Reference Architecture Guide

MICROSOFT CLOUD REFERENCE ARCHITECTURE: FOUNDATION

- EMC VNX, EMC VMAX, EMC ViPR, and EMC VPLEX
- Microsoft Windows Hyper-V, Microsoft Windows Azure Pack, and Microsoft System Center

EMC Solutions

September 2015

EMC²

Published September 2015

Microsoft Cloud Reference Architecture: Foundation

Part Number H14481.1

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Overview

Document purpose

EMC developed this reference architecture to help IT departments build a Microsoft cloud solution. The implementation of the technology described in this reference architecture maximizes your investment in Microsoft business applications on a tailored infrastructure that minimizes cost, reduces risk, and provides continuous access to your critical business data. This cloud model uses agile infrastructure to scale up and down to meet demand for your Microsoft business applications.

This reference architecture provides a design and architecture for a private cloud using a Microsoft System Center management platform for automation and management to deliver Infrastructure as a service (IaaS) on a Microsoft Hyper-V-based cloud platform.

Use this reference architecture to empower your organization to respond faster to business opportunities by incorporating cloud architecture into your enterprise application design.

Audience

This document is intended for technical engineering staff, managers, cloud administrators, solutions architects, and IT and storage administrators responsible for designing, creating, and managing cloud solutions/data centers.

Readers of this document should be familiar with Microsoft technologies such as Windows Azure Pack (WAP), System Center, Hyper-V, Windows Server 2012 R2, SQL Server, and with EMC products.

Scope

This reference architecture provides a technical overview of an EMC data center using Microsoft technologies. This reference architecture demonstrates how IT organizations can deliver IaaS and self-service provisioning for Microsoft business applications.

Business challenge

Organizations are increasingly looking to do more with less. One way to achieve this objective is by transforming to a fully virtualized cloud infrastructure to deliver IT as a service to increase performance, agility, and flexibility.

This reference architecture showcases a reference enterprise customer example with a need to deploy Microsoft applications in a rapid, low-cost model with “as a Service” capabilities. This reference architecture uses a converged infrastructure with virtualization, networking, and EMC Storage platforms that provide storage management integration. The infrastructure package provides management, monitoring, and reporting back to the Cloud administrators.

Many customers are looking for solutions based on Microsoft technologies using Microsoft Hyper-V as the hypervisor platform. Microsoft System Center with Microsoft WAP provides a toolset to manage infrastructure and applications across private, hosted, hybrid, and Microsoft Azure clouds.

EMC can help in the deployment of a cloud solution infrastructure to provide a robust platform built on Microsoft Hyper-V, enabling your business applications to operate with greater agility and efficiency.

This reference architecture demonstrates how the EMC storage platform and software integrate with Microsoft Windows Server 2012 R2 Hyper-V, Windows Failover Clustering, Microsoft System Center 2012 R2, and WAP to provide Infrastructure as a Service (IaaS) and self-service provisioning for both enterprise administrators and tenant users. EMC VPLEX® is also included in this solution to provide transparent, enterprise-grade active/active multi-site continuous availability for all management and tenant storage resources.

Reference architecture

Figure 1 shows the reference architecture.

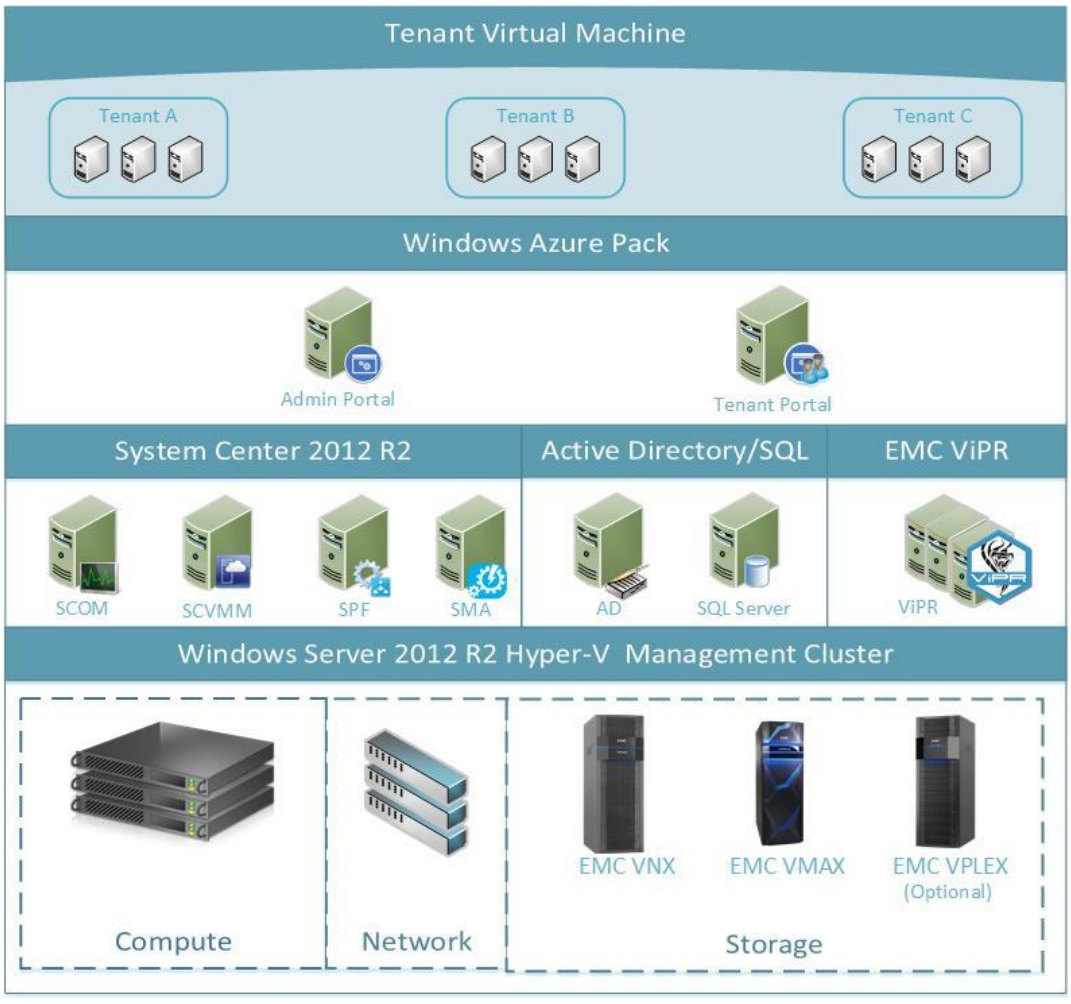

Figure 1. Reference architecture

Requirements

Hardware resources

Table 1 lists the hardware used in this reference architecture.

Table 1. Hardware

Hardware	Quantity	Configuration	Notes
Storage			
EMC VMAX® 100K	2	SAS, NL-SAS, and flash disks	Provides the Service Level Objective (SLO) feature to enable efficient provisioning and performance optimization
EMC VNX® 5600[1]	2	Serial-Attached SCSI (SAS), NL-SAS, and flash disks	Provides block and file storage, including FAST VP and EMC FAST Cache
EMC VPLEX(Optional)	2	Dual-engine VPLEX Metro systems	Supports the continuous availability features for both VNX and VMAX across two sites
Compute			
Blade servers	10	2 x six-core Intel Xeon Series, 96 GB RAM, 2 x converged network adapters	2 x chassis, each hosting 5 blades
Network			
Ethernet switch	2	10 Gb Ethernet	Infrastructure Ethernet switches
SAN switch	2	8 Gb/s FC	Dual Fibre Channel (FC) fabric

Software resources

Table 2 lists the software used in this reference architecture.

Table 2. Software

Software	Version	Description
Microsoft virtualization and cloud infrastructure		
System Center Virtual Machine Manager	2012 R2 UR6	Microsoft cloud management and infrastructure
System Center Operations Manager	2012 R2 UR6	Automated operations management
System Center Service Management Automation	2012 R2 UR6	Automates the creation, monitoring, and deployment of resources in WAP

[1] VNX and VMAX were utilized in this reference architecture, but both are not required. One or both can be used in the deployment.

Software	Version	Description
System Center Service Provider Foundation	2012 R2 UR6	Integrated IaaS capabilities for designing and implementing multi-tenant self-service portals
Windows Azure Pack (WAP)	1.0 UR6	Integrates with System Center and Windows Server to provide self-service portals for managing services and resource clouds
Microsoft SQL Server	2012 SP1	Database server for System Center and WAP
Microsoft Windows Server	2012 R2	Operating system for the server environment
EMC storage		
EMC ViPR™ (Hyper-V Edition)	2.2.0.1	Software-defined storage
EMC VNX Operating Environment	Release 33	Operating environment for VNX
EMC HYPERMAX OS	5977.498.472	Operating environment for VMAX
EMC SMI-S Provider	7.6.2	EMC SMI-S Provider included in Solutions Enabler
EMC PowerPath® for Windows	6.0	Multipathing and load balancing for block access
EMC and Microsoft integration		
EMC Storage Integrator (for x64 Windows systems)	3.5.331.8053	EMC plug-in for Windows
EMC ViPR plug-in for System Center Virtual Machine Manager	2.0.0.12	EMC ViPR plug in for System Center Virtual Machine Manager

Figure 2 shows an overview of the software and hardware resources used in this solution.

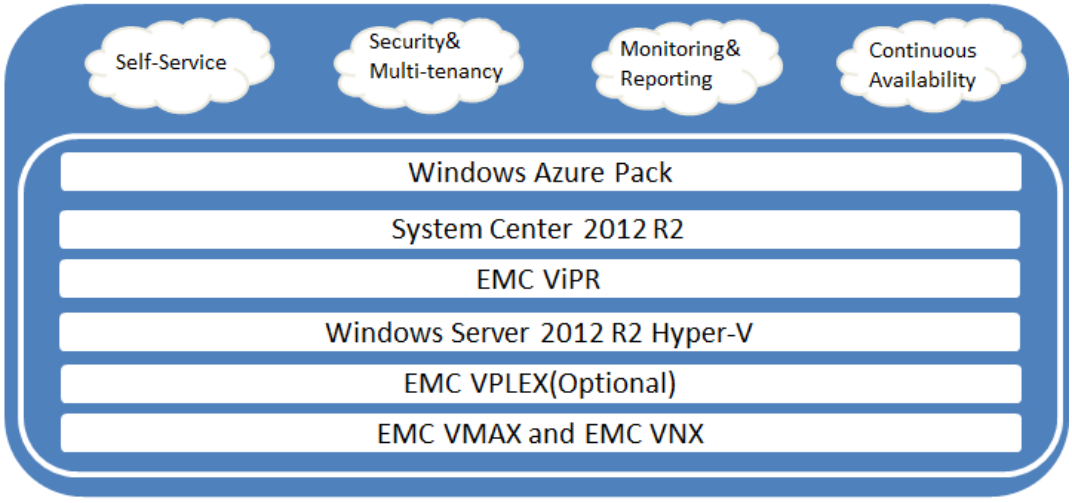

Figure 2. Overview of the software and hardware resources

Server and networking requirements

This section outlines the requirements that must be met for this solution.

The server hardware and networking requirements for this solution conform to the Windows Server Catalog. This solution uses standard Microsoft- and EMC-supported I/O devices to support Ethernet and FC connectivity, including:

- 10 Gb Ethernet
- 8 Gb/s FC

The Windows Server Catalog provides detailed lists of vendor devices that have been either physically tested or are similar to the devices tested by Microsoft or Microsoft partners.

Key components

The following sections provide a high-level overview of the key solution components.

Microsoft infrastructure platform

This section briefly describes the Microsoft components used in this solution.

Microsoft Windows Azure Pack

Windows Azure Pack (WAP) is available to Microsoft customers at no additional cost; it is provided as a collection of Windows Azure technologies that install in enterprise and service provider (SP) data centers. Running on top of Microsoft Windows Server and System Center, WAP delivers the power of Windows Azure into your data center, enabling you to offer a rich, self-service, multi-tenant cloud with Windows Azure-consistent experiences and services.

Microsoft Windows Server 2012 R2 Hyper-V

Windows Server 2012 R2 extends Hyper-V's capabilities with additional features and industry-leading scalability for host processors and memory, helping your organization to improve server utilization and reduce costs.

The Hyper-V cluster feature is implemented with Cluster Shared Volumes (CSVs) so that all components and services running on it remain available when one of the nodes shuts down. At the same time, tenant virtual machines are also allocated on CSVs, which are used for the tenant to achieve availability.

Microsoft System Center 2012 R2

Microsoft System Center 2012 R2 Virtual Machine Manager

System Center Virtual Machine Manager (SCVMM) is designed to manage virtualized data centers. It enables you to configure and manage your virtualization host, storage, and networking resources in order to deploy virtual machines and services to your cloud.

Microsoft System Center 2012 R2 Operations Manager

System Center Operations Manager (SCOM) provides you with infrastructure monitoring. It is flexible and cost-effective, helping to ensure the predictable performance and availability of certain applications, and offering comprehensive

monitoring for your cloud whether it is private, public, or hybrid. With EMC support, storage system monitoring is also available.

Service Management Automation

As a part of WAP, Service Management Automation (SMA) provides PowerShell workflows for automation. SMA is highly scalable and flexible and helps you transform the data center as needed.

Service Provider Foundation

Service Provider Foundation (SPF) exposes an extensible web service that interacts with SCVMM. SPF enables service providers to design and implement multi-tenant self-service portals.

EMC platform

This section briefly describes the EMC components used in this solution.

EMC VNX and EMC VMAX

Optimized for virtual environments and applications, EMC storage platforms provide simplicity and efficiency while providing storage replication for business continuity and disaster recovery solutions.

VNX and VMAX storage systems are powerful, trusted, and smart storage array platforms that provide the highest level of performance, availability, and intelligence in the cloud. VNX and VMAX systems offer advanced storage tiering features and efficiencies to deliver multiple storage service levels to organizations, accelerating and simplifying their as-a-service offerings in the cloud environment.

EMC VPLEX

VPLEX provides a single storage virtualization interface for multiple storage arrays, even if the physical storage is located on two different storage area networks (SANs) and at two different data centers at geographically separated sites.

VPLEX is deployed as clusters of one or more engines. Each engine is made up of two I/O directors, and each cluster runs a storage virtualization software environment called GeoSynchrony®. Each cluster has a service management station that provides storage management.

EMC ViPR

ViPR is a lightweight solution that transforms existing storage into a simple, extensible, and open platform. ViPR software extends current storage investments to meet new cloud-scale workloads, and enables simple data and application migration out of or into public clouds and back under or out of the control of IT. ViPR software gives IT departments the ability to deliver on-premises, fully automated storage services at price points that are the same as, or lower than, those of public cloud providers.

EMC ViPR Add-in for SCVMM

EMC ViPR is a software platform that provides a single point of access to heterogeneous storage arrays. The EMC ViPR Add-in for SCVMM integrates prepackaged services with SCVMM to allocate and manage ViPR storage with the SCVMM hypervisors and hosts through the SCVMM console.

ESI for Windows Suite

EMC Storage Integrator (ESI) for Windows Suite is a set of tools for Microsoft Windows and Microsoft applications administrators. The suite includes ESI for Windows, ESI Management Packs for SCOM, and ESI PowerShell Toolkit.

Features

Introduction

In this reference architecture, we use Microsoft private cloud technology and EMC storage services to provide IaaS and self-service provisioning feature for cloud tenants. Additionally, VPLEX can be used to ensure the high availability of all infrastructure management and tenant storage resources across different sites.

Self-service provisioning

Cloud services

This reference architecture provides self-service provisioning of an automated cloud service to end users and infrastructure administrators. This cloud reference architecture uses WAP and System Center components integrated with ViPR, VNX, and VMAX storage to provide the compute, storage, network, and security platform. This platform enables you to rapidly deploy and provision business-relevant cloud services across the cloud and physical infrastructures.

The WAP self-service portal enables both cloud admin and tenant roles to manage provisioning and operational tasks in a secure, separated way, while enabling them to configure and consume resources in line with the quality of service required. Using the WAP Self-service portal:

- WAP administrators can create and manage computing/networking/storage resources.
- Tenant users can request and manage their own virtual machines.

As shown in Figure 3, a tenant can apply and manage the virtual machine from the WAP tenant portal.

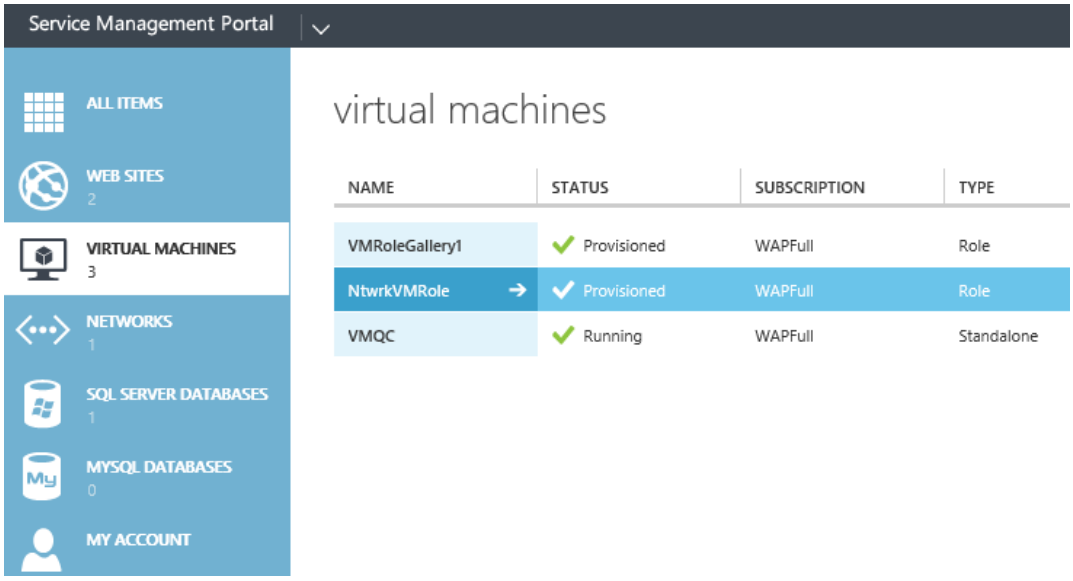

Figure 3. Virtual machines in the tenant portal

Virtual machines are deployed from the virtual machine role (VM Role) or standalone virtual machine (Standalone VM) function in WAP. The tenants can choose the virtual machine template with different storage tiers to meet the different business requirements, as shown in Figure 4.

Figure 4. Select the virtual machine template

At the same time, you can also deploy SQL Server/Exchange/SharePoint in WAP.

Refer to *MICROSOFT CLOUD REFERENCE ARCHITECTURE: MICROSOFT APPLICATIONS* for details on deploying Microsoft applications in WAP using the Standalone VM template.

The lifecycle of a virtual machine in WAP, as shown in Figure 5, can be summarized as follows:

1. WAP administrator sets up the plan and resource template.
2. Tenant registers the subscription and selects the virtual machine template.
3. A virtual machine is provisioned from the clouds and is used by the tenant.

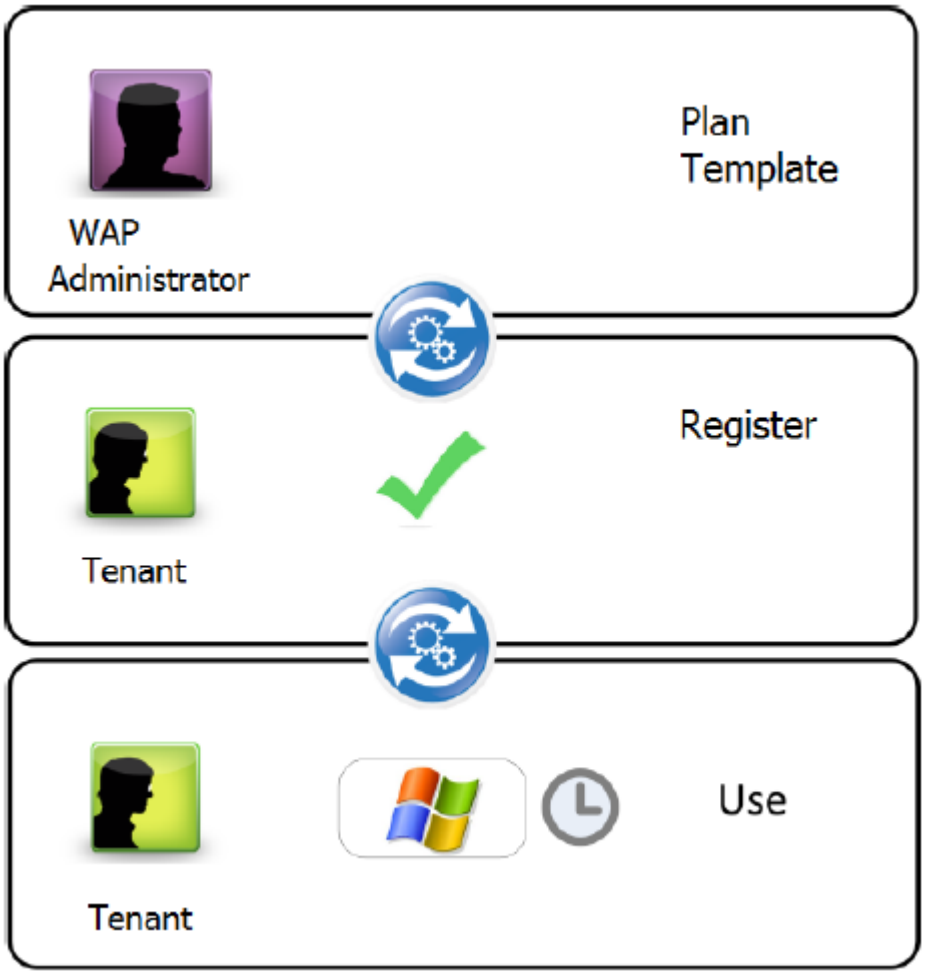

Figure 5. Cloud services lifecycle

Storage

ViPR software-defined storage provides a native GUI and catalog called the ViPR Admin and Self-Service UI. The ViPR management interface simplifies configuring the ViPR virtual data center and managing the diverse underlying physical storage infrastructure. The ViPR platform hides the underlying physical storage infrastructure, enabling storage to be selected by the level of service it provides, instead of the physical array characteristics.

The ViPR management interface presents the most common storage use cases as services through the service catalog, as shown in Figure 6. The system administrator can configure the service catalog to customize the services offered and to control access to the services.

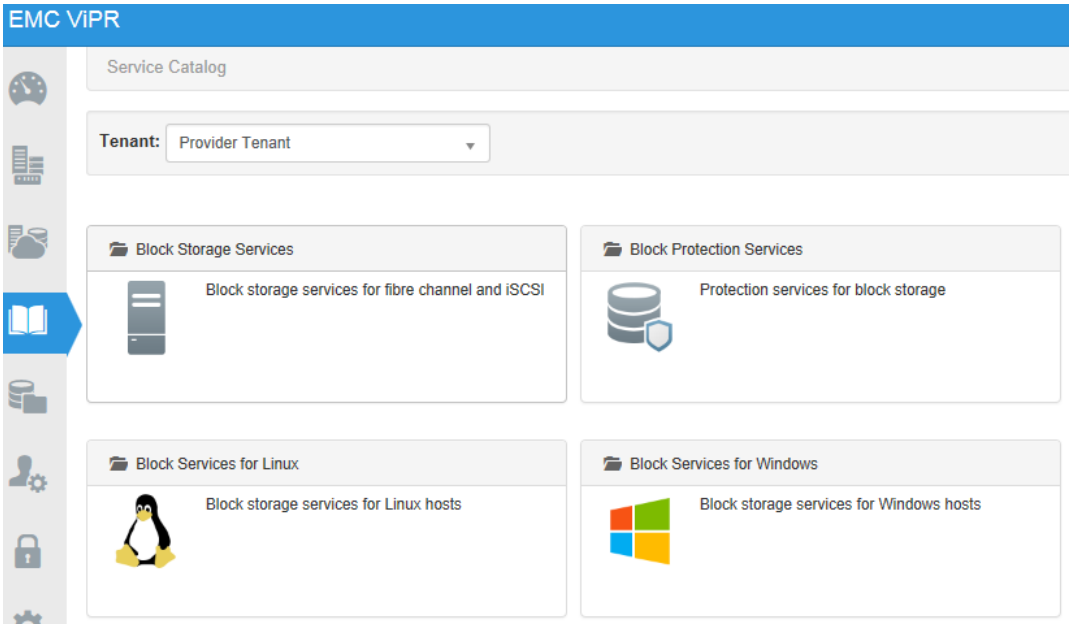

Figure 6. ViPR admin and self-service user interface

From this ViPR management interface, users can perform self-service provisioning by selecting the appropriate storage service from the service catalog and selecting the virtual pool and array that meets their storage needs.

Monitoring and reporting

This reference architecture features automated monitoring capabilities that provide cloud administrators with a comprehensive view of the cloud environment to enable smart decision-making for resource provisioning and allocation. These capabilities are based on a combination of SCOM monitoring and navigation panes, along with detailed views and reporting of EMC storage, using SCOM management packs and interfaces as part of ESI for VNX and VMAX.

Figure 7 shows an example of storage pool monitoring.

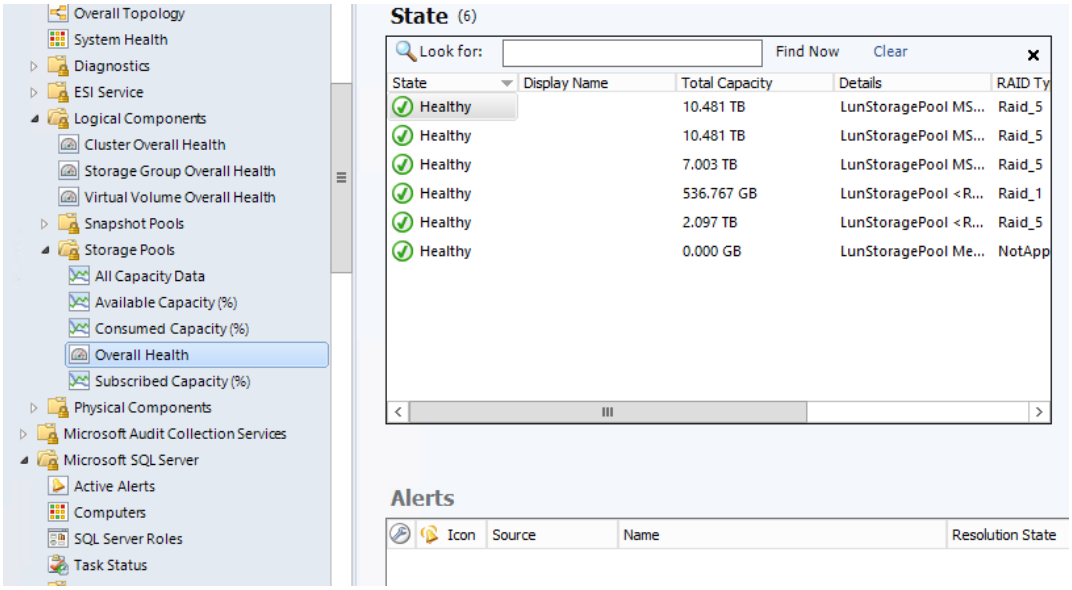

Figure 7. Storage pool monitoring

You can also integrate SCOM and SCVMM by installing the SCOM agent on SCVMM and importing the SCVMM management pack. This allows SCOM to monitor the entire virtual infrastructure, which includes Hyper-V hosts, virtual machines, and clouds. Figure 8 shows the state of several virtual machines that are managed by the agent.

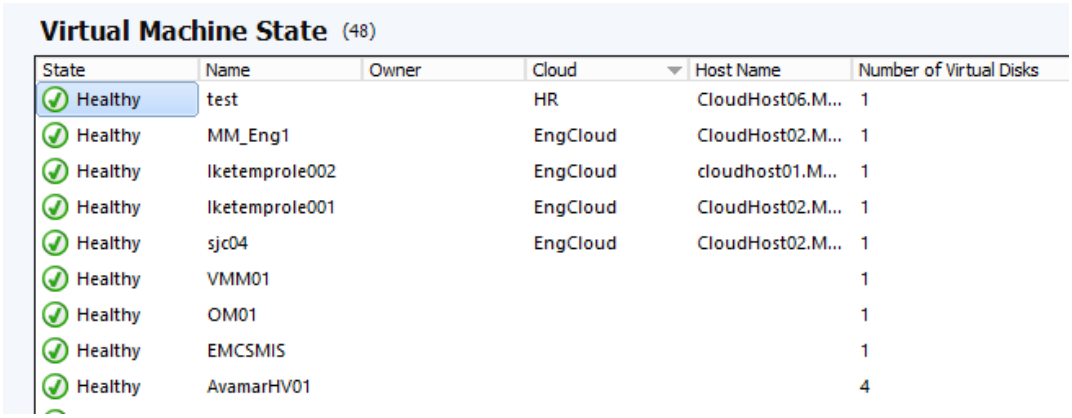

Figure 8. Virtual machine monitoring

Security and multi-tenancy

To help organizations maintain or improve their security posture while enabling the business, this reference architecture leverages the following security features:

- **Infrastructure security**: Integration with a public key infrastructure (PKI) to provide authenticity, non-repudiation, and encryption
- **Active Directory Federation Services (ADFS)**: Controls organization domain users' access to the cloud environment
- **Virtual networking**: For network separation and multi-tenancy
- **Plan access passcode**: Implemented for tenants to ensure that different departments have their own private resources that cannot be accessed by anyone else

Continuous availability

This reference architecture provides an optional continuous availability feature for all management and tenant storage resources across two sites, in an active/active situation. EMC VPLEX Metro™ is used with Microsoft clustering and replication capabilities for continuous availability across two data centers in close proximity (500 KM or 320 miles).

This reference architecture represents the best option for ensuring the availability of critical applications on an EMC infrastructure.

Designed for 100 percent continuous operations, VPLEX Metro allows you to:

- Take advantage of advanced data caching and distributed cache coherency that creates a high-availability infrastructure across arrays in a single site or across geographically dispersed data centers with unmatched resiliency and active-active data access, eliminating planned and unplanned downtime for application data
- Meet strict service level agreements (SLAs) that are at or approaching zero recovery point objectives (RPOs) and zero recovery time objectives (RTOs)
- Manage heterogeneous block storage from a single interface with EMC Unisphere® for VPLEX, which uses the same graphical user interface (GUI) framework as VNX and VMAX platforms, providing a way to simplify, normalize, and consolidate EMC management tools
- Create a new approach to ensuring the availability of your applications and data with EMC Continuous Availability Advisory Services, eliminating downtime and reducing operating expense

Typically, WAP has no built-in disaster recovery capabilities, so VPLEX can provide the ability to bring WAP back on a different site via VPLEX. VPLEX supports two levels of continuous availability in this reference architecture: storage outage and host failure. Figure 9 shows the VPLEX logical topology for this reference architecture.

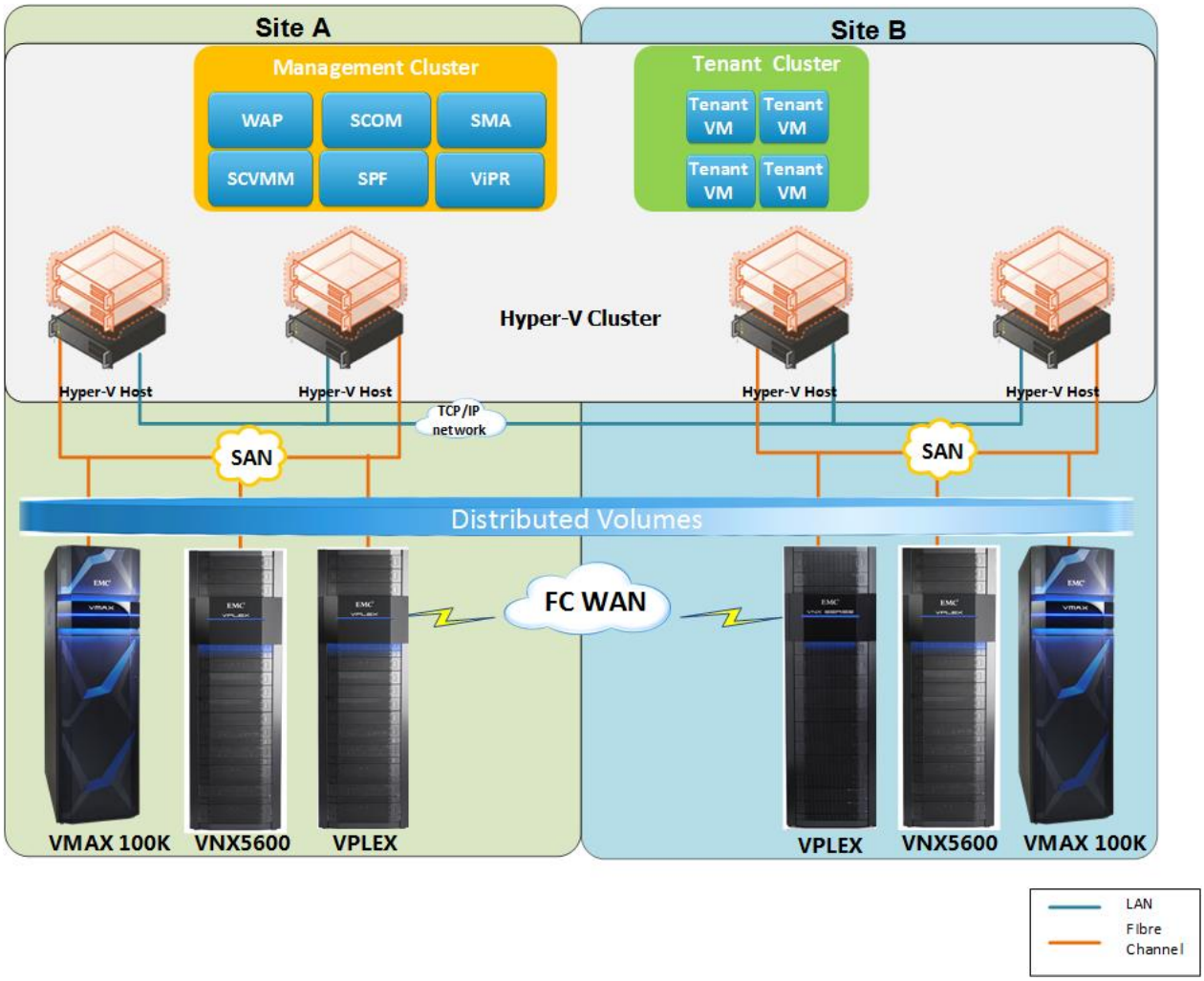

Figure 9. VPLEX logical topology

Storage outage

If a storage outage occurs in one site while the WAP management cluster and tenant workload are running, VPLEX continues to provide access to the Metro distributed virtual volumes through the back-end array. When access to the array is restored, the storage volumes from the preferred/non-preferred site back-end array are resynchronized automatically.

Host failure

The data must be shared across cluster nodes or physical servers for the virtual machines and applications to failover transparently. This is enabled by Hyper-V high availability. VPLEX Metro fits perfectly with VPLEX distributed cache coherence for automatic sharing, balancing, and failover of I/O across the cluster.

Hyper-V deployments are supported by Windows Server Failover Clustering (WSFC) to provide extremely robust and highly available application solutions. Hyper-V utilizes features of WSFC to enhance and extend certain availability functions. This forms the basis for features such as Hyper-V live migration and Cluster Shared Volumes (CSV).

Once the Hyper-V hosts are shut down at one site, the hosts try to live migrate all virtual machines to another site's hosts without interruption.

Conclusion

This reference architecture empowers IT organizations to be a broker of on-premises cloud services providing the control and visibility that IT organizations need, and the agility and on-demand self-service that developers and application users expect from a public cloud.

The following major features were incorporated in this reference architecture:

- Self-service provisioning
- Monitoring and reporting
- Security and multi-tenancy
- Continuous availability

This reference architecture uses the best of EMC and Microsoft products and services to empower customers to accelerate the implementation of Microsoft applications over a private cloud while enabling customer choice for the compute, storage and networking infrastructure within the data center.

References

EMC documentation

The following documents, located on EMC.com, provide additional and relevant information. Access to these documents depends on your login credentials. If you do not have access to a document, contact your EMC representative:

- ViPR Concepts Guide
- EMC VPLEX 5.0 Architecture Guide
- *MICROSOFT CLOUD REFERENCE ARCHITECTURE: MICROSOFT APPLICATIONS*

Microsoft documentation

Documents located on the following Microsoft website provide additional relevant information:

- Microsoft TechNet