



Bring your data to life with Power BI

Power BI Whitepaper

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Contributors: Adam Wilson, Alberto Ferrari, Ariel Netz, Carl Perry, Christoph Schuler, Cindy Song, Faisal Mohamood, Jennifer Underwood, John Doyle, Josh Caplan, Kay Unkroth, Lance Delano, Marco Russo, Mey Meenakshisundaram, Michael Tejedor, Miguel Llopis, Mini Nair, Patrick Baumgartner, Sandy Rivas, Sanjay Soni, Siva Harinath

Applies to: Microsoft Power BI

Summary: Business intelligence continues to evolve. Find out how Microsoft Power BI, a cloud-based business analytics service, can help your organization bring business intelligence to everyone – from the IT professional, to the BI analyst, to the business user. This paper is designed to orient business intelligence (BI) and information technology (IT) professionals to the key features and benefits of Power BI.

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Introduction

This document introduces the main capabilities of Power BI, Microsoft's business analytics service for visualizing, exploring, and deriving insights from data.

The objective of this document is to help you understand what Power BI offers and how it can support your organization's business intelligence (BI) strategy.

This document's target audience includes IT professionals, who manage organizations' BI platforms, solutions, and tools, as well as BI analysts, who specialize in data modeling, analytics, and presentation.

Note: As a cloud-based service, Power BI is frequently updated—please refer to the [Power BI website](#) for the latest information on the features and capabilities currently available.

A new generation of business intelligence

The concept of business intelligence has been around in various forms for more than a century and a half. At its core, BI is about understanding the facts - and the relationship between facts - in a way that guides decision-making and action. From a technology standpoint, BI is a set of techniques and tools for transforming raw data into meaningful business insights.

IT professionals have consistently played a key role in unlocking value from data by creating and maintaining data warehouses, building and exposing complex data models, or report creation. At the same time, end users have been relying largely on the support from IT to meet their BI needs, including the development of reports.

Microsoft Excel paved the way for self-service BI, as it was the first step in giving business analysts the ability to gain insights from data. Microsoft made self-service BI a reality with Power Pivot, extending capabilities to Excel that were previously found only in databases. These innovations enabled analysts to deliver insights from greater volumes of data and a broad array of data sources.

Today, BI continues to evolve and Microsoft is leading the way by bringing a new generation of BI to organizations, with solutions that will extend and build on, rather than replace, existing analytics platforms and tools. With Power BI, a business analytics service for visualizing and analyzing all of your data in one place, Microsoft's goal is to bring business intelligence to *everyone*.

With Power BI, the IT professional can

- Focus on what they love – Data, and provide quality and authoritative data sets to end users, business analysts and data scientists
- Meet the growing business need for consumable data
- Spend less time on infrastructure maintenance or report development
- Focus on increasing demand for real-time and streaming data sources
- Implement data governance and data-level security for cloud and on-premise data sources

The BI analyst is able to

- connect to authoritative data with ease and confidence
- visually explore data

- navigate through data quickly, optimized for performance
- pull data together from different sources, create data models and impactful, interactive reports
- easily share data models and reports with end users

The end user is empowered to

- get started and see results quickly
- monitor in real-time what matters most, in one place
- explore and use certified data sets to find immediate answers
- share reports and dashboards with others
- stay connected from anywhere

With Power BI, Microsoft is expanding the reach of analytics to more users than ever before.

Microsoft Power BI overview

Power BI is a SaaS offering that enables anyone and everyone to easily connect to any of their data, create live dashboards and reports, and explore data through interactive visualizations at any time. With Power BI, you can make all of your data viewable in a single location, regardless of where the data resides, enabling a consolidated view of business operations.

Power BI includes two companion applications. The first is Power BI Desktop, a visual data exploration and reporting tool. The second is a set of native, interactive mobile applications for Windows, iOS, and Android devices, providing secure access to live Power BI dashboards and reports from any device.

In addition, Power BI can be extended with a set of REST APIs which enable developers to integrate client and web solutions with Power BI or to build custom visualizations.

Power BI differentiators

Together, the Power BI ecosystem provides a unique set of features that empower everyone to benefit from direct access to the BI they need. Power BI's distinctive set of features include:

- Pre-built dashboards and reports for popular SaaS solutions
- Real-time dashboard updates
- Secure, live connectivity to your data sources, on-premises and in the cloud
- Intuitive data exploration using natural language query functionality
- Integrated with other Microsoft products and cloud services, including Azure Data Warehouse, Azure Stream Analytics, Azure Machine Learning, Office 365. Power BI benefits from the same commitment for scale & availability as Azure.

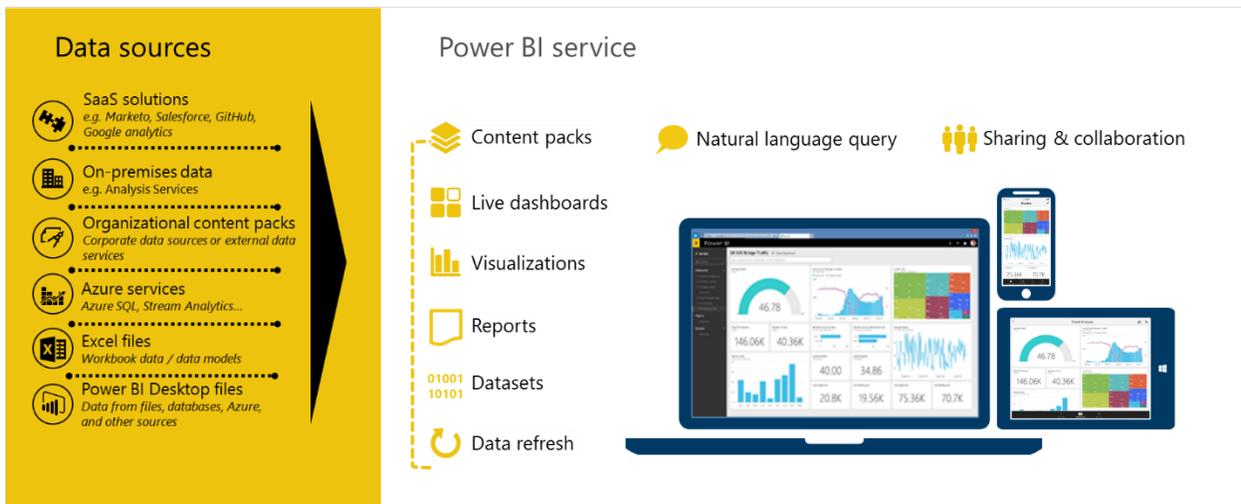
This set of capabilities is designed to help organizations get the most out of their data, no matter where that data lives – on-premise or in the cloud.

The Power BI service

The Power BI service offers a simple, intuitive experience for interacting with data. From creating and sharing dashboards to exploring and enhancing reports, Power BI makes it easy to engage with data from heterogeneous sources, fueling faster, more insightful business decisions. With Power BI, you get a rich, consolidated view of key information, no matter where all of the underlying data is stored.

The individual components and their capabilities of the Power BI service are further described below.

Figure 2. Power BI overview

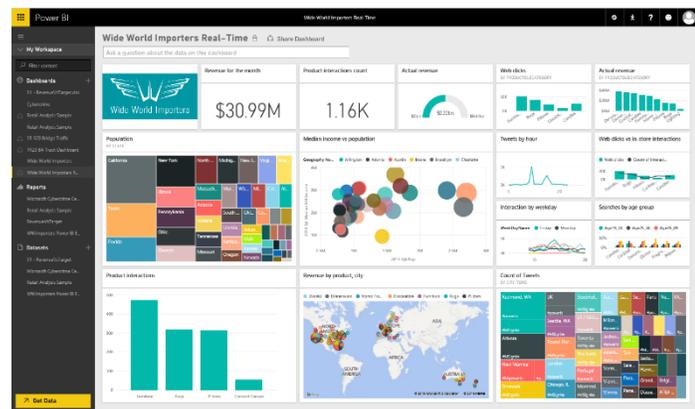


Live dashboards

A Power BI dashboard is a set of data visualizations, or charts, from one or more underlying reports, presented in an engaging way that makes it easy to glean insights - no analytics expertise needed. An advantage of Power BI is that dashboards are live. For example, when a visualization in a dashboard is connected to a real-time data source, the visualization updates continuously, enabling faster insights.

A dashboard may contain visualizations from multiple reports. Dashboards are highly customizable - you may add, or “pin”, any chart from any report to any dashboard. You may also add an image to a dashboard (like a company logo) from an Excel file. Setting up a dashboard is simple, especially when the data is from popular SaaS offerings like Dynamics CRM, Google Analytics, Marketo, Salesforce, ZenDesk, and many others. Once connected to a SaaS solution, Power BI displays data in pre-built dashboards and reports optimized

Figure 3. Sample Power BI dashboard



Construct highly visual, interactive dashboards that display live data in one place

for that solution, so you can start exploring in minutes.

In Power BI, dashboards are not only for viewing - they are interactive tools. If there is information on a dashboard that you want to look into more deeply, drill down into the underlying reports to see details. Interesting and useful drill-down views can then be pinned to a dashboard for easier access.

Interactive reports

With a user-friendly interface, Power BI enables anyone to create rich, interactive reports. A report is a set of charts, also known as visualizations, based on the same underlying dataset*. You may construct a report from scratch, select a pre-authored report (such as a report generated in Power BI Desktop), or apply a default report for a given dataset. Reports can be customized - for example, by modifying visualizations in an existing report, or adding new visualizations. If there is a need to highlight different aspects of operations using the same data, generate as many reports as needed from a single dataset.

Reports are the foundation for dashboards. Once a report contains the desired visualizations, pin the report, or a subset of its contents, to a dashboard for ease of viewing. Reports can also be shared with other individuals in an organization, and consumed on both desktop computers and mobile devices.

**If you want to create reports that use data from multiple sources, use Power BI Desktop or Power Pivot for Excel with multiple sources, then upload the Power BI Desktop or Excel file to Power BI.*

Data visualizations

Dashboards and reports are built using visualizations, or charts. Power BI offers a variety of visualization options, enabling you to present data in a compelling and visually appealing manner. There are a growing number of visualizations available that can be applied to any dataset. These include: comparison charts (bar, line, basic area and waterfall charts), composition charts (treemaps, donut and pie charts), mixed comparison and composition charts (stacked charts), relationship charts (bubble charts), geographical charts, and gauges based on a percentage value.

In addition, Microsoft has made the source code for the Power BI visuals publicly available and is enabling developers to build custom visuals for Power BI. This opens up unlimited possibilities for displaying your data.

For more information on custom visuals please visit <http://powerbi.microsoft.com/custom-visuals>

Once a set of visualizations is created, you can cross-filter among visualizations within a report to surface new insights. Use slicers to filter visualizations on the same report page so they display exactly what's needed. When a visualization is pinned to a dashboard, it is referred to as a tile.

Figure 4. Sample visualizations



View data using a variety of visualization types in addition to standard charts — options include geographical maps, bubble charts, gauges, waterfall charts and more.

Mobile applications

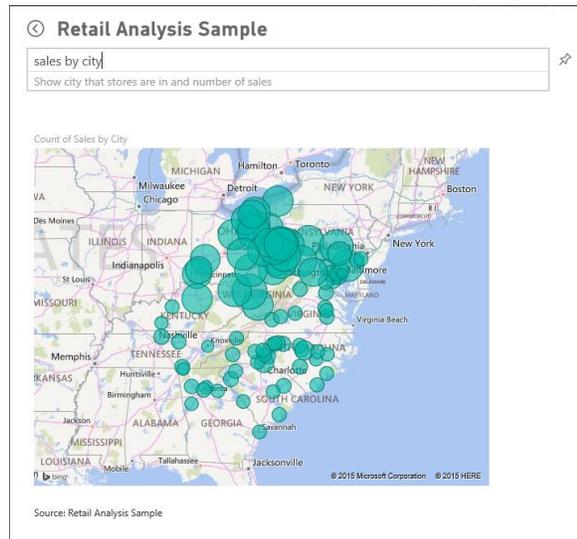
Power BI supports live, secure dashboard access on any device through native, interactive apps for Windows, iOS, and Android. To enhance the viewing experience, the dashboard user interface is optimized for smaller displays. Setting favorites makes it easier to access specific visualization tiles.

The apps include several mobile-specific features. You can zoom in and out of visualizations to look at data more closely. To stay on top of changes, set up alerts, and receive a notification when data exceeds or drops below certain thresholds. Take a snapshot of a report or visualization, and make annotations using highlight features. Collaborate with others by sharing your annotated snapshot via SMS or email.

Natural Language Query

Natural language query - also known as Q&A - is a unique feature of Power BI that lets you ask questions of your data phrased in plain English, and produces answers in the form of new visualizations, or charts. Ask anything of your data - Q&A then intelligently filters, sorts, aggregates, groups, and displays data

Figure 5. Ask questions of your data like you would ask a person



Power BI's Natural Language Query intelligently filters, sorts, aggregates, groups and displays data based on the key words in the question asked.

based on key words in the question asked. Even the least quantitatively-inclined can quickly find answers by asking questions the same way they would ask another person.

Use Q&A simply by typing a question in the Q&A textbox near the top of a dashboard, as shown in *Figure 5*. Power BI then generates a chart to answer the question, using the data from the underlying reports. Pin the chart to the dashboard if desired, and modify it by asking more questions. Because a dashboard can contain charts from multiple datasets, your questions can involve data from any one of the datasets.

The way a data model is set up has an important impact on Q&A usability. Q&A provides the best results when data models have been set up with natural key phrasing. As an example, every table in the data model should correspond to a single entity with a simple name, ideally using a single word and avoiding abbreviations and acronyms.

Sharing with others

By default, all of the data and reports you create and upload are privately visible only to you. But dashboards can be easily shared with other users in your organization if needed - simply provide the email addresses of the people from your organization with whom you want to share the dashboard. Any subsequent changes to a shared dashboard automatically sync across all users - no manual updates required. To control access, you can specify whether another user can share that same dashboard with others.

From a security point of view, the dashboard and the underlying reports are shared in reading view. A user who accesses the shared dashboard cannot create new reports or save changes to existing reports. Users of a shared dashboard cannot see or download a datasets that are used in the dashboard.

You can also collaborate and manage content with groups. Power BI groups offer a powerful collaborative experience built on Office 365 groups. A team of people can collaborate on dashboards and reports. The datasets for the dashboards and reports reside in the group's workspace. You can manage your group workspaces directly from within Power BI.

Power BI data sources

Connecting to a variety of data sources, on-premises and in the cloud

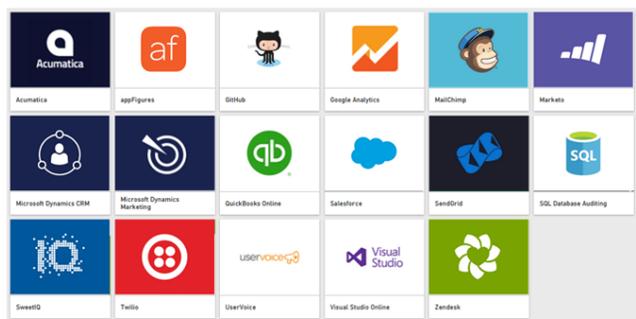
Power BI integrates with a wide range of data sources, including both cloud and on-premises solutions. With a wide variety of data sources, you can quickly and easily connect to SaaS solutions, on-premises data living in SQL Server Analysis Services, Azure services, and Excel and Power BI Desktop files. Using REST APIs, you can even connect to custom data sources, such as proprietary corporate data or external data services (e.g. an industry-specific SaaS solution not yet integrated with Power BI).

One of the advantages of Power BI is that it provides access to all of your data from a single location, regardless of where the data resides. This hybrid approach delivers a number of benefits: (1) fast time to insight with direct connections to popular SaaS solutions; (2) secure, live connectivity to existing, on-premises data sources, such as SQL Server Analysis Services tabular s; and (3) a scalable BI solution that does not require you to move any on-premises data to the cloud.

SaaS solutions

An increasing amount of information starts and lives in the cloud, never touching your organization's on-premises databases. With Power BI, users can connect directly to popular SaaS solutions and gain even more value from the cloud services they already use. There is no system configuration required; users enter existing SaaS solution credentials in the Power BI interface, and start exploring data in minutes.

Figure 6. Integrated SaaS solutions



Get more from the SaaS solutions your organization already uses. For the latest list of SaaS partners see: <http://support.powerbi.com>

Beyond simply facilitating access to data, Power BI delivers a seamless user experience through solution-specific “content packs” and automatic data refresh. Content packs include pre-configured dashboards, reports, datasets, embedded queries, and metadata. With content packs, users don't have to set anything up from scratch - when a user connects to a SaaS solution, the pre-built dashboards and reports populate automatically and are ready for use and customization. Data is refreshed automatically, eliminating the need for time-consuming data provisioning.

As an example, if you have a Salesforce account and want to use that data in Power BI, access your Salesforce data through Power BI with your Salesforce credentials. Once Power BI connects to Salesforce, you are prompted to specify whether you are a sales manager or a sales rep. Power BI then

automatically populates your Salesforce data in a pre-built dashboard that presents data in a manner tailored to your role. You can then customize the dashboard and the underlying report to fit your unique needs.

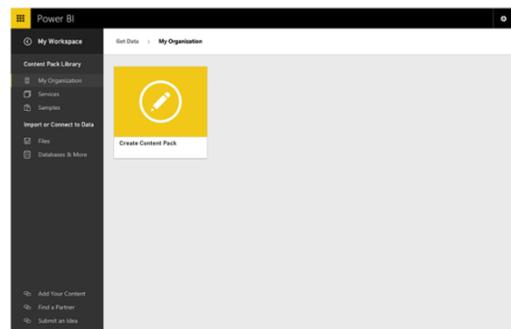
Salesforce is just one example of the SaaS solution connectivity that Power BI provides. Power BI has a constantly growing family of supported SaaS solutions - over time, more and more SaaS solutions will connect directly to Power BI.

Organizational content packs

Similar to the content packs for SaaS solutions introduced above, you can package up and share your own dashboard, reports, and datasets with your coworkers. You can create the reports in Power BI and publish them as an organizational content pack to your team. Content packs are easy to find - they are all in one location, the content gallery. And since they're part of Power BI, they leverage all the great features of Power BI including interactive data exploration, new visualizations, Q&A, integration with other data sources, data refresh, and more.

Organizational content packs can be used like the pre-defined content packs available for SaaS solutions, and offer a pre-packaged experience. For example, your finance team can use an organizational content pack to distribute finance data consistently and efficiently to executives across your organization. If you offer a data service, content packs can be a useful way to supplement your offerings and create more value for your users, enabling them to view data from your service along with other data.

Figure 8. Organizational content packs



On-premises data sources

A unique feature of Power BI is its ability to directly connect to on-premise data sources, including SQL Server Analysis Services (SSAS), SQL Server, etc. Following is an example for a live connection to SSAS.

Live connectivity with SQL Server Analysis Services

The Analysis Services Connector functionality built into Power BI allows live queries to SSAS tabular models. There is no need to move data to the cloud or to schedule data refreshes - you can view live data in Power BI dashboards and reports, and continue to manage and secure the data on-premises using existing methods.

The Analysis Services Connector is a client agent that enables Power BI to connect to on-premises SQL Server Analysis Services instances. When a user navigates within a Power BI report based on SSAS data, Power BI issues Data Analysis Expressions (DAX) queries to the connector, which acts as a proxy between Power BI and SSAS. The connector resolves the user name to an authorized user via Azure Active Directory* and applies existing, role-based SSAS security permissions. The connector then queries the on-premises SSAS cube to return the data, and the cached connection optimizes query performance.

Communication between the connector and Power BI occurs through Azure Service Bus. Azure Service Bus creates a secure SSL channel between the Power BI service and the on-premises data through an outbound port. It does not require an inbound port to be opened on the on-premises firewall.

Before users can access data in an SSAS database, the Analysis Services Connector must be installed on-premises. The connector may be installed on any server that has access to the web and the relevant Analysis Services instance. More details about installing and configuring the Analysis Services Connector can be found [here](#).

**When a company's Active Directory is federated to Azure, the authentication process automatically works. If there is no federation to Azure, it is still possible to enable authentication, but additional setup is required.*

Connectivity to other on-premises data sources

With Power BI Desktop or Excel, business analysts can import data from a wide range of on-premises data sources and publish it to Power BI. With the Power BI Personal Gateway which is further described below, the business analysts can keep this imported data in sync so that reports and dashboards in Power BI are always up-to-date.

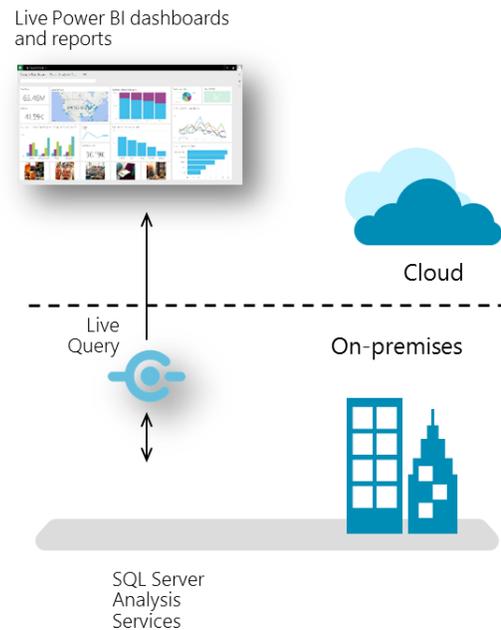
Integration with Azure services

Power BI integrates with other Microsoft cloud services, including Azure SQL Database, Azure SQL Database Auditing, and Azure Stream Analytics. By extending existing Azure services capabilities into Power BI, you can build seamless, end-to-end BI solutions. For example, you can use Azure Stream Analytics to process streaming data, then push the data into Power BI, enabling real-time dashboard updates.

Excel and Power BI Desktop files

Excel and Power BI Desktop files may be published directly to Power BI with a single click, where you can create dashboards and reports based on the data. When a file is uploaded, Power BI may automatically enhance the data by detecting key characteristics. For example, if a table in an uploaded Excel file includes a date field, Power BI may automatically create month and year columns to facilitate reporting based on those elements.

Figure 7. Live SSAS connectivity to Power BI



Establish live connectivity from Power BI to SQL Server Analysis Services without moving data to the cloud.

You can upload Excel workbooks from your computer, or connect to them on OneDrive for Business or OneDrive Personal. The advantage of connecting to workbooks on OneDrive is that any changes to a workbook will appear automatically in the dashboards and reports connected to the workbook in Power BI.

Power BI supports files with advanced data models, such as Power BI Desktop files and Excel files with Power Pivot data models. When an Excel workbook with a Power Pivot data model is loaded, Power BI loads the entire data model to provide a richer experience. The same is true with Power BI Desktop files.

Loading files from Power BI Desktop enables you to surface data from a variety of sources that do not directly connect to Power BI. For example, if you want to use Power BI to explore data from Facebook, a SharePoint list, or from your SAP system, you can access the data through Power BI Desktop, create a report, and then publish the file to Power BI. Similarly, if you want to mashup data from multiple sources, Power BI Desktop enables you to do just that. For more details, see the [Power BI Desktop](#) section in this document.

Authentication and data refresh

Secure data access, along with up-to-date data, are both very important for any BI solution. Below is an overview of how authentication and data refresh capabilities work in Power BI. For additional details, please also see the [Microsoft BI Authentication and Identity Delegation](#) article and document.

User authentication

A user accesses the Power BI service at powerbi.com using their organizational email address. Users of the same company usually share the same Power BI tenant and belongs to the same domain. Power BI requires users to be within the same organization in order to be able to share dashboards and reports. When Azure Active Directory (AD) is federated with the customer's Active Directory, access becomes even simpler. Single Sign-on is enabled down to the data source. Power BI automatically recognizes their user token as part of the organization and then grants access and sets permissions accordingly.

Data source security

The Power BI service connects to data sources in a secure and integrated way. It uses existing credentials and source-specific details to establish connections to each data source. Connections to supported data sources are secured as follows:

- **SQL Server Analysis Services (SSAS):** Azure Active Directory applies existing role-based security as well as row-level security to restrict data access. While users can view data with Power BI, data remains on-premises at the Analysis Services cube level, with dimension- and cell-level security applied.
- **Azure services:** Connect integrated Azure services to Power BI using Azure AD to manage the authorization process and control access across your cloud environment.
- **SaaS solutions:** Connect data from SaaS solutions to Power BI with existing SaaS credentials. The specific authentication method varies by service (see section below for details). Once entered, credentials are retained to enable automatic data refresh.
- **Excel and Power BI Desktop files:** With Power BI Desktop or Excel, business analysts can import data from a wide range of on-premises sources and publish it to Power BI. The business analysts needs credentials to connect to the on-premises data source. The Personal Gateway

keeps this imported data in sync so that reports and dashboards in Power BI are always up-to-date.

Authentication methods

Power BI, Power BI Desktop and Excel support authentication of the initial connection to a data source, as well as subsequent refreshes, based on various authentication methods. *Figure 9* shows examples (not a comprehensive list) of data sources and their corresponding authentication method. Certain types of data sources (e.g. ODATA feeds, web) can support multiple authentication methods.

Figure 9. Data Authentication methods

Authentication method	Example data sources that use this method
Basic	SQL Azure, Marketo, OData
Account key	Blob store, Table store, HDInsight
OAuth	Salesforce, Google Analytics, ODATA Feed
Marketplace key	Azure Marketplace
Anonymous	ODATA Feed, Web

Table includes both Power BI and Power BI Desktop examples

Data source authentication in Power BI Desktop

Authentication in Power BI Desktop works the same as in the Power BI service. You connect to data in Power BI Desktop with existing credentials for third-party data sources, or using Azure AD for integrated Microsoft offerings. Data refresh is also available through Power BI Desktop using the authentication methods described above.

Data refresh

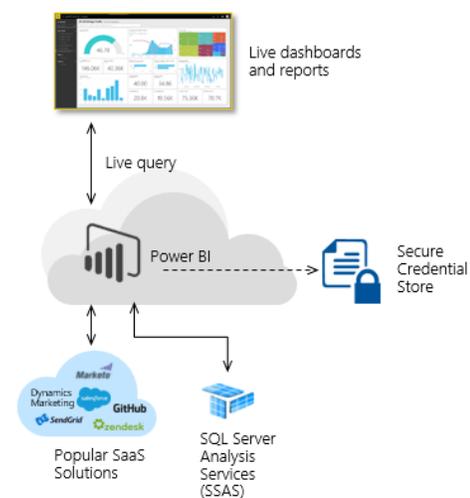
Power BI keeps all of your data current with real-time updates, automatic and scheduled refreshes, and live connectivity depending on the data source.

Real-time visibility and live connectivity

Real-time visibility is available via Azure Stream Analytics integration, and the Power BI REST API. With both of these options, data may be pushed directly into Power BI so you can stay up-to-date and uncover real-time insights. For example, constant data feeds from IoT devices such as temperature monitors can be processed by Azure Stream Analytics and pushed to Power BI for real-time analysis and insights.

Live connectivity to on-premises data sources, including SQL Server or SQL Server Analysis Services (SSAS), means there is no need to schedule data refresh. Data is accessed via live queries; when you click a visualization or navigate a report, live data comes back from the data source. But even without user intervention, data in Power BI is refreshed automatically every 10 minutes.

Figure 10. Data refresh for SaaS solutions and SSAS models



Keep your data current with automatic refreshes of SaaS solution data, and live connectivity to on-premise data

Automatic and scheduled refresh

With SaaS solutions, refresh occurs in two ways. For most SaaS solutions, Power BI automatically refreshes your data on a daily basis; no intervention required. You can also refresh data on-demand with one click.

Reports based on Excel files stored on OneDrive for Business can be refreshed (but files uploaded to Power BI cannot be refreshed). Power BI automatically refreshes report data based on such an Excel file on an hourly basis, or whenever a new version of the file becomes available.

Scheduled refreshes are supported for Power BI Desktop and Excel files that connect to a variety of cloud data sources, including Azure SQL, BLOB storage, Table storage, HDInsight, Azure Marketplace, Facebook, and Salesforce.

Scheduled refresh using Power BI Personal Gateway (on-premises sources)

The Power BI Personal Gateway acts as a bridge, providing quick and secure data transfer between the Power BI service and on-premises data sources that support refresh. With the Power BI Desktop or Excel, business analysts can import data from a wide range of on-premises sources and publish it to Power BI. The Personal Gateway keeps this imported data in sync so that reports and dashboards in Power BI are always up-to-date. Data transfer between Power BI and the Gateway is secured through Azure Service Bus. The Service Bus creates a secure channel between the Power BI service and your computer. Because the Gateway provides this secure connection, there's no need to open a port in your firewall.

The power of the Personal Gateway is in its ease of use. Once the Personal Gateway is running on the user's computer, data refresh is seamless. The Personal Gateway helps analysts to quickly get started and refresh content in Power BI without having to depend on IT – this is a tremendous productivity gain offering self-service in its truest sense!

Power BI Desktop

Turn data into valuable business information

Power BI Desktop - a desktop companion application to the Power BI service - is a visual data exploration and reporting tool geared toward BI analysts. Power BI Desktop centralizes, simplifies, and streamlines what can otherwise be a scattered, disconnected, and arduous process of designing and creating business intelligence repositories and reports.

Among other things, Power BI Desktop enables you to acquire and prepare data using its built-in query capability. You can then structure, transform and analyze the data using a variety of features. Explore data using a freeform, drag-and-drop canvas, and author reports with a broad range of data visualizations. When you are ready for others to use your data models and reports, publish directly to Power BI, and share through a unique, curated content library approach.

Below is a more detailed overview of Power BI Desktop's core capabilities. New capabilities are added continuously, please watch the [Power BI blog](#) for updates.

Prepare your data: connect to your data source

Power BI Desktop lets you easily connect to the ever expanding world of data. Retrieving data is as simple as finding and selecting your data source from four primary categories - namely **File** (such as Excel and CSV files), **Database** (such as Oracle and SQL Server databases), **Azure** (a variety of Azure services), and **other** (sources such as Facebook, Google Analytics, and the Web). Quickly locate the data source you need with an intuitive search function.

A major benefit of Power BI Desktop is its ability to manage big data - such as datasets from big data analytics tools like Azure HDInsight. At the same time, it is important to surface the right data to provide a streamlined report usage experience. Power BI Desktop optimizes large dataset management with in-memory data processing and allows you to pare down datasets by editing queries before loading data.

Figure 11. Data sources available through Power BI Desktop

File	Database	Azure	Other
<ul style="list-style-type: none"> • Excel • CSV • XML • Text • JSON • Folder 	<ul style="list-style-type: none"> • SQL Server Database • Access Database • SQL Server Analysis Services Database • Oracle Database • IBM DB2 Database • MySQL Database • PostgreSQL Database • Sybase Database • Teradata Database 	<ul style="list-style-type: none"> • Microsoft Azure SQL Database • Microsoft Azure Marketplace • Microsoft Azure HDInsight • Microsoft Azure Blob Storage • Microsoft Azure Table Storage 	<ul style="list-style-type: none"> • Web • SharePoint List • OData Feed • Hadoop File (HDFS) • Active Directory • Microsoft Exchange • Dynamics CRM Online • Facebook • Google Analytics • SAP Business Objects BI Universe • Salesforce Objects • Salesforce Reports • ODBC Query • ODBC Tables

Data sources supported—with more sources being continually added

Prepare data: query and shape your data

Datasets are not always in the right format, and may need adjustment before they are ready for analysis and reporting. Once you connect to your data, Power BI Desktop enables you to transform, or shape, data to meet your needs. With Power BI Desktop, shaping data involves defining and refining queries. Every table imported into Power BI Desktop is a query that can be modified. There are numerous ways to shape data. As an example, you can select a subset of data for inclusion in a report, and modify data types to support specific calculation requirements. Additionally, execute data cleansing functions, such as removing invalid rows. The intuitive Query view enables you to precisely tune queries without having to alter the underlying data. Power BI Desktop simply adjusts your view of the data.

Power BI Desktop captures the sequence of data-transformation activities in an Applied Steps list within the Query view. You can remove rows or columns, change data types, modify table names, and perform a variety of other steps to precisely tune how the data is shaped. Applied Steps records and displays each query step, and lets you re-order, add, edit or remove steps as needed.

There is more. Power BI Desktop has advanced features, for example it supports the formula language M, a powerful language for scripting of queries and transformations. With Power BI Desktop, you can also mashup data from multiple sources, supporting complex data model creation. Unlike more basic applications that connect to a single data source, Power BI Desktop allows you to create heterogeneous tables that draw from various data sources. By using Power BI Desktop to combine multiple tables from different data sources into a single table (also known as a query), you can deliver even richer analysis and reports.

Figure 12. Common data-shaping tasks using Query functionality

- Remove rows or columns
- Change a data type
- Pivot columns and group rows
- Identify and fix errors
- Merge or append queries to combine data from multiple queries into a single query

Prepare data: build relationships and use calculations

In Power BI Desktop, you can prepare and analyze data. Power BI Desktop provides advanced analytics capabilities that help you structure complex data, create relationships, define a variety of calculations, find correlations, highlight exceptions, forecast business outcomes and more.

When data is imported to Power BI Desktop, a data model is automatically created. Power BI Desktop detects relationships automatically, categorizes data and applies default summarization.

Specifically, Power BI Desktop's AutoDetect feature identifies relationships across all of your datasets - including between cloud and on-premises data sources - to accelerate analysis. Of course, you can also refine the model as needed - for example, by manually creating relationships or adjusting the type of relationship. Power BI Desktop supports one-to-one, one-to-many, many-to-one, and many-to-many relationships. You can also apply single-direction or bidirectional filters to cross-filter data for additional views.

You may also choose to enrich your data model with additional metadata, improving Power BI's user experience with better display formats, defaults, and synonyms for improving the functionality of the Power BI Natural Language Query feature.

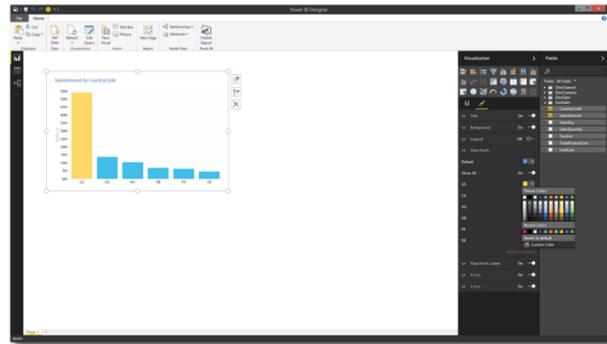
To support analysis, Power BI enables calculations, or measures, to be defined. The results of measures are new fields for use in reports, such as sums or averages. In some cases, measures will be automatically generated for you based on the dataset. You may also define your own measures using Data Analysis Expressions (DAX) language. Power BI Desktop includes a DAX library of over 200 formula elements - combining these elements lets you produce exactly the results you need.

Explore data

Explore your data in a variety of ways and across multiple visualizations, select data elements and sort data. You can filter data and use cross-filter capabilities, drill into and across datasets, pivot and slice data and change visualization types.

Select, transform and mashup data via a freeform, drag-and-drop canvas.

Figure 13. Explore your data on a freeform canvas



Author reports

Along with rich data shaping features, Power BI Desktop provides an intuitive report-authoring experience. Once you have loaded data, Power BI Desktop's freeform, drag-and-drop canvas makes it easy to select, transform and mashup data, and create reports. You may jump right into report-authoring after connecting to a data source - data preparation and analysis are optional steps.

Similar to the Power BI service, Power BI Desktop offers a range of interactive visualization features and options, enabling you to create reports that tell visually compelling stories.

Figure 14. Visually author reports



Power BI Desktop allows you to create reports that tell visually compelling data stories

Going a step beyond the service, Power BI Desktop allows you to use data from as many different sources as you want in a single report. There are a variety of ways to explore data within a report—for example, you can sort and filter data, cross-filter data across multiple visualizations, drill into and across datasets, and pivot and slice data.

Authors can continuously edit reports, visualizing the data in new ways to provide dynamic perspectives. You can work and re-work queries during the authoring phase to make sure the insights you're looking for are displayed in your report. Move around, copy and paste, and merge visualizations to drive further data insights. Similar to the Power BI service, a report can be any number of pages, with

any number and combination of visualizations. The result is a visually impactful, interactive report that you can publish to end users.

Publish to Power BI

When a report is ready for use, the Power BI Desktop file (in PBIX format) may be saved and uploaded to the Power BI service with a single click.

By publishing Power BI Desktop files to Power BI, you can enable end users to reap the benefits of advanced data preparation and reporting, giving them access to reports that are richer than what they could produce on their own. For example, users can pin visualizations from the report directly to their dashboards. All of the elements of the data model, such as measures and relationships between tables, are loaded, so users can create visualizations that mix data from any table in the dataset.

Keep in mind that if you send a PBIX file to someone else, you are providing access to the entire contents of the file (a PBIX file contains the data model, queries, and a copy of the dataset). If you want to restrict access to the underlying data, publish the file to Power BI, and provide access only to authorized users. This way, only the right audience can consume the information.

You can also author dashboards and reports directly on Power BI. All you need is a web browser to explore your data.

Power BI REST APIs

Power BI is an extensible platform thanks to a library of REST APIs, which manipulate data in Power BI by accessing a collection of JSON objects. These APIs enable developers to programmatically access certain Power BI resources. In order to use Power BI APIs, applications must be registered. Once your application is registered, you use Azure Active Directory (AD) to manage authentication.

Common API usage scenarios

Integrate other applications with Power BI. Power BI REST APIs make it possible to integrate Power BI with existing application workflows to deliver immediate insights for professional and non-technical users. Applications send data into Power BI, adding data exploration capabilities to an existing system.

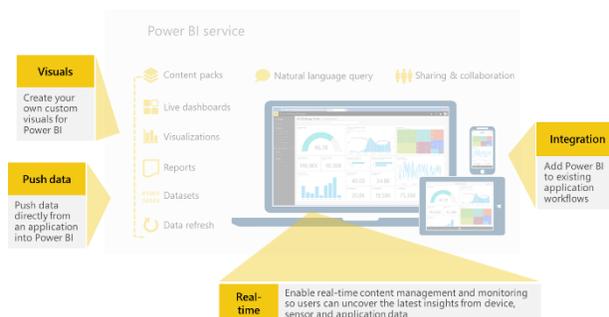
Push data into Power BI and enable real-time monitoring. Using Power BI REST APIs, data can be pushed directly from an application into Power BI, or transferred on-demand or based on another application schedule or event. Power BI then dynamically updates dashboards in real-time when the data changes, ensuring dashboard users have the latest information. This real-time content management and monitoring capability helps users uncover the latest insights from device, sensor, and application data.

Build custom connectors. With Power BI REST APIs (or OData, ODBC and other APIs), developers can create custom connectors and for Power BI. Connectors allow authorized Power BI users to access your data source and retrieve data. Examples of potential data sources include corporate data sources, and cloud services that Power BI does not yet support.

If Power BI does not currently support your cloud service, Microsoft invites you to reach out. We would love to hear feedback on which applications you are looking to integrate with Power BI.

Build custom visuals. Developers can add custom visuals into Power BI for use in dashboard, reports and content packs. Microsoft has published the code for all Power BI visualizations to GitHub. The

Figure 15. Power BI extensibility



visualization framework, the test suite and tooling is provided to help the community build high quality custom visuals for Power BI.

Available APIs

There are several Power BI REST APIs available that make it possible to perform a variety of operations:

- Return a list of datasets with GET Datasets
- Create a new dataset with POST Datasets
- Add new rows to a table with POST Rows
- Clear all rows in a table with DELETE Rows
- Return a list of tables in a dataset with GET Tables
- Update the schema of a dataset with PUT Table

For more information, please visit <https://powerbi.microsoft.com/developers>

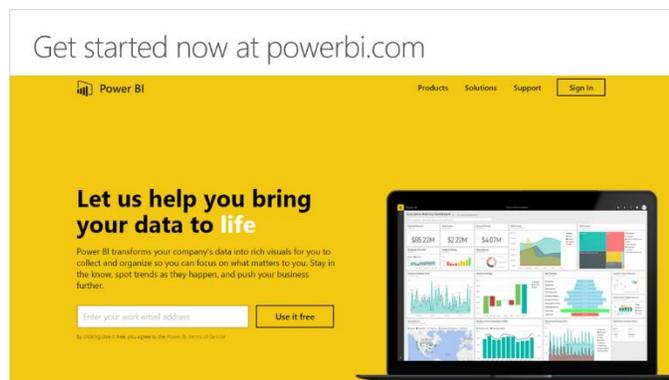
Conclusion

Power BI offers your organization enormous potential by expanding access to business intelligence and supporting a culture of data-driven decision making. IT professionals and developers benefit from fast deployment, a secure, hybrid configuration, and easy integration with existing IT systems. Business analysts can leverage powerful analysis capabilities for easy data discovery, exploration, and report creation. And business users no longer need to rely solely on BI from others - they can view and analyze all of their data in one place with live dashboards and reports. By adding Power BI to your organization's portfolio, you can make BI available to the people who need it, when they need it.

For more information, please see <http://powerbi.com>.

Call to action

Start today and bring your data to life by signing up at <http://powerbi.com> to see results in minutes.



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