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IBM Power Systems Bits: Understanding IBM Patterns for Cognitive Systems

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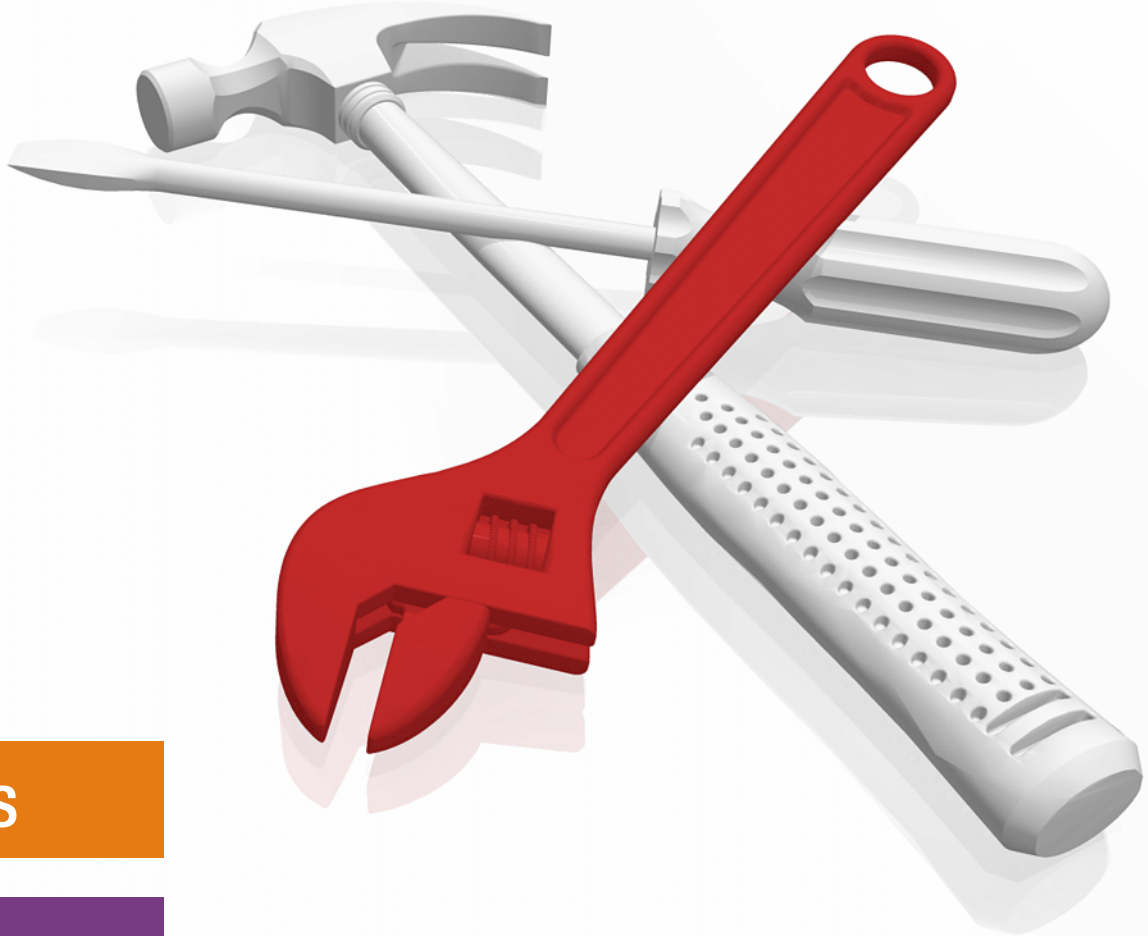

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IBM Power Systems Bits: Understanding IBM Patterns for Cognitive Systems

This IBM® Redpaper™ publication addresses IBM Patterns for Cognitive Systems topics to anyone developing, implementing, and using Cognitive Solutions on IBM Power Systems™ servers. Moreover, this publication provides documentation to transfer the knowledge to the sales and technical teams.

This publication describes IBM Patterns for Cognitive Systems. Think of a *pattern* as a use case for a specific scenario, such as event-based real-time marketing for real-time analytics, anti-money laundering, and addressing data oceans by reducing the cost of Hadoop. These examples are just a few of the cognitive patterns that are now available. Patterns identify and address challenges for cognitive infrastructures. These entry points then help you understand where you are on the cognitive journey and enables IBM to demonstrate the set of solutions capabilities for each lifecycle stage.

This book targets technical readers, including IT specialist, systems architects, data scientists, developers, and anyone looking for a guide about how to unleash the cognitive capabilities of IBM Power Systems by using patterns.

This paper contains the following topics:

- Introduction to IBM Patterns for Cognitive Systems
- Understanding what a cognitive system solution should achieve
- Architectural components of the solution
- How to build your infrastructure and your application API
- What to do with your data
- Putting your solution to work
- Summary and conclusion

Introduction to IBM Patterns for Cognitive Systems

IBM Patterns for Cognitive Systems are solutions that address a combination of customers' challenges and challenges by using an IBM solutions portfolio to deliver a viable solution to help solve the problem. IBM Patterns for Cognitive Systems helps to classify (predict) with Some examples include using a history for different customers, ratings on products and machine learning and deep learning (MLDL) techniques to make targeted recommendations that ensure better product purchase rates, click rates, customer retention rates, better customer experiences, and so on.

IBM Patterns for Cognitive Systems

This section describes each of the different IBM Patterns for Cognitive Systems that are available.

Machine learning and deep learning patterns

MLDL patterns help to create an environment for existing premises data by looking for insight in to the information. MLDL patterns help to achieve the following goals:

- Anti-money laundering
- Data science as a service (self service analytics for in-house customers)
- Visual inspection of transmission towers by using deep learning (DL)
- Large banks credit risk analysis

Anti-money laundering

Individuals and entities can use shell companies for legitimate purposes, but there are concerns regarding the identification of shell companies laundering money for criminal purposes, such as sanctions avoidance, tax evasion, and terrorist financing. A machine learning (ML)-based solution provides a potentially competitive method to identify and classify such illegal and criminal activities. It also helps organizations meet compliance and regulatory requirements in a pro-active manner.

Data science as a service (self service analytics for in-house customers)

Obtaining relevant business insights from data (in-house and external plus structured and unstructured) is fast proving to be a decisive competitive advantage, enabling companies to create markets and business models. Multiple lines of business (LoBs) analytics teams needing self-services drive the need for a high-performance, resilient, multi-tenanted, and efficient *Data Science Playground* to deliver on the goals for each of their business units.

Visual inspection of transmission towers by using deep learning

Businesses are moving to regimes where even low downtimes because of infrastructure failures are a severe competitive disadvantage. In addition, operating expenses must be minimized and assets must be used to their maximum. Optimization strategies that are overly manual cannot deliver these requirements, so cognitive and artificial intelligence (AI)-based solutions provide a path forward in such scenarios.

Large banks credit risk analysis

The ability to classify risk and fraudulent transactions by using structured and unstructured data that is present within the organization provides the ability to both hedge against risk and fraud effectively and use the capital that is saved more productively. To make these classifications as accurate as possible within a near real-time window, companies must take advantage of state-of-the-art accelerated-computing infrastructures running cognitive and AI frameworks to build their MLDL applications so that they can derive insights from their in-house and external data sources.

Data ocean patterns

Data ocean patterns help to reduce complexity, manage data growth, and unify data lakes. In addition, data ocean patterns help to achieve the following goals:

- Reduce the cost of a Hadoop infrastructure
- Back up, restore, and archive big data
- Eliminate data infrastructure silos and manage the information lifecycle
- Meet performance requirements for technical workloads
- Augment data warehouses with Hadoop
- Set up database as a service for model data platform development

Reducing the cost of a Hadoop infrastructure

This pattern helps to reduce the cost of the Hadoop infrastructure by using IBM Spectrum™ Scale and IBM Elastic Storage™ Server technologies to replace and augment node-based storage in a Hadoop cluster. By using the enterprise qualities of IBM Spectrum Scale™ and IBM Elastic Storage Server, data storage infrastructure can be reduced by as much as two thirds while providing improved access and manageability of data.

Many customers began their use of Hadoop as a specialty tool for data scientists. The common configuration is to create a cluster of storage-rich servers with direct-attached disks. Hadoop File System (HDFS) typically creates copies of files on three different servers within the cluster, which provides simple protection against loss of access or loss of data, and enables some choice in where work is scheduled. Despite the impact of three complete copies, the low cost of direct-attached disk compares favorably to that of traditional SAN storage. Beyond the protection, multiple copies offer protection from device or path failure. Hadoop distributions do not offer storage services comparable with the ones that are common in enterprise storage, namely data backup, archive, disaster protection, and management of data within performance and cost hierarchies.

Although the cost of storage devices in the Hadoop model is low, the opportunity still exists to provide protection through a software RAID structure that is applied to similarly low-cost hardware. For large data collections, there are considerable savings in using RAID 6 with 1.7X redundant capacity versus 3X. IBM Spectrum Scale with IBM Elastic Storage Server provides software RAID 6 protection that is applied to the file storage that is shared across the entire cluster. Workload placement is more flexible than in the Hadoop model because all compute nodes can have access to all files. Furthermore, as the cluster grows in size, the compute and storage resources can be scaled independently; if the compute capacity is sufficient but more storage capacity is needed, more storage can be added without paying for more compute capacity.

Performance at a lower cost is not the only benefit that is provided by IBM Spectrum Scale. Through multiple storage pools and policy-based management, IBM Spectrum Scale can provide a backup and archive function, remote replication and disaster recovery, and export of data to IBM Cloud Object Storage. With these capabilities that are provided on the shared storage, the big data environment moves beyond a tool for data scientists and becomes a part of the mission-critical enterprise data collection.

Backing up, restoring, and archiving big data

With the massive amounts of data that comes with big data implementations, it is often difficult to back up business-critical sets of data. By using the IBM Spectrum family of products (IBM Spectrum Scale, IBM Spectrum Archive™, and IBM Spectrum Protect™) and low-cost and high-capacity storage capabilities (IBM Cloud Object Storage, IBM Elastic Storage Server, and IBM Tape), customers can establish economic and performant backup, restore, and archive capabilities for their big data environments.

Many customers began their use of Hadoop as a specialty tool for data scientists. In this role, there is not a full collection of storage services for data protection. Even where clients provided for backup, it is often a collection of functions that is unique to a Hadoop cluster. Most users do not provide a long-term archive of Hadoop data, and policy-based movement of data from HDFS into protected or archival storage is rare. Despite this situation, big data is growing in size and enterprise value, and requires protection and management commensurate to its value.

Through support of multiple storage pools and policy-based management, IBM Spectrum Scale can provide various data protection functions. IBM Spectrum Scale can embed a IBM Spectrum Protect backup client, or simply create file system snapshots that are copied to low-cost media. IBM Spectrum Scale can replicate data to remote IBM Spectrum Scale instances through the Advanced File Management (AFM) facility, and can export data to IBM Cloud Object Storage through the Transparent Cloud Tiering feature. With these capabilities that are provided on shared storage, the big data environment moves beyond a tool for data scientists and becomes a part of the mission-critical enterprise data collection.

Figure 1 shows how IBM Spectrum Scale redefines unified storage.

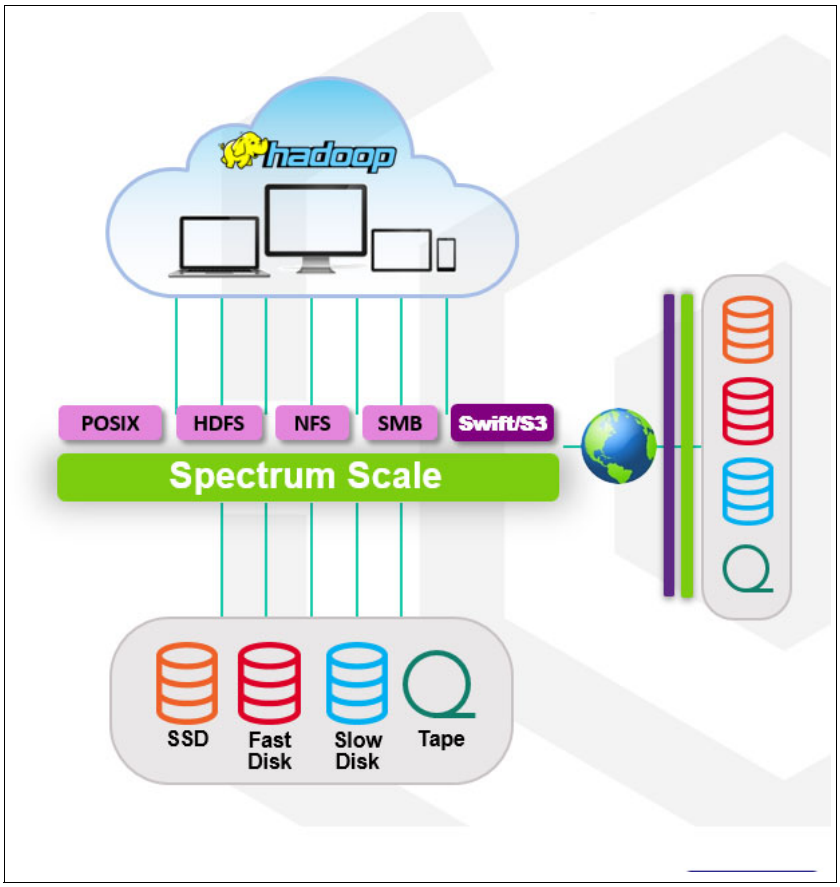

Figure 1 IBM Spectrum Scale redefining unified storage

In addition to data protection, IBM Spectrum Scale can lower the cost of protected data capacity, as described in “Reducing the cost of a Hadoop infrastructure” on page 3.

Using IBM Spectrum Scale provides more than cost savings through RAID. IBM Spectrum Scale supports multiple storage pools, which can be configured with high-performance flash storage, enterprise or low-cost hard disk drives (HDDs), or tape. By moving inactive data to slower, cheaper storage, the facility can deliver high storage performance at lower cost than a cluster that is configured entirely with high-performance storage.

Eliminating data infrastructure silos and managing the information lifecycle

In the fast-paced environment that customers are faced with, information storage often gets optimized to a single application or departmental requirement, which leads to information silos in an organization and creates significant difficulties in synchronizing and sharing this information across the enterprise. These silos can be spread across many different storage and file system technologies, further complicating this unifying process. Using IBM Spectrum Scale and IBM Elastic Storage Server, a customer can logically or physically combine these silos into a unified, more manageable, and sharable storage environment.

Many customers began their use of Hadoop as a specialty tool for data scientists. In this role, there is not a full collection of storage services for data protection, or for movement from application to application. Even where applications do not share data, there is considerable value in providing a common method for data ingest and curation, capacity and performance management, backup and data protection, and archival storage. Each big data application can solve these problems in a unique way, which can result in duplication of function and multiply the operational expense load. Big data is growing in size and enterprise value, and requires protection and management that is commensurate to its value.

Meeting performance requirements for technical workloads

As customer's requirements for instantaneous analysis of information grows with high-performance computing (HPC), high-performance data analysis (HPDA), and cognitive workloads, the high-performance access of data becomes critical. Using IBM Elastic Storage Server with IBM Spectrum Scale Native RAID provides high data reliability, high data integrity, and consistent performance.

Augmenting data warehouses with Hadoop

This cognitive pattern uses Hadoop to help customers optimize and improve the cost-effectiveness of their data warehouses. Traditional, proprietary data warehouse systems are expensive to purchase, upgrade, and maintain, which makes them a highly desirable area for cost reduction. These systems also have difficulty in supporting unstructured data. However, they tend to be integrated into customer business operations, which makes them difficult to eliminate. Customers often enrich the structured data in a data warehouse with unstructured data in a Hadoop environment to provide a complete data environment.

Database as a Service for model data platform development

This cognitive pattern provides a flexible, easy to deploy development environment for modern data platform-based applications.

Real-time analytics patterns

Real-time analytics means different things to different customers depending on the business problem they are trying to address. The decision response time can be measured in seconds, minutes, or hours depending on the business requirements. Some examples of the different situations and the resulting required decision response times are given. You must have some insight into your customer's response time requirements.

Real-time analytics patterns help to achieve the following goals:

- Event-based real-time marketing
- Healthcare neonatal monitoring
- Logistics real-time route optimization
- Smart grid preventive maintenance

Event-based real-time marketing

This solution enables a customer to react to, and in some cases predict shifts in customer behavior, in a more timely fashion, which then allows their supply chain, marketing, call centers, and others to adjust, ideally before their competition. Instead of waiting for the quarterly reports, clients can analyze the various sources of information, and when the information arrives, make decisions in a more timely fashion.

This particular use case was derived from a telecommunications customer. They had a treasure trove of information coming into their enterprise about their customers: call data records, location information, their own network diagnostic information, and social media feeds. However, they were challenged to turn this information into actionable insight in a timely manner because the sheer velocity and volume of the information was challenging.

Working with IBM, the team devised a solution by using various IBM and open source components to process and filter several incoming streams of information, correlating events, and looking for certain combinations of events that might indicate that some adjustment to the existing business process might be appropriate. The response to this detection of a significant event can be as simple as sending an email to senior management or it can trigger the running of various business rules that can automatically adjust some aspect of the business operations.

This client had a large historical data store that they were anxious to use to take advantage of predictive behavior models. Again, the goal was to get ahead of shifts in their customer's behavior with the objective of providing appropriate goods and services at the appropriate time while providing a better customer experience.

For the technology, IBM InfoSphere® Streams was used to analyze the incoming data streams along with a Redis database that provided an in-memory data cache for some of the stream operations. The IBM SPSS® Analytic tools were used to both develop and then run a predictive model that used a historical database to help develop the model that was then used in the predictive analysis on the new incoming data streams. Finally, an IBM BigInsights® Hadoop based repository was used to land the incoming data to be used by the data visualization tools, IBM Cognos® BI, and the Rave Visualization software.

Healthcare neonatal monitoring

This is an interesting application of real-time analytics. The business problem was the need to monitor multiple EKG readouts that are attached to infants. Compounding the challenge was that it takes extensive training to correctly interpret an EKG to detect the conditions leading up to a seizure, especially in real time.

A working solution was developed with the EKG SMEs and clinical personnel, essentially codifying the various parameters and indicators that a clinician can look for when reading an EKG and looking for the tell-tale signs of the impending seizure. The team was able to encode this experience into a set of stream processing algorithms that can now be used to monitor the EKG data. The Streams algorithms analyze the incoming streams, and reference historical information as part of the determination. After this task is done, the algorithm and the necessary hardware are duplicated to enable the clinic to monitor many patients.

This solution did not incorporate a landing zone for the streaming data. The focus was on monitoring and alerting the staff when the conditions start to materialize that can seem to indicate that a seizure had a high probability of occurring. A key point here is that this solution augments the existing staff, does not replace them, and it enables them to monitor more patients and respond in a more timely fashion if a patient begins to exhibit signs of an impending crisis.

The technology that was used in this use case is IBM InfoSphere Streams with encoded SME into as set of stream-based analytics to not replace but augment the staff's ability to monitor EKGs.

Logistics real-time route optimization

This use case variant of the real-time analytics pattern focuses on a GPU-accelerated database that is named Kinetica. Kinetica is an ODBC-compatible database that supports ANSI SQL-92 compliant syntax.

What makes Kinetica different? It uses GPUs as the worker nodes in a distributed cluster environment. GPUs are designed around thousands of small, efficient cores that are suited to performing repeated similar instructions in parallel, which also makes them suited to the compute-intensive workloads that are required of large data sets.

Kinetica harnesses the power of GPUs for unprecedented performance to import, explore, and visualize data in motion and at rest. The GPU-parallelized processing architecture enables near-linear scalability and reduces analytical processing times for multi-billion row data sets by more than 100x compared to leading in-memory and analytical databases.

The business problem to be addressed here was to do a better job of routing a large vehicle distribution fleet specifically by taking into account real-time traffic reports (accidents, road closures, construction delays, and so on). In addition to traffic information, the client also wanted to factor in real-time weather factors.

Given the many vehicles, the amount of real-time data (traffic, vehicle locations, and others), cargo information that is combined with weather information, the need to do advanced geo-spatial calculations, and do it all in a timely manner to provide a real-time interactive and responsive visualization. You can imagine this requires some significant performance requirements of the primary and core database engine.

The Kinetica clustered, in-memory, and GPU-based architecture addresses all these requirements.

Smart grid preventive maintenance

This use case variant on the analyzing data in real-time pattern focuses on another technology that is available to help clients process large data streams.

Time series data is a sequence of data points that are measured typically at successive times that are spaced at uniform time intervals. Depending on the frequency of data acquisition through sensors and other data retrieval mechanisms, the volume of time stamped data can be massive; when stored in tall-thin relational tables, this data can require large amounts of storage space. Managing and retrieving such a huge volume of data can require complex querying, resulting in high disk I/O and reduction in performance.

The IBM Informix® TimeSeries data type alleviates the classical relational time series implementation issues of storage, performance, and complex querying. The Informix TimeSeries data type provides a native object-relational data implementation that requires less storage while reducing I/O and increasing performance.

This managing of large amounts of real-time data was at the core of the business problem on which this use case is based. The client was collecting the data from many smart meters, and their traditional database engines and data storage strategies were overwhelmed. Compounding the storage management issues was the client's inability to extract actionable information from their real-time data streams. The client knew that they had the data that they needed to better manage their network and to become more proactive rather than constantly be in react mode and ultimately provide a better customer experience.

After the solution was in place, the customer was able to gain insight in real time into pending equipment failures, outages, and others. The net result was improved client customer experience.

Hybrid cloud patterns

These patterns provide a flexible, easy to deploy development environment for modern data platform-based applications.

Understanding what a cognitive system solution should achieve

A cognitive system solution must help achieve a goal or goals for the customers. The solution is designed to consider the challenges that are presented by you to prototype a solution to support your business initiatives and goals.

You must gain an understanding of what cognitive technology can do, and specifically how it can help your business. You must envision the possibilities and define the possible business outcomes.

No one starts down this path expressly to adopt cognitive technology; the whole point is to improve your organization. Adopting cognitive technology must align to your business priorities. Early adopters identify a problem, then build a case for how solving that problem supports specific outcomes, such as saving money, gaining customers, or increasing revenue.

Good planning results in the selection of a specific and strategic use case. However, one temptation is to pursue cognitive technology for the technology's sake. There are so many things you can do with cognitive technology, and you get excited. In the end, you must focus on what impacts your bottom line.

How IBM Patterns for Cognitive Systems relates or connects with IBM PowerAI Deep Learning, IBM Cloud, and IBM Cognitive solutions

Today, organizations are using DL to develop powerful new analytic capabilities spanning multiple usage patterns, including computer vision and object detection, improved human computer interaction through natural language processing, and sophisticated anomaly detection capabilities. At the heart of any use case that is associated with DL are sophisticated pattern recognition and classification capabilities that serve as the birthplace for revolutionary applications and insights of the future. However, in situations where organizations try to expand their area for DL or to start working on the development of DL, there are enormous difficulties, especially the performance issues that are caused by hardware limitations, and time-consuming processes in each framework, such as setup, tuning, and upgrades.

Positioning guide

The IT industry is seeing a strong shift toward cloud deployment models, and greater insight through advanced analytics and cognitive computing. These areas are being driven largely by collaboration and partnerships, particularly in open source projects, including the Linux operating system. In response to these trends, the scale-out line of IBM Power Systems servers is growing as more partners join the OpenPOWER Foundation. But, that leads many people to ask: What is the best server for my workload, and what choices do I have?

There are a few ways to find these answers. One way is to read the technical documentation that is available that is available from the IBM Redbooks organization, which provides a deep technical understanding of specific server models with a strong focus on workloads and use cases. IBM Redbooks® technical documentation ensures a clear understanding of different application areas, along with examples. The different server models are described, including relevant technical features, capabilities, and more components that can be incorporated in the overall solution.

Another way is to start a conversation with IBM Lab Services to discuss your project goals, and work with this team to find the best options that available for your organization.

Architectural components of the solution

After gathering all the requirement and discussing them with IBM, you can define an architecture that takes into account meshing many components to deliver the required solution. The proposed solution can be similar to one already created because a particular pattern is considered and applicable to your requirements. Depending on the workload, data requirements, and whether the solution will be on-premises, cloud, or hybrid cloud, a solution can be designed that addresses your requirements.

The next section presents a particular case scenario to illustrate an architectural design putting together many solutions to come up with an architecture to solve your business requirements.

Hardware and software integration

This section shows a pattern solution for data-intensive cognitive computing with IBM Power Systems clusters, IBM Spectrum Scale, and IBM Elastic Storage Servers. Figure 2 shows a solution with IBM Elastic Storage Server that removes data-related bottlenecks, simplifies data management at scale, empowers global collaboration, manages the full data lifecycle cost effectively, lowers capital expenditures and operating expenditures, and uniquely ensures end-to-end data availability, reliability, and integrity for the most demanding data-intensive workflows.

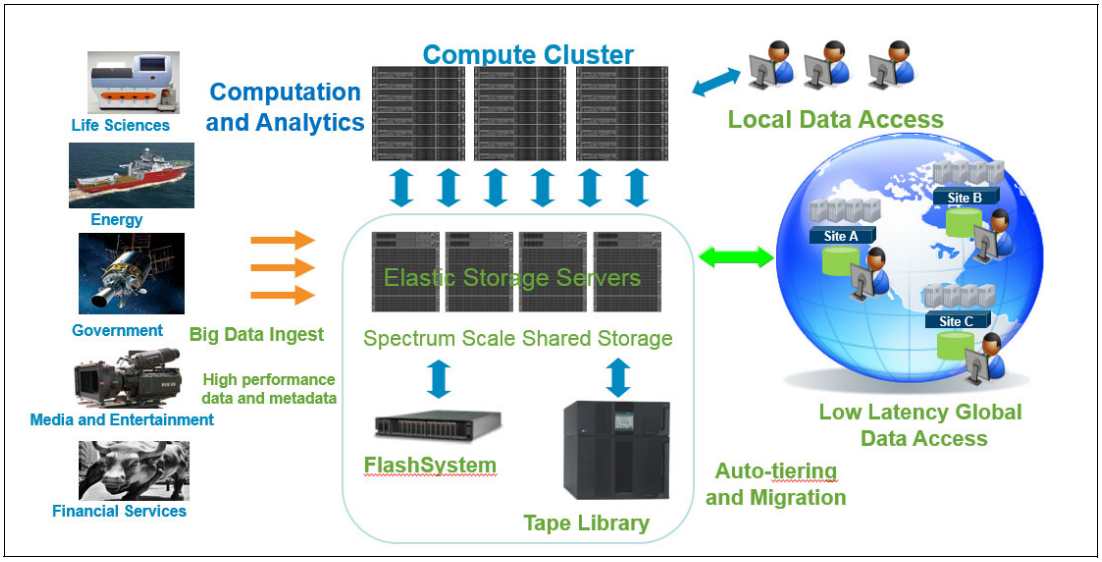

Figure 2 Data-intensive workload with IBM Power Systems clusters, IBM Spectrum Scale, and IBM Elastic Storage Server

Reference architecture

Depending on your requirements, a reference architecture can be designed that meets your goals, and provides you with a solution that is going to help your organization.

How to build your infrastructure and your application API

You can build a solution to include your already built infrastructure. You can also scale your solution by adding more components, including servers, storage, high availability, and others. You can keep your solution on-premises, in a cloud, or build a hybrid cloud solution. Your corporate users must connect to this solution to mine and gain valuable insights from the data that is already in the infrastructure to make business decisions. Accessibility is a key component of the solution, and creating an open solution that users can access through an API is critical to the success of the solution.

What to do with your data

Although it is possible to implement a cognitive system without understanding your data, the result might not be the most accurate or efficient one. The first critical task is to understand and agree upon the actual business needs and requirements.

With the business requirements and expectations discussed and agreed upon, the next phase focuses on the data itself. There must be a clear understanding across the involved teams to appreciate the data that will be used. People must have agreed expectations of what information the data provides and what it does not.

Local (on-premises) or cloud

This is an important point for dialogue because where the data resides is a significant challenge for the solution. There are many ways to read the data from the data lakes into the computing cluster, on-premises, or in the cloud such that the data can be analyzed.

Why keep your solution or part of it on-premises versus the cloud

To provide feedback about on-premises versus the cloud, a few definitions are helpful.

The on-premises hardware and software, sometimes abbreviated as *on-prem*, is installed and runs on computers on the premises (in the building) of your organization by using software and hardware, rather than at a remote facility, such as a server farm or cloud. Often, the terminology that is used is an *on-premises private cloud*. This format, also known as an internal cloud, is hosted within an organization's own data center. It provides a more standardized process and protection, but is often limited in size and scalability. There are options where you have an on-premises private cloud, and to scale it, you add a portion of the cluster as part of the cloud, that is, you use a *hybrid cloud*.

You can implement your solution in the cloud where the hardware and software are installed and runs on computers at a remote facility, such as a server farm or cloud.

If you are deciding whether to use on-premises versus a cloud solution, each option has its positives and negatives, which fall into categories of cost, security, deployment and scalability, and user access. Ultimately, you must decide depending on the factors that are described whether on-premises versus the cloud works for your organization.

Putting your solution to work

Customers looking for solutions to their data-intensive workflows challenges can start a conversation about their business requirements and request a solution that uses IBM Spectrum Scale, IBM Elastic Storage Server, and IBM Power Systems servers.

As part of the solution to help with the challenges of data silos, IBM Elastic Storage with IBM Spectrum Scale helps to remove data-related bottlenecks, simplifies data management at scale, empowers global collaboration, manages the full data lifecycle cost-effectively, which lowers capital expenses and operating expenses, and uniquely ensures end-to-end data availability, reliability, and integrity for the world's most demanding data-intensive workflows.

Data lake options

For more information about data lake options, see "Eliminating data infrastructure silos and managing the information lifecycle" on page 5.

Business problem and solution scenario

This business problem is one of the most prolific and currently one of the most difficult business challenges to solve. Customers are looking into ways to access and unify their data that is distributed in independent silos and use it to discover new business opportunities. These opportunities can be to mine the data looking for computing usage gaps, customer-buying patterns, fraud detection, risk reporting analysis, application development, and others.

Customers also need a solution to analyze their data, including a component that can learn from their data and continuously provide information to different groups within the company who are looking for information to make better business decisions, implement new applications, create models, prevent proactively fraud, and others.

Figure 3 show a sample implementation of a solution that delivers information to different groups to help them with their respective missions within the company.

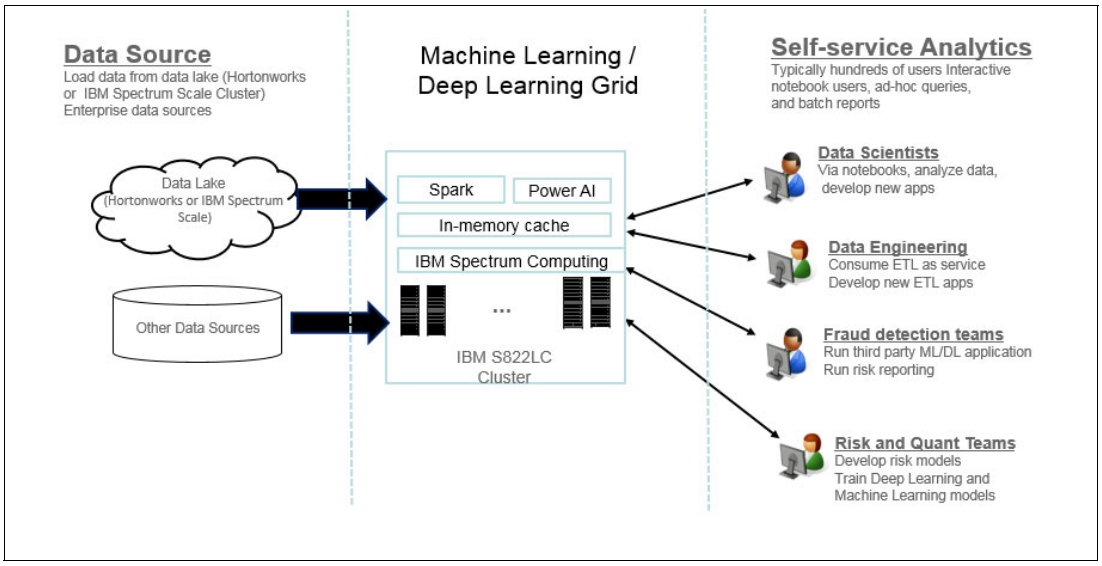

Figure 3 Self-service analytic solution unifying multiple data lakes from different silos

This is one example of how IBM Patterns for Cognitive Systems can provide a solution to help different groups across a corporation. The primary goal is to extract the data from large disparate silos and bring it into a solution that provides the necessary output for daily business decisions.

Summary and conclusion

IBM can provide you with end-to-end solutions that can help you accomplish your business goals. All that you need to do to start is to open a conversation with IBM to understand your business goals, analyze where you are today, and where you want to be tomorrow. IBM can then design a solution that can incorporate similar pattern characteristics, and deliver it to help you with your business goals.

In today's business environments, working with the data dynamically or in real time is quite a challenge because of many constraints, including disparate locations of the data, size of the data, computing power, and others. There are already solutions that are available for real-time analysis where the IBM Systems portfolio provides the capabilities.

For more information about real-time Analytics Solutions, see the following resources:

- IBM Power Systems Considerations for IBM Streams:

  https://developer.ibm.com/streamsdev/docs/ibm-power-systems-considerations-infosphere-streams/

- IBM Knowledge Center: IBM Streams:

  https://www.ibm.com/support/knowledgecenter/SSCRJU_4.2.0/com.ibm.streams.welcome.doc/doc/kc-homepage.html

- Gartner – 6 Best Practices for Real-Time Analytics:

  http://www.gartner.com/smarterwithgartner/six-best-practices-for-real-time-analytics/
- WindyGrid - Intelligent Operations Platform built on MongoDB:

  https://www.mongodb.com/customers/city-of-chicago

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Thanks to the following people for their contributions to this project:

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REDP-5462-00

ISBN 0738456675

Printed in U.S.A.