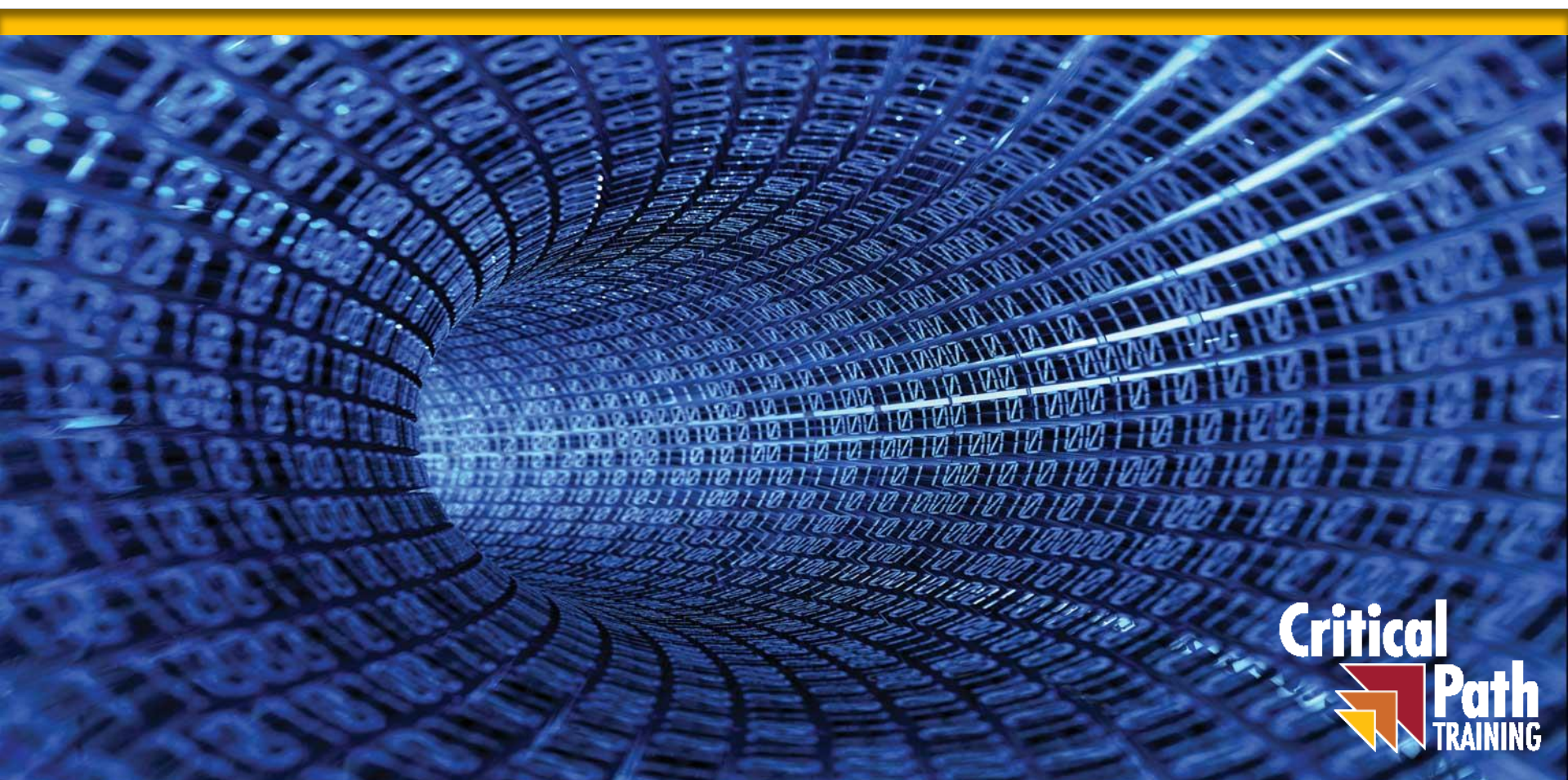


Developing Secure Applications using Azure AD



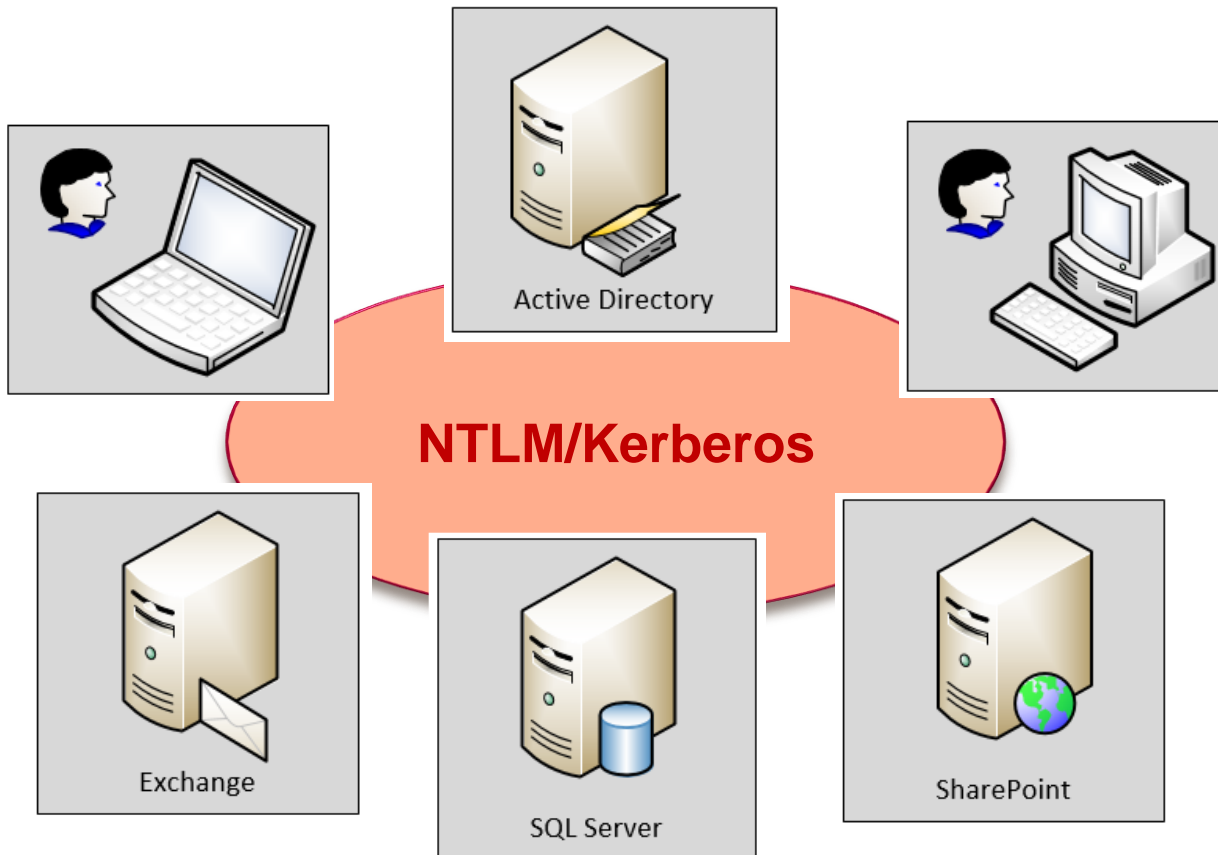
Agenda

- 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

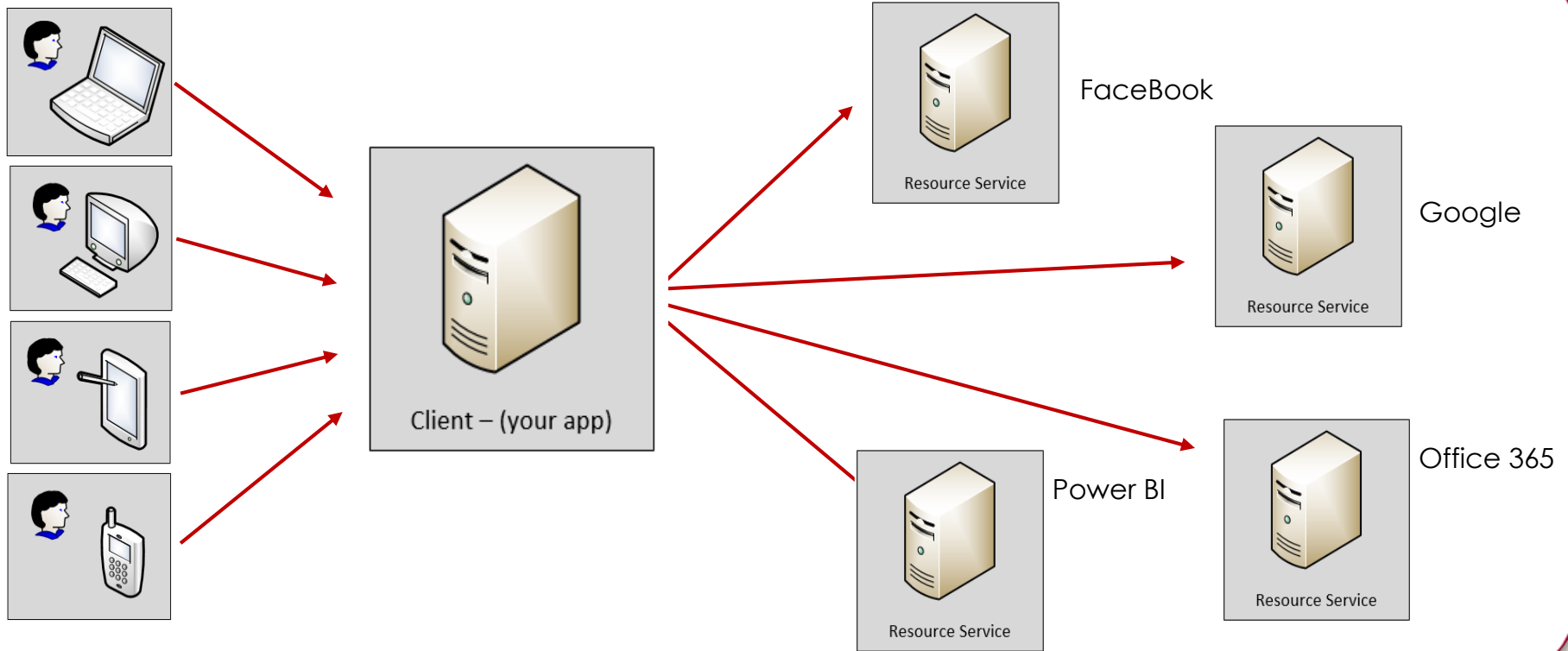


Old-school Enterprise Security

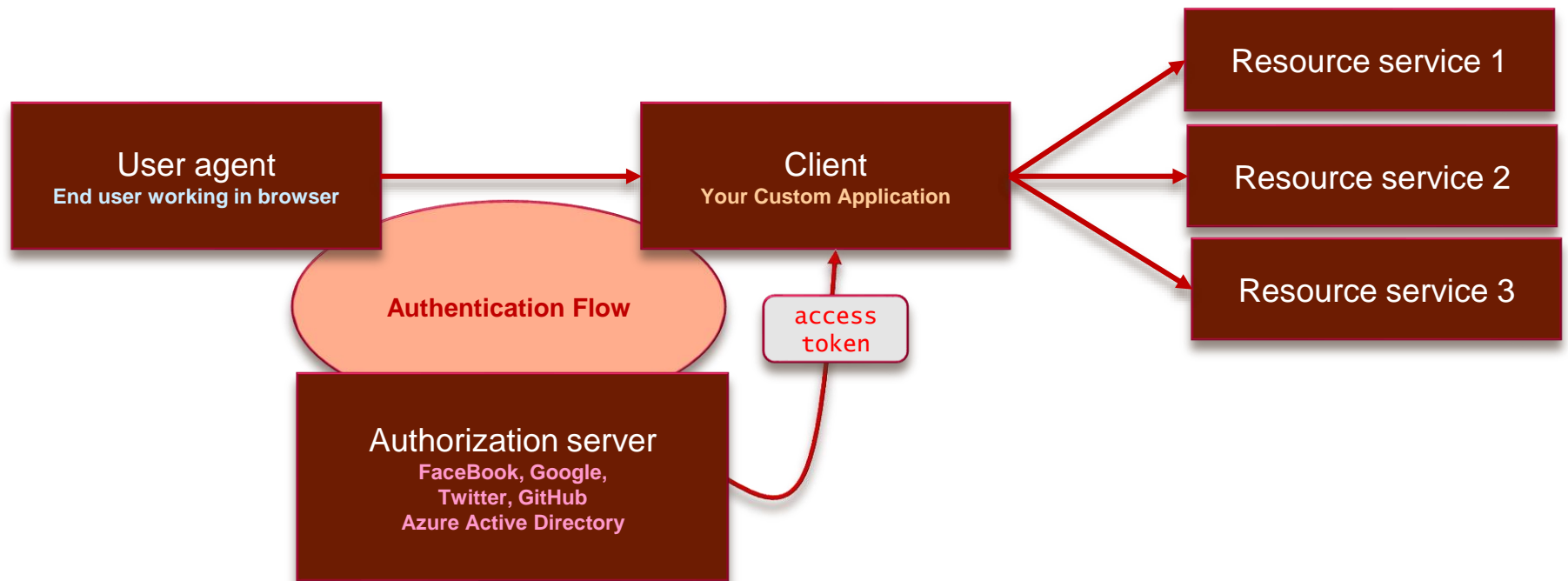
Local AD Domain: WINGTIP.COM



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

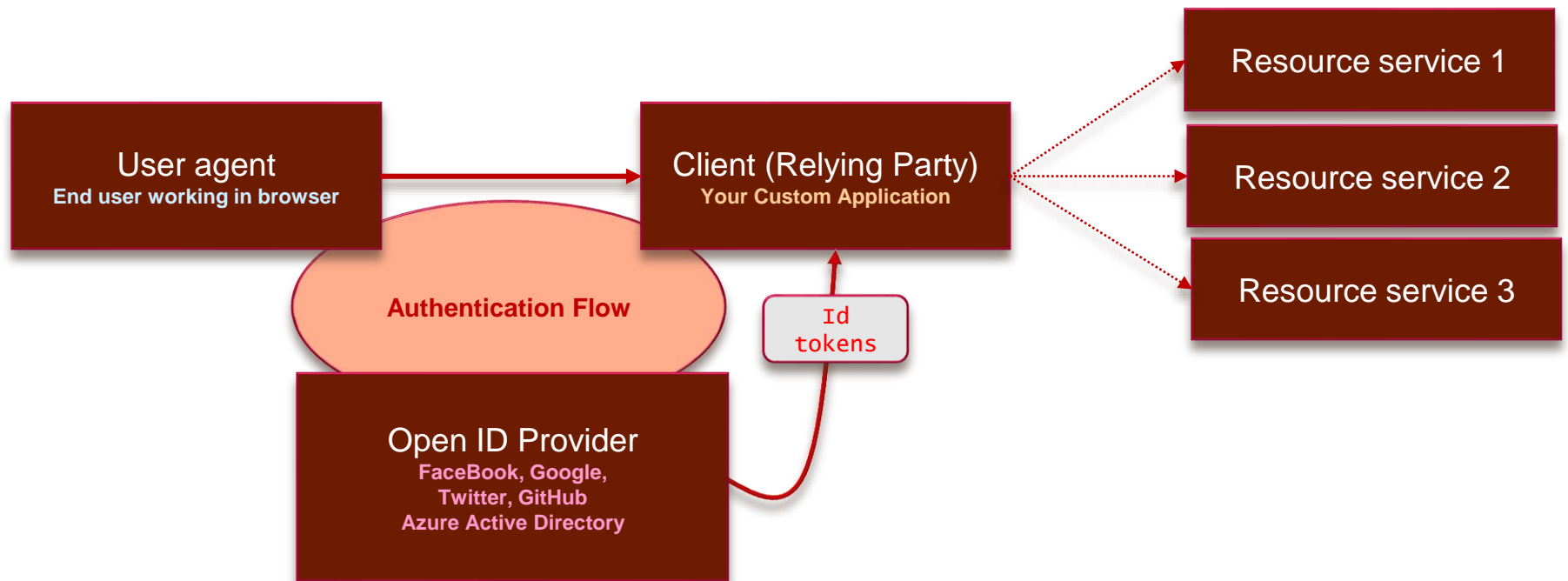


OAuth 2.0 and Authentication

- 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



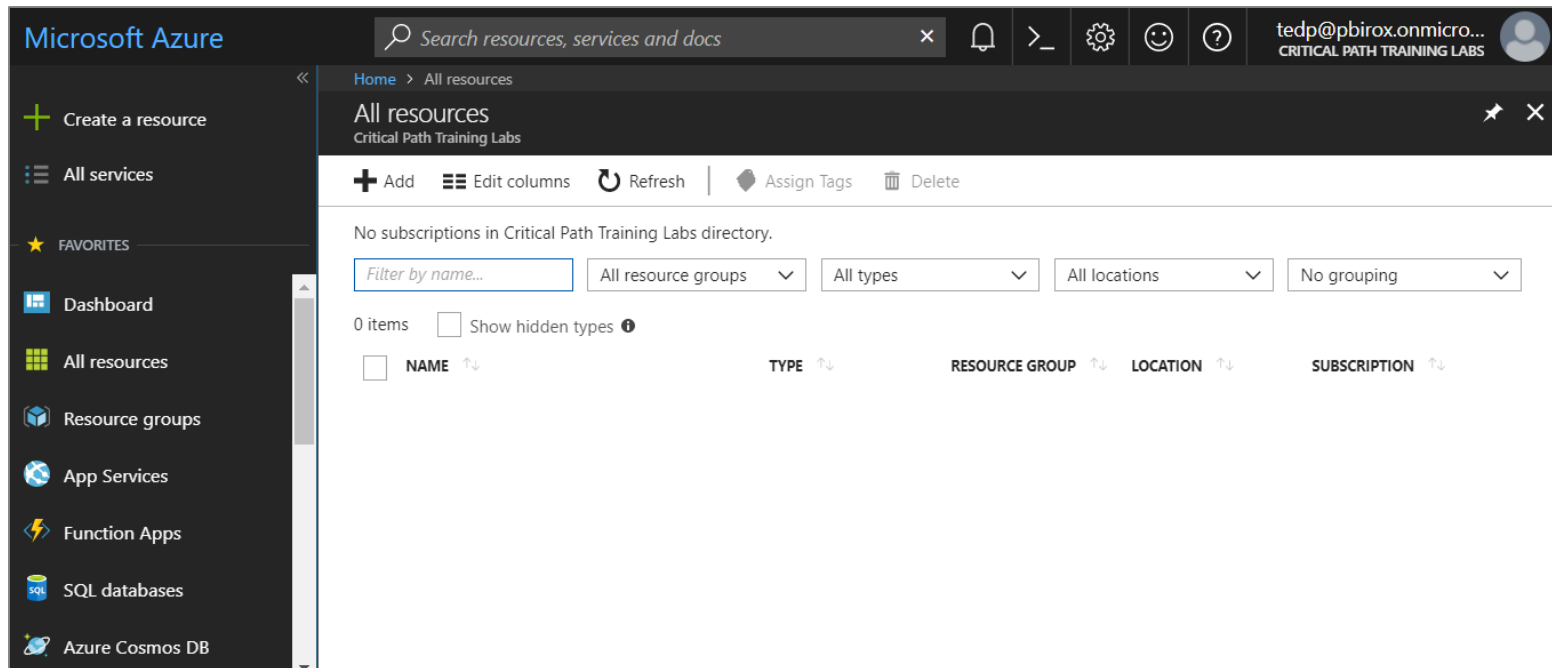
Agenda

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



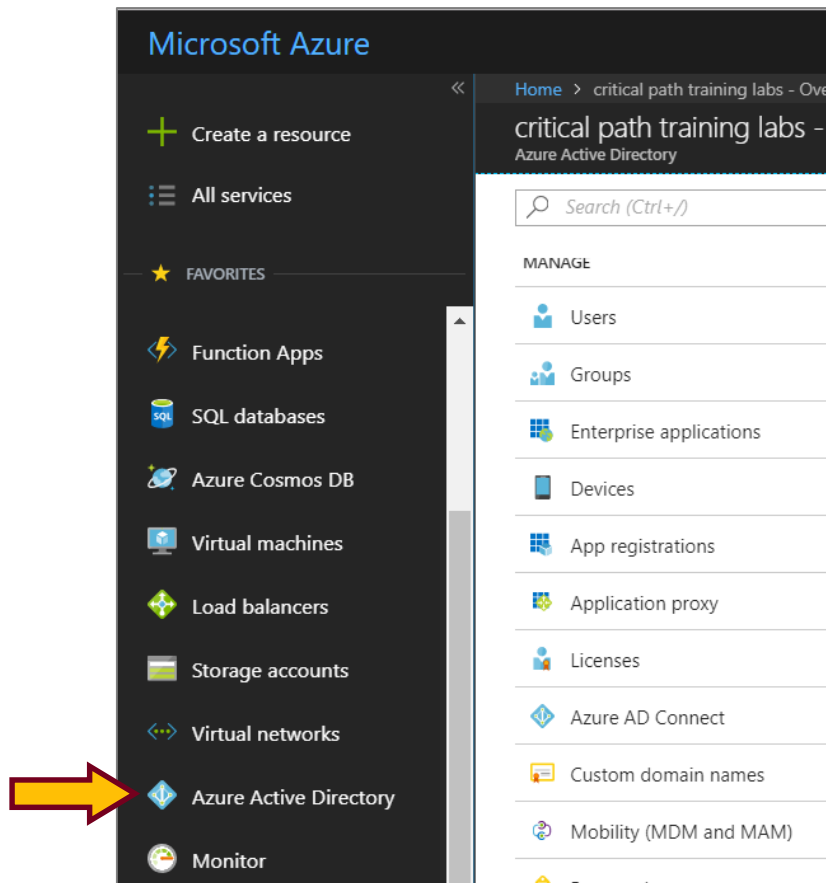
The Azure Portal

- 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



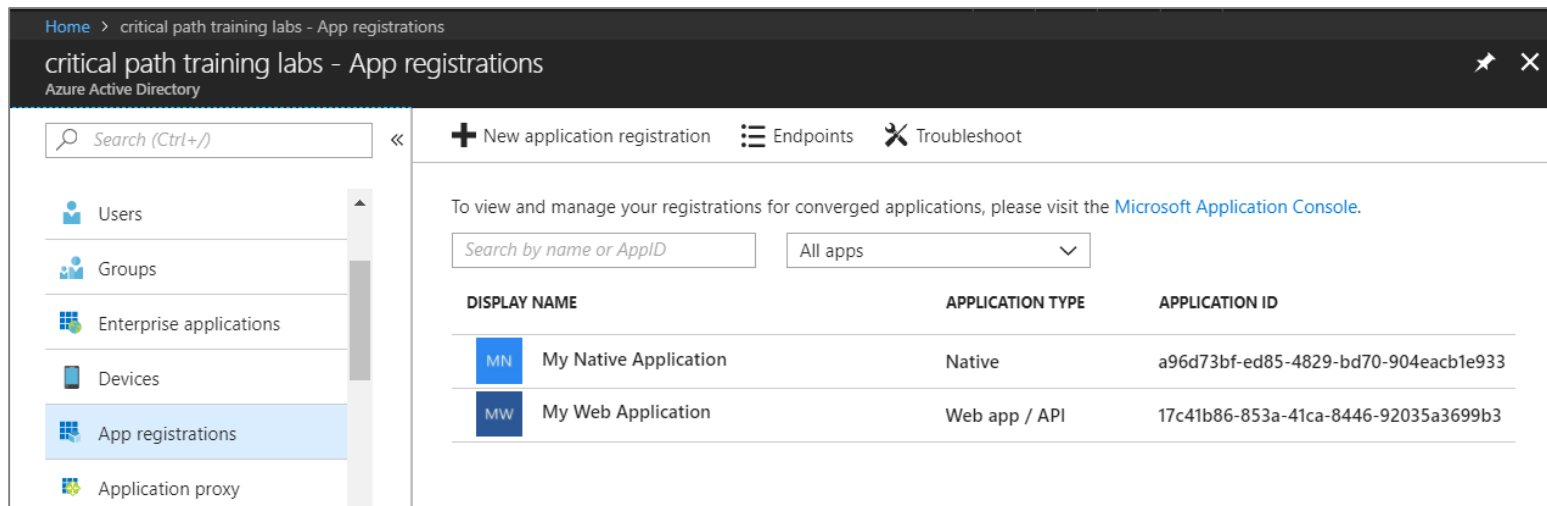
Azure Active Directory

- 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



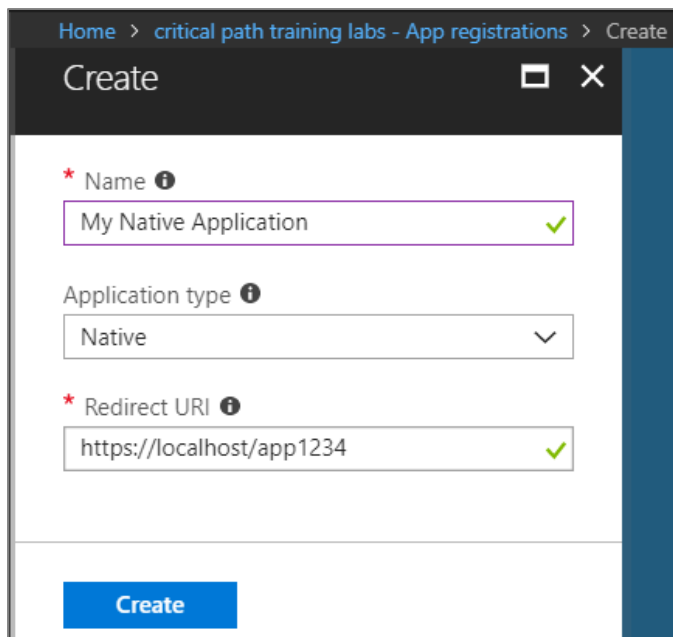
The screenshot shows the Azure Active Directory (Azure AD) 'App registrations' page. The left sidebar contains navigation links: Users, Groups, Enterprise applications, Devices, App registrations (selected), and Application proxy. The main content area has a search bar and a list of application registrations. The table below shows the details of two applications: 'My Native Application' and 'My Web Application'.

	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 the 'Create' dialog box in the Azure portal. The breadcrumb navigation at the top reads 'Home > critical path training labs - App registrations > Create'. The dialog has a title bar with 'Create' and window control buttons. It contains three required fields, each marked with a red asterisk and an information icon:

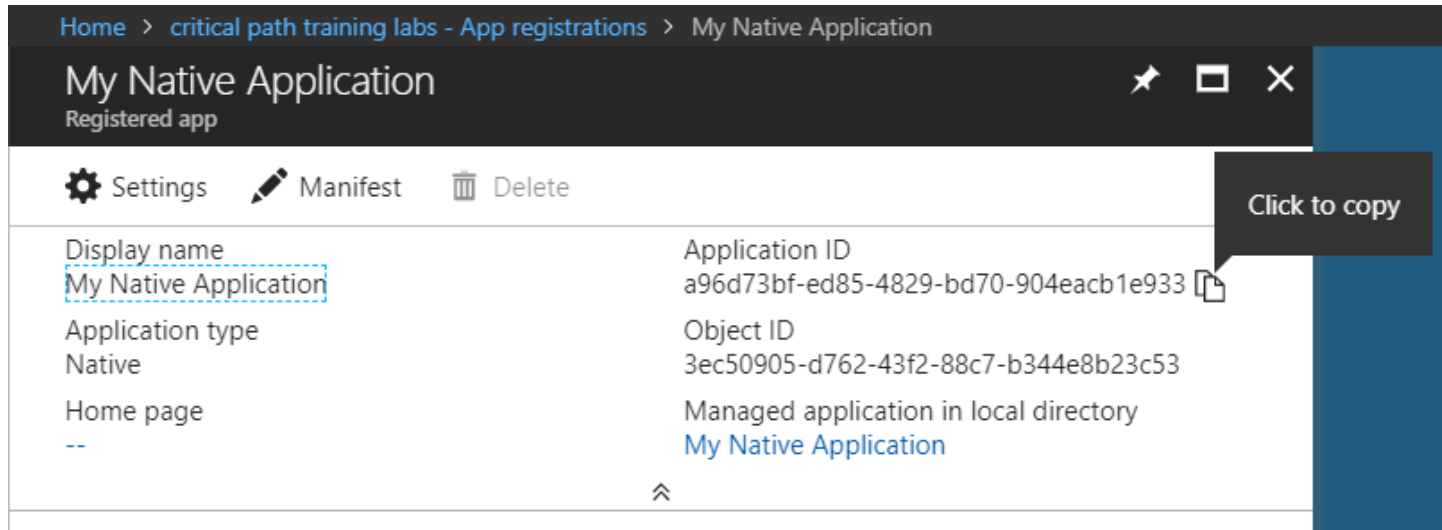
- Name:** The text 'My Native Application' is entered in the input field, followed by a green checkmark icon.
- Application type:** A dropdown menu is open, showing 'Native' as the selected option with a downward arrow.
- Redirect URI:** The text 'https://localhost/app1234' is entered in the input field, followed by a green checkmark icon.

At the bottom of the dialog is a blue button labeled 'Create'.



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
--	My Native Application

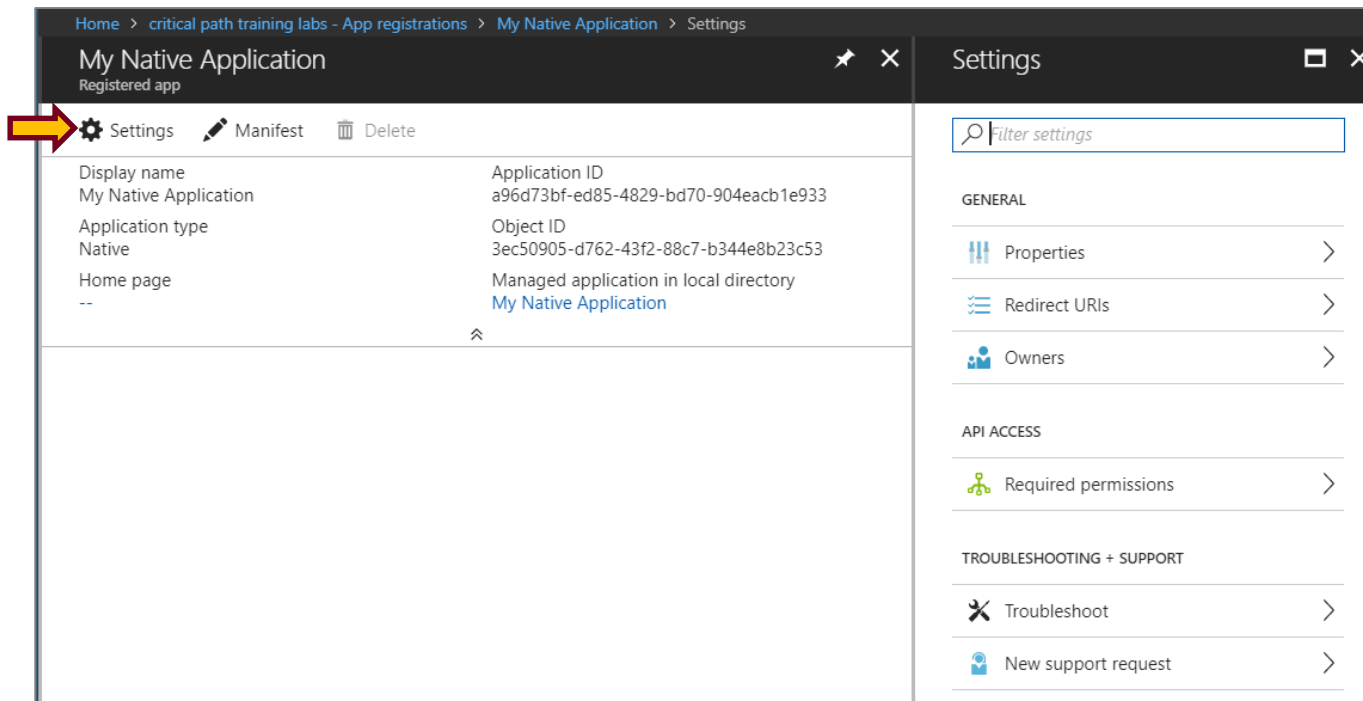
⌵

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 the sub-header indicates it is a 'Registered app'. Below the header, there are three action buttons: 'Settings' (highlighted with a red arrow), 'Manifest', and 'Delete'. The main content area is divided into two panels. The left panel lists application properties: Display name (My Native Application), Application type (Native), and Home page (a link to 'My Native Application'). The right panel, titled 'Settings', contains a search bar 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
Object ID	3ec50905-d762-43f2-88c7-b344e8b23c53
Home page	Managed application in local directory My Native Application

Settings

Filter settings

GENERAL

- Properties
- Redirect URLs
- Owners

API ACCESS

- Required permissions

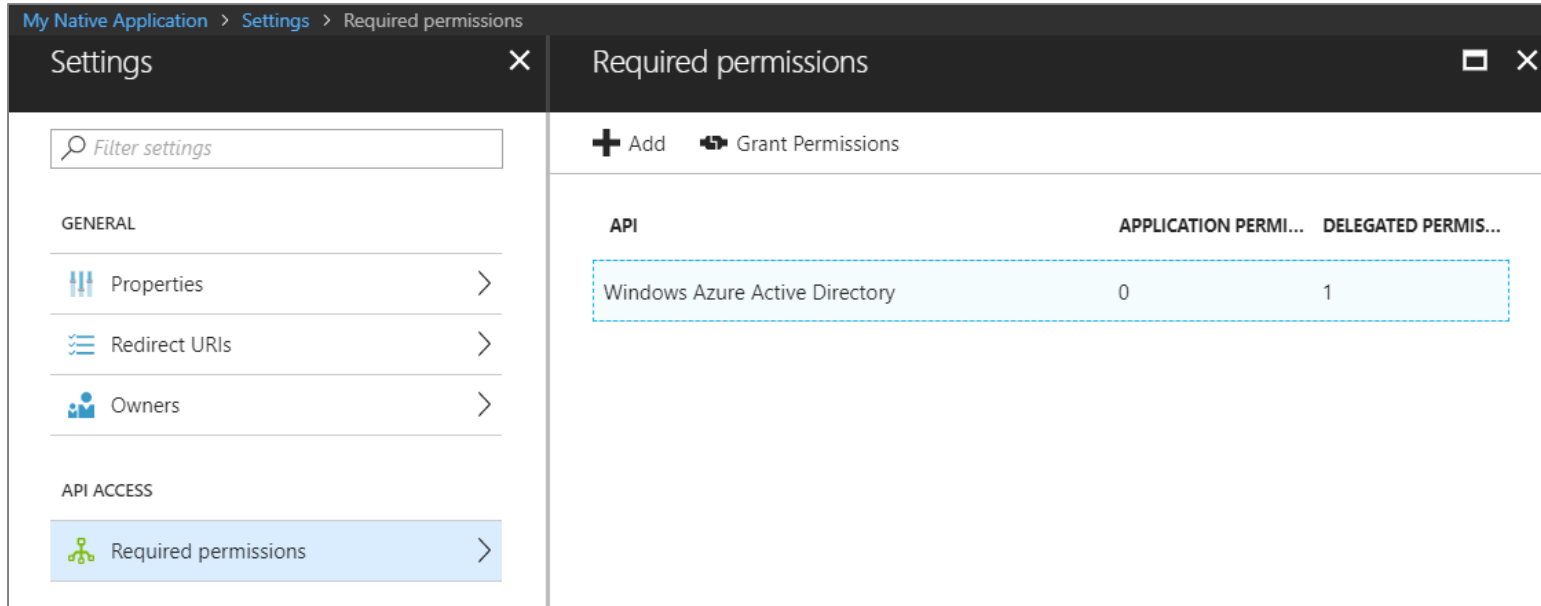
TROUBLESHOOTING + SUPPORT

- 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

The screenshot shows the 'Add API access' dialog in the Azure portal. The breadcrumb trail at the top reads: 'My Native Application > Settings > Required permissions > Add API access > Select an API'. The dialog is split into two panes. The left pane, titled 'Add API access', contains a numbered list of steps: '1 Select an API' (with 'Power BI Service' listed below it) and '2 Select permissions'. The right pane, titled 'Select an API', features a search bar with the placeholder text 'Search for other applications with Service Principal name'. Below the search bar is a list of available APIs: 'Windows Azure Active Directory', 'Office 365 Exchange Online', 'Microsoft Graph', 'Office 365 SharePoint Online', 'Skype for Business Online', 'Office 365 Yammer', 'Power BI Service' (which is highlighted with a dashed blue border), 'Microsoft Rights Management Services', and 'Microsoft Intune API'. At the bottom of the left pane is a 'Done' button, and at the bottom of the right pane is a 'Select' button.



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

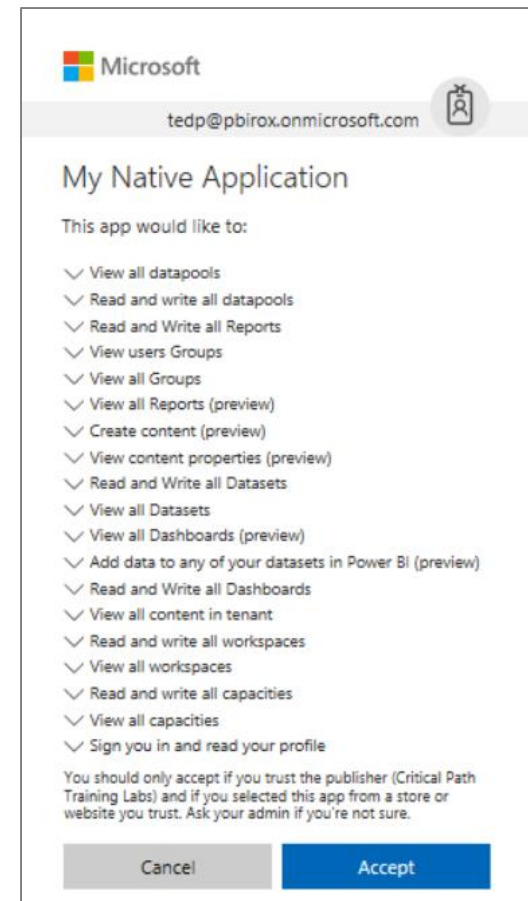
<input type="checkbox"/> DELEGATED PERMISSIONS	REQUIRES ADMIN
Run search queries as a user	✓ Yes
Read user profiles	✓ Yes
<input checked="" type="checkbox"/> Read user files	✗ No
Read managed metadata	✓ Yes
<input checked="" type="checkbox"/> Read items in all site collections	✗ No
Read and write user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



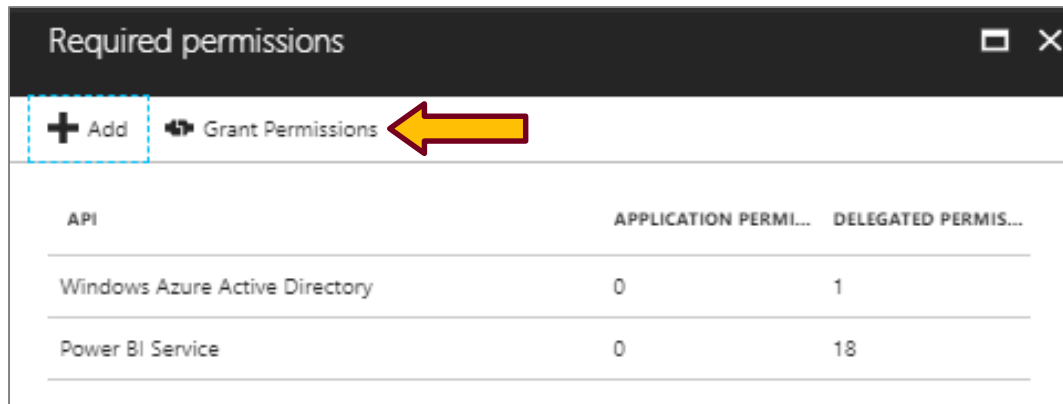
Interactive Consent for Delegated Permissions

- 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>+ Add 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

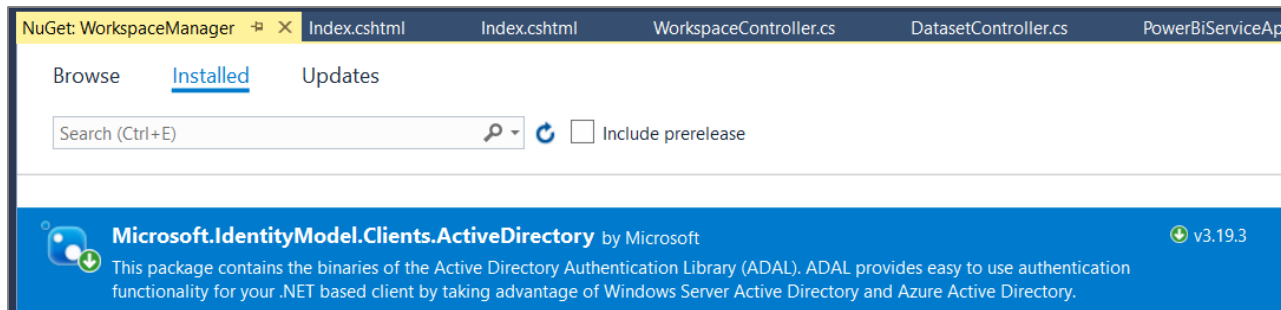
Agenda

- ✓ 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 caching for access tokens and refresh tokens



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





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



Authorization Code Grant 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)



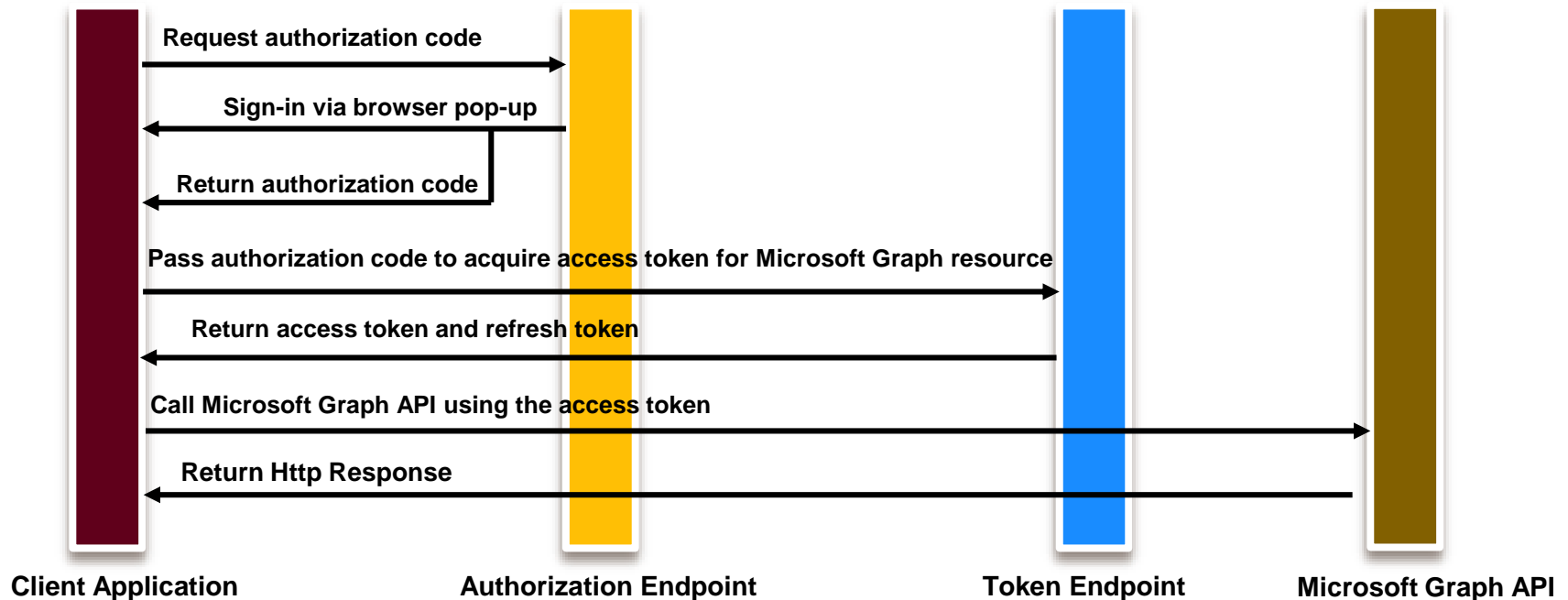
Authorization Code Grant Flow Example

- **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>
- **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

