International Journal of Leading Research Publication (IJLRP)

E-ISSN: 2582-8010 ● Website: www.ijlrp.com ● Email: editor@ijlrp.com

Advanced SAP Data Analytics using Microsoft Power BI

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Abstract

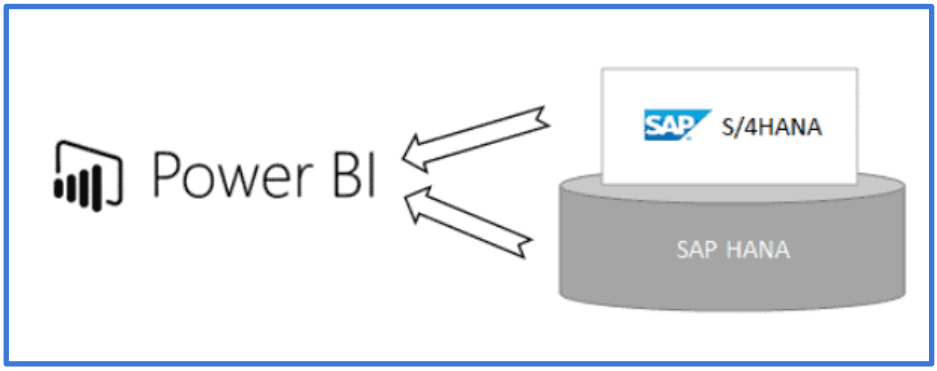
SAP S/4HANA is an advanced enterprise resource planning (ERP) system that enables real-time business reporting and analytics. Power BI, a Microsoft business intelligence tool, provides interactive dashboards and data visualizations. Integrating SAP S/4HANA with Power BI allows organizations to harness the power of SAP's in-memory data processing with Power BI's rich visualization and analytics capabilities. This paper provides a detailed technical overview of the integration process, covering data extraction methods, connection architectures, best practices, and performance optimization strategies.

Keywords: SAP S/4 HANA, Microsoft Power BI, CDS views, OData, Reporting, Analytics

1 Introduction:

Importance of SAP S/4HANA and Power BI Integration

SAP S/4HANA is a next-generation enterprise resource planning (ERP) suite designed to help businesses run simple in a digital and networked world. It offers real-time data processing and reporting capabilities. Power BI is a business analytics service by Microsoft that provides interactive visualizations and business intelligence capabilities. Integrating these two powerful tools can provide organizations with robust reporting and analytics capabilities. There is a lot more to gain from utilising Power BI to integrate SAP data. Business users may generate dynamic dashboards and reports from your SAP data using Power BI's powerful mashups in the field of data visualisation and analytics. SAP data becomes more accessible as a result of the seamless integration, allowing real-time insight and intelligence in decision-making. Additionally, Power BI contains collaboration features that make it simple for the team members to work on and share reports. Over the past few years, Microsoft has significantly improved Power BI integration with SAP, addressing several key challenges such as connectivity, performance, security, and data modeling.



Below are some of the key improvements over the past few years which makes the integration between Power BI and SAP more robust and future ready.

- DirectQuery Enhancements allows Real-time access to SAP BW & SAP HANA
- Performance Boosts that helps Faster MDX queries & optimized SAP BW connections
- Security Upgrades that provide Single Sign-On (SSO) & Row-Level Security (RLS) integration
- Cloud & Hybrid Support for Seamless integration with Azure & cloud storage
- AI & Data Prep for Automated insights & Power BI Dataflows for SAP data

2 Connection Modes:

Power BI provides two primary connection modes for integrating with SAP systems: Import Mode and DirectQuery Mode. Each mode has its own advantages, limitations, and ideal use cases. In **Import Mode,** Power BI imports and stores SAP data in its internal VertiPaq engine. The entire dataset is loaded into memory within Power BI Desktop or Power BI Service. Reports & dashboards retrieve data from the in-memory model, not directly from SAP after initial import. Whereas in **DirectQuery Mode**, Power BI does not store the data. Instead, queries are sent directly to the SAP database every time a user interacts with the report. This mode retrieves data in real-time from SAP HANA, SAP BW, or SAP S/4HANA. Queries are executed dynamically, meaning Power BI acts as a visualization layer while SAP handles data processing.

Here are the factors to be considered while choosing the right mode for your system.

Feature	Import Mode	DirectQuery Mode
Data Storage	Stored in Power BI	Data remains in SAP
Performance	Very fast (cached)	Slower (live queries)
Data Refresh	Manual/Scheduled	Real-time
Data Size Handling	Limited (depends on RAM)	Can handle large datasets
Complex Calculations	Fully supported	Limited support
Merging with Other Data	Easy	Difficult
Best for	Fast, historical analysis	Real-time, live dashboards

Best Use Cases for Import Mode:

- When working with smaller to medium-sized SAP datasets (millions of rows).
- When fast query performance is more important than real-time data.

- When users need complex calculations and custom transformations.
- When combining SAP data with other non-SAP data sources.

Best Use Cases for DirectQuery Mode:

- When real-time reporting is required (e.g., live financial data, inventory tracking).
- When working with large SAP datasets that cannot be fully imported.
- When SAP security roles and access control must be enforced.
- When Power BI is used only as a visualization tool, without complex calculations.

Both Import Mode and DirectQuery Mode have unique advantages. The best choice depends on the business needs, SAP environment, and data refresh requirements.

3 Types of Connections from SAP to Power BI:

Integrating SAP with Power BI can be achieved using various connection methods, each with its own advantages and limitations. The choice of connection depends on factors such as real-time vs. batch data, performance needs, and security considerations. Below are the main connection types available for extracting SAP data into Power BI:

3.1 Direct Connection to SAP HANA Database:

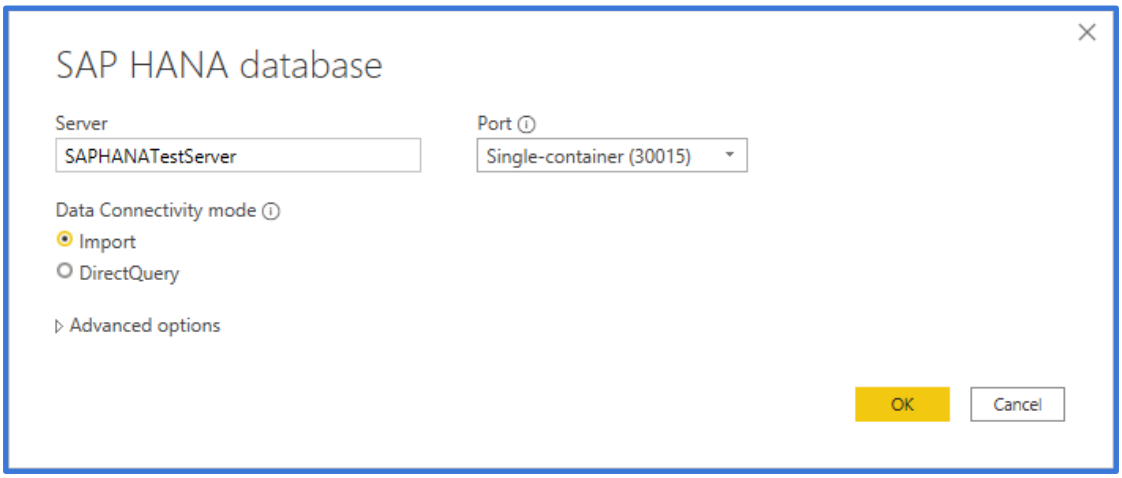
Power BI natively supports direct connections to SAP HANA, enabling real-time analytics on SAP's in-memory database. It uses the SAP HANA ODBC Driver installed on the Power BI machine. It can be accessed through Get Data → SAP HANA Database in Power BI. Both DirectQuery mode and Import Mode are supported in this connection.

Use Case:

- Suitable for real-time dashboards and large datasets.
- Ideal for businesses with SAP HANA-based ERP or data warehouse.

Limitations:

- Performance bottlenecks in DirectQuery mode with complex queries.
- Requires SAP HANA credentials and database access.



3.2 SAP BW (Business Warehouse) Connector:

Power BI can connect to SAP BW Queries, InfoProviders, and DSOs (DataStore Objects) using the SAP BW Connector. It uses SAP NetWeaver RFC to extract data. It can be accessed through Get Data →

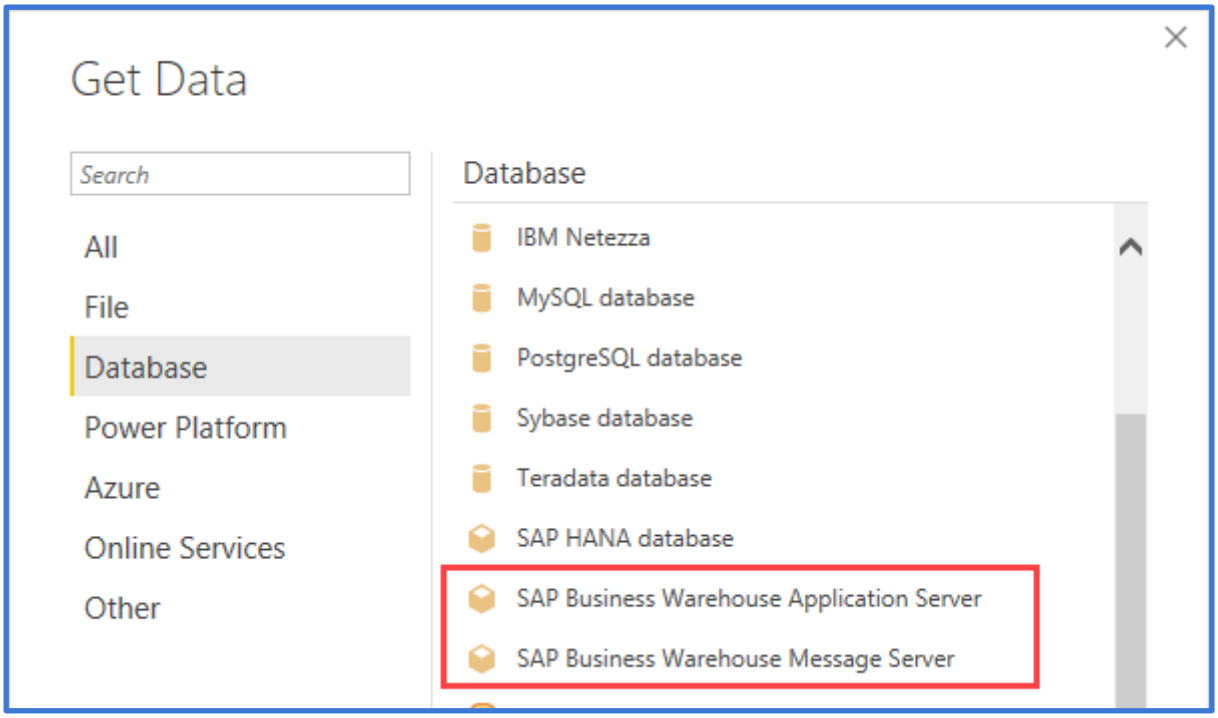
SAP Business Warehouse Application Server or Message Server. Both DirectQuery mode and Import Mode are supported in this connection. The "SAP BW Application Server" connection directly connects to a specific SAP Business Warehouse server, while a "Message Server" connection uses a load balancing mechanism to route queries to the most optimal SAP BW application server within a cluster, providing better performance by distributing workload across available servers; essentially, the Application Server connection is a direct link, whereas the Message Server acts as a gateway to find the best available server to handle the query.

Use Case:

- Recommended for pre-modeled datasets in SAP BW.
- Suitable for enterprises using SAP BW on HANA or SAP BW 7.x.

Limitations:

- Large SAP BW queries can slow down Power BI refresh.
- Requires SAP BW query design optimization to enhance performance.



3.3 SAP CDS Views:

SAP S/4HANA allows defining CDS Views, which can be consumed directly in Power BI using OData or SAP HANA connections. Both DirectQuery mode and Import Mode are supported in this connection. CDS Views are published as OData Services in SAP Gateway. Then Power BI can be connected via Get Data → OData Feed.

Use Case:

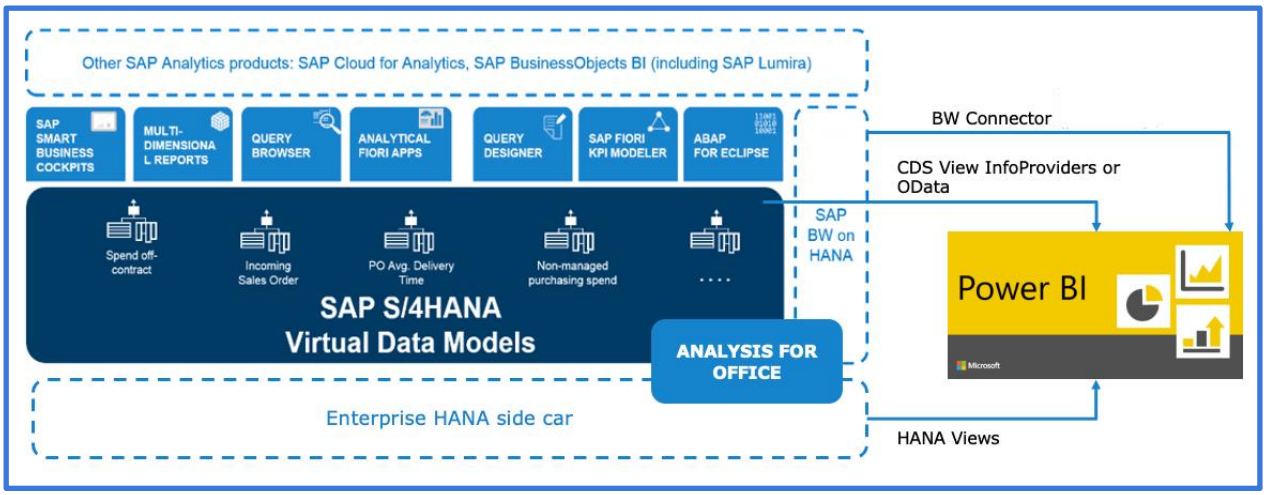
- Ideal for pre-modeled business data in SAP S/4HANA.
- Reduces manual SQL transformations in Power BI.

Limitations:

- Requires SAP Basis team to configure CDS View permissions.
- Some complex business logic may not be supported in OData format.

However, please note that the CDS view when created as an Analytics Query can be consumed in Power BI using the BW connector similar to a BW Query being consumed. Here the Query CDS view should have key Annotations as below.
@Analytics.query: True - To make sure it is recognized as a BW Query
@VDM.Viewtype: #CONSUMPTION - To make sure it can be consumed externally

Below picture shows a brief overview of the three types of connections discussed above with SAP and Power BI.



Conclusion:

Integrating SAP S/4HANA with Power BI enables organizations to leverage real-time ERP data with interactive business intelligence dashboards. By choosing the right data extraction method, whether Direct HANA Connection, OData Services, SAP BW Queries, or CDS Views, businesses can optimize reporting performance while maintaining data security and governance. Power BI's advanced analytics, combined with SAP's robust data processing capabilities, makes this integration a powerful tool for modern enterprise reporting and decision-making.

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