Clouds

IT

Microsoft Private Cloud-
Making It Real

Microsoft® System Center 2012 SP1

Windows Server 2012

Contents

Copyright information

The Microsoft Cloud OS

Cloud computing is happening. It is being driven by the exponential growth in modern applications, data and devices. These trends require organizations to quickly scale and deliver continuous services. Simultaneously, innovation is happening across storage, network and compute technologies. With these new requirements and innovations, IT is under pressure to deliver capacity on demand, whether for short-term projects or longer-term initiatives. At the same time, organizations have higher expectations for service levels – services must be always up, always on, with no planned or unplanned downtime.

To meet these challenges, a new modern platform is required. In the era of cloud computing, Microsoft delivers this with the Cloud OS. The Cloud OS takes on a broader role than just managing a server. Microsoft's vision for the Cloud OS is focused on the transformation of the datacenter, enabling modern applications, unlocking insights on any data and empowering people-centric IT.

transforms the datacenter
enables modern apps
unlocks insights on any data
empowers people-centric IT

Figure 1: The Cloud OS delivers on four fundamental tenets of the next generation of IT

The Cloud OS requires a comprehensive execution of vision crossing a wide range of enterprise technologies, including Windows Azure, SQL Server, System Center and Windows Server. This whitepaper sets out a step on that journey by focusing on the transformation of the datacenter. Fundamental to the modern datacenter, is the ability to build private cloud infrastructures and quickly scale within the datacenter as well as agile and secure consumption of Windows Azure and service provider cloud capacity. This paper explains Windows Server 2012 as the foundation for the Private Cloud and how System Center 2012 SP1, makes the management of private and public clouds consistent and seamless.

The Private Cloud in your datacenter

A private cloud aims to deliver many of the characteristics of public cloud computing such as scalability and elasticity, the pooling of shared infrastructure, user self-service, and higher levels of overall application availability and reliability. However, by taking a private cloud approach, organizations can deliver on these goals while still using their own physical resources allowing them to maintain complete control over their data and processes.

Figure 2: The private cloud delivers the broad benefits of cloud computing with added levels of control and customization

With shared infrastructure, compute, storage and even networking assets are virtualized and pooled together. This approach is a shift from today's model in which an application owner will likely know (and probably fund) the exact hardware on which their application is physically deployed. In a private cloud environment, application owners will only care that adequate capacity to run the application has been provided from the shared pool. Once deployed, services can scale up and down based on demand. IT no longer needs to over-provision infrastructure capacity to accommodate potential spikes in load.

Datacenter administrators and application owners can view resource utilization as well as the chargeback information related to their allocated capacity. By giving application owners better visibility over their resource usage organizations are able to more easily drive and deliver the right behavior to conserve capacity where possible. A self-service interface to which standardized services are published from central IT, empowers application owners and other internal customers to be able to easily provision resources when needed. Automation helps to drive efficiency in service delivery thereby freeing up IT Pros to focus on other tasks. Self-service also frees up application owners as well. They are empowered to directly access resources; no complicated approval process; no need to wait for the overworked IT team to eventually get to the request.

A private cloud deployment captures all of these characteristics, most of which are also in common with public and partner hosted clouds, but, the private cloud also allows organizations to maintain total control over their applications and data. These are common blockers for businesses looking at public cloud solutions. Ultimately, most customers will find portions of their organization that live best in a private deployment, portions that live best in a public deployment and in some cases portions that are best served by partner delivered clouds. The world will exist in a hybrid state for the foreseeable future and it is important for companies to evaluate their particular needs to determine the best combination for them.

Windows Server 2012 – built from the cloud up

Microsoft Windows Server 2012 provides the foundation of Microsoft private cloud solutions. This section looks at how the enhanced capabilities of Windows Server 2012 allows organizations to deliver their private cloud. For even greater detail on each of the specific feature areas please refer to the individual whitepapers noted in the *Resources* section at the end of the document.

Server virtualization

Virtualization enhancements in Windows Server 2012 provide significant benefit for organizations delivering private cloud solutions through enhanced scalability and virtual machine mobility.

Windows Server 2012 supports both larger hosts and larger virtual machines to allow private cloud deployment of even the most massive of enterprise application. These advances in overall scale are critical as customers strive to *virtualize every workload*.

Taiwanese hardware manufacturer Acer saved over $600,000 per annum by improving virtualization density with Windows Server 2012 Hyper-V

System	Resource	Maximum number		Improvement factor
		Windows Server 2008 R2	Windows Server 2012	
Host	Logical processors on hardware	64	**320**	5x
	Physical memory	1 TB	**4 TB**	4x
	Virtual processors per host	512	**2,048**	4x
Virtual machine	Virtual processors per virtual machine	4	**64**	16x
	Memory per virtual machine	64 GB	**1 TB**	16x
	Active virtual machines per server	384	**1,024**	2.7x
Cluster	Nodes	16	**64**	4x
	Virtual machines	1,000	**8,000**	8x

Windows Server 2012 allows Live Migration without needing to configure Failover Clustering and Cluster Shared Volumes; it can be performed with virtual drives on either local storage or simple SMB network shares. Beyond a single site, Windows Server 2012 provides Hyper-V Replica allowing near real time replication of virtual machines between two geographically separate sites. In the event of failure at the primary site, an administrator can fail over the production virtual machines to Hyper-V at the recovery site. During failover, the virtual machines are brought back to a consistent point in time, and within minutes they can be accessed once again with minimal impact to the business.
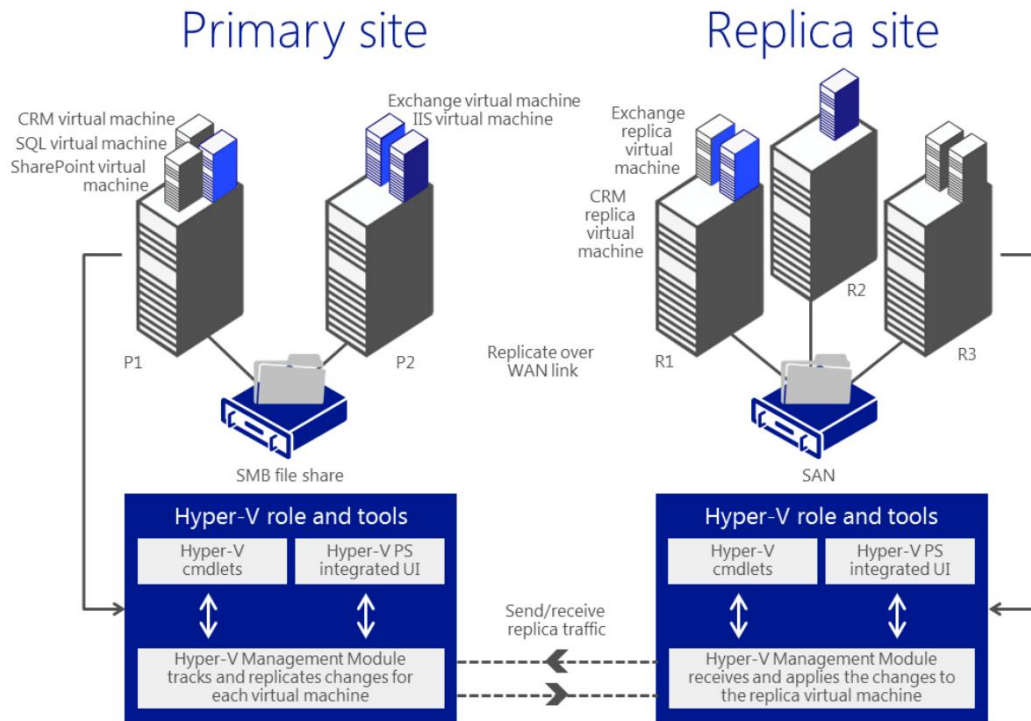

Figure 4: Hyper-V replica allows multi-site redundancy using typical hardware available in most private cloud deployments

Storage

A private cloud requires storage that is highly available, highly reliable and high performance. Organizations can build comprehensive virtualized storage architectures that leverage both commodity and enterprise grade hardware making complex storage systems as easy to manage as a single server.

Storage Spaces provides a complete storage virtualization solution. Datacenter administrators are able to pool physical storage devices, SAS, SATA or even USB drives, allowing both aggregation and elastic capacity expansion. Storage pools can be configured for both mirrored or parity based storage redundancy. Storage Spaces then builds virtual disks from these pools of capacity. Additional drives can be added at any time and Storage Spaces can be 'thinly provisioned' with full TRIM support.
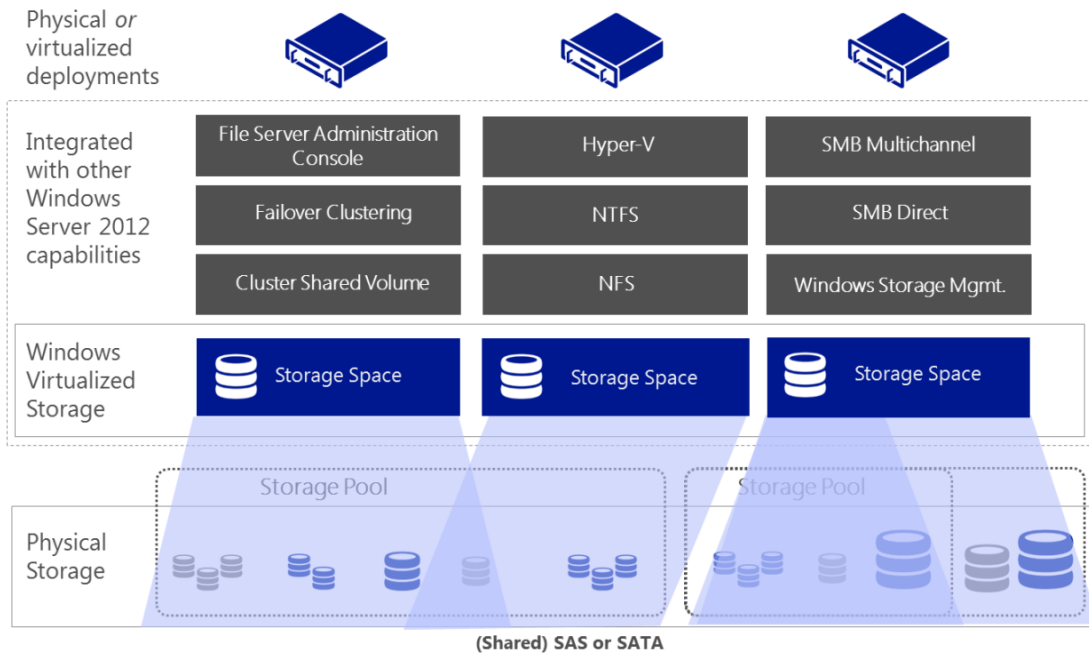
Figure 5: Storage Spaces provide a comprehensive storage virtualization solution for private cloud deployments

IO performance has long been regarded as a blocker for running workloads such as large database servers in cloud environments. A Windows Server 2012 private cloud can deliver levels of virtual machine storage performance that are unmatched by any other vendor. Hyper-V can deliver well in excess of 1 million IO operations per second (IOPS) into a virtual machine. Even large, mission critical database workloads can now be deployed into a private cloud environment.

Finally, organizations using Storage Area Network (SAN) backed storage for their private cloud can take advantage of Offloaded Data Transfer (ODX). Using ODX, data is transferred directly between two SAN's at significantly greater speeds than if it were to travel via a host machine. Within large private clouds this provides much greater performance during live migration transfers.
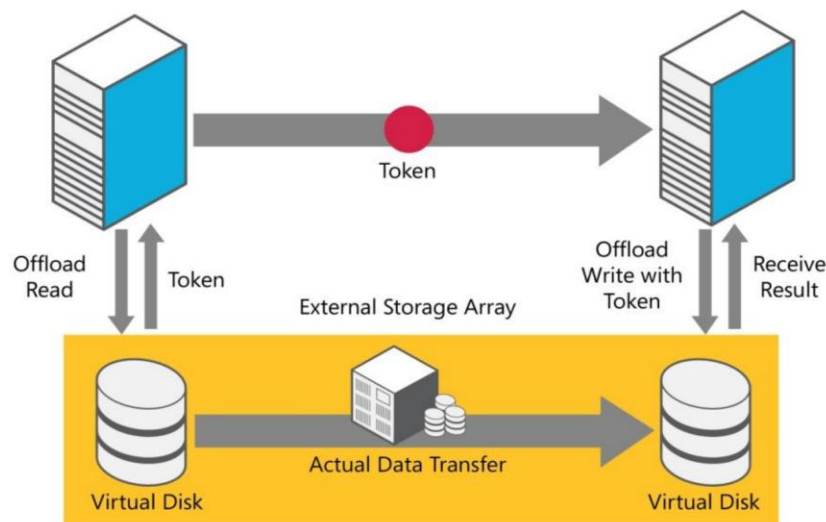

Figure 6: Offloaded Data Transfer (ODX) allows data to be transferred directly between SAN environments without needing to pass through an intermediating operating system.

Networking

Windows Server 2012 allows organizations to efficiently deliver even the most complex private cloud networking environments through virtualization, consolidation and automation. It also supports advanced multi-tenant isolation and connectivity to public clouds allowing organizations to take full advantage of hybrid IT.

Network virtualization provides a software defined network allowing organizations to migrate existing applications and virtual machine environments without the loss of network settings configured within their apps and virtual machines. By virtualizing network settings Windows Server 2012 automatically remaps IP addresses as changes are made at the physical layer. While the physical IP address of the VM may change due to changing location on the network, the change is transparent to both the application and the end user as they see only the virtualized IP address.
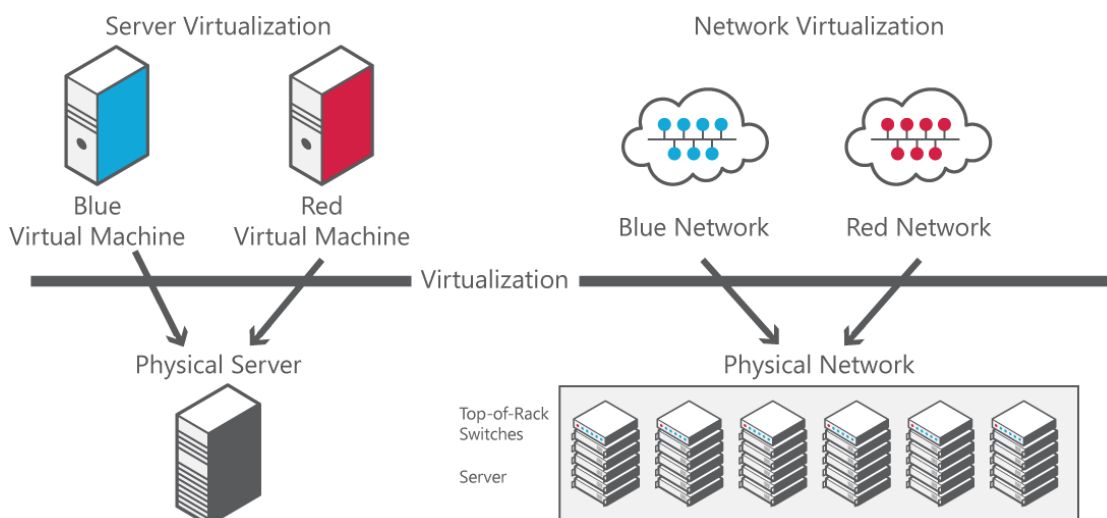

Figure 7: Network virtualization allows a private cloud to establish multiple isolated virtual networks in a similar fashion to the server isolation provided by a hypervisor

The Hyper-V Extensible Switch is a layer-2 virtual interface that provides programmatically managed and extensible capabilities to connect virtual machines to the physical network. The Extensible Switch isolates and protects the network from malicious virtual machine tenants allowing data center administrators much greater latitude to allow user self-service of virtual capacity. The Extensible Switch has extensive management and monitoring integration with Virtual Machine manager and also provides rich extensibility interfaces and PowerShell support.

To support the new massive scale capabilities of Hyper-V, Windows Server 2012 provides a high availability, high capacity network aggregation capability called NIC Teaming. NIC Teaming combines the capacity of multiple Network Interface Cards (NICs) to provide much greater network throughput and reliability. The native NIC teaming capability in Windows Server 2012 doesn't require any specific 3rd party hardware or software; it just works. NICs from any vendor can be combined together to provide higher throughput and greater reliability.

Management & automation

Automated systems management is key to delivering the efficiency of service required by cloud computing. Windows Server 2012 provides robust, standards based management allowing datacenter administrators to use a 'single pane of glass' to manage cloud environments across public, private and partner datacenters.

Windows PowerShell 3.0 provides an extensible foundation for delivering management automation with over 2300 *cmdlets* available out of the box. A new feature in Windows Server 2012 called Windows PowerShell Workflow provides much richer management of long running multi-machine processes. PowerShell Workflow leverages the familiar PowerShell syntax but also adds persistence, failure recovery, scheduling and throttling. PowerShell Workflow allows administrators to leverage their PowerShell expertise across massive tasks and complex scenarios; it is ideally suited to the management of large cloud environments.
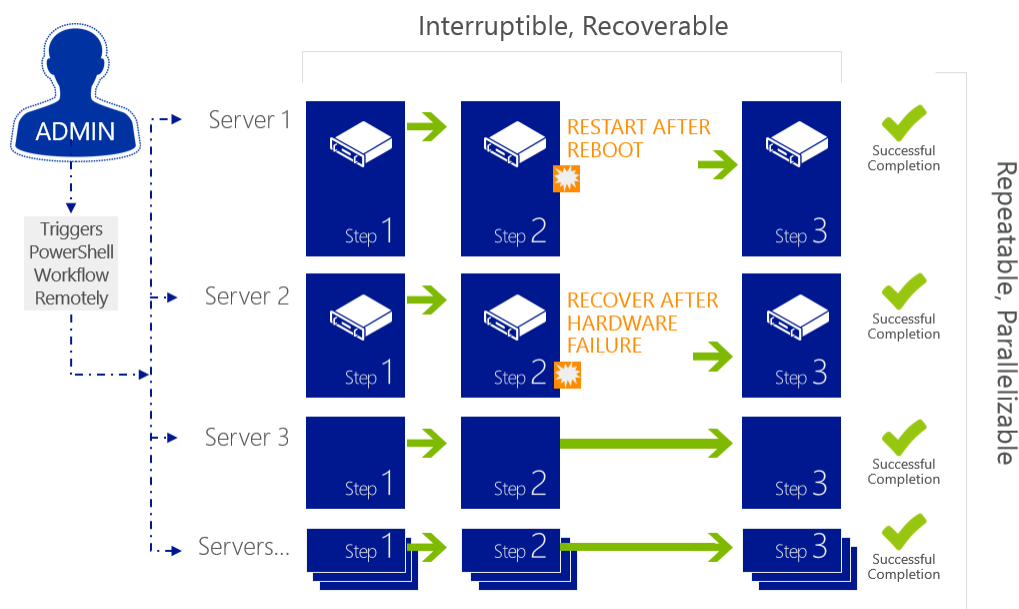
Figure 8: PowerShell Workflow provides a repeatable, parallelizable, interruptible, and recoverable automation mechanism

Windows Server 2012 is the first Windows Server release targeted specifically at cloud deployment scenarios. It forms the foundation of the Microsoft Cloud OS, able to deliver cost-effective private cloud solutions, providing a high-availability, an easy-to-manage multi-server platform and significant improvement in the efficient management and automation of large environments.

Why System Center 2012 SP1 for your Private Cloud

Over the last twenty years, Microsoft has built some of the world's largest datacenters running many of the world's largest cloud hosted services. The expertise that has been built up in efficiently running these massive data centers forms the foundation for the Microsoft private cloud offering. Built on System Center 2012 SP1 and Windows Server 2012, a Microsoft private cloud allows datacenter administrators to deploy a flexible and responsive infrastructure that is designed to simplify day-to-day tasks and to enable management of applications at the service level, rather than the level of individual servers.

System Center 2012 SP1 makes it easy for customers to build private clouds while taking advantage of currently deployed IT hardware and building an infrastructure for the future. This comprehensive offering was designed around the following principles.

These principles are surfaced through a core set of capabilities in Windows Server 2012 and System Center 2012 SP1, allowing datacenter administrators and application owners to access and consume IT services from these private clouds.

The rest of this paper will describe the private cloud capabilities provided by System Center 2012 SP1. For the datacenter administrator, this includes infrastructure management, service delivery and automation. For the application owner or business unit IT professional, this includes self-service application management, monitoring and reporting.

The table in Figure 3 highlights these capabilities, how they align to industry concepts and System Center 2012 SP1 components.

Customer Scenario	Industry Capability	System Center 2012 Component
Application Management	Application Self-Service	App Controller, Service Manager
	Application Performance Management	Operations Manager
	Application Management Across Clouds	Virtual Machine Manager
Service Delivery & Automation	IT Service Management & Reporting	Service Manager
	Process Automation & Orchestration	Orchestrator
Infrastructure Management	Cloud Creation & Delegation	Virtual Machine Manager
	Data Protection & Disaster Recovery	Data Protection Manager, Orchestrator
	Monitoring	Operations Manager
	Configuration & Compliance	Configuration Manager

Figure 9: Mapping of industry cloud computing concepts to System Center 2012 SP1 products and features.\

Delivering a Private Cloud with System Center 2012 SP1

By building on the core capability provided by Windows Server 2012, System Center 2012 SP1 helps organizations to deliver flexible and cost-effective private-cloud infrastructure in a self-service model, while leveraging existing datacenter hardware and software investments. As the Consumerization of IT drives diverse applications across diverse devices, organizations will increasingly need to look to hybrid deployments. System Center 2012 SP1provides a common management experiences across public, private and partner hosted clouds. To deliver the best experience for these modern applications System Center 2012 SP1 offers deep application insight, right down to client script performance. Finally social networking and new application patterns are driving explosion growth in the volumes of data that are created and stored. System Center 2012 SP1 delivers the tools and capabilities that organizations need to deal with these challenges; to scale their capacity and, where necessary, to leverage public cloud resources as well.

Infrastructure management

Despite the name, cloud computing won`t run on thin air.   Highly reliable and available physical infrastructure is the foundation of the private cloud. Before delving deeper into management specifics it's important to establish that a private cloud is formed around two core infrastructure approaches; one physical and one virtual.

Diverse infrastructure

The infrastructure components layer represents the physical; the bare metal servers, storage, networking and the virtualization layer atop which the private cloud will be built. This is the datacenter as it is today. System Center 2012 SP1 Virtual Machine Manager enables a datacenter administrator to bring these diverse components under unified management and control.

Elasticity is a key tenet of cloud computing. Both Virtual Machine Manager and Operations Manager provide detailed capacity utilization reports and *what*-if forecasting to identify growth constraints early enough to allow for new hardware to be provisioned. Using Virtual Machine Manager additional physical resources can be added to a Microsoft private cloud without downtime to production services. Administrators building large cloud environments can take advantage of the baseboard management support in Virtual Machine Manager to automatically deploy Hyper-V onto bare metal servers, massively improving time to deployment. Datacenter administrators can take advantage of current investments by managing their existing Citrix XenServer and VMware vSphere hypervisors within their Virtual Machine Manager host groups as well as Windows Hyper-V servers.
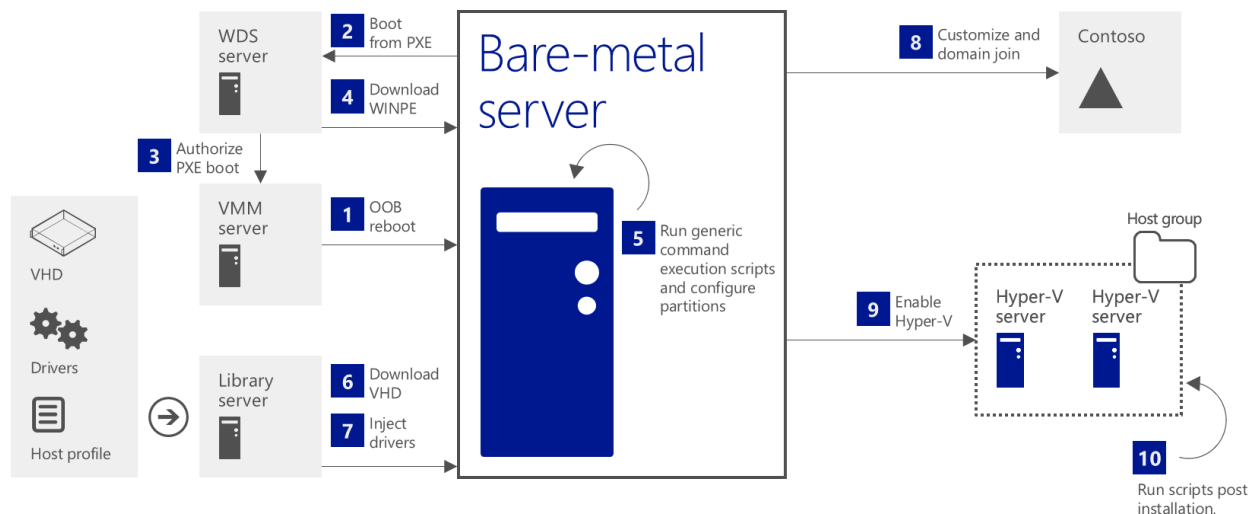
Figure 10: Virtual Machine Manager supports fully automated build of bare metal servers for fast large scale deployment

High availability is critical to application owners and their end users. A failure at the physical layer must not bring down cloud-based applications and in order to achieve this applications must be able to run across a diverse set of physical machines. This ability to abstract the running application from the physical hardware on which it resides allows for not only high availability and fault tolerance but benefits elasticity as workloads can, in many cases, be run across a logical pool of existing resources rather than by racking and stacking more physical boxes. Failover Clustering in Windows Server is core to meeting this need, and Virtual Machine Manager now includes a simple wizard based interface to create new Hyper-V clusters and add them to the compute pool; this capability, coupled with the bare metal server build process, has turned a once daunting task into something far simpler. Not only will Virtual Machine Manager create the failover cluster, but it will also mask the storage to the servers as necessary.

It's one thing for your own business to be dependent on your technology infrastructure but quite another when other people's businesses are dependent on that infrastructure.
Alan Bourassa
Chief Information Officer
EmpireCLS Worldwide Chauffeured Services

Datacenter administrators can now automate common storage tasks enabling more efficient management of their private cloud. This capability allows such activities as the creation of logical unit numbers (LUNS) and then assignment of storage to hosts and clusters as standalone LUNs or clustered shared volumes to be automated along with the creation of Hyper-V Clusters and Host Groups.
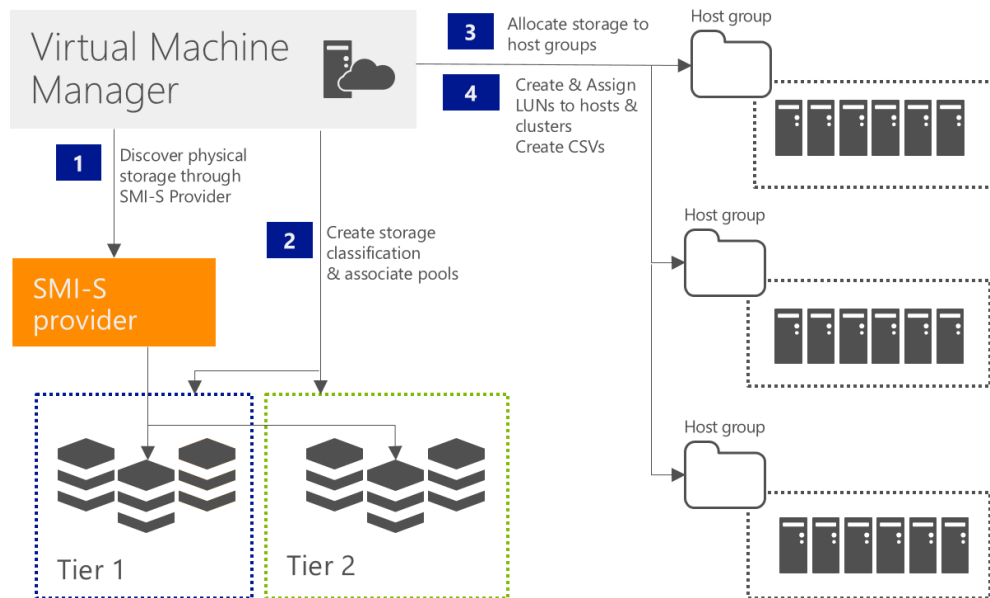
Figure 11: Virtual Machine Manager provides mechanisms to classify and assign storage includin creation of CSVs

Finally, consider network resource requirements. A key enabler of highly available and elastically scalable applications is the extensive support for network load balancing within System Center 2012 SP1. As well as native support for Microsoft Windows Network Load Balancing, Virtual Machine Manager interfaces with hardware load balancers and other network devices from a variety of vendors such as F5, Brocade, and Citrix.

Once these infrastructure components are deployed and configured, the datacenter administrator needs to ensure they remain up and running. Using Operations Manager, administrators can proactively monitor their resource utilization, preventing problems before they occur. In the event of an outage or a reduction in service level due to a failure in physical hardware, the embedded organizational knowledge that Operations Manager provides helps in reducing the time it takes to get the systems back up and running efficiently.

Logical and standardized

Most organizations source their hardware from a variety of vendors. They will typically have many different processor types, different classes or vendors of fiber-channel and iSCSI SAN storage and a variety of networking devices. The private cloud infrastructure is the aggregation and abstraction of these physical infrastructure components into logical resources.   These logical resources of compute, networking, and storage are allocated, as either dedicated or shared capacity, to make up cloud environments. It is these cloud resources that the datacenter administrator then delegates to application owners.   Application owners deploy their applications within the boundaries of the cloud resources provided to them.

By allowing a private cloud infrastructure to encompass a range of heterogeneous physical resources, datacenter administrators avoid a rip-and-replace approach when establishing their private cloud and the addition of new resources remains simple even as available hardware changes over time. Using Virtual Machine Manager's abstraction of the infrastructure components, datacenter administrators can deploy

many of their existing physical datacenter assets into their new private cloud and be confident they can take advantage of new technology trends.

Cloud abstraction

Microsoft private cloud infrastructure allows datacenter administrators to parcel heterogeneous datacenter resources from a range of physical hardware and virtualization vendors into consistent logical pools. These logical pools of resources are then interchangeable throughout the private cloud. It is this mapping of heterogeneous physical resources to logical resource pools that allows System Center 2012 SP1 to deliver a truly scalable, elastic and highly available cloud. It provides the ability to dynamically reallocate workloads and delegate capacity while maintaining granular control over resource utilization.
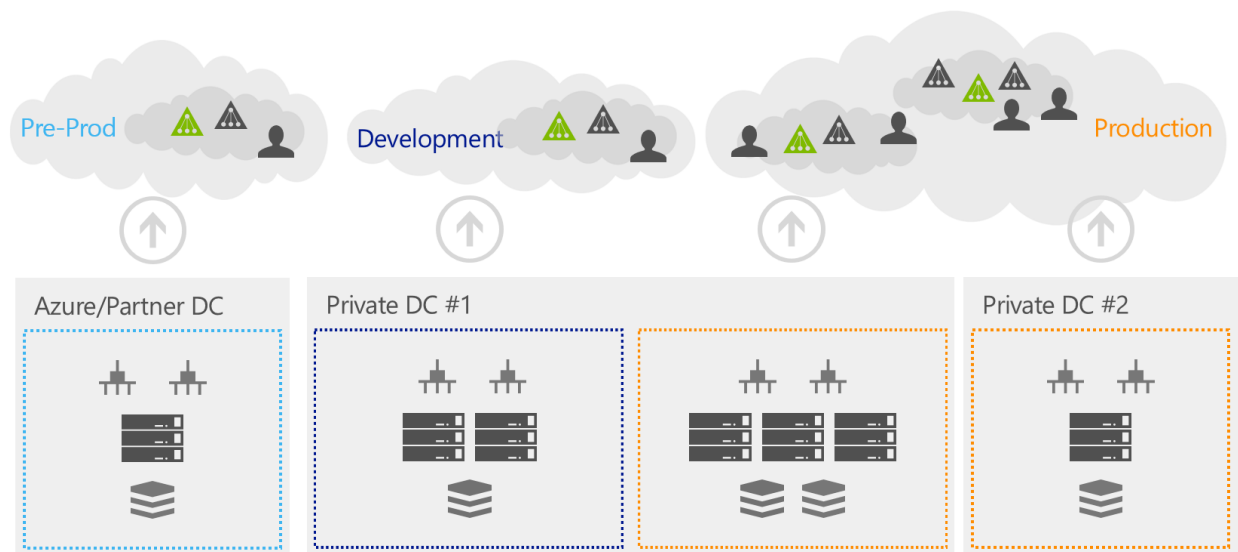

Figure 12: Private Cloud are built on heterogeneous infrastructure, transformed into logical resource pools and abstracted into one or more clouds for consumption

An important characteristic of these pooled resources is that the physical infrastructure on which they reside can be shared between multiple clouds. The increased scalability and flexibility that this affords does, however, come at a price in terms of overall efficiency. To help ensure that the services running on top of these clouds receive the resources they need, Virtual Machine Manager provides a feature called dynamic optimization which will migrate virtual machines between hosts within a cluster to rebalance workloads and ensure the best utilization of the physical resources. Virtual Machine Manager can even be configured to optimize power usage by moving workloads off certain nodes and then powering these nodes down during periods of inactivity in the private cloud.

Most organizations have distributed networking environments with multiple VLANs across different datacenters. Many line of business applications will typically span multiple tiers and as such have quite complex networking requirements. By abstracting a logical network from the physical network resources, Virtual Machine Manager takes the complexity out of network infrastructure making it simple for the datacenter administrator to present the network infrastructure in a logical and standardized manner. Virtual Machine Manager provides complete management support for the Windows Server 2012 Hyper-V Virtual Switch including adding and configuring Virtual Switch Extensions. This allows it to create and manage a Hyper-V virtualized network atop almost any physical network infrastructure.

Delegate capacity

Datacenter administrators can allocate cloud capacity to application owners based on need, application size, or any other requirement and are not limited by the physical resources allocated to that group. Delegated capacity in the private cloud sense is simply an allocation of compute, storage and memory to a specific user or group.

Datacenter administrators use Virtual Machine Manager to specify the overall capacity of each cloud and then provide quota to users (or groups).

- Virtual CPUs
- Memory
- Storage
- Number of Virtual Machines
- Custom quota points

Quota can be set at both the role level and member level. Role level quota defines the aggregate amount of resources that may be used by all members of that role. Member level quota defines the resources that may be consumed by any one member of that role.

Standardized services

Datacenter administrators create virtual machine templates leveraging the underlying virtual disk components of the hypervisor, be that Hyper-V or another platform such as Citrix XenServer or VMware vSphere. They then add the operating system and application information into the template to make it ready to deploy.

The additional option of using Server Application Virtualization (Server App-V) virtualizes the configuration and state information of an application; local disk, windows services, registry settings and so forth, allowing them to be packaged and moved as a single unit. Together, with service templates, Server App-V provides comprehensive application manageability. To support patching, the entire state of an application can be saved and reapplied to updated virtual machines.
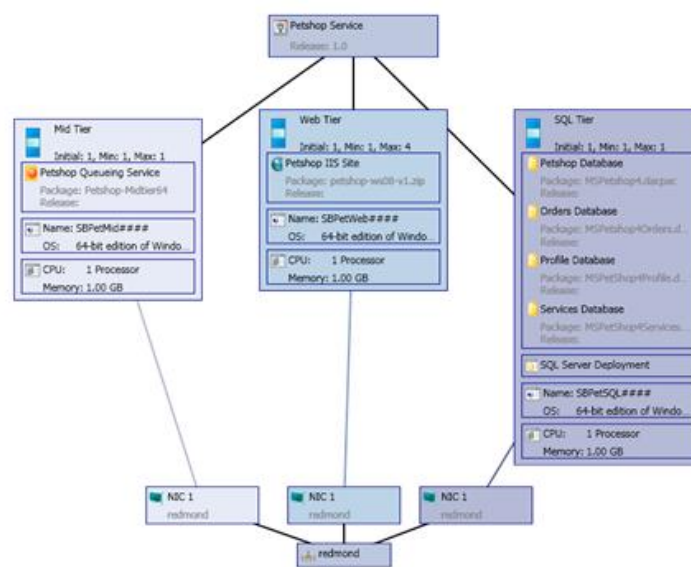

Figure 13: Sample Muilti-Tier Service Template in System Center 2012 SP1 Virtual Machine Manager

Through Virtual Machine Manager's service template designer, datacenter administrators specify both the business and IT requirements of an application into a single service template. This enables repeatable deployments of applications and services in a standardized fashion. Copying and modifying the service template allows for upgrading of existing services within the cloud, while offering the latest version for any new deployments. This enables an organization to deliver self-service within the private cloud in a consistent and controlled manner. Application owners can control how their cloud services perform, while allowing the datacenter administrator to manage all aspects of the infrastructure, including how to automatically scale out the service.

Our two primary data centers are in Germany, but we also have to provide our IBA applications to data centers in Mexico and Asia By using System Center 2012, we will be able to create a standard virtual machine template in Germany and give our hub data centers the rights to copy this template to create their own virtual machines and manage their applications themselves. They will have more autonomy while still adhering to corporate IT policies.

Steffen Seifert
Systems Analyst
Volkswagen Financial Services

Service delivery and automation

System Center 2012 SP1 helps datacenter administrators deliver standardized IT services through a self-service experience and enables service delivery at scale through automation. By systematically, and in most cases automatically, provisioning and managing their service delivery processes, IT organizations enable the repeatable and efficient service delivery that customers expect from a cloud environment. Using the System Center 2012 SP1 Service Manager and Orchestrator components, datacenter administrators can now deliver these services in a structured and repeatable fashion enabling:

- Self-service and standardization of offerings through a service catalog
- Automation of service delivery across the organization
- Integration across public, private and partner hosted clouds
- Reporting to ensure quality and to provide early identification of potential capacity constraints.
- Chargeback and governance of resource usage

Self-service and standardization of offerings through the Service Catalog

Delivering a self-service experience within the private cloud begins with defining what the standardized service offerings will be. For each proposed service, line of business application owners and IT agree on what information is required to fulfill requests, where this information will come from, who needs to approve such requests, and establish the expected performance levels that are required for each service.

Service Manager and Orchestrator allow the datacenter administrator to establish standardized offerings by storing the above information and using it to drive the service delivery and automation process. The primary interface to the above processes is through the Service Manager Service Catalog.
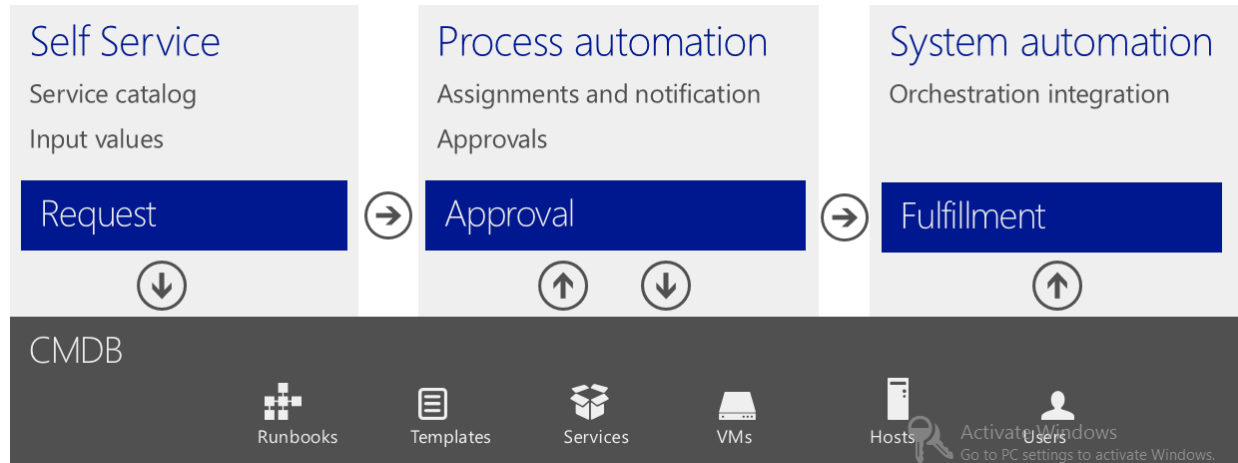
From the service catalog, cloud consumers identify and request services offered by IT. Users start by selecting a service offering. These provide the high level list of all of the things that can be requested; for example the top level offerings might be Cloud Services, Desktop Services and so forth.

Service offerings involving the creation of a new virtual machine can be provisioned from the Virtual Machine Manager Library. The library is a catalog of resources used to create and configure virtual machines. The library contains operating system, hardware, and template configurations stored in the Virtual Machine Manager database. Library resources are used by System Center 2012 SP1 for the provision of services on-demand.

Consistency of service across the business and at scale

Within each service offering that a datacenter administrator defines, a customer can select one or more request offerings. Request offerings contain details of a specific request that IT offers to the organization. Each request offering contains information such as cost, SLA details, knowledge articles and specific input requirements in the form of user prompts that a requestor, such as the application owner, completes as part of the request process. To drive further consistency, service requests can be created from a template allowing the organization to enforce common rules and data collection standards across all requests.

Managing systems takes less time, so employees can work on higher-level projects that positively affect the top and bottom lines, rather than on low-level troubleshooting. This helps us complete important projects on time and avoid hiring more staff.

Andre Garcia
Assistant Vice President, Global Infrastructure Services, ABM

The request fulfillment process is governed by the Service Manager and Orchestrator components within System Center 2012 SP1. Service Manager facilitates process, notification and approval related activities. Orchestrator executes and manages technical system activities necessary for the fulfillment process via an Orchestrator Runbook. Runbooks allow the automation of key private cloud tasks such as provisioning

new cloud capacity, automatically adding resources as demand thresholds are hit and moving workloads for maintenance purposes.

Activities

Intelligent tasks that perform defined actions

- Invoke web services
- Run .NET script
- Send e-mail
- Query database
- Compare values
- Check schedule
- Return data

Runbooks

System-level workflows that execute a series of linked activities

Create incident
↓
Create checkpoint → E-mail on error
↓
Start maint mode
↓
Shut down VM → Update on success

Databus

Used to publish and consume information as a Runbook executes

Get server ID from DPM   Get data sources   Create recovery point

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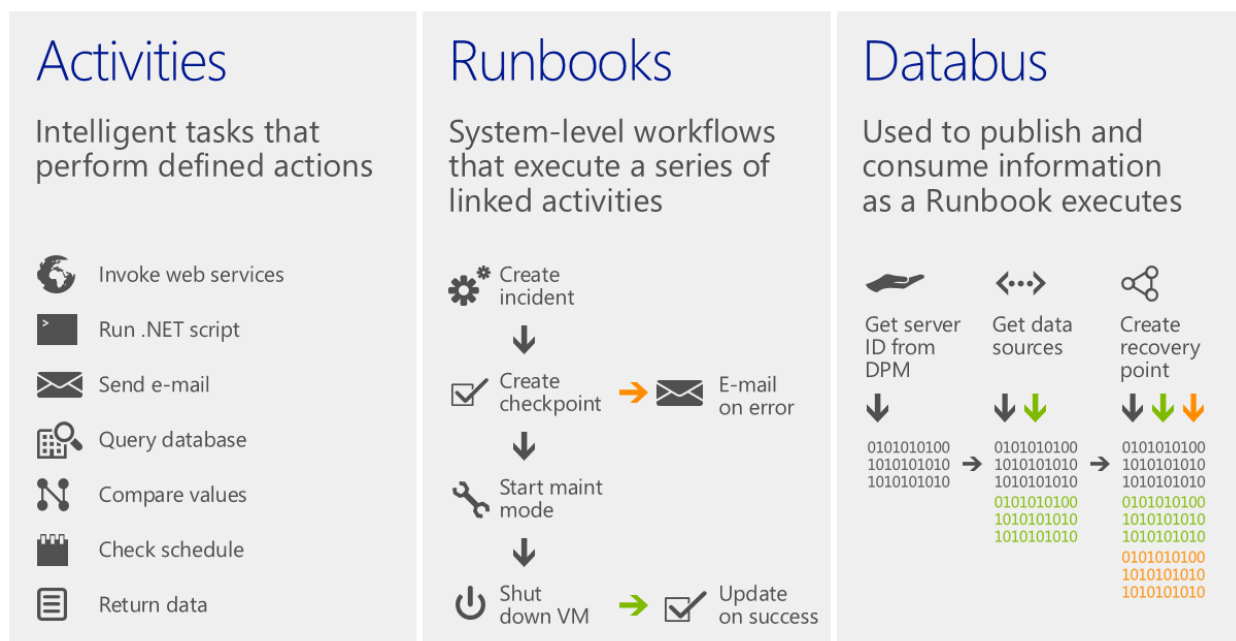0101010100
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Figure 15: Runbooks execute a series of linked activities, publishing to the Databus as they go

Integration across cloud technologies to reduce complexity

Having an accurate representation of the IT infrastructure, its components and their complex inter-relationship is a challenge for many organizations and is a core requirement for consistent service delivery. Service Manager uses connectors to populate the configuration management database (CMDB) to facilitate a single point of reference for IT organizations. Out of the box, connectors for Configuration Manager, Operations Manager, Active Directory, Virtual Machine Manager and Orchestrator populate and update the CMDB. Service Manager automatically reconciles this information providing a single point of reference for accurate understanding of the IT services. Many 3rd party hardware and software vendors ship connectors to allow information on their product configuration to be captured in the CMDB as well.

Integration packs are used within Orchestrator to automate processes and system activities in the private cloud. These integration packs allow Orchestrator to execute activities from a service request across other components of System Center 2012 SP1, line of business applications, and third party management tools. As private cloud demand grows the requirement for automation increases. The economic benefits of cloud computing rely on achieving economies of scale whereby the operational costs per unit of capacity, say per virtual machine, decreases as the overall capacity increases; automation is key to achieving this goal. Integration packs are available from a broad range of hardware and software vendors allowing automation of their tools and equipment from within Orchestrator.

Automation of processes and systems ensures best practices are delivered consistently, operational efficiency is enhanced, and compliance to company and industry regulations is supported. System Center 2012 SP1 brings these advanced automation capabilities to private cloud deployments.

IT service reporting

By managing the entire provisioning and operational processes of private cloud services, System Center 2012 SP1 is able to capture rich information on overall IT service delivery against agreed service levels. One of the traditional challenges in any datacenter is the ability to consolidate reporting across multiple, disparate systems. Service Manager builds a rich data warehouse of information from all of the deployed and integrated System Center 2012 SP1products. The data warehouse can also retrieve information from various other sources including Active Directory and any other Microsoft SQL Server based data repository. This information can then be surfaced to both business and IT users using tools that they are familiar with such as Excel pivot tables and SharePoint based dashboards.
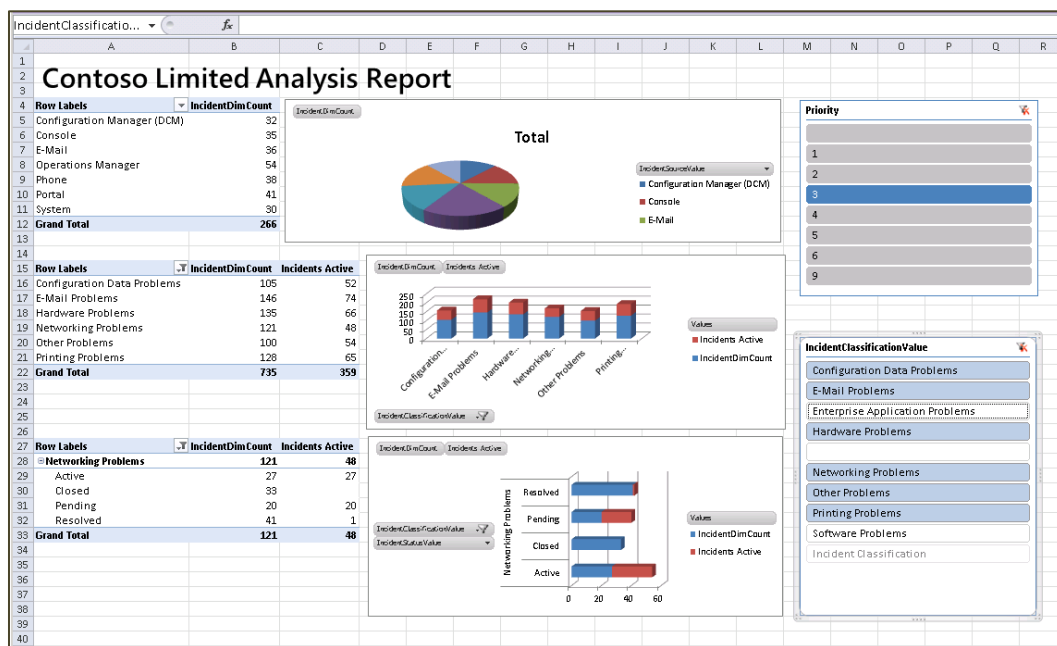

Figure 16: Sample Analysis Report from Service Manager Data Warehouse using Pivot Tables in Excel

Chargeback and governance of resource usage

As organizations move towards a private cloud model for IT delivery business units will move from purchasing dedicated resources for their application to the use of pooled cloud resources. There is a risk that private cloud consumers will continue to use IT services as they have in the past; that is, they will over-subscribe and under-utilize. To encourage conservation System Center 2012 SP1 provides a number of mechanisms for resource governance; quotas, leases, approvals and chargeback. These provide both top down rules and bottom up incentives to drive the right behavior from cloud consumers.

The new Chargeback capability delivered with Service Pack 1 allows organizations to better measure and account for the allocation of virtual resources in their private cloud. Data center administrators create a pricesheet for resources in their datacenter and then apply this pricesheet to one or more private clouds. A pricesheet sets out the fixed and variable costs for the consumption of resources such as virtual CPU cores, memory and storage. Different clouds will have differently SLAs; IT can price resources differently in their various clouds to reflect this. As business units create Cloud Resource Subscriptions to allocate capacity, Virtual Machine Manager and Windows Server 2012 capture cost records in the Service Manager

data warehouse. Finally, organizations can report on the data warehouse using off the shelf tools such as Microsoft Excel, or even support sophisticated cross charging models by integrating the chargeback reporting data to their financial management information systems.
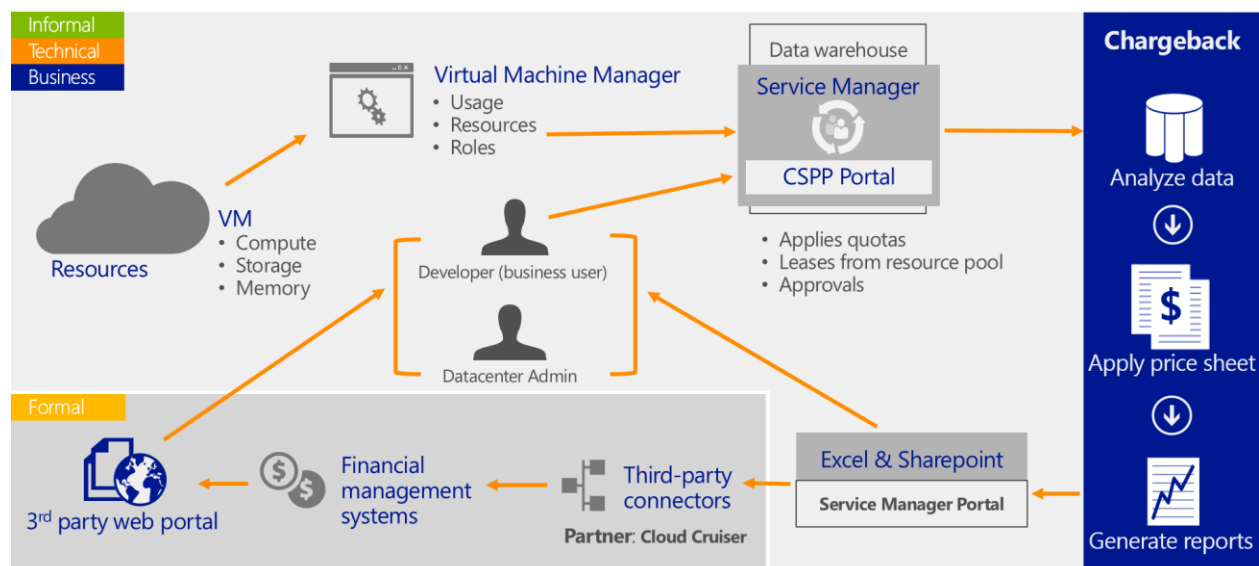

Figure 17: The Chargeback capability in System Center 2012 SP1 allows IT to better apportion costs of service provision within their businesses

Some organizations will use chargeback purely as a check & balance to drive conversations about usage between the business and IT. Others will apply a full cross-charge mechanism such that cost centers within the business actually pay for their internal IT usage; System Center 2012 SP1 allows organizations to easily support the full spectrum of approaches. By building atop industry standard SQL Server Analysis Services features the Service Manager data warehouse allows users to perform self-service reporting using tools such as Excel, to surface reports into Microsoft SharePoint and to integrate and aggregate chargeback data with other enterprise systems.

Figure 18: Out of the Box sample chargeback reports leverage the OLAP cube information from Microsoft Excel

Application management

A goal of the Microsoft private cloud is to enable a highly productive application and service experience to application owners. Microsoft has advanced System Center's datacenter application management and monitoring capabilities significantly to help to achieve this.

System Center 2012 SP1 provides application management across four key private cloud capabilities:

- Application Self-Service
- Application Performance Monitoring
- Governance, Resource Management and Chargeback
- Management Across Clouds

System Center 2012 SP1 also introduces a number of enhancements to enable service providers to deploy their own Infrastructure as a Service offerings.

Application self-service

On the surface, self-service would appear to exchange the datacenter administrators management and oversight for end-user convenience and chaos. This is not the case. Application self-service allows application owners to implement new applications with greater autonomy but this is only ever within their delegated cloud capacity and permission set. Datacenter administrators are able to delegate capacity and empower the application owner to deploy and operate applications within that capacity without encroaching on other application owners operating within the same private cloud.

System Center 2012 SP1uses service templates to set out the agreed requirements between the datacenter administrator and the application owner. The service template records configuration profiles, not just for application itself but for the underlying infrastructure that hosts the service; things such as networking, storage, compute resources, operating system configuration and databases.

The application owner provides the specification; defining the structure of the application, the required resources and the performance profiles needed to deliver the necessary service levels. Based on this specification, the datacenter administrator creates a service template, performs functional testing and then delegates rights back to the application owner for deployment. Using the service template, application services can then be deployed by the application owner. Application owners deploy and scale their applications within the boundaries of their delegated capacity.

Applications can be updated by creating and delegating new versions of the service template. The timing of these changes can be either forced by the datacenter administrator, when immediate security updates are required, or delegated to the application owner to apply when best suits their business needs.
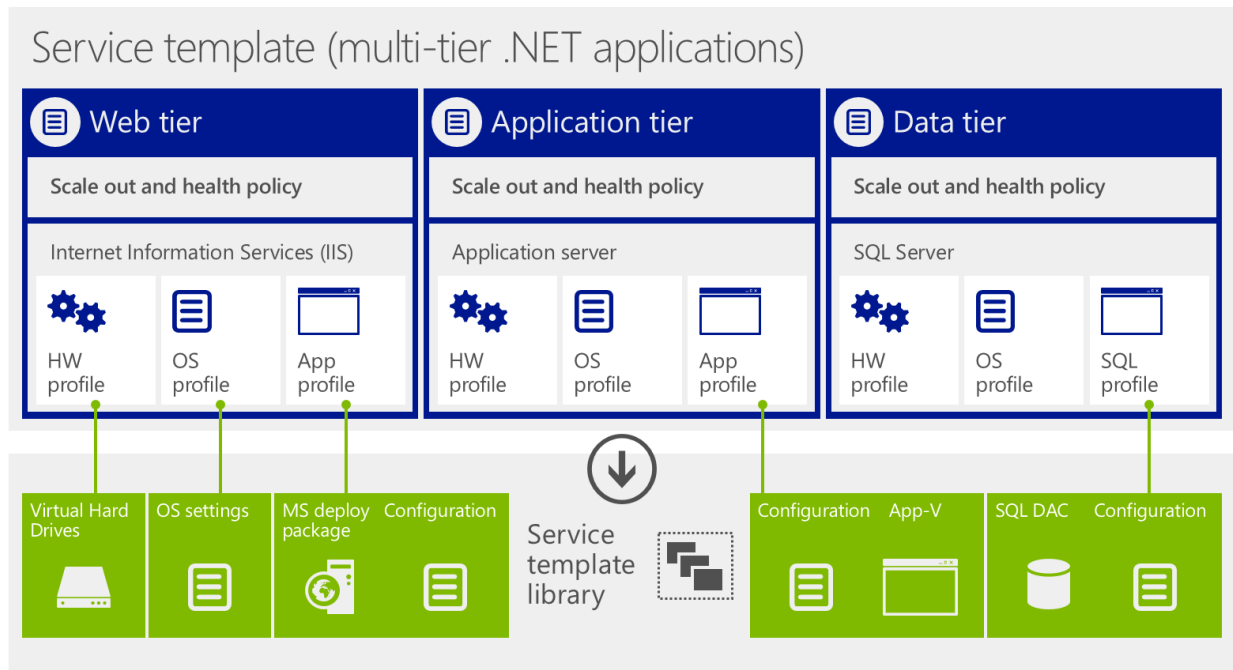
Figure 19: Service templates capture application and operating system configuration as well as the underlying hardware requirements for the service

Through System Center 2012 SP1 App Controller, the application owner has a self-service experience to deploy their application, start and stop instances of their application and make other changes to the application in response to their business needs. Self-service happens without direct involvement from IT, but, because the application is based on the agreed service template, they are still in overall control.

Templates apply throughout the application stack. Virtual machines are core to any cloud offering. In System Center 2012 SP1 these are created using virtual machine templates. Templates provide the definition of hardware specifications, operating system configurations and the dynamic configuration of Windows Server roles and features. Additionally, templates can include application packages such as Microsoft SQL Server and their accompanying configurations.

At the next level are single tier service templates. These templates capture everything that a machine template does, but also provide 'cloud style' characteristics to define scale units and upgrade domains. Upgrade domains allow the template to specify portions of the service that can be upgraded independently; this allows many applications to support rolling upgrades with zero downtime.

Finally, there is a full multi-tier service template which includes all elements of an application so it can be delivered as a service, from data tier to the web front ends. Leveraging a multi-tier service template delivers consistency across the entire application, allows referencing the application as a single entity and means that the performance of the application can be measured as a whole against desired service levels.

Private Cloud application performance monitoring

System Center 2012 SP1 provides a complete monitoring solution covering both the underlying infrastructure as well as all aspects of running applications. System Center 2012 SP1 monitors the performance of an application by tracking:

- The infrastructure hosting the application – the physical components like network and storage, the virtual platforms and the operating systems.
- The server-side components of the application – the execution performance of the application inside the service template.
- The client-side components of the application – the end user experience
- A set of synthetic workloads designed to highlight failures in situations that might not otherwise be caught.

Aggregating this information enables the datacenter administrator to build rich dashboards and visualizations to quickly see how applications are performing against the defined service levels. These dashboards can be delegated to application owners and operators to give them quick and rich visibility of application performance and availability.

In System Center 2012 SP1 Microsoft delivers deep application insight and diagnostics through Operations Manager. This allows performance monitoring and alerts right down to the line of code causing problems and even supports capture of the call stack using Intellitrace logs. Integration with Service Manager and Visual Studio Team Foundation Server mean this rich information can be passed to the business owner, support staff and the developer who authored the code. New in Service Pack 1 is specific monitoring support for ASP.NET MVC applications, WCF services, Windows Services an even native monitoring of SharePoint 2010 pages and sites.
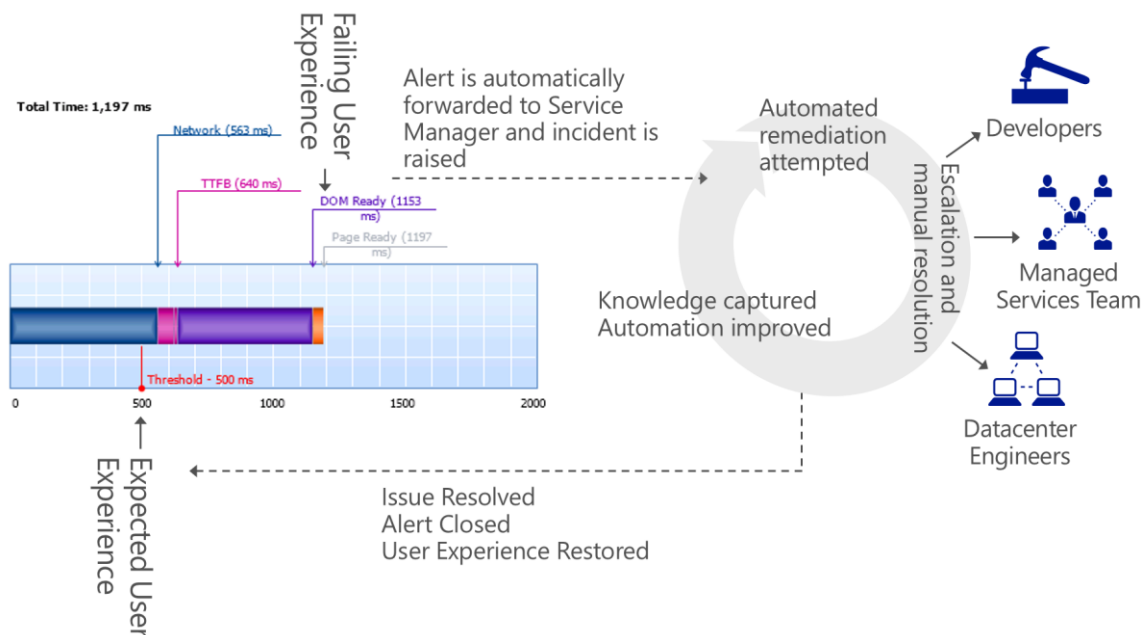

Figure 20: APM measures the entire application user experience including client side performance.
Resolution can be automated, escalation to IT staff managed and knowledge captured for the future

Global Service Monitor- ensuring applications are always up and always on.

For organizations with internet facing applications it is important to ensure that applications are always up, always on and always available to customers. Global Service Monitor (GSM) extends the management and monitoring capabilities outside the on-premises data center and into the public cloud. It provides test agents, hosted in Windows Azure locations around the globe. These look back into the private cloud environment and continuously monitor hosted applications. GSM gives private cloud administrators and application owners real time visibility of the performance and availability of their application from the internet; it sees what customers see from more than 20 locations around the globe.
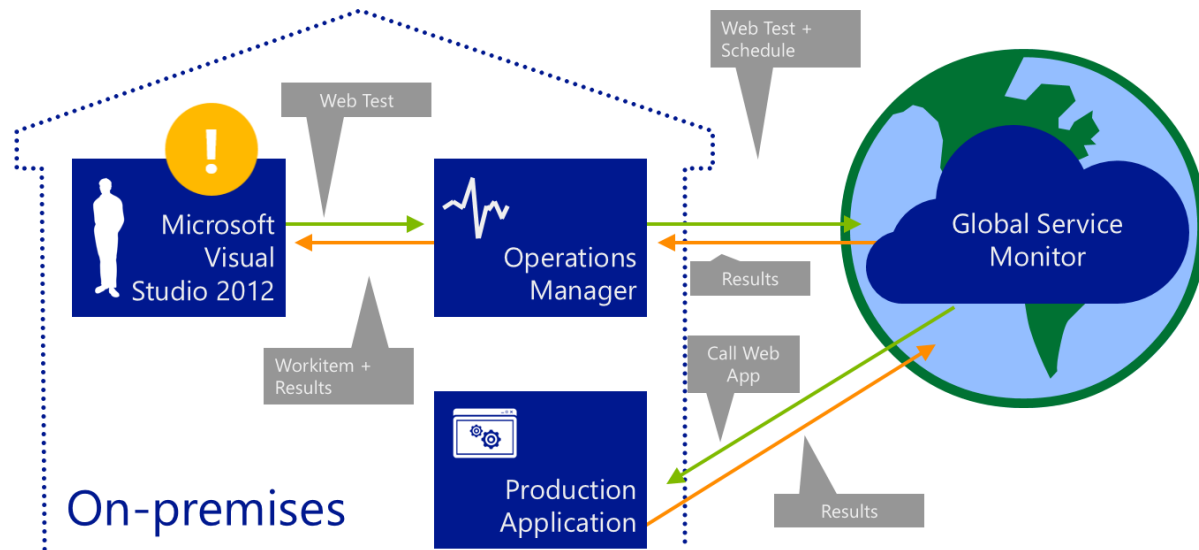

Figure 21: Global Service Monitor utilizes Microsoft managed test agents in loations around the globe to ensure that private cloud applications are always up, always on and always available to customers

Application management across clouds

Most customers will find certain applications that are more suited to public clouds than private. The world will exist in a hybrid state for the foreseeable future and it is important for companies to evaluate their particular needs to determine the best combination for them. System Center 2012 SP1 provides a common toolset for the management of both private and public cloud solutions. The rich integration with Windows Azure that is introduced in Service Pack 1 allows organizations to seamlessly work with applications and virtual machines running in Microsoft's public cloud.
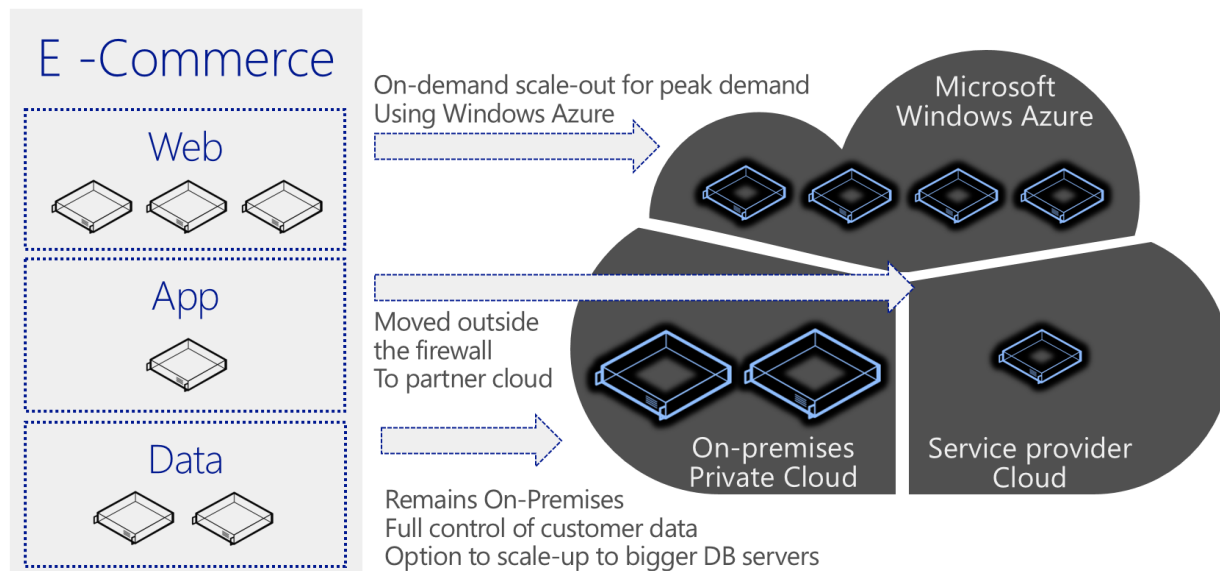
A key requirement, as organizations begin using hybrid apps, will be the ability to connect with services in other clouds and to manage them through a single management experience. App Controller provides extensive support for managing Windows Azure subscriptions and Azure hosted services. This includes both administration of subscriptions and management of their running applications. App Controller, and as such enterprise users with self-service rights, are able to start, stop and scale out their running applications in the Azure public cloud.

Virtual Machine Manager supports moving virtual machines from Hyper-V directly to Windows Azure. While this is not a full live-migration as supported on-premises it does provide the rapid migration of machines to the public cloud. The reverse scenario is also supported, that is moving a virtual machine running in Azure down to an on-premises Hyper-V node. Virtual hard drives stored in the Virtual Machine Manager can be moved directly to the Virtual Machine Image Gallery in Windows Azure allowing similar self-service creation of virtual machines in the public cloud.

Operations Manager 2012 provides application owners with the ability to track performance and other metrics of their applications running in the three types of clouds. This consolidated view allows the application owner to manage their applications regardless of the physical location in which they are ultimately deployed and to have complete insight over their app portfolio.

This capability to manage not only private cloud applications but also to span out into the public cloud is a critical requirement for many organizations to ensure they have the freedom to run their applications on the cloud that makes the most sense for their business.

Delivering a service provider hosted IaaS cloud
Service Pack 1 delivers new tooling to support hosting service providers looking to build their own Infrastructure as a Service (IaaS) clouds atop Windows Server 2012. This feature set is called Service Provider Foundation (SPF). SPF provides a set of oData web services on top of Virtual Machine Manager

and other System Center 2012 SP1 components. Service providers can use these web services to provide front-end management portals and other tooling to their clients allowing them to access and interact with virtual machines, services and applications running in the provider cloud.

The Service Provider Foundation is designed to allow providers to easily manage and scale their IaaS cloud services. It provides a robust mechanism for multi-tenant isolation such that tenant administrators can be granted rights to perform a broad set of self-service tasks relating to virtual machines and virtual machine networks. As providers grow they will expand their clouds through the use of '*stamps'*. Stamps represent a defined and reproducible set of physical hardware configurations.
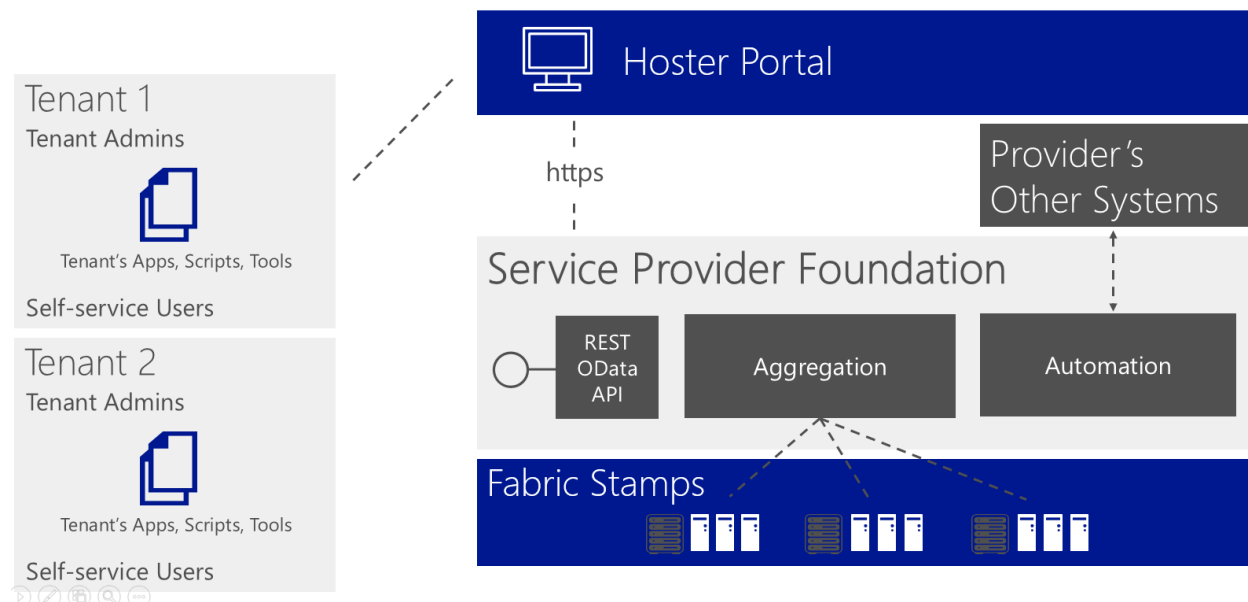

Figure 23: Service Provider Foundation allows providers to deliver rich IaaS cloud services to their customers

Because SPF uses the open standards oData web service protocol, providers are able to build custom front ends to provide cloud management in the tool of their choice. This could be .NET, Ruby on Rails, HTML+JS or literally any toolset capable of working with RESTful web service interfaces.

The interfaces exposed by SPF also allow enterprise customers (tenants) running System Center 2012 SP1 on-premises to connect directly and manage resources in the service provider cloud. So, for example, an organization can use App Controller to connect to a hosting provider and manage applications in the provider cloud or use Virtual Machine Manager to connect, deploy and run virtual machines.

The next steps to your Private Cloud

Providing technology solutions that meet business needs in a cost effective manner is a cornerstone of IT departments around the world. Consumerization of IT means that users expect to be able to consume their applications anywhere, anytime and on any device. New application patterns and the emergence of social networking, both public and private, is presenting an explosion of data to be stored and processed Many organizations are turning to cloud computing to deliver on these challenges. System Center 2012 SP1 allows organizations to realize the benefits of cloud computing by providing a common toolset for the management of physical and virtual resources and cloud hosted apps whether they are deployed in public, private or partner hosted cloud environments.

See what other customers are doing

Acer saved over $600,000 per year by improving virtualization density with Windows Server 2012.

ABM increased IT efficiency by deploying Windows Server 2012 and System Center 2012.

EmpireCLS delivered their own Software as a Service solution using a Microsoft Private Cloud

Volkswagen Financial Services improved business responsiveness through System Center 2012

Experience

Experience for yourself how the Microsoft private cloud solution can transform your business today and for tomorrow at http://microsoft.com/privatecloud, talk to your Microsoft representative about opportunities to see the Microsoft Private Cloud in action or even attend a *hands-on* Microsoft IT Camp.

Evaluate

Evaluate the Microsoft Private Cloud in your own environment by downloading the trial versions of Windows Server 2012 and System Center 2012 SP1 now.

Educate

Get educated on the private cloud with resources from the Private Cloud Solution Hub, Microsoft TechNet, and Microsoft Virtual Academy.

Certify

Certify yourself and your team to build private cloud solutions. Check out Microsoft Learning's Private Cloud Microsoft Certified Solutions Expert qualification.

Join the conversation

Join the Microsoft Windows and cloud platform teams via social media sites Twitter and Facebook or on their MSDN blogs.

Windows Server
http://twitter.com/windowsserver
http://blogs.technet.com/b/windowsserver
https://www.facebook.com/windowsserver

Microsoft Server and Cloud Platform
http://twitter.com/msservercloud
http://blogs.technet.com/b/server-cloud/
https://www.facebook.com/ServerCloud

Private Cloud resources

Here's a list of available resources to help you plan, design, and build your private cloud:

Windows Server 2012 feature whitepapers

- Virtualization (Whitepaper: Windows Server 2012 Server Virtualization)
- Storage (Whitepaper: Windows Server 2012 Server Storage)
- Networking (Whitepaper: Windows Server 2012 Server Networking)
- Manageability, Automation & Availability (Whitepaper: Windows Server 2012 Server Manageability and Automation)

Private Cloud solution hub

http://technet.microsoft.com/en-us/cloud/private-cloud

Microsoft Private Cloud

http://www.microsoft.com/privatecloud

Microsoft System Center 2012 SP1 primary site

http://www.microsoft.com/systemcenter

Microsoft System Center marketplace

http://systemcenter.pinpoint.microsoft.com

Microsoft System Center 2012 SP1– TechNet

http://technet.microsoft.com/en-us/library/hh546785.aspx

Learn how to configure and deploy Microsoft's private cloud technologies through the Microsoft Virtual Academy

http://www.microsoftvirtualacademy.com/tracks/configuring-and-deploying-microsoft-s-private-cloud

Purchase private cloud solutions pre-configured with hardware, Microsoft software, and best practices

http://www.microsoft.com/en-us/server-cloud/private-cloud/hyperv-cloud-fast-track.aspx