Cloud Ready: Architectural Integration into FlexPod with Microsoft Private Cloud Solution

What You Will Learn

Industry trends indicate a dramatic data center transformation to shared infrastructure. To help organizations in this journey, Cisco and NetApp have developed FlexPod, a private cloud platform validated by Microsoft to run Microsoft applications. Based on industry-leading servers, switches, storage, and software, FlexPod can help organizations rapidly address current virtualization needs and simplify the evolution to an IT-as-a-service (ITaaS) infrastructure while reducing the cost and risk of such an endeavor.

Trends and Challenges in the Enterprise Data Center and Cloud Computing

IT departments are undergoing a radical change. They are rapidly moving away from application-centric, dedicated infrastructure silos and instead choosing to virtualize the business application environment for greater flexibility and efficiency. This move to the cloud offers the means to deliver even greater value from IT, including:

- **Supporting business needs:** To support the transformation to service-based IT, technology departments want to rapidly deploy applications and deliver better application performance.

- **Running IT efficiently:** The data center needs to be designed and operated for optimal efficiency and use across normal operations and peak workloads, whether it is on premises or relies on service providers.

- **Aligning IT costs with business needs:** IT and business alignment typically entails optimizing application lifecycles, improving the predictability of project lifecycles and costs, and delivering IT services consistently.

In addition to numerous benefits, shared infrastructure presents a variety of new challenges. Organizations moving to the cloud typically need to navigate hurdles such as:

- **Management:** Organizations need to rebalance workloads and meet capacity on demand, but they are burdened with physical and virtual server sprawl, disparate management tools, and inefficient operations.

FAST FACTS

What Is FlexPod?

Jointly delivered by Cisco and NetApp, the FlexPod platform is a turnkey, private cloud platform that has been validated by Microsoft to run Microsoft applications.

What Are the Benefits?

FlexPod helps companies:

- Rapidly make the journey to the cloud through a preconfigured solution

- Approach the private cloud confidently

- Scale up and out with ease

FlexPod™

- **Risk:** Many organizations lack repeatable processes and consistency in documenting best practices. IT administrators are not always certain where to turn for architectural and deployment guidance.
- **Orchestration and efficiency:** When organizations with a private cloud infrastructure need to expand their cloud capabilities, do they face starting again from the foundation?

Characteristics of a Successful Cloud-Based Application Infrastructure Platform

As demand for shared infrastructure grows, IT departments are looking for ways to make use of this important resource. They want to accelerate private cloud deployments to support business goals and increase agility, and they want to do so affordably while avoiding complexity and risk. With this in mind, IT departments today are considering a turnkey approach to private cloud computing. Through such an approach, they can deliver preconfigured and validated implementations of the private cloud. Here are some of the main characteristics of such a turnkey solution:

- It is built for high availability, with redundancy and failover.
- It can withstand outages without service degradation.
- It provides local control over data and operations so that IT professionals can dynamically pool, allocate, and manage resources for agile infrastructure as a service (IaaS).
- It lets business unit managers deploy line-of-business applications quickly and consistently by using self-provisioning, decommissioning, and automated data center services in a virtualized environment.
- It supports rapid deployment, reduced risk, and low cost of ownership.
- It is easy to purchase, implement, scale, and replicate, and it includes documentation of architecture, best practices, and prescriptive guidance, which can help you avoid starting every private cloud deployment from the very beginning.
- It is application-centric in its shared IT infrastructure and data management.
- It offers an integrated management interface and tools for server, storage, networking, orchestration, backup and restore operations, and data replication.
- It supports an incremental move to the cloud, without the need to remove and replace your current infrastructure.

FlexPod Architectural Integration

Meeting your needs for turnkey cloud infrastructure, the FlexPod platform, jointly delivered by Cisco and NetApp, consists of a defined set of hardware and software designed specifically for IaaS environments based on Microsoft platforms. A pre-validated data center platform, FlexPod can address current virtualization needs and simplify the evolution to an IaaS infrastructure.[1] FlexPod with Microsoft Private Cloud can help improve agility and responsiveness, reduce total-cost-of-ownership (TCO), and align IT costs with business needs.

The following sections of this document describe the characteristics and components of this predesigned private cloud infrastructure.

Overview

FlexPod is built on leading computing, networking, storage, and infrastructure software components:

- Cisco Unified Computing System™ (Cisco UCS®)

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[1] FlexPod from Cisco and NetApp is validated through the Microsoft Private Cloud Fast Track program.

FlexPod™

- The Cisco Nexus® Family of data center switches
- NetApp Fabric-Attached Storage (FAS) storage components
- Microsoft Windows Server with Hyper-V and Microsoft System Center 2012 software

The solution provides an excellent virtualized data center configuration for running Microsoft applications through:

- Validated technologies from industry leaders in computing, storage, networking, and server virtualization
- A single platform built from unified computing, fabric, and storage technologies, with popular and trusted software virtualization
- Integrated components that help you centrally manage all your infrastructure pools
- An open management framework that integrates with your existing third-party infrastructure management solutions

Application Availability

By design, there is no single point of failure in the FlexPod configuration, so you can keep your critical business applications running. At the application level, either the application is clustered or redundant instances of it are running. A FlexPod configuration includes, for example:

- Domain controllers (optional): If an organization does not already have domain controllers in place, FlexPod offers two of them for redundancy.
- Microsoft System Center 2012: Microsoft System Center 2012 components are clustered either at the application level or at the virtual machine level. At the virtual machine level, if the node on which the virtual machine is running fails, that virtual machine will restart on a surviving node.
- Microsoft SQL Server. The Microsoft SQL Server cluster is native. There are multiple instances running on two nodes, and if one of the nodes fails, a surviving node takes over the instance.

Reliability

FlexPod is built on industry-leading components. Individually or together, these components support a high degree of availability for your critical business applications. All systems and fabric links offer redundancy, providing high availability throughout the entire system.

Data Center Solutions: Cisco UCS Server Platform and Cisco Nexus Switches

Designed to provide a high level of availability throughout, Cisco® data center solutions provide features such as redundant power distribution units, storage paths, networking, and disks. To help provide this level of availability, FlexPod uses two storage controllers to support multipathing for I/O.

To further support a reliable cloud platform for your applications, FlexPod relies on multiple network adapters on each host server. Virtual network interface cards (NICs) provide redundancy by using hardware-based NIC teaming known as Cisco Fabric Failover. The following network connections in the FlexPod design help support high availability:

- One network dedicated to management purposes on the host machine
- One network dedicated to the clustered shared volumes and cluster communication network
- One network dedicated to the live migration network
- One or more networks dedicated to the guest virtual machines (use 10-Gbps network adapters for highest consolidation)

- Two networks dedicated to Small Computer System Interface over IP (iSCSI) with multipath I/O (MPIO)

Cisco UCS uses a 10-Gigabit Ethernet unified fabric as the underlying I/O transport mechanism. FlexPod uses the unified fabric with a Cisco UCS virtual interface card (VIC). The Cisco UCS VIC is a standards-compliant converged network adapter (CNA) that enables traditional Ethernet and Fibre Channel traffic to share a common physical transport. An added advantage to using this card is the capability to dynamically carve out and assign large numbers of NICs and host bus adapters (HBAs) from the same physical card. By using two fully redundant 10 Gigabit Ethernet upstream ports, up to 128 I/O devices can be presented to the PCIe bus and to the operating system running on top of it. At the administrator's discretion, the administrator can mix these I/O devices between NICs and HBAs.

Integrated Network Strategy

An integrated network strategy at the core of Cisco UCS provides 10 Gigabit Ethernet connectivity to all components. Coupling this fabric with a stateless, policy-based server architecture allows vast simplification of the physical infrastructure typically deployed in a new server build-out.

Rather than including localized Ethernet and Fibre Channel switching in each chassis, all fabric aggregation is performed at a top-of-rack type of device called the fabric interconnect. Cisco UCS 6200 Series Fabric Interconnects are a family of line-rate, low-latency, lossless 10 Gigabyte Ethernet, Cisco Data Center Ethernet (DCE), and Fibre Channel over Ethernet (FCoE) interconnect switches that consolidate I/O at the system level. Based on the same switching technology as the Cisco Nexus 5000 Series Switches, the Cisco UCS 6200 Series Fabric Interconnects provide the additional features and management capabilities that make up the core of Cisco UCS.

Fabric Interconnects

The fabric interconnects supply a unified fabric that connects every server in the system through wire-once 10 Gigabyte Ethernet and FCoE downlinks and flexible 10 Gigabyte Ethernet and 1-, 2-, 4-, or 8-Gbps Fibre Channel uplinks. Out-of-band management, including switch redundancy, is supported through dedicated management and clustering ports. The interconnects feature front-to-back cooling, redundant front-plug fans and power supplies, and rear cabling that facilitate efficient cooling and serviceability. Typically deployed in active-active redundant pairs, the fabric interconnects provide uniform access to both networks and storage, eliminating the barriers to deploying a fully virtualized environment based on a flexible, programmable pool of resources.

Fabric Failover

FlexPod also offers hardware-based NIC teaming that relies on fabric failover capability in Cisco UCS. In the event of an upstream fabric failure, the NICs assigned to the failed fabric automatically fail over to use the remaining fabric. This occurs without the need for special teaming drivers that frequently introduce instability to a system. For storage-based fabric, FlexPod uses two SAN fabrics. It offers redundant connections to both fabrics and relies on multipathing software on the hosts to manage the path availability and load balancing.

Multipathing

To help further bolster reliability in FlexPod, multipathing solutions use redundant physical path components—adapters, cables, and switches—to create logical paths between the server and the storage device. In the event that one or more of these components fails, causing the path to fail, multipathing logic uses an alternate path for I/O so that applications can still access their data. By design in FlexPod, each NIC (in the iSCSI case) or HBA is connected by using redundant switch infrastructures to provide continued access to storage in the event of a failure in a storage fabric component.

Failover times can be configured by using timers in the Microsoft iSCSI Software Initiator driver or by modifying the Fibre Channel HBA driver parameter settings.

As shown in Figure 1, the standard FlexPod configuration provides a virtual PortChannel (vPC) between the Cisco access layer and the storage layer. A SAN PortChannel aggregates the paths between the fabric interconnects and the network switches.

FlexPod uses a vPC through the fabric for connections between the Cisco Nexus switches and the fabric interconnect and to the NetApp filers for iSCSI access. The configuration also provides redundancy between the NetApp filers and the Cisco Nexus switches.

Figure 1. FlexPod with Microsoft Private Cloud Logical Architecture
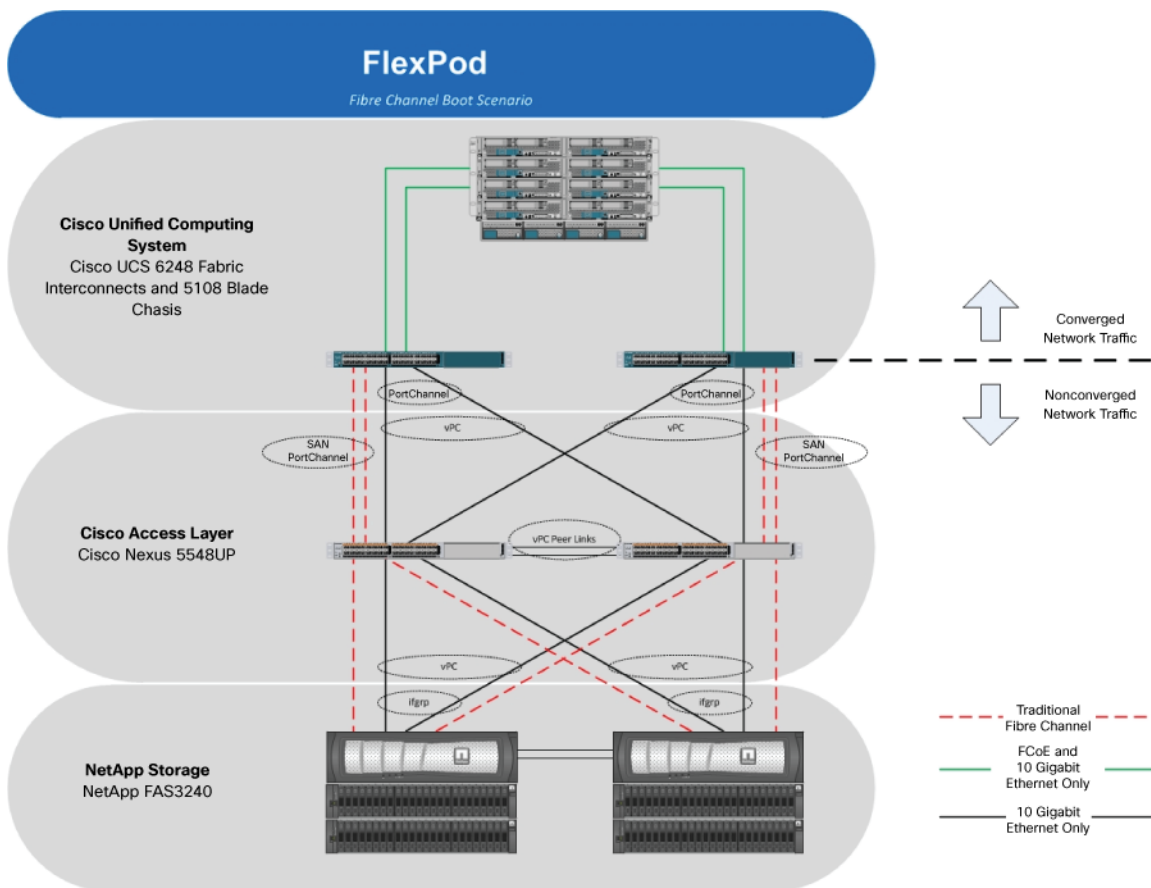
Performance

The FlexPod platform uses industry-standard Intel processors with 10 Gigabyte Ethernet connectivity. The platform also has optimal virtualization support through hardware virtualization capabilities. Intel Virtualization Technology serves as the baseline, along with the Second Level Address Translation capabilities of Microsoft Windows Server 2012 R2 with Hyper-V to optimize performance.

Scalability

The FlexPod architecture is a base configuration that is also highly modular, or "pod" like. After you build a FlexPod unit, you can easily scale it when requirements change.

You can scale the unit up for greater performance and capacity by adding resources within a FlexPod unit, without complicating management. In addition, you can add up to 20 chassis and 8 servers per chassis. To meet greater I/O requirements or to support more servers, you can also upgrade Cisco UCS 6200 Series Fabric Interconnects and Cisco Nexus switches to components that have more ports. FlexPod gives you the freedom to scale your private cloud infrastructure. No matter how far you scale it, you manage it the same way so that you avoid complicating administration.

If your environment requires it, you can also scale out by adding FlexPod units. This expansion requires re-creating the core infrastructure and managing the new Cisco UCS domain independently from prior FlexPod units.

Components

Bringing together industry-leading technologies in an integrated private cloud solution, FlexPod serves as an integrated foundation for virtualization solutions. In this modular solution, the computing and storage resources can fit in one data center rack, with the networking residing in a separate rack or deployed according to an organization's data center design. Due to port density, the networking components can accommodate multiple such configurations.

As shown in Figure 1, the typical FlexPod with Microsoft Private Cloud solution uses the following hardware:

- Eight Cisco UCS B200 M3 Blade Servers
- One Cisco UCS 5108 Blade Server Chassis, with two fabric extenders per chassis
- Two Cisco Nexus 5548UP Switches
- Two Cisco 6248UP 48-Port Fabric Interconnects
- One pair of NetApp FAS3240 high-availability storage appliances
- Four NetApp DS2246 disk shelves (96 drives; 1.8 terabytes [TB])

The NetApp storage components have two controllers that also can provide redundancy. They operate in active-active mode but are capable of failing over for each other.

Cisco B-Series Blade Server and Cisco UCS

Cisco UCS is the first converged data center platform that combines industry-standard, x86-architecture servers with networking and storage access in a single system. The system is entirely programmable by using unified, model-based management to simplify and accelerate deployment of enterprise-class applications and services running in bare-metal, virtualized, and cloud-computing environments.

The system's x86-architecture rack-mount and blade servers are powered by Intel Xeon processors. These industry-standard servers deliver world-record performance to power mission-critical workloads. Cisco servers, combined with a simplified, converged architecture, increase IT productivity and promote superior price and performance for lower TCO. Building on the strength of Cisco in enterprise networking, Cisco UCS is integrated with a standards-based, high-bandwidth, low-latency, virtualization-aware unified fabric. The system is wired once to support the desired bandwidth and carries all Internet protocol, storage, interprocess communication, and virtual machine traffic with security isolation, visibility, and control equivalent to physical networks. The system meets the bandwidth demands of today's multicore processors, eliminates costly redundancy, and increases workload agility, reliability, and performance.

Cisco UCS is designed from the foundation to be programmable and self-integrating. A server's entire hardware stack—ranging from server firmware and settings to network profiles—is configured through model-based management. By using Cisco UCS VICs, even the number and type of I/O interfaces is programmed dynamically, making every server ready to power any

workload at any time. With model-based management, administrators manipulate a model of a desired system configuration and associate a model's service profile with hardware resources, and then the system configures itself to match the model. This automation accelerates provisioning and workload migration with accurate and rapid scalability. The result is increased IT staff productivity, improved compliance, and reduced risk of failures due to inconsistent configurations.

Cisco Nexus fabric extender technology reduces the number of system components that need to be purchased, configured, managed, and maintained by condensing three network layers into one. It eliminates both blade server and hypervisor-based switches by connecting fabric interconnect ports directly to individual blade servers and virtual machines. Administrators can then manage virtual networks in the same way that they maintain physical networks, and take advantage of massive scalability. This approach represents a radical simplification over traditional systems, reducing capital and operating costs while increasing business agility, simplifying and accelerating deployment, and improving performance.

Cisco UCS helps organizations go beyond efficiency: It helps them become more effective through technologies that increase simplicity rather than complexity. The result is flexible, agile, high-performance, self-integrating information technology; reduced staff costs with increased uptime through automation; and faster return on investment (ROI).

Cisco Nexus 5548UP Switches

Cisco Nexus 5548UP Switches deliver innovative architectural flexibility, infrastructure simplicity, and business agility. With support for networking standards for virtualized, unified, and high-performance computing environments, the switches offer many IT and business advantages, including:

- Architectural flexibility
  ◦ Takes advantage of unified ports that support traditional Ethernet, Fibre Channel, and FCoE
  ◦ Synchronizes system clocks with accuracy of less than one microsecond, based on the IEEE 1588 standard
  ◦ Offers converged fabric extensibility, based on the emerging standard IEEE 802.1BR, through the Cisco Fabric Extender Technology (FEX Technology) portfolio
- Infrastructure simplicity
  ◦ Takes advantage of a common, high-density, high-performance, data center–class, fixed-form-factor platform
  ◦ Consolidates LAN and storage
  ◦ Supports any transport over an Ethernet-based fabric, including Layer 2 and 3 traffic
  ◦ Manages storage traffic, including iSCSI, network-attached storage (NAS), and Fibre Channel
  ◦ Reduces management points with Cisco FEX Technology
- Business agility
  ◦ Addresses diverse data center deployments on one platform
  ◦ Provides rapid migration and transition for traditional and evolving technologies
  ◦ Offers performance and scalability to meet growing business needs

NetApp Family of FAS Storage Controllers

The NetApp unified storage architecture provides customers with an agile and scalable storage platform. All NetApp storage systems use the Data ONTAP operating system to provide SAN (FCoE, Fibre Channel, and iSCSI), NAS (Common Internet File System [CIFS] and network file server), and primary and secondary storage within a single unified platform so that all virtual

desktop data components can be hosted on the same storage array. Administrators use a single process for activities, such as installation, provisioning, mirroring, backup, and upgrading, throughout the entire product line—from the entry level to enterprise-class controllers. Having a single set of software and processes brings great simplicity to even the most complex enterprise data management challenges. Unifying storage and data management software and processes reduces the complexity of data ownership, enables companies to adapt to their changing business needs without interruption, and reduces TCO.

In a shared infrastructure, the availability and performance of the storage infrastructure are critical because storage outages or performance problems can affect thousands of users. The storage architecture must provide a high level of availability and performance. For detailed documentation surrounding best practices, NetApp and its technology partners have developed a variety of best-practice documents.

Microsoft Private Cloud Solutions

Built on Microsoft Windows Server 2012 with Hyper-V technology and Microsoft System Center 2012 solutions, Microsoft private cloud offerings provide the powerful capabilities that you need to build a private cloud infrastructure that can transform the way that your organization delivers IT services.

Microsoft private cloud solutions dramatically change the way that enterprise customers produce and consume IT services by creating a layer of abstraction over pooled IT resources.

Microsoft Hyper-V, the hypervisor in Microsoft Windows Server 2012, provides a scalable, reliable, and high-availability platform. Features in Microsoft Windows Server increase availability and performance, improve management, and simplify methods for deployment, including live migration.

By using Microsoft Hyper-V with Microsoft System Center 2012, customers gain enterprise-class virtualization, end-to-end service management, and deep insight to keep applications up and running more reliably. Microsoft private cloud solutions enable application-level management and monitoring, providing deep application insights with the capability to automatically orchestrate resources, deliver applications as services, rapidly resolve problems, increase application uptime, and meet service-level agreements (SLAs). In addition, the solutions support Microsoft and non-Microsoft hypervisors, operating systems, and open source tools, enabling you to extend your existing infrastructure investments and skills.

Microsoft private cloud solutions offer superior economics by integrating a highly available and easy-to-manage multiserver platform with breakthrough efficiency and ubiquitous automation. They also provide dynamic, multi-tenant virtualization, storage, and networking infrastructure, providing the flexibility needed to deliver and connect to cloud services.

Best-Practices Guidance and Documentation

FlexPod's comprehensive features and detailed guidance make private clouds easy to deploy. Features include:

- End-to-end architectural and deployment guidance
- Best practices and intellectual property to jump-start your private cloud project
- Technical reference architecture and design, build, and operate guides

At the end of this document, you will find links to FlexPod documentation.

Private Cloud Management

Private clouds require a level of automation and self-service that goes beyond what is required for traditional virtualized environments. Built-in management capabilities make it easy to manage your

FlexPod-based private cloud with Cisco UCS Manager, Microsoft System Center 2012, and NetApp plug-ins.

The implementation of a stateless computing model is a unique feature of the Cisco UCS architecture. By building a single point of management for all system components across as many as 160 server blades, Cisco has created a single-pane view for the entire computing infrastructure.

Cisco has created integration between Cisco UCS Manager and Microsoft System Center 2012. Likewise, NetApp has developed plug-ins for its storage components that open them to management by Microsoft System Center 2012. Both companies have also developed command-line interface (CLI) integration and libraries of cmdlets based on Microsoft Windows PowerShell that can help simplify management of the FlexPod shared infrastructure.

All components of the management system use the automation layer and do not introduce their own protocols, scripting languages, or other technologies. This approach simplifies management and operations and reduces the tools expertise that staff must maintain.

Administrators can use the management layer to perform activities such as provisioning the SAN, deploying an operating system, or monitoring an application. A critical attribute of the management layer is its ability to manage and monitor every individual component of the infrastructure remotely and to capture the dependencies among all of the infrastructure components.

Simplify the Transition to the Cloud and Deliver ITaaS

Your IT department can rely on FlexPod with Microsoft Private Cloud to achieve the benefits of the private cloud quickly and cost effectively while reducing risk.

Expedite Deployment for Increased Business Agility

As mentioned earlier, with FlexPod's rich features and detailed guidance make private clouds easier to deploy. Features include: [[THIS SENTENCE REPEATS THE SENTENCE THAT INTRODUCED THE LIST UNDER "Best Practices Guidance" ABOVE. IT ALSO DOESN'T SEEM TO FIT THIS LIST. PLS REWRITE.]]

- End-to-end architectural and deployment guidance
- Streamlined infrastructure planning due to predefined capacity
- Enhanced functions and automation tailored to your needs for supporting Microsoft applications in the private cloud
- Ease of scalability and repeatability, enabling your organization to add or upgrade servers, switches, or fabric interconnects for greater capacity, or to simply deploy another FlexPod solution as your needs grow and change, without the need to start from the beginning

Approach the Cloud with Confidence

Validated configurations mean that you can implement a solution with confidence. Lowering the risk in your move to the cloud, FlexPod offers:

- Integrated management for physical and virtual machines
- Self-service portal for rapid and simplified provisioning of resources
- Tested, end-to-end interoperability of computing, storage, and networking resources
- Predefined out-of-the-box solutions based on a common cloud architecture
- High degree of service availability through automated load balancing

Control Cost

FlexPod from Cisco and NetApp streamlines and economizes your journey to the private cloud while providing the flexibility to meet your organization's unique needs for an application-centric, shared IT infrastructure, offering:

- A cost-optimized, platform-independent, and software-independent solution for rack system integration
- Improved resource optimization that lowers costs for applications and IT services
- Shorter backup times and recovery time for each business-critical environment

Conclusion

FlexPod with Microsoft Private Cloud delivers application-centric turnkey infrastructure that is reliable and scalable. Developed by industry leaders and validated by Microsoft for Microsoft workloads, FlexPod can help improve business agility and responsiveness, reduce TCO, and improve alignment between IT capabilities and business needs.

How You Can Obtain the FlexPod Platform and Professional Services and Support

Whether you are looking for services for planning and design, implementation, integration, or operations, turn to Cisco and NetApp.

To obtain FlexPod, contact a reseller.

NetApp and Cisco are committed to accelerating resolution of a FlexPod support issue. Through our cooperative support model that takes advantage of the combined experience, resources, and technical support expertise across NetApp and Cisco, we streamline the identification and resolution of your FlexPod support case, regardless of where the problem resides.

For More Information

Visit the following sites for more information about FlexPod and related solutions:

- To learn about the FlexPod program, please visit http://www.cisco.com/go/flexpod.
- Other designs tested and validated by Cisco for critical Microsoft applications, such as Microsoft Exchange Server, Microsoft SharePoint Server, and SQL Server, are available at http://www.cisco.com/go/microsoft.
- To learn more about the Microsoft private cloud platform, visit http://www.microsoft.com/readynow and http://www.microsoft.com/en-us/server-cloud/new.aspx.

Why Cisco and NetApp for Microsoft Private Cloud?

Cisco and its strategic alliances help businesses realize the benefits of comprehensive solutions that draw on powerful technologies from industry leaders. To that end, FlexPod brings together the power of Cisco server and network infrastructure with leading NetApp storage solutions and a Microsoft technology–based private server and desktop virtualization solution. By using FlexPod, your business will be well on its way to moving to an IaaS model quickly, cost effectively, and with minimal risk.

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