

Microsoft Power BI

Enterprise Deployment Workshop

github.com/tylerchessman/PBIEnterpriseDeploymentWorkshop

Tyler Chessman (tylerc@Microsoft.com)
Last Saved: Aug 2024



Agenda

- *Introductions and Expectations for the Day*
- Architectural Overview of Power BI - Including New Fabric Experiences
- Roles/Responsibilities
- Provisioning of Services, Users, & Software
- Training and Evangelism
- Managing/Exposing Data Sources
- Publishing and Sharing Content - Best Practices
- Supporting Data Refresh and Live Connections
- Security Best Practices
- Monitoring and Auditing activity

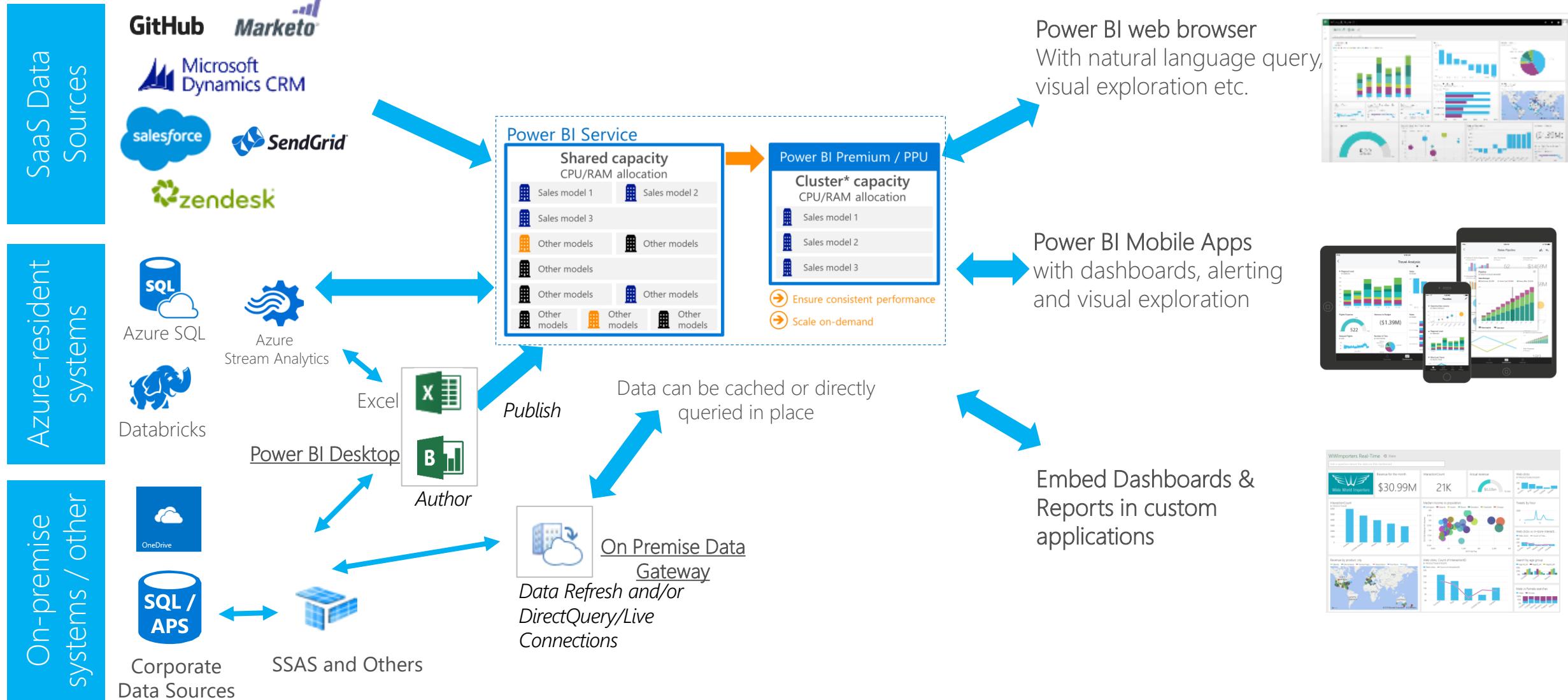
Notes

- This material was originally developed in 2017
 - It is intended to be delivered as a 1-day workshop (instructor led – with demos, no formal hands-on activities)
 - I periodically maintain/refresh this material – please check the GitHub repository for updates, <https://github.com/tylerchessman/PBIEnterpriseDeploymentWorkshop>
- Additional resources are also available, including
 - Power BI implementation planning - [Power BI implementation planning - Power BI | Microsoft Learn](#)
 - Fabric / Power BI adoption roadmap – [Microsoft Fabric adoption roadmap - Power BI | Microsoft Learn](#)
 - Please refer to the Power BI Whitepapers web-page for additional resources:
<https://docs.microsoft.com/en-us/power-bi/guidance/whitepapers>

Power BI Technical Architecture

Bring your data.....

...to life



Introducing the new Microsoft
Fabric solution



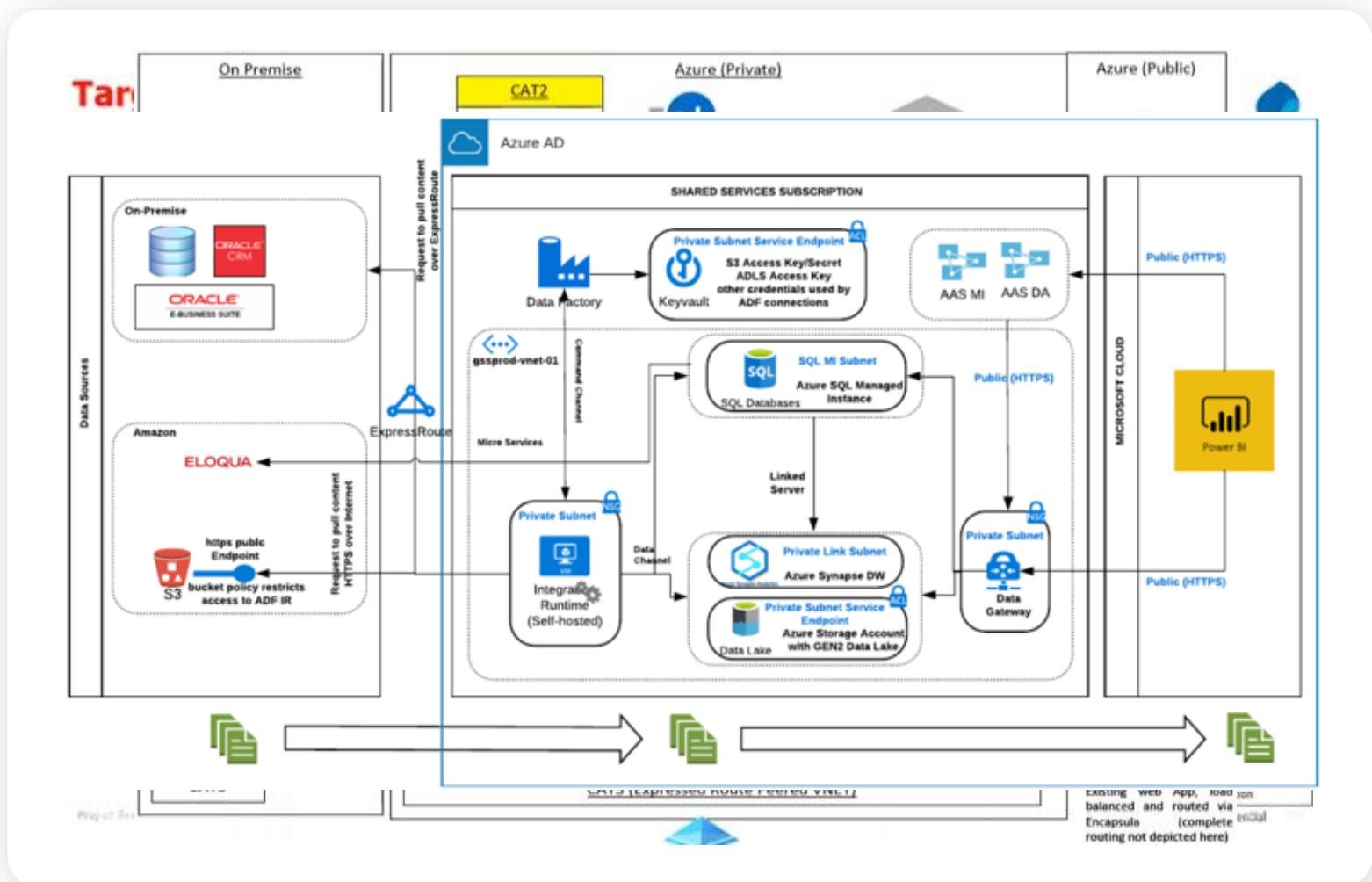
Scalable analytics are complex and fragmented

Every analytics project has many subsystems

Every subsystem need a different class of product

Products often comes from multiple vendors

Integration at scale across products is complex, fragile and expensive



A silver lining?

Analytics systems have very predictable patterns

Microsoft has all the products with the right scale needed to build a complete analytics system



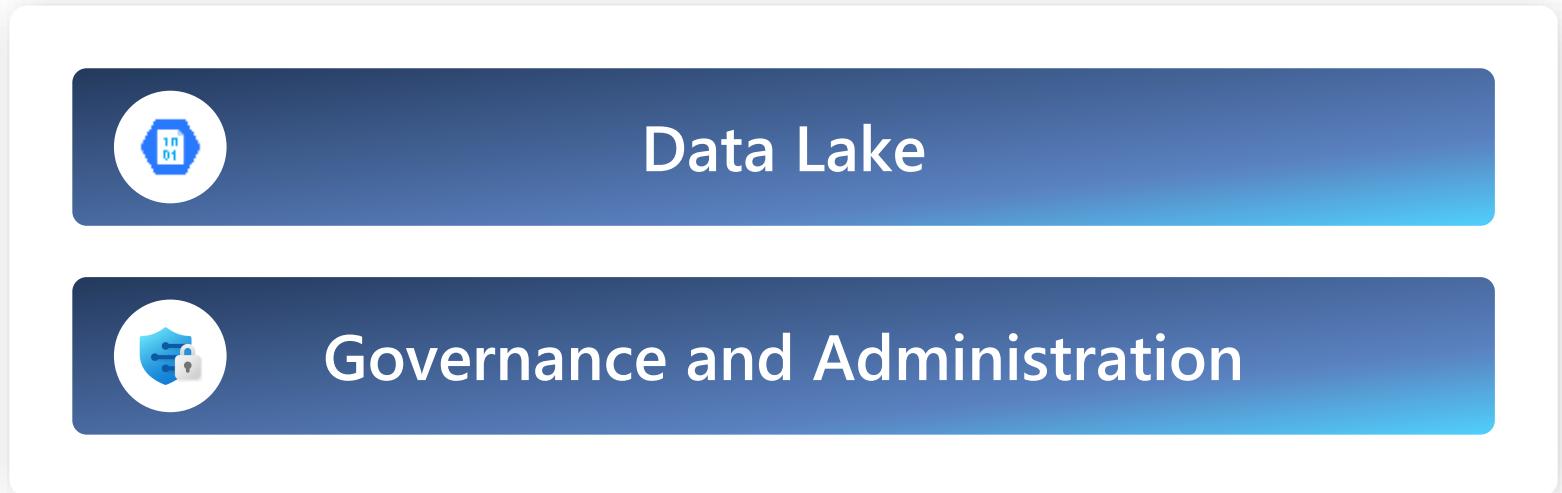
Data Lake

Governance and Administration

A silver lining?

Analytics systems have very predictable patterns

Microsoft has all the products with the right scale needed to build a complete analytics system



Still far too complex

Many Products

Different Experiences

Proprietary and Open

Dedicated and Serverless

PaaS and SaaS

Different Business Models

Steep Learning Curves

Deep Expertise Needed

High Integration Effort



Purview



Power BI



Kusto



Data Factory



Azure AI



Synapse DW



Synapse Spark

Microsoft Fabric



Data
Integration



Data
Lake



Spark
Engines



Data
Warehouse



Real Time
Analytics



Data
Science



Business
Intelligence



Governance

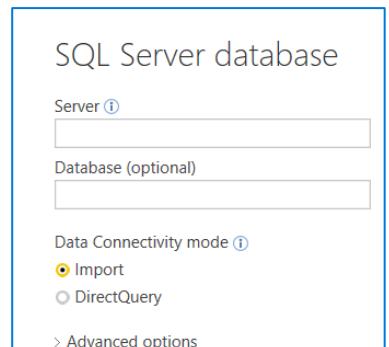
Unified analytics fabric

End-to-end analytics data fabric
From the data lake to the business user

Power BI Authoring

Semantic Models - cached (*imported*) vs live (*direct query*/*Direct Lake*)

- The building blocks of authoring content in Power BI are a -
 - Semantic Model (aka Data Model) – detailed data, metadata (e.g., table/column names), and relationships among data tables
 - Report (can be created in the PBI Desktop – and/or in the Power BI Service via a browser)
 - Dashboard (created in the Power BI Service)
- Most Semantic Models are first built in the Power BI Desktop, with a few notable exceptions -
 - Apps e.g., Salesforce, Google Analytics, etc. are created directly in the Power BI Service
 - They are “imported” datasets (see below) – and may be refreshed on a schedule
 - Streaming Semantic Models are also created in the Power BI Service
 - an API is used to push (stream) data directly into these datasets; they are typically used for near “real-time” dashboards
 - Authors may choose to first use PBI dataflows to extract/transform/load data – and then load the dataflow into the Desktop
- When creating a semantic model, the author in most cases decides to either* -
 - Import data. Data is pulled down, compressed, and saved as part of the Power BI Desktop file (.pbix).
 - Data from 1-to-many disparate data sources can be mashed-up and related together; data is refreshed on-demand
 - Create a Live Connection (*DirectQuery / Connect Live***). A connection to 1 data source*.
 - Only “metadata” (e.g., table names, field names, relationships between tables) is pulled down and stored in the desktop file
 - Note - support for live connections is limited to a smaller set of data sources (e.g., SSAS, SQL Server, Oracle, SAP Hana, Teradata)



*Composite Models can include multiple DirectQuery and Import data connections -
<https://docs.microsoft.com/en-us/power-bi/desktop-composite-models>

**Live Connect is reserved for Analysis Services database (and is the method used for connections to Power BI datasets)

Power BI Authoring

Connecting to data with Power Query

- What is it?
 - A "data connectivity and data preparation technology that enables end users to seamlessly import and reshape data from within a wide range of Microsoft products, including Excel, Power BI, Analysis Services, Common Data Service, and more."
- Originally released as a free add-in for Excel 2010/2013, Power Query is now a native feature within Excel 2016+
- Is the native Data Load engine in Power BI (Desktop, Data Flows, and DataFlow Gen2)
- Supports Multiple Data Sources
- Provides a graphical UI to Connect and Transform Data
- Every "Step" in a Query is part of a script
 - Viewable from the Advanced Editor
 - Informally called "M" (James Bond?)
 - Script can be re-run / scheduled for subsequent data refreshes
- **Query Results are stored in a worksheet/semantic model***
 - Load to Data Model for >1 million rows
 - Other tools (e.g., PBI) load to a different destination

The screenshot shows the Microsoft Power Query Editor interface. The main area displays a preview of a table with columns: WellHeaderKey, ProductName, Value, and DateKey. The preview shows 24 rows of data, mostly for 'Oil' and some for 'Water'. The editor's ribbon includes File, Home, Transform, Add Column, View, Tools, and Help. The Home tab is selected. On the right, the 'Properties' pane shows the 'Name' is 'Forecasts'. The 'Applied Steps' pane lists several transformations, with 'Changed Type1' being the most recent step applied.

*When working with a Live Connection, only metadata is stored in the semantic model

Power BI Authoring

Drilldown.... Import, DirectQuery, Connect live, and more...

• Imported (cached). The author -

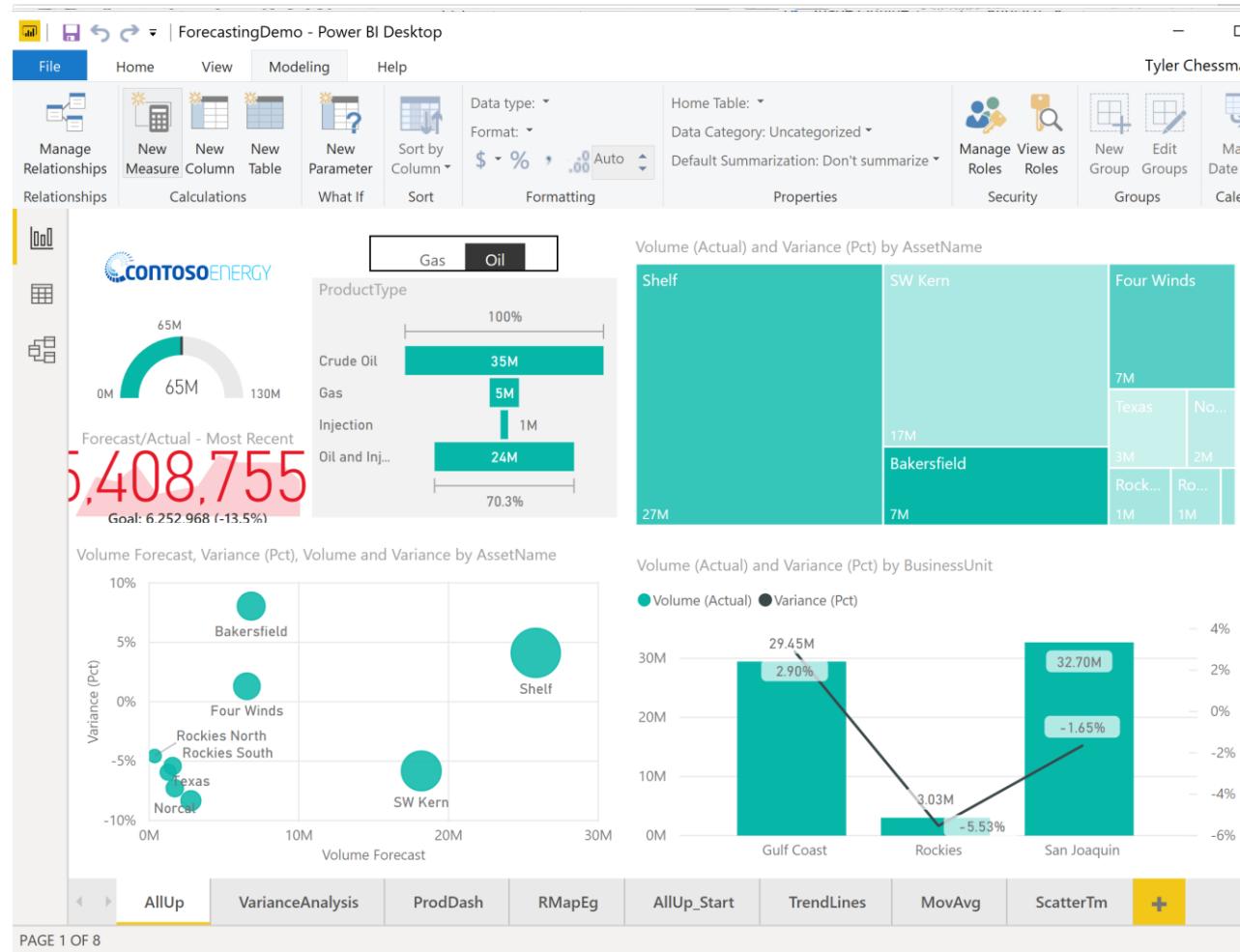
- Imports data and metadata from data source(s)
- May also create calculated columns and measures
- Defines relationships among sources
- Create a report with 1 or more pages.
- Imported data may be refreshed manually or, after publishing, on a schedule (up to 8x in PBI Service, 48x daily in PBI Premium)
 - Incremental refresh can help with overhead and performance

• Direct query. The author -

- Imports metadata from a data source
 - May also create calculated columns and measures
- Defines relationships among sources
- Creates a report with 1 or more pages.
- Every visual is rendered via a real-time query result set.
 - Once published, a gateway can be used for on-prem data source

• Connect Live. The author -

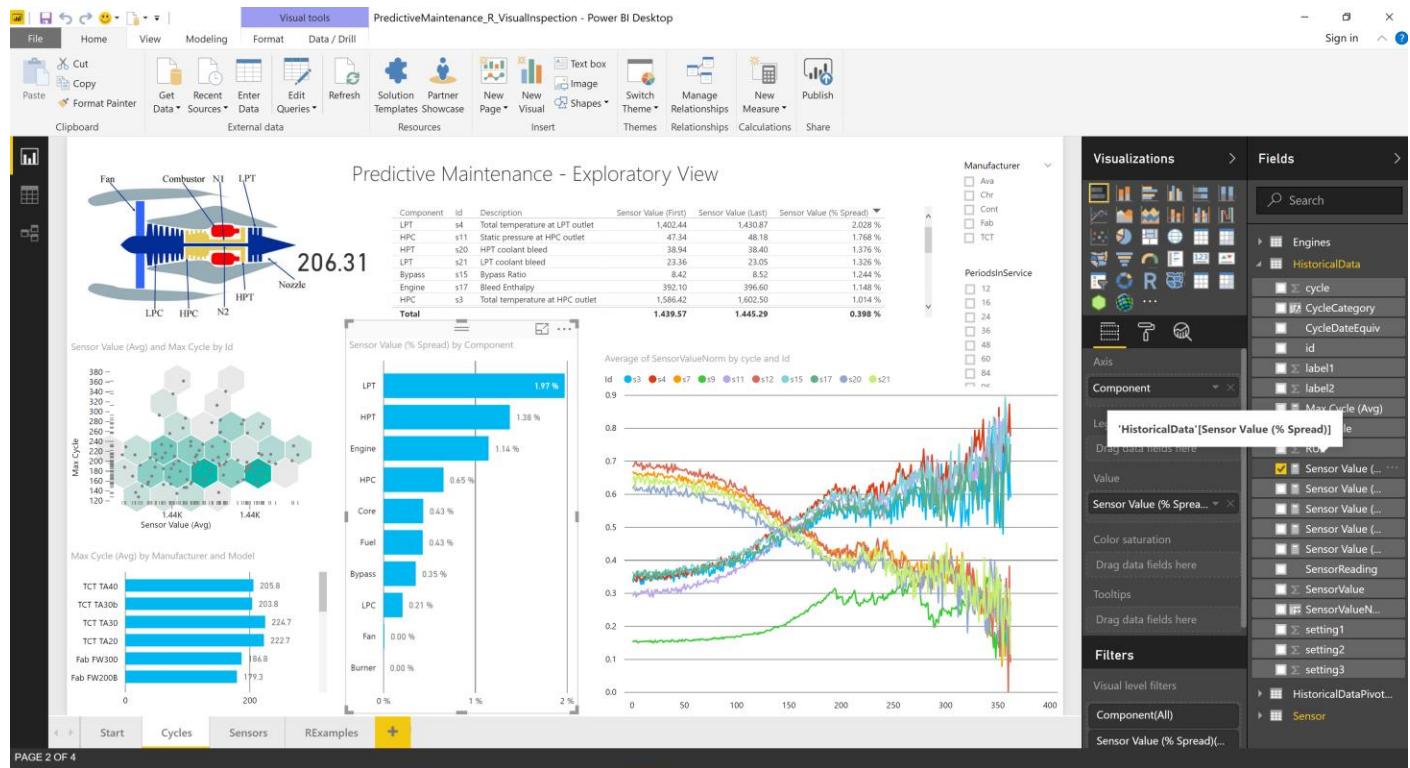
- Connects to a cube/perspective (or Power BI dataset)
- May also create additional measures (Tabular only)



Power BI Authoring

Building a Report

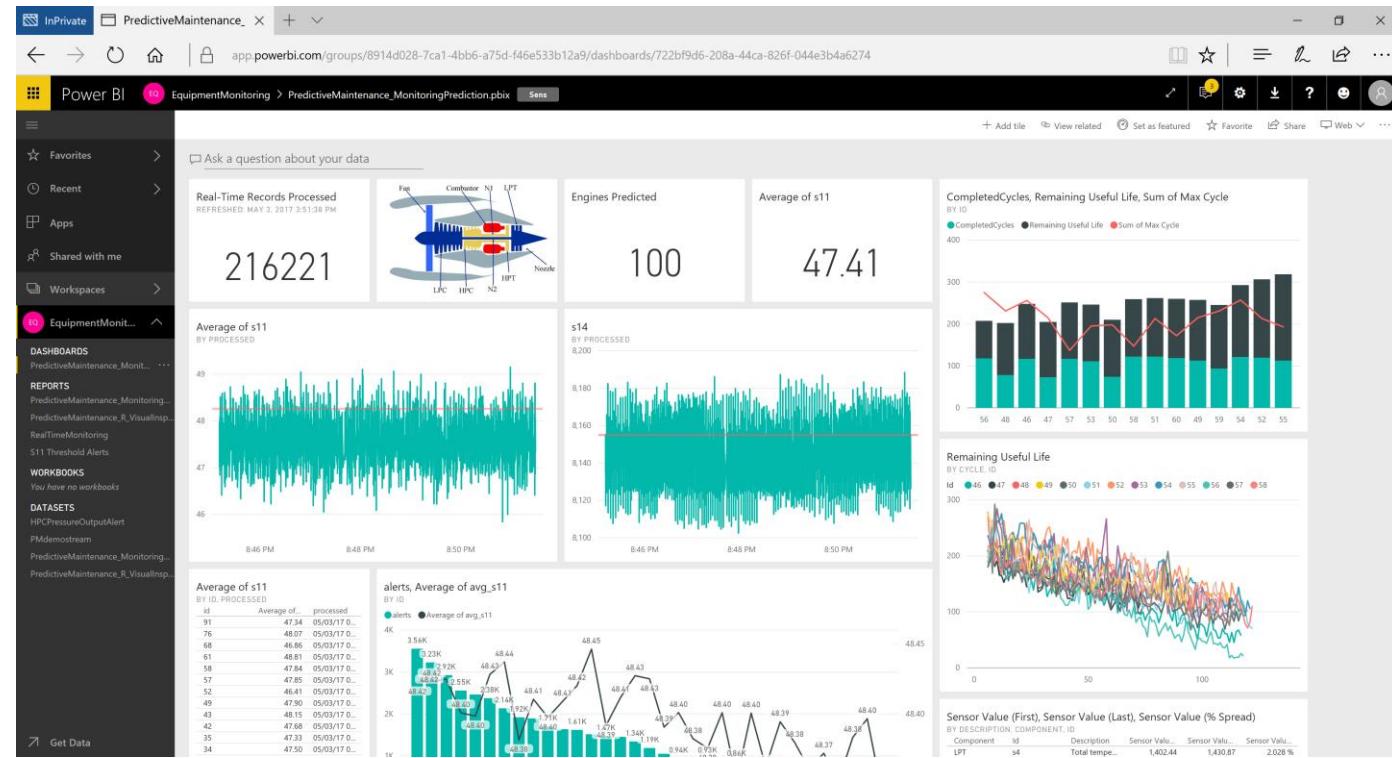
- In the Desktop, the author chooses columns from the dataset to create tables and charts
- A Report is similar to an Excel workbook - it can contain multiple “pages” (worksheets)
- Building a report against a live or imported connection is essentially the same experience
- The author can save the dataset/report as needed
 - Everything is saved in a .pbix file
- The author can email the .pbix file to someone else, place it on a file share, etc.
 - Anyone else with the Power BI Desktop can then open/edit it.
- Most enterprise organizations will want to “publish” the file for easy consumption..



Power BI Authoring

Publishing to the Power BI Service

- The author publishes the Power BI Desktop file to the Power BI Service
 - Remember – the .pbix file contains a data set (live or imported) along with a report
 - These two components (dataset and report) are split out and stored in a workspace
 - Note – we also support publishing Excel workbooks to the Power BI Service
- After the file is published, the author can
 - Edit and/or create new reports directly in the browser
 - Schedule data refresh (may require a [gateway](#))
 - Build a dashboard (a collection of visuals from one or more reports/datasets)
 - Share the dashboard/report/dataset with others



- A note about Workspaces
 - Every user has a personal "My Workspace"
 - A user may be a member of other group Workspaces
 - A Workspace contains Datasets, Reports, and Dashboards
 - We will cover this in more detail during the publishing topic

Power BI Service

Shared Service, Premium, On-Premise Report Server

As of June, 2017....

- The Power BI Service is available in both Shared and the new "Premium" mode

- Shared Mode

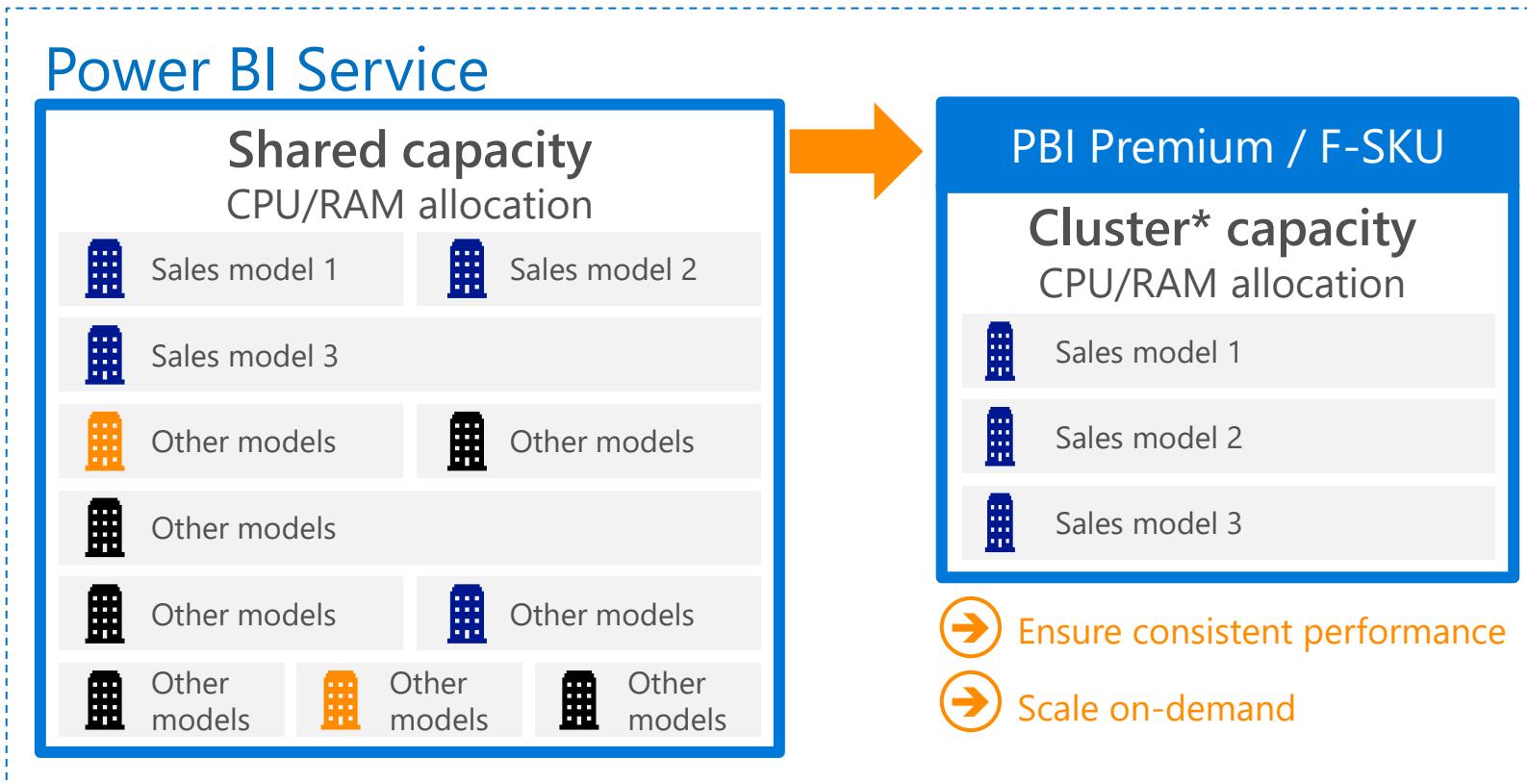
- Licensed by user (Pro licenses)
- Multiple tenants on shared hardware

- Premium Mode

- Licensed by user (Pro licenses for authors) and v-cores
 - Consumers don't need a Pro license
 - Update – Fabric F-Skus will replace P-Skus
- Premium-specific hardware

- The Power BI Report Server is available for on-premise deployments

- Power BI Desktop files can be published alongside traditional SSRS reports



Company 1 Company 2 Company 3

Models run on distributed hardware
servicing multiple tenants

*Premium Gen2 leverages a regional cluster of physical nodes, shared by tenants using Premium

Power BI Premium

Additional Capabilities vs Shared Service

Last Updated (Nov 2023)....

- Ability for all users to consume content without a paid per-user license
- **Access to all Fabric Workloads** – including data factory, data engineering, data warehouse, etc.
- Larger Imported Models (up to 400 GB)
 - <https://docs.microsoft.com/en-us/power-bi/service-premium-large-datasets>
- Higher dataset refresh rate (48 per day), unlimited via XML/A endpoint
- Incremental refresh (for imported models) with real-time DirectQuery partition
 - <https://docs.microsoft.com/en-us/power-bi/service-premium-incremental-refresh>
- Geo-specific deployment of Premium capacity
 - <https://docs.microsoft.com/en-us/power-bi/service-admin-premium-multi-geo>
- Advanced Dataflows capabilities

Semantic Model

Decision Criteria, Capabilities, and Examples

- Model Size

- < 1 GB
- 1 GB - 10 GB
- 10 GB – 400 GB
- 400 GB +

- Refresh Requirements

- Daily to 8x a day
- Up to 48x daily
- Every few minutes
- Real-time

Example Scenarios

- I have a 400 MB data set; it needs to be refreshed nightly. Recommendation – PBI Service/Premium
- I have a 2 GB data set; it need to be refreshed nightly. Recommendation – PBI Premium
- I have a 2 GB data set that needs to be refreshed every 10 minutes. Recommendation – PBI Premium
- I have a 25 GB data set; it needs to be refreshed on the hour. Recommendation – PBI Premium / Azure Analysis Services
- I've developed a report against my relational DW (which is 20 TB). The data is refreshed is throughout the day. Recommendation – DirectQuery, or consider a composite model with [Hybrid Tables / aggregations](#)

- PBI Service – 1 GB, 8x daily refresh (full)
- PBI [Premium](#) – 400 GB, 48x daily refresh (full / incremental), unlimited refresh via [XML/A](#), Scale-out replicas in [preview](#)
- Azure Analysis Services – 400 GB, unlimited refresh (full / incremental), Scale-out replicas (built-in)
 - Alternatively supports a [limited](#) set of DirectQuery sources
- SQL Server Analysis Services – ~4 TB, unlimited refresh, scale-out replicas (custom)
 - Alternatively supports a [limited](#) set of DirectQuery sources

DEMO

Build/Publish Report

Agenda

- Introductions and Expectations for the Day
- Architectural Overview of Power BI
- *Roles/Responsibilities*
- Provisioning of Services, Users, & Software
- Training and Evangelism
- Managing/Exposing Data Sources
- Publishing and Sharing Content - Best Practices
- Supporting Data Refresh and Live Connections
- Security Best Practices
- Monitoring and Auditing activity

Roles and Responsibilities

Common Areas/Tasks and role mappings

- Provisioning → • Business Sponsor
 - dependent services, software, licenses
- Training and Education → • Azure AD administrator
 - Office 365 Global Admin
- Data Access and Usage → Power BI Champion
 - Basic on-boarding, how-to's, company standards, tips/tricks, knowledge sharing
- Data Steward
 - Approved sources, master data, sharing and publishing policies
- Authoring
 - Creating/connecting to datasets, creating reports
- Publishing → • Power User/Analyst
 - BI Practitioner/IT Developer
- Sharing → • BI Architect
 - Individual versus teams vs corporate wide
- Securing → Security Architect
 - Data (at-rest & in-transit; on-premise & cloud), authentication/authorization
- Monitoring and Auditing → Power BI Administrator
 - Publishing, Creating, Sharing, Exporting, and Deleting of content

Provisioning Dependent Services

- Azure AD administrator
- Office 365 Global Admin

• ~~Azure Active Directory (Azure AD, AAD)~~ Microsoft Entra ID

- Required for user authentication – used by a variety of 3rd party & Microsoft services – Office 365, Exchange Online, SharePoint Online, Power BI, etc.
- In Power BI, AD security groups can also be used to help securing/distributing content to end-users.
- Large enterprises will synchronize their on-premise Active Directory with Azure AD to provide a single sign-on experience
 - AAD Connect - <https://docs.microsoft.com/en-us/azure/active-directory/connect/active-directory-aadconnect>
- **Action Item** - Check with your internal Domain Administrators/Security Team to determine the current state of AAD integration

• Office 365

- Technically, Power BI doesn't require Office 365 licensing. But, it does use Office 365 artifacts/management capabilities
- The Office 365 Admin portal is also used for license management (you can use Power Shell scripting as well)
- Many organizations already have some Office 365 licensing in place
- **Action Item** – Find out if your organization is using Office 365, and contact the Office 365 Global Admin
- The Office 365 Global Admin has administrative rights over Power BI, but he can delegate a "Power BI Service Administrator" role
 - "Your account needs to be marked as a Global Admin, within Office 365 or Azure Active Directory, or have been assigned the Power BI service administrator role, to get access to the Power BI admin portal!"
- <https://powerbi.microsoft.com/en-us/documentation/powerbi-admin-administering-power-bi-in-your-organization/>
- <https://powerbi.microsoft.com/en-us/documentation/powerbi-admin-role/> . Note, this role does not provide....
 - Ability to modify users and licenses within the Office 365 Admin Center
 - Access to the audit logs (though Power BI now offers its own view of PBI Specific logs! More on this topic later)

Provisioning Users and Software

- Power BI Desktop - <https://powerbi.microsoft.com/en-us/desktop/>
 - The authoring tool for Power Users/IT Developers (and anyone else who is going to author and publish content)
 - A free application, it has no dependency on the Power BI Service; requires local administrative rights to install on a machine
 - Updated monthly – though you don't have to install every update; some organizations are choosing to perform controlled quarterly rollouts
 - E.g., <https://blogs.msdn.microsoft.com/samlester/2016/09/30/installing-power-bi-desktop-through-sccm/>
 - **Action Item** – Develop Power BI Desktop rollout and update strategy
- Power BI Gateway – covered later
- Power BI Service – data center location*
 - <https://www.microsoft.com/en-us/trustcenter/privacy/powerbi-location>
- Power BI Service – User Licenses
 - By Default, users can self-sign up for a Power BI Free license
 - The free license is now severely limited – no sharing capabilities. Free license users can automatically bump themselves up to a 60-day Pro trial
 - **Action Item** – Consider blocking individual sign up - <https://powerbi.microsoft.com/en-us/documentation/powerbi-admin-powerbi-free-in-your-organization/>. Instead, assign licenses in mass or as part of an employee on-boarding process
 - Power BI Pro (or PPU) licenses are required for any users who want to publish/share/modify content.
 - To view shared content, a user will also need a Pro license – unless that content is published to a workspace hosted in a Premium capacity
 - **Action Item** – Identify end-user community of authors and consumers. Look at licensing/pricing, and evaluate against performance requirements
 - <https://powerbi.microsoft.com/en-us/pricing/>

Training and Evangelism

Role out strategy

- Power BI Champion
- BI Architect

- Identify Training Needs

- Power Users – Gather/Store Data, Build Data Models, Build Initial Reports, Publish Content, Share Content
- Consumers – Find Content, Explore Dashboards/Reports (extend dashboards/reports?)
- Administrators – Today!

- Build Internal Awareness for the masses

- Present and record internal presentations/webinars (~1.5 hours) – conduct multiple times and make available for on-demand viewing

- Consider Hands-On Training for Power Users

- Dashboard in a Day Sessions often held at local Microsoft Offices e.g.,
<https://www.microsoftevents.com/profile/form/index.cfm?PKformID=0x188356617d4>
- See Next Slide for Online, Classroom, Books, and Self-Paced training options

- Conduct “Launch” Event(s)

- A repeat of internal awareness content along with Testimonials/internal case studies
- Call to actions (any training materials/follow up sessions)

- Update (April 2021) – See my COE document for additional ideas - [tylerchessman/PBICOE: Guidance for establishing a Power BI Center of Excellence \(github.com\)](https://github.com/tylerchessman/PBICOE)

Business App Summit, Schlumberger PBI Rollout - <https://www.youtube.com/watch?v=yKRdZW5WUVY>
~starts at 26 minutes into video, deployment approach at ~34

Training Links and Resources

- Microsoft provides several free training resources and virtual labs (train yourself):
 - Getting Started with Power BI - <https://powerbi.microsoft.com/en-us/learning/>
 - YouTube Video Library - <https://www.youtube.com/channel/UCy--PYvwBwAeuYaR8JLmrfg>.
 - Power BI Documentation - <https://powerbi.microsoft.com/en-us/documentation/powerbi-landing-page/>
 - July, 2021 – free 60-minute virtual training sessions - [Announcing availability of virtual workshops and training to get started with Power BI | Microsoft Power BI Blog | Microsoft Power BI](#)
 - Contact your local Microsoft sales team to learn more about customized training options – for Admins, Power Users, and End-users
- Training/learning from 3rd party sources
 - www.sqlbi.com. Deep expertise on Tabular, Multidimensional, PowerPivot, and DAX. Provide both books and online training. Recommend signing up for their newsletters
 - Bluegranite. <http://msbiacademy.com/>
 - www.powerpivotpro.com. <https://p3adaptive.com/>.
 - Artis Consulting. Great boutique MSFT BI consulting shop that also offers training www.artisconsulting.com
 - Pragmatic Works. Free and paid training, along with workshops, (<http://pragmaticworks.com>)

Agenda

- Introductions and Expectations for the Day
- Architectural Overview of Power BI
- Roles/Responsibilities
- Provisioning of Services, Users, & Software
- Training and Evangelism
- *Managing/Exposing Data Sources*
- Publishing and Sharing Content - Best Practices
- Supporting Data Refresh and Live Connections
- Security Best Practices
- Monitoring and Auditing activity

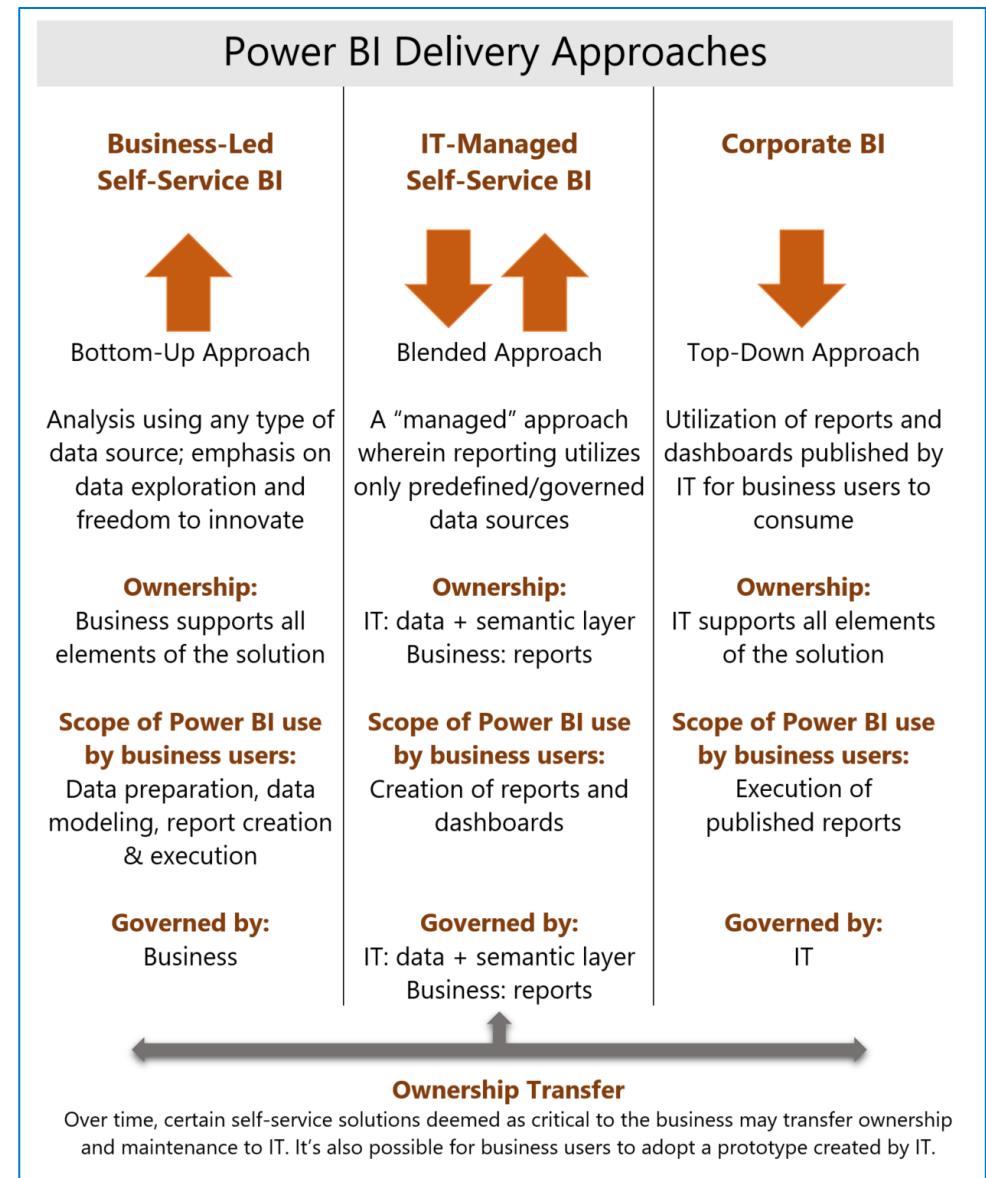
Governance Overview

- Definition

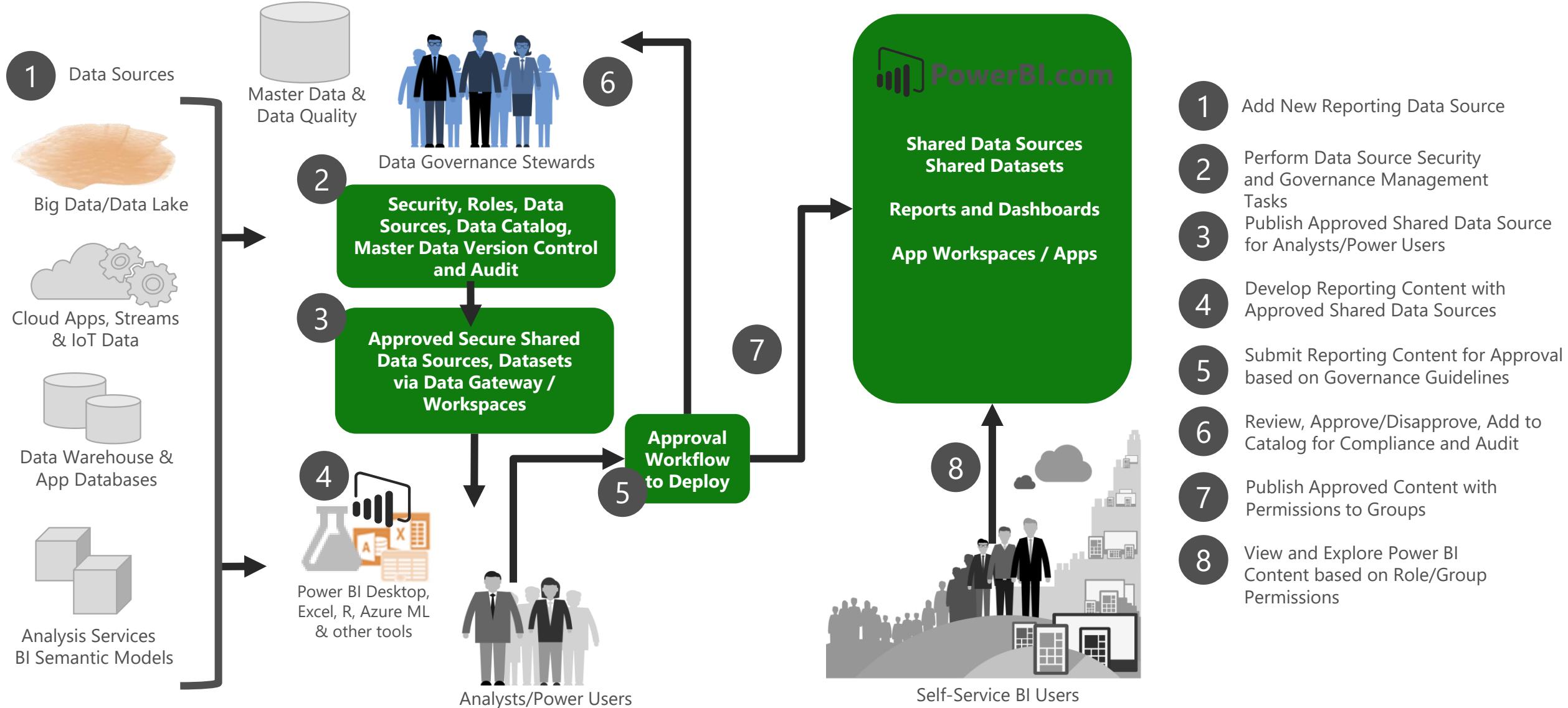
- "Establishment of policies, and continuous monitoring of their proper implementation, by the members of the governing body of an organization. It includes the mechanisms required to balance the powers of the members (with the associated accountability), and their primary duty of enhancing the prosperity and viability of the organization." - www.businessdictionary.com/definition/governance.html

- It is useful to think about governance in the context of three delivery approaches and corresponding levels of control.

1. Business-Led Self-Service BI. Business (typically Power) Users -
 - Have direct access to data (Gather/Store)
 - The ability to create custom data models (Model) and reports (Analyze)
 - Publish data model and reports (Share)
2. IT-Managed Self-Service BI.
 - IT gathers/stores/models and publishes a data model
 - Business users build reports and share with others
3. Corporate BI
 - Typically a "turn-key" solution. IT delivers a ready-to-consume dashboard
 - Additional reports/authored tightly controlled



Governance Example Process



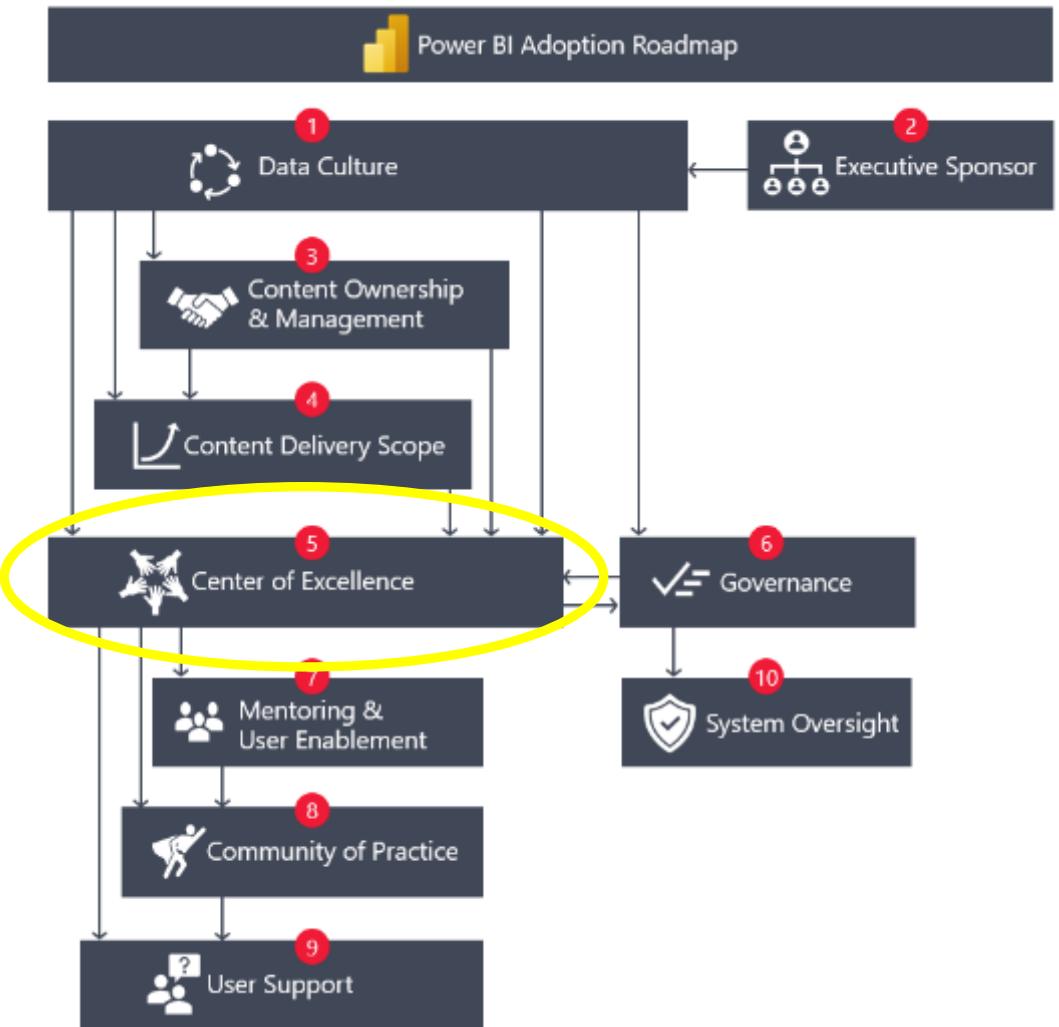
Governance

Introducing into an existing environment

- Review the new Governance documentation, specifically, Method 1
 - Be sure to review the Considerations and [key actions](#)
- Low hanging fruit – Tenant Settings [Tenant settings guidance - Power BI | Microsoft Docs](#) e.g.,
 - Share content with external users
 - Publish to web
 - Export data
- Monitoring – Audit Logs
 - Capture key events (e.g., Export data, data source/gateway usage, etc.)
 - Update – May 2023, The new [Admin Monitoring workspace](#) provides the Feature Usage and Adoption report
- Monitoring – Inactive Usage e.g.,
 - [Power BI Unused Artifacts API \(preview\) | Microsoft Power BI Blog | Microsoft Power BI](#)
 - Custom Scripts/Jobs
- Introduce Sensitivity Labels [\(Microsoft Information Protection sensitivity labels in Power BI - Power BI | Microsoft Docs\)](#)
 - Uses Azure Information Protection Premium P1/P2
 - Allows users to classify content (Desktop and Service)
 - Can be applied to datasets, reports, dashboards, and dataflows
 - Labels apply to exported data/.pbix files

Power BI Adoption Roadmap

Building a Center of Excellence



Area	Description
1	Data culture: Data culture refers to a set of behaviors and norms in the organization that encourages a data-driven culture. Building a data culture is closely related to adopting Power BI, and it's often a key aspect of an organization's digital transformation.
2	Executive sponsor: An executive sponsor is someone with credibility, influence, and authority throughout the organization. They advocate for building a data culture and adopting Power BI.
3	Content ownership and management: There are three primary strategies for how business intelligence (BI) content is owned and managed: business-led self-service BI, managed self-service BI, and enterprise BI. These strategies have a significant influence on adoption, governance, and the Center of Excellence (COE) operating model.
4	Content delivery scope: There are four primary strategies for content delivery including personal BI, team BI, departmental BI, and enterprise BI. These strategies have a significant influence on adoption, governance, and the COE operating model.
5	Center of Excellence: A Power BI COE is an internal team of technical and business experts. These experts actively assist others who are working with data within the organization. The COE forms the nucleus of the broader community to advance adoption goals that are aligned with the data culture vision.
6	Governance: Data governance is a set of policies and procedures that define the ways in which an organization wants data to be used. When adopting Power BI, the goal of governance is to empower the internal user community to the greatest extent possible, while adhering to industry, governmental, and contractual requirements and regulations.
7	Mentoring and user enablement: A critical objective for adoption efforts is to enable users to accomplish as much as they can within the guardrails established by governance guidelines and policies. The act of mentoring users is one of the most important responsibilities of the COE. It has a direct influence on adoption efforts.
8	Community of practice: A community of practice comprises a group of people with a common interest, who interact with and help each other on a voluntary basis. An active community is an indicator of a healthy data culture. It can significantly advance adoption efforts.
9	User support: User support includes both informally organized, and formally organized, methods of resolving issues and answering questions. Both formal and informal support methods are critical for adoption.
10	System oversight: System oversight includes the day-to-day administration responsibilities to support the internal processes, tools, and people.

Center of Excellence (COE)

Getting Started – Establish an *initial* Definition, for your Organization/Business Unit

An internal team of technical and business experts ... assists others within the organization who are working with data .. forms the nucleus of the broader community to advance adoption goals, which align with the data culture vision

[Power BI Adoption Roadmap](#)

Developed by building connections and creating partnerships, establishing regular touch points, and focusing on user enablement. Internal communities bring people together by finding internal champions, connecting with PBI user groups and the PBI team at Microsoft, and local partners.

[How Rockwell Automation is building a world-class Power BI Center of Excellence – YouTube](#)

A business function that organizes people, processes, and technology components into a comprehensive set of business competencies and capabilities.

[Microsoft's BI COE](#)

Helps businesses "maximise the benefits realisation, fast track the ROI, provide an all-around greater experience" while minimizing risks and downsides guidelines and best practices to help the organization leverage all of the PBI Platform benefits (existing and new) – while ensuring a "safe, controlled, and governed environment".

Alex Garcia, [Power BI Centre of Excellence, What and Why – Part 1 of PBI COE Series. – Smart Power BI](#)

A team who provides leadership, best practices, resources, and guidelines to help an organization maximize the benefits of Power BI in a safe, controlled environment.

Tyler Chessman - [COE Guidance](#)

Center of Excellence (COE)

Create an Implementation Plan – *Define Goals*

- Define Goals
- Scope Responsibilities
- Staff Team
- Build and Empower the community

Potential Goals Include:

- Evangelize a data-driven culture.
- Promote the adoption and value of using Power BI.
- Nurture, mentor, guide, and educate internal users to increase their skills and level of self-reliance.
- Coordinate efforts and disseminate knowledge across organizational boundaries.
- Create consistency and transparency for the user community, which reduces friction and pain points related to finding relevant data and analytics content.
- Maximize the benefits of self-service BI, while reducing the risks.
- Reduce technical debt by helping make good decisions that increase consistency and result in fewer inefficiencies.

Action Item

With a COE definition in place, identify key goals along with a justification as to why a COE is needed – and the risks of not having one.

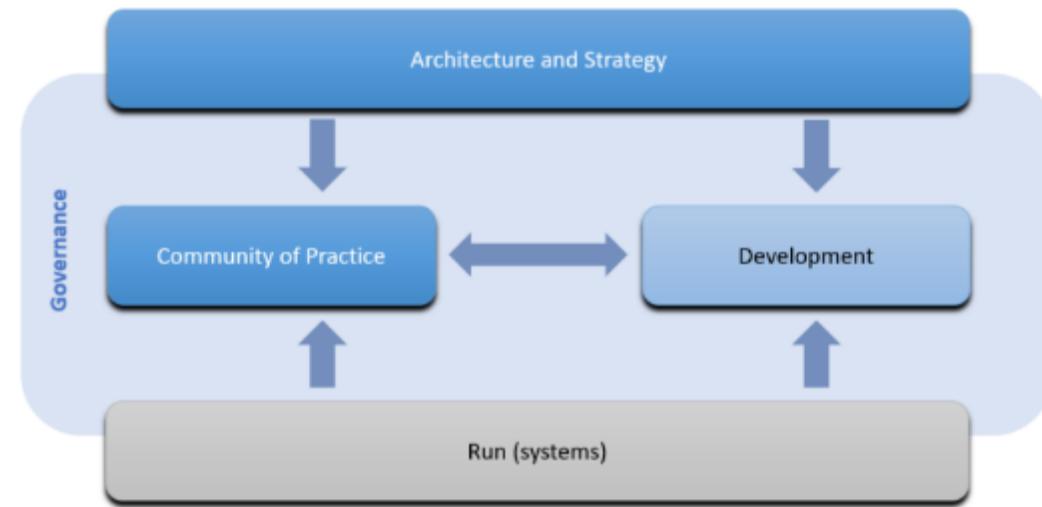
Center of Excellence (COE)

Create an Implementation Plan – Scope Responsibilities

- Define Goals
- **Scope Responsibilities**
- Staff Team
- Build and Empower the community

Common responsibilities include:

- Mentoring the internal Power BI community.
- Producing, curating, and promoting training materials.
- Creating documentation and resources to encourage consistent use of standards and best practices.
- Applying, communicating, and assisting with governance guidelines. For more information, see the Governance article.
- Handling and assisting with system oversight and administration. For more information, see the System oversight article.
- Responding to user support issues escalated from the help desk. For more information, see the User support article.



The scope of the COE includes architecture and strategy guidance, community enablement, governance, development , and run (monitoring, troubleshooting, licensing)

[Scoping a Power BI Centre of Excellence – Part 3 of PBI CoE Series. – Smart Power BI](#)

Center of Excellence (COE)

Create an Implementation Plan – Staff Team

- Define Goals
- Scope Responsibilities
- Staff Team
- Build and Empower the community

Good candidates are those who:

- Have a vested interest in seeing Power BI be used and adopted successfully (a career bet)
- Understand the analytics vision for the organization.
- Have a desire to continually improve analytics practices for the organization.
- Have a deep interest in, and expertise with, Power BI.
- Take the initiative to continually learn, adapt, and grow.
- Readily share their knowledge with others.
- Are interested in repeatable processes, standardization, and governance with a focus on user enablement.
- Are hyper-focused on collaboration with others.
- Are comfortable working in an agile fashion.
- Have an inherent interest in being involved and helping others.

Role	Description
COE leader	Manages the day-to-day operations of the COE. Interacts with the executive sponsor and other organizational teams, such as the data governance board, as necessary. For details of additional roles and responsibilities, see the Governance article.
Coach	Coaches and educates others on BI skills via office hours (community engagement), best practices reviews, or co-development projects. Oversees and participates in the discussion channel of the internal community. Interacts with, and supports, the champions network.
Trainer	Develops, curates, and delivers internal training materials, documentation, and resources.
Data analyst	Domain-specific subject matter expert. Acts as a liaison between the COE and the business unit. Content creator for the business unit. Assists with content certification. Works on co-development projects and proofs of concept.
Data modeler	Creates and manages shared datasets and dataflows to support self-service content creators.
Report creator	Creates and publishes reports and dashboards.
Data engineer	Plans Power BI deployment and architecture, including integration with Azure services and other data platforms. Publishes data assets which are utilized broadly across the organization.
User support	Assists with the resolution of data discrepancies and escalated help desk support issues.

Center of Excellence (COE)

Create an Implementation Plan – *Build and Empower*

- Define Goals
- Scope Responsibilities
- Staff Team
- Build and Empower the community

Build

- If PBI is already broadly deployed, poll existing users to understand the key areas of strength, issues, challenges, and goals; if available, use the monitoring reports to identify key users.
- Find the internal champions that can help “shepherd the platform along”.
- Enhance the internal community with connections to local user groups, the Microsoft PBI team, and (where applicable) local partners. Define and begin delivery of regular touch points

Empower

- Remember the COE needs to be able to serve both new and existing users – at different skill levels.
 - If an analyst or BI practitioner wanted to start leveraging Power BI, how would they begin?
 - End-users will not create data models (they may not even create reports) but they will still want to learn how to find reports, how to use bookmarks, set up subscriptions, etc. Is there an onboarding site, is there end-user training available?
- With regular touchpoints and community interactions, the COE will be able to see what user are doing, and continue to find opportunities to educate, make things easier and more efficient, and refine the guardrails

Action Item(s)

- *Start small – pick one area that can deliver a win for the organization/end-user community.*
- *Combine community events/training with actionable follow ups i.e. encourage a hear-see-do approach where possible.*

Center of Excellence (COE)

Case Study – ABC Company

Background

- ABC Company, a large manufacturer in the U.S., had an existing footprint of 1000 active Power BI users, along with two Premium capacities. An engineering group within the organization, in the process of migrating an on-premise Hadoop environment, began ramping up its usage of Power BI.
- Consisting of engineers, data analysts, and several hundred end-users, there was concerns around
 - data duplication
 - deployment lifecycle management, and
 - establishment and implementation of best practices.
- A director of data engineering, within the group, reached out to Microsoft to talk about his concerns and seek input/guidance for moving forward.
- ABC reviewed existing links/resources – and began to put in place as set of informal goals/objectives for a COE.

Team and Scope

- *Given there was already an existing Power BI community, along with an admin team, the director put focus on supporting the roughly 400 users within the core engineering group*
- *His team was virtual – and initial efforts were designed to address issues related to self-service analytics – specifically, the use of legacy tools, reliance on experts with limited bandwidth, and lack of best-practices related to data acquisition and refresh.*
- *The organization already had logging/monitoring of PBI activities in-place, but the data and associated reports were limited to a small IT team. It was recommended to give the extended team access to the reports.*

Center of Excellence (COE)

Case Study – ABC Company

Build

- *Noticing many users were extracting data to their local machine (using a legacy home-grown tool), copying the data (as files) to SharePoint folders, and then building the Power BI Desktop reports (from the files in SharePoint), the group decided to first invest in **building out a playbook for self-service analytics**. The playbook would -*
- *show users how to leverage Power Query to connect to some of the more popular organizational data sources (including the new cloud data warehouse)*
- *give step-by-step guidance of how to build, publish, and refresh a report*
- *provide links to workspaces with example reports*

Empower

- *To introduce the playbook, it was suggested to first select and work with a small “pilot” group to use the playbook guidance in refactoring an existing report.*
- *The group could then present (at an upcoming internal user-group meeting) their implementation – and talk about how the new approach*
 - *saved time,*
 - *reduced dependency on automation scripts, and*
 - *eliminated potential points of failure.*
- *At the end of the group meeting, the playbook would be the “leave-behind”, (hear-see-do)*
- *In parallel to the playbook, the team also begin building a training course – based on publicly available content but customized to include common ABC data sources, and oriented around how to **address specific business problems** e.g., analyzing product yield.*

Center of Excellence (COE)

Checklist and Resources

- ✓ **Define the scope of responsibilities for the COE:** Ensure that you're clear on what activities the COE can support. Once the scope of responsibilities is known, identify the skills and competencies required to fulfill those responsibilities.
- ✓ **Identify gaps in the ability to execute:** Analyze whether the COE has the required systems and infrastructure in place to meet its goals and scope of responsibilities.
- ✓ **Determine the best COE structure:** Identify which COE structure is most appropriate (centralized, unified, federated, or decentralized). Verify that staffing, roles and responsibilities, and appropriate organizational chart relationships (HR reporting) are in place.
- ✓ **Plan for future growth:** If you're starting out with a centralized or decentralized COE, consider how you will scale the COE over time by using the unified or federated approach. Plan for any actions that you can take now that'll facilitate future growth.
- ✓ **Identify customers:** Identify the internal customers, and any external customers, to be served by the COE. Decide how the COE will generally engage with those customers, whether it's a push model, pull model, or both models.
- ✓ **Verify the funding model for the COE:** Decide whether the COE is purely a cost center with an operating budget, whether it will operate partially as a profit center, and/or whether chargebacks to other business units will be required.
- ✓ **Create a communication plan:** Create your [communications strategy](#) to educate the Power BI community about the services the COE offers, and how to engage with the COE.
- ✓ **Create goals and metrics:** Determine how you'll measure effectiveness for the COE. Create KPIs (key performance indicators) or OKRs (objectives and key results) to validate that the COE consistently provides value to the user community.

Resource/Links

- Power BI Center of Excellence (COE) [documentation](#) (part of the Adoption Roadmap)
- Summary of customer implementations, and a case study of a [COE rollout](#) at a manufacturing account
- Microsoft's [internal transformation](#).
- [How Rockwell Automation is building a world-class Power BI Center of Excellence - YouTube](#)
- [Building a Power BI Center of Excellence with Alex Garcia - YouTube](#)
- [Introducing the PowerApps Center of Excellence Starter Kit | Microsoft Power Apps](#)
- [Customer stories with Fiserv and Schlumberger - BRK1014 - YouTube](#)

Data Sources

Managing & Exposing

- Data Steward
- Power BI Champion

- Self-Service BI may require access to original source systems, data warehouses, big-data stores, and/or 3rd party data sources
 - The Data Steward, along with source systems owners and data administrators, is responsible for providing access to the system(s) they control
- Common concerns and issues WRT data sources & Power BI
 - This tool makes data proliferation easier (Your giving my users a bigger gun)
 - For imported data models, Power BI is similar to an Excel spreadsheet; it is a local copy of a data source that has been extracted and potentially transformed/blended with other data sources. However, the Power BI Service helps reduce data proliferation (emailing spreadsheets and copying charts/graphs into PowerPoint deck).
 - Power BI provides a level of auditing/monitoring that isn't available with local spreadsheets (covered later) – which makes it possible to "upgrade" popular data models to an IT-Managed/Enterprise approach in the future
 - The data is stored in the cloud – I have security, safety, compliance concerns
 - Who has access to this data – how do we secure it
- To address concerns, consider a set of PBI Desktop "templates" to
 - Standardize data access patterns/practices
 - Encourage direct access to authoritative data
- Consider the use of a "Data Catalog" to make it easier for
 - Data Stewards to publish and describe authoritative data sources
 - End-Users to find/consume these data sources

Agenda

- Introductions and Expectations for the Day
- Architectural Overview of Power BI
- Roles/Responsibilities
- Provisioning of Services, Users, & Software
- Training and Evangelism
- Managing/Exposing Data Sources
- *Publishing and Sharing Content - Best Practices*
- Supporting Data Refresh and Live Connections
- Security Best Practices
- Monitoring and Auditing activity

Publishing and Sharing Content

Overview

- Power BI Champion
- Power User
- BI Practitioner

- How data & reports get into the Power BI Service

- Discover Content ("Apps")
 - My Organization
 - Services
- Create new content (Power BI Desktop / Excel)
 - Files - upload .pbix file (alternative to publishing from Desktop)
 - Databases – don't use!
 - Dataflows – (Power Query data prep in the Service)
 - Build on existing (published) datasets

- Where to Publish

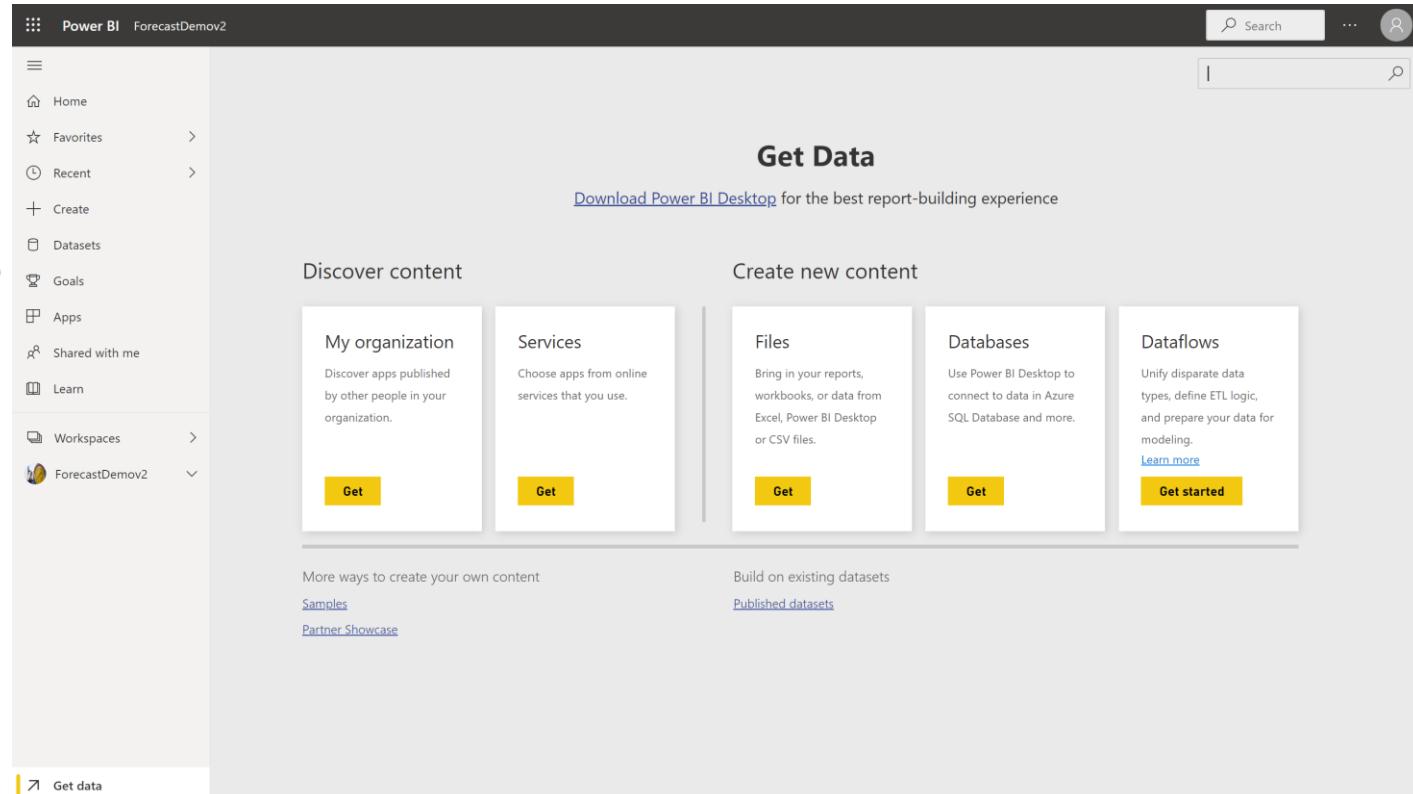
- My Workspace
- App Workspace

- What gets Published

- Dataset (Imported or Live Connection)
- Report

- What you can create (after publishing initial content)

- Additional Reports / Dashboards
- Apps and/or "published" datasets



Publishing and Sharing Content

Different Sharing Options

- Power BI Champion
- Power User
- BI Practitioner

• Share a Dashboard / (Share a Report)

- Share via a list of email addresses (new – security groups)
- Recommendation – Use Sparingly. Monitor for usage and choose different approach for larger audiences

• Use an App Workspace

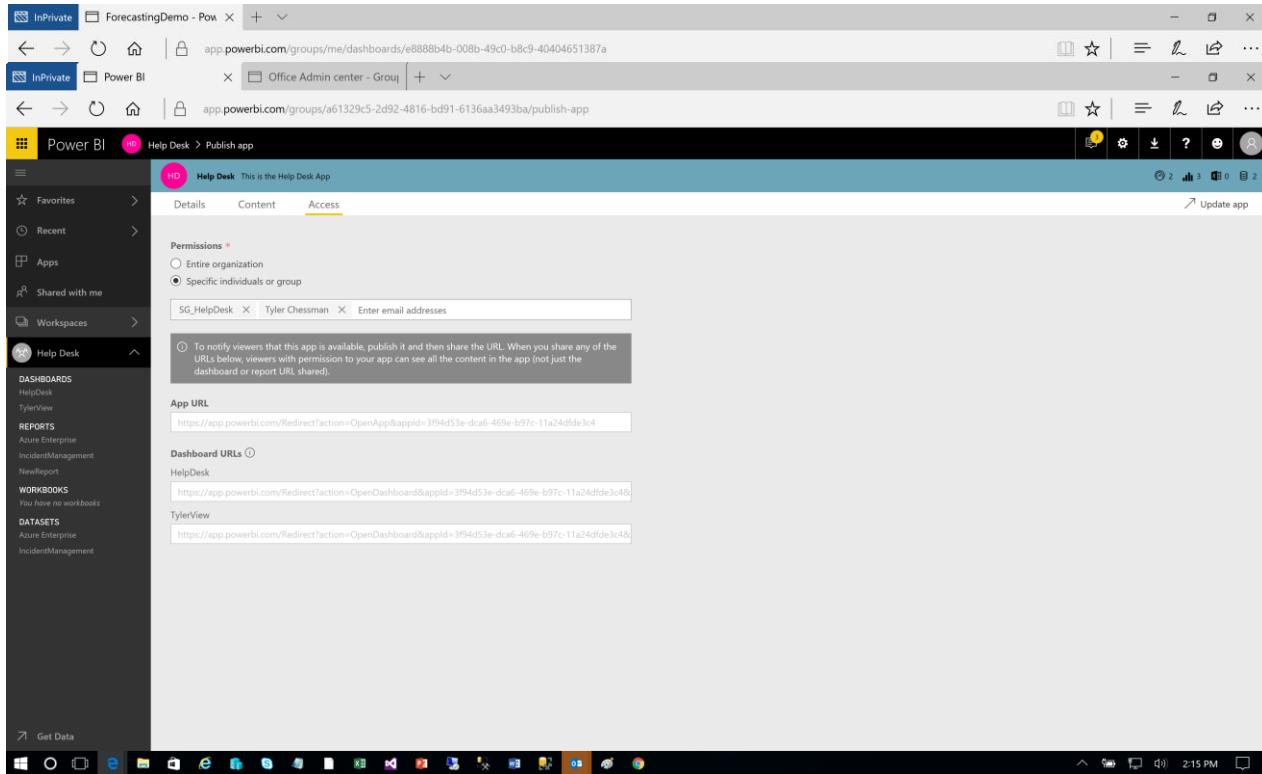
- Add admins and members/contributors/viewer to a workspace; deploy content directly to the workspace – no “publishing” or explicit sharing necessary
- Note – members can have read-only or edit rights

• Publish an App

- You can select what workspace content is included in an App (but currently only 1 App per workspace)
- User can customize with report filters or by saving a report copy to their workspace

• Share a Dataset

- Let users create their own reports in PBI Desktop and other workspaces
- Users can extend dataset with additional measures, composite models



*Users can get your apps in a few different ways:

- They can find and install your app from Microsoft AppSource
- You can send them a direct link.
- You can install it automatically in your coworkers' Power BI accounts if your Power BI administrator gives you permission.

Publishing and Sharing Content

Use Case Recommendations

- Power BI Champion
- Power User
- BI Practitioner

Use Case	Dashboard/Report Share	Workspace Membership	Shared Dataset	App
Share a "read-only" view with small team	Use Sparingly	Yes (first create an App workspace*)		Yes (first create an App workspace)
Share a "read-only" view with a large audience e.g., everyone, a particular security group		Perhaps, with Viewer Role		Yes
Developer/Project "shared space"		Yes - but remember permissions allow overwrite of content		
Share a report / data model that can be customized/extended		Yes – but with overwrite caveat	Yes	Yes, combine with Shared Dataset

*New App Workspaces generally available as of Apr 2019

** Shared datasets - <https://docs.microsoft.com/en-us/business-applications-release-notes/october18/intelligence-platform/power-bi-service/shared-certified-datasets>, <https://docs.microsoft.com/en-us/power-bi/service-datasets-share>

Agenda

- Introductions and Expectations for the Day
- Architectural Overview of Power BI
- Roles/Responsibilities
- Provisioning of Services, Users, & Software
- Training and Evangelism
- Managing/Exposing Data Sources
- Publishing and Sharing Content - Best Practices
- *Supporting Data Refresh and Live Connections*
- Security Best Practices
- Monitoring and Auditing activity

Data Refresh & Live/DQ Connections

Overview

- Power User
- Power BI Admin
- Data Steward

- Recall – Power BI Desktop supports three operating modes (along with composite mode)

- Import. Data is pulled down, compressed, and saved as part of the Power BI Desktop file (.pbix).
 - Note – Excel PowerPivot workbooks and Service Packs are also imported models
- Create a Live Connection (DirectQuery / Connect Live) . A live connection to 1 data source (composite mode allows for multiple)

- After the .pbix file is published into the Power BI Service....

Mode	View in the Service	Schedule Refresh in the Service
Import	No further configuration needed	Personal or On-Premise Data Gateway may be required
Live Connection	On-Premise Data Gateway may be required	N/A

- Basic workflow for supporting Data refresh and Live Connections

- Power BI Administrator installs an on-premise data gateway on a server/virtual machine within the corporate datacenter; he “registers” the gateway with the Power BI Service using a Power BI Pro account
 - Note - multiple gateways can be installed; each gateway can support 1-to-many back-end data sources
- The Power BI Administrator (from the Power BI console) adds 1 or more data sources to the gateway; he adds users/groups who will be allowed to use this gateway for refresh or live connections
- The Power User publishes .pbix file to the Power BI Service; he specifies (for the dataset) a gateway to use for refresh/live connections

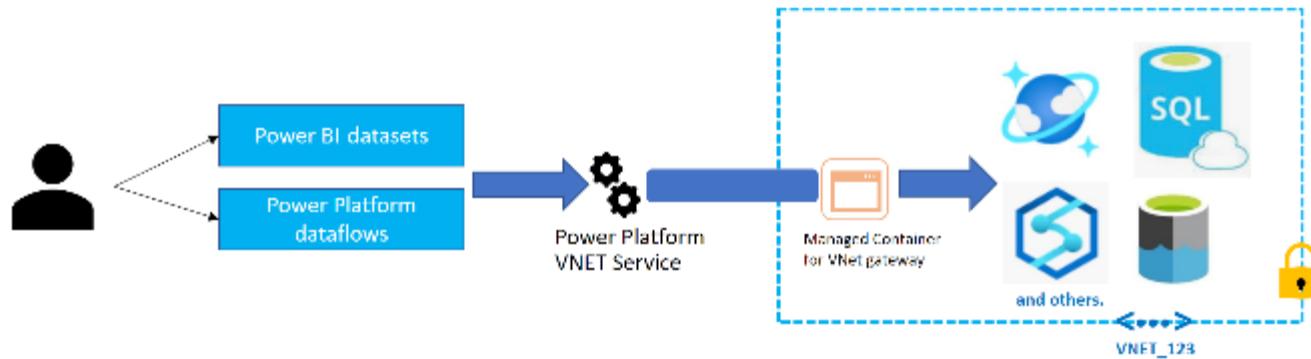
Data Sources

Gateway / Use for cloud data sources (Azure SQL), when, and why

- By default, the Gateway is not required to connect to cloud data sources, like SQL Azure
 - Azure SQL DB allows Firewall rules to restrict client IP access
 - The “allow access to Azure Services” option (On/Off) allows access from Azure Resources, including VMs
- To further restrict Azure SQL DB access, Vnet service endpoints can be employed
 - Architecture discussion to include clustering, high availability, disaster recovery and operational excellence
- By deselecting “allow access to Azure Services”, the Power BI Service can no longer connect to the database
 - The workaround is to use the on-premise data gateway on a VM residing within the Subnet
- Note the restrictions on this approach
 - Must use the SQL Connector, and only basic authentication is supported
- **UPDATE – 2021 – Power BI Now Supports Virtual Network data gateways**
 - Only available in Power BI Premium workspaces
 - Allows import or direct query datasets to connect to data services within an Azure VNet without the need of an on-premises data gateway.

The Virtual Network (VNet) Data Gateway

Overview



- Azure SQL
- Azure Synapse Analytics
- Azure Databricks
- Azure Data Explorer (Kusto)
- Azure Table Storage
- Azure Blob Storage
- Azure HDInsight (Spark)
- Azure Data Lake (Gen2)
- Cosmos DB
- Azure SQL Managed Instance (MI)
- Snowflake
- PostgreSQL

Supported Azure data services
(as of Oct. 2022) for Power BI -
[Use virtual network \(VNet\) data gateway and data sources in Power BI | Microsoft Learn](#)

Helps you “connect from Microsoft Cloud services [PBI] to your Azure data services within a VNet without the need of an on-premises data gateway.” Currently available for Premium/PPU workspaces.

Creation Steps:

1. Register Microsoft.PowerPlatform as a resource Provider (in the subscription where the data service resides)
2. Associate the subnet to the Microsoft Power Platform
 - Assumes you have already created a VNet – and associated the data service(s) to the VNet
 - This subnet cannot be shared with other services
3. [Create the VNet data gateway](#)
 - This is done in the Power Platform admin center

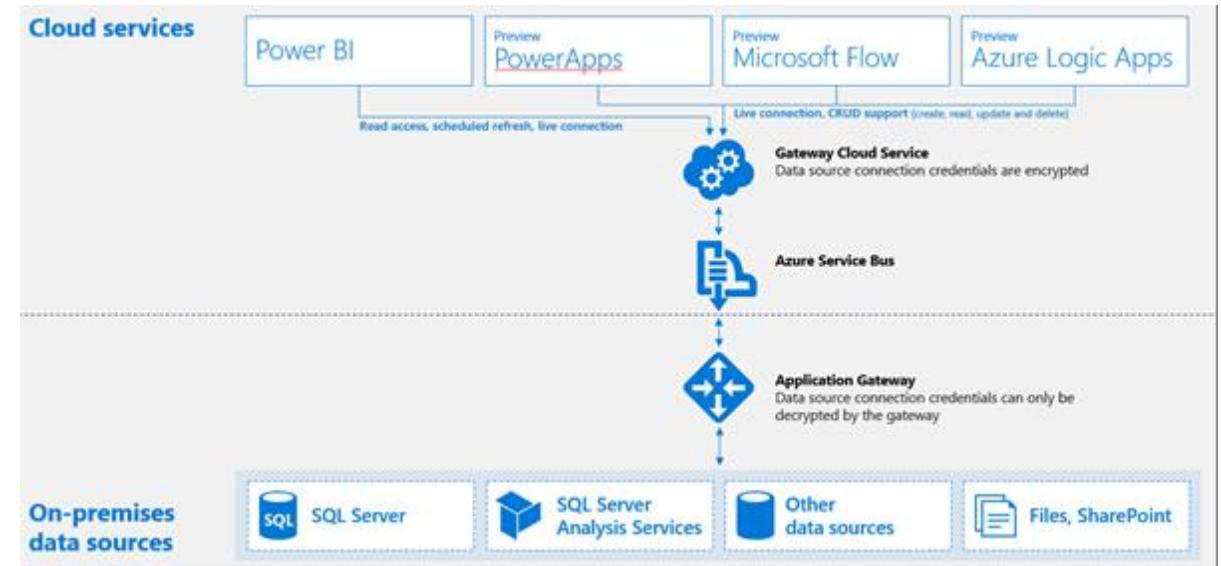
The On-Premises Data Gateway

Overview

The on-premises data gateway acts as a bridge, providing quick and secure data transfer between on-premises data (data that is not in the cloud) and the Power BI, Microsoft Flow, Logic Apps, and PowerApps services.

Two different gateway modes

1. On-premises data gateway: multiple users can share and reuse a gateway; can be used by Power BI, PowerApps, Flow or Logic Apps. For Power BI, this includes support for schedule refresh & DirectQuery
2. Personal: for Power BI only and can be used as an individual without any administrator configuration*. This can only be used for on-demand refresh and schedule refresh.



*The on-premise gateway installs as a service. Personal gateway will install as a service or, without admin rights, an application

Keeping data current in Power BI

On-Premises Data Gateway

- IT can install the On-Premises Data Gateway to serve large groups of users to refresh supported on-premises data sources
- IT can:
 - Centrally manage the set of users who have access to the underlying data sources
 - Gain visibility into gateway usage, such as most commonly accessed data sources, and the users accessing them
- Ports. The gateway creates an outbound connection to Azure Service Bus. It communicates on outbound ports: TCP 443 (default), 5671, 5672, 9350 thru 9354. The gateway does not require inbound ports.

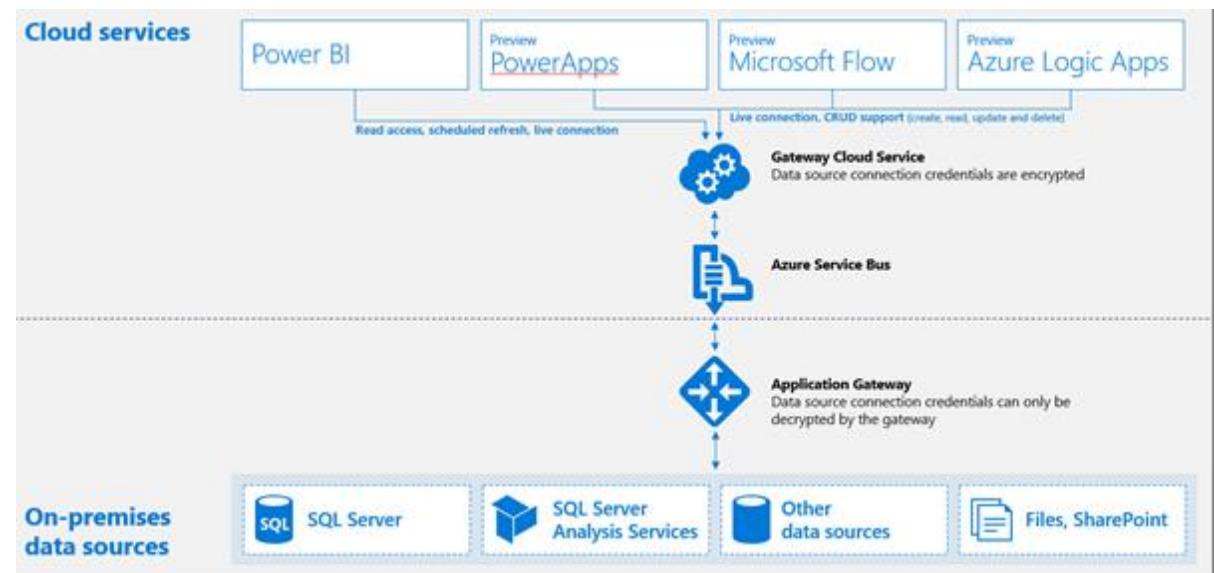
Data sources A-B

Data source	Connect from Desktop	Connect and refresh from service	DirectQuery / Live connection	Gateway (supported)	Gateway (required)	Power BI Dataflows
Access database	Yes	Yes	No	Yes ¹	Yes	Yes
ActiveDirectory	Yes	Yes	No	Yes	Yes	Yes
Adobe Analytics	Yes	Yes	No	No	No	No
Amazon Redshift	Yes	Yes	Yes	Yes	No	Yes
appFigures	Yes	Yes	No	No	No	No
AtScale cubes	Yes	Yes	Yes	Yes	No	No
Azure Analysis Services	Yes	Yes	Yes	No	No	No
Azure Blob Storage	Yes	Yes	No	Yes	No	Yes
Azure Cosmos DB	Yes	Yes	No	No	No	No
Azure Cost Management	Yes	Yes	No	No	No	No
Azure Data Explorer (Kusto)	Yes	Yes	Yes	Yes	No	Yes
Azure Data Lake Storage Gen1	Yes	Yes	No	No	No	No
Azure Data Lake Storage Gen2	Yes	Yes	No	Yes	No	Yes
Azure Databricks	Yes	Yes	Yes	Yes	No	No
Azure DevOps	Yes	Yes	No	No	No	No
Azure DevOps Server	Yes	Yes	No	Yes	Yes	No
Azure HDInsight (HDFS)	Yes	Yes	No	No	No	No
Azure HDInsight Spark	Yes	Yes	Yes	No	No	Yes
Azure SQL Database	Yes	Yes	Yes	Yes	No	Yes
Azure Synapse	Yes	Yes	Yes	Yes	No	Yes
Azure Table Storage	Yes	Yes	No	Yes	No	Yes
BI Connector	Yes	Yes	Yes	Yes	Yes	No
BI360 - Budgeting & Financial Reporting	Yes	Yes	No	No	No	No

How the Gateway works

What happens when a user interacts with an element connected to an on-premises data source -

1. A query will be created by the cloud service, along with the encrypted credentials for the on-premises data source, and sent to the queue for the gateway to process.
2. The gateway cloud service will analyze the query and will push the request to the Azure Service Bus.
3. The on-premises data gateway polls the Azure Service Bus for pending requests.
4. The gateway gets the query, decrypts the credentials and connects to the data source(s) with those credentials.
5. The gateway sends the query to the data source for execution.
6. The results are sent from the data source, back to the gateway, and then onto the cloud service. The service then uses the results.



<https://powerbi.microsoft.com/en-us/documentation/powerbi-gateway-onprem-indepth/>

The On-Premises Data Gateway

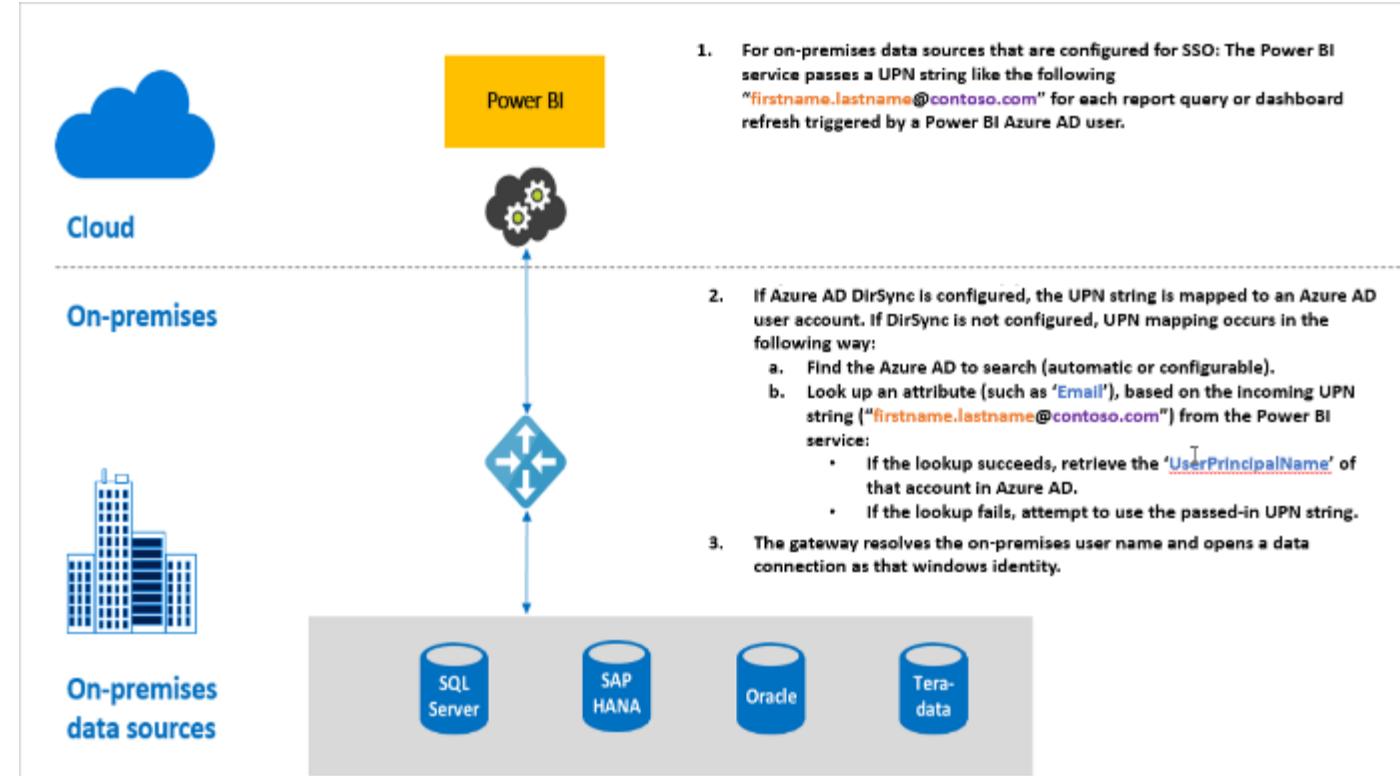
SSO

SSO is currently supported (for DirectQuery*) for a limited set of data sources e.g.,

- Amazon Redshift (Microsoft Entra ID)
- Azure Databricks
- Azure Data Explorer (Microsoft Entra ID)
- Azure SQL (Microsoft Entra ID)
- Azure Synapse Analytics (Microsoft Entra)
- Denodo (Kerberos)
- Hive LLAP (Kerberos)
- Impala (Kerberos)
- Oracle (Kerberos)
- SAP BW Application Server (Kerberos)
- SAP BW Message Server (Kerberos)
- SAP HANA (Kerberos and SAML)
- Snowflake (Microsoft Entra ID)
- Spark (Kerberos)
- SQL Server (Kerberos)
- Teradata (Kerberos)
- Tibco Data Virtualization (Kerberos)

Query Steps when running SSO

1. For each query, the Power BI service includes the user principal name (UPN) when sending a query request to the configured gateway.
2. The gateway needs to map the Azure Active Directory UPN to a local Active Directory identity.
 - If Azure AD DirSync (also known as Azure AD Connect) is configured, then the mapping works automatically in the gateway.
 - Otherwise, the gateway can look up and map the Azure AD UPN to a local user by performing a lookup against the local Active Directory domain.
3. The gateway service process impersonates the mapped local user, opens the connection to the underlying database, and sends the query.



* Live Connections to SSAS use impersonation via EffectiveUserName

Gateway Management/Monitoring

Management

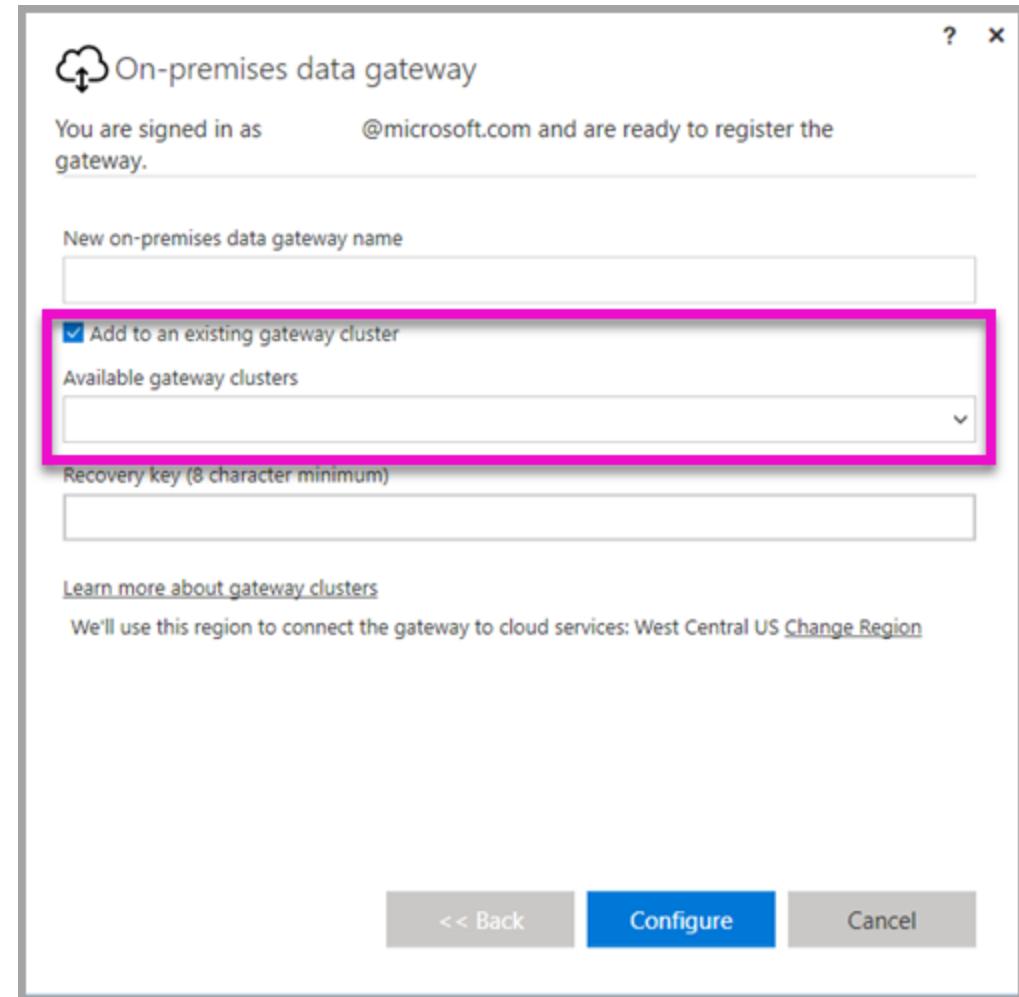
- Today, anyone with a Pro license can install a gateway.
- Consider organization policies to monitor/prevent unwanted installations
- Audit logs can also monitor gateway events
- Consider a “shared” Power BI Pro Account (e.g., “GatewayAdmin”) to configure/register a Gateway (the gateway is tied to a single Pro Account – though multiple admins can be added to the gateway)
- **New** – Power Platform Admin Center to see full list of gateways installed.

Monitoring

- The Gateway can be monitored via Service availability/Performance Counters
- The following link details an approach and considerations in monitoring the On-Premises Data Gateway - <https://insightsquest.com/2016/08/08/monitor-on-premises-data-gateways/>
- **New** - <https://docs.microsoft.com/en-us/power-bi/service-gateway-performance-monitoring>
- New – <https://github.com/RuiRomano/pbigtwmonitor>

High Availability

- (Dec 2017) - High availability with active/passive configuration now available (load-balancing is now available as well) - <https://docs.microsoft.com/en-us/power-bi/service-gateway-high-availability-clusters>
- (Older) Alternative, use a recovery key for a smooth take-over scenario
 - Install a gateway on the first machine, configure, and note the recovery key
 - Install a gateway on a 2nd machine – but don’t configure
 - Choose “Migrate, restore, or takeover an existing gateway” option



DEMO

On Premise Data Gateway

Lifecycle Management

Moving from Dev to Test to Production

- Power BI Champion
- Power User
- BI Practitioner

- Assumption – You are using an App for “deployment to the masses”

- App is deployed within a workspace with a small set of Admins/Members; Admins are responsible for member management and app publishing.
- Members are the developers and/or power users who participate in creating/maintaining/validating content

- Option 1 – One Workspace

- Use the “Included in App” capability to include/exclude items from App (dashboards/reports)
- Changes to “included” dashboards/reports are not visible to the App until the App is updated (re-published)
- Note that “breaking changes” – e.g., removing/renaming a dataset table field, are reflected immediately (i.e. no dataset versioning)

- Option 2 – Multiple Workspaces

- Note that you can still use the “Included in App” capability to include/exclude items from App (dashboards/reports)
- Creation of content & changes to existing content is done in a workspace independent of the “Production” workspace
- Migration of content from workspaces can be done manually or via scripts (Power BI Rest APIs) e.g., <https://powerbi.microsoft.com/en-us/blog/duplicate-workspaces-using-the-power-bi-rest-apis-a-step-by-step-tutorial/>
- Datasets can also be updated to point to a different data source via script

- Option 3 – Deployment Pipelines

- <https://docs.microsoft.com/en-us/power-bi/create-reports/deployment-pipelines-overview>

- Option 4 – Git integration

- <https://learn.microsoft.com/en-us/fabric/cicd/git-integration/intro-to-git-integration?tabs=azure-devops>

Agenda

- Introductions and Expectations for the Day
- Architectural Overview of Power BI
- Roles/Responsibilities
- Provisioning of Services, Users, & Software
- Training and Evangelism
- Managing/Exposing Data Sources
- Publishing and Sharing Content - Best Practices
- Supporting Data Refresh and Live Connections
- *Security Best Practices*
- Monitoring and Auditing activity

Power BI Security

Agenda

1. User Identity (Authentication)
2. Data Security
3. Collaboration within your organization
4. Collaboration outside of your organization



Find compliance offerings

Filter by Region Country Industry Power BI Clear all

Title	Description
CCSL (IRAP)	Microsoft is accredited for the Australian Certified Cloud Services List based on an IRAP assessment.
China GB 18030	Azure and Office 365 operated by 21Vianet are certified as compliant with the Chinese character standard.
CJIS	Microsoft government cloud services adhere to the US Criminal Justice Information Services Security Policy.
CSA STAR Attestation	Azure and Intune were awarded Cloud Security Alliance STAR Attestation based on an independent audit.
CSA STAR Certification	Azure, Intune, and Power BI were awarded Cloud Security Alliance STAR Certification at the Gold level.
DoD	Microsoft received Department of Defense (DoD) Provisional Authorizations at Impact Levels 5, 4, and 2.
EU Model Clauses	Microsoft offers EU Standard Contractual Clauses, guarantees for transfers of personal data.
EU-U.S. Privacy Shield	Microsoft complies with this framework for protecting personal data transferred from the EU to the US.
FedRAMP	Microsoft was granted US Federal Risk and Authorization Management Program P-ATOs and ATOs.
FERPA	Microsoft aligns with the requirements of the US Family Educational Rights and Privacy Act.
FIPS 140-2	Microsoft certifies that its cryptographic modules comply with the US Federal Info Processing Standard.
FISC	Microsoft meets the requirements of the Financial Industry Information Systems v8 standard in Japan.
HIPAA/HITECH	Microsoft offers Health Insurance Portability & Accountability Act Business Associate Agreements (BAAs).
HITRUST	Azure is certified to the Health Information Trust Alliance Common Security Framework.
ISO 27001	Microsoft is certified for its implementation of these information security management standards.
ISO 27018	Microsoft was the first cloud provider to adhere to this code of practice for cloud privacy.
MeitY	The Ministry of Electronics and Information Technology in India awarded Microsoft full accreditation.
NZ CC Framework	Microsoft NZ addresses the questions published in the New Zealand cloud computing framework.
PCI DSS	Azure complies with Payment Card Industry Data Security Standards Level 1 version 3.2.
SOC 1	Microsoft cloud services comply with Service Organization Controls standards for operational security.
SOC 2	Microsoft cloud services comply with Service Organization Controls standards for operational security.
SOC 3	Microsoft cloud services comply with Service Organization Controls standards for operational security.
UK G-Cloud	The Crown Commercial Service renewed the Microsoft cloud services classification to Government Cloud v6.

<https://www.microsoft.com/en-us/trustcenter/Compliance/default.aspx>

Power BI Security

User Identity (Authentication)

- Power BI is part of the larger Microsoft cloud
- Like other cloud services, PBI leverages Azure Active Directory (AAD)
 - AAD is the default authentication mechanism for PBI
 - Other authentication approaches can be used for Embedded scenarios
- AAD setup and configuration is a key building block for PBI
 - Most large organizations will synchronize their on-premise Active Directory with AAD
 - Advanced authentication requirements (e.g., multi-factor) are supported in AAD
- AAD is also used, and can be supplemented, for the PBI mobile devices (next slide)

Power BI Security

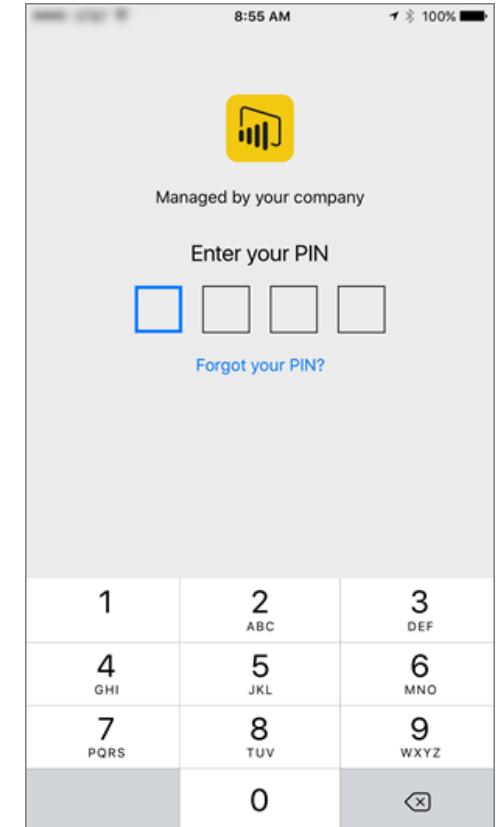
User Identity (Authentication)

Mobile Device/App Management:

- Controlled via Intune for Power BI Mobile apps on iOS (7+) /Android (4+)
- Policies such as:
 - Require PIN
 - Max failed PIN attempts

Configuring InTune:

- Specify the app
- Configure policies (i.e. require PIN)
- Enable for deployment
- End-users install from Company Portal app

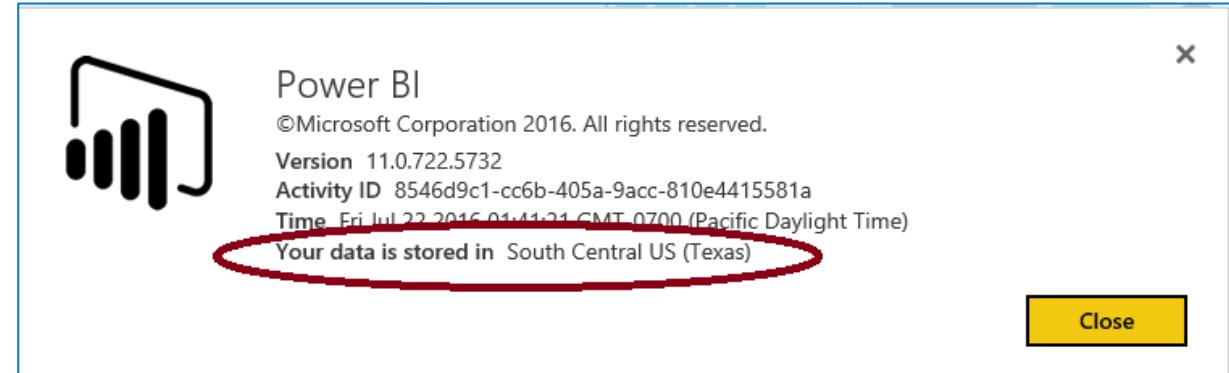
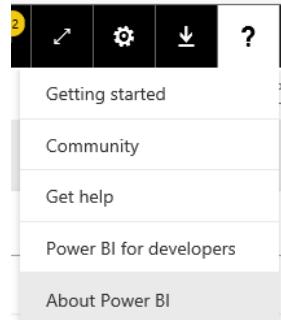


Power BI Security

Date Storage & Encryption Keys

Where is my data stored?

Power BI encrypts data
at-rest & in-process



The encryption keys....

- to Azure Blob keys are stored, encrypted, in a separate location in the Power BI service.
- for Azure SQL Database, TDE technology is managed by Azure SQL itself.
- for Data Movement service and on premises Gateway are stored:
 - On-prem data sources: In the on-premise Gateway on customer's infrastructure
 - Cloud-based data sources: In the Data Movement Role
- Power BI Premium offers additional BYOK encryption options for datasets

Power BI Security

Data Security: User Data Access

- Data Access can be considered a subset of authorization (what you can do)
- Some data access requirements can be handled with item-level sharing e.g.,
 - Share a dashboard or reports for read-only access with a user or group
 - Share a collection of dashboards/reports (via an App) with a user or group
 - Assign membership in a workspace (e.g., viewer, contributor, admin) to allow a user/group to view and/or modify dashboards/reports/datasets
 - Note: knowing whether an item has been shared/viewed/exported is handled via PBI monitoring capabilities (covered in subsequent slides)
- Other use-cases require more granular data access rules e.g.,
 - We both can view a report - you can only see North America sales, & I should see South America; Fred the admin can see everything
 - This is referred to as row-level security (RLS) aka dynamic security

Power BI Security

Data Security: RLS Overview

- **Imported datasets**
 - RLS can be defined as part of the authoring/publishing process (next slide)
- **Direct Query datasets**
 - RLS can be defined as part of the .pbix file (next slide)
 - RLS can alternatively be handled by an “RLS-enabled” data sources, which means...
 - The back-end data source implements some form of RLS
 - Power BI can pass (or impersonate) the user credentials when connecting to the data source (i.e. Single Sign On – SSO)
- **RLS-enabled data sources**
 - Data presented is based on permissions of the user who is accessing the report/dashboard, etc.
 - SSO is available for several on-prem DirectQuery data sources (e.g., SQL Server, SAP Hana/BW, Oracle, Teradata, Spark, Impala) - <https://docs.microsoft.com/en-us/power-bi/service-gateway-sso-overview>
 - SSO is also available for some cloud-based sources (e.g., Azure SQL DB, Azure Synapse Analytics)

Power BI Security

Row Level Security (RLS) for SSAS/PBI Datasets

- SQL/Azure Analysis Services is a RLS-enabled data source
 - Analysis Services allows data to be secured based on a user's Role, and via Row Filters (if configured)
 - Power BI can emit the username used to sign into the PBI service (UserPrincipalName) via Analysis Services' EffectiveUserName option – which is used to impersonate the user and set role mappings/RLS
- Role-Level Security is also available for an imported/direct query dataset
 - You configure Roles and define RLS for the dataset in The PBI Desktop
 - You then map users to roles within PowerBI.com (i.e. after the Desktop file has been published)
 - Note: be aware of performance implications for direct query datasets (additional filter on each query)

Define Roles in the Desktop

The screenshot shows the 'Manage roles' section of the Power BI Desktop interface. It lists two roles: 'BU_View_Gulf_Coast' and 'UserNameSimulation'. Below the roles, there are 'Create' and 'Delete' buttons. To the right, there is a 'Tables' section listing several tables: DimDate, DimProduct, FactProductionWithFutureEstim..., Forecasts, ProductPrices, and WellHeaders. A 'Table Filter DAX Expression' field contains the formula: [BusinessUnit] = "Gulf Coast".

Map Users in the Service

The screenshot shows the 'Row-Level Security' configuration in the Power BI service. It lists a single member: 'UserNameSimulation (1)'. Below it, there is a 'Members (1)' section with a text input field 'Enter email addresses' containing 'Gary Chessman'. An 'Add' button is located at the bottom of this section.

Power BI Security

Row Level Security (RLS) – Enterprise Design-Pattern

- Secure (as needed) source files in Azure Storage via ACLs and least privileges
- Populate and Maintain Security Tables in Data Warehouse

- [Row-Level Security - SQL Server | Microsoft Docs](#)
- [Row-Level Security: Performance and common patterns - Microsoft Tech Community](#)

- Create Function & Security Policy
- In Power BI

- Direct Query – Use SSO to leverage RLS in Data Warehouse
- Import – Import the Security Table; replicate Security Policy with DAX (see prior slide)

	BU	AssetKey	AssetName	UserId
1	Gulf Coast	2	Bayou	garyc
2	Rockies	7	Rockies Central	tannerc
3	Rockies	7	Rockies Central	taylorc
4	San Joaquin	1	Bakersfield	fredc
5	San Joaquin	4	Four Winds	fredc

```
CREATE FUNCTION Security.tvf_securitypredicateAsset(@AssetKey AS int)
RETURNS TABLE
WITH SCHEMABINDING
AS
RETURN SELECT 1 AS accessResult
        FROM dbo.UserAssetSecurityTbl
        WHERE ( UserId = USER_NAME() OR USER_NAME() = 'dbo' )
              AND AssetKey = @AssetKey;
GO

-- Security Policy with the above function as a filter predicate.
CREATE SECURITY POLICY Security.AssetFilter
ADD FILTER PREDICATE Security.tvf_securitypredicateAsset(AssetKey)
      ON dbo.DimWellHeader WITH (STATE = ON);
```

Power BI Security

Collaboration outside of your organization

- You can share dashboards/reports with people outside your organization via email with a link to the shared dashboard/report
 - The recipient has to sign-in to Power BI to see the dashboard/reports
 - If they don't have a Power BI account, they can create one after clicking the link
 - External sharing can be turned off by the tenant admin
- Note – you can also expose a report for anonymous access (publish to web)
 - This can also be turned on/off by the tenant admin
- Update (Feb 2018) – Power BI now integrates with Azure AD B2B
 - Allows distribution of Power BI content to guest users outside of the org
 - Three licensing options – Power BI Premium, Assign Pro license to guest user, or guest user brings their own Power BI Pro license
 - <https://docs.microsoft.com/en-us/power-bi/service-admin-azure-ad-b2b>

Power BI Tenant-Level Settings

Help and support settings

- ▶ Publish "Get Help" information
Disabled for the entire organization
- ▶ Receive email notifications for service outages or incidents
Enabled for the entire organization

Workspace settings

- ▶ Create workspaces (new workspace experience)
Enabled for the entire organization
- ▶ Use datasets across workspaces
Enabled for the entire organization

Information protection (preview)

- ▶ Connect Power BI to Microsoft Information Protection sensitivity labels (step 1)
Disabled for the entire organization
- ▶ Allow users to apply sensitivity labels for Power BI content (step 2)
Disabled for the entire organization

Export and sharing settings

- ▶ Share content with external users
Enabled for the entire organization
- ▶ Publish to web ⓘ
Enabled for the entire organization
- ▶ Export data
Enabled for the entire organization
- ▶ Export to Excel
Enabled for the entire organization

- ▶ Export reports as PowerPoint presentations or PDF documents
Enabled for the entire organization

- ▶ Export reports as image files (Preview)
Disabled for the entire organization

- ▶ Print dashboards and reports
Enabled for the entire organization

- ▶ Certification
Enabled for the entire organization

- ▶ Allow external guest users to edit and manage content in the organization
Disabled for the entire organization

- ▶ Email Subscriptions
Enabled for the entire organization

- ▶ Featured content
Disabled for the entire organization

Content pack and app settings

- ▶ Publish content packs and apps to the entire organization
Enabled for the entire organization

- ▶ Create template organizational content packs and apps
Disabled for the entire organization

- ▶ Push apps to end users
Enabled for the entire organization

Integration settings

- ▶ Use Analyze in Excel with on-premises datasets
Enabled for the entire organization

- ▶ Use ArcGIS Maps for Power BI
Enabled for the entire organization

- ▶ Use global search for Power BI (Preview)
Enabled for the entire organization

- ▶ Snowflake SSO
Disabled for the entire organization

Custom visual settings

- ▶ Add and use custom visuals
Enabled for the entire organization

- ▶ Allow only certified custom visuals (block uncertified)
Disabled for the entire organization

R visuals settings

- ▶ Interact with and share R visuals
Enabled for the entire organization

Audit and usage settings

- ▶ Create audit logs for internal activity auditing and compliance
Enabled for the entire organization

- ▶ Usage metrics for content creators
Enabled for the entire organization

- ▶ Per-user data in usage metrics for content creators
Enabled for the entire organization

DEMO

RLS / Adjusting Tenant Level Settings

<https://docs.microsoft.com/en-us/power-bi/guidance/admin-tenant-settings>

Agenda

- Introductions and Expectations for the Day
- Architectural Overview of Power BI
- Roles/Responsibilities
- Provisioning of Services, Users, & Software
- Training and Evangelism
- Managing/Exposing Data Sources
- Publishing and Sharing Content - Best Practices
- Supporting Data Refresh and Live Connections
- Security Best Practices
- *Monitoring and Auditing activity*

Monitoring and Auditing

Overview

- Power BI Champion
- Power BI Admin
- Security Architect

- Basic “Usage Metrics” in the admin portal – ignore
- Metrics can be generated at a workspace level
- Optionally, a Tenant Level Setting (“Audit and usage settings”) can be configured
 - Power BI will start logging various activities that your users perform in Power BI. The logs take up to 48 hours to show up in the O365 Security & Compliance Center
 - From the “Audit logs” section, you can then navigate to the Office 365 Admin Center (Audit Log Search) to query the logs
 - Feb 2018 – a Coworker example/template that automates the log extraction and provides base reports - angryanalytics.com/
 - Note – You can assign audit log privileges to non-admin accounts

• Update – Feb 2018

- The Office 365 Admin APIs can now be used in lieu of the Audit logs. Does not require audit and usage setting to be marked in Power BI, but still requires O365 Admin tenant privileges. 7-day retention, so important to extract/load.
- Pre-configured partner solution available - <https://powerbi.microsoft.com/en-us/blog/announcing-the-power-bi-usage-metrics-solution-template/>

• Update – Dec 2019 – Power BI Audit logs as alternate to the usage logs

• Update – May 2023 – New Admin Monitoring Workspace for Tenant Admins

Power BI activities		
Viewed Power BI dashboard	Created Power BI dashboard	Edited Power BI dashboard
Deleted Power BI dashboard	Shared Power BI dashboard	Printed Power BI dashboard
Viewed Power BI tile	Exported Power BI tile data	Viewed Power BI report
Deleted Power BI report	Printed Power BI report page	Downloaded Power BI report
Published Power BI report to web	Exported Power BI report visual data	Created Power BI report
Edited Power BI report	Created Power BI dataset	Deleted Power BI dataset
Created Power BI group	Added Power BI group members	Removed Power BI group members
Created organizational Power BI content pack	Created Power BI app	Installed Power BI app
Updated Power BI app	Updated organization's Power BI settings	Started Power BI trial
Started Power BI extended trial	Analyzed Power BI dataset	Created Power BI gateway
Deleted Power BI gateway	Added data source to Power BI gateway	Removed data source from Power BI gateway
Changed Power BI gateway admins	Changed Power BI gateway data source users	Set scheduled refresh on Power BI dataset
Unpublished Power BI app	Deleted organizational Power BI content pack	Renamed Power BI dashboard
Edited Power BI dataset	Updated capacity display name	Changed capacity state
Updated capacity admin	Changed capacity user assignment	Migrated workspace to a capacity
Removed workspace from a capacity	Shared Power BI report	Generated Power BI Embed Token
Discovered Power BI dataset data sources	Updated Power BI dataset data sources	Requested Power BI dataset refresh
Binded Power BI dataset to gateway	Changed Power BI dataset connections	Took over Power BI dataset
Updated Power BI gateway data source credentials	Imported file to Power BI	Updated Power BI dataset parameters

DEMO

Custom Solution – Power BI Audit Logs

- Power BI Admin

Power BI Premium Management Basics

- After purchasing a Power BI Premium subscription, the tenant receives a corresponding number of v-cores to assign to capacities ("v-core pooling) E.g.,

- A P1 subscription provides 8 v-cores to create a single P1 capacity
- A P3 subscription can be used to create one, or up to four (4 x P1) capacities

- Multi-Geo support is now available

- Cannot be changed after the capacity is created.

- Role of the Capacity Admin

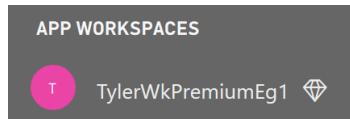
- Assign workspaces to the capacity
- Manage user permissions, to add additional Capacity Admins or users with assignment privileges (i.e. enable them to assign a workspace to the capacity)
- Manage workloads (configure max memory usage) / Restart capacity

- Capacity Workloads

- The services made available to user (see [here](#))
- Memory and other settings can be used to bound performance

- Assigning a Workspace to a Capacity

- This is done during/after the setup of a workspace
- Workspace admin needs assignment privilege to set this configuration



Edit workspace

Name
TylerWkPremiumEg1

Privacy
Private - Only approved members can see what's inside
Members can only view Power BI content

Workspace members
Enter email addresses
Add
tylerc@contoso.onmicrosoft.com Admin

Advanced ▲
Dedicated capacity ⓘ
On

Choose an available dedicated capacity for this workspace
BI Champs Premium P1 - East US 2

Learn more about Premium capacity

Workspace Connection
powerbi://api.powerbi.com/v1.0/myorg/TylerWkPremiumEg1

Copy

X Remove all + Assign workspaces

Power BI Premium Monitoring Basics

- Monitoring is available in both the portal, and via the Power BI Premium Capacity Metrics app

- Portal provides a quick view with high-level metrics (currently for the last 7 days)
- The App provides more in-depth info (currently for the last 7 days)

Using the Capacity Metrics app

- Can be installed from the Apps (Get Apps – Apps – Power BI)
- Refreshed automatically, with rolling 7-day history (may want to consider use of a subscription to review older data)
- High-level dashboard provides summary statistics, with ability to drill down into detailed report
- Tip – Keep a close watch on Memory usage, specifically overall memory consumption

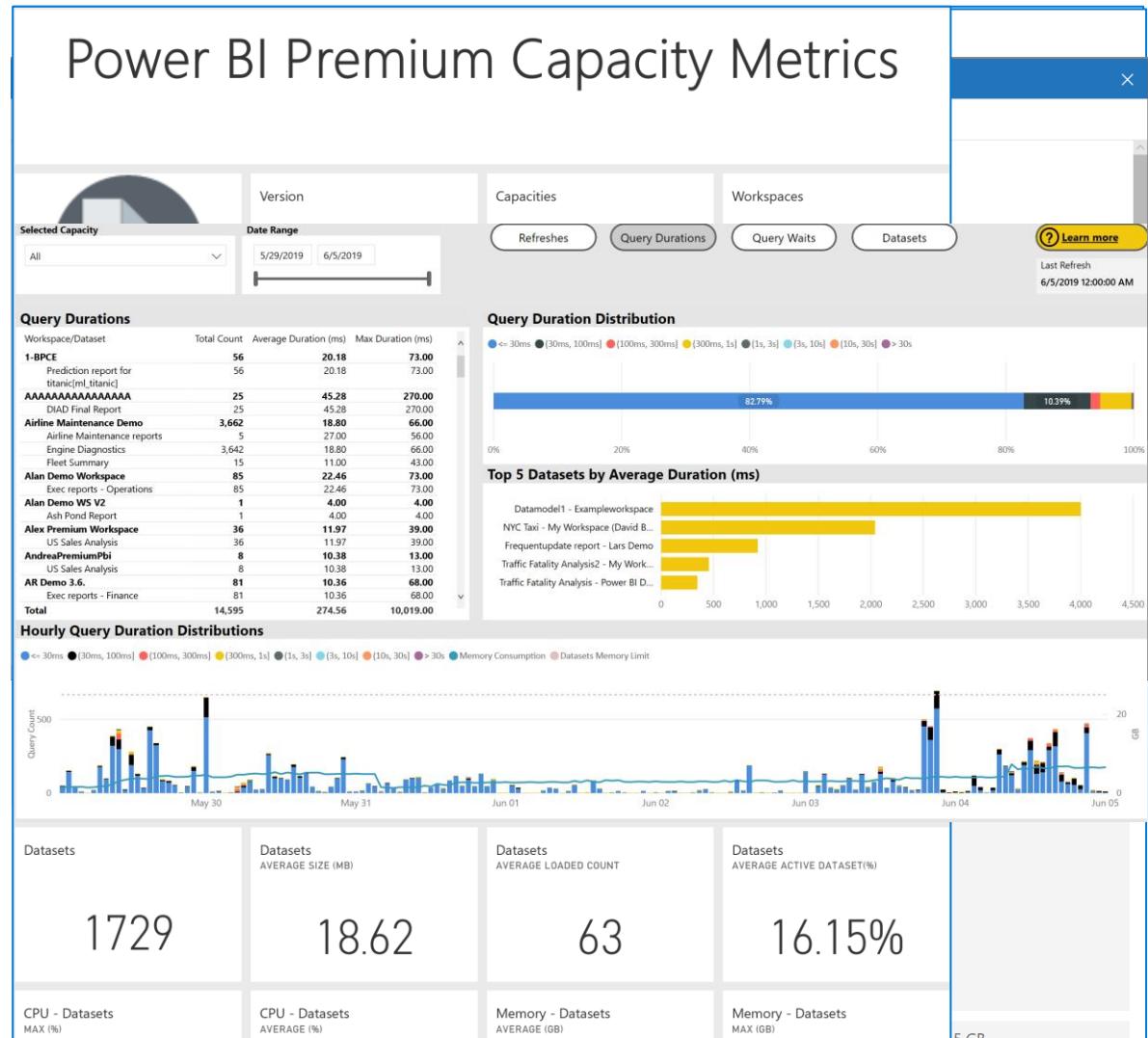
May 2020

- New Alerts for Premium Capacity Overload events -
<https://powerbi.microsoft.com/en-us/blog/announcing-timely-premium-capacity-overload-alerts/>

June 2021 – Public Preview, Log Analytics integration

- Workspaces can now be configured to export usage & performance related information to Log Analytics; supports retention up to 2 years
- [Announcing long-term usage and performance insights \(Public Preview\) | Microsoft Power BI Blog | Microsoft Power BI](https://powerbi.microsoft.com/en-us/blog/announcing-long-term-usage-and-performance-insights-public-preview-microsoft-power-bi-blog-microsoft-power-bi/)

- Power BI Admin



Capacity Monitoring

Capacity Metrics App

- Power BI Admin
- Capacity Admin

• Usage

- F-SKUs, P SKUs
- Also includes support for EM/A SKUs

• Installation

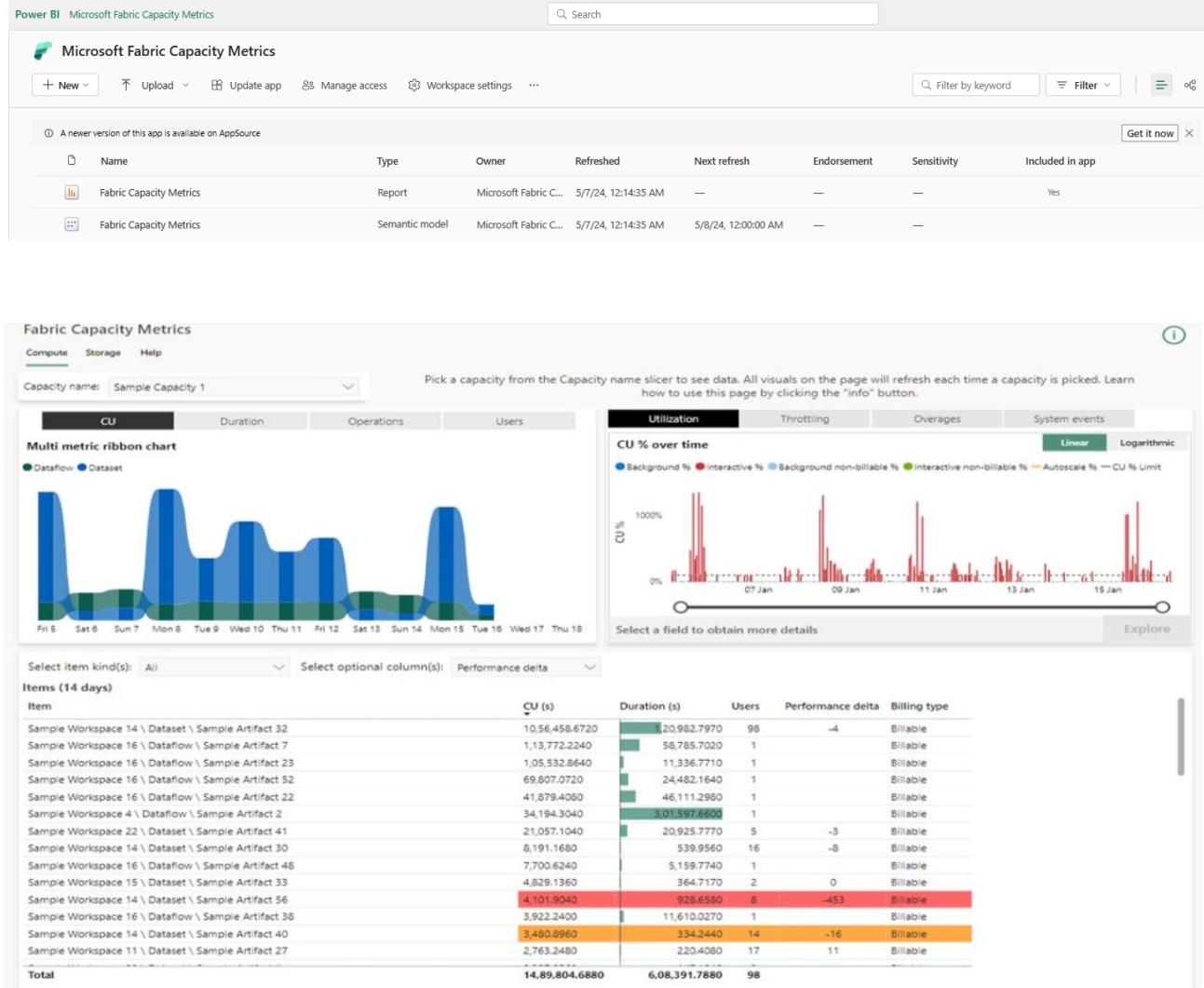
- Need to be a capacity administrator to install/view Metrics App (but you can also share the report/model with non-admins)
- Tip: Check Version of App installed from the Report-Help-Release Notes
- You will also get a notification from the Capacity Metrics App Workspace

• Getting Started

- Search for *Microsoft Fabric Capacity Metrics* workspace
- Open the Fabric Capacity Metrics Report.
- Save a Copy of the Report for customization/new reports.

• Note(s)

- Review the Documentation for a high-level overview of the App compute/storage/timelpoint pages - [Understand the metrics app compute page - Microsoft Fabric | Microsoft Learn](#)
- Videos are also available/useful e.g., [Bing Videos](#)



DEMO

Monitoring Power BI Premium

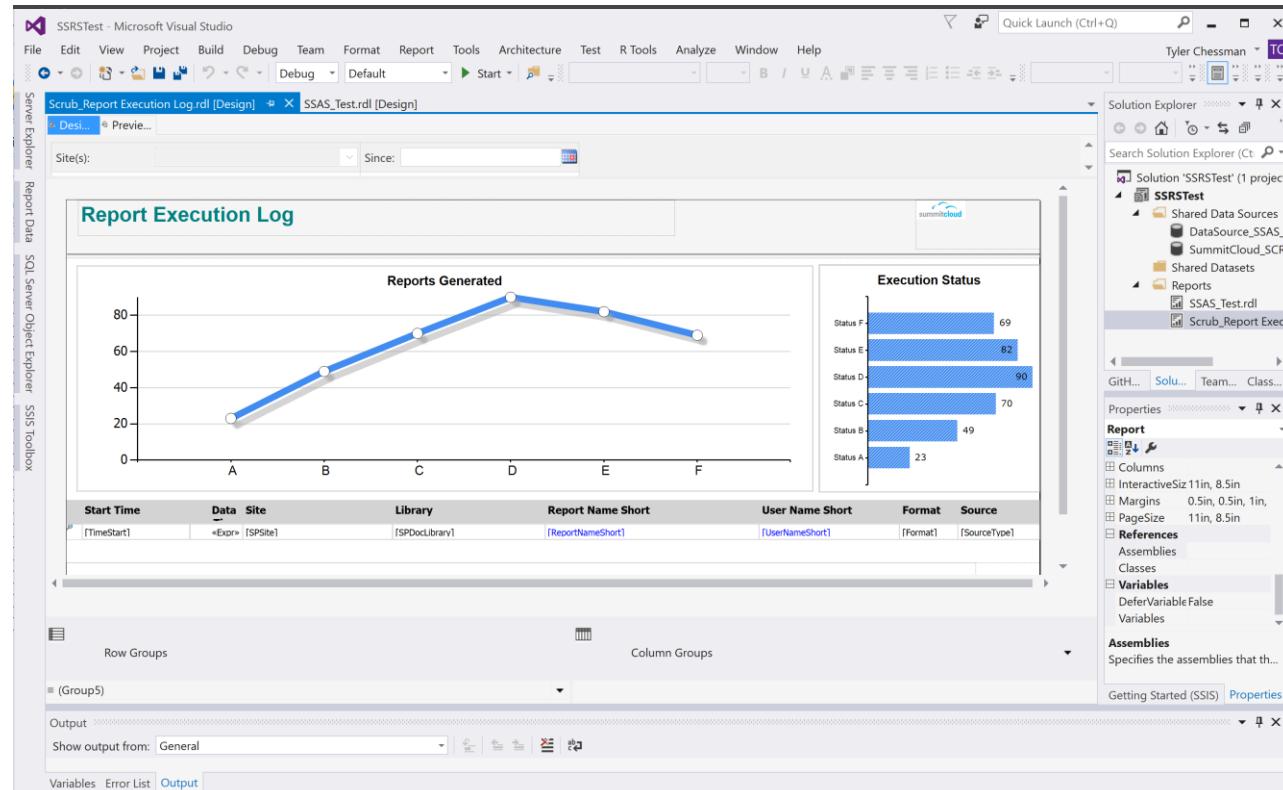
Agenda

- Introductions and Expectations for the Day
- Architectural Overview of Power BI
- Roles/Responsibilities
- Provisioning of Services, Users, & Software
- Training and Evangelism
- Managing/Exposing Data Sources
- Publishing and Sharing Content - Best Practices
- Supporting Data Refresh and Live Connections
- Security Best Practices
- *Monitoring and Auditing activity*
- **MISC**

Power BI Paginated Reports

Getting Started

- Reports are authored in the Power BI Report Builder*
 - Visual Studio can also be used to author reports – be aware of feature support differences (next slide)
- Basics of building a report....
 - Create one or more data sources (e.g., SQL Server, Oracle)
 - Create one or more datasets (queries against a data source)
 - Optional – define parameter(s)
 - Design Report Layout
 - Preview Report
 - Publish
 - Monitor
- Note - Reports are saved in the SSRS .rdl format



[Power BI Paginated Reports in a Day course - Power BI | Microsoft Docs](#)

*Free download - <https://www.microsoft.com/en-us/download/details.aspx?id=58158>

Power BI Paginated Reports

Data Source & Feature Support

Supported Data Sources

- Power BI Datasets (via single sign-on (SSO))
- Azure Analysis Services (via single sign on (SSO) and oAuth)
- Azure SQL Data Warehouse
- Azure SQL Database (username/password, SSO and oAuth)
- Azure SQL Managed Instance via Public Endpoint (username/password)
- SQL Server*
- SQL Server Analysis Services (SSAS) tabular (DAX) and multidimensional (MDX) models*
- Oracle*
- Teradata*

*requires the on-premises Gateway.

SSRS features not yet available

- Shared data sources (workaround – inline data sources)
- Shared datasets
- Subreports
- Drillthrough and click-through to other reports
- Linked reports
- Data-driven subscriptions (Use Power Automate instead)

Migration Resource(s)

<https://docs.microsoft.com/en-us/power-bi/guidance/powerbi-migration-overview>

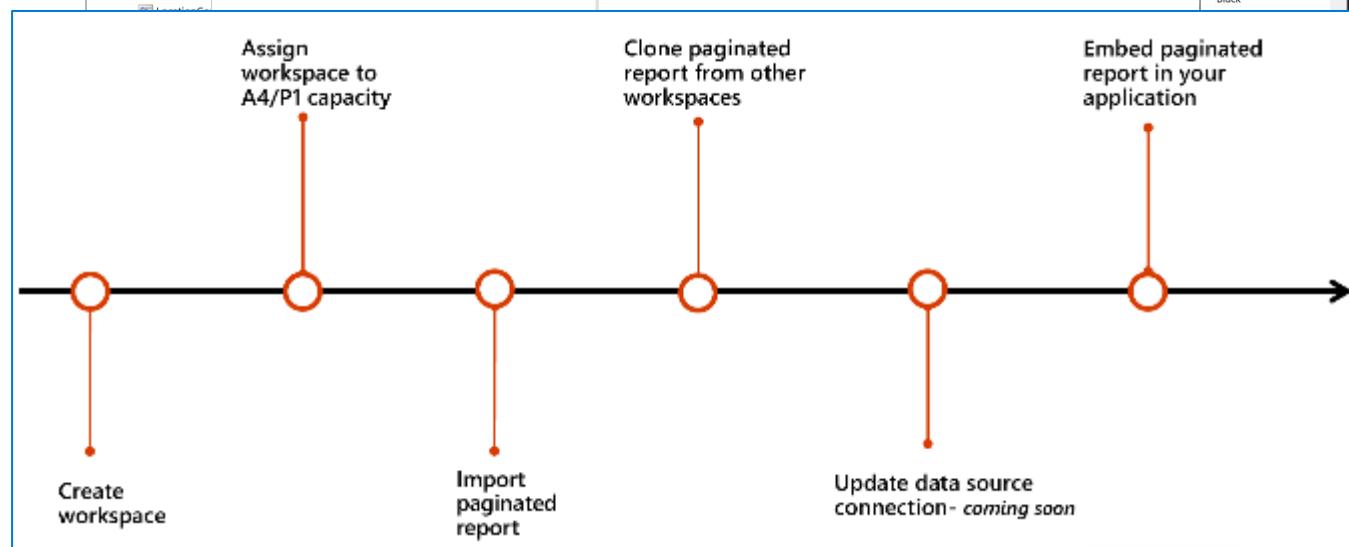
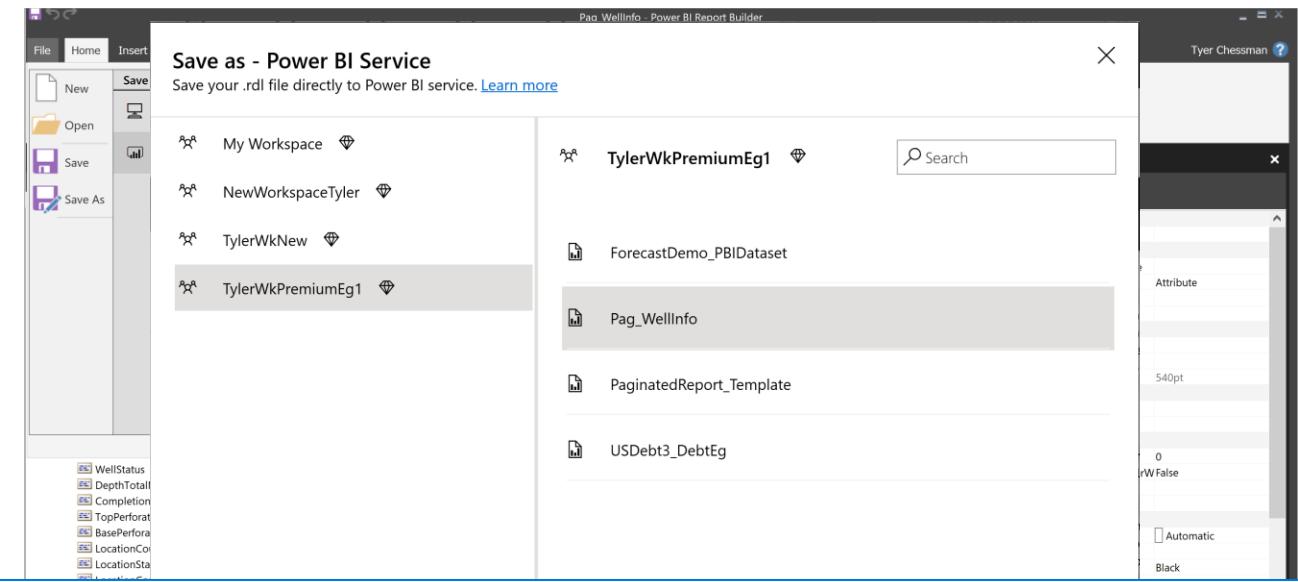
DEMO

Design Paginated Reports

Power BI Paginated Reports

Publishing

- From Report Builder, reports can be directly published to the Service
- Alternatively, a user can upload an .rdl file to the workspace via the browser
- Developers may want to leverage REST APIs for deployment automation e.g.,
 - Create workspace
 - Assign workspace to capacity
 - Import paginated report
 - Clone paginated report from another workspace
 - Update datasource connection (API coming soon – workaround via the RDL data source property change)
 - Embed paginated report in your application



Tabular Modeling

AAS | PBI Premium



- PBI Premium is the [future](#) ("Power BI as a superset of Azure Analysis Services") - and should be the default choice for new implementations
- (Perceived) Cost differences and/or (current lack-of) Scale-out in Premium may necessitate AAS

AAS Cache Size / Monthly Pricing

S1 Standard	S2 Standard	S4 Standard	S8V2 Standard	S9V2 Standard
100 Query Processing U...	200 Query Processing U...	400 Query Processing U...	640 Query Processing U...	1,280 Query Processing U...
Up to 25 GB Cache	Up to 50 GB Cache	Up to 100 GB Cache	Up to 200 GB Cache	Up to 400 GB Cache
Dedicated service				
SSL	SSL	SSL	SSL	SSL

PBI Cache Size / Monthly Premium

	P1	P2	P3
Artifact Cache	25 GB	50 GB	100 GB
USD/MONTH	6,000	10,000	20,000

Notes:

- Cost comparison with AAS and PBI Premium is not apple-to-apples. Beyond additional features and capabilities, PBI Model Size applies to a single model – it doesn't preclude hosting multiple models
- Scale-out planned in CY2022 for PBI Premium

Tabular Modeling

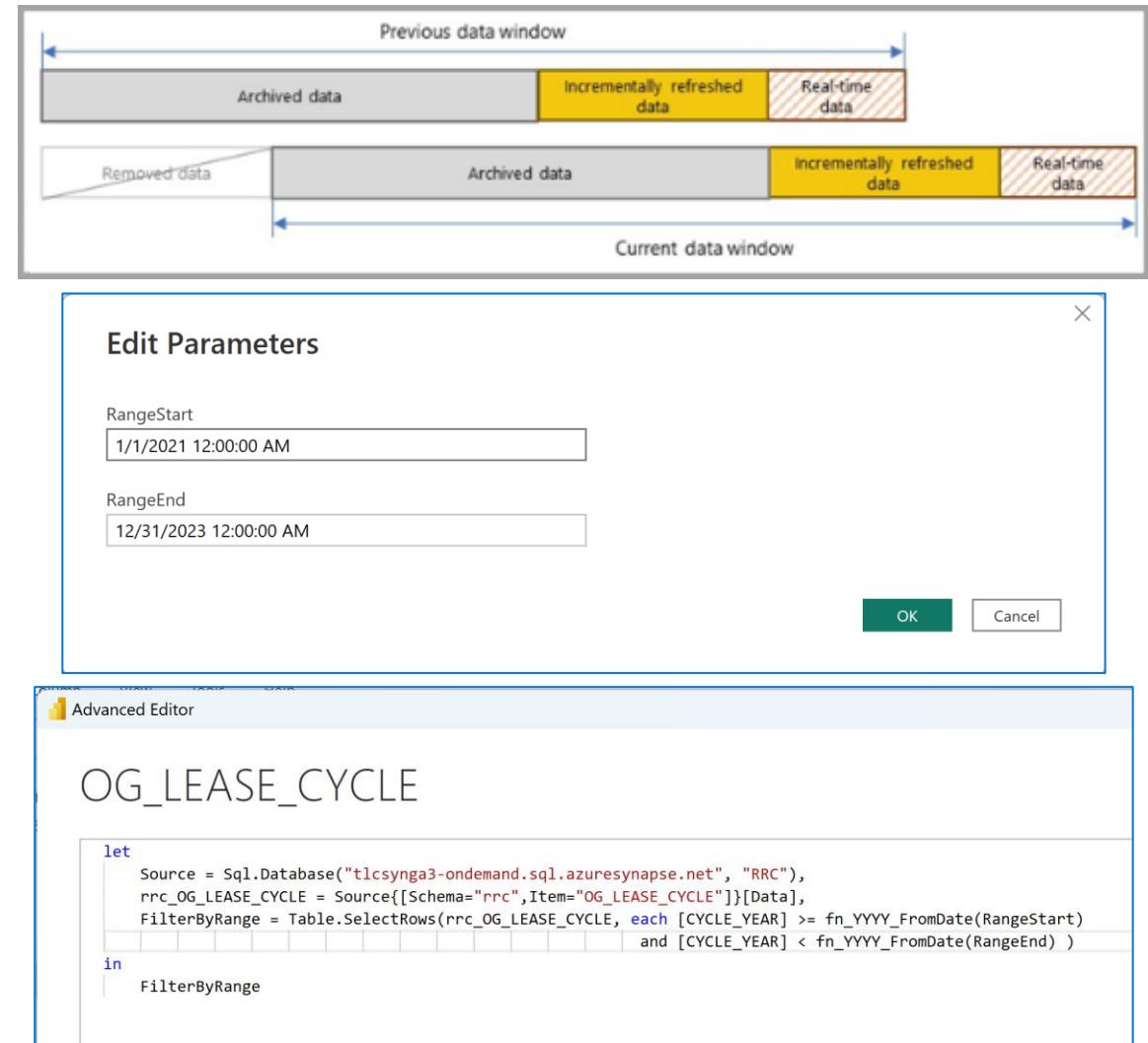
Migrating from AAS to PBI Premium

- Technical Options
 - XML/A - [New authentication option facilitates AAS migrations to Power BI Premium at a low price point](#) | [Microsoft Power BI Blog](#) | [Microsoft Power BI](#)
 - Visual Studio - [Deploy Analysis Services tabular models from Visual Studio](#) | [Microsoft Docs](#)
 - Tabular Editor
 - Backup/Restore ([Backup and restore Power BI Premium datasets](#) - [Power BI](#) | [Microsoft Docs](#))
 - SSMS
- Testing Options
 - Power BI Embedded A Skus for Hourly pricing
 - [What is Microsoft Power BI Premium?](#) - [Power BI](#) | [Microsoft Docs](#)
 - [Optimize Microsoft Power BI Premium capacities](#) - [Power BI](#) | [Microsoft Docs](#)
- Migration Experiences
 - Customer A - Replicated SSAS On-Prem Farm to AAS & PBI Premium – landed on PBI Premium (already had Premium Capacity).
 - Customer D – AAS to PBI Premium for marketing/sales
 - Customer D2 - AAS

Power BI Incremental Refresh

Overview

- Available in Pro* and Premium
- What is Incremental Refresh
 - “extends scheduled refresh operations by providing automated partition creation and management for dataset tables that frequently load new and updated data”
 - A way to load/process more recent data, and (optionally) a means of archiving (removing) older data
 - Begins with reserved named parameters to inject time-based filters into table queries (can also be used to keep .pbix file smaller during local development)
 - Incremental Refresh then set as a Table property
- Use Cases/Benefits
 - Fewer refresh cycles needed
 - Refreshes are faster. Only the most recent data that has changed needs to be refreshed.
 - Refreshes are (potentially) more reliable.
 - Resource consumption (at both source system(s) and PBI) is reduced.
 - Larger datasets are possible



Power BI Hybrid Tables

Overview

- Premium capability – announced in Dec, 2021
- What is a Hybrid Table?
 - A single table with multiple partitions – with one or more in import mode partitions as well as another partition in DirectQuery mode
 - In most cases the most *recent* partition is placed in DirectQuery mode
- Use Case(s)
 - Reduce data latency by minimizing data refresh requirements
 - Still realize the benefits of import-mode query performance
 - Also offload (some) requests against the back-end data source
 - Keep historical data in DirectQuery partition
 - Old, possibly large and infrequently needed, historical data is kept in the data warehouse
 - Newer data is imported – makes sense when new data is the majority of data being queried
 - Note – This scenario not directly supported in PBI Desktop; use XMLA

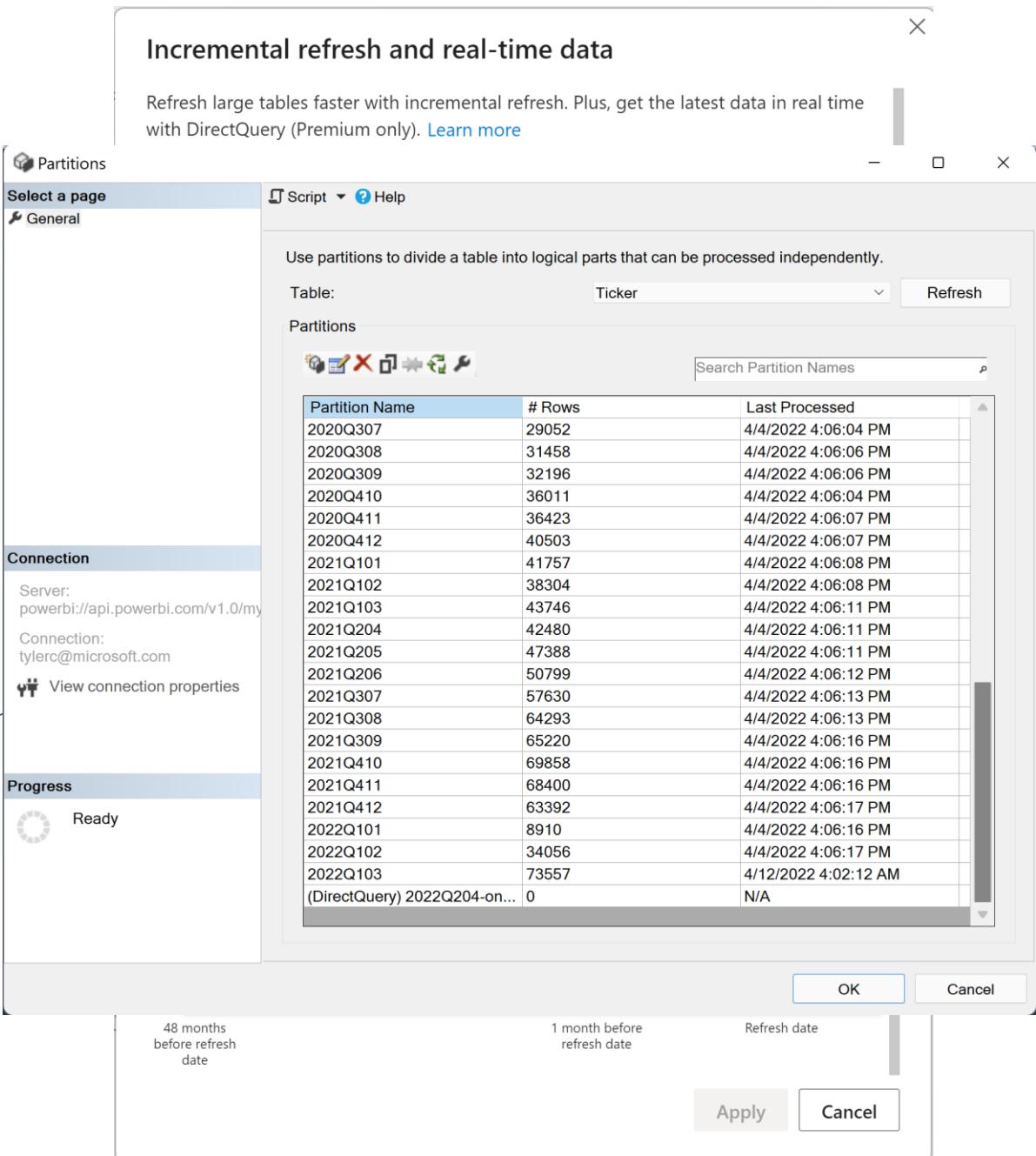
Granularity	Name	Row Count
Year	2011	295,489,717
Year	2012	297,678,498
Year	2013	295,575,442
Year	2014	292,477,875
Year	2015	297,780,469
Year	2016	294,060,081
Year	2017	300,419,682
Year	2018	296,541,108
Year	2019	292,787,420
Year	2020	299,273,979
Quarter	2021Q1	74,135,277
Month	2021Q104	24,939,498
Day	2021Q10501	820,805
Day	2021Q10502	826,885
Day	2021Q10503	821,043
Day-DirectQuery	2021Q10504-DQ	271,110
Total		3,063,898,887

<https://powerbi.microsoft.com/en-us/blog/announcing-public-preview-of-hybrid-tables-in-power-bi-premium>
<https://docs.microsoft.com/en-us/power-bi/connect-data/service-dataset-modes-understand>

Power BI Hybrid Tables

Getting Started

- Prepare Dataset for DirectQuery
 - Hybrid Table(s) – Start in DirectQuery, then switch to Import
 - Dimension Tables – Start in DirectQuery; then set to Dual-Mode
- Implications for DirectQuery and Hybrid Table
 - Remove calculated columns - required
 - Remove complex query syntax/filters – best practice
 - Be careful/test measures (e.g., LastNonBlank)
- Set Incremental Refresh policies
 - Optional – configure automatic page refresh to show latest data in the service (without user having to refresh the page)
- Deploy to Power BI Service
 - Partitions are created after deployment and initial data refresh
- For manual configurations, consider the use of...
 - PBI Desktop – Base Configuration
 - XMLA Scripts – post partition creation/management



DEMO

Hybrid Tables

The screenshot shows the Power BI Desktop interface with a dashboard titled "Cryptocurrency - Asset Performance". The dashboard features two line charts: "AskPrice - Cumulative Change %" for Bitcoin (XXBT) from March 6 to April 3, and another for the same period. To the right of the charts is a "BaseFriendlyName" card set to "Bitcoin". A context menu is open over the first chart, with "Data / Drill" selected.

Incremental refresh and real-time data

Refresh large tables faster with incremental refresh. Plus, get the latest data in real time with DirectQuery (Premium only). [Learn more](#)

Combining import and DirectQuery makes this a hybrid table. Set your related tables, **AssetPair**, to dual mode to speed up their performance with hybrid tables. [Learn more](#)

These settings will apply when you publish the dataset to the Power BI service. Once you do that, you won't be able to download it back to Power BI Desktop. [Learn more](#)

1. Select table

Ticker:

2. Set import and refresh ranges

Incrementally refresh this table

Archive data starting Months before refresh date
Data imported from 3/1/2018 to 2/28/2022 (inclusive)

Incrementally refresh data starting Months before refresh date
Data will be incrementally refreshed from 3/1/2022 to 3/31/2022 (inclusive)

3. Choose optional settings

Get the latest data in real time with DirectQuery (Premium only) [Learn more](#)
Real-time data will be from 4/1/2022 (inclusive) onwards

Only refresh complete month [Learn more](#)

DEMO

Publish/Manage Paginated Reports



Microsoft

Handling Large Data Sets

Imported Models – Getting Started

Pre-work

- Be familiar with the setup, considerations, and limitations of [large datasets](#) in Power BI Premium.
- Review the applicable content already discussed in this workshop e.g.,
 - [Datasets, Decision Criteria](#) – talks about different sizes/scenarios, & when to use import, Direct Query, Composite Models, etc.
 - [Hybrid tables](#) – enables mixed storage within a single table.
- Understand your *existing* model size (vpax) via DAX Studio (View Metrics)
 - Note: the overall sizes listed here will differ from the actual .pbix file size (.pbix is compressed)

The screenshot shows the VertiPaq Analyzer interface with the 'Tables' tab selected. The main table displays various data tables with their respective statistics. The columns include Name, Cardinality, Total Size, Data, Dictionary, Hier Size, and Encoding. The table lists several tables such as FactProductionWithFutureEstimates, WellHeaders, DimDate, DimProduct, Forecasts, LocalDateTable, UserAssetSecurityTbl, ProductPrices, DateTableTemplate, and UserAssetSecurityBypass. The 'Total Size' column shows values ranging from 552 to 71,226,240. The 'Data' column shows values ranging from 264 to 18,758,672. The 'Dictionary' column shows values ranging from 272 to 44,756,664. The 'Hier Size' column shows values ranging from 16 to 115,240. The 'Encoding' column shows values ranging from VALUE to Many.

Tables	Name	Cardinality	Total Size	Data	Dictionary	Hier Size	Encoding
Columns	FactProductionWithFutureEstimates	3,300,377	71,226,240	18,758,672	44,756,664	7,652,848	Many
Relationships	WellHeaders	3,597	17,483,576	64,312	17,300,096	115,240	Many
Partitions	DimDate	5,479	11,444,488	103,920	11,175,768	149,736	Many
Summary	DimProduct	3	2,133,508	536	2,132,876	96	Many
	Forecasts	58,603	509,004	305,664	65,036	137,560	Many
	LocalDateTable_2556d901-54c6-4d34...	5,479	396,796	22,048	238,428	44,544	Many
	UserAssetSecurityTbl	5	52,520	536	51,856	128	Many
	ProductPrices	336	41,436	1,392	35,740	3,952	Many
	DateTableTemplate_04c81bac-e71c-4...	1	36,316	1,080	35,068	72	Many
	UserAssetSecurityBypass	2	552	264	272	16	VALUE

DEMO

Dax Studio

DAX Studio - 3.0.6

File Home Advanced Help

Import Metrics Export Metrics View Metrics Export Data View As Run Benchmark SQL Profiler Analyze in Excel Swap Delimiters Utilities

Metadata Functions DMV

ForecastingDemo_RLS_V2 Model

Search DateTableTemplate_04c81bac-e... DimDate DimProduct FactProductionWithFutureEstim... DateKey IsEstimate mCountRows MeasureURL Months12M ProductKey Revenue Variance Variance (Pct) Volume Volume (Actual)

Query Builder

Columns / Measures New

AC CalendarYearLabel

i23 Volume (Actual)

Filters

Order By

Auto Update Update Reset

```
1 /* START QUERY BUILDER */
2 EVALUATE
3 SUMMARIZECOLUMNS(
4     DimDate[calendarYearLabel],
5     "Volume (Actual)", [volume (Actual)]
6 )
7 ORDER BY
8     DimDate[CalendarYearLabel] ASC
9 /* END QUERY BUILDER */
```

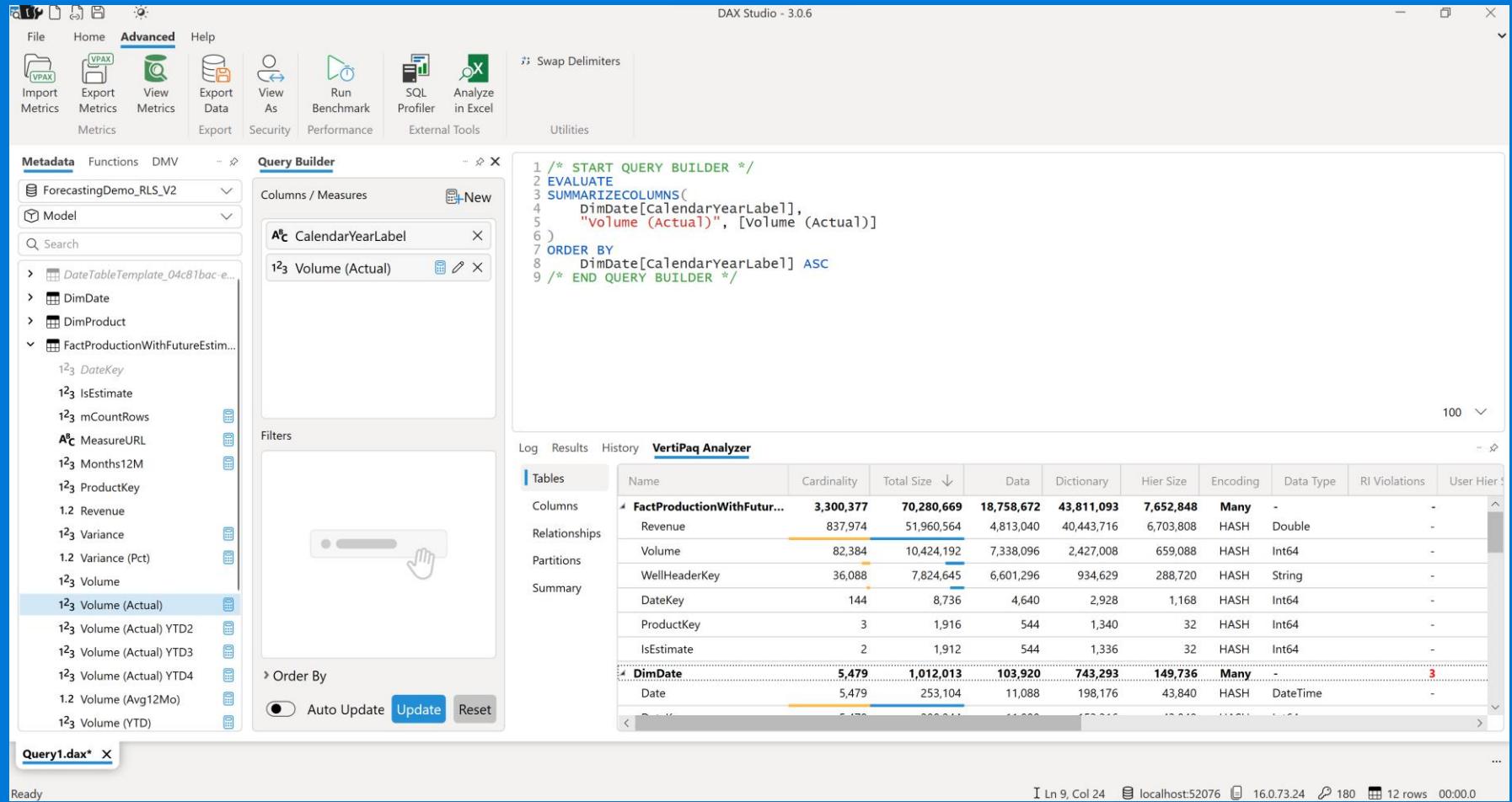
Log Results History VertiPaq Analyzer

Tables

Name	Cardinality	Total Size	Data	Dictionary	Hier Size	Encoding	Data Type	RI Violations	User Hier S
FactProductionWithFutur...	3,300,377	70,280,669	18,758,672	43,811,093	7,652,848	Many	-	-	-
Revenue	837,974	51,960,564	4,813,040	40,443,716	6,703,808	HASH	Double	-	-
Volume	82,384	10,424,192	7,338,096	2,427,008	659,088	HASH	Int64	-	-
WellHeaderKey	36,088	7,824,645	6,601,296	934,629	288,720	HASH	String	-	-
DateKey	144	8,736	4,640	2,928	1,168	HASH	Int64	-	-
ProductKey	3	1,916	544	1,340	32	HASH	Int64	-	-
IsEstimate	2	1,912	544	1,336	32	HASH	Int64	-	-
DimDate	5,479	1,012,013	103,920	743,293	149,736	Many	-	3	-
Date	5,479	253,104	11,088	198,176	43,840	HASH	DateTime	-	-

Ready

Ln 9, Col 24 localhost:52076 16.0.73.24 180 12 rows 00:00.0



DAX Studio

Handling Large Data Sets

Imported Models – Reduce Model Size

Eight data reduction techniques ([Data reduction techniques for Import modeling - Power BI | Microsoft Learn](#))

- Remove unnecessary columns (vertical filtering)
 - Tip- Shorten large text fields (if they are even needed in the first place) e.g., only show the first ~30-40 characters
- Remove unnecessary rows (horizontal filtering)
- Group by and summarize
 - Raising the Grain of fact tables. May be able to partially raise grain e.g., monthly aggregate for data > 3 years old
- Optimize column data types (numeric where possible)
- Preference for custom columns
 - Create calculate columns in Power Query if possible
- Disable Power Query query load (for unneeded/intermediate tables)
- Disable auto date/time
- Switch to Mixed mode (and/or Hybrid mode)

Bonus Tip - For large fact tables, pre-sorting data may result in better compression (though load time may be slower)



Use the Best Practices Analyzer to help with these (and other) suggestions

Handling Large Data Sets

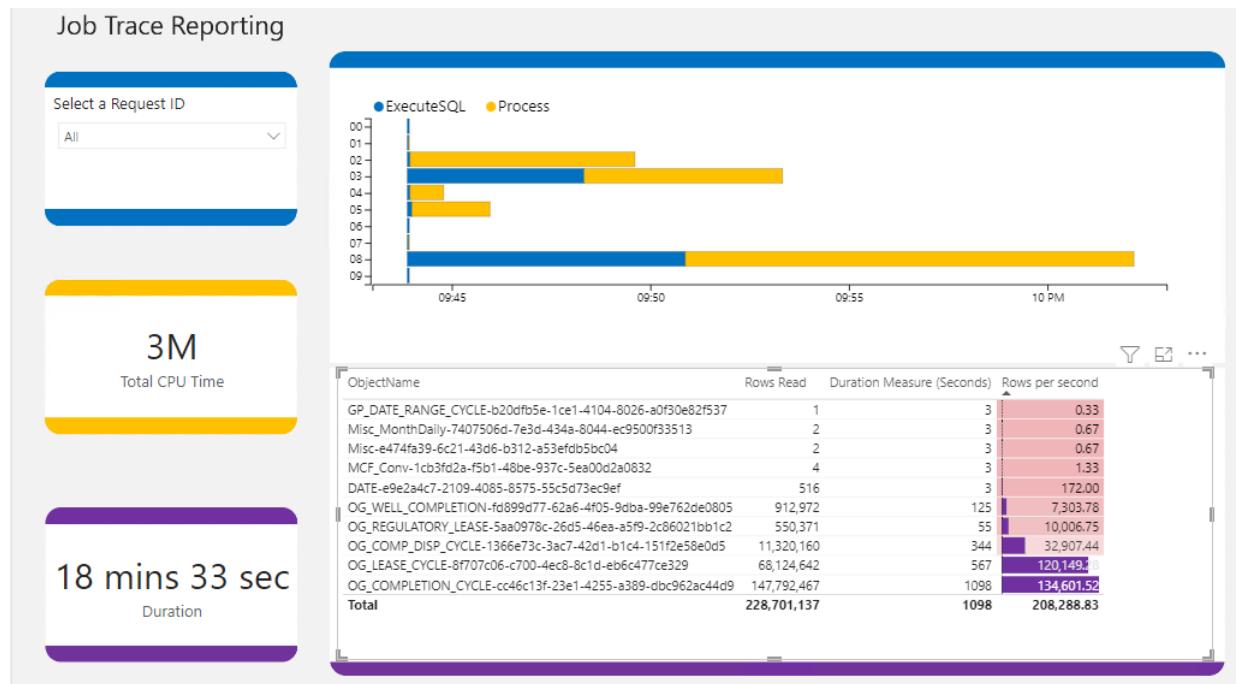
Imported Models – Optimizing Processing

Pre-work

- Establish a processing baseline to understand time spent for query retrieval and encoding/compressing operations
- Tip – expect typical encoding/compressing rates, for a single table partition, in the range of ~100-150 Megabits per second

Primary Techniques

- Data Reduction / Optimization
 - Everything from Prior Slide
 - Query Folding (at the source)
 - [Best practices when working with Power Query - Power Query | Microsoft Learn](#)
 - Incremental Refresh (i.e. only refresh recent data)
- Parallelization
 - Partitions – part of Incremental Refresh



[Visualise your Power BI Refresh - Phil Seamark on DAX](#)