



Microsoft Private Cloud Fast Track Reference Architecture Program

How to reduce private cloud risk and complexity while driving efficiency through the Fast Track Reference Architecture Program

Table of Contents

- Private Cloud Overview..... 4
 - Business Value 4
 - Technical Value..... 5
 - Private Cloud Operating System Vision..... 5
- New in R2 7
 - Windows Server 2012 R2..... 7
 - System Center 2012 R2..... 9
 - Windows Azure Pack..... 11
 - Impact of Differences to Private Cloud Offering..... 13
- Private Cloud Fast Track Reference Architecture 14
 - Compute..... 16
 - Storage 17
 - System Center 2012 R2..... 18
 - Fabric Logic Architecture 18
 - Why Fast Track? 20
- Conclusion 20

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Private Cloud Overview

Private cloud computing shares many of the same characteristics of public cloud computing, including resource pooling, self-storage, elasticity, and pay-by-use, all delivered in a standardized manner with additional control and customization available from dedicated resources. The major difference between public and private cloud is that private cloud uses resources which are dedicated to your organization. The key benefits of cloud computing are pooled resources, self-service, elasticity, and bandwidth usage. With private cloud, you have the added benefits of control and customization, because the cloud is dedicated to you.

While virtualization is an important component of private cloud, private cloud allows for abstraction of computing resources from infrastructure and the machines, virtual or otherwise. With private cloud, higher workload density and greater resource utilization lead to better cost effectiveness than virtualized infrastructure.¹

Business Value

Enterprises that choose to implement a private cloud solution experience a variety of business benefits, including increased utilization and decreased administrative burden on IT staff. Private cloud reduces deployment costs by allowing organizations to leverage the investments they have already made in large data centers, servers, supporting infrastructure, and management software to create a dynamic, fully-automated cloud. For organizations that want to leverage new hardware capabilities, there are many programs to help deployment of these new hardware architectures. Private cloud increases the utilization of existing infrastructure, which decreases costs. According to David Linthicum of Gigaom Research, utilizing private cloud can increase utilization from 40 percent up to 75 percent or 85 percent, and give administrators detailed insight concerning how the infrastructure is being used².

With the type of automation enabled through private cloud, the hands-on provisioning for multiple workloads performed by administrators is decreased, allowing them to focus on strategic functions. Private cloud allows enterprises to better meet its business needs by customizing according to its technology, standards, application, and users. As a result, users enjoy a self-service experience.³ The increase in utilization leads to improved systems availability and more highly-scalable platforms to meet escalating demands. Another benefit of private cloud is the flexibility to integrate with other public and private cloud resources. When determining if private cloud is the right option for your organization, it is important to consider if your organization is ready from an internal system perspective. For more information on assessing if your organization is ready, please see [Private Cloud: A Technical Perspective](#) and [Define Your Private Cloud Strategy](#). Unlike public clouds, the enterprise needs to purchase, configure, and maintain the hardware and software. Additionally, it is important to assess the organizational readiness for the private cloud in terms of skills within the company for design, maintenance, and installation.

¹ "Microsoft Private Cloud." http://download.microsoft.com/download/A/D/9/AD9E9446-D20C-42DE-8FD7-2352C1D15518/Microsoft_Private_Cloud_Whitepaper.pdf

² Linthicum, David. "Are Private Clouds Worth It?" Gigaom Pro. 13 Feb. 2013. <http://research.gigaom.com/2013/02/are-private-clouds-worth-it/>

³ "Tech Debate: Cloud: Public or private?" NetworkWorld. <http://www.networkworld.com/community/tech-debate-private-public-cloud>

Technical Value

The technical benefits of adopting a private cloud service, when properly deployed, should include: performance, reliability, security, and control. From a performance perspective, organizations experience greater bandwidth and lower latency as a result of private cloud implementation, while also providing a more consistent experience worldwide. Private cloud gives IT departments control of their infrastructure solution and allows enterprises to customize their data center, achieve greater acceleration when deploying workloads, and better optimize the enterprise's cloud infrastructure management.

With a private cloud, enterprises experience better reliability through redundant and scalable architectures. Use of private cloud allows IT departments to set up solutions that have excellent uptime characteristics and operations support. Run time for private cloud is significantly higher than the 99.5 percent uptime commonly available in other computing options.

With the private cloud, organizations have control over their data: who has access, where it is stored, and how it is transferred⁴. The additional flexibility benefits organizations as they can more quickly shift to meet business needs. Some organizations may choose private over public because it better meets the needs of those in IT who are maintaining core enterprise systems. For some, trusting a third party with core business processes and data is not an option⁵.

Private cloud gives IT departments more control in terms of networking choices and billing options. In terms of billing, enterprises can set up their own costing models and cost recovery models for chargeback. By controlling their own network, IT pros have the ability to manage who can access the network and what users have access to.

Private Cloud Operating System Vision

The Microsoft private cloud solution is composed on the software side of a combination of Windows Server with Hyper-V and System Center, which together provide enterprise-class virtualization, end-to-end service management, and deep insight into applications so you can focus more attention on delivering business value. Microsoft private cloud is best illustrated through four key pillars: all about the app, cross-platform from the metal up, foundation for the future, and cloud on your terms.

All About the App

In today's business environment, a central mission of IT is to deploy applications faster and keep them up and running more reliably. IT must go beyond just managing infrastructure and provide deep allocation insight and management of services. With Microsoft private cloud, IT pros can optimize the application lifecycle with service templates and self-service to improve availability and performance with deep application monitoring and diagnosis.

With Microsoft private cloud, IT pros can deliver new and legacy applications on a self-service basis and manage them across private cloud and public cloud environments. With stronger management, IT pros can see what's happening inside the performance of applications and address issues faster, before they

⁴ "Tech Debate: Cloud: Public or private?" NetworkWorld. <http://www.networkworld.com/community/tech-debate-private-public-cloud>

⁵ Linthicum, David. "Are Private Clouds Worth It?" Gigaom Pro. 13 Feb. 2013.

severely impact users' efficiency. The ultimate effect is better customer satisfaction, better service-level agreements (SLA), and a higher level of agility.

Cross-Platform from the Metal Up

In today's IT environment, a heterogeneous environment is common with a wide range of operating systems, hypervisors, and development tools in the mix. Microsoft's open and comprehensive approach puts customer's needs ahead of any particular technology, helping IT departments to implement private cloud without walking away from existing IT investments or adding new layers of complexity.

The comprehensive management of heterogeneous IT environments in the Microsoft private cloud helps IT departments to manage and monitor multiple operating systems. IT pros can drive process automation and configuration across platforms and toolsets, and develop applications using multiple application toolsets. With the flexibility to use any technology or vendor for infrastructure needs, organizations can put business needs first.

Foundation for the Future

The Microsoft private cloud helps organizations to go beyond virtualization to a true cloud platform, which will have long-term implications in terms of providing agility for various IT environments. Using Microsoft private cloud, enterprises benefit from the best-in-class performance for key Microsoft workloads, such as SharePoint, Exchange, Lync, and SQL Server. The Microsoft private cloud platform and management approach was designed to be comprehensively and deeply integrated, spanning the private and public cloud.

The Microsoft private cloud solution offers the economics of the private cloud with easy virtualization rights licensing. Using a private cloud solution can help enterprises to attain higher levels of utilization of server resources: a dedicated server may not run at full processor and hard disk capacity, but given its dedicated nature, it will not be able to take on additional capacity. With Hyper-V, IT administrators can get additional utilization by running more than one process on the same machine. The private cloud helps enterprises to take advantage of the capabilities Microsoft built to utilize servers as efficiently as possible, and use fewer computing resources to perform the same workload.

Cloud on Your Terms

In order to experience the benefits of public and private cloud computing, organizations need the ability to leverage existing investments, infrastructure, and skill sets to build the right mix of public and private cloud solutions. IT departments can distribute services across physical, virtual, and cloud computing models because of Microsoft's common set of management, identity, virtualization, and development technologies. Additionally, IT departments have the power to construct and manage clouds across multiple data centers, infrastructures, and service providers. With Microsoft private cloud, IT departments can delegate authority and tools to enable self-service across environments while retaining control across the private and public clouds for compliance and security.⁶

Microsoft private cloud allows enterprises to focus on primary business value through application services management and make the best use of current investments and skills. IT departments can deliver greater customization and control by providing the increased scale and flexibility of cloud computing on dedicated resources while managing across public and private clouds through common management,

⁶ "Microsoft Private Cloud." November 2012. http://download.microsoft.com/download/A/D/9/AD9E9446-D20C-42DE-8FD7-2352C1D15518/Microsoft_Private_Cloud_Whitepaper.pdf

identity, and developer tools. Additionally, Microsoft private cloud provides the flexibility to build solutions that work across platforms.

System Center tenant-based utilization of resources can be viewed to enable chargeback and billing. Enterprise-friendly identity providers are supported to authenticate and authorize tenants. Additionally, IT pros can subscribe to select Azure services hosted on the cloud platform from their service provider. With Microsoft private cloud, a quick-responding portal can be offered to tenants, as well as an API user experience that scales across an organization's infrastructure. Other benefits include offering backup services, monitoring, and troubleshooting of hosting fabric. Virtual machines and virtual machine services can be managed via a web-facing API that is consistent with Azure and can manage multi-virtual machine services in a single portal experience. Web site and service bus service can be easily set up, configured, and managed. With Microsoft private cloud, Windows and Linux virtual machines can be created from a volume of templates. Additionally, applications can be built that leverage websites as a service in Windows Server 2012 R2.

New in R2

With the release of Windows Server 2012 R2 and System Center 2012 R2, Microsoft has strengthened its Private Cloud solution with new features and enhanced alignment between tools. The section below outlines the advances made in Windows Server 2012 R2 and System Center 2012 R2 that highlight the features needed to build a private cloud. These features have been selected to highlight the private cloud advancements made in the Windows Server 2012 R2 release.

Windows Server 2012 R2

Server Virtualization

Windows Server 2012 R2 with Hyper-V provides the platform and tools needed to increase business agility⁷. Live migration is an important virtual machine mobility feature that has been improved in Windows Server 2012 R2 by allowing the administrator to configure optimal performance options when moving virtual machines to a different server. This can reduce the overhead for network and CPU usage, as well as reducing the time it takes to perform a live migration. Hyper-V live migration has also been updated to support the move from Windows Server 2012 to Windows Server 2012 R2, and upgrading to a new version of Windows Server no longer requires downtime to the virtual machines.

In addition to the standard TCP/IP method used by Hyper-V in Windows Server 2012, Windows Server 2012 R2 includes a compression option, which compresses the memory content of the virtual machine to be migrated before copying it over to the destination server via TCP/IP connection. Windows Server 2012 R2 also includes support for SMB 3.0 connections. For more information, see [Improve Performance of a File Server with SMB Direct](#).

⁷ http://download.microsoft.com/download/0/2/1/021BE527-A882-41E6-A83B-8072BF58721E/Windows_Server_2012_R2_Overview_White_Paper.pdf

Windows Server 2012 R2 provides complete flexibility with multiple options for guest clustering to meet the needs of service providers with multi-tenant environments. Windows Server 2012 R2 offers shared VHDX files in addition to Fibre Channel, iSCSI, and server message block (SMB). VHDX can be stored either on a scale-out file server cluster or on Cluster-shared Volumes (CSV) on block storage. For a virtual machine that is part of the guest cluster, shared VHDX clustering preserves dynamic memory, live migration and storage live migration.

Hyper-V Replica is another update to Windows Server 2012 R2. Hyper-V Replica provides a storage-agnostic and workload-agnostic solution that replicates efficiently, periodically, and asynchronously over IP-based networks, typically to a remote site. Additionally, ongoing replication will not be disrupted while an administrator tests the replica virtual machine. It allows for variable (configurable) replication frequencies down to 30 seconds or up to 15 minutes and also supports multiple nodes, which means that tertiary replica sites are supported.

Windows Server 2012 R2 integrates with heterogeneous IT environments and supports a cross-platform cloud infrastructure by adding comprehensive functional support for Linux guests running on top of Hyper-V. Full dynamic memory support for Linux guests was introduced in Windows Server 2012 R2, including a minimum memory setting, Hyper-V smart paging, memory ballooning, and runtime configuration. With Windows Server 2012 R2 there is no manual step involved to take advantages of Linux Integration Services.

Storage

Windows Server 2012 R2 was designed with a strong focus on storage capabilities to meet growing storage demands. With storage tiering, a new feature in Windows Server 2012 R2, high-capacity spinning disks are used to store less frequently used data, while high-speed solid state disks are reserved to store frequently used data. By letting you store server application data on file shares and obtain a similar level of reliability, Windows Server 2012 R2 reduces server downtime and application disruption.

New in Windows Server 2012 R2, SMB sessions can be managed per share (not just per file server), which increases flexibility. Windows Azure Hyper-V Recovery Manager is another new feature in Windows Server 2012 R2, which offers a robust recovery solution that can protect data centers by automating the replication of the virtual machines that compose them at a secondary location. Windows Azure Hyper-V Recovery Manager also provides continuous health monitoring of the primary data center, and it helps automate the orderly recovery of services in the event of a site outage at the primary data center.

Networking

Windows Server 2012 R2 makes it more straightforward to manage an entire network as a single entity, giving you the reliability and scalability of multiple servers at a lower cost. Hyper-V Network Virtualization and the Hyper-V Extensible Switch are the foundations of software defined networking in Windows Server 2012 R2. You can isolate network traffic from different business units or customers on a shared infrastructure and not be required to use VLANs.

New to Windows Server 2012 R2 is Storage Quality of Service (QoS), which allows you to restrict disk throughput for overactive or disruptive virtual machines and can be configured dynamically while the virtual machine is running. Providers can build a multi-tenant environment using Hyper-V in Windows Server 2012 R2 by serving multiple clients in a more insulated fashion. Windows Server 2012 R2 simplifies aggregation of resource use data through resource metering, which tracks important performance indicators such as average CPU used by a virtual machine in megahertz and the average physical memory used by a virtual machine over a period of time.

Windows Server 2012 R2 includes the Hyper-V Extensible Switch, which provides programmatically managed and extensible capabilities to connect virtual machines to the physical network. Windows Server 2012 R2 includes a multi-tenant virtual network gateway for cross-premises connectivity.

Server Management and Automation

With Windows Server 2012 R2, IT professionals can automate and manage their growing data center ecosystem through an integrated platform. New APIs provide support for recent standards and add new Windows PowerShell commands (cmdlets) that make managing multiple servers and devices simpler and more cost-effective. With Windows Server 2012 R2, you get Server Manager to enable provisioning of server and offline virtual hard disks from your desktop without physical access or Remote Desktop Protocol.

Windows Server 2012 R2 increases business agility through Windows PowerShell 4.0, which helps IT pros manage server roles, quickly automate management tasks, and monitor scripts more efficiently. Using the built-in integrated scripting environment, PowerShell scripts can be written more quickly and intuitively. Other new management capabilities, such as desired state configuration, help to deploy resources in a repeatable and standardized manner. Desired state configuration helps standardize deployments by ensuring that components of the data center have the right configuration.

System Center 2012 R2

Infrastructure Provisioning

Infrastructure provisioning enables the allocation of physical, virtual, and cloud infrastructure to meet requirements such as workload scale and performance, enterprise-class multi-tenancy for hybrid environments, and chargeback. With System Center 2012 R2, custom or standardized infrastructure can be provisioned for on-premises, service provider, or Windows Azure environments.

System Center 2012 R2 delivers world-class management for Windows Server environments by supporting the scale and performance delivered by Windows Server 2012 R2. Microsoft will deliver System Center 2012 R2 simultaneously with Windows Server 2012 R2 so that infrastructure deployments can take maximum advantage of native platform capabilities⁸. Virtual Machine Manager (VMM) is a feature of System Center 2012 R2 that helps enable virtualization-management scale. For maximum flexibility and efficiency, VMM enables storage management across a variety of storage approaches across file and block storage. New enhancements to System Center 2012 R2 VMM include new functionality for site-to-site gateways for Hyper-V network virtualization using Microsoft software. This functionality supports higher capacity and better reliability for hosts of virtualized networks, and enables the majority of tenant scenarios⁹.

In System Center 2012 R2, VMM supports at-scale management of Windows Server 2012 File and Storage Services, providing availability, resiliency, and performance normally expected from high-end hardware¹⁰. Windows Server R2 offers the ability to automatically upgrade Hyper-V clusters to reduce the time, effort, and downtime required to upgrade from Windows Server 2012 to Windows Server 2012 R2.

⁸ <http://channel9.msdn.com/Events/TechEd/Europe/2013/MDC-B206#fbid=I1flmSWeP8u>

⁹ <http://technet.microsoft.com/library/dn246490.aspx>

¹⁰ <http://technet.microsoft.com/library/dn246490.aspx>

As cloud computing adoption increases, large enterprises are looking to increase the scale and efficiency of their data center infrastructure while delivering infrastructure services in a secure, isolated manner. With System Center 2012 R2, flexible workload mobility is enabled in hybrid cloud environments through multi-tenant edge gateways. Additionally, System Center 2012 R2 enables chargeback for multi-tenant environments with detailed infrastructure metering and business and operational analytics.

With System Center 2012 R2, enterprise IT organizations can provision and manage their data center infrastructure using a single management toolset. System Center R2 provides a unified tool to provision and manage virtual machines into on-premises and Windows Azure environments. The App Controller feature enables migration of on-premises Hyper-V virtual machines into Windows Azure virtual machines. At-scale provisioning and management of Windows Azure virtual machines and Windows Azure storage can be conducted in an automated manner using the Orchestrator component of System Center 2012 R2¹¹.

Infrastructure Monitoring

System Center 2012 R2 provides comprehensive monitoring of physical, virtual, and cloud data center infrastructure, which helps ensure reliable performance and availability to deliver on business and operational SLAs. Many organizations have a mix of both Windows Server and non-Windows Server platforms, which requires a tool that can help manage infrastructure in a diverse environment. System Center 2012 R2's Operations Manager component produces a dashboard view of performance metrics across storage, network, and compute on a variety of resources such as load balancers, Internet Information Services pools, storage logical unit numbers (LUN), hosts, storage pools, files servers, virtual machines, SMM servers, and host clusters.

Automation and Self-Service

System Center 2012 R2 empowers application owners with the agility they expect while providing IT pros with the tools needed to drive automation and control. IT needs centralized control over delivering infrastructure, while providing application owners the ability to define infrastructure requirements. System Center 2012 R2's VMM component provides service templates, which enables application owners to work with IT to define standard application blueprints.

With the App Controller component of System Center 2012 R2, IT has the visibility and control it needs across on-premises, service provider, and Windows Azure infrastructure. Additionally, App Controller enables easy virtual machine and workload portability between Windows Server and Windows Azure without a need for format conversion.

For additional flexibility required for transient usage patterns, System Center 2012 R2 enables application owners to work with their infrastructure counterparts to deploy automated workflows that would trigger additional capacity provisioning. Microsoft provides and supports automation toolsets including Orchestrator and PowerShell.

Application Performance Monitoring

Deep application insight into application health is essential with the current fast pace of application cycles and real-time collaboration between application developers and IT staff. With System Center 2012 R2's Operations Manager, IT has visibility into performance and availability metrics from multiple perspectives, such as server-side monitoring, end-user experience, and synthetic transaction monitoring. Additionally,

¹¹ <http://www.microsoft.com/en-us/server-cloud/products/system-center-2012-r2/default.aspx>

operations staff can dig into application stack traces to identify problematic lines of code. System Center 2012 R2 has new Java application performance monitoring capabilities, which enables support for Java Tomcat application servers and multiple Java web services frameworks. By integrating with Microsoft Visual Studio, Operations Manager enables productive development and operations collaboration helping ensure applications are up to date and delivered to a rapid application lifecycle.

IT Service Management

IT services need to be defined and consumed in a centralized manner in order for IT to maintain oversight and governance into core data center processes and systems. At the same time, IT departments must balance control with flexibility to allow for self-service consumption by business users and application owners.

With the Service Manager component of System Center, users and application owners can request IT services including private cloud capacity through a service catalog using the Cloud Service Process Pack. System Center 2012 R2 enables SharePoint 2013 support for the service catalog portal. Through integration with VMM and Operations Manager, Service Manager delivers in-box metering and price sheets for virtual machines and private cloud, which incentivizes better consumption behaviors. Additionally, operational SLA trends can be analyzed through self-service reporting.

Windows Azure Pack

The Windows Azure Pack for Windows Server provides a solution for enterprises to deliver Windows Azure technologies into the private cloud, facilitating a rich, self-service, multi-tenant cloud with Windows Azure-consistent experiences and services and a single pane of glass from which to manage them. The Windows Azure Pack is a collection of Windows Azure technologies available to Microsoft customers at no additional cost. Windows Azure Pack's Management Portal provides a self-service interface that every subscriber uses to provision and manage services, such as web sites and virtual machines. Service Management API is a Rest API that underlies the management portal and enables automation. The Service Management API can be called by other management portals and automation services such as Parallels.

Enterprises want flexibility and agility around cloud choice whether for financial, business, or compliance reasons, in order to meet business needs. Enterprises are looking to decrease costs by simplifying operations through automated billing and more effectively utilizing existing hardware assets, while providing flexibility to tenants in how they choose to use capacity. At the same time, they want to be able to integrate with their existing system and implement a multi-tenant cloud that is as easy for users as Windows Azure.

Core to delivering on the cloud operating system promise is enabling parity of application owner experiences regardless of where the underlying infrastructure may reside: on-premises, in a hosted environment, or on Windows Azure. Organizations want a uniform self-service and management experience for tenant users that allow them to consume the infrastructure needed by their application services for both Windows Azure and Windows Server environments. Organizations and service providers are already running a sophisticated operating system, virtualization, and management platform with Windows Server with System Center on their own compute, storage, and network infrastructure in their data centers.

The Microsoft cloud operating system vision drives consistency across Windows Azure, enterprise, and service provider environments. The Windows Azure Pack takes Windows Azure technology developed for Microsoft's data centers and repurposes it to provide the same capabilities running on System Center and

Windows Server on customers' infrastructure. With Windows Azure Pack, the technology to develop and test highly distributed cloud services can be delivered to enterprises as part of the technology found in Windows Server and System Center¹².

Windows Azure Pack provides consistency in portal, API, and select services across Microsoft and Enterprise. This allows IT departments to deliver:

- Enterprise-friendly, frictionless cloud
- Multi-tenant Infrastructure as a service based on Windows Azure
- Usage billing
- Automation
- Improved hardware utilization
- Tenant choice
- Offer management
- Portal integration and branding

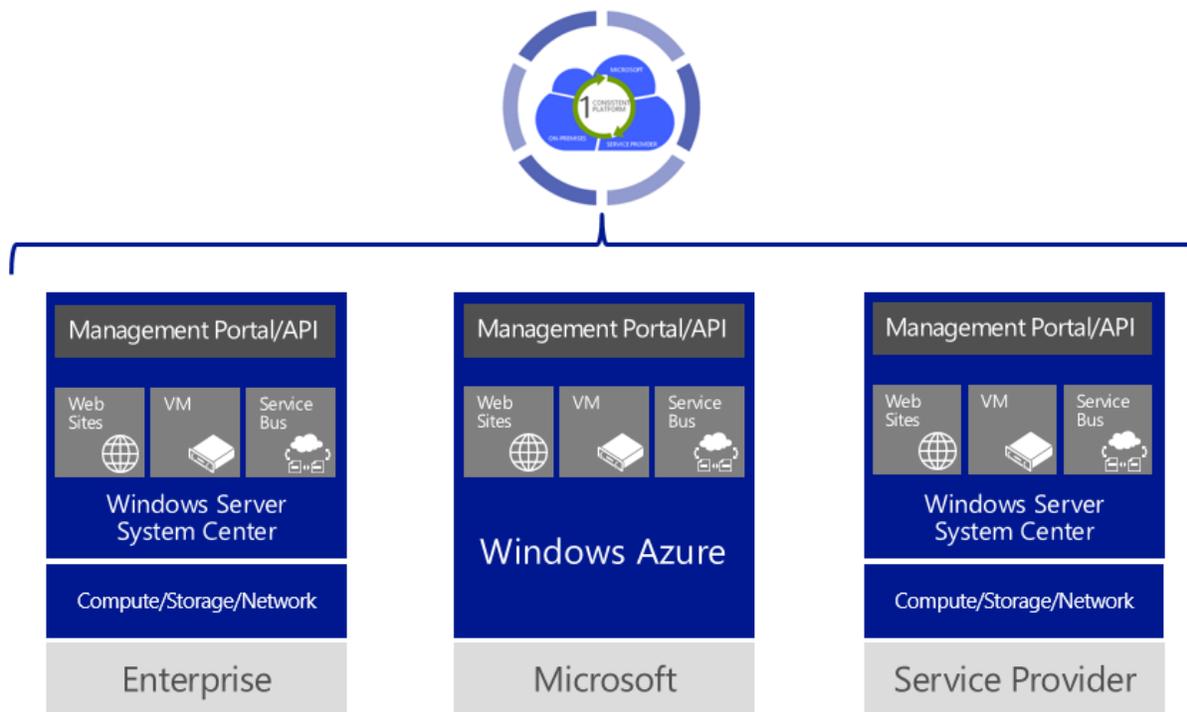


Figure 4: Windows Azure technology in enterprise and service provider data centers

With Windows Azure Pack, the enterprise can have Azure technology running in its data center. It is important to note that these services are deployed on existing infrastructure, meaning that organizations can utilize what they already own. The management portal replicates the Windows Azure Developer portal experience in Windows Azure with a subset of the services available in full Windows Azure. All the capabilities available in the management portal can be accessed programmatically through the Service Management API. This allows the portal to be completely replaced, for example, if an enterprise has their own portal which they want to integrate the Azure services into.

¹² "Windows Server 2012 R2 Preview." 2013. <http://www.microsoft.com/en-us/server-cloud/windows-server/windows-server-2012-r2.aspx>

By bringing the Windows Azure Service Management Portal experience and API to Windows Server, Microsoft is helping IT departments to administer web sites and virtual machine services on Windows Server while offering a self-service user experience to provision and manage their websites and virtual machines. The portal experiences are customizable and extensible because the management portal is built on a REST-based Service Management API¹³.

Impact of Differences to Private Cloud Offering

With the release of Windows Server 2012 R2, System Center 2012 R2, and Windows Azure Pack, IT departments can continue to enable the rich self-service, transparent accounting, and guaranteed uptime expected from a cloud. Through private cloud, enterprises have the added benefits of privacy and security of private machines.

Additionally, enterprises benefit from easy mobility of applications from developer environments to servers to hyper-V virtual systems to Private Cloud to Windows Azure through one solution to allow for instantiation of servers and services in the appropriate realm for business and IT needs¹⁴.

The changes to Windows Server 2012 R2 include many small changes in key areas, which together make the server operating system an even more robust and scalable system. One of the largest updates include the improvements to Hyper-V, which not only close the gap between Microsoft and VMWare, they leave VMWare behind, according to Mike Brown of ServerWatch¹⁵. The updates to Hyper-V allows you to:

- Share virtual hard disk format files (VHDX) as storage for clustered applications
- Allow guest operating systems to connect to the VHDX without needing the storage method to be defined
- Specify minimum and maximum I/O load for each virtual hard disk using storage QoS
- Export a virtual machine while it is still running
- Detect problems in cluster nodes using failover clustering, and automatically start other nodes in the cluster to provide service
- Monitor unmanaged storage used by clustered virtual machines

These updates provide enormous benefit and utility to enterprises that leverage Windows Server 2012 R2 and System Center 2012 R2 in the private cloud. The breadth of updates and new offerings provide administrators greater control and better tools for managing the enterprise networks, and facilitates greater productivity and convenience for users.

¹³ "Windows Azure Pack for Windows Server." 7 Oct. 2013. <http://www.microsoft.com/en-us/server-cloud/windows-azure-pack.aspx>

¹⁴ "Unified management for the Cloud OS System Center 2012 R2." 7 Oct. 2013 <http://www.microsoft.com/en-us/server-cloud/system-center/system-center-2012-r2.aspx>

¹⁵ "Windows Server 2012 R2: It's the Little Things that Count" July 23, 2013. <http://www.serverwatch.com/server-reviews/windows-server-2012-r2-its-the-little-things-that-count.html>

Private Cloud Fast Track Reference Architecture

The Microsoft Private Cloud Fast Track Program is a joint effort between Microsoft and its hardware partners to help organizations decrease the time, complexity, and risk of implementing private clouds. The benefits of the Microsoft Private Cloud Fast Track Program include faster deployment, reduced risk, and lower cost of deployment. Private Cloud Fast track Reference architecture provides a high level of pre-integration with reduced risk and deployment time. The End to End Deployment Guide provides step by step instructions and configuration details that enable consistency in multiple deployments. Microsoft and its partners become trusted advisors for customers deploying new private cloud solutions. Customers can trust that the validation process will greatly simplify the deployment process and help mitigate any issues that arise.

Resiliency is a key tenet of Microsoft Private Cloud Fast Track solutions, which includes the following features:

- Disaster recovery with Hyper-V
- Asynchronous replication with Hyper-V Replica
- Synchronous replication using cluster shared volume (CSV) 2.0 integration with storage arrays
- Application and service failover for:
 - Non-Cluster Aware Apps: Hyper-V App Monitoring
 - Virtual machine guest cluster: iSCSI, Fibre Channel
 - Virtual machine guest teaming of SR-IOV NICs
- I/O redundancy using:
 - Network Load Balancing and Failover via Windows NIC Teaming
 - Storage Multi-Path IO (MPIO)
 - Multi-Channel SMB
- High availability during:
 - Planned maintenance with Live Migration
 - Unplanned maintenance or incidents with failover clustering
- Hardware fault monitoring with Windows Hardware Error Architecture (WHEA)/RAS

The Fast Track program is designed with key architectural principles in mind. Pooled resources allow aggregation of resources that can then be parsed for better efficiency. The design is elastic, allowing for changes in the availability of applications and services based on need. A consistent performance experience is delivered through high availability and predictability. The multi-tenancy feature allows for the separation of departments and customer-enabling capabilities, such as separate chargebacks and resources for self-service and management. Additionally, the architecture is partner extensible.

The Fast Track Reference Architecture provides flexibility through three design patterns: continuous availability over SMB storage, converged infrastructure, and non-converged infrastructure. With the first design pattern, continuous availability over SMB storage, Hyper-V clusters consume storage from scale-out file server clusters or SMB 3.0-enabled storage devices. This design pattern requires network infrastructure between the Hyper-V servers and file servers and is optimal for low cost “just a bunch of disks” (JBOD) strategy enabled by networking capabilities of SMB Multichannel and remote direct memory access. The second design pattern is converged infrastructure and provides cost savings and operational

efficiency of a single common Ethernet network, compared to multiple physical networks and host bus adapters (HBA) for storage traffic. Converged infrastructure is appropriate for large or recent investment in blade servers with converged-network and storage-network infrastructure. This design pattern is optimal for leveraging a converged-network architecture. With the third design pattern, non-converged infrastructure, there is an emphasis on minimizing risk and cost of new hardware and designs since this design can reuse existing hardware. For example, this design is ideal for large or recent investment in server and blade hardware with HBAs and is optimal for leveraging an existing storage area network (SAN) investment.

The Fast Track validation process is comprised of four steps:

1. Formulate solution: choose and formulate solution based on Fast Track architecture and management guides.
2. Build checklist: review your Fast Track validation checklist for chosen hardware configuration and program compliance.
3. Install solution: build the system using physical hardware and Microsoft's software guides and review of your failover cluster validation wizard reports for any potential issues.
4. Validation: perform and evaluate the functional and stress tests using an in-person or remote session.

In Fast Track implementations, it is mandatory that each architecture solution pass several validation requirements including Windows hardware certification, failover-clustering validation, clustered RAID controller validation (if a third-party clustered RAID controller is used), and other pre-defined validation criteria. The validation criteria includes mandatory, recommended, and optional criteria.

Mandatory requirements are necessary for passing the Microsoft validation. The following are a sample of mandatory criteria:

- Fast Track infrastructures will provide a minimum of two hosts configured as a failover cluster, with the Hyper-V role enabled to support fabric management operations
- The rack or blade-chassis design must provide redundant power connectivity
- Support for virtual machine mobility
- Support for Hyper-V live migration
- Support for storage migration
- All features must work with Live Migration

Recommended requirements are standard best practices that are strongly recommended, yet are not required for passing the Microsoft validation. The following are a sample of recommended criteria:

- BitLocker Encrypted Cluster Storage. BitLocker-encrypted CSV for deployments that lack strong physical security and access controls to servers.
- Network isolation. For the private cloud scenario, the recommendation is to use one or more external networks per virtual machine, and segregate the networks with VLANs or network virtualization as appropriate.
- If the chosen server hardware supports an out-of-band management adapter, establish a dedicated LAN for these adapters.
- Standardized virtual machine deployments. The use of VMM service templates is recommended.
- Windows Azure Pack deployment.

Optional requirements are voluntary considerations that can be implemented in the solution at the discretion of each partner. Sample optional criteria include the following:

- Hyper-V application monitoring
- Virtual machine failover prioritization
- Virtual machine affinity (and anti-affinity) rules

- Use of third-party Hyper-V Virtual Switch extensions
- Resource metering
- Fibre Channel disks
- Solid-state hard drives

Compute

The system architecture of the host server refers to the general category of the server hardware including rack mounted servers, blade servers, and large symmetric multiprocessor servers. The host server must provide the required capacity in terms of processors, RAM, storage, and network capacity. When selecting system architectures, it is important to consider that each Hyper-V host will contain multiple guest operating systems with multiple workloads. The rack or blade chassis design should provide multiple power distribution unit capability for racks, or multiple hot-swappable power supplies for the blade chassis.

Server and blade design recommendations:

- 2 to 12 socket server with a maximum of 64 logical processors enabled
- 64-bit CPU with virtualization technology support, data execution prevention, and second level address translation
- 64 gigabytes (GB) RAM minimum
- Min 40 GB local RAID 1 or 10 hard-disk space for the operating system partition or an equivalent boot from a SAN design

Server and blade storage connectivity recommendations:

- Internal serial advanced technology attachment (SATA) or serial attached storage (SAS) controller for direct attached storage unless design is 100 percent SAN-based including boot from SAN for the host operating system
- If you are using a Fibre Channel SAN, two or more 4 to 8 gigabit fibre channel HBAs
- If you are using iSCSI, two or more 1 Gb or 10 Gb network adapters or HBAs
- If you are using Fibre Channel over Ethernet two or more 10 Gb converged network adapters

Server and blade high availability and redundancy recommendations:

- If the solution uses rack mounted servers or blade servers, each server should have redundant power supplies and fans.
- If the solution utilizes a Hyper-V host system partition that uses direct attached storage, each server should provide SAS or SATA RAID capability for the system partition.

Windows Server 2012 R2 Hyper-V

The virtualization in Fast Track is provided at multiple layers, including storage, network, and server. Resource pooling is supported at all three layers through virtualization. Storage virtualization is the separation of logical storage from physical storage so that it can be accessed without regard to physical storage.

Windows Server 2012 R2 Hyper-V supports running on a host system that has up to 320 logical processors on hardware and four terabytes (TB) of physical memory, which helps to encourage compatibility with the largest scale-up server systems. Windows Server 2012 R2 Hyper-V lets you configure a virtual machine with up to 64 virtual processors and up to 1 TB of memory. The result is the ability to support very large workload scenarios. Additionally, Hyper-V now supports running up to 8,000 virtual machines on a 64-node failover cluster. Enabling Hyper-V to use SMB file shares for virtual storage

provides administrators a new option to provision devices. SMB 3.0 supports CSV version 2, is less expensive to deploy, and provides performance capabilities and features that rivals those with Fibre Channel SANs. Hyper-V over SMB 3.0 supports flexible configurations that facilitate different levels of capabilities and availability, including single-node, dual-node, and multi-node file-server modes¹⁶.

Storage

The storage design is an important element of private cloud architecture because of its impact on overall cost, performance, and agility. The Fast Track Reference Architecture program outlines three design patterns for storage architecture: continuous availability over SMB, non-converged infrastructure, and converged infrastructure.

The continuous availability over SMB storage pattern supports Windows Server 2012 R2 Hyper-V clustered deployments where continuous availability and transparent failover are delivered over a scale-out file server infrastructure and SMB shares using a converged hardware configuration and native Windows Server 2012 R2 operating system capabilities. The continuous availability over SMB storage pattern is expected to have three variations: SMB Direct using shared serial attached SCSI (SAS) and storage spaces, SMB Direct using SAN, and SMB 3.0-enabled storage. SMB Direct using shared SAS and storage spaced combines scale-out file cluster infrastructure with SMB Direct to provide back-end storage that has similar characteristics to traditional SAN infrastructures. SMB Direct using SAN provides advanced storage capabilities that are found in SAN infrastructures and delivers benefits in terms of capability and manageability. The third variation uses SMB 3.0-enabled storage devices instead of scale-out file server clusters and SMB Direct to provide basic storage capabilities. This option is an affordable option for Hyper-V workloads.

Critical performance factors for hard disks are the interface architecture (for example, U320 SCSI, SAS, or SATA), the rotational speed of the drive (7,200, 10,000, or 15,000 RPM), and the average latency in milliseconds. The RAID type should deliver high availability and high performance even in the event of disk failures and RAID parity rebuilds. The general recommendation for virtual machine volumes is RAID 10 (0+1) or a proprietary hybrid RAID type. Multipathing should be used in all cases.

Cluster Shared Volumes

New CSV capabilities in Windows Server 2012 R2 include optimized CSV placement policies, CSV cache allocation, the ability to diagnose CSV, and CSV interoperability.

- Optimized CSV placement policies: in Windows Server 2012 R2, CSV ownership is evenly distributed across the failover cluster nodes based on the number of CSVs that each node owns.
- CSV resiliency: to increase CSV resiliency, there are multiple service instances per failover cluster node, such as default instances that handle incoming traffic from SMB. New to Windows Server 2012 R2 is CSV health monitoring of the server service.
- CSV cache allocation: up to 80 percent of total physical memory can be allocated to the CSV cache in Windows Server 2012 R2 compared to 20 percent in Windows Server 2012.
- CSV diagnosing the state of a CSV can be viewed on a per-node basis in Windows Server 2012 R2. With Windows PowerShell you can view the state information and the redirection reason.
- CSV interoperability: CSV functionality has been enhanced in Windows Server 2012 R2 to include Resilient File System, deduplication, parity storage spaces, tiered storage spaces, and storage spaces write-back caching.

¹⁶ <http://www.microsoft.com/en-us/download/details.aspx?id=30417>

Storage Automation

Enabling rapid provisioning and deprovisioning of virtual machines on a large scale requires tight integration with the storage architectures and robust automation. Through SAN integration using the Storage Management Initiative Specification (SMI-S), Virtual Machine Manager enables end-to-end automation of provisioning a new SCV LUN and adding it to a host cluster. With SMI-S, a common set of tools can be utilized across heterogeneous storage solutions.

System Center 2012 R2

The following are the primary management scenarios addressed in Fast Track, although the management layer can provide many more capabilities:

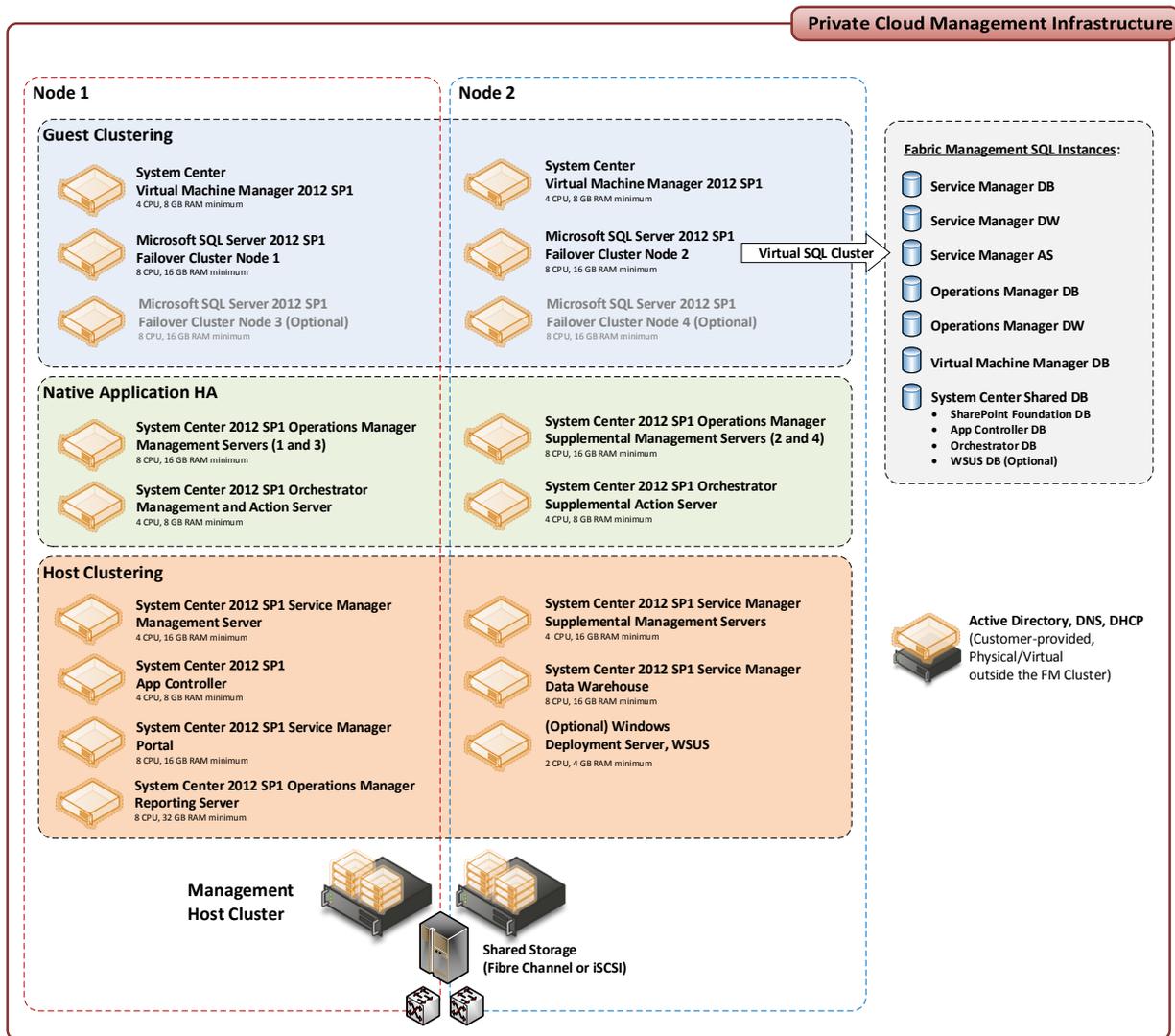
- Fabric management
- Fabric provisioning
- Virtual machine provisioning and de-provisioning
- IT service provisioning (including platform and application provisioning)
- Fabric and IT service maintenance
- Fabric and IT service monitoring
- Resource optimization
- Service management
- Reporting (used by chargeback, capacity, service management, health, and performance)
- Backup and disaster recovery
- Security

The act of pooling multiple disparate computing resources together and being able to sub-divide, allocate, and manage them as a single fabric is fabric management. Hardware integration refers to the management system being able to perform deployment or operational tasks directly against the underlying physical infrastructure such as storage arrays, network devices, or servers. In Virtual Machine Manager, remote storage supported on storage arrays can be classified and provisioned through the Virtual Machine Manager console. Virtual Machine Manager automates the assignment of storage to a Hyper-V host or Hyper-V host cluster, and tracks the storage.

Fabric Logic Architecture

The diagram below illustrates the management of logical architecture if using a dedicated two-node management cluster (four-node management is recommended). Note that the Windows Server and System Center versions in the diagram have not been updated to reflect 2012 R2, but the architecture is

the same:



This management architecture contains of a minimum of two physical nodes in a failover cluster with shared storage and redundant network connections. It provides a highly available platform for management systems. With management systems with additional highly available options, the most effective highly available option will be used.

The management systems include:

- Two SQL Servers in a guest cluster configuration
- Two System Center 2012 R2 - Virtual Machine Manager servers in a guest cluster configuration
- Two System Center 2012 R2 - Operations Manager management servers using the built-in failover and redundancy features (up to four management servers may be required for agent-managed monitoring of up to 8,000 virtual machines)
- One System Center 2012 R2 - Operations Manager reporting server
- Two System Center 2012 R2 - Orchestrator servers using the built-in failover and redundancy features
- Two System Center 2012 R2 - Service Manager management servers

- One System Center 2012 R2 - Service Manager data warehouse
- One System Center 2012 R2 - Service Manager self-service portal
- One System Center 2012 R2 - App Controller server
- One deployment server providing Windows Deployment Services and Windows Server Update Services (optional)

Why Fast Track?

The Fast Track program is a joint effort between Microsoft and its hardware partners, designed to deliver pre-configured cloud solutions. The following are the benefits of choosing the Fast Track:

- Increased speed to deployment with the Fast Track reference architecture, which helps enterprises achieve time-to-value quicker.
- Decreased learning curve with a provided end-to-end deployment guide which includes thorough do-it-yourself steps.
- Reduced risk by deploying a validated Microsoft design and a rich software portfolio.
- Integrated, end-to-end solution comprised of compute, networking, and storage options.
- Flexibility and choice in the selection of innovative partner solutions with ready-to-deploy options available, which help you to choose the scale and performance that your enterprise needs.

Conclusion

The Microsoft Private Cloud Fast Track program reduces private cloud risk and complexity through a validated, pre-configured solution. The benefits of implementing a private cloud solution using Fast Track include faster deployment and decreased complexity with pre-configured, partner-led solutions. The program provides flexibility of solution and customer choice across hardware vendors' technologies, while using the updated capabilities of the Windows Server 2012 R2 operating system, Hyper-V technology, Microsoft System Center 2012 R2, and Windows Azure Pack. The result is out-of-the-box offerings with reduced risk and greater confidence that leverages the building blocks of a private cloud infrastructure as a service offering.

With Windows Server 2012 R2, it is now easier than ever for organizations to take advantage of the cost savings of virtualization and make the optimum use of server hardware investments by consolidating multiple server roles as separate virtual machines. This technology improves virtualization density and makes optimal use of server hardware investments by consolidating multiple server roles as separate virtual machines. These virtual machines use Hyper-V to efficiently run multiple operating systems such as Microsoft Windows, Linux, and others in parallel, on a single server. Hyper-V also extends virtualization capabilities with more features, greater scalability, and built-in reliability mechanisms.

Microsoft System Center 2012 R2 builds on the core capability provided by Windows Server 2012 R2. It delivers a flexible, cost-effective private cloud infrastructure in a self-service model, while using existing data center hardware and software investments. System Center 2012 R2 helps facilitate agility and control for enterprises over infrastructure, automation and self-service, monitoring, and IT service management.

Windows Azure Pack for Windows Server extends the functionality of Windows Server 2012 R2 by providing a solution that enables a single pane of glass for enterprises to deliver Windows Azure technologies into the private cloud. This helps facilitate a rich, self-service, multi-tenant cloud with

Windows Azure consistent experiences and services. The Windows Azure Pack is a collection of Windows Azure technologies available to Microsoft customers at no additional cost.

All of these offerings make the Microsoft Private Cloud Fast Track program a powerful, consolidated solution for enterprises looking to deploy to or upgrade their private cloud. To find out more about the Fast Track program, visit <http://www.microsoft.com/en-in/server-cloud/fast-track.aspx#fbid=WvzQIAhVJPy>.