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Evolution of the Semantic Layer

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Introduction

In this whitepaper we explore the evolution of the Semantic Layer by looking at how it forms the core of enterprise business intelligence platforms. The Semantic Layer maps an organization's underlying data to a user friendly business view for building reports or conducting ad-hoc queries. We discuss how organizations that undergo digital transformation evolved and adopted new technologies implementing advanced analytic solutions. Taking a look at the benefit of a Semantic Layer that has evolved to keep up with these applications while also catering to new types of data, we discuss how TIBCO® Data Virtualization software supports this evolved Semantic layer and provides new functionality in support of building a data fabric for the transformed business.

Introducing the Semantic Layer

Reporting and analytic technologies started in the early 80's with the introduction of decision support systems and executive information systems. These systems rapidly evolved into business intelligence platforms that addressed the need for operational and management reporting to be in the hands of business users spread across the organization. Business intelligence solutions focus on optimizing the business by providing access to information stored in the various operational systems. Data warehouses or data marts became popular as they were built to store and integrate data from these operational systems. The design of all of these databases followed methodologies for optimizing the database and resulted in complex tables, views and stored procedures that only the database designer clearly understood and could build queries that yielded the correct information. The Semantic layer started as a data dictionary that provided business names and definitions of the underlying data and as business intelligence platforms evolved, these data dictionaries soon became the conduit between the user and the underlying data.

The screenshot shows a BI tool interface with a 'Query' window. On the left, a 'Catalog' pane lists data sources: Orders, Products, Customers (with sub-items like Customer No., Name, Status, Type, Note, Sites, Conditions), Admin, Prompts, Branch Alias, and Custsite Alias. On the right, a list of business views is shown under 'GO Sales and Retailers', including Orders, Products, Sales reps, Countries, Sales branch address, Sales branch address (multiscrpt), Retailers, Retailers (multiscrpt), Product forecasts, Sales targets, Staff name, Retailer name, Product name, Sales year, Sales month, Actual revenue, Sales target, and Filters.

First evolution moved from desktop decision support to web based business intelligence.

Both using the Semantic layer to provide a business view of underlying data.





Business Intelligence Platforms Adopt the Semantic Layer

Enterprise BI platforms include a Semantic Layer that resides between reporting databases and the business analyst building a report or dashboard. Using the BI reporting or query interface, the analyst is provided with a business representation of data along with commonly used calculations. The analyst can use the data knowing it is secured for their use, without an understanding of the underlying database structure or writing SQL code, simply by dragging and dropping data elements onto the report writing palette.

The Semantic Layers provides:

- A data access layer allowing programmers to connect to databases and define how data should be queried using tables, views or stored procedures. This requires a knowledge of the underlying database structures.
- Data modeling takes place in which the joins between these data objects are created, ensuring that business analysts do not need to understand a database design to query data from various tables. The physical database structure is translated into logical business terms.
- Business aggregations and calculations that are commonly used in reports are defined directly in this metadata model for reuse by all.
- Security is implemented to ensure that the user only has access to their information.

Two of the popular enterprise business intelligence platforms include IBM Cognos® and SAP Business Objects®. Each of these have their own Semantic layer:

IBM Cognos® Framework Manager is a metadata modeling tool that drives query generation for IBM Cognos software. A model is a collection of metadata that includes physical information and business information for one or more data sources. IBM Cognos software enables performance management on normalized and denormalized relational data sources and a variety of OLAP data sources.

A Business Objects Universe is the Semantic Layer that resides between an organization's database and the end user. But more importantly, it is a business representation of a data warehouse or transactional database. It allows the user to interact with their data without having to know the complexities of their database or where the data is stored. The universe is created using familiar business terminology to describe the business environment and allows the user to retrieve exactly the data that interests them.

Advanced Analytic Solutions Require an Evolved Semantic Layer

The challenges solved by the Semantic Layer are returning because legacy business intelligence systems are no longer the only platform providing access to the enterprise data. Enterprise reporting and ad-hoc query building provided by the BI platform remains important and focused on management and operational reporting, however



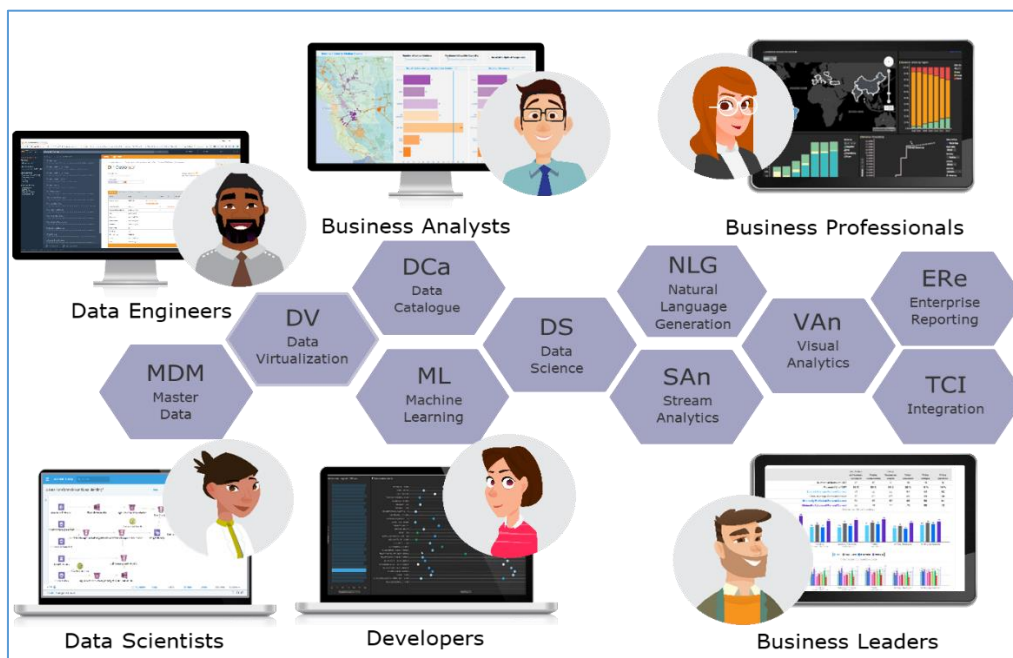


leading organizations have undergone a digital transformation in which data is incorporated into all aspects of business operations.

The business analyst now has a choice of technologies used to explore data and to produce reports and dashboards and they are finding ungoverned ways to access data from the existing system and feed them into the new technologies to better explore and use the data. A common scenario is the analyst that runs a report from an operational system, stores this as an export file such as a csv file, and then imports this data to the dashboard or data discovery tool of choice. Calculations are done in the visualization tool and no longer centralized and ultimately a new dashboard is then shared with others introducing security risks, a lack of data governance and enterprise approved interpretations are left to the analyst to define.

The process of moving all data into a data warehouse and selecting a single technology to report on this data is no longer efficient.

Advanced analytic solutions include visual discovery and dashboards, natural language generation, streaming analytics, and data science (artificial intelligence, machine learning, and predictive analytics). Data has changed, and we can no longer rely on a single relational database to store all the data we need. Data is collected in many formats from all across the enterprise. Streaming data from equipment or IOT devices needs to be accessible and processed in real time. The Semantic Layer needs to cater to all data regardless of source, volume, or speed.



The data warehouse and business intelligence semantic layer require a new approach.





Data as a Service

Above we discussed how the Semantic layer, inherent to business intelligence platforms, was used to provide easy to understand data to business users, and how this layer incorporated business rules and provided the organization with a layer of data governance. Today a single technology for reporting on data is no longer sufficient. Organizations need to establish a data fabric that delivers easy to find data across the enterprise including business analysts, end users, data scientists, and others.

By incorporating all aspects of the traditional semantic layer, and extending this with capabilities required to provide the corner stone of an enterprise data fabric, data virtualization provides immediate access to all data, streaming and static, structured and unstructured. Data virtualization includes the evolved Semantic Layer ensuring that users are empowered. They can easily search for and select from a self-service directory of virtualized business data and then use their favorite analytics tools to obtain results. Data virtualization incorporates the Semantic layer in the architecture providing a modern data layer that provides a single point of access to IT curated data in a governed and secure manner.

The following table shows a high level comparison between the business intelligence platform and data virtualization supporting all analytics:

Business Intelligence	Data Virtualization
<ol style="list-style-type: none"> 1. Data connectivity <ol style="list-style-type: none"> a. Relational, OLAP b. Data warehouse 2. Data access plan <ol style="list-style-type: none"> a. Joins b. Typically single DB 3. Business rules 4. Security 5. Presentation layer 6. BI reporting and query building <p>BI Platform data only</p>	<ol style="list-style-type: none"> 1. Data connectivity <ol style="list-style-type: none"> a. Relational, OLAP, API, Hadoop, No SQL, graph, streaming, adapters to extend b. Data warehouse, data lake, structured and unstructured, streaming. 2. Data access plan <ol style="list-style-type: none"> a. Joins b. Integrated data sources c. In-memory cache d. Transformation 3. Business rules 4. Security 5. Presentation layer 6. Data catalog 7. Governance and auditing 8. Advanced query engine 9. BI, data visualization and exploration, data science, streaming analytics, natural language generation, application integration,... <p>Data as a service for use by all analytic tools</p>

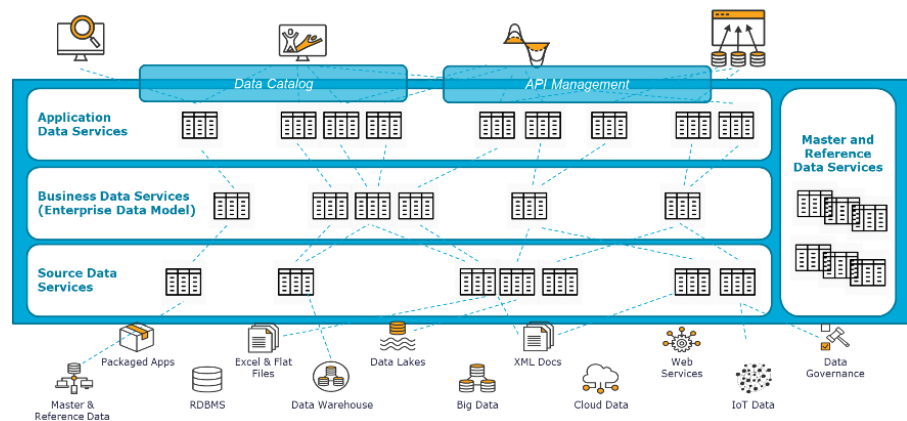




The volume and speed of collecting data is increasing, and the option of adding this data to a warehouse through a lengthy development cycle is no longer acceptable. New data may also have a shorter shelf life and not belong in a warehouse. Leveraging a data virtualization platform allows a central data authority to deliver short term and prototype new data sources quickly and cost effectively while maintaining data governance standards.

TIBCO® Data Virtualization – Delivering Data as a Service

As a modern data layer, the TIBCO® Data Virtualization system addresses the evolving needs of companies with maturing architectures. Remove bottlenecks and enable consistency and reuse by providing all data, on demand, in a single logical layer that is governed, secure, and serves a diverse community of users.



Data Sources & Discovery	Data Views	High Performance Run Time	Caching	Security	Developer Studio	Business User Data Catalog
<p>Access to 200+ data sources including applications, databases, big data, files, web service, and cloud</p> <p>Data and relationship discovery with profiling</p>	<p>Create business-friendly data views from multiple data sources</p> <p>Supports syntactic and semantic transformations plus enrichment</p>	<p>Query acceleration via cost and rules-based optimizers and massively parallel processing (MPP) engine</p> <p>Clustering to meet reliability, availability, and scalability SLAs</p>	<p>Support for 15+ cache targets out-of-the box</p> <p>Flexible caching configurations</p> <p>Optional persistence for (slow) big data sources</p>	<p>Policy driven, fine grained multi level security--down to cell level</p> <p>Flexible authentication, authorization, encryption, and data masking</p>	<p>Advanced studio supports the entire development lifecycle, agile and DataOps</p> <p>Native support for: SQL, SQL Script, Java, XQuery, and XSLT</p>	<p>Support business user self-service that includes both virtualized and non-virtualized sources</p> <p>Complete lineage and where-used</p>

The functionality of a Semantic layer is now incorporated into the data fabric and the business user data catalog provides a fully searchable catalog of data with information about that data such as the lineage of where the data originated.

Conclusion

Data virtualization now forms the foundation of the new data fabric and brings with it the much needed Semantic Layer. Just as importantly, data virtualization extends capabilities far beyond the Semantic Layer by providing an engine to source, integrate, optimize, and provision governed data to all data consumers.

Organizations that have relied on a business intelligence platform, and are transforming their business through the use of data, are faced with the challenge of supporting and embracing advanced analytic solutions that will require





secure access to governed data from existing and new data sources. New data users including business users, data scientists, and developers will rely on efficient access to data, sometimes in real-time. Operational systems will be redesigned to incorporate data in the workflow and will require integration with the data platform in support of automated real-time decision making and processing.





About Us

About the Author Sherlock Holmes

Sherlock Holmes is the CEO of Genware Computer Systems where he leads the team in delivering advanced analytic solutions that allow customers to leverage information as an asset. Sherlock is a frequent speaker at events that focus on Business Transformation and provides strategic consulting to organizations requiring leadership in transformation through data. Genware Computer Systems is headquartered in New Jersey, USA with offices in Uruguay and South Africa.

Sherlock is Chief Operating Officer and co-founder of Data Shack LTD. based in the United Kingdom where the team focuses on Data Science and Advanced analytics. Sherlock is also co-founder of The Genware Shack and NLG Africa in South Africa.

Sherlock started his career in technology in 1986 as a software developer and went on to form Genware Computer Systems, a New Jersey based corporation in 1999. Serving on various boards and filling roles on partner advisory boards for companies including TIBCO and IBM. Sherlock brings a wealth of experience implementing solutions that automate and optimize business processes.

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Websites featuring Sherlock include:

www.Genware.com

www.NLGAfrica.com

www.data-shack.co.uk

Youtube Channel: https://www.youtube.com/channel/UC3QSrOG-sHU0dNy3VI_J0FA

Genware Computer Systems Inc.

A TIBCO Elite partner providing consulting, development, and teaching services to companies implementing Advanced Analytic solutions.

We commit to provide successful end-to-end service, Advanced Analytics solutions, training and audit capabilities to information hungry companies. We are adaptive to your needs and we will provide you with the tools and services required, and help you to develop and implement solutions that enable you to make better business decisions.

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TIBCO

TIBCO Software unlocks the potential of real-time data for making faster, smarter decisions. Our Connected Intelligence Platform seamlessly connects any application or data source; intelligently unifies data for greater access, trust, and control; and confidently predicts outcomes in real-time and at scale. Learn how solutions to our customers' most critical business challenges are made possible by TIBCO at www.tibco.com.

The Data Shack LTD

The Data Shack LTD is a Genware joint venture that brings extensive Data Science experience to our customers. The Data Shack specializes in the field of Data Science and provides a world class training curriculum presented by Data Scientists that are recognized in the industry for delivering advanced Data Science and analytic solutions that yield business results. More info at www.data-shack.co.uk

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