HPE Reference Configuration for Big-Data-as-a-Service with BlueData EPIC software

Accelerating Big Data infrastructure deployments on HPE Elastic Platform for Big Data Analytics (EPA)

Contents

Executive summary

As enterprises strive to achieve value from Big Data insights, many now seek more agile and efficient systems for their Big Data analytics. Some of the business drivers are to improve customer retention, increase operational efficiencies, influence product development and quality, and to gain a competitive advantage.

The concept of Big-Data-as-a-Service (BDaaS) has emerged as an option in the past several years, as public cloud providers have introduced Hadoop-as-a-Service and Spark-as-a-Service offerings running on cloud-based infrastructure. As in the Infrastructure-as-a-Service (IaaS) market, the cloud operating model of self-service and elasticity is compelling to many organizations deploying Big Data applications. However, until now, the benefits of BDaaS weren't available for on-premises deployments of Hadoop, Spark, and other Big Data workloads.

This white paper describes a new solution for Big-Data-as-a-Service combining the BlueData EPIC (Elastic Private Instant Clusters) software platform with the HPE Elastic Platform for Big Data Analytics (EPA). BlueData is transforming how enterprises deploy their Big Data applications and infrastructure. The BlueData EPIC software platform leverages Docker container technology and proprietary innovations to make it easier, faster, and more cost-effective for enterprises of all sizes to leverage Big Data – enabling Big-Data-as-a-Service either on-premises or in the cloud. With this solution customers can speed up deployment times and lower the TCO of Apache Hadoop and Apache Spark workloads compared to a traditional deployment model of dedicated and isolated workload clusters.

With BlueData, enterprise customers can spin up virtual Hadoop or Spark clusters within minutes, providing their data scientists with on-demand access to the applications, data and infrastructure they need. They can minimize the need to copy data by separating compute and storage – enabling Big Data analysis using a shared storage infrastructure in a multi-tenant environment.

The HPE Elastic Platform for Big Data Analytics is designed as a modular infrastructure foundation to address the need for a scalable multi-tenant platform, by enabling independent scaling of compute and storage through infrastructure building blocks that are optimized for density and workloads. When deployed with the HPE Elastic Platform for Big Data Analytics, BlueData customers benefit from a secure, scalable, and high performance architecture for Big-Data-as-a-Service. They can dramatically reduce deployment complexity while improving business agility by providing elastic self-service infrastructure for Hadoop, Spark, and other Big Data workloads. The time-to-value for Big Data deployments can be reduced from months to days, while reducing overall costs compared to traditional Big Data deployments.

Target audience: This paper is intended for decision makers, system and solution architects, Hadoop administrators, Spark administrators, system administrators and experienced users that are interested in simplifying the deployment of their Big Data infrastructure and applications. Basic knowledge of Apache Hadoop and Apache Spark is recommended.

Document purpose: This document describes the deployment of the BlueData EPIC software platform on HPE infrastructure. In addition to outlining the opportunity and key solution components, this white paper also provides guidelines for configuring and deploying this combined solution.

Introduction

On-premises Big Data infrastructure is evolving from the traditional model of a single dedicated bare-metal cluster for Hadoop with direct-attached storage, serving many different users and use cases. Analytics and processing engines have evolved from only MapReduce to a very broad set now including advanced engines such as Spark. The Big Data ecosystem offers an almost unlimited palette of tools that you can pick from – depending on your specific use case, processing requirements (from batch to real-time), and the existing systems that need to be integrated. The complexity of the Big Data ecosystem continues to increase as new frameworks, new versions, and new innovations are constantly being introduced.

As companies grow their on-premises Big Data implementations, they often find themselves deploying multiple clusters to support the diverse and growing needs of their data scientists, analysts, and other business users. This could be to support different Big Data environments (MapReduce, Spark, Kafka, NoSQL databases, etc.), to support workload partitioning for departmental requirements and different use cases, or simply as a byproduct of multi-generational hardware. They typically deploy multiple dedicated bare-metal servers to support the needs of each of these user groups.

This traditional approach can be complex, expensive, and time-consuming. It often takes several weeks to provision the systems and infrastructure required for each new cluster, and leads to cluster sprawl. There are typically multiple clusters containing mostly the same data. They may even use different distributions of Hadoop (and/or other Big Data frameworks and tools) for each cluster. There is often massive data duplication and the need to copy large amounts of data between these systems.

This leads to management challenges on multiple fronts – data management and governance, infrastructure deployment, software maintenance, and lastly, the availability of resources with skills to manage all these technologies for each cluster.
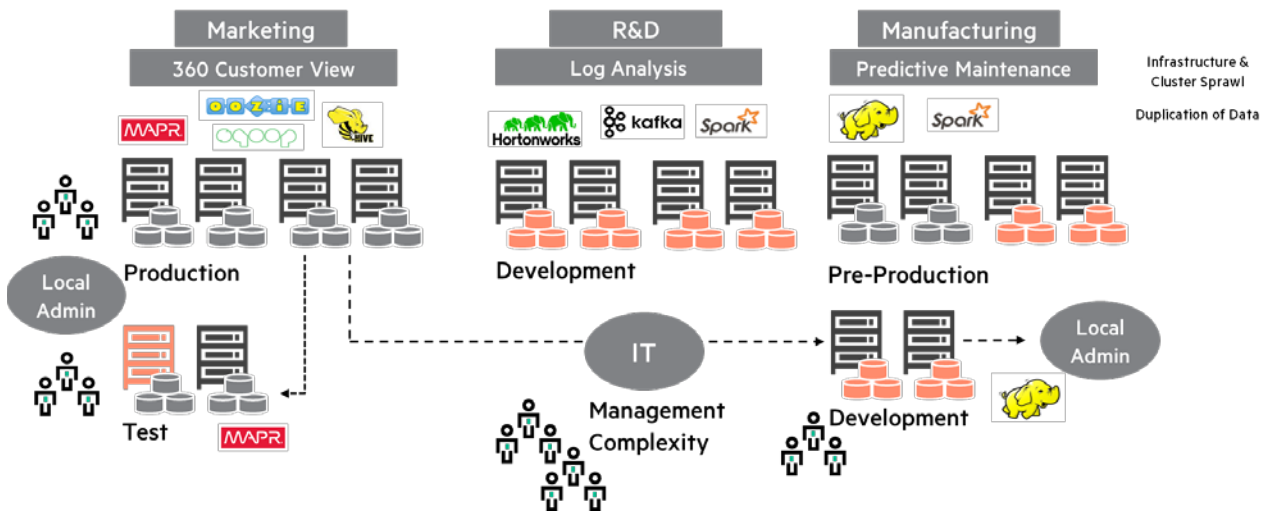

Figure 1. The complexity and challenges of traditional Big Data deployments

Many enterprise customers are searching for a way to recapture some of the traditional benefits of shared infrastructure such as the ability to easily share data between different applications running on different platforms, the ability to scale compute and storage separately, and the ability to rapidly provision new compute clusters without repartitioning data to achieve optimal performance. While the public cloud is attractive for some Big Data workloads, in many cases these organizations need to retain their data on-premises due to security, regulatory, and data gravity considerations.

To address these needs, HPE provides cost-effective and flexible on-premises infrastructure to optimize compute and storage resources in response to these ever-changing requirements in the evolving Big Data ecosystem. BlueData provides a software platform to run Hadoop, Spark, and other Big Data workloads on Docker containers – enabling Big-Data-as-a-Service in an on-premises deployment model. By leveraging the technology advances that have occurred since the inception of the Hadoop architecture in 2005, both HPE and BlueData have challenged the traditional on-premises Hadoop architecture with its compute and data elements co-located in the same server.

By combining BlueData's software innovations with HPE infrastructure, enterprise Big Data deployments that may have taken months can now be completed within a few days. Leveraging BlueData software and the power of Docker containers, data scientists and analysts can create their own Hadoop or Spark clusters on-demand within minutes. They can spin up clusters for their Big Data analytics tools of choice, with the ability to access common pools of data stored in local or remote systems. They can easily try out new versions, new applications, and new Big Data frameworks – without waiting for additional infrastructure. Now IT administrators have complete visibility and control, in a multi-tenant environment with secure data isolation.
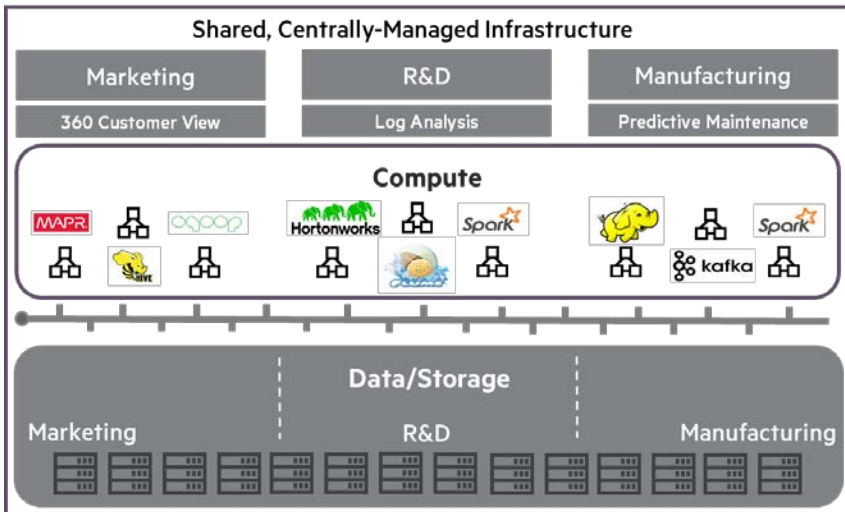
Figure 2. A new multi-tenant deployment model using shared infrastructure

The result is a more flexible, agile, and cost-effective approach to Big Data infrastructure. Enterprise customers can leverage all the benefits of the cloud operating model (self-service, agility, and elasticity) for Hadoop, Spark, and other Big Data workloads – while keeping their data on-premises. Key benefits include:

- **Simplify on-premises deployments** with a Big-Data-as-a-Service solution, including support for all major Hadoop distributions as well as Spark, Kafka, and other Big Data frameworks.

- **Increase business agility** by empowering data scientists and analysts to quickly create Big Data clusters running in Docker containers, in a matter of minutes with just a few mouse clicks.

- **Deliver faster time-to-insights** with the ability to rapidly deploy new Docker images for a wide range of different business intelligence, analytics, visualization, and data preparation tools.

- **Minimize the need to copy data** by separating compute and storage – enabling Big Data analysis on data stored in NFS, HDFS and other storage systems.

- **Maintain security and control** in a multi-tenant environment, integrated with enterprise-class security models (e.g., LDAP, Active Directory, Kerberos).

- **Lower cost of operation** by improving hardware utilization, eliminating cluster sprawl, and minimizing data duplication.

Solution overview

The HPE Elastic Platform for Big Data Analytics (EPA) harnesses the power of faster Ethernet networks and density optimized servers, providing a scalable and elastic multi-tenant architecture for Big-Data-as-a-Service when combined with BlueData's EPIC software platform. The HPE Elastic Platform for Big Data Analytics provides modular building blocks for compute, storage and networking that can be combined to build a density optimized big data platform. HPE EPA also provides "accelerator" building blocks for optimizing workload performance, storage efficiency, or accelerating deployment. Additionally, HPE provides baseline reference architectures (e.g., for Cloudera, Hortonworks, and MapR) as well as use case-based reference architectures (e.g., based on workload or application) to help customers understand how to build solutions with the EPA building blocks.[1]

BlueData's mission is to streamline and simplify big data infrastructure, eliminating complexity as a barrier to adoption.

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[1] Please visit the HPE RA library for a complete listing of HPE references architectures for Hadoop.

The BlueData EPIC (Elastic Private Instant Clusters) software platform makes it easier, faster, and more cost-effective for enterprises to deploy big data infrastructure and applications. When combined with the modern Big Data architecture provided by HPE Elastic Platform for Big Data Analytics, BlueData EPIC provides the flexibility and agility to support the rapidly changing requirements and uses cases for Big Data analytics.

The BlueData EPIC software platform works with each of the major Hadoop distributions (e.g., Cloudera, Hortonworks, MapR) as well as Spark, Kafka, Cassandra, and other Big Data frameworks. It works with the leading Big Data analytics and business intelligence applications, so data scientists and analysts can use the tools they prefer. It leverages the power of Docker containers, while ensuring near bare-metal performance for Big Data analytics. It can run with any shared storage environment, so enterprises don't have to move their data. It delivers the enterprise-grade security and governance that enterprise IT teams require for a multi-tenant deployment.

With BlueData EPIC and the HPE Elastic Platform for Big Data Analytics, enterprises can now deliver value from Big Data within days instead of months and with significantly lower TCO compared to traditional approaches. They can deliver the self-service agility, elasticity, and flexibility of Big-Data-as-a-Service in an on-premises deployment model.

Some example use cases for this combined solution are discussed below.

Lab for prototyping, evaluating, and exploring Big Data tools

Challenges: Big Data technologies such as Hadoop and Spark are complex and require multiple components, systems and infrastructure resources. It can be time consuming, costly, and challenging to get these new environments deployed and operational – even in a lab for initial evaluation or development, testing and quality assurance (QA). Getting these technologies up and running in a lab may take several months using the traditional deployment model, and onboarding new Hadoop or Spark clusters for new users requires new infrastructure with little to no reusability.

Solution: With BlueData and HPE, enterprises can accelerate their Hadoop and Spark deployment in a multi-tenant lab environment for dev/test/QA, evaluate different Hadoop distributions and Big Data tools, or quickly prototype multiple data pipelines (e.g., for real-time analytics with tools like Spark Streaming, Kafka, and Cassandra). They can achieve faster time-to-results with the ability to quickly and easily try out multiple distributions, versions, services / components, and BI / analytical tools on shared infrastructure. They can increase business agility by empowering their data scientists and analysts to spin up new clusters in a matter of minutes, with just a few mouse clicks.

Multiple Big Data departmental deployments: Shared infrastructure

Challenges: Big Data initiatives (e.g., Hadoop) usually begin in small isolated groups. This often results in a proliferation of clusters, with each team managing their own environment. From an IT perspective, this can lead to a number of challenges including cluster sprawl, lack of governance, lack of standardization, and significant maintenance challenges. Almost every tenant wants to keep at least some of the applications, data, and computing resources separate from the other groups or departments within their organization. Each Hadoop cluster is on a separate physical server, typically with direct attached storage, so each cluster stores its own data and is managed individually. This approach prevents different groups from sharing data sets across clusters, and makes it difficult for IT to gain any operational efficiencies or benefits from standardization.

Solution: With BlueData and HPE, enterprises can leverage shared infrastructure for multiple departments and user groups on centrally managed, shared infrastructure. This multi-tenant architecture allows enterprises to consolidate and simplify management for greater efficiency, enabling the sharing of resources for cost savings as well as the sharing of data – to eliminate the hassles and security risks of having to duplicate and store the same data for different user groups.

Enterprise-wide, mission-critical Big Data implementation in production

Challenges: As Big Data initiatives within an organization evolve, there are a variety of different operational challenges: including high availability, security, backup/recovery, upgrades and patches, and more. In many enterprises, there are strict regulatory and compliance controls on internal data that need to be addressed as these deployments move from dev/test and QA/UAT to production. Performance becomes increasingly important, as Big Data implementations move from "nice to have" science projects to "must have" mission-critical enterprise-wide deployments. As more and more users are onboarded for a variety of Big Data projects and using a variety of tools (e.g., data wrangling, machine learning, real-time analytics), IT needs to support these new environments and applications – with limited resources.

Solution: With BlueData and HPE, customers can benefit from rapid deployment and provisioning, enterprise-class performance, security, and scalability as they expand their Big Data initiatives. They can ensure security and privacy, as well as resource allocation and QoS controls, while gaining the benefits of shared resources in a multi-tenant architecture. They can implement enterprise-grade authorization mechanisms based on user directories and authentication technologies such as Kerberos, with strict access controls. Multiple groups can access the same data in a shared "logical" data lake for their Big Data analytics, avoiding the cost of moving or duplicating data.

BlueData enables faster software development and testing cycles, and non-disruptive testing and upgrades of the software components platform, including new versions of Hadoop distributions. As applications move from development and testing to production for their Big Data initiatives, customers can leverage the same shared infrastructure to quickly provision different development and testing environments as needed, and have access to relevant datasets for comprehensive testing, without having to duplicate data. Data scientists and analysts can spin up instant clusters with their preferred applications and tools, to evaluate new technologies and analytic models, which reduce time-to-insight for Big Data analytics.

Solution components

BlueData EPIC software platform

The BlueData EPIC software platform leverages Docker container technology and patent-pending innovations to deliver self-service, speed, and efficiency for Big Data environments:

- ElasticPlane enables users to spin up virtual clusters on-demand in a secure, multi-tenant environment.

- IOBoost ensures performance on par with bare-metal, with the agility and simplicity of Docker containers.

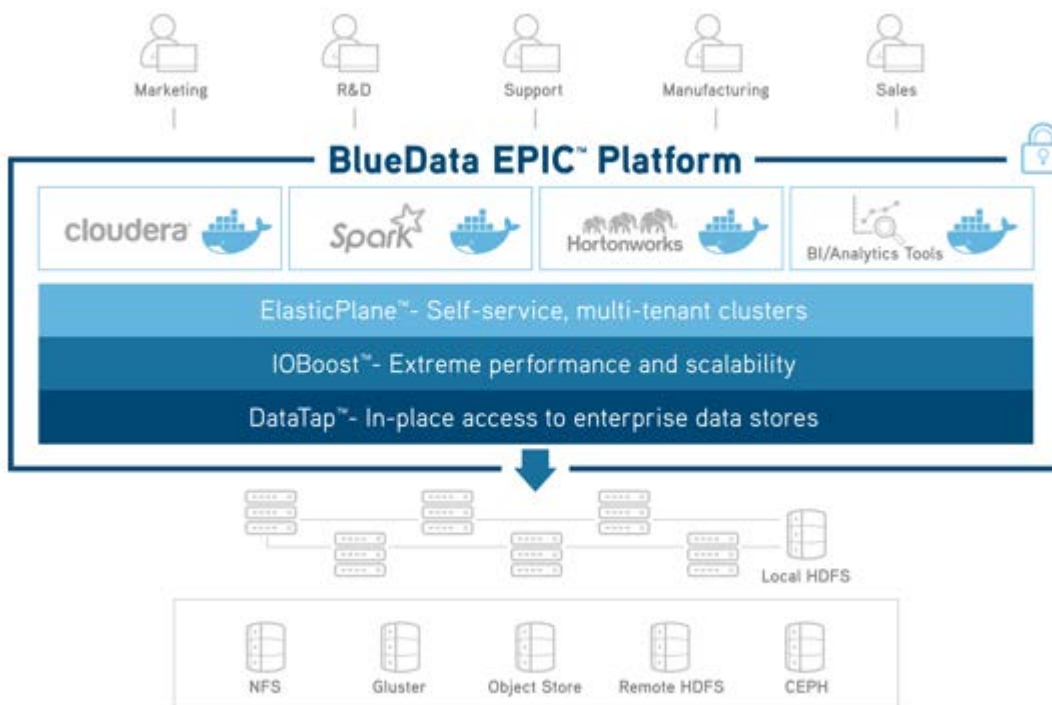- DataTap accelerates time-to-value for Big Data by eliminating time-consuming data movement.

Figure 3. The BlueData EPIC software platform

BlueData installs as a software layer between the underlying infrastructure and the Big Data distributions and applications. The use of Docker is completely transparent, but BlueData customers benefit from greater agility and performance due to the lightweight nature of containers. They can leverage the flexibility of Docker to simplify development for Big Data applications, and the portability of containers to support both on-premises and public cloud deployments.

The key capabilities of the BlueData EPIC software solution include:

Self-Service, instant clusters. Users can easily create Hadoop or Spark clusters with BlueData EPIC's ElasticPlane functionality. New container-based clusters are provisioned on-demand – whether for prototyping in a lab, a development and testing environment, or a production deployment. Data scientists and analysts can now quickly respond to dynamic business requirements by running a variety of jobs ranging from analytical SQL to Spark machine learning scripts against their data, with just a few mouse clicks.

Multi-Tenancy. With BlueData EPIC, different project teams, groups, or departments across the enterprise can run multiple virtual clusters on the same shared infrastructure – and the same shared data – for their Big Data analytics. BlueData provides multi-tenancy and data isolation to ensure logical separation between each project, group, or department within the organization. BlueData customers can prioritize the allocation of resources for a specific tenant (e.g., mission-critical data processing applications) over other tenants (e.g., data scientists experimenting with the latest innovations and tools from the ecosystem) to meet SLA and QoS requirements.

Security. The BlueData EPIC platform integrates with security and authentication mechanisms, such as LDAP, Active Directory and Kerberos, to meet enterprise-class auditing, governance, and regulatory compliance requirements. Customers can leverage user authentication, authorization, granular resource management controls, performance optimizations, and quota enforcement for their multi-tenant Big Data deployments.

Performance. BlueData has developed patent-pending I/O optimization innovations to deliver the agility and flexibility benefits of Docker containers for Big Data, while ensuring performance comparable to that of bare-metal servers. EPIC's IOBoost functionality provides application-aware caching and elastic resource management that adapts dynamically to changing application requirements, delivering the best possible performance in a containerized environment.

Data access from any storage. With EPIC's DataTap capability, enterprises can access data from any shared storage system (including HDFS as well as NFS and others) for their Big Data analytics. That means they don't need to make multiple copies of data or move data into HDFS, before running their analysis. Sensitive data can stay in their secure storage system with enterprise-grade data governance, without the cost and risks of creating and maintaining multiple copies.

Compute and storage separation. BlueData disconnects analytical processing from data storage, providing the ability to independently scale compute and storage on an as-needed basis. With BlueData EPIC, you have unparalleled flexibility to mix and match different server generations for your Big Data needs. This enables more effective utilization of compute resources, more flexibility on server/storage configurations and, as a result, lower data center operating costs.

Any distribution, any application. The BlueData EPIC platform works with each of the most popular Hadoop distributions unmodified: Cloudera, Hortonworks, and MapR. You can spin up virtual clusters for multiple Hadoop distributions as well as different versions of the same distribution on common infrastructure. You can create standalone Spark clusters independent of a Hadoop distribution. With BlueData, you can quickly deploy virtual clusters for business intelligence and data preparation applications (e.g., ETL), other Big Data frameworks (e.g., Kafka, Cassandra), and other tools (e.g., Zeppelin or Jupyter notebooks).

Add your own apps and versions. The EPIC platform includes an "App Store" with pre-configured Docker images for common Big Data frameworks, applications, and tools. BlueData provides an App Workbench that allows administrators to easily modify and update the pre-configured Docker images in their App Store (e.g., with a different version of the application or distribution) – or create new images for other applications and tools. Each BlueData customer has its own App Store populated with the applications and tools that their users need, providing the ultimate in flexibility and configurability.
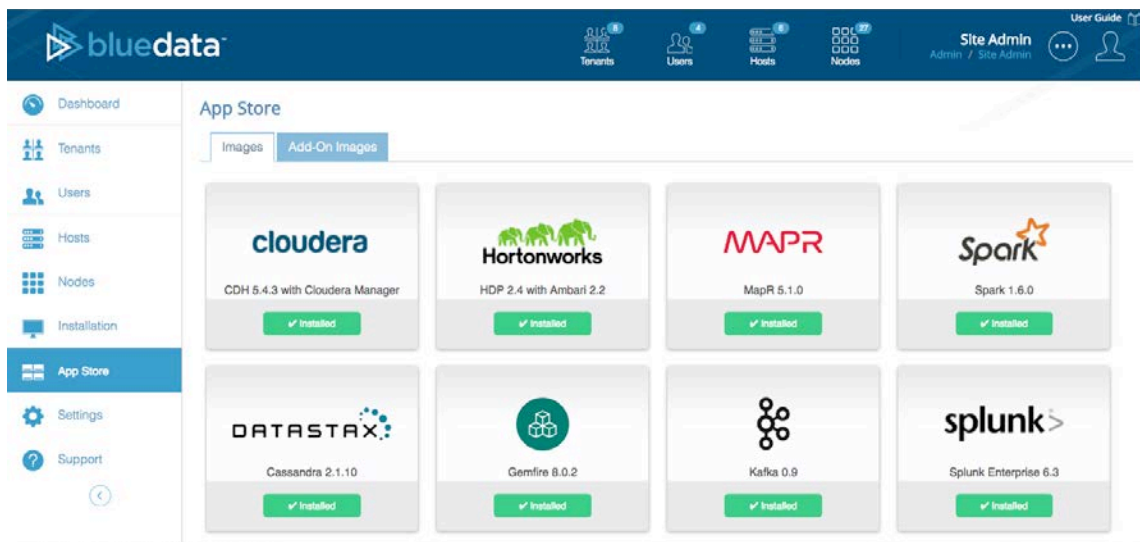

Figure 4. Screenshot of the "App Store" in the BlueData EPIC software platform

HPE Elastic Platform for Big Data Analytics (EPA)

The HPE Elastic Platform for Big Data Analytics is a premier modular infrastructure foundation to accelerate business insights, enabling organizations to rapidly deploy, efficiently scale and securely manage the explosive growth in volume, speed and variety of Big Data workloads.

HPE supports two different deployment models under this platform:

- **HPE Balanced and Density Optimized (BDO) system** – Supports conventional Hadoop deployments that scale compute and storage together, with some flexibility in choice of memory, processor, and storage capacity. This is primarily based on the HPE ProLiant DL380 server platform, with density optimized variants using HPE Apollo 4200 and Apollo 4530 servers.

- **HPE Workload and Density Optimized (WDO) system** – Harnesses the power of faster Ethernet networks that enables a building block approach to independently scale compute and storage and lets you consolidate your data and workloads growing at different rates. The base HPE WDO system uses the HPE Apollo 4200 as a storage block and the HPE Apollo 2000 as a compute block. Additional building blocks such as HPE Moonshot, can be layered on top of the base configuration to target different workloads and requirements.

Figure 5 below highlights the different building blocks that are part of the HPE BDO and WDO system offerings. By leveraging a building block approach, customers can simplify the underlying infrastructure needed to address a myriad of different business initiatives around Data Warehouse modernization, Analytics and BI, and building large-scale data lakes with diverse sets of data. As the workloads and data storage requirements change (often uncorrelated to each other) the HPE WDO system allows customers to easily scale by adding compute and storage blocks independently from each other, maximizing the infrastructure requirements for the workload demands.
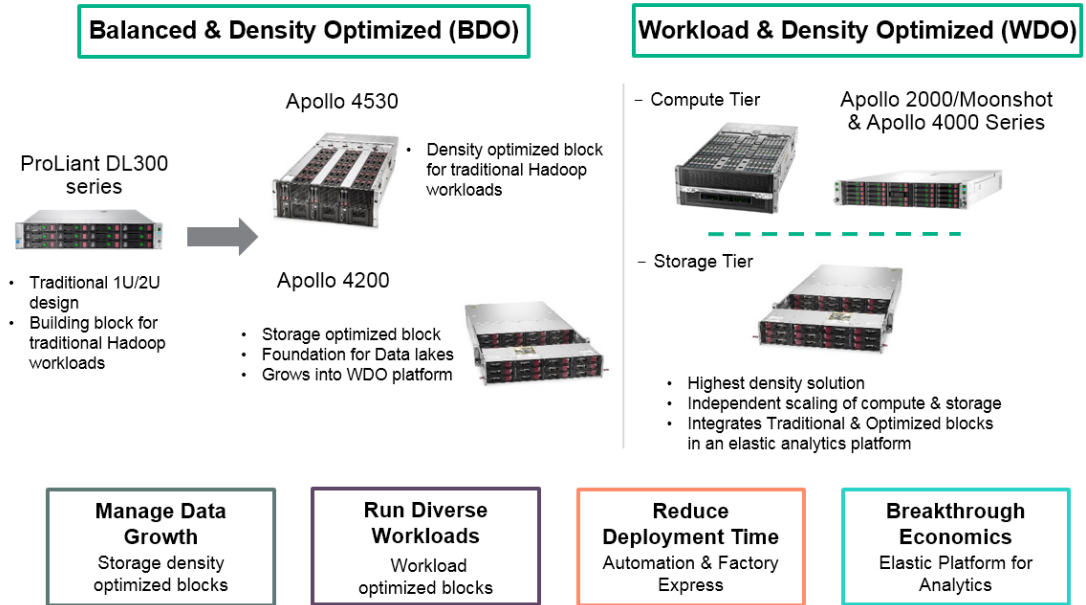

Figure 5. HPE Elastic Platform for Big Data Analytics (EPA)

Accelerators

An additional component of the HPE Elastic Platform for Big Data Analytics is the concept of Accelerators. Accelerators are specialized building blocks for optimizing workload performance, storage efficiency and deployment. As new workloads with more diverse requirements are added, accelerator building blocks are designed to target intended outcomes. Examples include accelerating performance of NoSQL databases, like HBase, that require low-latency processing of events in near real-time, in-memory analytics using Spark and SAP HANA Vora, deep learning on GPU accelerated servers, address storage efficiency with HDFS tiering and erasure coding, or deployment agility through automation and as-a-service solutions.

Figure 6 below provides an example multi-rack HPE WDO system supporting a wide variety of workloads leveraging a common HDFS data set. By separating out the compute and storage tiers, customers are able to address diverse workloads without having to duplicate the storage tier for each workload, which can be a costly, restrictive and siloed approach to solving disparate Big Data challenges.
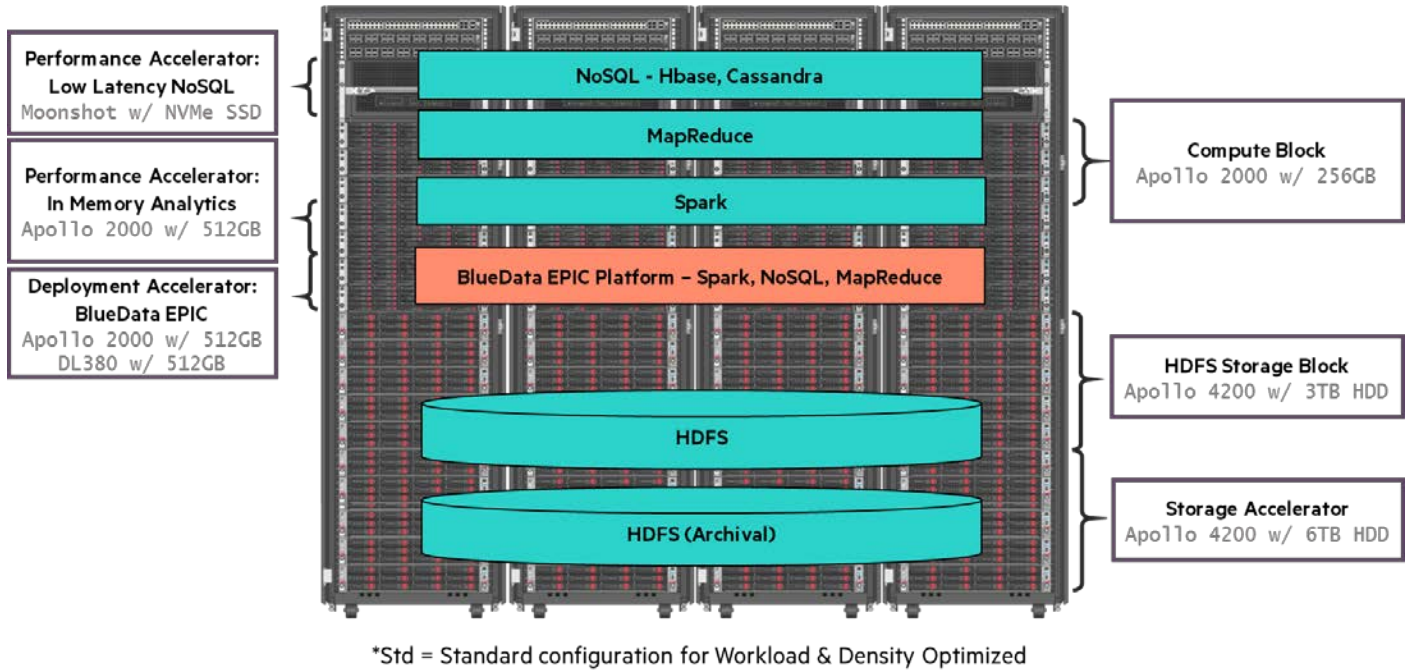

*Std = Standard configuration for Workload & Density Optimized

Figure 6. HPE EPA – Flexible architecture for Big Data workloads

Best practices and configuration guidance for the solution

This white paper is intended to provide high-level guidance and recommendations for deploying a BlueData solution with the HPE Elastic Platform for Big Data Analytics (EPA). Two options will be presented as examples for each of the use cases described below:

- HPE WDO system configuration using the HPE Apollo 2000 and Apollo 4200, which allows for better density and more flexibility in scaling out deployment of compute and storage independently.

- HPE BDO system configuration using the HPE ProLiant DL380 to integrate BlueData with existing conventional Big Data clusters.

These solutions examples are based on the following example use cases:

Starter deployment: Typically used for prototyping, development, evaluating and exploring Big Data tools.

- 4-20 servers

- 10 cores per server

- 128GB RAM per server

- Number of tenants: 2

- Number of clusters per tenant: 5

- Number of nodes (containers) per cluster: 8

- HDFS raw storage: Minimal

Medium deployment: This is a production BlueData deployment – used to support multiple teams/tenants with their applications

- 20-48 servers

- 28 cores per server

- 256GB to 512GB RAM per server

- Number of tenants: 5

- Number of clusters per tenant: 5

- Number of nodes (containers) per cluster: 12

- HDFS raw storage: 1PB

Large deployment: This is a production BlueData deployment – where there are multiple long running Hadoop and Spark clusters for many different tenants and lines of business.

- 48-100+ servers

- 28 cores per server

- 256GB to 512GB RAM per server

- Number of tenants: 10

- Number of clusters per tenant: 5

- Number of nodes (containers) per cluster: 40

- HDFS storage: 2PB

HPE WDO system configuration for BlueData EPIC software

The HPE WDO system provides great flexibility in deploying your workloads and managing your data growth, by decoupling storage growth from compute through high-speed networking. This allows you to add compute or storage as needed without having to add both lock-step. The architecture preserves the performance and availability benefits achieved through rack locality, while eliminating the need for node locality by leveraging high-speed networks for I/O performance and intelligent placement of Hadoop services on servers optimized for running specific components

In the HPE WDO example, the storage tier is an external HDFS cluster with the BlueData EPIC software running on the compute tier. This allows the BlueData clusters to be deployed on optimized servers for running containerized services and to easily scale by adding more compute servers as new tenants and services are brought online without incurring the cost of scaling storage capacity unnecessarily.

HPE Apollo 2000 compute servers

HPE Apollo 2000 system delivers a scalable, high-density layer for compute tasks and provides a framework for workload-optimization with four HPE ProLiant XL170r servers in a single 2U chassis. Each HPE ProLiant XL170r Gen9 server is serviced individually without impacting the operation of other servers sharing the same chassis to provide increased server uptime. Each server harnesses the performance of up to 2400 MHz memory (16 DIMM slots per server) and dual Intel® Xeon® v4 processors in a very efficient solution that shares both power and cooling infrastructure. Other features of the HPE ProLiant XL170r Gen9 server include:

- Support for high-performance memory (DDR4) and Intel Xeon E5-2600 v3 and v4 processor up to 22C, 145W

- Additional PCIe riser options for flexible and balanced I/O configurations

- FlexibleLOM feature for additional network expansion options

- Support for dual M.2 drives

For more information on HPE Apollo 2000 servers, visit hpe.com/us/en/servers/hpc-apollo-2000.html

For more information on the HPE ProLiant XL170r Gen9 server, visit hpe.com/servers/xl170r

HPE Apollo 4200 storage servers

HPE Apollo 4200 Gen9 servers make up the HDFS storage layer, providing a single repository for Big Data. The HPE Apollo 4200 allows you to save valuable data center space through its unique density optimized 2U form factor which holds up to 28 LFF disks and with capacity for up to 224 TB per server. It has the ability to grow your Big Data solutions with an infrastructure that is ready to scale. Another benefit is that the HPE Apollo 4200 fits easily into standard racks with a depth of 32-inches per server – no special racks are required.

The storage controllers in the HPE Apollo 4200 support HPE Secure Encryption, an HPE Smart Array controller-based data encryption solution that provides encryption for data at rest.

For more detailed information, visit hpe.com/us/en/servers/hpc-apollo-4000.html

HPE WDO with BlueData EPIC use case

Following are three example configurations based on the use cases described previously.

Table 1. Starter deployment

Compute servers	Small HPE WDO system
Cluster size	4-20 servers
Model	HPE Apollo r2600 chassis holds 4 HPE ProLiant XL170r servers
Server	4-20 HPE ProLiant XL170r Gen9
Processor	(1) Intel Xeon E5-2680 v4 2.4GHz 14-core per XL170r server
Memory	128GB RAM per XL170r server
BlueData EPIC and OS	2 960GB SATA SSD per XL170r server
Local HDFS storage	2-4 1.2TB SFF SAS HDD per XL170r server
Controller	HPE Smart Array P440/4GB FBWC 12Gb controller per XL170r server
Network card	HPE Ethernet 10Gb 2P 546FLR-SFP+ per XL170r server
HDFS storage servers	
Model	HPE Apollo 4200 Gen9 28 LFF CTO server
Processor	(1) Intel Xeon E5-2640 v4 2.4GHz 10-core
Memory	128GB RAM
OS	HPE 120GB RI Solid State M.2 Kit
Controller	HPE Smart Array P840ar/2G controller
HDFS storage	224TB raw storage per server
Network card	HPE 40Gb 2P 544+FLR-QSFP adapter

Table 2. Medium deployment

Compute servers	Medium HPE WDO deployment
Cluster size	20-48 servers
Model	HPE Apollo r2600 chassis holds 4 HPE ProLiant XL170r servers
Server	20-48 HPE ProLiant XL170r Gen9
Processor	(2) Intel Xeon E5-2680 v4 2.4GHz 14-core per XL170r server
Memory	256-512GB per XL170r server
BlueData EPIC and OS	2 960GB SATA SSD per XL170r server
Local HDFS storage	2-4 1.2TB SFF SAS HDD per XL170r server
Controller	HPE Smart Array P440/4GB FBWC 12Gb per XL170r server
Network card	HPE Ethernet 10Gb 2P 546FLR-SFP+ per XL170r server
HDFS storage servers	
Model	HPE Apollo 4200 Gen9 28 LFF CTO server
Processor	(1) Intel Xeon E5-2640 v4 2.4GHz 10-core per server
Memory	128GB RAM
OS	HPE 120GB RI Solid State M.2 kit
Controller	HPE Smart Array P840ar/2G controller
HDFS storage	224TB raw storage per server
Network card	HPE 40Gb 2P 544+FLR-QSFP adapter

Table 3. Large deployment

Compute servers	Large HPE WDO deployment
Cluster size	48-100 servers
Model	HPE Apollo r2600 chassis holds 4 HPE ProLiant XL170r servers
Server	48-100 HPE ProLiant XL170r Gen9
Processor	(2) Intel Xeon E5-2680 v4 2.4GHz 14-core per XL170r server
Memory	256-512GB per XL170r server
BlueData EPIC and OS	2 960GB SATA SSD per XL170r server
Local HDFS storage	2-4 1.2TB SFF SAS HDD per XL170r server
Controller	HPE Smart Array P440/4GB FBWC 12Gb per XL170r server
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HDFS storage	224TB raw storage per server
Network card	HPE 40Gb 2P 544+FLR-QSFP adapter

HPE BDO system configuration for BlueData EPIC software

For traditional cluster models, an HPE BDO configuration leveraging the HPE ProLiant DL380 Gen9 server can provide a balanced compute/storage design model to build your BlueData EPIC cluster.

Server platform: HPE ProLiant DL380 Gen9

The HPE ProLiant DL380 Gen9 (2U) shown below, is an excellent choice as the server platform for BlueData EPIC. HPE ProLiant DL380 Gen9 server delivers the best performance and expandability in the HPE 2P rack portfolio. Reliability, serviceability and near continuous availability, backed by a comprehensive warranty, make it ideal for any environment.

The HPE ProLiant DL380 Gen9 server has a flexible chassis, including HPE Universal Media Bay configuration options with 8 to 24 SFF and 4 to 12 LFF drive options along with NVMe options and additional rear drive support for expandability and investment protection.

In conjunction with the embedded SATA HPE Dynamic Smart Array B140i controller for boot, data and media needs, the redesigned HPE Flexible Smart Array and HPE Smart SAS HBA controllers allow you the flexibility to choose the optimal 12 Gb/s controller most suited to your environment.

You have a choice of embedded 4x1GbE, HPE FlexibleLOM or PCIe standup 1GbE to 40GbE adapters providing you flexibility of networking bandwidth and fabric so you can adapt and grow to changing business needs.

World-class performance and industry-leading energy efficiency

The HPE ProLiant DL380 Gen9 server supports industry standard Intel Xeon E5-2600 v3 and E5-2600 v4 processors with up to 22 cores, 12G SAS and 3.0 TB of HPE DDR4 SmartMemory.

High efficiency redundant HPE Flexible Slot Power Supplies provide up to 96% efficiency (Titanium), HPE Flexible Slot Battery Backup module and support for the HPE Power Discovery Services offering.

Improved ambient temperature standards with HPE Extended Ambient Operating Support (ASHRAE A3 and A4) and optional performance heatsinks help to reduce cooling costs.

Enhanced performance with active and passive, double-wide GPU support for workload acceleration.

For more detailed information, visit hpe.com/servers/DL380

HPE BDO with BlueData EPIC use case

Following are three example configurations based on the use cases described previously.

Table 4. Starter deployment

BlueData EPIC	Starter – HPE BDO deployment
Cluster size	4-20 servers
Server	HPE ProLiant DL380 Gen9
Processor	(1) Intel Xeon E5-2640 v4 2.4GHz 10-core per server
Memory	128 RAM per server
BlueData EPIC and OS	2 960GB SATA SSD per server
Local HDFS storage	150TB raw storage per server
Controller	HPE Smart Array P840ar/2G controller per server
Network card	HPE 10Gb 2P 561FLR-T per server

Table 5. Medium deployment

BlueData EPIC	Medium – HPE BDO deployment
Cluster size	20-48 servers
Server	HPE ProLiant DL380 Gen9
Processor	(2) Intel Xeon E5-2680 v4 2.4GHz 14-core per server
Memory	256-512GB per server
BlueData EPIC and OS	2 960GB SATA SSD per server
Local HDFS storage	150TB raw storage per server
Controller	HPE Smart Array P840ar/2G controller per server
Network card	HPE 10Gb 2P 561FLR-T per server

Table 6. Large deployment

BlueData EPIC	Large – HPE BDO deployment
Cluster size	48-100 servers
Server	HPE ProLiant DL380 Gen9
Processor	(2) Intel Xeon E5-2680 v4 2.4GHz 14-core per server
Memory	256-512GB per server
BlueData EPIC and OS	2 960GB SATA SSD per server
Local HDFS storage	150TB raw storage per server
Controller	HPE Smart Array P840ar/2G controller per server
Network card	HPE 10Gb 2P 561FLR-T per server

Capacity and sizing

The recommended capacity for a BlueData EPIC software deployment is dependent on the expected load. The load is determined by considering the values for:

- Number of **tenants** to be supported
- Number of active **virtual clusters** per tenant
- Number of **containers** per cluster
- Average **CPU, memory, and disk capacity** of a server

From these values, the required amounts of physical CPU, memory, and disk storage space can be computed. Once these are determined, they can be converted to specific server configurations for deployment.

Definitions for the terms **tenant**, **virtual cluster**, and **node** in the context of the BlueData EPIC software platform, are as follows:

- **Tenant:** A tenant is a unit of resource partitioning and data/user access control in a given site. The resources of an EPIC platform are shared among the tenants on that platform. Resources used by one tenant cannot be used by another tenant. All users who are a member of a tenant can access the resources and data objects available to that tenant.

- **Virtual cluster:** A virtual cluster is a collection of virtual nodes (i.e., containers) that are available to a specific tenant. There are two types of virtual clusters:

  - A **persistent cluster** is not tied to any particular job and remains intact when the job is complete.

  - A **transient cluster** is created on-demand for a job that is not using a persistent cluster; it is destroyed when the job is completed.

- **Node:** A node (also called a virtual node or instance) is a Docker container that is created when running a transient job or when creating a persistent cluster.

The total number of nodes needed for the BlueData EPIC deployment can be computed by taking the number of tenants, the number of clusters per tenant, and the number of nodes per cluster:

- Total number of nodes = (number of tenants) * (number of clusters per tenant) * (number of nodes per cluster)

And the amount of vCPU (virtual CPU), memory, and storage needed for these containers can be computed as:

- Total node vCPU = (vCPU per node) * (total number of nodes)
- Total node memory = (memory per node) * (total number of nodes)
- Total node disk capacity = (disk capacity per node) * (total number of nodes)

The total values for CPU and memory must be adjusted to account for the resources required to run the EPIC services (e.g., cluster management, data caching service) themselves. The EPIC services require:

- 1 CPU core in each physical host
- 5 GB memory + 13% (1/8) of memory in each physical host

A node vCPU maps to physical CPU cores based on a consolidation ratio. This indicates how many vCPUs will be the equivalent of 1 physical CPU core. By default, BlueData EPIC assumes a CPU consolidation ratio of 1 to 1. The EPIC system administrator can change this default value by editing the Settings/Other Settings/CPU Allocation ratio. For the purpose of this example, it will be assumed that the consolidation ratio has been set to 3 to 1 indicating 3 vCPUs should be allocated for each physical CPU core.

The disk capacity needs to be adjusted to account for the boot disk for the Red Hat® Enterprise Linux® (RHEL) operating system, the storage to hold the root file system of running Docker Containers (node storage), the Docker image files in the application library, and for any local storage used for the tenant storage Hadoop Distributed File System (HDFS):

- (1) 1 TB or greater HDD for the OS boot disk
- (1) 1 TB or greater SSD or HDD for the node storage, the use of SSD is strongly recommended for node storage
- 5 GB of capacity for each Docker image in the application library per physical host (5 GB is the average size of a Docker image file)
- 3 * the amount of tenant storage capacity required (tenant storage is a shared storage space that may be provided by either a local HDFS installation on the EPIC platform or a remote storage service). This accounts for the three-way data replication done by HDFS.

Putting this all together in an example, assume that the configuration needs to support 5 tenants, 10 clusters per tenant, with 8 nodes per cluster. On average, each node would require 5 vCPU cores, 15 GB of memory, and 50 GB of disk capacity. This results in:

- Total number of nodes = 5 * 10 * 8 = 400
- Total node vCPUs = 5 * 400 = 2000
- Total node memory = 15 * 400 = 6000 GB
- Total storage capacity = 50 * 400 = 20000 GB

In this example, we assumed 10 Docker images in the application library for a total of 5 * 10 or 50 GB of storage capacity. We also assumed 200 TB of storage capacity for the tenant storage HDFS, which means 600 TB of physical capacity are required.

To determine the requirements of each physical host, we need to state the number of physical hosts we want in our deployment. A host in this context is a physical server that is available to the BlueData EPIC platform. Nodes and virtual clusters resides on hosts. For example, if we want to have 16 physical hosts then:

- CPU cores per host = (total node vCPU/number of physical hosts/consolidation ratio) + 1 core per host for services = (2000/16/3) + 1 = 42 cores

- Memory per host = (total node memory/number of physical hosts) + 5 GB per host + 13% of memory per host = (6000/16) + 5 + 13% = 380 + 13% = 380 + 56 = 430 GB of memory

- HDFS storage capacity per host = total tenant storage/physical hosts = 600000/16 = 37500 GB of storage per host

- BlueData storage = (total node storage/number of physical hosts) + Docker images = (20000/16) + 50 = 1300 + OS

Summary

Every day, we create 2.5 quintillion bytes of data. This data is full of key business insights that enterprises want to exploit and use to derive competitive advantage. Hadoop, Spark and related Big Data technologies have made it possible for large amounts of data to be extracted, processed, and presented in meaningful ways to businesses and end-users.

Today's demands on data are increasingly dynamic and diverse across business units and can only be met by agile and elastic management of clustered resources. Virtualization and container technologies have already introduced flexibility, agility, and reduced costs to most applications in the enterprise data center. Using embedded, fully managed Docker containers, the BlueData EPIC software platform when deployed on HPE Elastic Platform for Big Data Analytics (EPA) allows enterprises to create virtual Docker container based clusters on demand and execute jobs without ever having to worry about the underlying infrastructure. Benefits include reduced Big Data deployment complexity; increased business agility by providing an elastic self-service infrastructure that reduces the time-to-value from months to days and overall TCO reduction compared too traditional, non-containerized Hadoop and Spark deployments. In particular, enterprises can now deliver a "Big-Data-as-a-Service" (BDaaS) for their business users, empowering them to design and implement analytics on demand while leveraging on-premises infrastructure with governance, and security. With the BlueData EPIC software platform combined with HPE Elastic Platform for Big Data Analytics (EPA), enterprises of all sizes can create a public cloud-like consumption experience from their on-premises environments, simplify management of their infrastructure, data and analytics workloads through consolidation to a shared multi-tenant platform, and realize value from their Big Data implementations by accelerating time to insight.

Resources and additional links

BlueData
bluedata.com

HPE Big Data Solutions
hpe.com/bigdata

HPE Reference Architectures
hpe.com/info/ra

HPE Servers
hpe.com/servers

HPE Storage
hpe.com/storage

HPE Networking
hpe.com/networking

HPE Technology Consulting Services
hpe.com/us/en/services/consulting.html

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