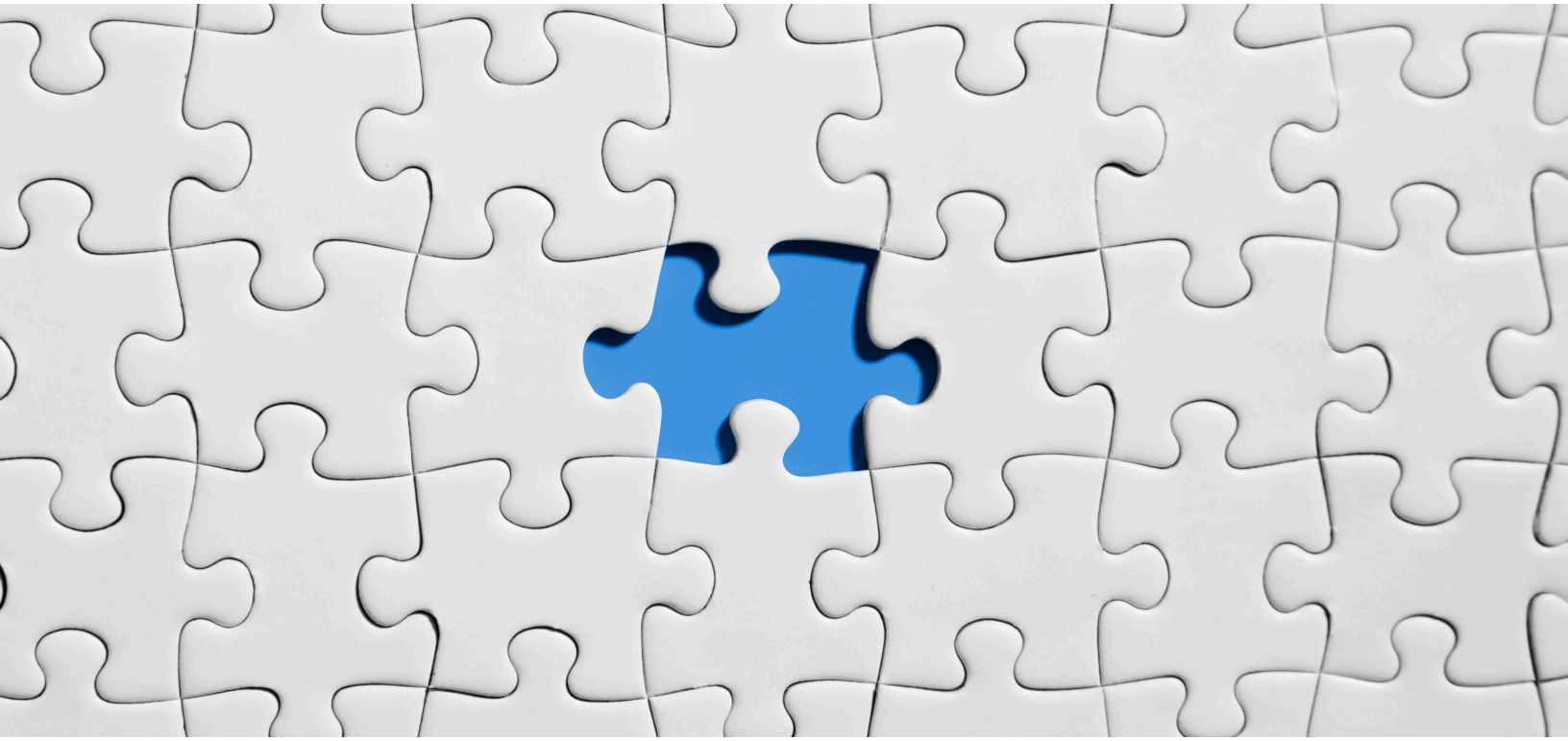
DELL Technologies

GET READY FOR EDGE COMPUTING



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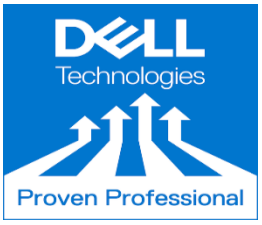
Knowledge Sharing Article



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Preface

Edge computing is a fast-growing technology field with strong evidence of multiple use cases such as remote monitoring of assets, predictive maintenance, in-hospital patient monitoring, autonomous vehicle, chatbots, smart homes and more. If you want to deploy edge computing successfully, you need to seriously consider the goals of business and technology.

Edge computing exists at the intersection of the digital world and the physical world to collect, create and process data to create new value.

To successfully implement edge computing requires strategic planning, innovative technology and a certain degree of adventurous spirit.

When organizations plan for edge computing, they are able to define, build, and protect it without adding complexity or sacrificing consistency. Since each organization is unique, no two edge computing implementations are the same, so it must be well planned. Although the starting point may be different, the business focus may require curriculum adjustments and effective methods in one organization may not succeed in another organization.

Introduction

This article introduces the strategy and technology of edge computing to perform consistent operation and management on infrastructure, data, applications and security to help readers successfully deploy edge environments and develop management strategies. It can help to create new business opportunities for companies and successfully carry out innovation and transformation.

We will discuss and describe an Edge Computing architecture, including Dell EMC Hyper-Converged Infrastructure (HCI) platform and storage infrastructure with data era functions, the benefits it can provide and how to get the most value from Edge Computing technology.

Opportunities at the Edge

KPMG and IDC analyzed which industries will benefit from 5G and edge computing technologies based on analysis of different industries. It is estimated that by 2023, Industrial manufacturing, connected healthcare, smart transportation, environmental detection and e-sports entertainment will benefit from 5G technology and edge computing first due to the anticipated growth over the next few years. In addition, there will be considerable growth in the connectivity, software, hardware and service markets, with the value exceeding 500 billion US dollars. 5G and edge computing will play the greatest role of digital transformation in various fields, making transportation more convenient, cities more intelligent, and highly efficient factories, warehouses, workplaces, hospitals and homes.

According to a report by Market Research Future, a professional research organization, due to advances in computing technology, coupled with the growth of Internet of Things (IoT) and development of 5G, the global edge computing market will reach USD 22.453 billion, with a compound annual growth rate (CAGR) of 28.4% in 2024.

IDC estimates that at least 60% of the world's top 2,000 companies will actively monitor and manage edge computing. By 2022, nearly 40% of global companies will double their spending on edge computing. Thus, we can see the importance of edge computing to companies in the near future.

5G and edge computing are moving us toward a highly automated industry, where sensors can analyze data from every corner. Moreover, artificial intelligence (AI) will continuously adjust production to meet demand. Through predictive maintenance, all assets will be monitored 24/7 to improve performance, reduce downtime and increase safety. The product will also be evaluated throughout the process to identify and solve the problem of quality degradation. High-quality products are produced faster and at lower cost, waste, maintenance, material and energy. Therefore, the environment becomes more sustainable, and emissions lower.

Data Era

As in the past, companies relying on intuition and experience to make decisions today may not be able to respond to market needs or time to market. Thus, companies need to transform by using information and data to innovate and make more informed, immediate decisions.

Data can be described as a treasure of modern business. Analyzing data provides new insights for operations and may uncover new opportunities. The rise of IoT provides more data than ever before. The Gartner report points out that the number of IoT devices such as sensors and surveillance cameras will grow to more than 20 billion in 2020.

IoT generates a large amount of data. Analyzing these data and taking appropriate actions or responses can help companies improve efficiency, enhance customer and user experience, and explore new business. Processing the response from the place where the data is generated or the location of the user is ideal: the so-called Edge.

Most companies will focus on data centers or cloud computing environments to store, manage and analyze these data.

Gartner predicts that 75% of enterprise data will be created and processed outside the data center or cloud by 2025. Further, they forecast that by 2023, more than 50% of large enterprises will deploy at least six edge computing scenarios for IoT, but traditional IT infrastructure and cloud computing cannot meet these requirements. For example, in the case of IoT, there needs to be minimal delay. High-speed, high-availability networks to process large amounts of data in real-time require the capabilities of edge computing to meet these requirements.

Edge computing processes data near the source without the need to transmit raw data to cloud computing or data centers for processing and analysis.

Therefore, it can effectively relieve network bandwidth and server workloads, effectively making appropriate actions and respond more quickly. Edge computing releases the true power of IoT, thus accelerating digital transformation of industries and enterprises to edge computing and development of AI to create more innovative applications and uncover new business opportunities.

Industry 4.0

Industry 4.0 is also known as the fourth Industrial Revolution. In history, Industry 1.0 used to steam and machinery as power instead of labor. Industry 2.0 replaced steam power with electricity. In Industry 3.0, electronic devices and information technology drive digital production. Industrial economic innovation includes invention and application of atomic energy technology, electronics, computer technology, and bioengineering technology. Industry 4.0 adopts fully automated smart manufacturing as the focus of the revolution. It integrates existing industry-related technology sales and product experience, uses modern smart technology and technology to build smart factories with adaptive resource efficiency and ergonomics in business processes and value processes and integrates customers and business partners to provide complete after-sales service. Its technical foundation uses IoT sensing technology to communicate with machinery to transform traditional production methods into highly customized, intelligent and service-oriented business models to cope with rapidly changing markets.

In this process, the wide variety of data generated will likely become a treasure of the company. Big data analysis offers opportunity to optimize manufacturing and service processes. Many well-known large companies leverage big data analysis to provide better services and user experience.

Principles for Edge Deployment

According to IDC forecasts, the total amount of global data will be greater than 40 zettabytes (ZB) by 2020. In this case, the centralized processing model with cloud computing as the core will not be able to efficiently process data generated by edge devices due to:

- Insufficient real-time performance: IoT applications have real-time requirements. Under the traditional cloud computing model, the application transmits data to the cloud computing center and then requests the data processing result, which increases system delay.
- Insufficient bandwidth: Edge devices generate a large amount of data in real-time, and the transmission of all data to the cloud causes great pressure on network bandwidth.
- Higher energy consumption: Data centers consume a lot of energy. With more and more user applications, the amount of data processed increases. Energy consumption will become a bottleneck restricting development of cloud computing centers.
- Higher risk to data security and privacy: IoT data is closely related to user privacy. Data transmission to the cloud increases the risk of user data leakage.

To deal with the above challenges, edge computing performs computing at the edge of the network. The components of edge computing operations include any computing and network resources between the data source and the cloud computing platform. Edge computing and cloud computing are not a replacement relationship, but a mutual promotion relationship. While edge computing requires the strong computing power offered by the cloud computing platform and support of massive storage, the cloud computing platform also needs the processing of large amounts of data and private data by edge devices in edge computing.

Principles for Successful Edge Deployment

The Dell Technologies whitepaper “An Edge Field Guide: Five Practical Principles for Successful Edge Deployment” recommend the five key principles of a successful Edge technology deployment. Each principle is discussed below.

Principle 1: Define your Edge

Information technology professionals should discuss with business owners in the early stage the business outcome of implementing the edge computing solution to formulate the requirements and functions of edge computing. After determining the requirements and functions, the IT department can perform in-depth research on edge computing deployment and for deeper consideration. For example, how to use flexible data architecture to process shared data of different applications and platforms, build cloud-native and cross-platform applications, maintain a consistent data processing at the edge and hybrid clouds, and how to ensure the governance and security of data demand.

Principle 2: Build your Edge incrementally

As most technological inventions, development is gradual, starting from small goals and gradually evolving to large-scale projects. It should be noted that edge computing can develop very quickly. It

needs an agile and fast response to be realized in a short period of time, which can help prove the value proposition of edge computing. When edge computing is gradually established, the edge data and existing business data must be properly connected. Even if there is new data, there is no need to redesign the edge data schema. In terms of data security and supervision, a set of data security and supervision, I.e. parameters such as tags which are commercially sensitive data, needs to be developed at an early stage. This design needs to be able to cope with a three to five year development timeframe.

Principle 3: Protect data at the Edge

Build a separate network fabric for data assurance operations, including backup, restore, archive and snapshot. This should cover all Edge locations and extend all the way to the core. We need to separate the metadata on its own high-performance infrastructure because it has a positive impact on overall business performance.

Principle 4: Maintain consistent standards

In addition to undertaking ever-changing business pressure, professionals must also account for the rapid development of edge technology and deploy edge computing solutions that may be inconsistent with the environmental standards of hybrid cloud computing, resulting in reduced efficiency and dysfunction. Therefore, it is necessary to develop a standardized edge and cloud environment whether in tools or operations as much as possible to achieve the same standard, as different tools and processes will introduce complexity and risks.

Principle 5: Keep it simple

Reducing complexity and standardizing on one or two technologies simplifies deployment, management and maintenance. It is possible to reduce the investment and cost of operation. Moreover, it can provide an opportunity to reduce costs and risks of life-cycle deployment and maintenance.

Example of Edge Computing Technology

Traditional IT teams face a massive amount of complexity when building, configuring, maintaining and scaling applications. Customers need to successfully deploy and operate an environment without the complexity of configuration and supporting a wide range of tools. Hyper-Converged Infrastructure (HCI) platform is the best solution for the customer.

Hyper-Converged Infrastructure Platform

VxRail Appliances are HCI turnkey solutions developed by Dell EMC and VMware. They are the only fully integrated, preconfigured, and tested HCI appliance powered by VMware vSAN technology for software-defined storage (SDS). VxRail Appliance provides VMware vSphere features include Storage vMotion, Distributed Resource Scheduler (DRS) and High Availability (HA) for avoiding planned and unplanned downtime and site maintenance of your virtual environment. Figure 1 is the physical architecture diagram of VxRail Appliances.

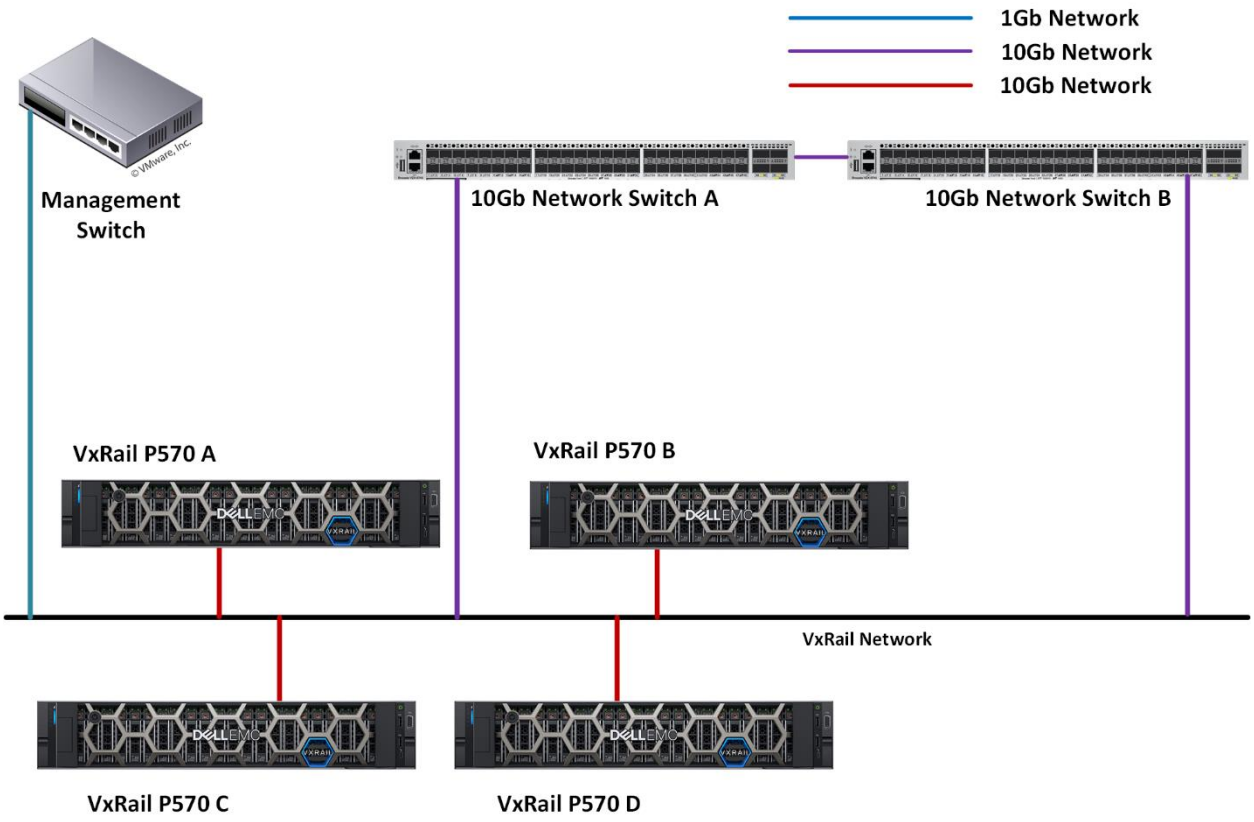

Figure 1 - The physical architecture diagram of VxRail Appliances

In Figure 1, there are four VxRail Appliances (P570), two 10Gb network switches, and one 1Gb network switch. Table 1 summarizes each hardware component. The two pairs of 10Gb switches are used to network VxRail Appliance, and the 1Gb switch is used for the Integrated Dell Remote Access Controller (iDRAC) network:

Components	Model	Network
VxRail Appliance A	VxRail P570	10Gb/25Gb
VxRail Appliance B	VxRail P570	10Gb/25Gb
VxRail Appliance C	VxRail P570	10Gb/25Gb
VxRail Appliance D	VxRail P570	10Gb/25Gb
Network switch A	N/A	10Gb/25Gb
Network switch B	N/A	10Gb/25Gb
Management switch	N/A	1Gb

Table 1 - The summary of each hardware component in VxRail

When we deploy the VxRail Appliances, it automatically builds a VxRail cluster and enables all VMware vSphere features. Figure 2 is the logical architecture diagram of VxRail Appliances.

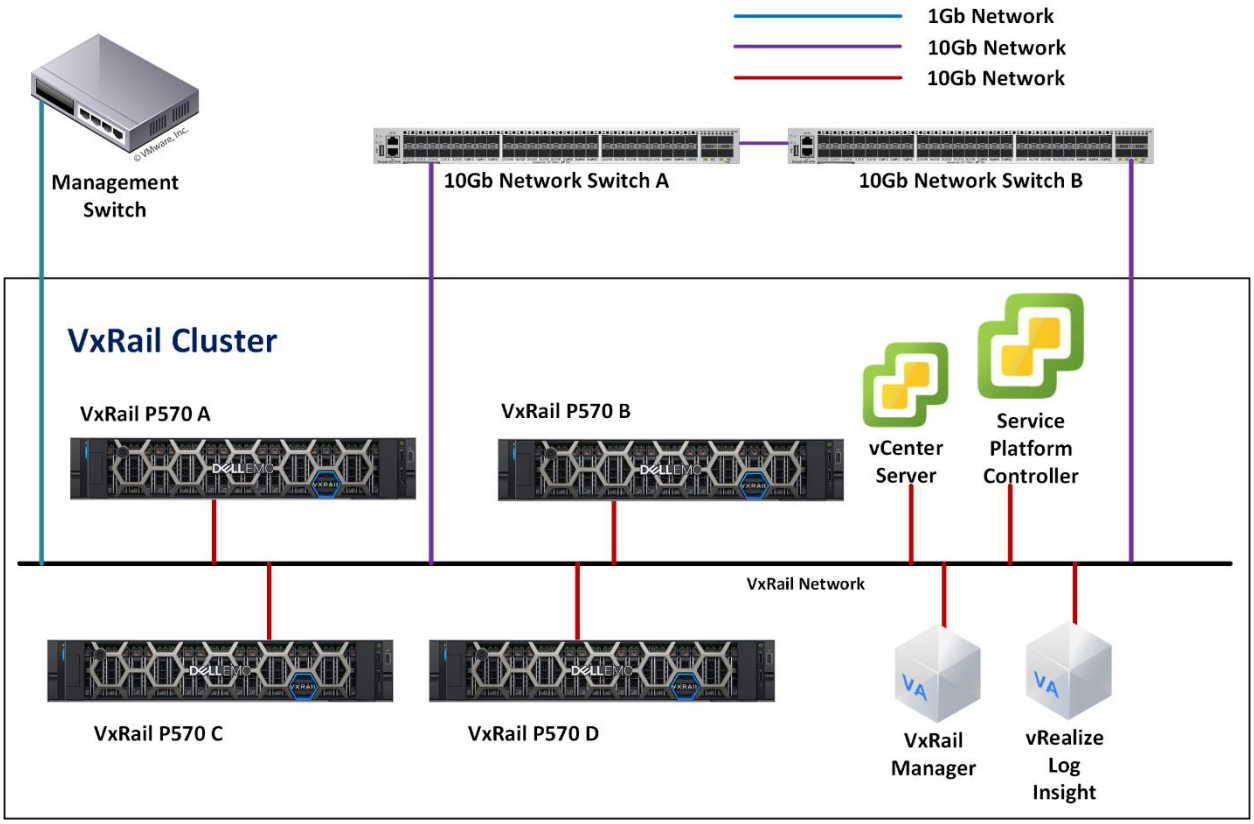

Figure 2 - The logical architecture diagram of VxRail Appliances

Figure 2 depicts four VMware vSphere hosts running in the VxRail Cluster, with vSAN feature enabled. There are four VxRail system virtual machines pre-deployed after the VxRail initialization, i.e. vCenter Server, Service Platform Controller, VxRail Manager and vRealize Log Insight.

Components	Operating System	Software-Defined Storage	Roles
VxRail Appliance A	VMware vSphere	VMware vSAN	VxRail Cluster
VxRail Appliance B	VMware vSphere	VMware vSAN	
VxRail Appliance C	VMware vSphere	VMware vSAN	
VxRail Appliance D	VMware vSphere	VMware vSAN	
vCenter Server	Virtual Appliance	N/A	Central Management

Service Platform Controller	Virtual Appliance	N/A	Permission Management
VxRail Manager	Virtual Appliance	N/A	VxRail Manager for vCenter Plug-in
vRealize Log Insight	Virtual Appliance	N/A	Log Management

Table 2 - The summary of each software component in VxRail

Next Generation of Data Storage

The current generation of storage array technologies can only deliver higher protection, efficiency, performance and capacity. Innovative data services and capabilities, i.e. unified storage and scale-out NAS, new storage media (including Flash and SCM) and data reduction technologies, cannot be addressed by the current generation of arrays. To fulfill this need Dell developed the PowerStore Appliance.

The Dell EMC PowerStore storage appliance is designed for the data era. It is designed to support any workload by delivering unified storage (physical or virtual, file-based, or container-based) in a performance-optimized appliance that supports end-to-end NVMe and can scale up and out when demands increase. PowerStore also delivers efficiency without compromise with always-on inline data reduction.

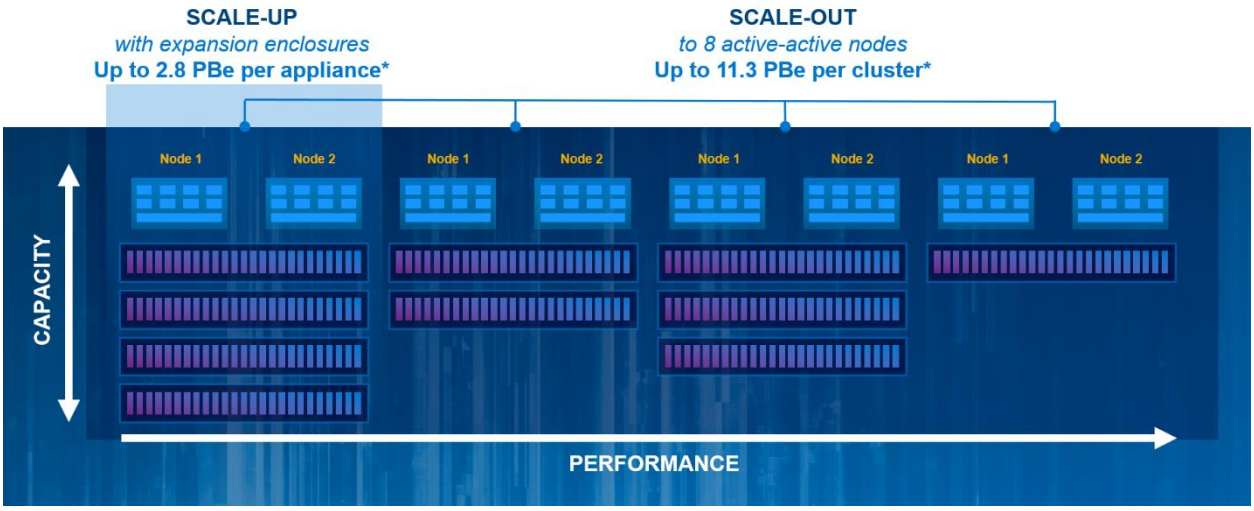

Figure 3 - Scale-Up and Scale-Out on PowerStore

PowerStore supports the combination of scale-out and scale-up capabilities, enabling capacity and performance to be tailored to the needs of individual environments. Advanced clustering technology allows PowerStore to scale up system capacity by adding expansion enclosures (up to 2.89PB effective

capacity per base appliance). Meanwhile, it can scale out to 8 active-active nodes (up to 11.4PB effective capacity per cluster).

We can also access the hypervisor to deploy our own applications directly on the PowerStore appliance, using the same VMware methods and technologies we use with external hosts. This hypervisor deployment, known as AppsON, is used for data-intensive workloads in headquarter or edge data centers where infrastructure simplicity and density is required.

PowerStore cluster management combines with VMware features including vMotion and Storage vMotion. It uses a single storage instance to deploy applications on external ESXi servers, Hyper-Converged Infrastructure (VxRail), or directly on the PowerStore appliance and move transparently between them.

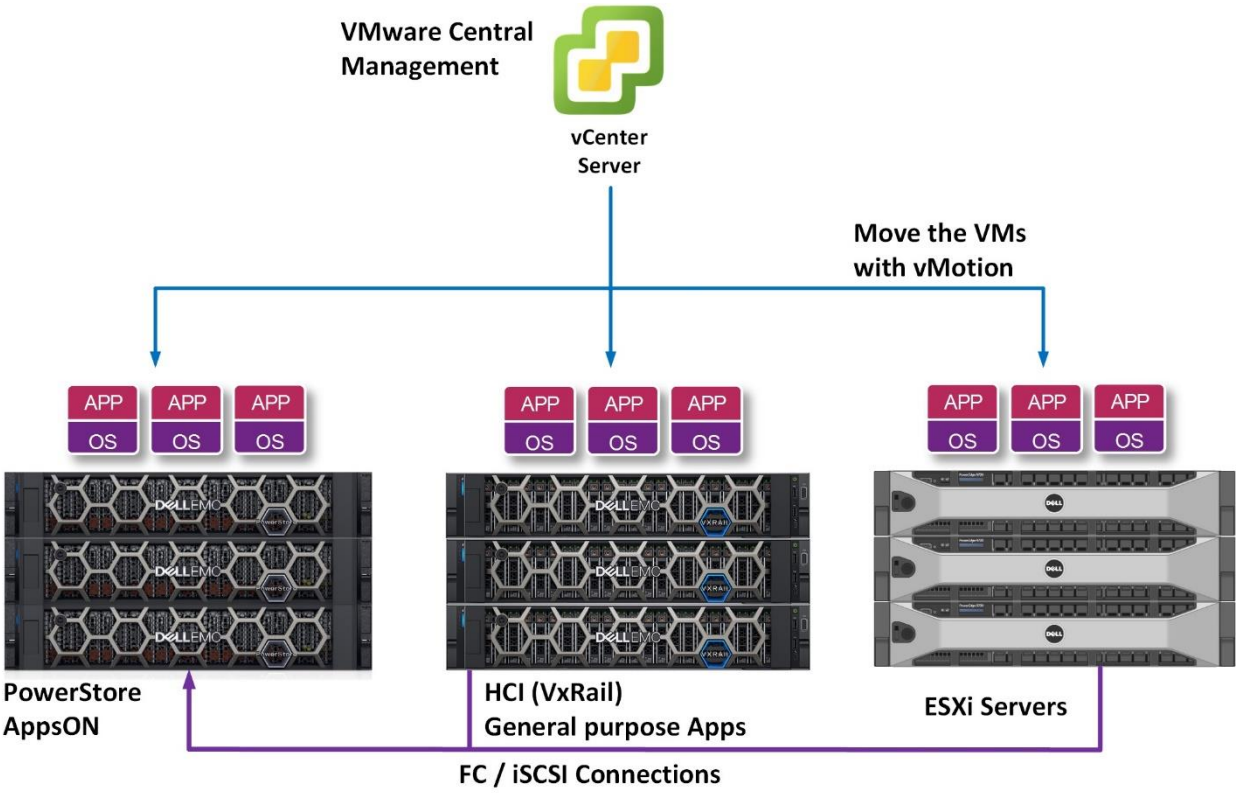

Figure 4 - Data center modernization

Dell EMC VxRail Appliance and PowerStore Storage solution

Figure 5 shows four locations; headquarters and three edge locations. A VxRail Cluster is installed in the headquarters, and the PowerStore Cluster is installed in each edge location.

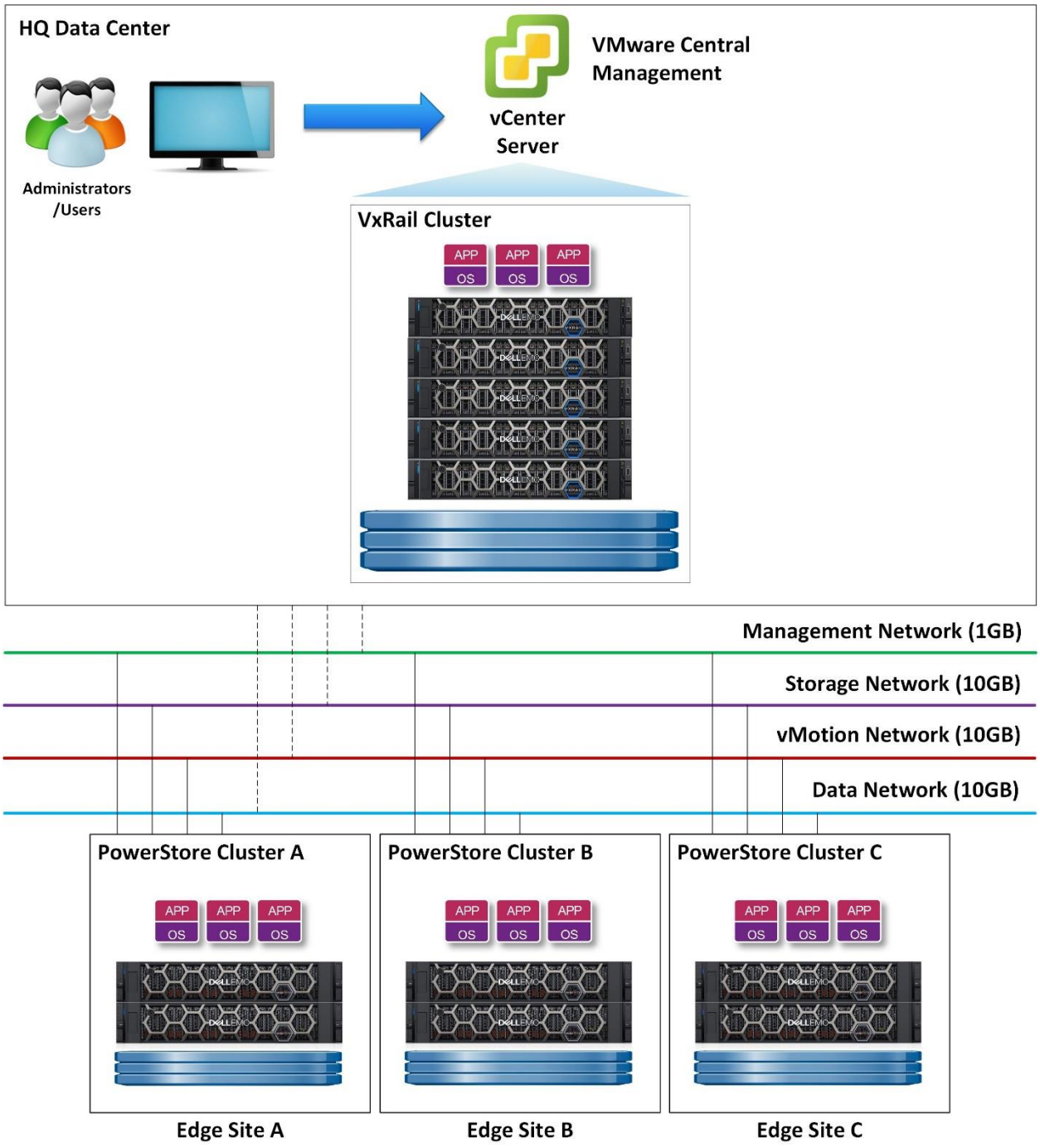

Figure 5 – Dell EMC VxRail and PowerStore Solution

In the headquarters, all production servers and applications are running in the VxRail Cluster that can provide the VMware High Availability (HA), Distributed Resource Scheduler (DRS), Storage Policy-Based Management (SPBM) and VxRail Lifecycle Management (LCM), etc. These features provided flexibility and mobility for application deployment and maintenance tasks, such as system scale-out, software/firmware upgrade, configuration of failures to tolerate (FTT) and failure tolerance method

(FTM), etc. Administrators and users can perform all operation and configuration tasks in a single central management dashboard (VMware vCenter Server Appliance).

In each edge location, the data-intensive applications are running in the PowerStore Cluster. PowerStore can provide the large volume analysis of real-time IoT data and information in a secure, cost-effective manner. PowerStore offers unique capabilities for environments where infrastructure simplicity and density are desirable or critical, including edge computing, remote office/branch office (ROBO) and mobile devices. This two-rack unit (per node) offers ease of deployment, flexible architecture and ability to support multiple data types. With 5G network technology, the data can replicate to the headquarters data centers with advanced replication.

If the PowerStore Cluster requires a maintenance window for software or hardware upgrade in one of the edge sites, we can migrate the application virtual machines to the headquarters or PowerStore Cluster in the other edge locations with VMware vMotion or storage vMotion.

With PowerStore's AppsON capability through VMware vSphere, we can also easily migrate the applications and data between PowerStore and AWS based on requirements, without requiring additional management tools for simple and consistent operations.

Without Edge Computing Technology

According to principles for successful edge deployment, we will summarize the difference with and without edge computing technology.

	Without Edge Computing Technology	**With Edge Computing Technology**
Define your Edge	The architecture of traditional server and storage does not support shared data of different applications and platforms nor building cloud-native and cross-platform applications.	HCI architecture and PowerStore deliver shared data of different applications and cross-platform applications, e.g. On-Premises HCI, PowerStore's AppsON, VMware Cloud on AWS, etc.
Build your Edge incrementally	Traditional server and storage environment cannot build up the infrastructure from a small size, and cannot scale-out easily. It does not fulfil the requirement of Edge deployment.	An HCI platform can build up from small and supports flexible scale-out. PowerStore can build up the infrastructure from small at Edge, eases deployment and offers a flexible architecture.
Protect data at the Edge	We may consider two backup solutions; one for headquarters, the other for ROBO/remote site.	Build a separate network fabric for data assurance operations, including backup, restore, archive and snapshot. This should cover all Edge locations and extend to the headquarters.

Maintain consistent standards	Traditional server and storage environment cannot maintain consistent standards, e.g. if the hardware platform is different in headquarters and other remote offices, the supported software and firmware is different, deployment and configuration is different making it difficult to maintain consistent standards.	HCI platform (VxRail) can deliver consistent deployment models, and provide the standard software upgrade in a single software package. PowerStore storage can offer flexible deployment models in the headquarters, edge and cloud. Due to VxRail cluster and PowerStore cluster (X-series) running in VMware vSphere platform, we can easily maintain consistent standards.
Keep it simple	In a traditional server and storage environment, deployment and configuration have many dependencies, e.g. hardware and software.	HCI platform and PowerStore storage can deliver standardized deployment, management and maintenance. It reduces the complexity and simplifies day-one deployment and day-two operation and configuration.

Advantages of edge computing

- Process a large amount of temporary data at the edge of the network instead of uploading all of it to the cloud, which greatly reduces the pressure on network bandwidth, server workload and data center power consumption.
- Data processing is done close to the data, without the need to request a response from the cloud computing center through the network, greatly reducing system delays and enhancing service response capabilities.
- Edge computing no longer uploads user privacy data, but stores it on the network edge device, reducing the risk of network data leakage and protecting user data security and privacy.
- In the past, IT and Operational Technology (OT) belonged to two different disciplines with their own management goals. As cloud-based IoT deployments become larger, IoT devices have become network virus intrusion points The new targets of malicious attacks have increased the need for IT and OT integration management. Edge computing has become a common language between the two, from establishment of an easy-to-deploy and maintain edge infrastructure to coordinate and cooperate to reduce IT and OT Individual burden.

Clearly, it is important to plan the deployment of edge computing based on established principles.

Summary

This Knowledge Sharing article discusses opportunities for Edge Computing deployment and how to plan and build an Edge Computing project based on the principles highlighted. We described an Edge Computing architecture, including Dell EMC Hyper-Converged Infrastructure (HCI) platform and storage infrastructure with data era functions and listed the benefits Edge Computing provides and how customers can maximize value from Edge Computing technology.

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Dell EMC PowerStore Product Overview