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Become a Microsoft Graph Ninja

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CollabDays Belgium 2022 by BIWUG

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ABOUT ME

- Solution Architect, Consultant, Trainer
  - PiaSys.com based in the USA and in Italy
- More than 50 Microsoft certification exams passed
  - MCSM – Charter SharePoint
  - MVP M365 Development + M365 Apps & Services
  - Microsoft 365 PnP Team Member
- Focused on SharePoint, Teams and Microsoft 365
- Author of many books about XML, SOAP, .NET, LINQ, SharePoint, and Microsoft 365
- Speaker at main IT conferences worldwide
- Follow me @PaoloPia
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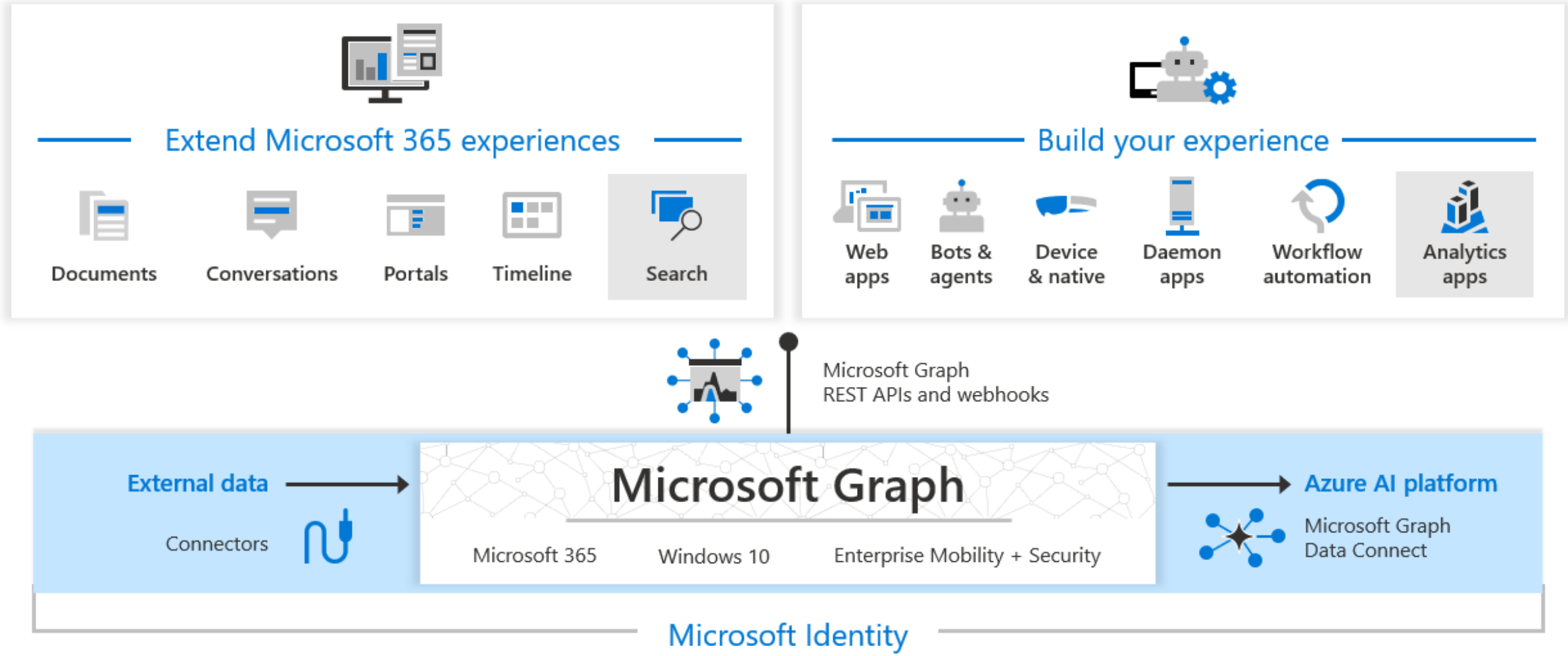
Microsoft Graph API

What is the Microsoft Graph API?

- A unique set of API to rule all the Microsoft services
- Unified endpoint
- Unique handshake and Access Token
- Unique development experience
- Unique consumption model: REST

Microsoft 365 Platform



Cross-platform technology

- You can consume the Microsoft Graph from:
  - Android
  - Angular
  - ASP.NET
  - Go
  - iOS
  - Node.js
  - PHP
  - Python
  - Ruby
  - REST
  - UWP
  - Xamarin
  - JavaScript
  - etc.
- You just need an HTTP client and support for OAuth 2.0

App registration and consumption model

Understanding the Microsoft Identity platform

Consumption Model

- Register an application in Azure AD
  - Choose the permission model and the token flow
- Make an OAuth 2.0 handshake with Azure AD
  - Get Access Token (and eventually Refresh Token)
- Invoke Microsoft Graph providing the Access Token
  - Authorization: Bearer …

Security Tokens

- ID Tokens
  - Are tokens for users' identification purposes
  - Allow the client to verify that user is who she/he claimed to be
  - Are JWT objects made of claims
  - By default they last 1 hour
- Access Tokens
  - Enable clients to securely consume Web APIs
  - Web APIs rely on access tokens to perform AuthN and AuthZ
  - Are JWT objects made of claims
  - They have a variable lifetime (60-90 mins)
- Refresh Tokens
  - When provided, are used to obtain a new access/refresh token when the current one expires
  - Their content is opaque
  - Lifetime is 24 hours for SPA and 90 days for all other scenarios
  - Can be revoked by the server because of change of credentials, user action, or admin action

OAuth 2.0 Token Flows (1/2)

- Auth code grant
  - Leverages browser-based authentication and redirection
  - Provides access token and refresh token, eventually id token, too
  - Used by web apps, SPA, desktop, mobile apps, etc.
- Client credentials grant
  - Authenticates application using ClientId and ClientSecret/Certificate
  - Used for daemons, server-to-server communication, etc.
- Device code grant
  - Requests user to browse to a web page, provide a code, and sign-in
  - Provides access token and refresh token
  - Used to authenticate on devices like Smart TV, IoT, etc.

OAuth 2.0 Token Flows (2/2)

- On-behalf-of grant
  - A user invokes a back-end Web API/service providing an access token
  - The back-end Web API/service needs to consume another back-end API (like Microsoft Graph) on behalf of (OBO) the front-end user
  - The back-end Web API/service needs client credentials to request the OBO token
- Implicit code grant
  - Allows retrieval of tokens with direct/implicit request to the authorization endpoint
  - Returns access token or id token, only
  - Does not return the refresh token
  - Try to stay away from this flow, sooner or later it will be deprecated
- Resource owner password credentials
  - Don’t use it, unless it is really needed and unless you really trust all the actors in your architecture
  - Sends username and password to the token endpoint
  - Provides access token and refresh token

Permissions Model

- Application
  - You consume Microsoft Graph with an application-only identity
  - Ideal for daemons, background processes, automated tasks
  - Permissions are those granted to the application
- Delegated
  - You consume Microsoft Graph with user and application identity
  - The user delegates the app to work under her/his own identity
  - Permissions are the intersection of those granted to user and application

Permission Consent

- Needed to grant resources access to the Azure AD Application
- Depending on the permissions it could be
  - Admin's consent
  - User's consent
- At the very first access to the application, you're automatically prompted
  - If you're using a regular user account
    - You can only grant user's consent
    - Or ask an admin to grant tenant-wide consent
  - If you're using an admin account
    - You can choose to consent permission tenant-wide (or still for your user only)
- Manual consent can be done by browsing to the following URL
  - https://login.microsoftonline.com/{tenant-id}/adminconsent?client_id={client-id}&redirect_uri={return_URL}
    - Or by using the "Grant Permissions" button in Azure AD management UI
  - Specific permissions for tenant-wide consent are required
    - Global Administrator, Privileged Role Administrator, Cloud Application Administrator, Application Administrator, or custom role

DEMO

Registering a Microsoft Graph consumer application

Consuming Microsoft Graph with Microsoft Graph SDK + MSAL

Throttling with Microsoft Graph

Understanding throttling

- When throttling threshold is exceeded
  - Response is 429 (Too many requests)
  - Request fails
  - Suggested wait time is provided in the response headers
- Best practices to avoid throttling
  - Reduce the number of operations per request
  - Reduce the frequency of calls
  - Avoid immediate retries, because all requests accrue against your usage limits
- Best practices to handle throttling
  - Trap 429 response code
  - Look for Retry-After (secs) response header and take it into account, if any
  - Use the Microsoft Graph SDK to mitigate throttling
  - Leverage batching of requests

Willing to learn more about throttling limits?

- https://learn.microsoft.com/en-us/graph/throttling-limits

Batching Microsoft Graph requests

Microsoft Graph batching requests

- Supported in v1.0 of Microsoft Graph
- Allows combining multiple requests into a single JSON request
  - Uses JSON batching
- Dedicated endpoint (POST): https://graph.microsoft.com/v1.0/$batch
- Correlation id in the requests to associate responses and to define dependencies (*dependsOn*)
  - If parent request fails, dependent requests fail too (424 – Failed Dependency)
- Supports images (Base64 encoded)
- Batching is also useful to bypass URL length limitations

DEMO

Batching with the Microsoft Graph SDK

Know Issues/Limitations

- No nested batch
- All individual requests must be synchronous
- No transactions
- Use relative URIs for batch items
  - So, you cannot mix v1.0 and beta endpoints
- Up to 20 requests limit
- Dependencies just on a single other request (Parallel, Serial, Same)
  - Fully sequential or fully parallel

Microsoft Graph Change Notifications

Microsoft Graph change notifications

- Leverages a webhook mechanism to deliver change notifications
- Based on a subscription model
  - Create a subscription for a resource
  - Receive notifications
  - Renew subscription before it expires (for up to 3 more days)
  - Keep on receiving notifications
- Supported change notifications
  - created
  - updated
  - deleted
- You can provide a custom *clientState* (up to 128 chars) while subscribing
- Some notifications can *includeResourceData* which will be encrypted

Required permissions

- Generally speaking, requires *Read* permission on the target resource
- Supported account types:
  - Delegated - Work or school account
  - Delegated - Personal Account (depends on the resource)
  - Application

Supported Resources

- Security alert
- Teams callRecord
- Teams channel
- Teams chat
- Teams chatMessage
- Teams conversationMember
- Teams team
- Group conversation
- OneDrive driveItem
- SharePoint list
- Outlook message, event, contact
- Directory user, group, others
- Presence
- Print printer
- Print printTaskDefinition
- ToDo task

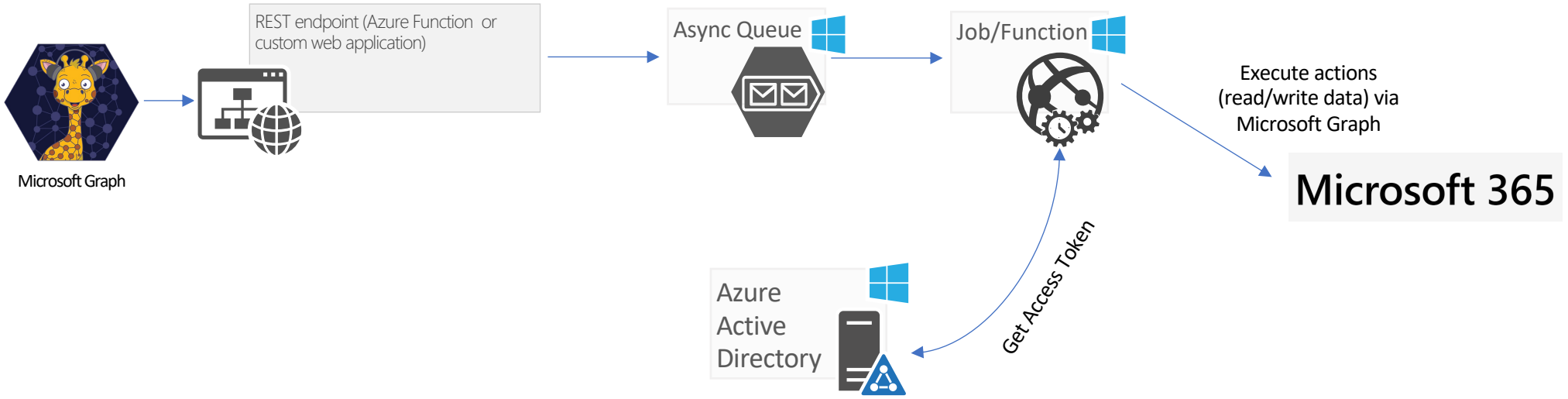
Notification endpoint validation

- Microsoft Graph sends a POST request to the notification URL
  - Including a *validationToken* in the querystring
- The notification endpoint replies within 10 seconds with:
  - 200 (OK)
  - Content-type: text/plain
  - The *validationToken* in the body of the response
- A subscription renewal doesn’t imply a validation process

Processing notifications

- Microsoft Graph sends a POST request to the notification endpoint with:
  - subscriptionId
  - subscriptionExpirationDateTime
  - clientState
  - changeType
  - resource
  - resourceData
- The notification endpoint replies within 30 seconds with:
  - 202 (Accepted)
- The notification endpoint must validate the *clientState* value

Suggested architecture



DEMO

Playing with the Microsoft Graph Change Notifications

Technical Limits

- For Azure AD resources (user, groups) there are some limits:
  - Per app: 50.000 total subscriptions
  - Per tenant: 1.000 total subscriptions across all apps
  - Per app and tenant combination: 100 total subscriptions
  - When limits exceeded:
    - 403 Forbidden + error message
- For Outlook resources (messages, events, or contacts)
  - UPN does not support apostrophes, use user ID instead
- Azure AD B2C tenants are not supported, either
- Some notifications do not provide resource details (OneDrive for example)
  - Use other techniques to retrieve actual data (for example /delta for OneDrive)

Microsoft Graph extensibility model

Graph Extensibility Options

- Extension attributes
  - For users and devices there are up to 15 extension attributes
  - Are just string values stored on the target object
- Directory extensions
  - Strongly-typed, discoverable, and filterable extensions
  - Available for directory objects: User, Group, AdministrativeUnit, Application, Device, Organization
- Open extensions
  - Un-typed, not discoverable, not filterable extensions
  - Easy to use and available for many more resources, rather than just directory objects
- Schema extensions
  - Conceptually similar to Directory extensions
  - Are world-wide defined and a good option for ISVs

Microsoft Graph Open Extensions

- You can add **untyped** properties to resources in Graph
  - Using a key/value pair approach
- Just some of the resources support Open Extensions
- Name of extensions should include reverse DNS name
  - For a TLD that you own, indeed
  - For example: *com.contoso.contactExtension*
- **Can be added, updated, deleted**
- **Resources cannot be filtered based on open extensions!**
- Supported methods: POST, GET, UPDATE, DELETE
- Required permission can vary based on the resource

Microsoft Graph Schema Extensions

- You can add **strongly-typed** custom data to resources in Graph
- Just some of the resources support Schema Extensions
- They are “schema based”
  - First you define the schema
  - Then you use it to enrich instances of resources
- Schema Extensions have a reference owner (i.e. the app that defined it)
- Cannot be created within an App-Only context
  - Requires delegated permission for: Directory.AccessAsUser.All
- If “InDevelopment” state can be: added, updated, deleted
- **Resources can be filtered based on schema extensions**

Schema Extensions (cont.)

- Name of schema extensions can follow any of the following rules
  - {*domainName*}_{*schemaName*} if you have a registerd TLD
    - Your organization must own the namespace piasys as a part of one of the verified domains
  - {name} and Graph will rewrite it to:
    - ext{*8-random-alphanumeric-chars*}_{*schema-name*}
- To create Schema Extensions an app requires *Directory.AccessAsUser.All* permission
- To read and write values of schema extensions, you need permissions to read or write the target resource

Schema Extensions Data Types

- Binary (up to 256 bytes)
- Boolean (not supported for contacts, messages, events and posts)
- DateTime (ISO 8601 format. Stored in UTC)
- Integer (32bit - not supported for contacts, messages, events and posts)
- String (up to 256 characters)

DEMO

Working with the Microsoft Graph Extensions

Microsoft Graph - Wrap up!

- Microsoft Graph is the present (and the future) of Microsoft 365 development
- Rely on the Microsoft Graph SDK for a better developer experience
- Learn about REST, OAuth 2.0, JSON batching, and the Graph
- Keep an eye on Microsoft Graph know limitations
  - https://docs.microsoft.com/en-us/graph/known-issues
- Play with the Microsoft Graph and have fun!

Code sample download

https://github.com/PiaSys/Conferences-Samples/tree/master/MSGraph-VSCode

https://collabdays.be

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