

# Embedding Power BI Reports with ASP.NET MVC



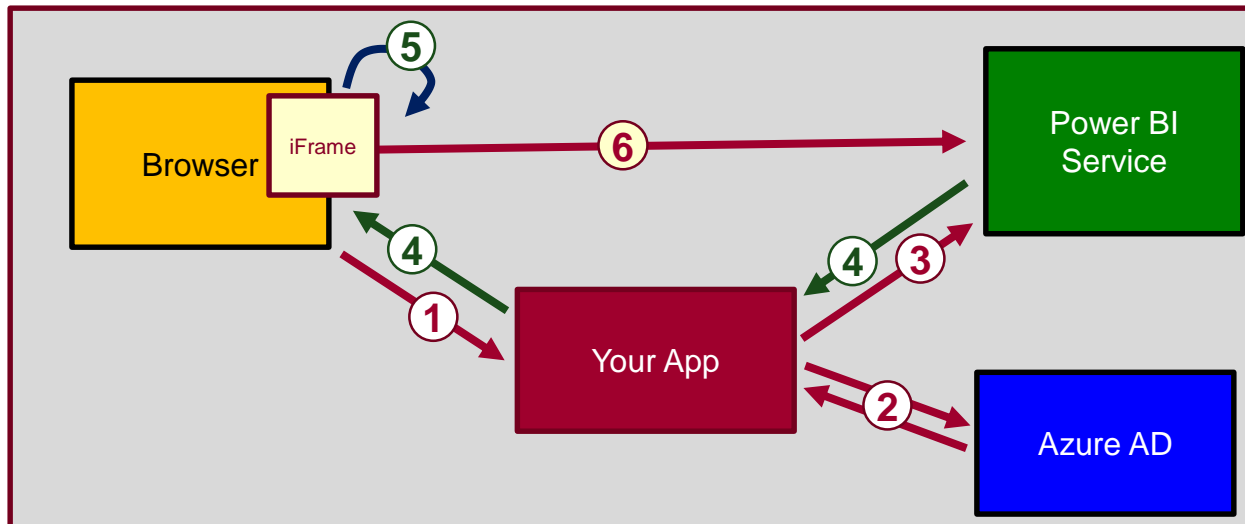
# Agenda

- Power BI Embedding Overview
- Embedding with App-Owns-Data Model
- Caching Access Tokens using OWIN Middleware
- Embedding with the User-Owns-Data Model
- Developing with the Power BI JavaScript API



# Power BI Embedding – The Big Picture

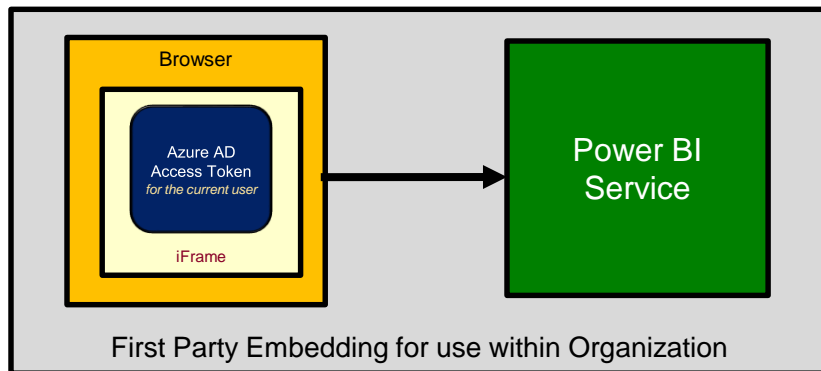
- User launches your app using a browser
- App authenticates with Azure Active Directory and obtains access token
- App uses access token to call to Power BI Service API
- App retrieves data for embedded resource and passes it to browser.
- Client-side code uses Power BI JavaScript API to create embedded resource
- Embedded resource session created between browser and Power BI service



# First Party Embedding vs Third Party Embedding

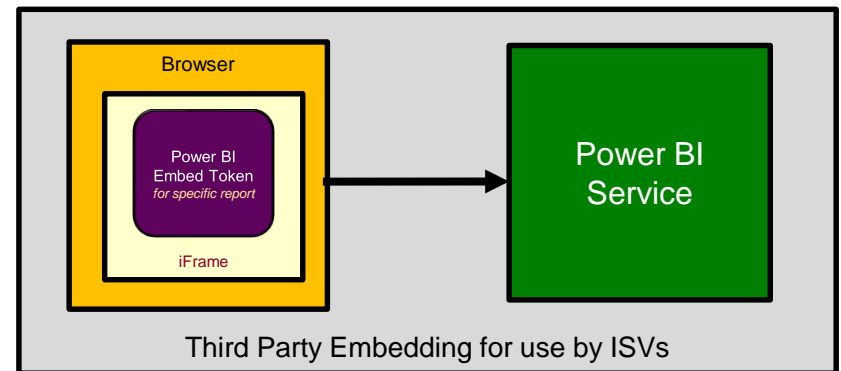
## First Party Embedding

- Known as **User-Owns-Data** Model
- All users require a Power BI license
- Useful in corporate environments
- App authenticates as current user
- Your code runs with user's permissions
- User's access token passed to browser



## Third Party Embedding

- Known as **App-Owns-Data** Model
- No consumers require Power BI license
- Useful for commercial applications
- App authenticates with app-only identity
- Your code runs with admin permissions
- Embed token passed to browser



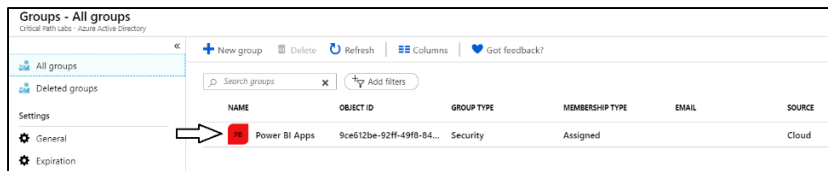
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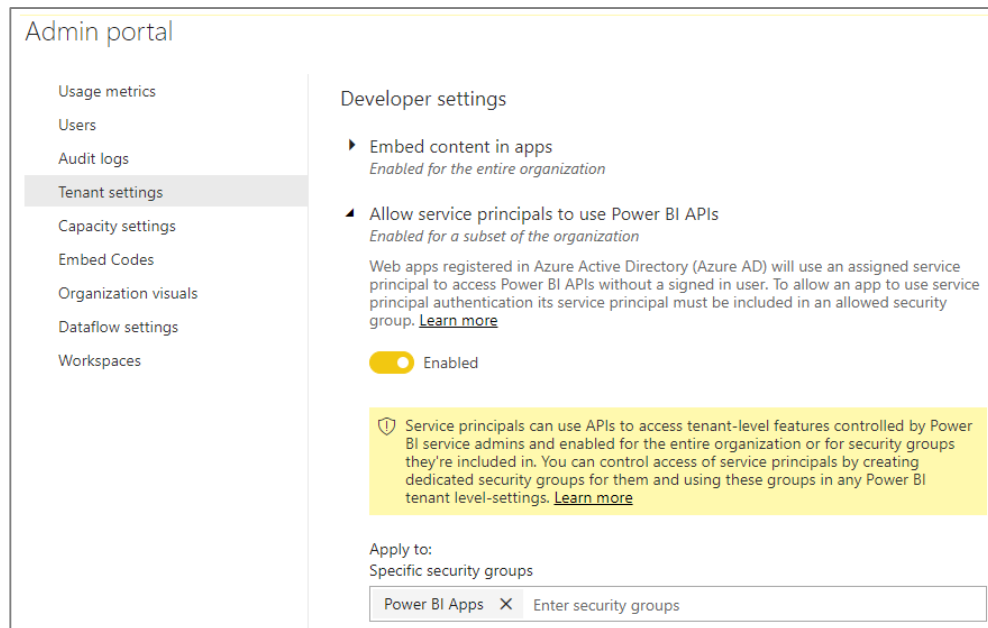


# Setting Up for App-Owns-Data – Part 1

- Enable Service Principal Access to Power BI Service API
  - Create an Azure AD security group (e.g. Power BI Apps)



- Add group to *Power BI Allow service principals to use Power BI APIs*





# Setting Up for App-Owns-Data – Part 2

- Create a confidential client in your Azure AD tenant

Display name	: <a href="#">App-Owns-Data App</a>	Supported account types	: My organization only
Application (client) ID	: af5d13b2-daa3-4b14-ac20-3ee338220630	Redirect URIs	: <a href="#">Add a Redirect URI</a>
Directory (tenant) ID	: 17b8d777-a84a-4b90-b4a3-559ee5cbf07e	Managed application in ...	: <a href="#">App-Owns-Data App</a>
Object ID	: 8f1f9327-f5cc-46b5-babf-6e821a5df079		

- Configured as **TYPE=Web** and no need for a redirect URL

Manage	Redirect URIs
Branding	The URLs that we will accept as destinations when returning authentication responses (tokens) after successfully authenticating users. Also referred to as reply URLs.
Authentication	<a href="#">Learn more about adding support for web, mobile and desktop clients</a>
Certificates & secrets	
API permissions	
Expose an API	

TYPE	REDIRECT URI
Web	e.g. <a href="https://myapp.com/auth">https://myapp.com/auth</a>

- Add a client secret or a client certificate

Manage	Client secrets
Branding	A secret string that the application uses to prove its identity when requesting a token. Also can be referred to as application password.
Authentication	<a href="#">+ New client secret</a>
Certificates & secrets	
API permissions	
Expose an API	

DESCRIPTION	EXPIRES	VALUE
No description	6/3/2020	Hidden

- No need to configure any permissions

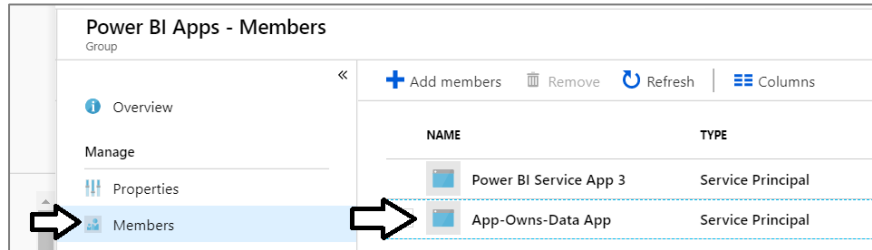
Manage	API permissions
Branding	Applications are authorized to use APIs by requesting permissions. These permissions show up during the consent process where users are given the opportunity to grant/deny access.
Authentication	<a href="#">+ Add a permission</a>
Certificates & secrets	
API permissions	
Expose an API	
Owners	

API / PERMISSIONS NAME	TYPE	DESCRIPTION	ADMIN CONSENT REQUIRED
No permissions added			

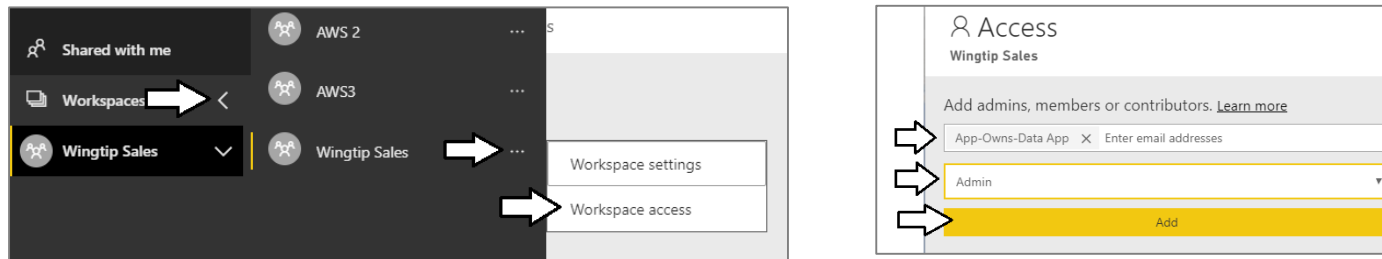


# Setting Up for App-Owns-Data – Part 3

- Add application's service principal in **Power BI Apps** security group



- Configure application's service principal as workspace admin



- Service principal should now be workspace admin

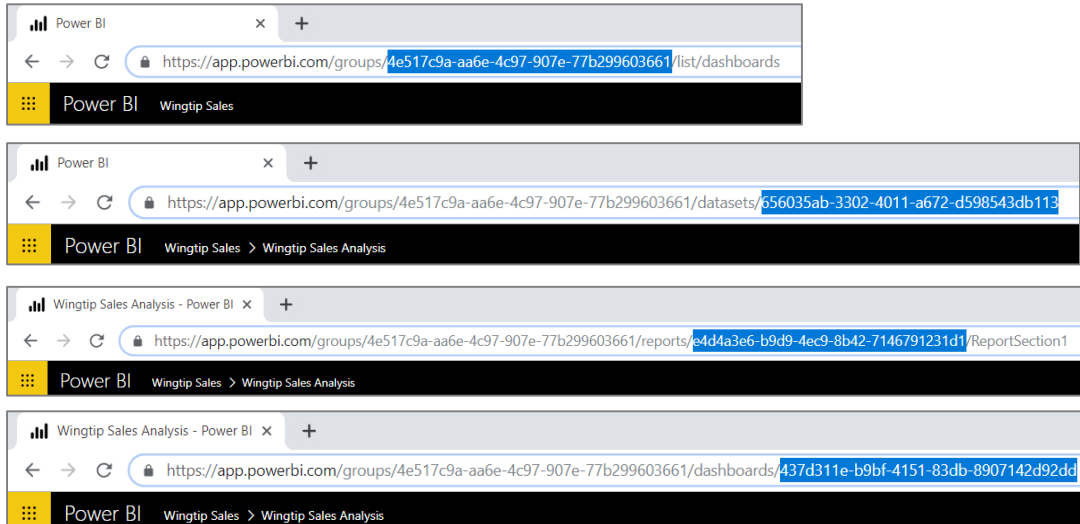
NAME	PERMISSION	
App-Owns-Data App (Service Principal)	Admin	...
Power BI Service App 3 (Service Princip...Admin		...
Ted Pattison	Admin	...





# Setting Up for App-Owns-Data – Part 4

- Record the GUIDs for your embeddable resources



- Gather all configuration data which will be required by application

```
AppOwnsDataApp.txt - Notepad
File Edit Format View Help
--- Confidential Client App Info for AppOwnsDataApp ---
ClientId: af5d13b2-daa3-4b14-ac20-3ee338220630
ClientSecret: YjVhYWVjNjktMmM0NS00N2I4LWIyYWVhZDExNzBmODVi=
TenantName: devinaday2019.onmicrosoft.com

AppWorkspaceId: 4e517c9a-aa6e-4c97-907e-77b299603661
DatasetId: 656035ab-3302-4011-a672-d598543db113
ReportId: e4d4a3e6-b9d9-4ec9-8b42-7146791231d1
DashboardId: 437d311e-b9bf-4151-83db-8907142d92dd
```



# Generating Embed Tokens

- You can embed reports using an AAD token, but...
  - You might want embed resource using more restricted tokens
  - You might want stay within the bounds of Power BI licensing terms
- You generate embed tokens with the Power BI Service API
  - Each embed token created for one specific resource
  - Embed token provides restrictions on whether user can view or edit
  - Embed token can only be generated in dedicated capacity (semi-enforced)
  - Embed token can be generated to support row-level security (RLS)

```
Report report = reports.Where(r => r.Id == reportId).First();  
var generateTokenRequestParameters = new GenerateTokenRequest(accessLevel: "edit");  
var token = client.Reports.GenerateTokenInGroupAsync(appWorkspaceId,  
                                                    report.Id,  
                                                    generateTokenRequestParameters).Result;
```



# Getting the Data for Report Embedding

```
public static async Task<ReportEmbeddingData> GetReportEmbeddingData() {  
    PowerBIClient pbiClient = GetPowerBiClient();  
  
    var report = await pbiClient.Reports.GetReportInGroupAsync(workspaceId, reportId);  
    var embedUrl = report.EmbedUrl;  
    var reportName = report.Name;  
  
    GenerateTokenRequest generateTokenRequestParameters = new GenerateTokenRequest(accessLevel: "edit");  
    string embedToken =  
        (await pbiClient.Reports.GenerateTokenInGroupAsync(workspaceId,  
                                                            report.Id,  
                                                            generateTokenRequestParameters)).Token;  
  
    return new ReportEmbeddingData {  
        reportId = reportId,  
        reportName = reportName,  
        embedUrl = embedUrl,  
        accessToken = embedToken  
    };  
}
```



# Getting the Data for Dashboard Embedding

```
public static async Task<DashboardEmbeddingData> GetDashboardEmbeddingData() {  
    PowerBIClient pbiClient = GetPowerBiClient();  
  
    var dashboard = await pbiClient.Dashboards.GetDashboardInGroupAsync(workspaceId, dashboardId);  
    var embedUrl = dashboard.EmbedUrl;  
    var dashboardDisplayName = dashboard.DisplayName;  
  
    GenerateTokenRequest generateTokenRequestParameters = new GenerateTokenRequest(accessLevel: "view");  
  
    string embedToken =  
        (await pbiClient.Dashboards.GenerateTokenInGroupAsync(workspaceId,  
                                                                dashboardId,  
                                                                generateTokenRequestParameters)).Token;  
  
    return new DashboardEmbeddingData {  
        dashboardId = dashboardId,  
        dashboardName = dashboardDisplayName,  
        embedUrl = embedUrl,  
        accessToken = embedToken  
    };  
}
```



# Getting the Data for Tile Embedding

```
public static DashboardTileEmbeddingData GetDashboardTileEmbeddingData() {  
    PowerBIClient pbiClient = GetPowerBiClient();  
  
    var tiles = pbiClient.Dashboards.GetTilesInGroup(workspaceId, dashboardId).Value;  
  
    // retrieve first tile in tiles connection  
    var tile = tiles[0];  
    var tileId = tile.Id;  
    var tileTitle = tile.Title;  
    var embedUrl = tile.EmbedUrl;  
  
    GenerateTokenRequest generateTokenRequestParameters = new GenerateTokenRequest(accessLevel: "view");  
    string embedToken = pbiClient.Tiles.GenerateTokenInGroup(workspaceId,  
                                                            dashboardId,  
                                                            tileId,  
                                                            generateTokenRequestParameters).Token;  
  
    return new DashboardTileEmbeddingData {  
        dashboardId = dashboardId,  
        TileId = tileId,  
        TileTitle = tileTitle,  
        embedUrl = embedUrl,  
        accessToken = embedToken  
    };  
}
```



# Getting Data for New Report Embedding

```
public static NewReportEmbeddingData GetNewReportEmbeddingData() {  
    string embedUrl = "https://app.powerbi.com/reportEmbed?groupId=" + workspaceId;  
    PowerBIClient pbiClient = GetPowerBiClient();  
    GenerateTokenRequest generateTokenRequestParameters = new GenerateTokenRequest(accessLevel: "create",  
                                                                                        datasetId: datasetId);  
    string embedToken = pbiClient.Reports.GenerateTokenForCreateInGroup(workspaceId,  
                                                                           generateTokenRequestParameters).Token;  
    return new NewReportEmbeddingData {  
        workspaceId = workspaceId,  
        datasetId = datasetId,  
        embedUrl = embedUrl,  
        accessToken = embedToken  
    };  
}
```



# Getting the Data for Q&A Embedding

```
public static QnaEmbeddingData GetQnaEmbeddingData() {  
    PowerBIClient pbiClient = GetPowerBiClient();  
  
    var dataset = pbiClient.Datasets.GetDatasetByIdInGroup(workspaceId, datasetId);  
  
    string embedUrl = "https://app.powerbi.com/qnaEmbed?groupId=" + workspaceId;  
    string datasetId = dataset.Id;  
  
    GenerateTokenRequest generateTokenRequestParameters = new GenerateTokenRequest(accessLevel: "view");  
  
    string embedToken = pbiClient.Datasets.GenerateTokenInGroup(workspaceId,  
                                                                dataset.Id,  
                                                                generateTokenRequestParameters).Token;  
  
    return new QnaEmbeddingData {  
        datasetId = datasetId,  
        embedUrl = embedUrl,  
        accessToken = embedToken  
    };  
}
```





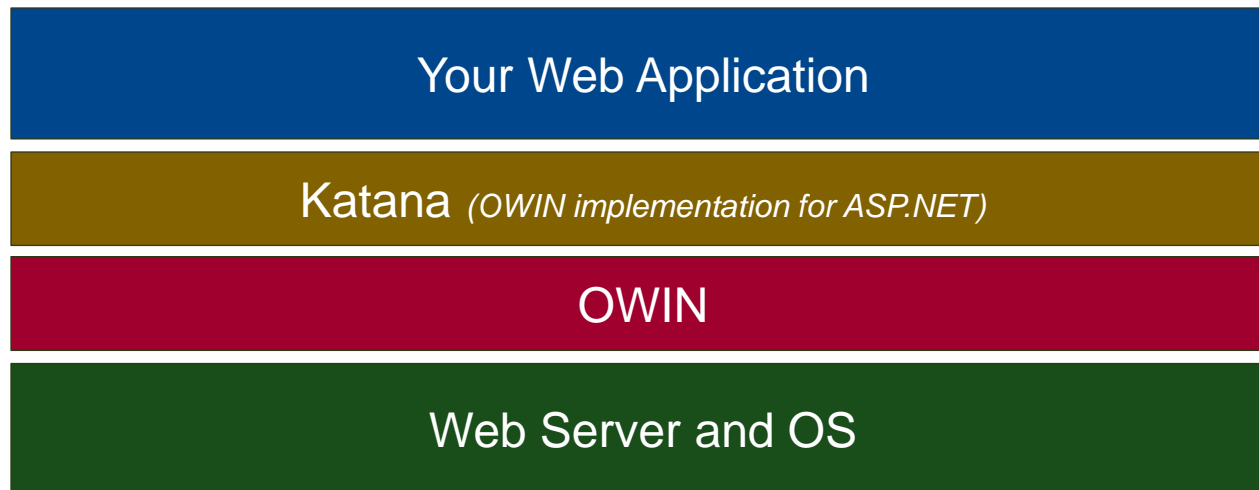
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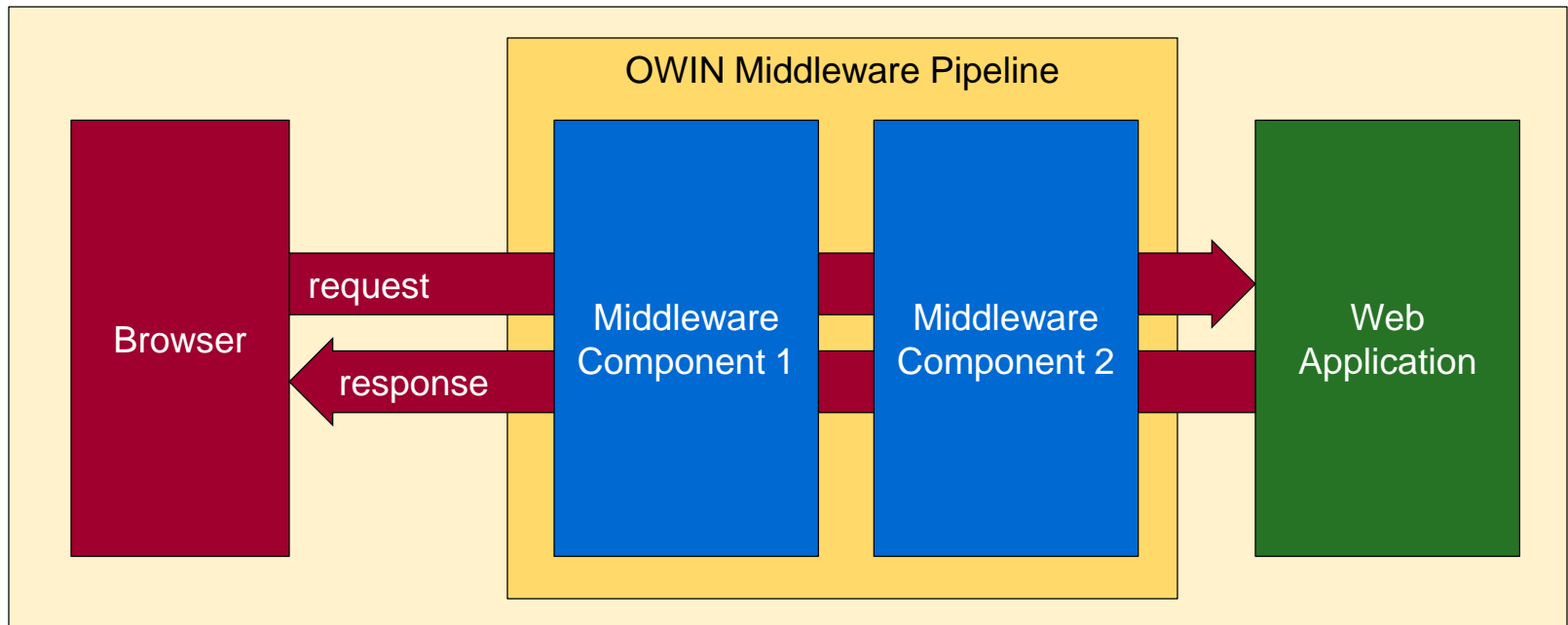
# Open Web Interfaces for NET (OWIN)

- OWIN interfaces decouple web server from application
  - OWIN serves to decouple .NET applications from Windows and IIS
  - OWIN promotes the development of smaller modules (middleware)
- Microsoft's Implementation known as Katana
  - Makes it possible to use OWIN with ASP.NET and ASP Core
  - Microsoft provides OWIN-based security middleware



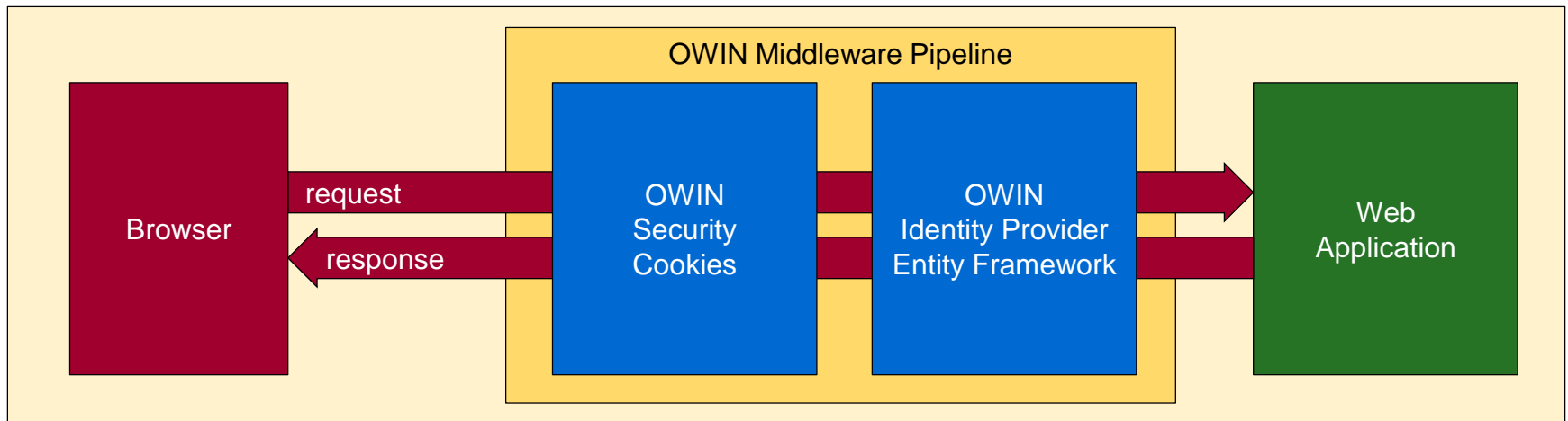
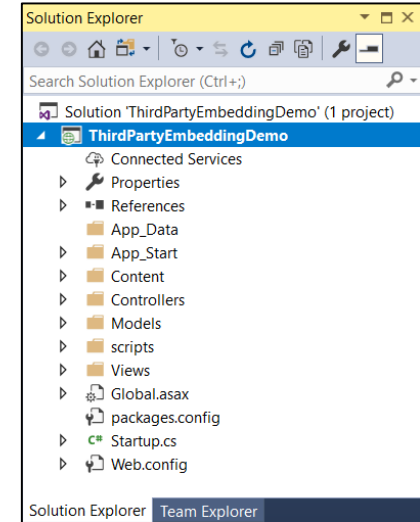
# OWIN Middleware Modules

- OWIN create pipeline of middleware components
  - Middleware components added to pipeline on application startup
  - Middleware components pre-process and post process requests
  - Middleware components commonly used to set up authentication



# ThirdPartyEmbeddingDemo

- Demonstration key points
  - Entity Framework Identity Provider
  - OWIN Security module



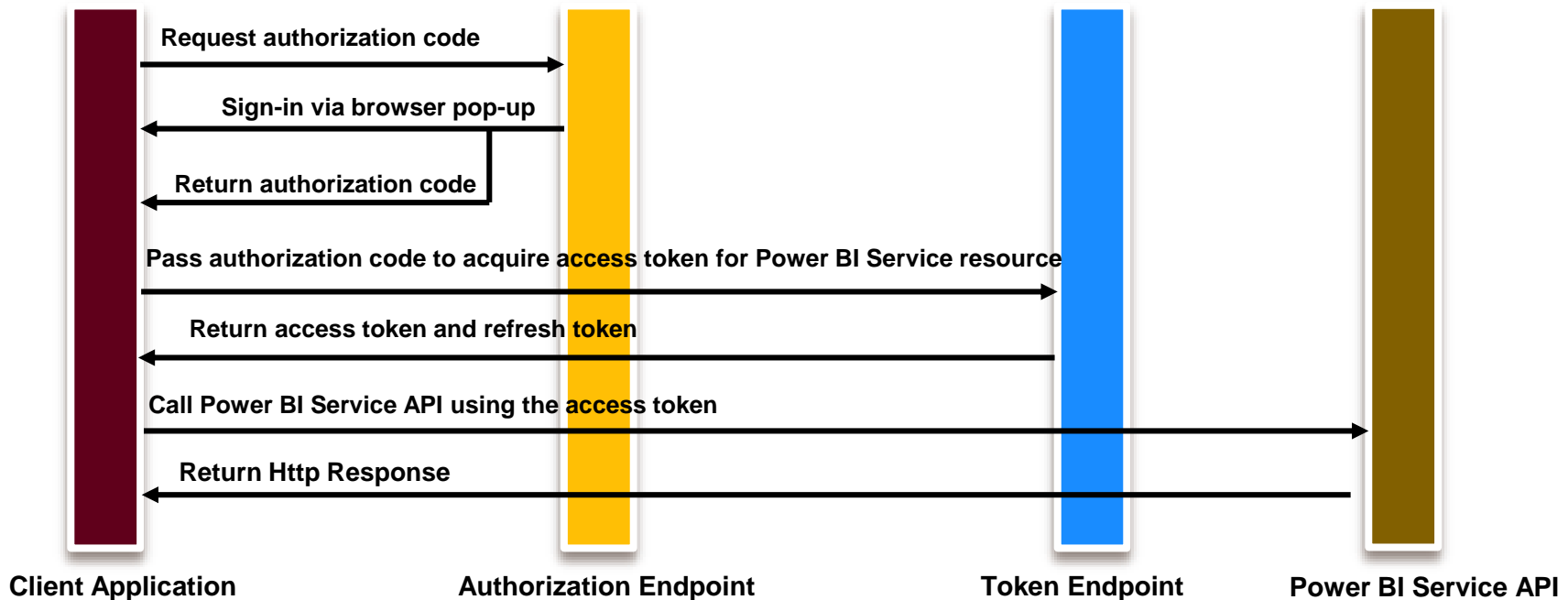
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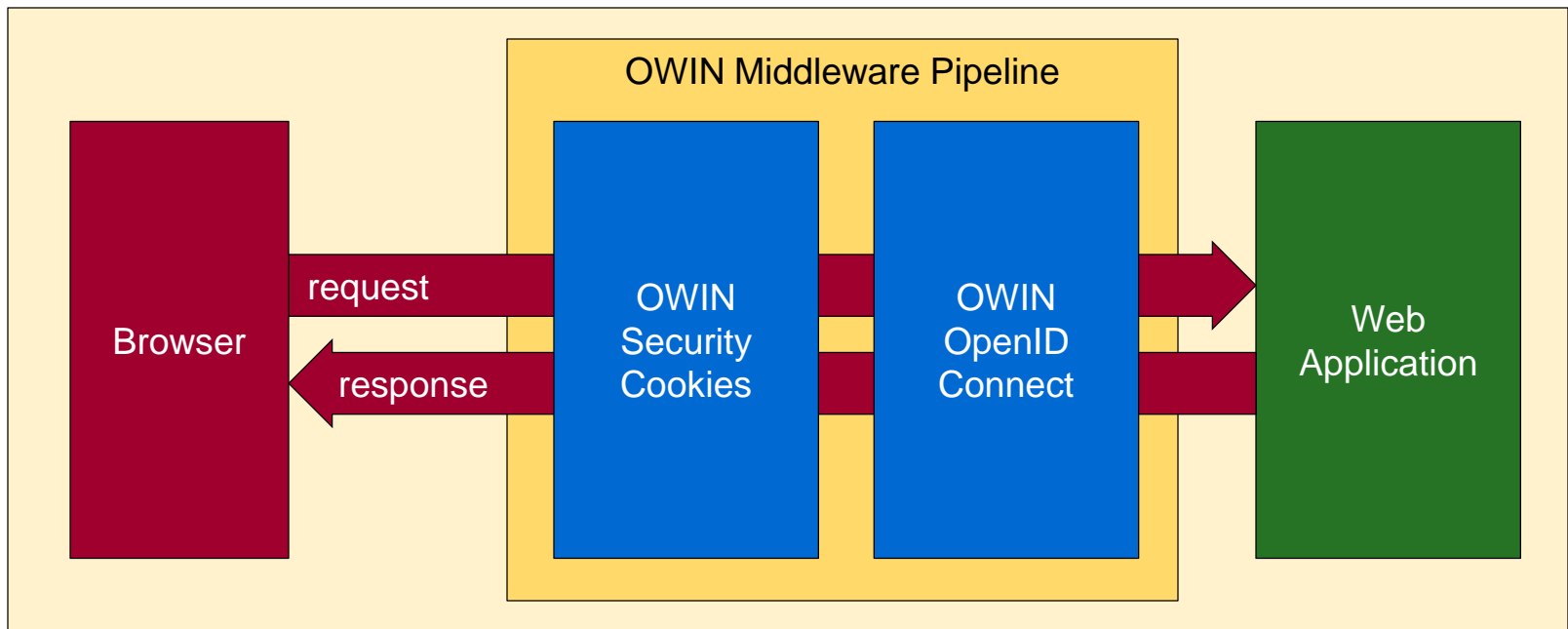
# Authorization Code Grant Flow

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



# OWIN OpenID Connect Module

- OpenID Connect module used to implement Authorization Code Flow
  - Redirects browsers to authorization endpoint
  - Provides notification when receiving authorization code callback







**DEMO**

**DailyReporterPersonal**

# Understanding Implicit Flow

- Single Pages Applications (SPAs) are public clients
  - SPA not able to keep secrets such as application secret
  - No ability to execute server-to-server calls
  - SPAs cannot implement authorization code flow
- Implicit flow requires lowering security bar for SPAs
  - Azure AD application must be configured to allow implicit flow
  - Allows SPAs to retrieve access tokens
  - Access token returned to browser in URL fragment







**DEMO**

**PowerBIDaySPA**

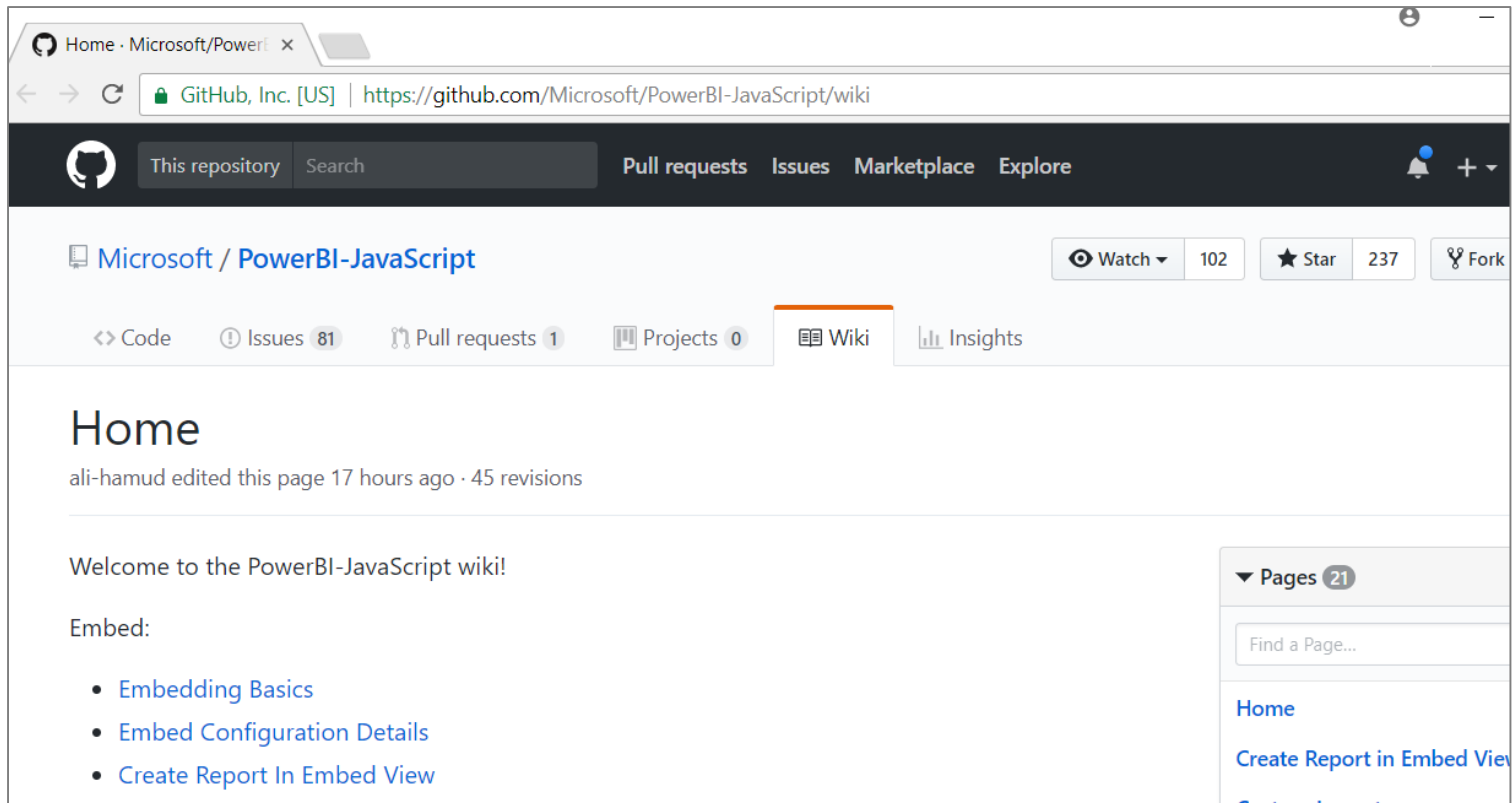
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# Power BI JavaScript API (powerbi.js)

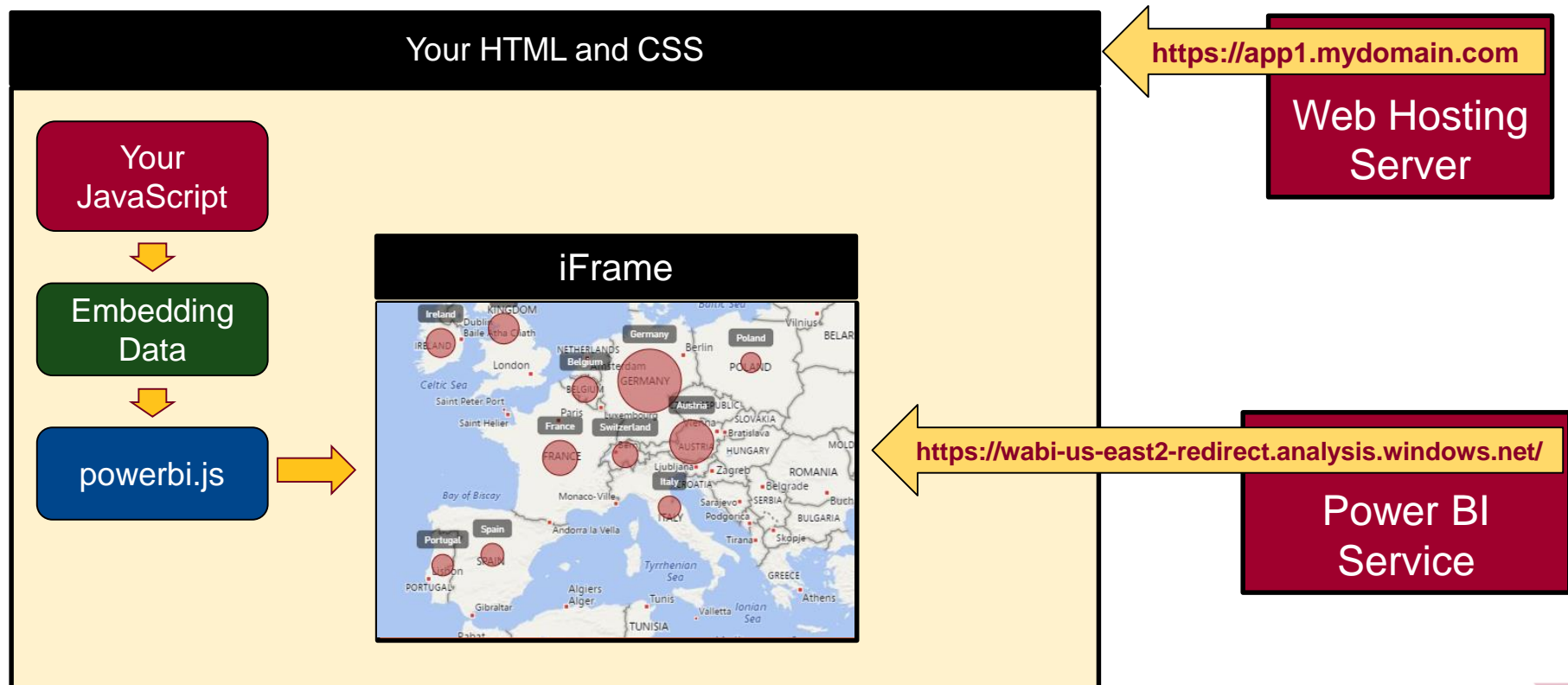
- Power BI JavaScript API used to embed resources in browser
  - GitHub repo at <https://github.com/Microsoft/PowerBI-JavaScript/wiki>
  - GitHub repository contains code, docs, wiki and issues list





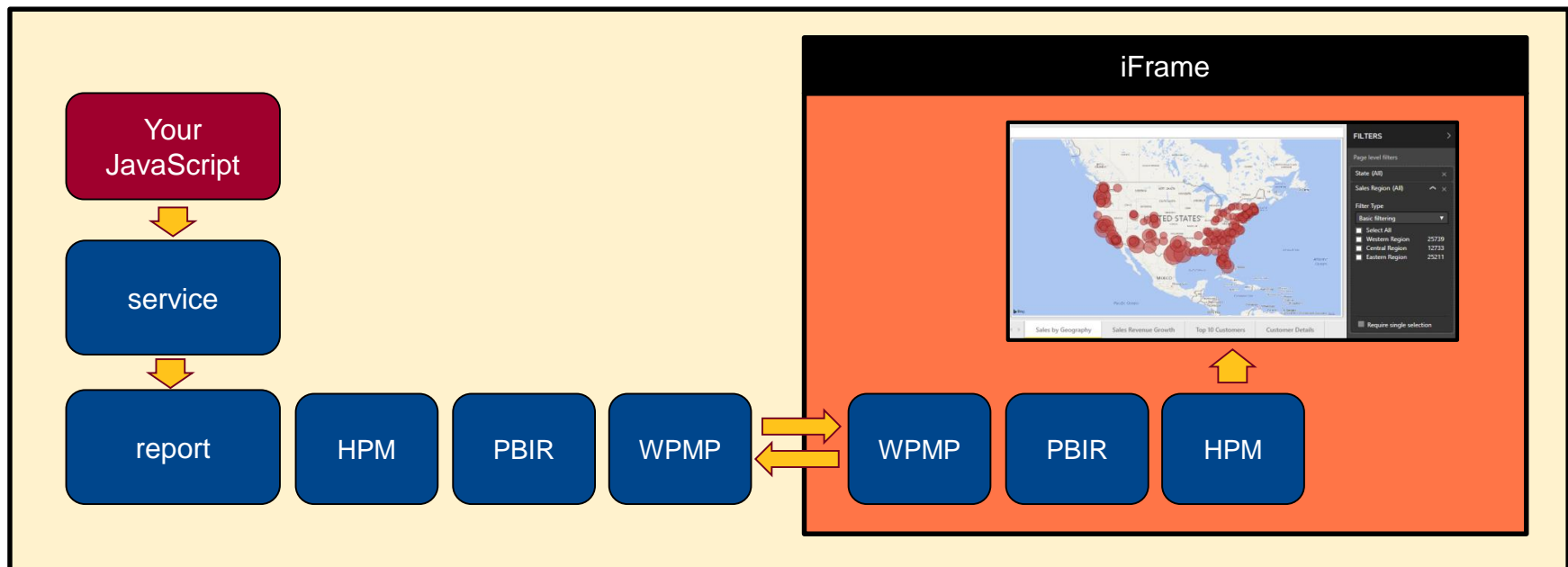
# Report Embedding Architecture

- Embedding involves creating an iFrame on the page
  - PBIJS transparently creates iFrame and sets source to Power BI Service
  - ***The iFrame and hosting page originate from different DNS domains***



# Post Message Communications Flow

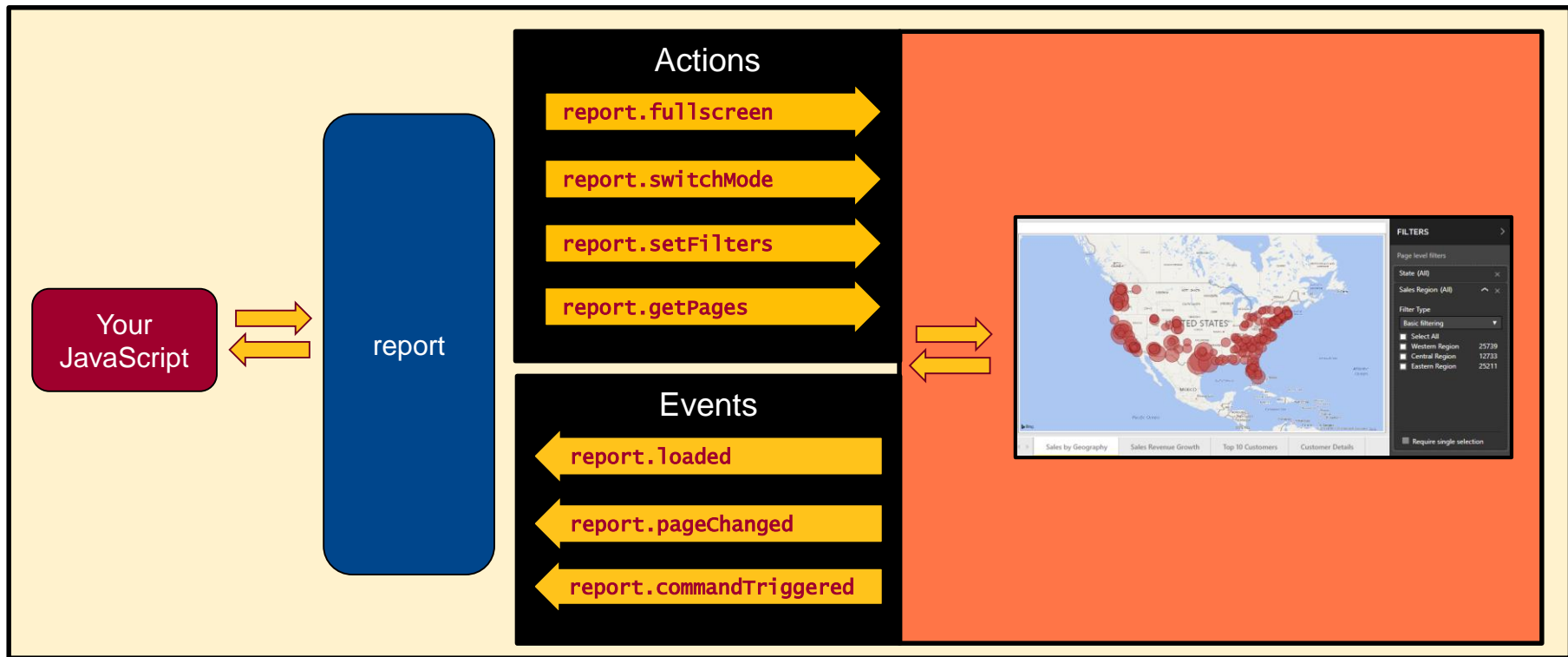
- 4 extra libraries used communicate with report in iFrame
  - window-post-message-proxy (WPMP)
  - http-post-message (HPM)
  - powerbi-router (PBIR)
  - powerbi-models (PBIM)





# A Promise-based Programming Model

- Design of PBIJS simulates HTTP protocol
  - Creates more intuitive programming model for developers
  - Programming based on asynchronous requests and promises
  - Embedded objects programmed using actions and events



# Hello World with Power BI Embedding

- **powerbi.js** library provides **powerbi** as top-level service object
  - You call **powerbi.embed** and pass **configuration** object with access token
  - **models** object available to supply configuration settings
  - **configuration** object sets **tokenType** to either **TokenType.Embed** or **TokenType.Aad**

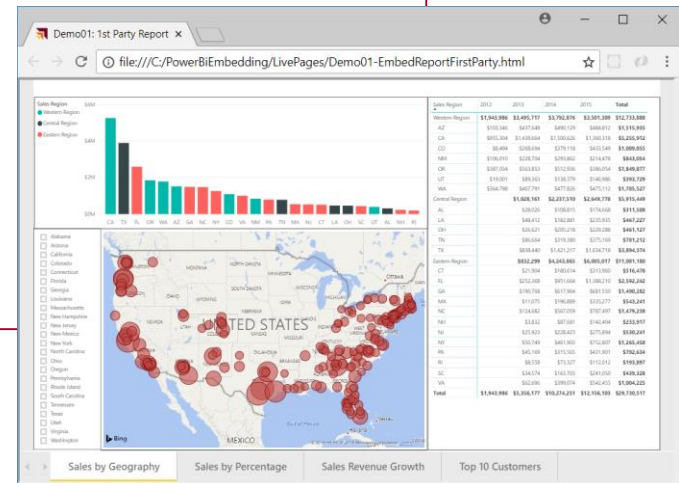
```
// data required for embedding Power BI report
var embedReportId = "ba274ba0-93be-4e53-af65-fdc8a559c557";
var embedUrl = "https://app.powerbi.com/reportEmbed?reportId=ba274ba0-93be-4e53-af65-fdc8a559c557&groupId=7f4...";
var accessToken = "eyJ0eXAiOiJKVlQiLCJhbGciOiJSUzI1NiIsIngldCI6ImRpb0d5d3dsahZkRmJWYwYjgxdGF5OUFVSisImpwZDQ...";

// Get models object to access enums for embed configuration
var models = window['powerbi-client'].models;

// create embed configuration object
var config = {
    type: 'report',
    id: embedReportId,
    embedUrl: embedUrl,
    accessToken: accessToken,
    tokenType: models.TokenType.Aad // First party embedding
};

// Get a reference to the embedded report HTML element
var reportContainer = document.getElementById('embedContainer');

// Embed the report and display it within the div container.
var report = powerbi.embed(reportContainer, config);
```



# Embedded Report Configuration Options

- **permissions** determines what permissions are given to user on resource
- **viewMode** determines when report opens in read-only view or edit view
- **pageView** determines how reports scales to fit embed container element

```
var models = window['powerbi-client'].models;  
  
var config: embed.IEmbedConfiguration = {  
  type: 'report',  
  id: reportId,  
  embedUrl: embedUrl,  
  accessToken: accessToken,  
  tokenType: models.TokenType.Embed,  
  permissions: models.Permissions.All,  
  viewMode: models.ViewMode.Edit,  
  pageView: "fitToWidth",  
  settings: {  
    filterPaneEnabled: false,  
    navContentPaneEnabled: false  
  }  
};
```

**Read:** Allows view report only.  
**ReadWrite:** Allows view, Edit and Save report.  
**Copy:** Allows Save a copy of a report using Save As.  
**Create:** Allows creating a new report.  
**All:** Allows everything.

**View** - Opens report in View mode.  
**Edit** - Opens report in Edit mode.

**fitToWidth:** Fit to width of host HTML element.  
**oneColumn:** Opens in single column.  
**actualSize:** Actual size as designed in report



# PowerBiEmbeddedScratchpad Sample

<https://github.com/CriticalPathTraining/PowerBiEmbeddedScratchpad>

The screenshot shows the GitHub repository page for **CriticalPathTraining / PowerBiEmbeddedScratchpad**. The repository is described as "A sample application for developer's learning about Power BI Embedding". It has 4 commits, 1 branch, 0 releases, 1 contributor, and is licensed under MIT. The repository is currently on the **master** branch. A table of recent updates is shown below the repository information.

Update	Author	Time
<b>DemoPagesWithEmbedding</b>	TedPattison	8 days ago
<b>PBIX</b>	TedPattison	7 days ago
<b>PowerBiEmbeddedScratchpad</b>	TedPattison	8 days ago



# Handling Report Events

```
var report = powerbi.embed(embedContainer, config);

var pages;

report.on('loaded', function () {
    // call getPages with callback
    report.getPages().then(
        function (reportPages) {
            pages = reportPages;
            // call method to load pages into nav menu
            loadReportPages(pages);
        });
});

var loadReportPages = function (pages) {
    for (var index = 0; index < pages.length; index++) {
        // determine which pages are visible and not hidden
        if (pages[index].visibility == 0) { // 0 means visible and 1 means hidden
            var reportPageDisplayName = pages[index].displayName;
            pageNavigation.append($("<li>")
                .append($("<a href='javascript:;' >'")
                    .text(pages[index].displayName))
                .click(function (domEvent) {
                    var targetPageName = domEvent.target.textContent;
                    // get target page from pages collection
                    var targetPage = pages.find(function (page) { return page.displayName === targetPageName; }));
                    // navigate report to target page
                    targetPage.setActive();
                }));
        }
    }
}
```

```
▼ Report ⓘ
  ▼ allowedEvents: Array(12)
    0: "loaded"
    1: "saved"
    2: "rendered"
    3: "saveAsTriggered"
    4: "error"
    5: "dataSelected"
    6: "filtersApplied"
    7: "pageChanged"
    8: "commandTriggered"
    9: "swipeStart"
    10: "swipeEnd"
    11: "bookmarkApplied"
```



# Embedding a New Report

```
// Get data required for embedding
var embedWorkspaceId= "7f4576c7-039a-472f-b998-546a572d5da2";
var embedDatasetId = "b4a48602-71da-42b2-8cf5-44d35b2ac70b";
var embedUrl = "https://app.powerbi.com/reportEmbed?groupId=7f4576c7-039a-472f-b998-546a5
var accessToken = "H4sIAAAAAAAEAB2Wxw60CA6E3-W_shIZmpXmQE5NztzIOwdG--7bM3dbsj67qvz3HzN5-i

// Get models object to access enums for embed configuration
var models = window['powerbi-client'].models;

var config = {
  datasetId: embedDatasetId,
  embedUrl: embedUrl,
  accessToken: accessToken,
  tokenType: models.TokenType.Embed,
};

// Get a reference to the embedded report HTML element
var embedContainer = document.getElementById('embedContainer');

// Embed the report and display it within the div container.
var report = powerbi.createReport(embedContainer, config);
```



# New Report with SaveAs Redirect

```
// Embed the report and display it within the div container.
var newReport = powerbi.createReport(embedContainer, config);

// this event fires whenever user runs save or SaveAs command on a new report
newReport.on("saved", function (event) {

    // get ID and name of new report
    var newReportId = event.detail.reportObjectId;
    var newReportName = event.detail.reportName;

    // set new title for browser window
    document.title = newReportName;

    // reset report container element
    powerbi.reset(embedContainer);

    config = {
        type: 'report',
        id: newReportId,
        embedUrl: "https://app.powerbi.com/reportEmbed?reportId=" + newReportId + "&groupId=" + embedWorkspaceId,
        accessToken: accessToken,
        tokenType: models.TokenType.Aad,
        permissions: models.Permissions.All,
        viewMode: models.ViewMode.Edit,
    };

    // Embed the report and display it within the div container.
    var savedReport = powerbi.embed(embedContainer, config);
```





# Embedding the Q&A Experience

```
// Get data required for embedding
var datasetId = "b4a48602-71da-42b2-8cf5-44d35b2ac70b";
var embedUrl = "https://app.powerbi.com/qnaEmbed?groupId=7f4576c7-039a-472f-b998-546a57";
var accessToken = "H4sIAAAAAAAEAC2Wx6rFDI6E3-XfeuA4h4Fe00ecvXPO0buZd58L3XuBpK8K1f79j5W-";

// Get models object to access enums for embed configuration
var models = window['powerbi-client'].models;

var config = {
  type: 'qna',
  tokenType: models.TokenType.Embed,
  accessToken: accessToken,
  embedUrl: embedUrl,
  datasetIds: [ datasetId ],
  viewMode: models.QnaMode.Interactive,
  question: "What is sales revenue by quarter and sales region as stacked area chart"
};

var embedContainer = document.getElementById('embedContainer');

var embeddedObject = powerbi.embed(embedContainer, config);
```



# Configuration Options

```
// Get models object to access enums for embed configuration
var models = window['powerbi-client'].models;

var config = {
  type: 'report',
  id: embedReportId,
  embedUrl: embedUrl,
  accessToken: accessToken,
  tokenType: models.TokenType.Embed,
  permissions: models.Permissions.All,
  viewMode: models.ViewMode.View,
  settings: {
    filterPaneEnabled: false,
    navContentPaneEnabled: true,
    localeSettings: { language: "en", formatLocale: "es" },
    background: models.BackgroundType.Transparent
  }
};

// Get a reference to the embedded report HTML element
var reportContainer = document.getElementById('embedContainer');

// Embed the report and display it within the div container.
var report = powerbi.embed(reportContainer, config);
```







**DEMO**

## **The Power BI Embedded Scratchpad App**

# Summary

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- ✓ Embedding with App-Owns-Data Model
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- ✓ Developing with the Power BI JavaScript API

