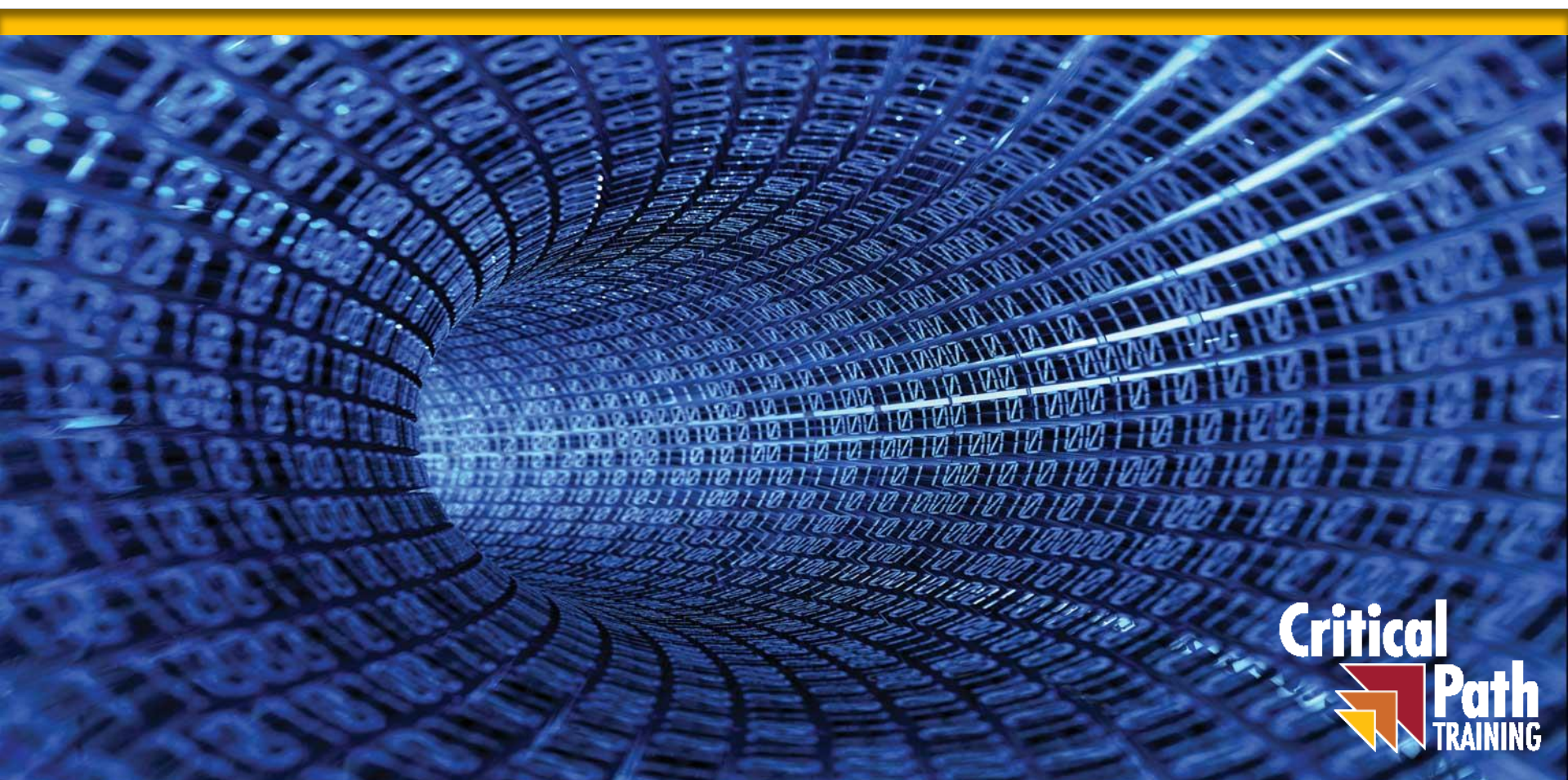


# Developing Secure Applications using Azure AD



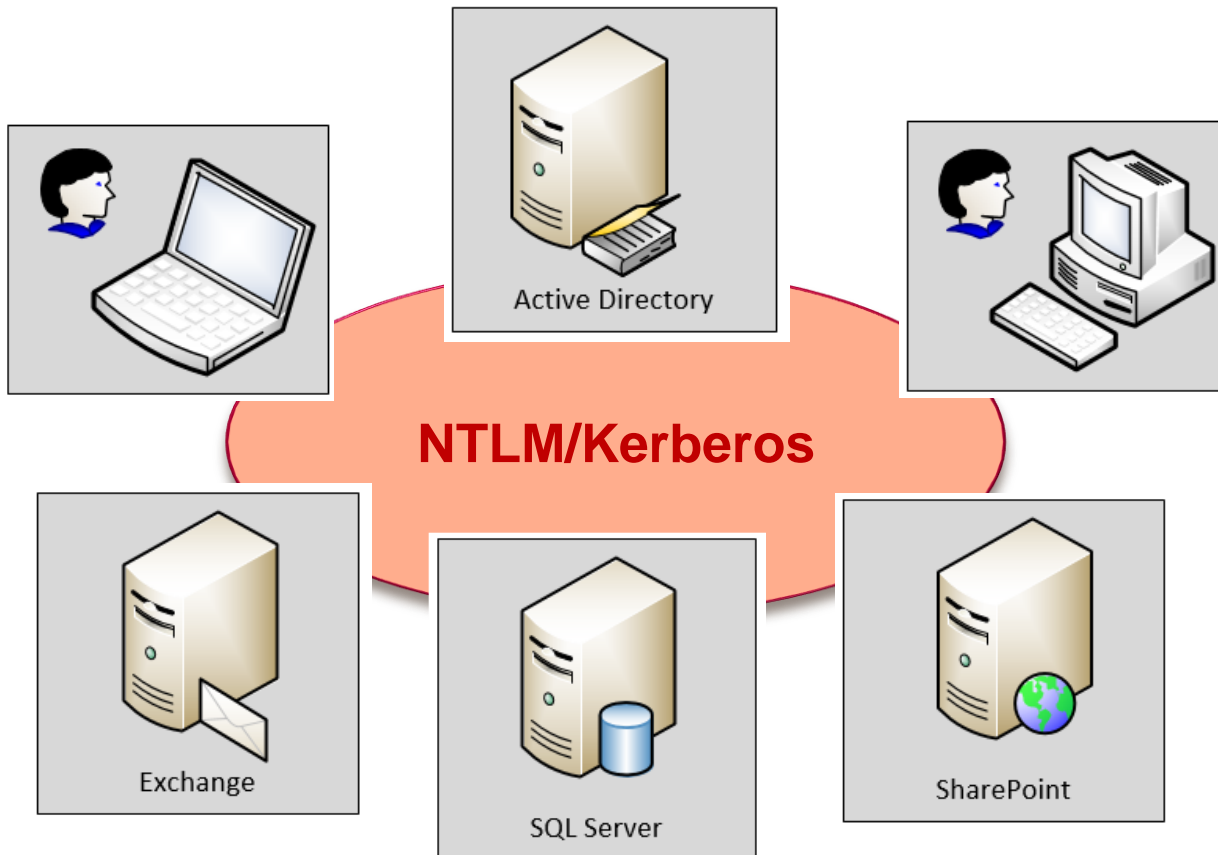
# Agenda

- Understanding OAuth 2.0 and OpenID Connect
- The Role of Azure Active Directory
- Creating & Configuring Azure AD Applications
- Securing MVC Applications using ADAL and OWIN
- Securing SPAs using ADAL.js & Implicit Grant Flow

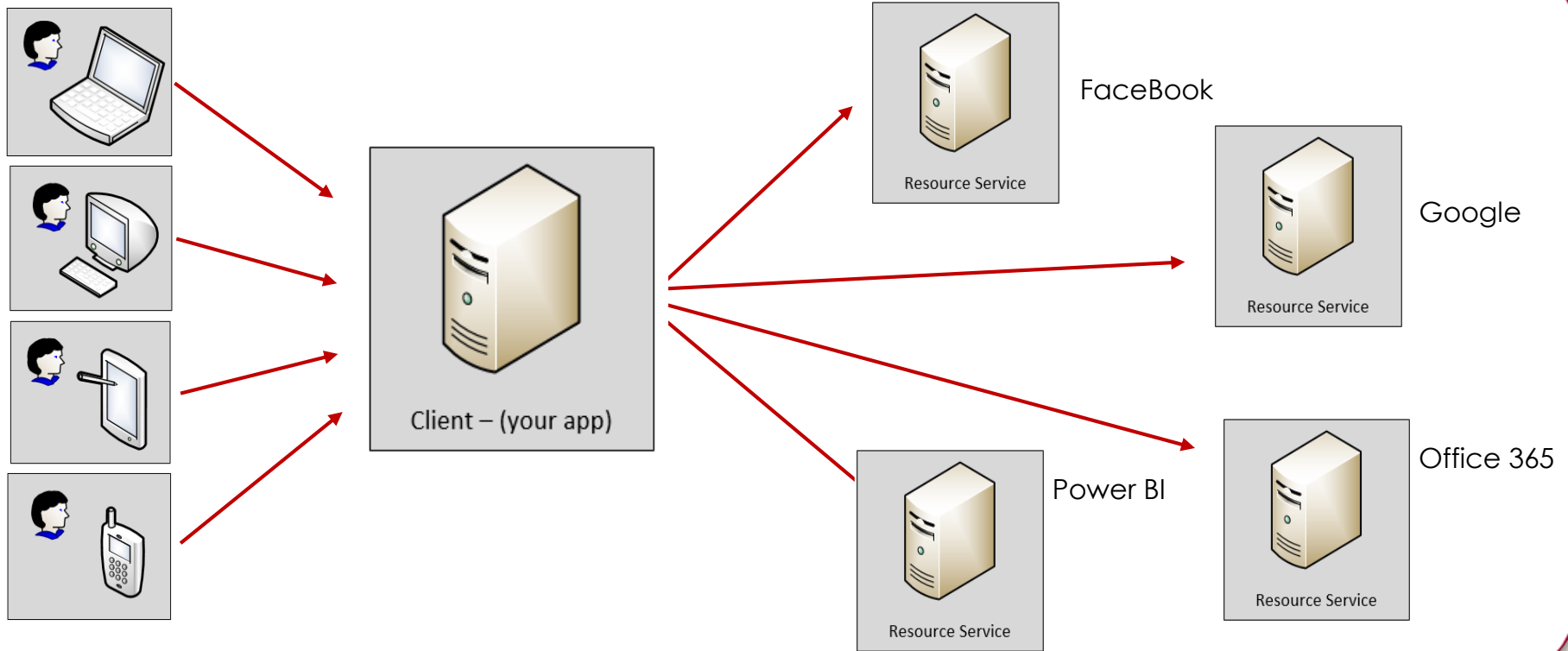


# Old-school Enterprise Security

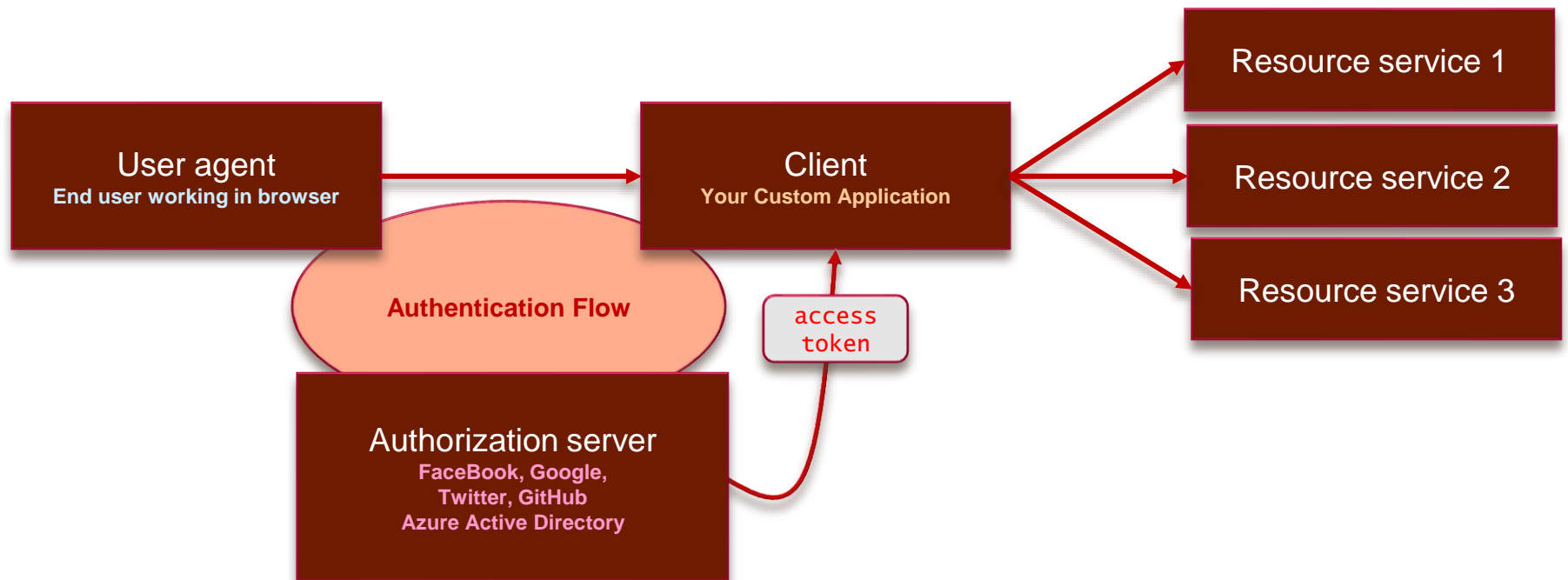
Local AD Domain: WINGTIP.COM



# Internet Security



# OAuth 2.0



# View into an Access Token

```
{
  "aud": "https://outlook.office365.com",
  "iss": "https://sts.windows.net/f995267b-5b7d-4e65-b929-d3d3e11784f9/",
  "iat": 1427935797,
  "nbf": 1427935797,
  "exp": 1427939697,
  "ver": "1.0",
  "tid": "f995267b-5b7d-4e65-b929-d3d3e11784f9",
  "amr": ["pwd"],
  "oid": "eb679998-e8b9-40c9-b61e-4198b02b3ade",
  "upn": "TedP@sharepointconfessions.onmicrosoft.com",
  "puid": "1003BFFD85265F3D",
  "sub": "CI3lh-1kN6YD_JVKoSPjmFLTd8GyOMtgMsrvdJJdaUw",
  "given_name": "Ted",
  "family_name": "Pattison",
  "name": "Ted Pattison",
  "groups": ["a5fa8ce1-abdf-44e4-9f84-158da6ec38d0"],
  "unique_name": "TedP@sharepointconfessions.onmicrosoft.com",
  "appid": "33d561fb-59a7-4817-bddf-2117193d62e0",
  "appidacr": "1",
  "scp": "Calendars.Read Contacts.Read Contacts.Write Mail.Read Mail.Send",
  "acr": "1"
}
```



# OAuth Client Registration

- Client must be registered with authorization server
  - Authorization server tracks each client with unique Client ID
  - Client should be registered with one or more Reply URLs
  - Reply URL should be fixed endpoint on Internet
  - Reply URL used to transmit security tokens to clients
  - Client registration tracks permissions and other attributes





# Authentication Flows

- User Credentials Flow (*public client*)
  - Used in Native clients to obtain access code
  - Requires passing user name and password
- Authorization Code Grant Flow (*confidential client*)
  - Client first obtains authorization code then access token
  - Server-side application code never sees user's password
- Client Credentials Grant Flow (*confidential client*)
  - Authentication based on SSL certificate with public-private key pair
  - Used to obtain access token when using app-only permissions
- Implicit Grant Flow (*public client*)
  - Used in SPAs built with JavaScript and AngularJS
  - Application obtains access token w/o acquiring authorization code



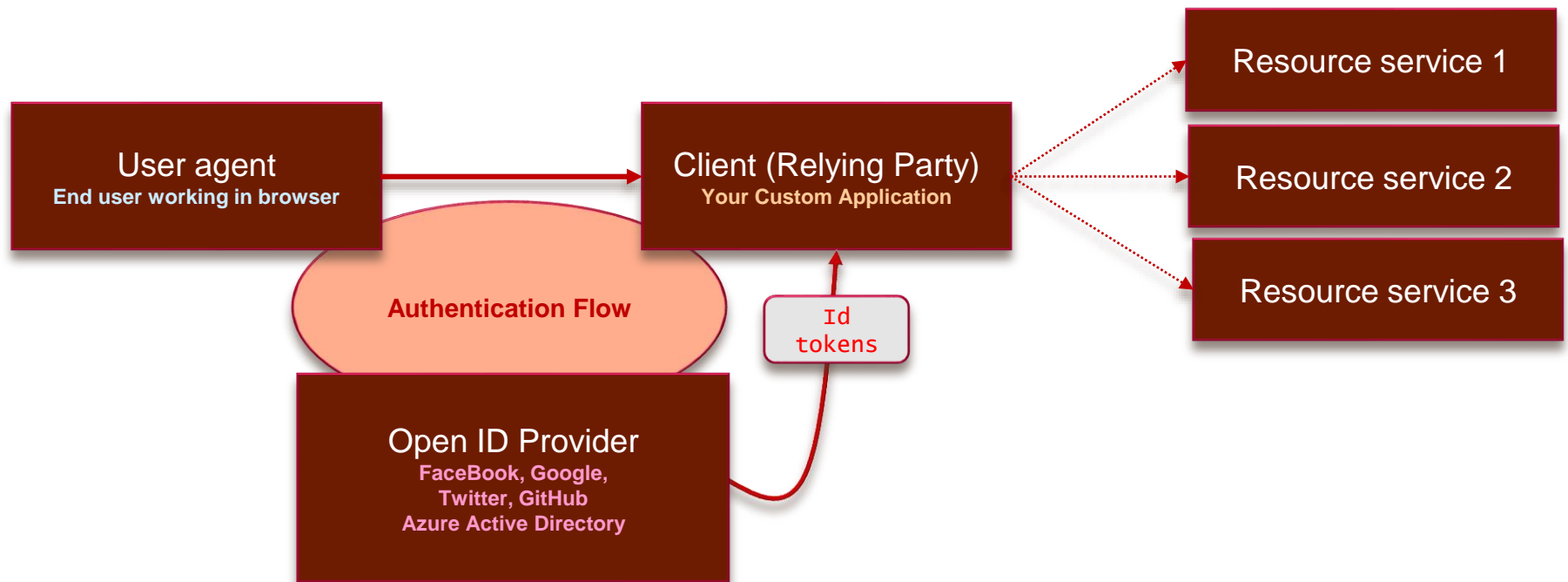


# OAuth 2.0 and Authentication

- OAuth 2.0 was designed for authorization
  - Creation of access token requires authentication
  - Authorization server passes access token to client
  - Client passes access token when calling resource services
  - Access token serves as app credentials for authorization
- Access token not intended for user authentication
  - Access token not designed to carry user identity data
  - OAuth 2.0 doesn't require validation of access token
  - Naïve OAuth 2.0 implementations subject to attack



# Open ID Connect



# Agenda

- ✓ OAuth 2.0 and OpenID Connect
- Azure Active Directory
  - Creating Azure AD applications
  - Active Directory Authentication Library for .NET
  - Programming Web Clients



# Tenants and Organizational Accounts

- Azure AD used to authenticate users and apps
  - PBI licenses are assigned to Azure AD user accounts
  - Organization owns a tenant (i.e. directory)
  - AAD tenant contains user accounts and groups
  - AAD tenant contains set of registered applications
- You must register your application with Azure AD
  - Requirement of calling to Power BI service API
  - Applications registered as Web app or Native app
  - Registered applications are assigned GUID for client ID
  - Application is configured with permissions



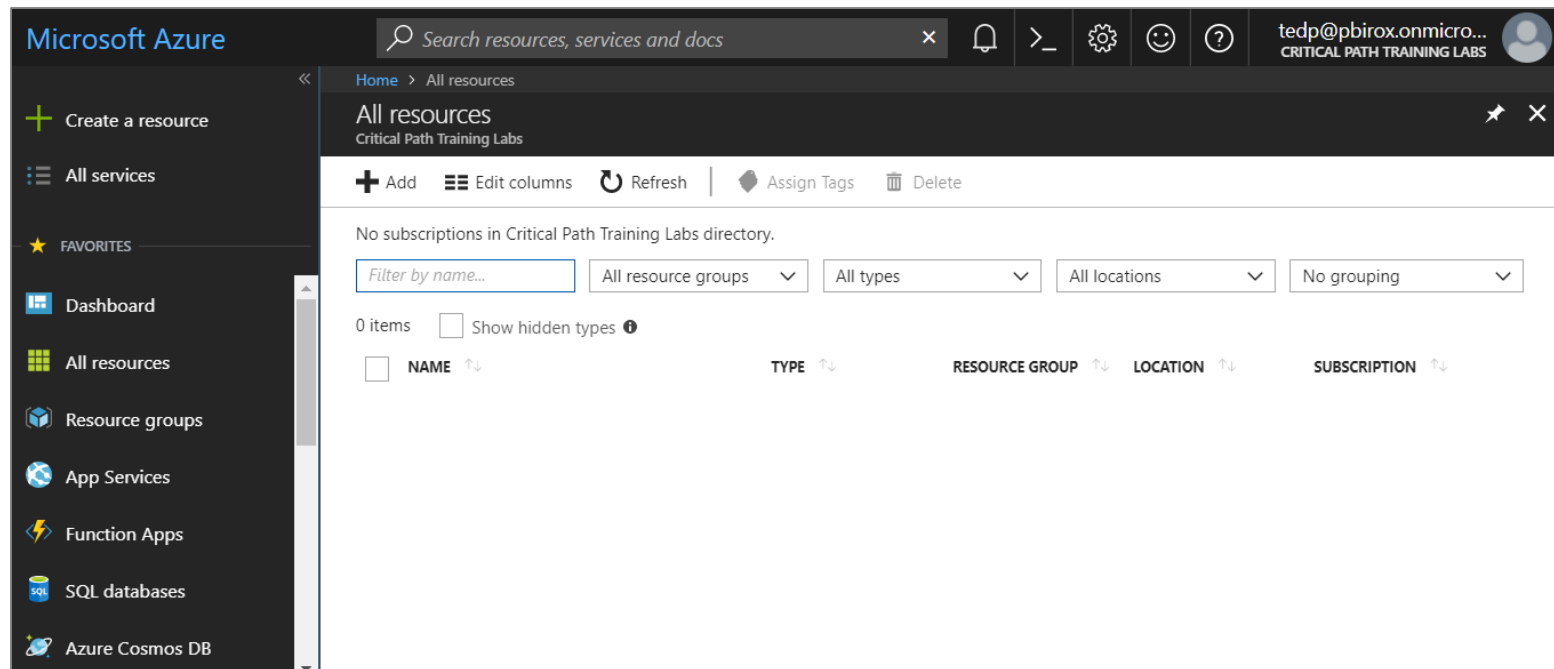
# Agenda

- ✓ OAuth 2.0 and OpenID Connect
- ✓ Azure Active Directory
- Creating Azure AD applications
  - Active Directory Authentication Library for .NET
  - Programming Web Clients



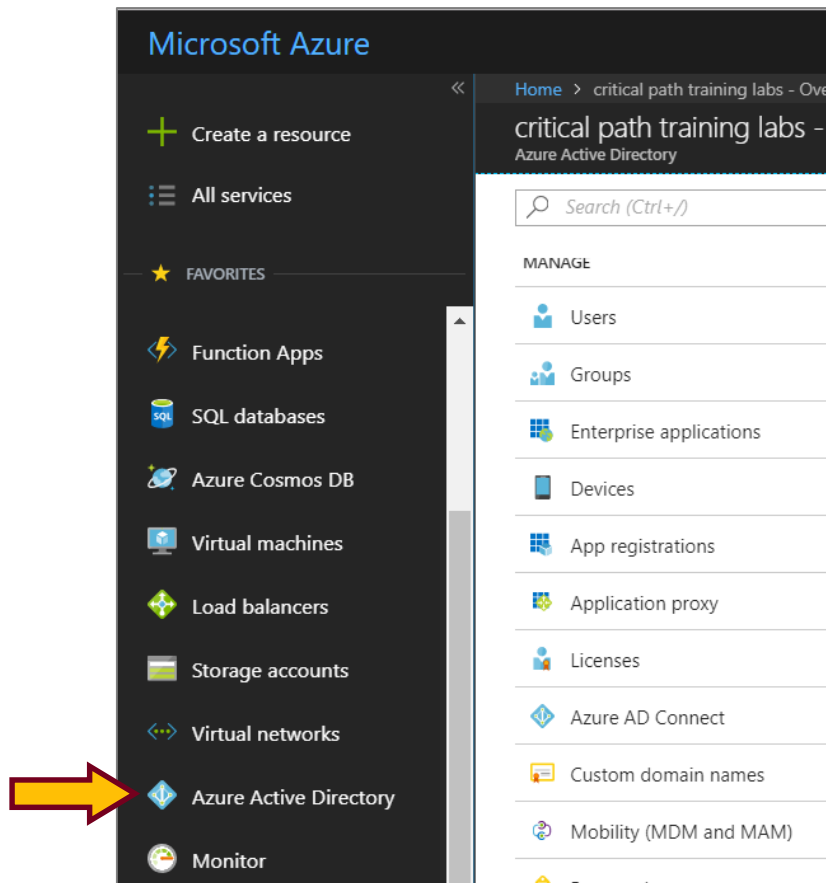
# The Azure Portal

- Azure portal allows to create application
  - Azure Portal accessible at <https://portal.azure.com>
  - Azure subscription required to create resources (e.g. VMs)
  - No Azure subscription required to manage users or applications



# Azure Active Directory

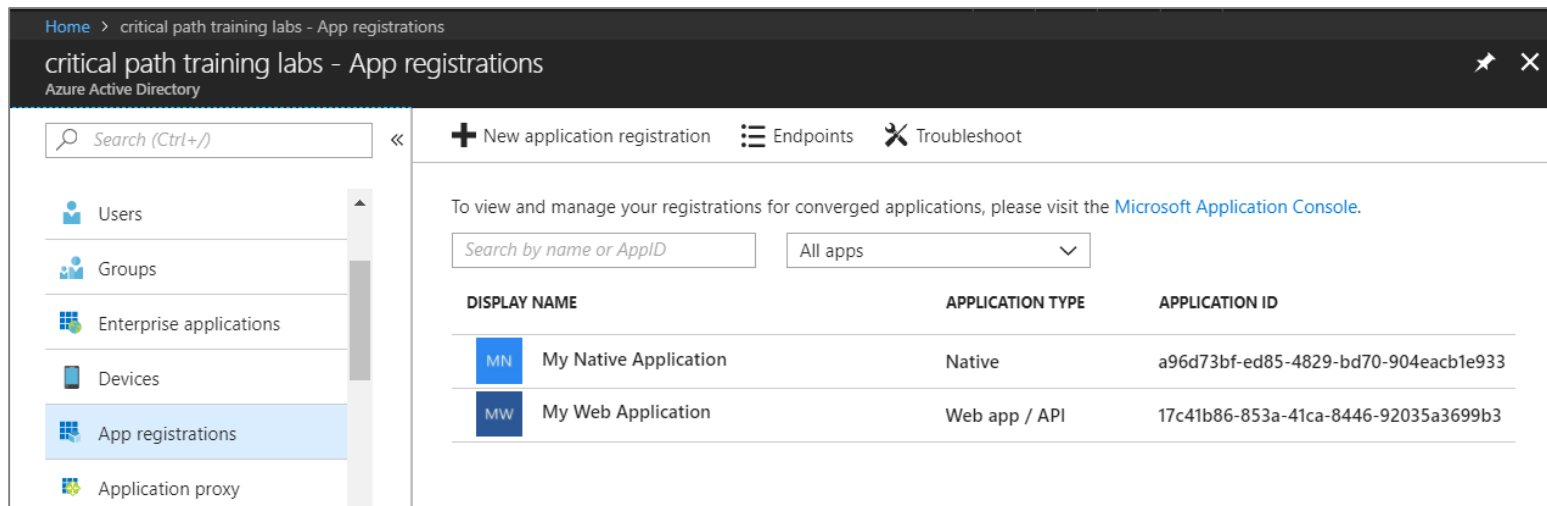
- Azure portal access to Access Azure Active Directory
  - Provides ability to configure users, groups and application





# Azure AD Applications

- Creating applications required for AAU authentication
  - Applications are as Native application or Web Applications
  - Application identified using GUID known as application ID
  - Application ID often referred to as client ID or app ID



Home > critical path training labs - App registrations

critical path training labs - App registrations

Azure Active Directory

Search (Ctrl+/)

Users

Groups

Enterprise applications

Devices

App registrations

Application proxy

+ New application registration

Endpoints

Troubleshoot

To view and manage your registrations for converged applications, please visit the [Microsoft Application Console](#).

Search by name or AppID

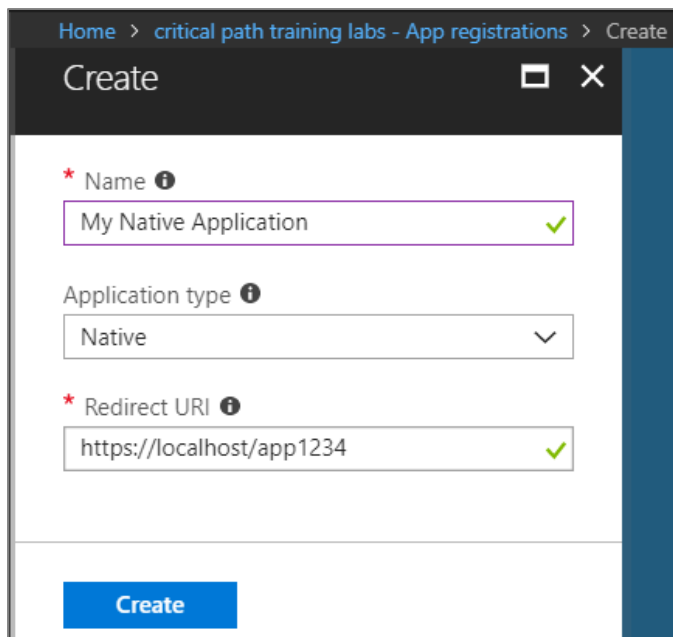
All apps

|    | DISPLAY NAME          | APPLICATION TYPE | APPLICATION ID                       |
|----|-----------------------|------------------|--------------------------------------|
| MN | My Native Application | Native           | a96d73bf-ed85-4829-bd70-904each1e933 |
| MW | My Web Application    | Web app / API    | 17c41b86-853a-41ca-8446-92035a3699b3 |



# Creating a Native Application

- Power BI supports Native applications
  - Can be used for desktop applications and Console applications
  - Used for third party embedding (known as App Owns Data model)
  - Application type should be configured as Native
  - Requires Redirect URI with unique string - not an actual URL



The screenshot shows a 'Create' dialog box with the following fields:

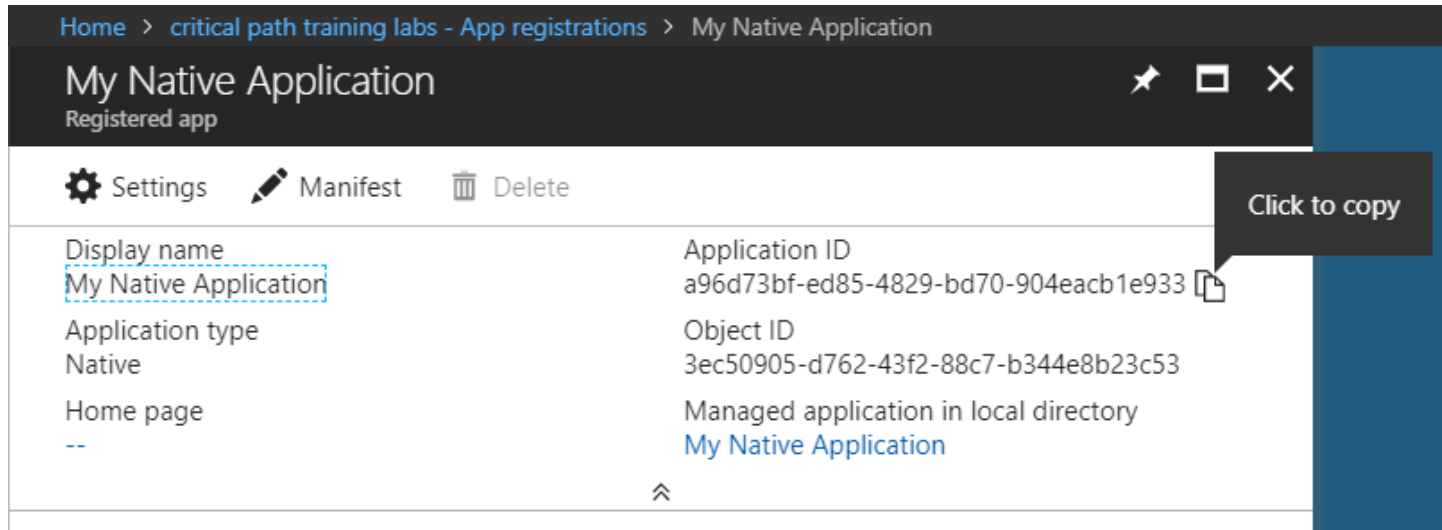
- Name:** My Native Application (with a green checkmark icon)
- Application type:** Native (with a dropdown arrow)
- Redirect URI:** https://localhost/app1234 (with a green checkmark icon)

A blue 'Create' button is located at the bottom left of the dialog box.



# Copying the Application ID

- Each new application created with Application ID
  - You cannot supply your own GUID for application ID
  - Azure AD will always create this GUID
  - You can copy the application ID from the azure portal



Home > critical path training labs - App registrations > My Native Application

## My Native Application

Registered app

Settings Manifest Delete

|                       |  |
|-----------------------|--|
| Display name          | Application ID                         |
| My Native Application | a96d73bf-ed85-4829-bd70-904eacb1e933   |
| Application type      | Object ID                              |
| Native                | 3ec50905-d762-43f2-88c7-b344e8b23c53   |
| Home page             | Managed application in local directory |
| --                    | <a href="#">My Native Application</a>  |

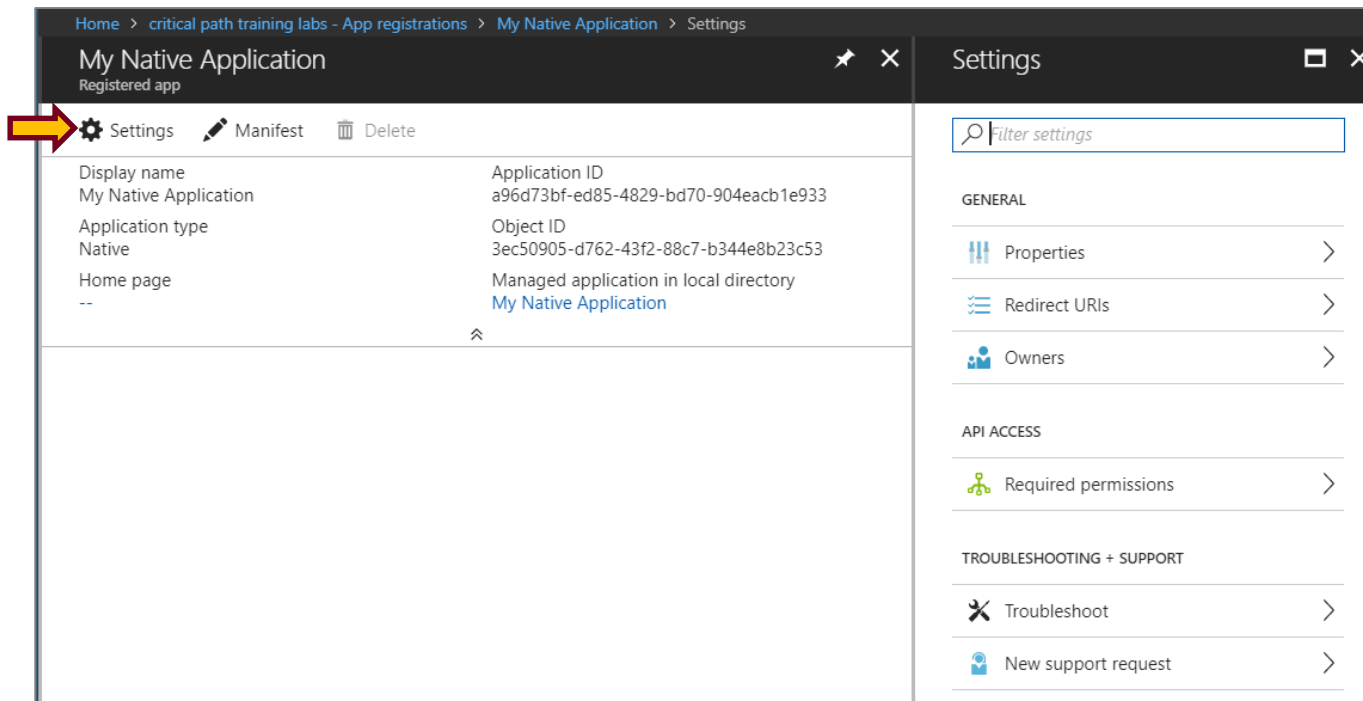
⌵

Click to copy



# Native Application Settings

- Properties
- Redirect URLs
- Owners
- Required Permissions



The screenshot displays the Azure Portal interface for managing a native application. The breadcrumb navigation at the top reads: Home > critical path training labs - App registrations > My Native Application > Settings. The main header shows 'My Native Application' with a star icon and a close button, and below it, 'Registered app'. The left sidebar contains three buttons: 'Settings' (highlighted with a red arrow), 'Manifest' (pencil icon), and 'Delete' (trash icon). The main content area is divided into two panels. The left panel lists application properties: Display name (My Native Application), Application ID (a96d73bf-ed85-4829-bd70-904eacb1e933), Application type (Native), and Home page (Managed application in local directory, with a link to 'My Native Application'). The right panel, titled 'Settings', features a search bar 'Filter settings' and three sections: 'GENERAL' with links for Properties, Redirect URLs, and Owners; 'API ACCESS' with a link for Required permissions; and 'TROUBLESHOOTING + SUPPORT' with links for Troubleshoot and New support request.

| Property         | Value   |
|------------------|---|
| Display name     | My Native Application   |
| Application ID   | a96d73bf-ed85-4829-bd70-904eacb1e933  |
| Application type | Native  |
| Home page        | Managed application in local directory<br><a href="#">My Native Application</a> |

**Settings**

Filter settings

**GENERAL**

- Properties
- Redirect URLs
- Owners

**API ACCESS**

- Required permissions

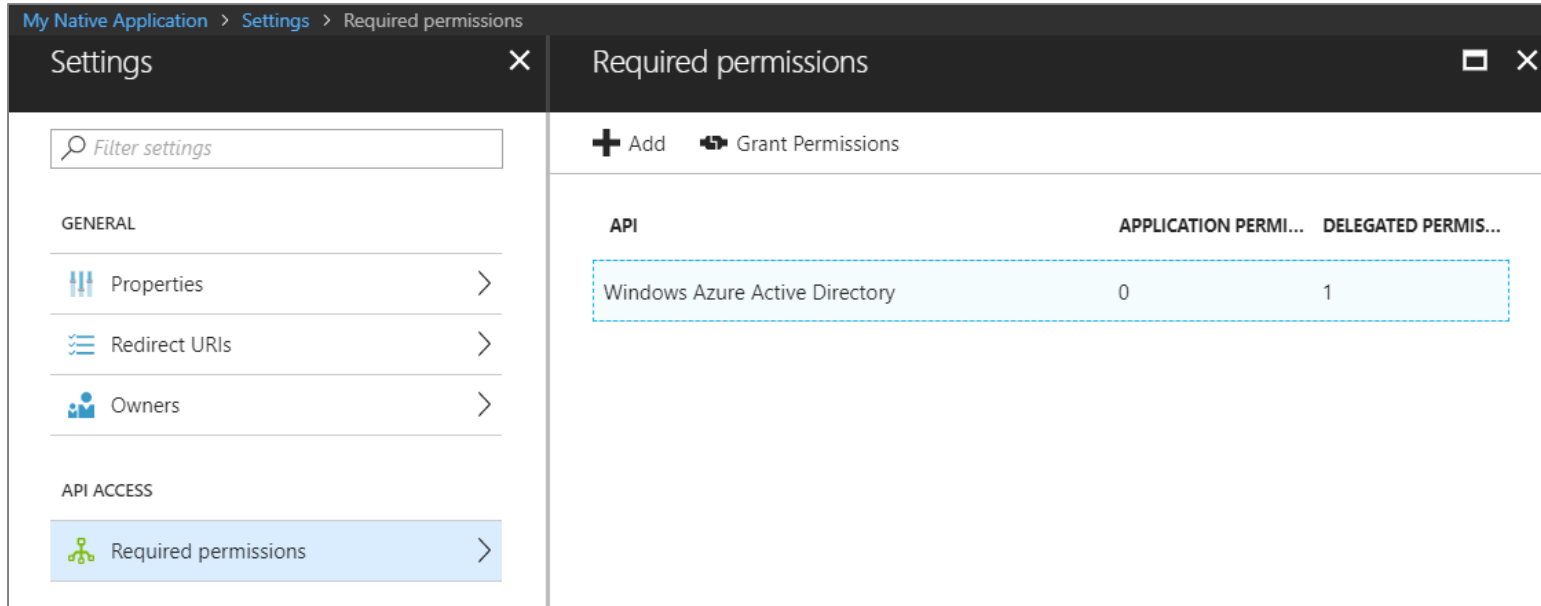
**TROUBLESHOOTING + SUPPORT**

- Troubleshoot
- New support request



# Configuring Required Permissions

- Application configured with permissions
  - Default permissions allows user authentication – but that's it
  - To use APIs, you must assign permissions to the application



The screenshot shows the 'Required permissions' settings page for a native application. The left sidebar contains a 'Settings' menu with a search bar and two sections: 'GENERAL' (Properties, Redirect URIs, Owners) and 'API ACCESS' (Required permissions). The main panel is titled 'Required permissions' and includes '+ Add' and 'Grant Permissions' buttons. Below these is a table with columns 'API', 'APPLICATION PERMI...', and 'DELEGATED PERMIS...'. A single row is visible, representing 'Windows Azure Active Directory' with values '0' and '1'.

| API                            | APPLICATION PERMI... | DELEGATED PERMIS... |
|--------------------------------|----------------------|---------------------|
| Windows Azure Active Directory | 0                    | 1                   |



# Choosing APIs

- There are lots of APIs to choose from
  - Microsoft Graph
  - Office 365 SharePoint Online
  - Power BI Service

My Native Application > Settings > Required permissions > Add API access > Select an API

Add API access

1

Select an API

Power BI Service

>

2

Select permissions

>

Done

Select an API

Windows Azure Active Directory

Office 365 Exchange Online

Microsoft Graph

Office 365 SharePoint Online

Skype for Business Online

Office 365 Yammer

Power BI Service

Microsoft Rights Management Services

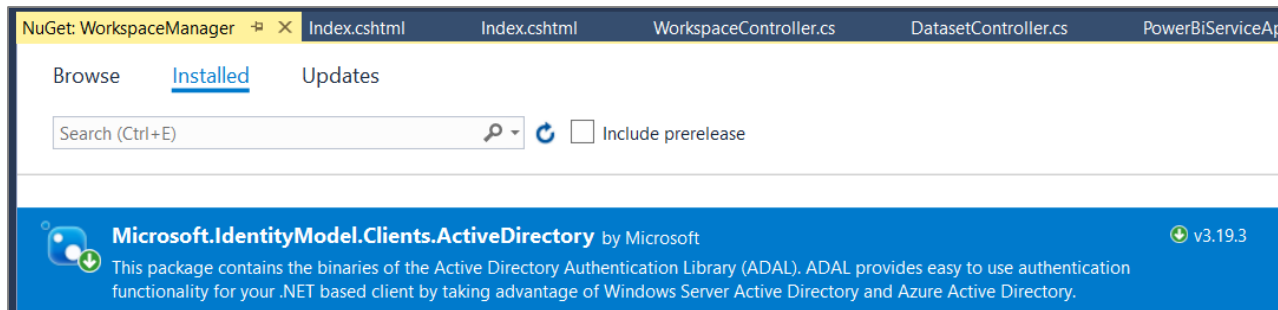
Microsoft Intune API

Select



# ADAL for .NET

- Active Directory Authentication Library for .NET
  - Used in Native Clients and in Web Clients
  - Handles authentication flow behind the scenes
  - Provides caching for access tokens and refresh tokens



- ADAL .NET installs as a NuGet Package
  - Package name is **Microsoft.IdentityModel.Clients.ActiveDirectory**





# Access Token Acquisition (Native Client)

- With interactive login

```
static string aadAuthorizationEndpoint = "https://login.windows.net/common/oauth2/authorize";
static string resourceUriPowerBi = "https://analysis.windows.net/powerbi/api";
static string urlPowerBiRestApiRoot = "https://api.powerbi.com/";

public const string clientId = "315e87eb-a6a0-4886-9b20-9f7ecdaca888";
public const string redirectUrl = "https://localhost/app1234";

static string GetAccessToken() {
    // create new authentication context
    var authenticationContext = new AuthenticationContext(aadAuthorizationEndpoint);

    // use authentication context to trigger user sign-in and return access token
    var userAuthnResult = authenticationContext.AcquireTokenAsync(resourceUriPowerBi,
                                                                clientId,
                                                                new Uri(redirectUrl),
                                                                new PlatformParameters(PromptBehavior.Auto)).Result;

    // return access token to caller
    return userAuthnResult.AccessToken;
}
```

- With Direct User Credentials (non-interactive)

```
string userName = "tedp@sharepointconfessions.onmicrosoft.com";
string userPassword = "Dublin@1234";

UserPasswordCredential creds = new UserPasswordCredential(userName, userPassword);
var userAuthnResult = authenticationContext.AcquireTokenAsync(PowerBiServiceResourceUri,
                                                                ClientID,
                                                                creds).Result;

// cache access token in AccessToken field
AccessToken = userAuthnResult.AccessToken;
```



# Delegated Permissions vs Application Permissions

- Permissions categorized into two basic types
  - Delegated permissions are (app + user) permissions
  - Application permissions are app-only permissions (far more powerful)
  - Not all application types and APIs support application permissions
  - Power BI Service API does not yet support application permissions
- Example permissions for Office 365 SharePoint Online
  - Some delegated permissions requires administrative permissions

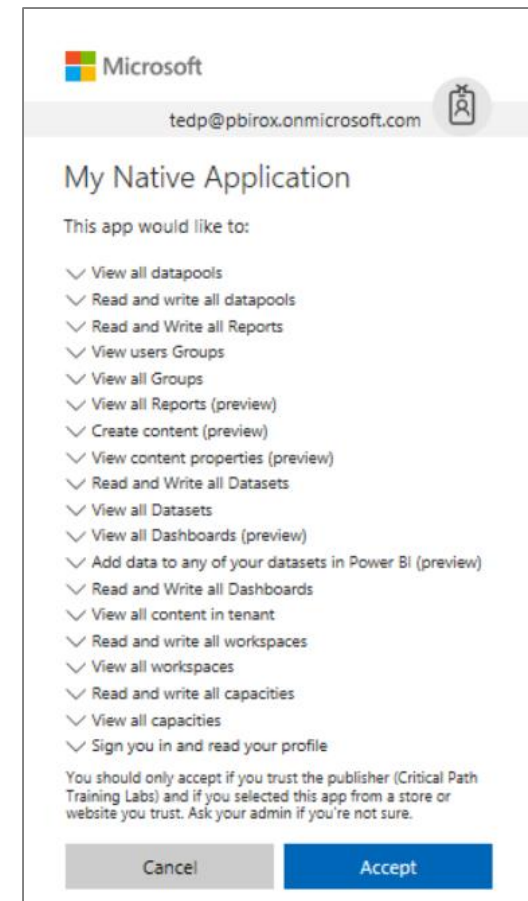
| <input type="checkbox"/> DELEGATED PERMISSIONS   | REQUIRES ADMIN |
|--|----------------|
| Run search queries as a user   | ✓ Yes          |
| Read user profiles   | ✓ Yes          |
| <input checked="" type="checkbox"/> Read user files  | ✗ No           |
| Read managed metadata  | ✓ Yes          |
| <input checked="" type="checkbox"/> Read items in all site collections                     | ✗ No           |
| Read and write user profiles   | ✓ Yes          |
| <input checked="" type="checkbox"/> Read and write user files                              | ✗ No           |
| Read and write managed metadata  | ✓ Yes          |
| <input checked="" type="checkbox"/> Read and write items in all site collections           | ✗ No           |
| <input checked="" type="checkbox"/> Read and write items and lists in all site collections | ✗ No           |
| Have full control of all site collections  | ✓ Yes          |

| APPLICATION PERMISSIONS                                | REQUIRES ADMIN |
|--|----------------|
| Read user profiles                                     | ✓ Yes          |
| Read and write user profiles                           | ✓ Yes          |
| Read and write managed metadata                        | ✓ Yes          |
| Read managed metadata                                  | ✓ Yes          |
| Read and write items and lists in all site collections | ✓ Yes          |
| Have full control of all site collections              | ✓ Yes          |
| Read items in all site collections                     | ✓ Yes          |
| Read and write items in all site collections           | ✓ Yes          |



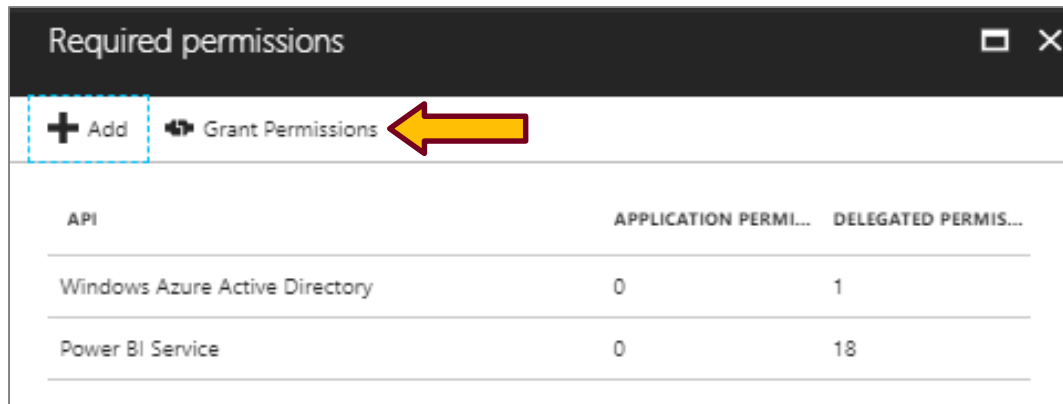
# Interactive Consent for Delegated Permissions

- Users must consent to delegated permissions
  - User prompted during first log in
  - User must click Accept
  - Only occurs once for each user



# Granting Delegated Permissions

- It can be helpful to Grant Permissions in Azure portal
  - Prevents the need for interactive granting of application by user
  - Might be required when authenticating in non-interactive fashion



| Required permissions   |                      |                     |
|--|----------------------|---------------------|
| <div><span>+</span> Add <span>🔑</span> Grant Permissions</div> |                      |                     |
| API  | APPLICATION PERMI... | DELEGATED PERMIS... |
| Windows Azure Active Directory                                 | 0                    | 1                   |
| Power BI Service   | 0                    | 18                  |



# Single versus Multi-tenant

- Single tenant application
  - intended for use within a single organization
  - line-of-business applications written by an Office 365 developer
  - only needs to be accessed by users in one Office 365 tenancy
  - typically registered by a developer in the organization
- Multi-tenant application
  - intended for use across many organizations
  - software-as-a-service (SaaS) applications written by ISVs
  - need to be provisioned in each directory where they will be used
  - requires user or administrator consent to register them







**DEMO**

# Creating an AAD Application

# Agenda

- ✓ OAuth 2.0 and OpenID Connect
- ✓ Azure Active Directory
- ✓ Creating Azure AD applications
- Active Directory Authentication Library for .NET
- Programming Web Clients





# ADAL for .NET

- Active Directory Authentication Library for .NET
  - Used in Native Clients and in Web Clients
  - Handles authentication flow behind the scenes
  - Provides token cache



## **Microsoft.IdentityModel.Clients.ActiveDirectory**

This package contains the binaries of the Active Directory Authentication Library (ADAL). ADAL provides easy to use authentication functionality for your .NET client and Windows Store apps by taking advantage of Windows Server Active Directory and Windows Azure Active Directory.



- ADAL .NET installs as a NuGet Package
  - Version 2.x is latest stable version
  - Version 3.x is in prerelease





**DEMO**

# Using ADAL in a Native Client

# Agenda

- ✓ OAuth 2.0 and OpenID Connect
- ✓ Azure Active Directory
- ✓ Creating Azure AD applications
- ✓ Active Directory Authentication Library for .NET
- Programming Web Clients



# Authentication Code Flow

- Provides Highest Levels of Security
  - User credentials never seen by client
  - Access token passed to client with Reply URL
  - Access token not passed through user agent
- Refresh tokens used to get new access tokens
  - Access token lifetime is about 1 hour
  - Refresh token lifetime is 14 days
  - AAD supports multi-resource refresh tokens (MRRTs)





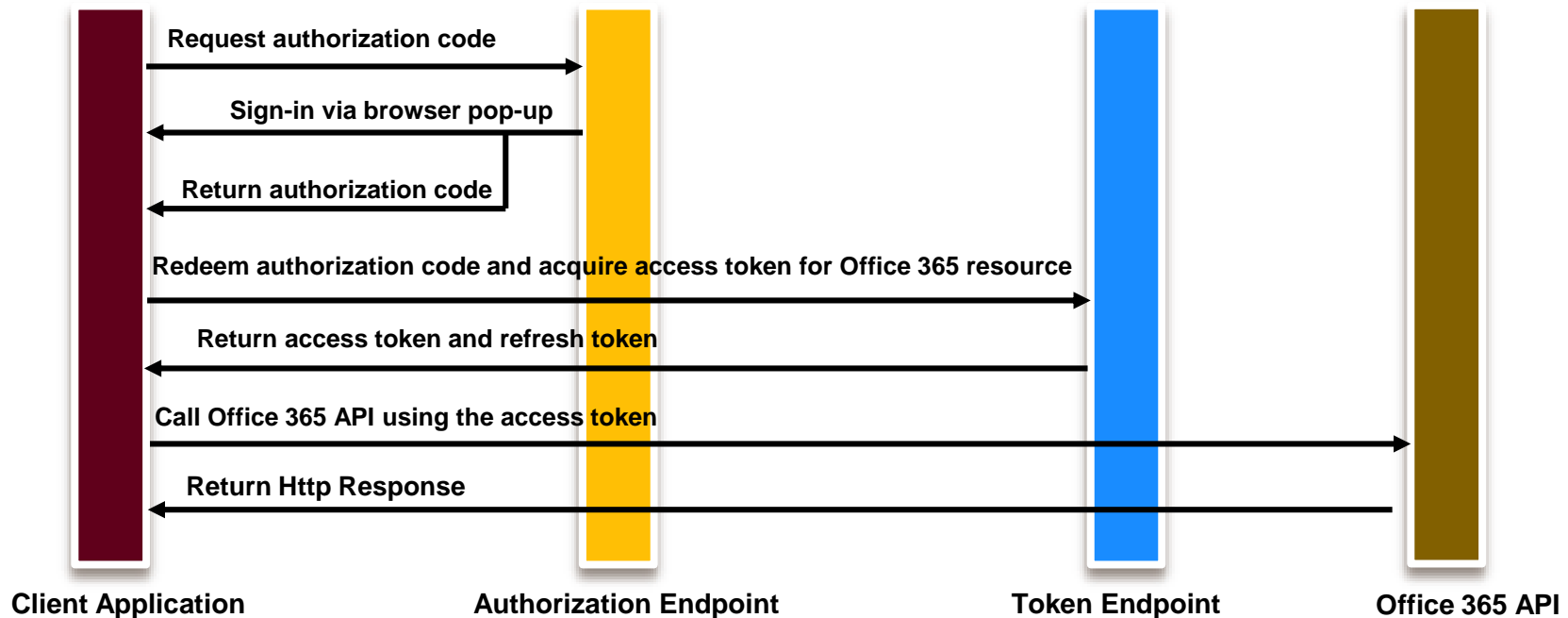
# Authorization Code Grant Flow Example

- **Sign-on URL**
  - Development: <https://localhost:44300/>
  - Production: <https://www.MyDomain.com/>
- **Reply URL**
  - Development: <https://localhost:44300/AcceptDirect>
  - Production: <https://www.MyDomain.com/AcceptDirect>
- **Application ID URI**
  - String-based identifier for an application – *not a retrievable URL*
  - <https://sharepointconfessions.onmicrosoft.com/HelloWorldApp>
- **Client ID**
  - GUID-based identifier for a specific AAD application
  - [33d561fb-59a7-4817-bddf-2117193d62e0](#)
- **Key** (aka Client Secret)
  - Key that acts as a secret password between Azure AD and application
  - [ouWdh2LxDI0Pcu2SKlujEiQ5GmSbKRbBM24nETb5dw=](#)



# Authorization Code Grant Flow

- Sequence of Requests in Authorization Code Grant Flow
  - Application redirects to AAD authorization endpoint
  - User prompted to log on at Windows logon page
  - User prompted to consent to permissions (first access)
  - AAD redirects to application with authorization code
  - Application redirects to AAD access token endpoint





**DEMO**

# Using ADAL in a Web Client

# Summary of OAuth Client Types

|                                   | Web Client SPA | Hybrid Native Client   | Web Application Client | Web Service Client |
|-----------------------------------|----------------|------------------------|------------------------|--------------------|
| Client Type                       | Public         | Public or Confidential | Confidential           | Confidential       |
| Verifiable Reply URL              | Yes            | No                     | Yes                    | Yes                |
| Authenticates Client              | No             | It Depends             | Yes                    | Yes                |
| Token from Authorization Endpoint | Yes            | Yes                    | No                     | No                 |
| Access Token from URI Fragment    | Yes            | No                     | No                     | No                 |
| Token from Token Endpoint         | No             | Yes                    | Yes                    | Yes                |
| Can use refresh tokens            | No             | Yes                    | Yes                    | Yes                |
| Permissions                       | Delegated      | Delegated + App        | Delegated + App        | Delegated + App    |





# Summary

- ✓ OAuth 2.0 and OpenID Connect
- ✓ Azure Active Directory
- ✓ Creating Azure AD applications
- ✓ Active Directory Authentication Library for .NET
- ✓ Programming Web Clients

