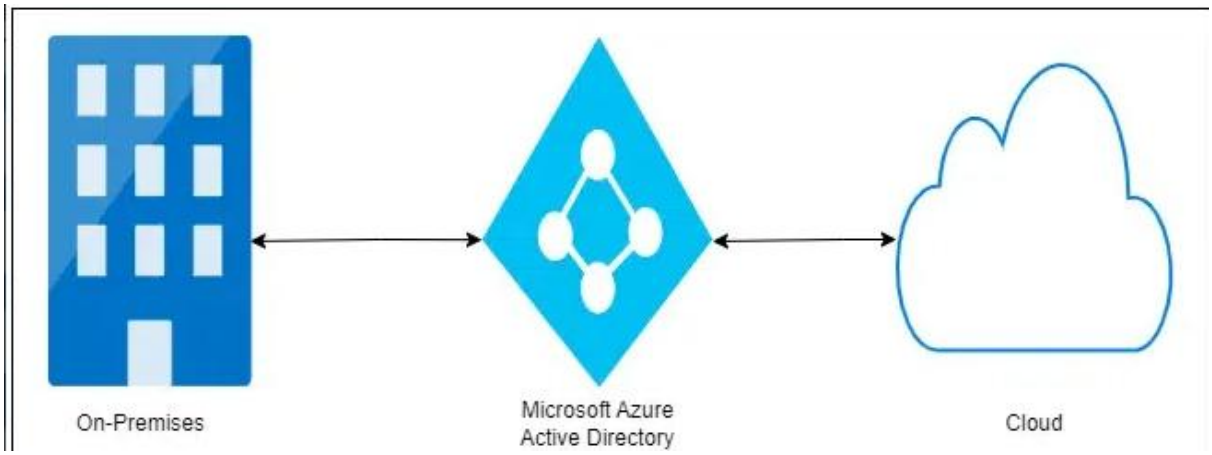
Use of Azure Active Directory

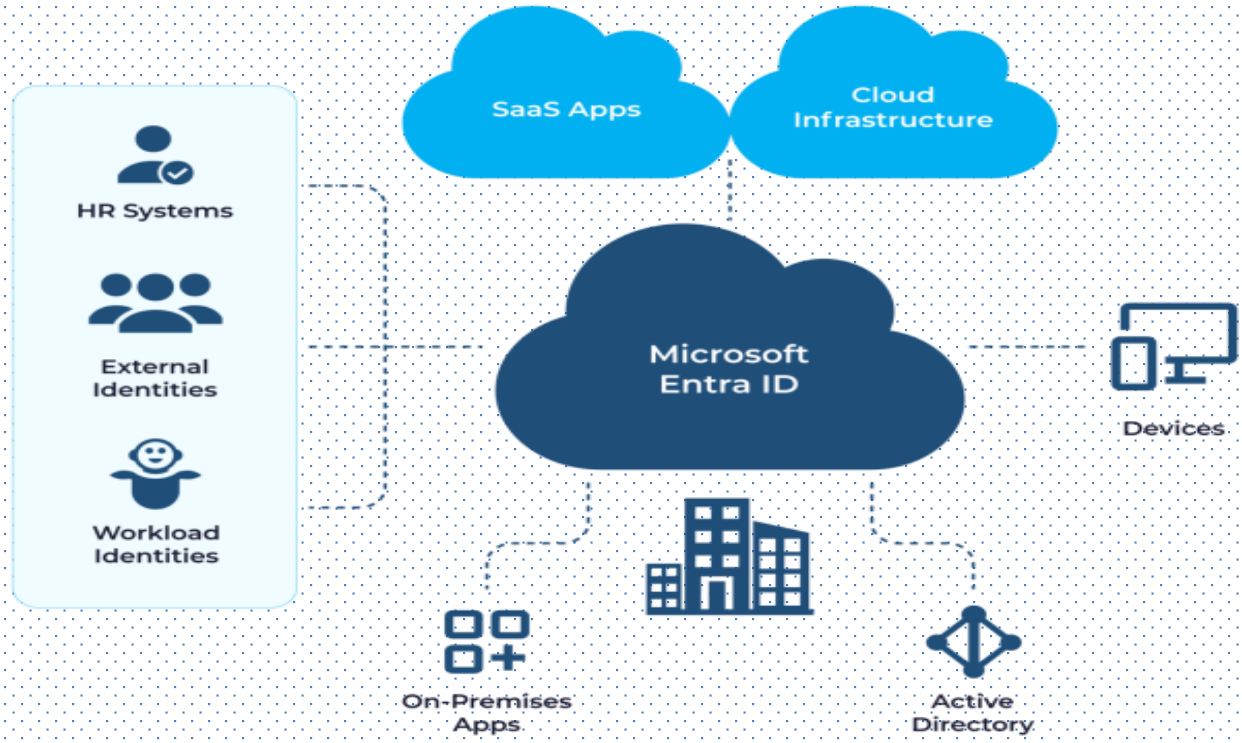
Suppose you have a large organization with a lot of developers. Some Azure services must be available to all developers for them to perform their responsibilities. When the administrator gives them a unique username and password for each service, they can access services like databases, virtual machines, or Azure storage services. It might be challenging for administrators and employees to manage many user logins at once. Azure Active Directory (AD) enters the scene in this situation. Administrators can easily manage numerous user logins with Azure AD. To access each service, administrators must provide a single login and password in Azure. It is used by:

- Administrators
- Developers
- Users

Structure of Azure AD/ Microsoft Entra ID:

Azure Active Directory (Azure AD) is structured as a cloud-based directory and identity management service with a flat hierarchy. It organizes resources into tenants, where each tenant represents a dedicated and isolated instance of Azure AD. Within a tenant, **users**, **groups**, and **applications** are managed**. Users are individual accounts**, **groups are collections of users**, and **applications are registered entities that Azure AD can authenticate**. Additionally, administrators can set up roles and permissions to control access and enforce policies across these resources.





Working of Azure AD/Microsoft Entra ID:

Azure Active Directory (Azure AD) simplifies identity and access management in the cloud. Users authenticate with Azure AD credentials, enabling secure access to applications and services. Single sign-on (SSO) streamlines user experience by allowing access to multiple resources with one login. Robust security features like multifactor authentication (MFA) and access policies ensure secure access control. Azure AD Connect facilitates seamless integration between on-premises and cloud environments for unified identity management.

Licensing of Microsoft Entra ID:

Licenses of Entra ID are:

- **Microsoft Entra ID Free:** Provides user and group management, on-premises directory synchronization, basic reports, self-service password change for cloud users, and single sign-on across Azure, Microsoft 365, and many popular SaaS apps.
- **Microsoft Entra ID P1**: In addition to the Free features, P1 also lets your hybrid users access both on-premises and cloud resources. It also supports advanced administration, such as dynamic membership groups, self-service group management, Microsoft Identity Manager, and cloud write-back capabilities, which allow self-service password to reset for your on-premises users.
- **Microsoft Entra ID P2**: includes features in addition to the features included in Free and P1. P2 includes Microsoft Entra ID Protection to help provide risk-based Conditional Access to your apps and critical company data and Privileged Identity Management to help discover, restrict, monitor administrators, their access to resources and to provide just-in-time access when needed.

In addition to Microsoft Entra ID licenses, you can enable additional identity management capabilities with licenses for other Microsoft Entra products, including:

- **Microsoft Entra ID Governance. Microsoft Entra ID Governance is an advanced set of identity governance capabilities for Microsoft Entra ID P1 and P2 customers.**
- **"Pay as you go" feature licenses. You can also get licenses for features such as Microsoft Entra Domain Services, and Microsoft Entra customer identity and access management solution (CIAM). CIAM can help you provide identity and access management solutions for your customer-facing apps. For more**

information, see our next-generation solution for external identities, Microsoft Entra External ID.

Basic Terminology of Entra ID:

- **Identity:** A thing that can get authenticated. An identity can be a user with a username and password. Identities also include applications or other servers that might require authentication through secret keys or certificates.
- **Account:** An identity that has data associated with it. You can't have an account without an identity.
- **Microsoft Entra account:** An identity created through Microsoft Entra ID or another Microsoft cloud service, such as Microsoft 365. Identities are stored in Microsoft Entra ID and accessible to your organization's cloud service subscriptions. This account is also sometimes called a Work or school account.
- **Tenant:** A dedicated and trusted instance of Microsoft Entra ID. The tenant is automatically created when your organization signs up for a Microsoft cloud service subscription. These subscriptions include Microsoft Azure, Microsoft Intune, or Microsoft 365. This tenant represents a single organization and is intended for managing your employees, business apps, and other internal resources.

1. Configure & manage Azure Multifactor Authentication (MFA)

Enabling MFA for Users:

Azure MFA can be enforced using:

- **Per-user MFA:** Manually enable MFA for individual users.
- **Conditional Access Policies (recommended):** Define policies based on user location, device state, and more.

Supported MFA Methods Diagram:

MFA Verification

Authenticator App

SMS

Call

FIDO2 key

2. Two-Factor Authentication (2FA)

2FA is a type of **MFA** that requires two forms of identity from different categories:

- Something you know (password)
- Something you have (mobile device or hardware token)

Comparison Table:

Authentication Type	Description
Password	Knowledge-based
OTP via SMS/App	Possession-based
Biometrics	Inherence-based

Benefits of 2FA:

- **Blocks unauthorized access**
- **Reduces identity theft**
- **Required for many regulatory frameworks**

Authentication

Authentication is the process of challenging a person, software component, or hardware device for credentials to verify their identity or prove they're who or what they claim to be. Authentication typically requires the use of credentials

Multifactor authentication (MFA) is a security measure that requires users to provide more than one piece of evidence to verify their identities, such as:

- Something they know, for example a password.
- **Something they are, like a biometric (fingerprint or face).**

Single sign-on (SSO) allows users to authenticate their identity once and then later silently authenticate when accessing various resources that rely on the same identity. Once authenticated, the IAM system acts as the source of identity truth for the other resources available to the user. It removes the need for signing on to multiple, separate target systems.

3. Methods of Two-Factor Authentication

1. Microsoft Authenticator App

- Sends push notification
- Time-based One Time Password (TOTP)

2. SMS Verification

- One-time passcode sent via text

3. Phone Call

- Automated call with code

4. FIDO2 Security Keys

- USB/NFC-based hardware authentication

5. Windows Hello

- Biometric sign-in for Windows 10/11

Difference between MFA and 2FA

Feature	Two-Factor Authentication (2FA)	Multi-Factor Authentication (MFA)
Number of Factors	Requires two distinct factors (e.g., password + code from phone)	Requires two or more factors
Flexibility	Less flexible; limited to two factors	More flexible; allows for various combinations of factors
Security Level	Generally provides good security, especially compared to single-factor authentication	Considered more secure than 2FA due to additional layers of verification
User Experience	Usually more streamlined and user-friendly due to fewer steps	May introduce more friction to the login process, depending on the number and type of factors
Examples	Password + SMS code, Password + Authenticator app code	Password + Fingerprint + Security key

Relationship to A specific type of MFA	Encompasses any authentication method
MFA	with two or more factors

4. Setup Self-Service Password Reset (SSPR)

Self-Service Password Reset (SSPR) is an Azure AD feature that allows users to reset their own passwords without administrator or helpdesk intervention, as long as they verify their identity using configured authentication methods.

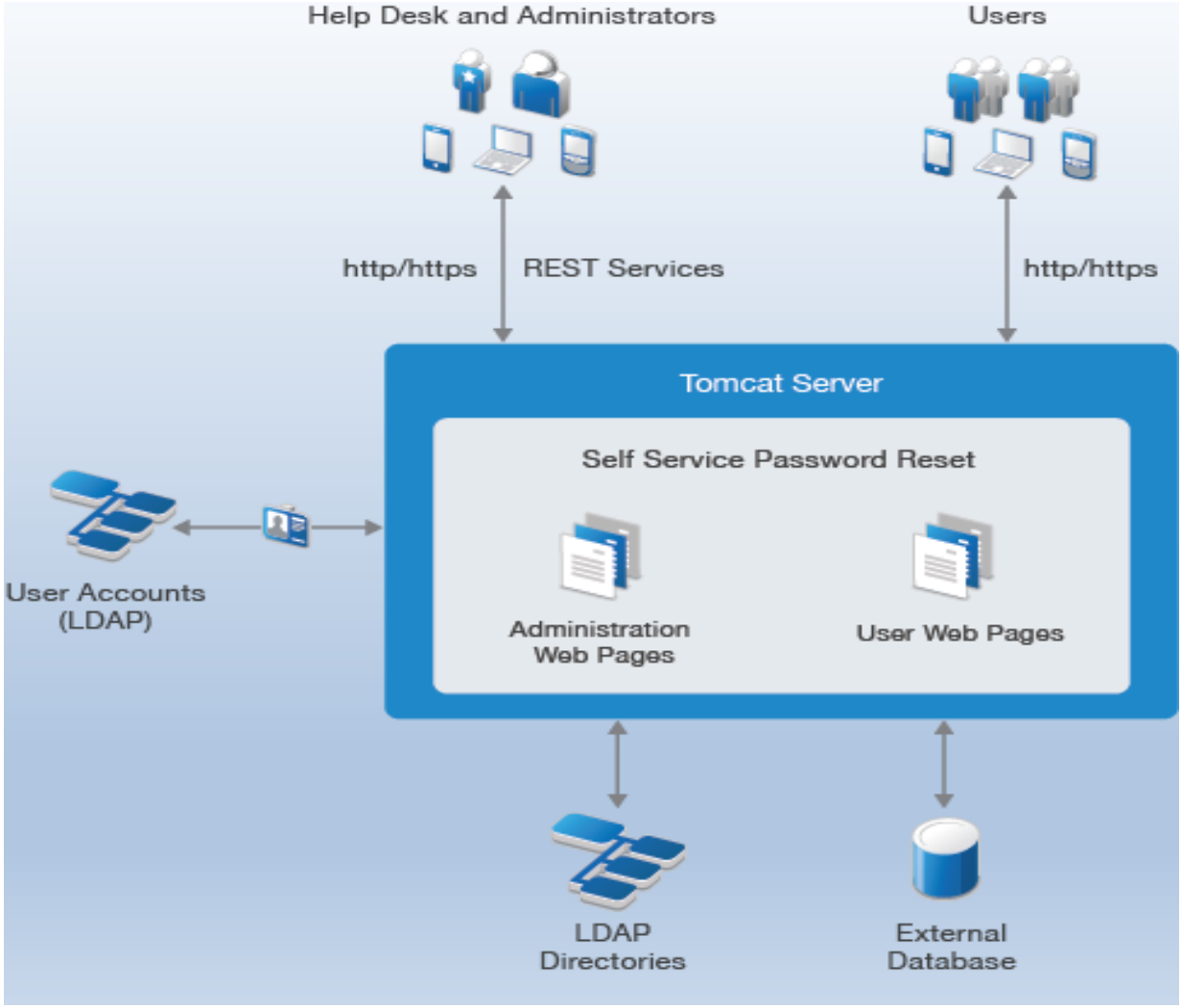
Allows users to reset passwords securely without admin help.

Benefits of SSPR:

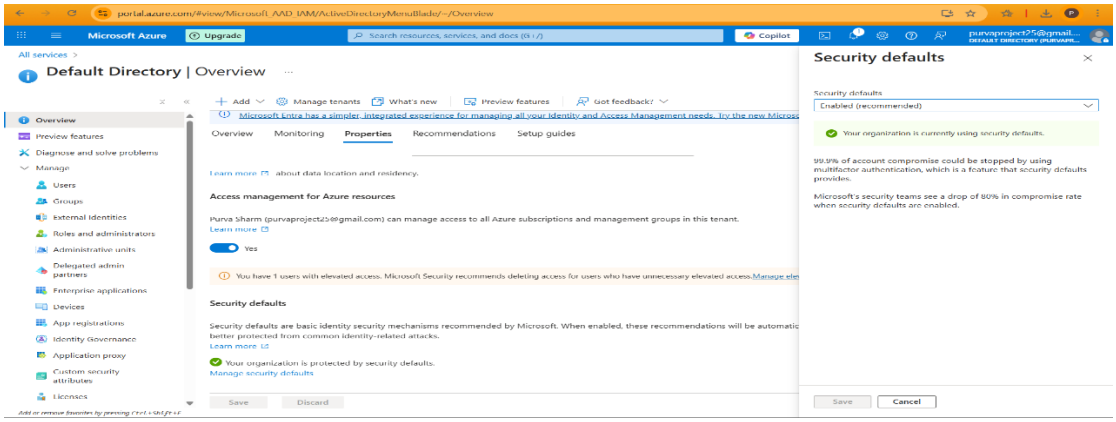
- Reduces support/helpdesk workload
- Enables users to unlock accounts or reset passwords anytime
- Improves security with MFA during reset
- Enhances productivity and user satisfaction

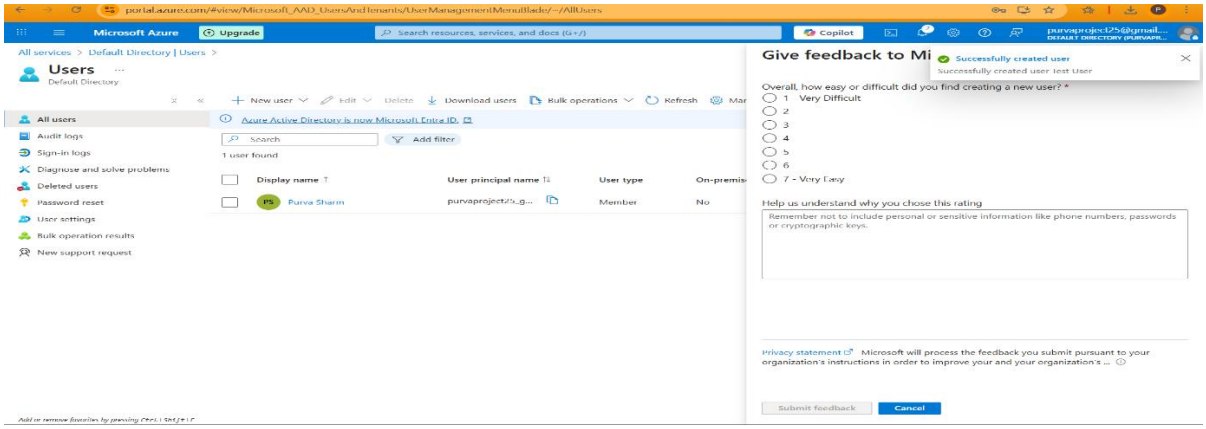
How SSPR Works:

1. User forgets password and visits the reset page: https://passwordreset.microsoftonline.com
2. User verifies identity using one or more authentication methods (e.g., phone, email, security questions, Microsoft Authenticator).
3. User sets a new password securely.



5. Setting up for Roles and Licences





Steps:

1. **Verify License**
   - **Go to: Azure AD > Licenses > Overview**
   - **Ensure Azure AD Premium P2 is assigned to users and admins.**
2. **Check Required Roles**
   - **You must be either:**
     - **Global Administrator**
     - **Privileged Role Administrator**
3. **Consent to PIM**
   - **Go to: Azure AD > Privileged Identity Management**
   - **Click Consent to PIM if prompted.**
4. **Enable PIM for Azure AD Roles**
   - **Go to: PIM > Azure AD roles > Manage > Roles**
   - **Click Discover roles > Select > Click Enable PIM.**

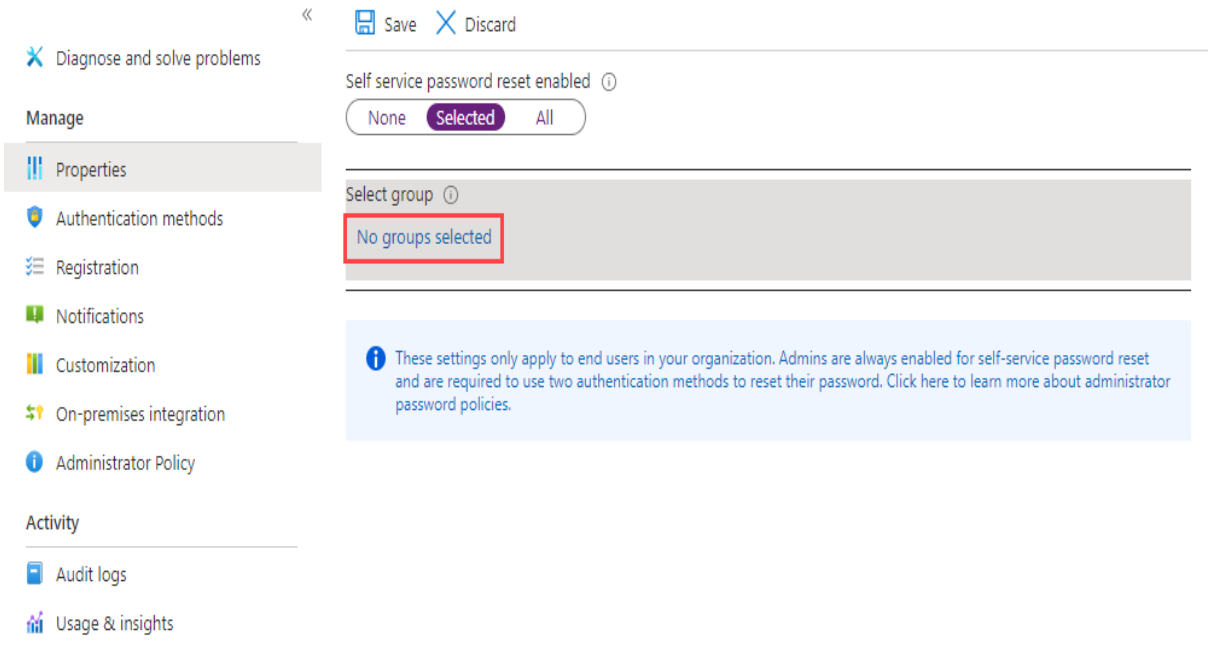
6. Deploy Self-Service Password Reset (SSPR)

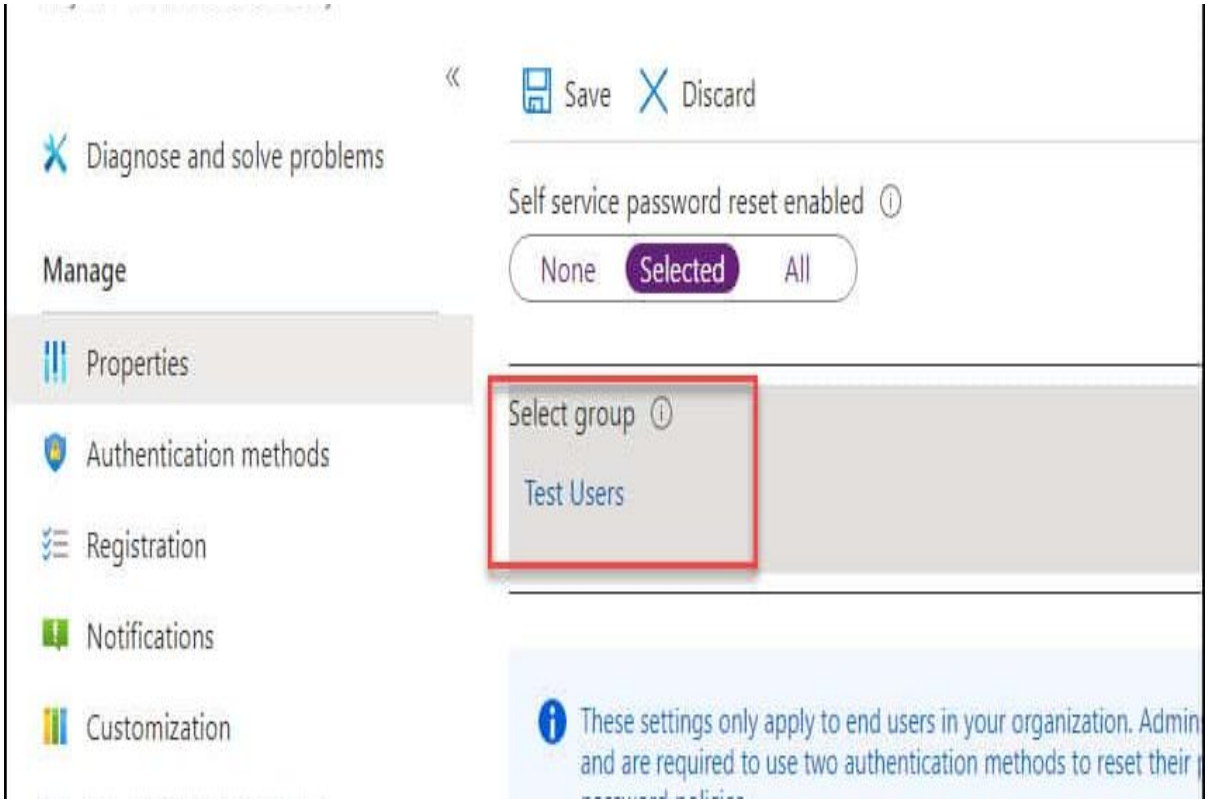
Configuration Steps:

1. Navigate to Azure AD > Password Reset
2. Choose target group (e.g., interns, developers)
3. Define number of authentication methods
4. Customize helpdesk contact info for locked users

User Experience:

- Visit https://passwordreset.microsoftonline.com
- Authenticate using MFA
- Reset password securely


Diagnose and solve problems
Manage
Properties
Authentication methods
Registration
Notifications
Customization
On-premises integration
Administrator Policy
Activity
Audit logs
Usage & insights
Save
Discard
Self service password reset enabled
None
Selected
All
Select group
No groups selected
These settings only apply to end users in your organization. Admins are always enabled for self-service password reset and are required to use two authentication methods to reset their password. Click here to learn more about administrator password policies.


Diagnose and solve problems
Manage
Properties
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Customization
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Self service password reset enabled
None
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Select group
Test Users
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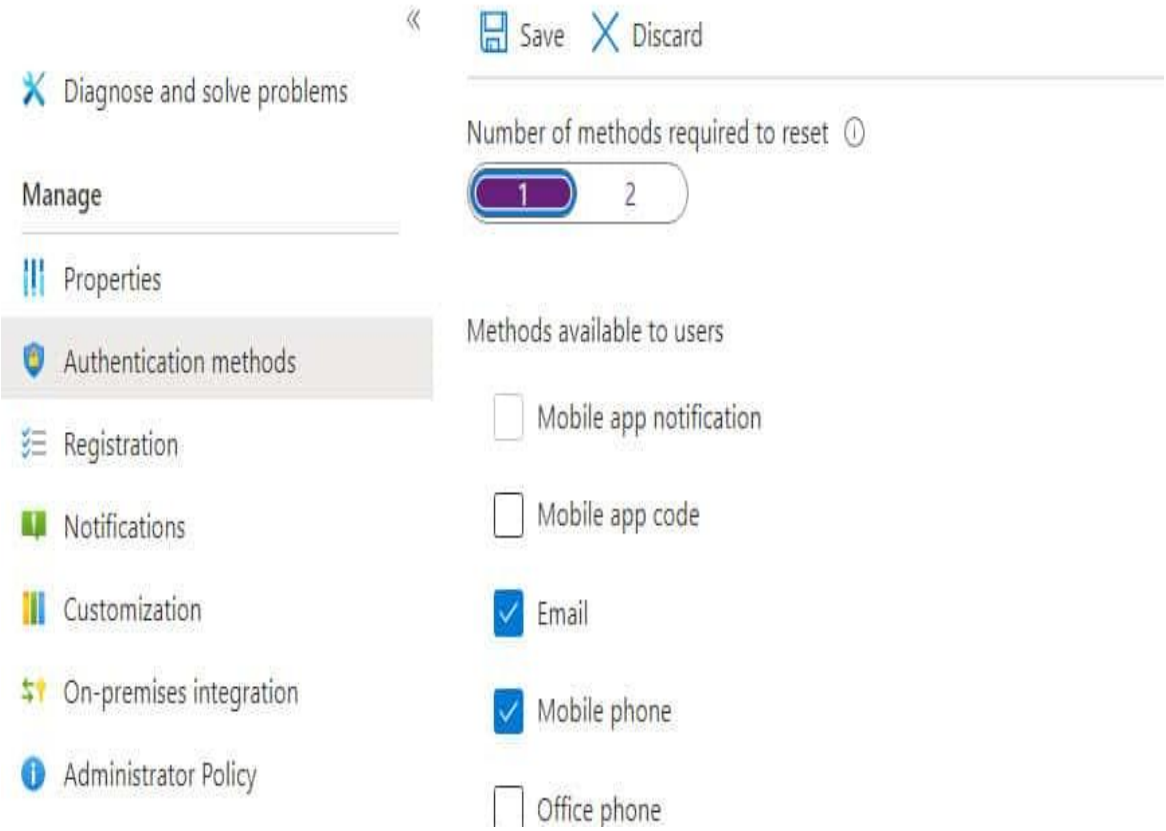
and are required to use two authentication methods to reset their



7. Implement and Manage Azure MFA Settings

Access MFA Settings

1. Go to Azure Portal → Microsoft Entra ID
2. Navigate to Security → Multifactor Authentication
3. Click Additional cloud-based MFA settings

   Available Settings:

- App Passwords – Used for older apps not supporting modern auth
- Trusted IPs – Skip MFA for known corporate networks
- Verification Options – Choose allowed methods
- Remember Multi-Factor Authentication – Skip MFA for remembered devices (configurable)

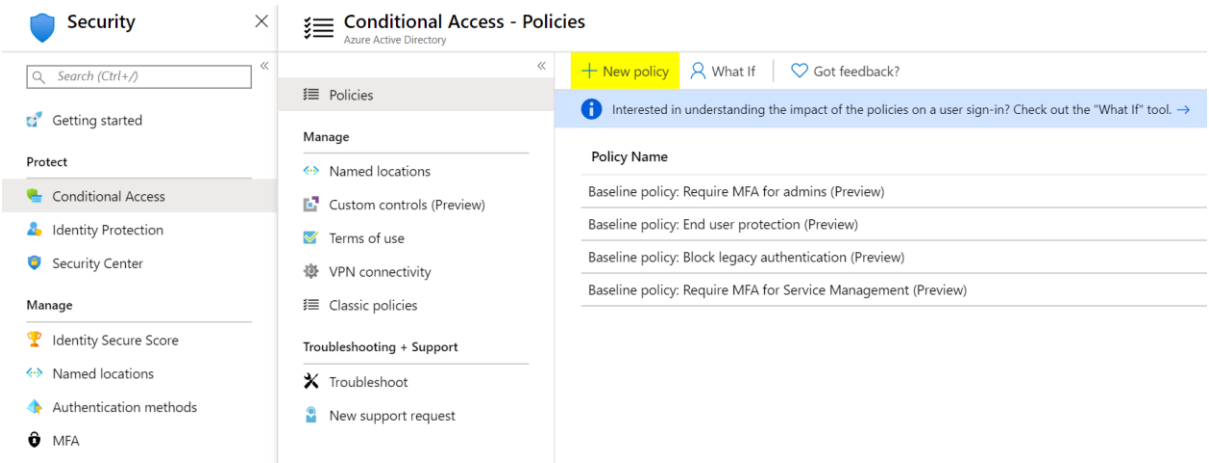
Configure MFA Registration

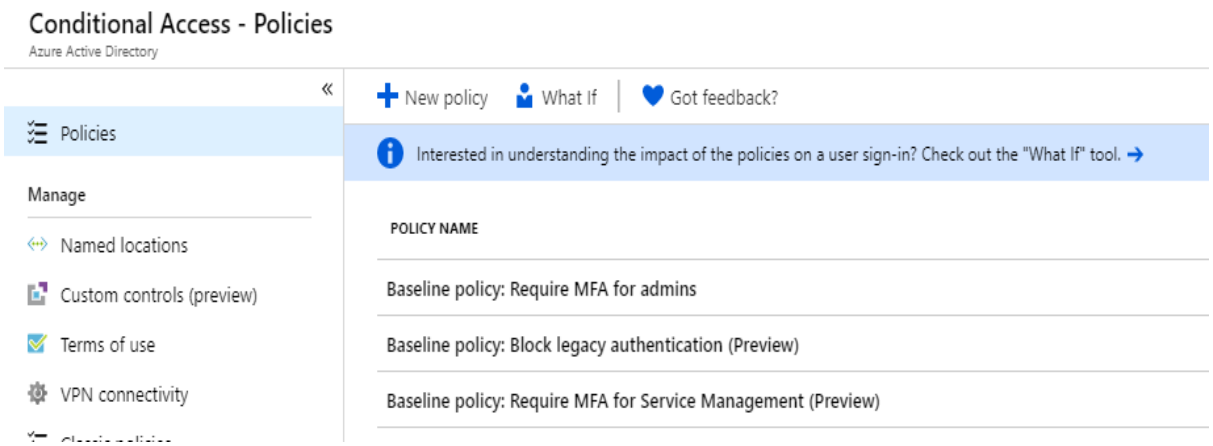
1. Go to Microsoft Entra ID → Security → Authentication Methods
2. Select Microsoft Authenticator
3. Enable for All or specific users
4. Configure registration requirements and method priority

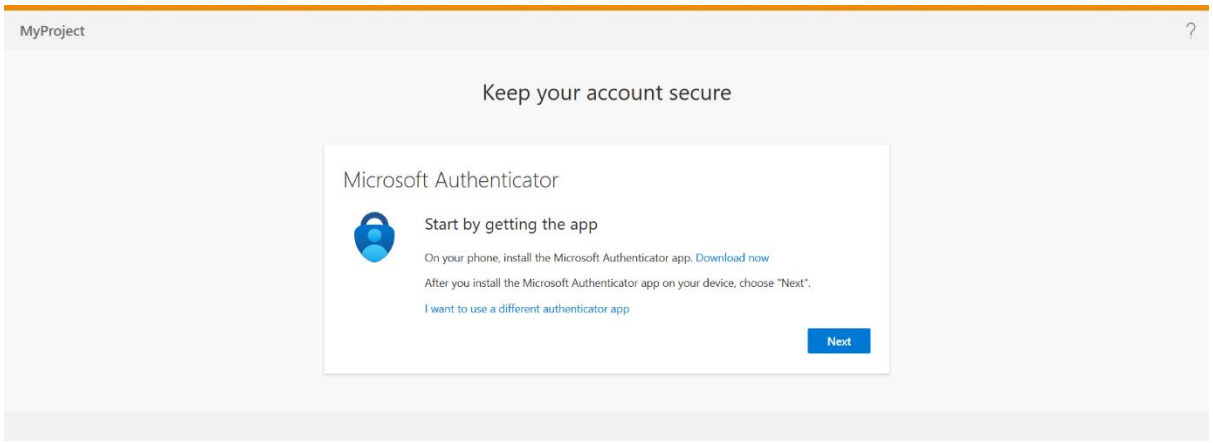
Enforcing MFA via Conditional Access (Recommended Method)

1. Go to **Microsoft Entra ID → Security → Conditional Access**
2. Click **+ New Policy**
3. Name: Enforce MFA for All Users
4. **Assignments:**
    - Users: All users (or specific group)
    - Cloud apps: All apps (or select apps)
5. **Access Controls → Grant → Require multi-factor authentication**
6. Enable Policy → **On → Create**

This is the most flexible and enterprise-grade way to enforce MFA.







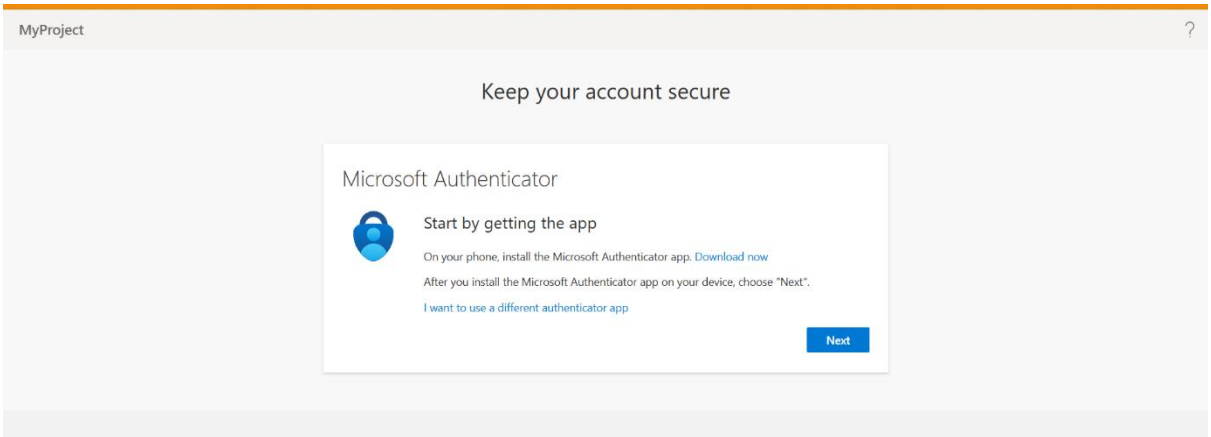
Monitoring MFA Usage and Reporting

➔ **View Reports**

1. Go to **Azure Portal → Microsoft Entra ID → Sign-in logs**
2. Filter by **Authentication requirement**
3. View columns like MFA Required, MFA Result

➔ **Usage & Insights**

1. Navigate to **Microsoft Entra → Protection → Authentication methods**
2. Click **Usage & Insights**
3. Review registered methods by users



Account Lockout Protection

To prevent brute-force attacks:

1. Go to Azure Portal → Microsoft Entra ID → Security → Authentication Methods
2. Choose Microsoft Authenticator or Password Protection
3. Set Lockout threshold, Duration, and Reset interval

Azure intelligently locks accounts after multiple failed attempts.

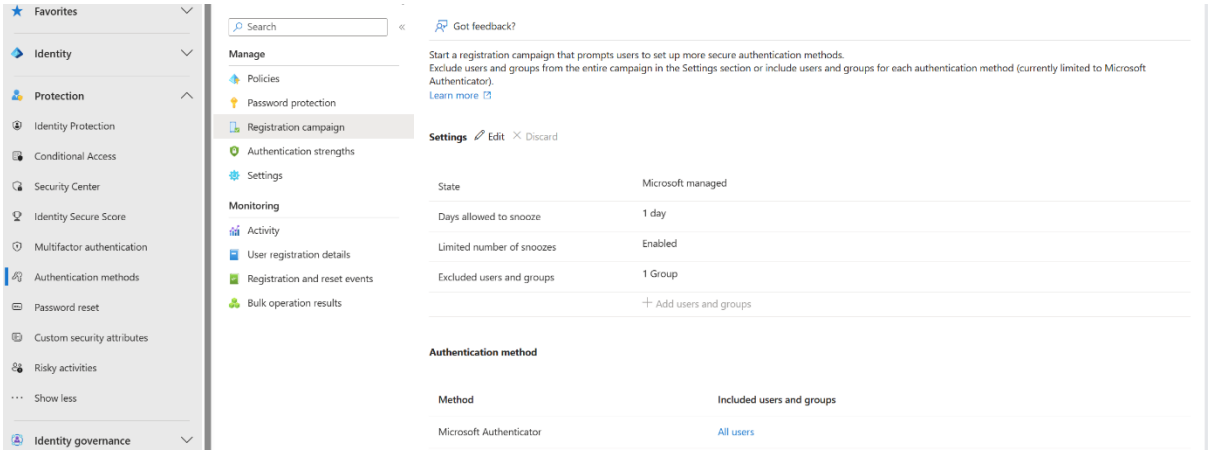
Extending MFA to On-Premise and 3rd-Party Apps

- Use Azure AD Application Proxy to enable MFA for on-prem apps.
- Integrate MFA with:
    - VPN devices
    - Remote Desktop Gateway
    - Salesforce, Dropbox, etc. via Enterprise Applications

Go to Azure AD → Enterprise applications → New Application → Add Gallery App

Best Practices for Managing MFA

- Enforce MFA for all users using Conditional Access
- Use Authenticator App over SMS
- Enable registration campaign to onboard users
- Regularly monitor sign-in logs for MFA failures
- Educate users about phishing-resistant MFA



8. Account Lockout Settings

Purpose:

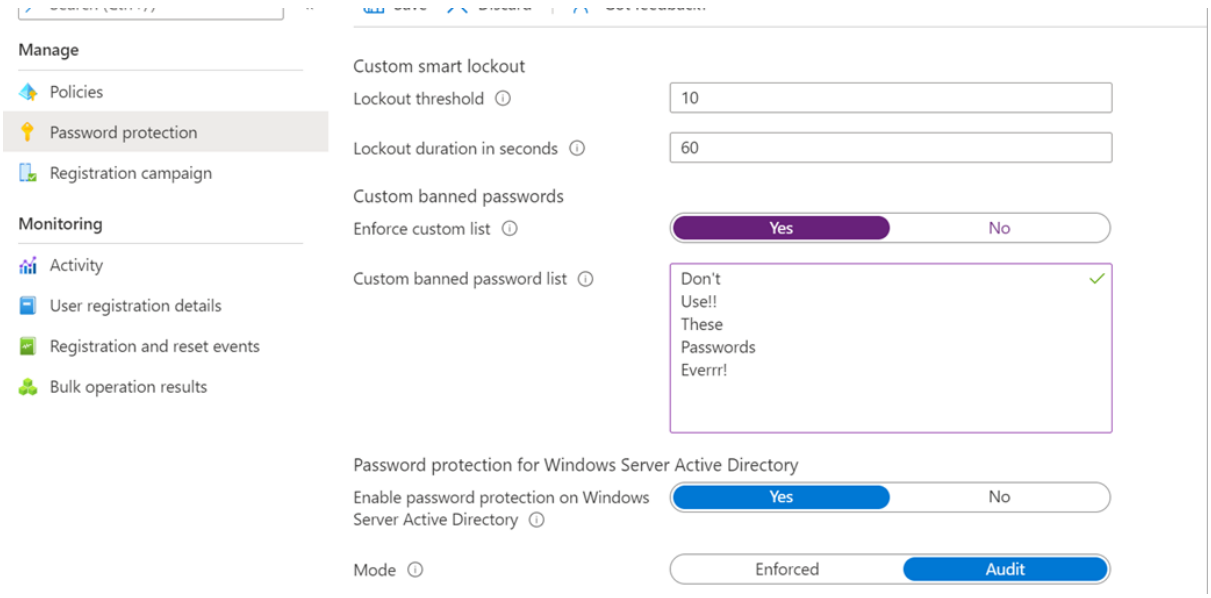
Prevent brute-force MFA attacks

Settings Location:

- Azure AD > Security > Authentication methods > MFA > Account Lockout

Configurable Options:

- Lockout threshold: Attempts before lock (default: 10)
- Lockout duration: Duration in minutes (default: 1)



Implementing and managing Azure MFA is **critical to securing modern cloud environments**. With proper configuration using Conditional Access, registration policies, and reporting, organizations can protect user accounts and comply with security standards.

References

- Microsoft Docs – Azure MFA
- Microsoft Entra ID – Conditional Access
- Authentication Methods in Azure

9. Manage MFA Settings for Users

Ways to Manage:

1. Per-user MFA configuration
2. User registration campaigns
3. Conditional Access for MFA enforcement

Tools for Admins:

- Authentication Methods Policy
- PowerShell & Graph API scripting

Why Extend Azure MFA?

- Strengthen authentication for legacy or hybrid apps
- Prevent breaches across all access points
- Meet compliance standards like NIST, HIPAA
- Centralize authentication across cloud and on-prem systems

Architecture of Extending Azure MFA

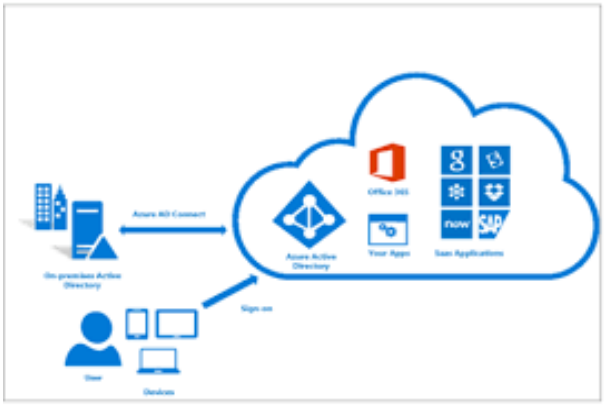
Azure MFA supports various integration methods, primarily through:

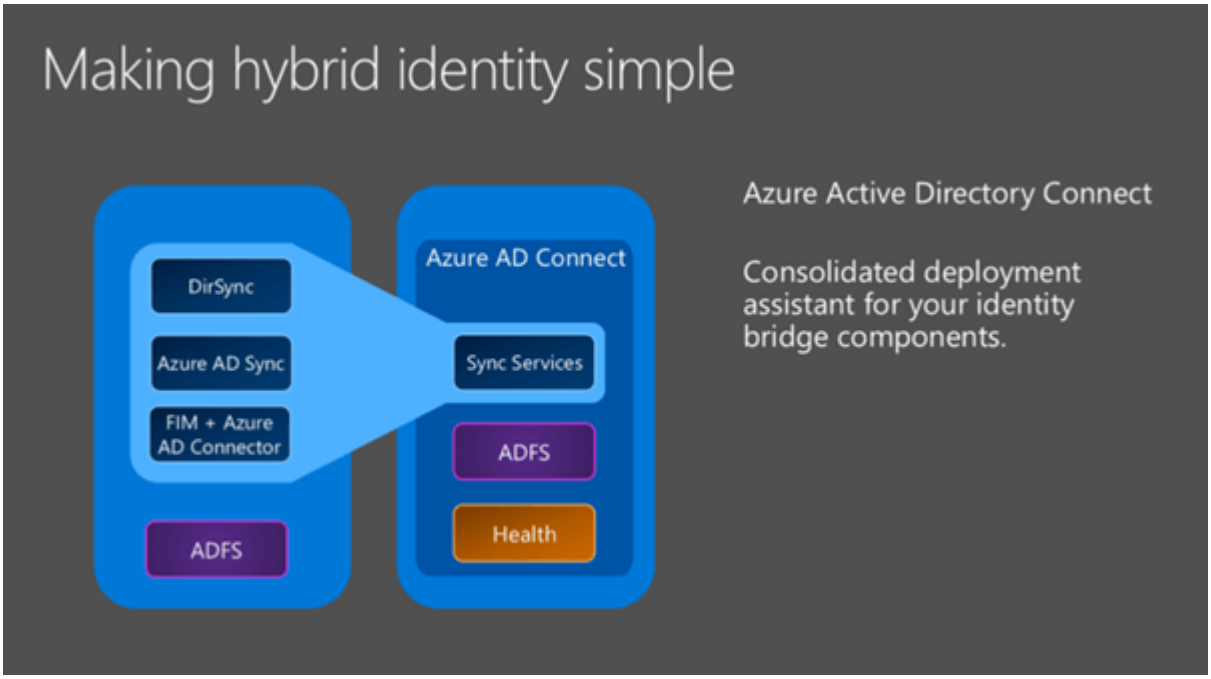
- **NPS Extension (RADIUS)**
- **Azure AD Application Proxy**
- **SAML / OIDC Federation**
- **Conditional Access policies**

10. Supported Third-party and On-Prem Systems

These allow MFA enforcement outside Azure cloud apps

System	Integration Method
Cisco / Fortinet VPN	NPS + RADIUS
Remote Desktop Gateway	NPS Extension
On-Prem Web Apps (IIS)	Application Proxy
Salesforce / Dropbox	SAML Federation
Custom Apps	OAuth/OpenID or Legacy Federation
Linux Servers (SSH)	PAM Modules or Jump Servers





On Prem integration with MS AZURE 1

11. Monitor Azure MFA Activity

Monitoring Azure MFA activity is essential to ensure users are authenticating securely, to detect any unusual login behavior, and to audit compliance. Microsoft Entra provides various monitoring and reporting capabilities.

Why Monitor MFA Activity?

- Detect suspicious login attempts
- Ensure all users are registered for MFA
- Investigate MFA failures or bypasses
- Meet audit and compliance requirements
- Create alerts for high-risk sign-ins

Monitoring Tools:

- Azure Sign-in Logs
- MFA Usage Reports
- Conditional Access Insights

Key Metrics:

- User sign-in attempts
- Method usage statistics
- Failure and success trends

Audit User MFA Registration Status

Steps:

1. Go to **Azure Portal → Microsoft Entra ID → Users**
2. Select **Per-user MFA** or go to:
    - **Authentication Methods → Registration campaign**
3. Or, use:
    - **Microsoft Entra → Protection → Authentication methods → Registration**

- **On activation, require Microsoft Entra Conditional Access authentication context**: You can require users who are eligible for a role to satisfy Conditional Access policy requirements. For example, you can require users to use a specific authentication method enforced through Authentication Strengths, elevate the role from an Intune-compliant device, and comply with terms of use.

- Require approval to activate: You can require approval for activation of an eligible assignment. The approver doesn't have to have any roles. When you use this option, you must select at least one approver.

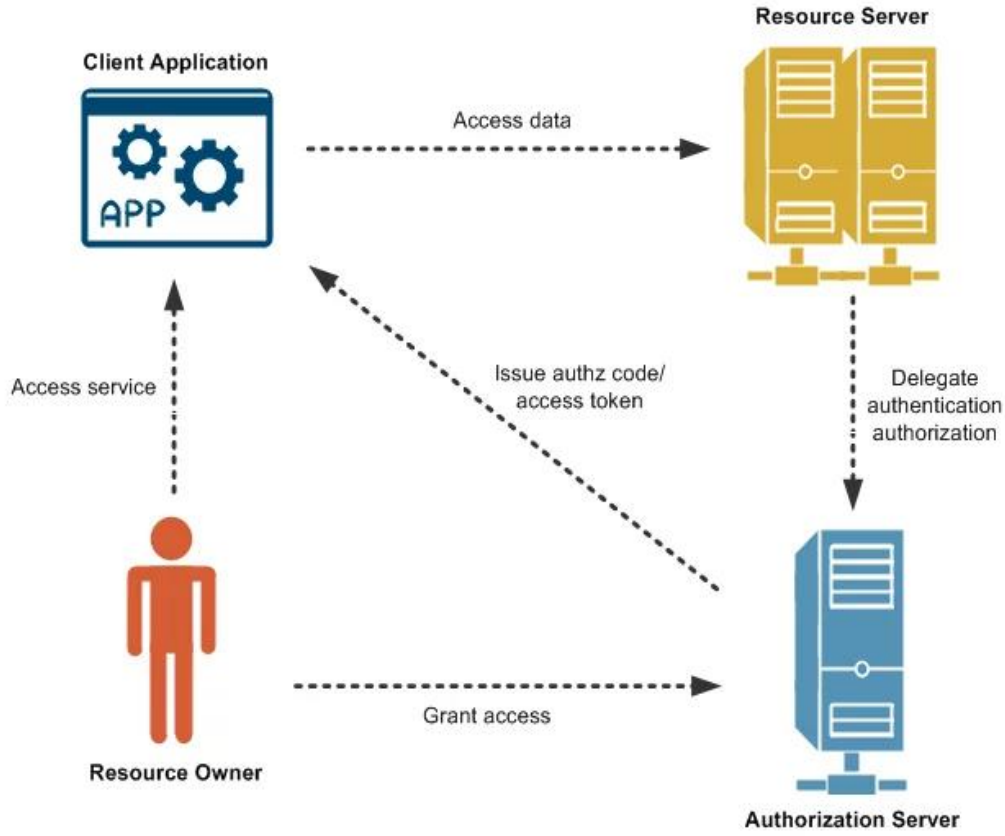
12. OAuth Tokens

- **What is OAuth?**

  OAuth (Open Authorization) is a secure open standard for **authorization** that allows one application to access data/resources on behalf of a user **without revealing their password**.

  Example: Logging into a third-party app using your Microsoft or Google account — the app accesses only the authorized parts of your profile.

  Tokens issued to users/applications to access services without using passwords repeatedly are called OAuth Tokens.



- **OAuth 2.0 Grant Types**

  OAuth 2.0 defines different **authorization flows (grant types)** for various use cases:

Grant Type	Use Case
Authorization Code	For web and mobile apps
Client Credentials	App-to-app communication
Implicit	For browser-based apps (not recommended now)
Password	For legacy scenarios (deprecated)
Device Code	For devices without browsers (TVs, CLI)

What are OAuth Tokens?

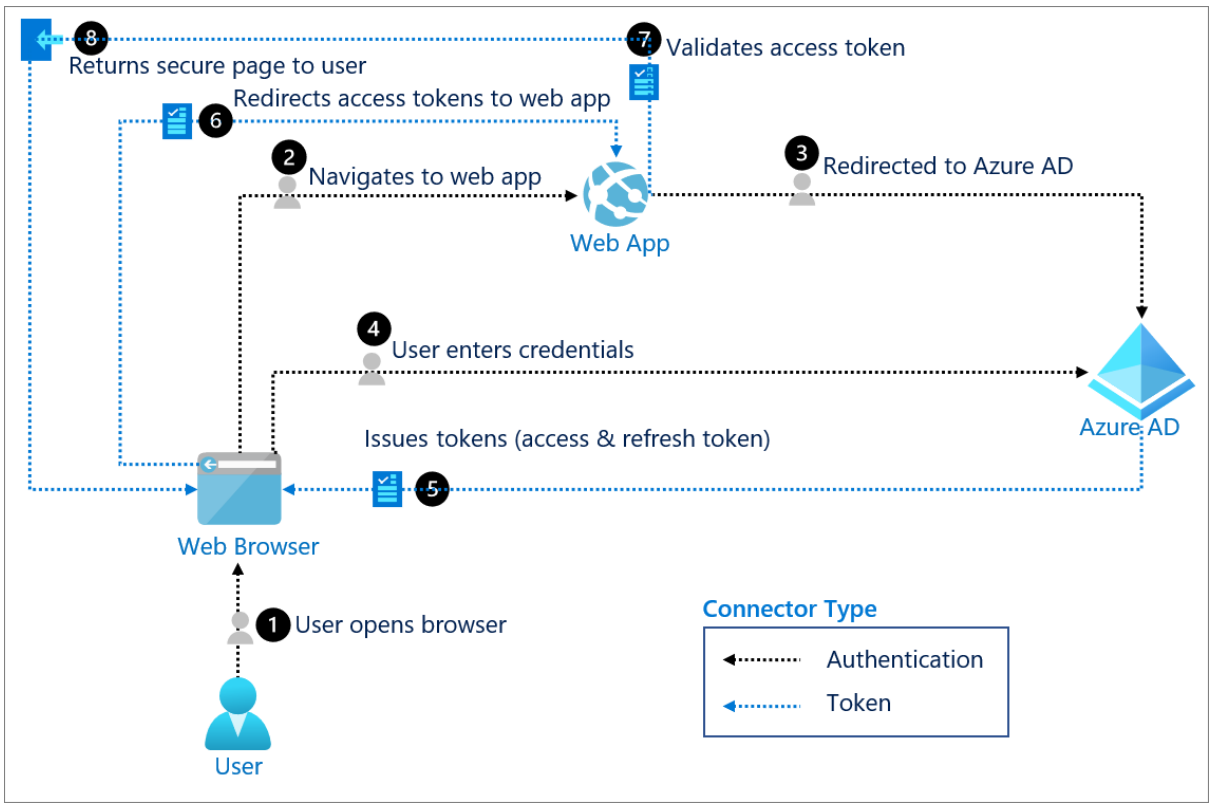
In OAuth, **tokens are used to access resources** instead of using a password. When a user grants access, the authorization server issues tokens to the client app. OAuth tokens are digital keys that grant third-party applications limited access to user resources on another service, without needing the user's actual username and password. These tokens act as secure intermediaries, allowing applications to interact with specific resources on behalf of a user. They are a core part of modern identity management and authorization processes.

What they are:

- **Delegated Authorization:**
  OAuth tokens enable a user to authorize a third-party application to access their data on another service (like Google or Facebook) without directly sharing their credentials with that application.
- **Secure Access:**
  Instead of giving the application your password, you grant it a token that allows it to access only the resources you've specified (e.g., reading your email, posting to your wall).
- **Different Types:**
  OAuth 2.0 commonly uses access tokens, refresh tokens, and ID tokens. Access tokens are used for immediate access, refresh tokens can be used to get new access

tokens, and ID tokens are used to provide information about the user's authentication.

- **Varying Formats:**
  Access tokens can come in various formats, including JSON Web Tokens (JWTs).
- **Scope of Access:**
  Tokens are associated with specific scopes, defining the level of access the application has to the user's resources.



How they work (Simplified):

1. **Authorization Request:**
   A user initiates an action that requires access to a third-party service (e.g., logging in to an app with Google).
2. **Redirection:**
   The user is redirected to the service's authorization server (e.g., Google's login page).
3. **Authentication:**
   The user authenticates with the service.
4. **Authorization Grant:**
   The user grants permission for the application to access specific resources.

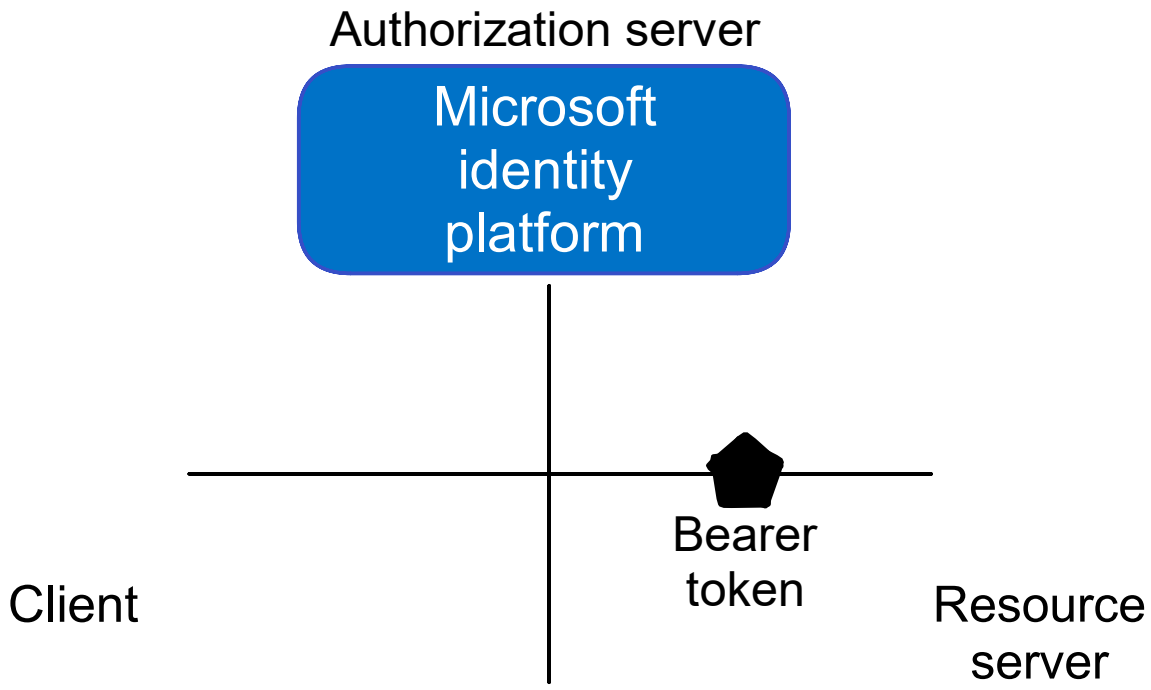
5. **Token Issuance:**
   The service issues an access token (and potentially a refresh token) to the application.
6. **Resource Access:**
   The application uses the access token to access the user's resources on the service.
7. **Token Refresh:**
   If the access token expires, the application can use the refresh token to get a new access token.

Example:

You might use an app to manage your social media. Instead of giving the app your Facebook password, you authorize it using OAuth. The app receives an access token, allowing it to post updates to your Facebook timeline, but only those you've authorized.

Key Benefits:

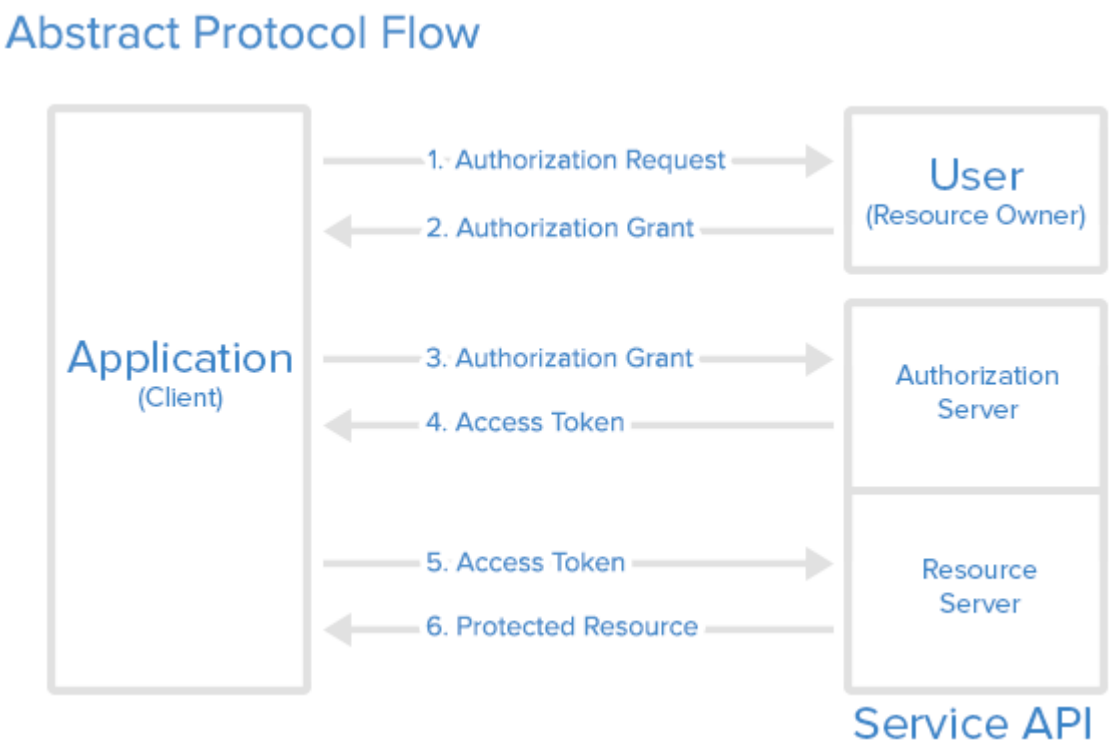
- **Enhanced Security:** Users don't have to share their passwords with third-party applications.
- **Granular Control:** Users can control the specific resources and actions that applications can access.
- **Simplified User Experience:** OAuth simplifies the login process, making it easier to use third-party applications.

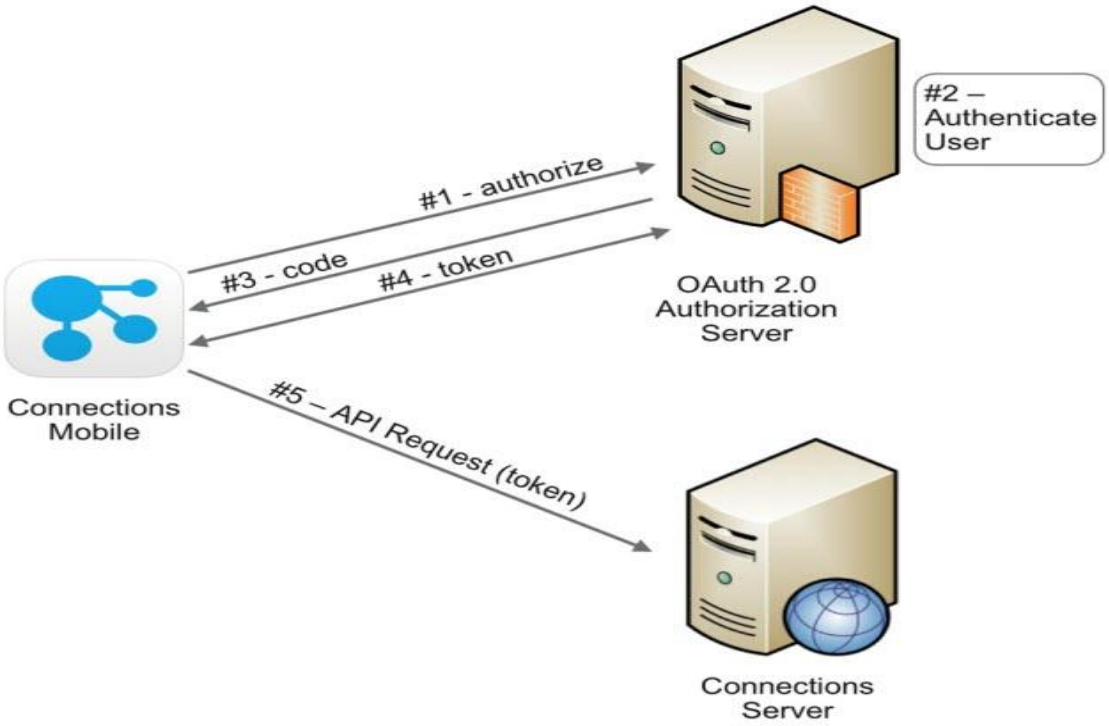


Types of OAuth Tokens

Token Type	Purpose
Access Token	Grants access to protected resources
Refresh Token	Used to obtain a new access token after expiration
ID Token	(OpenID Connect only) Contains user identity information in JWT format

How OAuth Works (Flow Diagram)





OAuth Tokens in Microsoft Azure (Microsoft Entra ID)

In Azure, OAuth is implemented via Microsoft Identity Platform (Microsoft Entra ID).

Why Use OAuth in Azure?

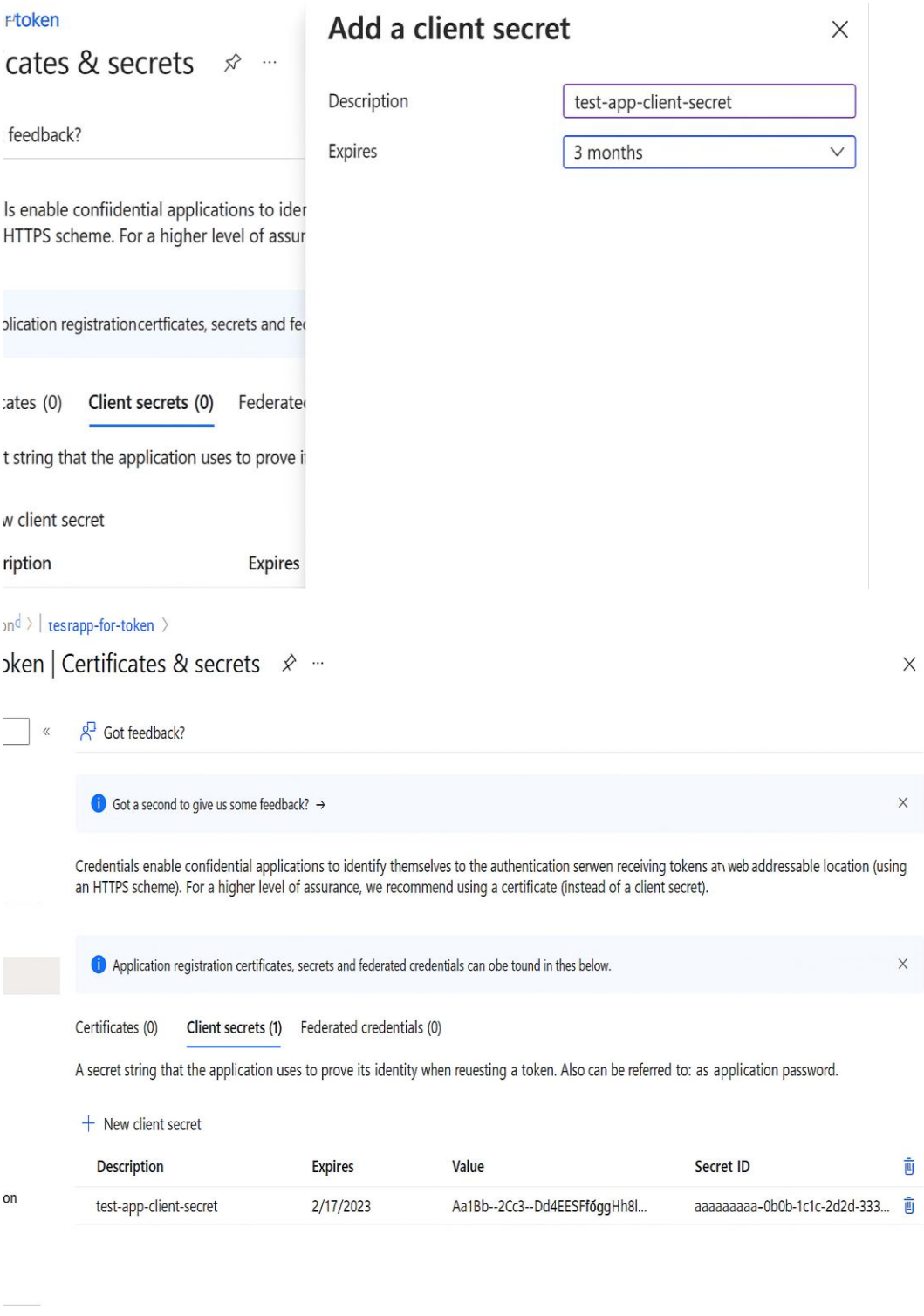
- Secure API Access: Applications authenticate using tokens, not credentials.
- Supports SSO: Enables seamless access across cloud apps.
- Works with MFA: Integrates with Conditional Access and MFA for security.
- Token-Based Authorization: Improves scalability and stateless communication.

Key Components:

Component	Description
Authorization Server	https://login.microsoftonline.com/{tenant}/oauth2/v2.0
Resource Server	e.g., Microsoft Graph API
Client (App)	Your registered app in Azure
User	Person who is granting permission

Azure issues OAuth 2.0 tokens when your application authenticates users or itself to access Azure services like:

- Microsoft Graph
- Azure REST APIs
- Custom web APIs


Add a client secret
Description
test-app-client-secret
Expires
3 months
cates & secrets
feedback?
Client secrets (0)
client secret
Expires
esrapp-for-token
Certificates & secrets
Got feedback?
Got a second to give us some feedback? →
Credentials enable confidential applications to identify themselves to the authentication serwen receiving tokens at web addressable location (using an HTTPS scheme). For a higher level of assurance, we recommend using a certificate (instead of a client secret).
Application registration certificates, secrets and federated credentials can obe tound in thes below.
Certificates (0)
Client secrets (1)
Federated credentials (0)
A secret string that the application uses to prove its identity when reuesting a token. Also can be referred to: as application password.
New client secret
Description
Expires
Value
Secret ID
test-app-client-secret
2/17/2023
Aa1Bb--2Cc3--Dd4EESFfőggHh8l...
aaaaaaaaa-0b0b-1c1c-2d2d-333...

Security Best Practices for OAuth Tokens

- Never expose tokens in browser URLs
- Store tokens securely (Key Vault, environment variables)
- Use short-lived access tokens
- Implement token revocation if compromised
- Always use HTTPS
- Enable Conditional Access policies in Azure

➢ Use Cases in Azure

Use Case	Token Required	Example
Access Graph API	Access Token	Get user profile
Automate Azure via REST	Client Credentials Token	Script deployments
Single Sign-On (SSO)	ID Token	Log in to 3rd-party
Refresh expired access	Refresh Token	Silent login

➢ Conclusion

OAuth tokens play a vital role in secure authentication and authorization in Azure. Azure issues JWT-based tokens to apps that allow access to protected APIs, including Microsoft Graph and Azure services. With proper handling, OAuth tokens offer scalable, secure, and password-less access to modern applications.

References

Azure Multifactor Authentication (MFA)

1. Microsoft Docs – What is Azure AD Multi-Factor Authentication
    - https://learn.microsoft.com/en-us/azure/active-directory/authentication/concept-mfa-howitworks

2. Configure Azure AD Multi-Factor Authentication Settings
    - https://learn.microsoft.com/en-us/azure/active-directory/authentication/howto-mfa-mfasettings

3. Enable per-user MFA in Azure AD
    - https://learn.microsoft.com/en-us/azure/active-directory/authentication/howto-mfa-userstates

4. Conditional Access and MFA Integration
    - https://learn.microsoft.com/en-us/azure/active-directory/conditional-access/concept-conditional-access-policies

Self-Service Password Reset (SSPR)

5. Microsoft Docs – Self-service password reset overview
    - https://learn.microsoft.com/en-us/azure/active-directory/authentication/concept-sspr-howitworks

6. Set up self-service password reset in Azure AD
    - https://learn.microsoft.com/en-us/azure/active-directory/authentication/tutorial-sspr

Authentication Methods, Account Lockout, and Policies

7. Authentication Methods Policy in Microsoft Entra ID
    - https://learn.microsoft.com/en-us/entra/id-authentication/concept-authentication-methods

8. Configure account lockout settings for Azure MFA
    - https://learn.microsoft.com/en-us/azure/active-directory/authentication/howto-mfa-mfasettings#account-lockout

OAuth and Tokens

9. Microsoft Identity Platform – OAuth 2.0 Authorization Code Flow
    - https://learn.microsoft.com/en-us/azure/active-directory/develop/v2-oauth2-auth-code-flow

10. Access Tokens and Identity Tokens – Microsoft Identity Platform
    - https://learn.microsoft.com/en-us/azure/active-directory/develop/access-tokens

Azure Portal & Admin Center

11. Microsoft Entra Admin Center (Azure AD)
    - https://entra.microsoft.com/

12. Azure Portal
    - https://portal.azure.com