The IBM Advantage for Implementing the Virtualization Reference Architecture

Introduction

This paper describes the Virtualization reference architecture and how customers can use IBM products and services to support the best practices for architecting virtualization solutions.

Enterprises want to leverage the agility and flexibility of the IBM® Cloud™ to extend their on–premises virtualized private cloud without incurring the cost and risk associated with retooling operations, restructuring applications, and redesigning security policies. You can create a VMware environment in the cloud to support use cases such as capacity expansion into the cloud, migration to the cloud, disaster recovery to the cloud, and backup into the cloud. A VMware environment in the cloud can also be used for development, testing, training, lab work, or production.

IBM customers can extend their existing data center to the cloud simply and quickly. IBM Cloud for VMware Solutions enables customers to deploy a software–defined data center to the cloud while seamlessly reusing their existing skill set, tooling, and processes.

IBM Cloud for VMware Solutions enables you to quickly and seamlessly integrate or migrate your on–premises VMware workloads to the IBM Cloud by using the scalable, secure, and high–performance IBM Cloud infrastructure and the industry–leading VMware hybrid virtualization technology.

Before we look at the actual architecture, let's review some of the factors that are driving the need for virtualization solutions.

Business problems

The following business problems can spur interest in virtualization:
- Significant growth in infrastructure requirements driven by workload growth or business continuity requirements
- Capacity limitations for existing data centers
- Aging data center infrastructure
- Requirements for the business to move from a capital expenditures (CapEx) model to an operational expenditures (OpEx) model

Use cases

Virtualization solutions can be attractive for the following use cases:
- Capacity expansion into cloud, including dynamic bursting with the possibility of contraction when no longer needed
- Migration to cloud, including the following use cases:
  - Data center evacuation
  - Infrastructure modernization
  - Adoption of software–defined networking and storage solutions
  - Virtualization of physical workloads
  - Modernization of security and compliance solutions
- Disaster recovery to cloud, with the ability to perform nondisruptive disaster testing in isolated networks

- Backup to cloud, including the ability to take advantage of IBM Cloud Object Storage economies

Value proposition

The value proposition for IBM Cloud for VMware Solutions is that it allows the customer to easily deploy their VMware virtual environments and manage the infrastructure resources on IBM Cloud. At the same time, customers can continue to use the familiar native VMware product console to manage the VMware workloads.

Functional and nonfunctional requirements

A number of functional and nonfunctional requirements must be considered for a Virtualization reference architecture.

Network

Network-related requirements:
- On–premise connectivity
- Network segmentation and security
- Public isolation
- Global load balancing
- Bring your own IP address

Storage

Storage-related requirements:
- Availability of dedicated in addition to shared storage
- Choice of storage performance tiers
- Encryption at rest and in motion, including key management

Business continuity

Requirements related to business continuity:
- Availability of industry-standard solutions spanning the range of high availability, disaster recovery, and backup
- Independent flexibility in storage and compute sizing
- Dynamic storage and compute sizing

Availability, performance, throughput considerations, SLAs

Requirements related to availability, performance, throughput, and service-level agreements (SLAs):
- Highly available infrastructure components
- Scalable infrastructure
- Scalable storage

Security, including encryption and key management

Security-related requirements:
- Availability of key management solutions
- Availability of storage encryption solutions

- Availability of scalable network security solutions
- Availability of scalable application security and load balancing solutions

Regulatory compliance

Requirements related to regulatory compliance:

- Industry standard compliance of cloud infrastructure
- Readiness to support building solutions capable of industry standard compliance of application workload

Virtualization reference architecture

Figure 1 shows the elements of the Virtualization reference architecture.

Figure 1. Elements of Virtualization reference architecture

IBM offers a solution for most of the elements shown above in figure 1.

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Enterprises want to leverage the agility and flexibility of the IBM Cloud to extend their on–premises virtualized private cloud without incurring the cost and risk associated with retooling operations, restructuring applications, and redesigning security policies.

IBM Cloud for VMware Solutions offerings deliver a fully automated deployment of a software–defined platform based on VMware-validated design, providing virtualized compute, storage, and networking. It is ordered, provisioned, and managed from the IBM Cloud console. Using advanced automation and single–tenant bare metal infrastructure, the entire VMware environment is rapidly deployed to the IBM Cloud and made available to the client in a matter of hours. Additional capacity can be added, or removed, to meet changes in workload demands. Optional additional capabilities or tooling can be added for specific use cases.

Components of a Virtualization reference architecture

Figure 2 shows the capabilities and relationships for supporting a Virtualization reference architecture.
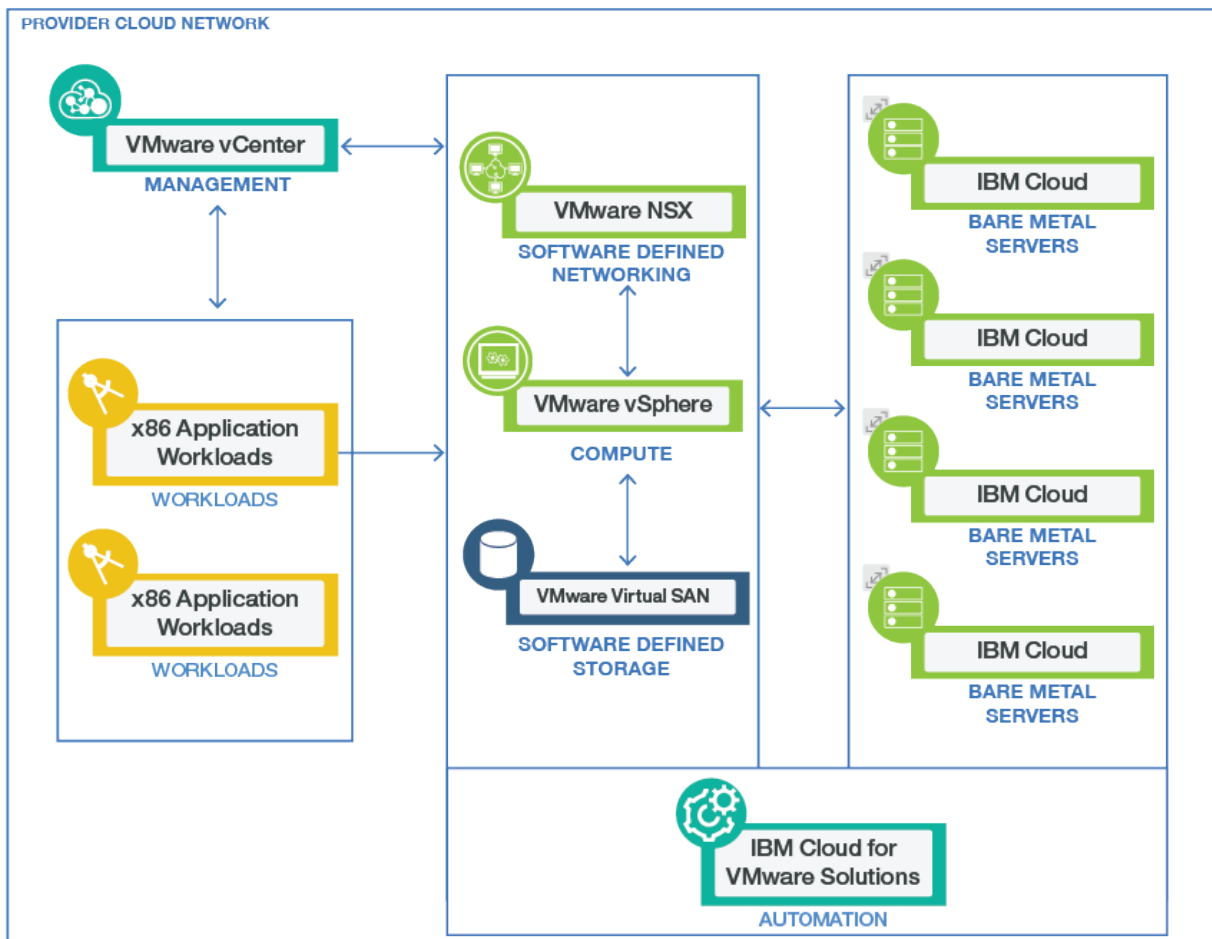

Figure 2. Cloud components for Virtualization reference architecture

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The remainder of this section describes the various components in detail.

Management

The Management component is a centralized platform for managing the entire software–defined data center.

Product capability: **VMware vCenter**

- VMware vCenter Server provides a centralized platform for managing your VMware vSphere environments, allowing you to automate and deliver a virtual infrastructure across the hybrid cloud with confidence.

Workloads

Workloads refers to all the x86 application workloads.

Software–defined networking

The Software-defined networking component provides a network overlay that virtualizes the physical network to provide a large number of customer–defined networks (VxLAN), intelligent network routing, and microsegmentation for enhanced firewall capabilities.

Product capability: **VMware NSX**

- Network virtualization platform for the software–defined data center (SDDC), delivering the operational model of a virtual machine for entire networks. With NSX, network functions that include switching, routing, and firewalling are embedded in the hypervisor and distributed across the environment.
- This effectively creates a "network hypervisor" that acts as a platform for virtual networks and services.

Compute

The Compute component enables many virtualized Linux and Windows servers to run concurrently on the same physical bare metal server, providing high levels of server use and capacity.

Product Capability: **VMware vSphere**

- vSphere provides a powerful, flexible, and secure foundation for business agility that accelerates your digital transformation to hybrid cloud.
- With vSphere, you can support new workloads and use cases while keeping pace with the growing needs and complexity of your infrastructure. vSphere is the heart of a secure SDDC, securing applications, data, infrastructure, and access.

Software–defined storage

For the Software-defined storage component, local storage of the physical host is aggregated into a high performance, highly available software–defined SAN.

Product Capability: **VMware Virtual SAN**

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- VMware vSAN powers industry–leading hyper–converged infrastructure solutions with a vSphere–native, high–performance architecture.

Bare metal servers

IBM Cloud bare metal servers provide a dedicated, single-tenant basis for deploying the client's private infrastructure. Clients can locate their deployment in any of dozens of IBM Cloud locations around the globe.

Product capability: **IBM Cloud**
- A full–stack cloud platform that spans public, private, and hybrid environments. Build with a robust suite of advanced data and AI tools, and draw on deep industry expertise to help you on your journey to the cloud.

Automation

For the Automation component, IBM Cloud provides automation that deploys and configures the entire standardized VMware software–defined stack, ready for your use.

Product capability: **IBM Cloud for VMware Solutions**
- IBM Cloud for VMware Solutions streamlines cloud adoption, allowing you to optimize the value of existing on–premises infrastructure, while confidently leveraging the same tools, technologies, and skills in the cloud.

Governance and operations

IBM Cloud operates the network and bare metal servers that underlie your VMware instance. IBM Cloud provides the ability to expand capacity by ordering additional bare metal servers or additional network attached storage (NAS). IBM provides basic monitoring of these resources, but the VMware instance is not offered as a fully managed service. You have the ability and the responsibility for ongoing configuration, security, management, and monitoring of all components of the instance. You need to design and test the solution and your ongoing operation of the solution with all of your requirements in mind, including capacity, availability, access control, authentication, encryption, auditing, vulnerability, maintenance, compliance, performance, and change management.

For more information, see: Post–deployment considerations for your VMware instance [1], which enumerates many of the responsibilities and activities you should plan for in order to fully operationalize your VMware instance.

Virtualization platform extensions

Now that you understand the architectural components of a VMware virtualization solution in the cloud, let's look at how to use IBM products to implement common scenarios using this architecture. The following scenarios are described:

- Scenario 1: VMware HCX on IBM Cloud
- Scenario 2: IBM Cloud storage for virtualization
- Scenario 3: Zerto disaster recovery
- Scenario 4: IBM Cloud Secure Virtualization

- Scenario 5: Veeam backup and replication

Scenario 1: VMware HCX on IBM Cloud

IBM Cloud for VMware Solutions provides the foundation of a hybrid cloud where on–premises virtualized workloads can be moved and run on a cloud–provisioned infrastructure as is, without conversion or modification

VMware HCX on IBM Cloud extends this hybridity. Hybrid cloud extension (HCX) enables seamless extension of the on–premises network into the cloud through an optimized, software–defined WAN. An encrypted connection is established over the public or the private network, if needed to meet public isolation requirements. VMware workloads can be moved to and from the cloud with zero downtime and no modifications. HCX offers improved performance of your stretched network while reducing WAN traffic up to 50%.

Figure 3 illustrates the flow of VMware HCX on IBM Cloud.
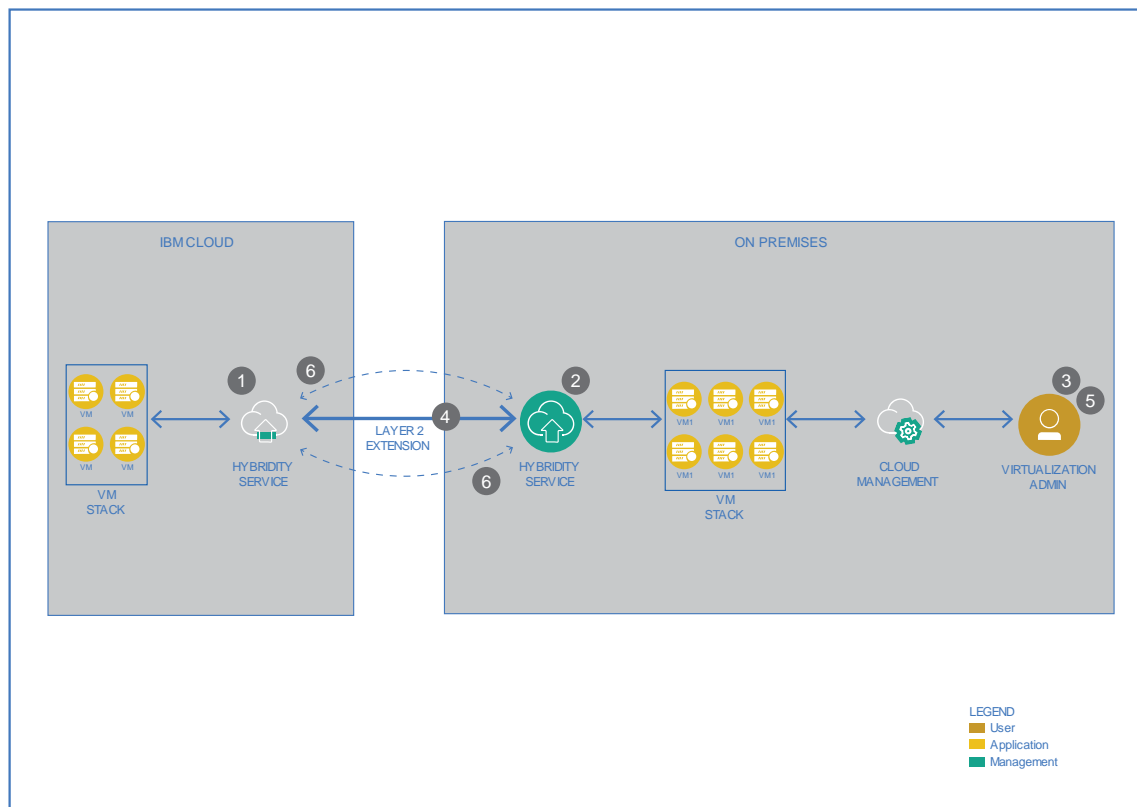
Figure 3. VMware HCX on IBM Cloud

Basic information flow:

1. VMware HCX on IBM Cloud is deployed in the cloud instance.
2. HCX is deployed on–premises.
3. Virtualization administrator uses the HCX user interface in vCenter to establish the network connection.

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4. The two HCX deployments establish a software–defined WAN connection to extend the on–premises layer 2 network to the cloud instance.
5. Virtualization administrator uses the standard vSphere user interface to initiate migration of on–premises workload to the target site in the cloud.
6. HCX uses WAN optimization to efficiently migrate the workload to the target site, maintaining the current workload IP configuration.

Scenario 2: IBM Cloud storage for virtualization

IBM Cloud for VMware Solutions supports the option to choose between vSAN and Network File System (NFS) storage during initial deployment.

Figure 4 illustrates the flow of VMware vSAN:
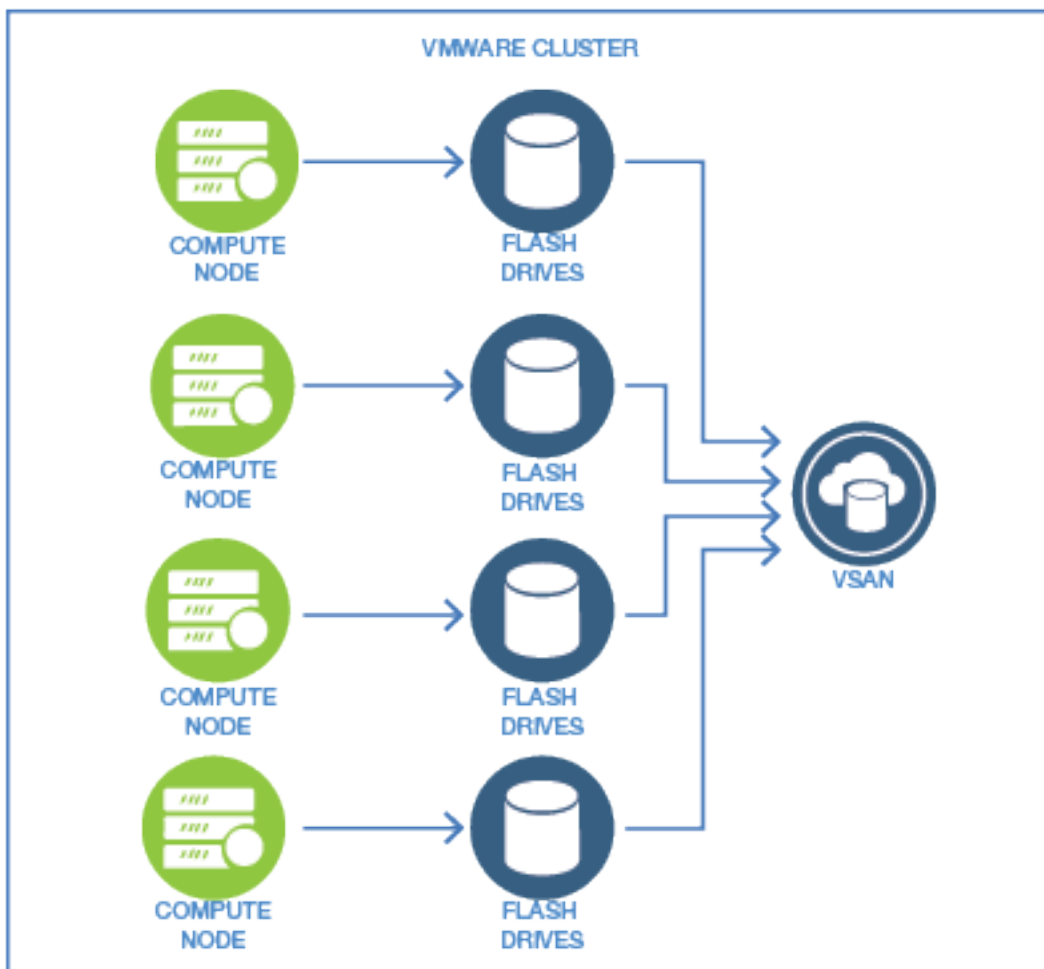
Figure 4. IBM Cloud storage for virtualization

The vSAN option is a software–defined storage offering, virtualizing dedicated all–flash disks on your bare metal servers. You have a number of configuration choices for disk type, size, and quantity, including the High–Performance Intel Optane option. You can enable vSAN compression, deduplication, and encryption according to your requirements.

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Figure 5 illustrates the flow of NFS:
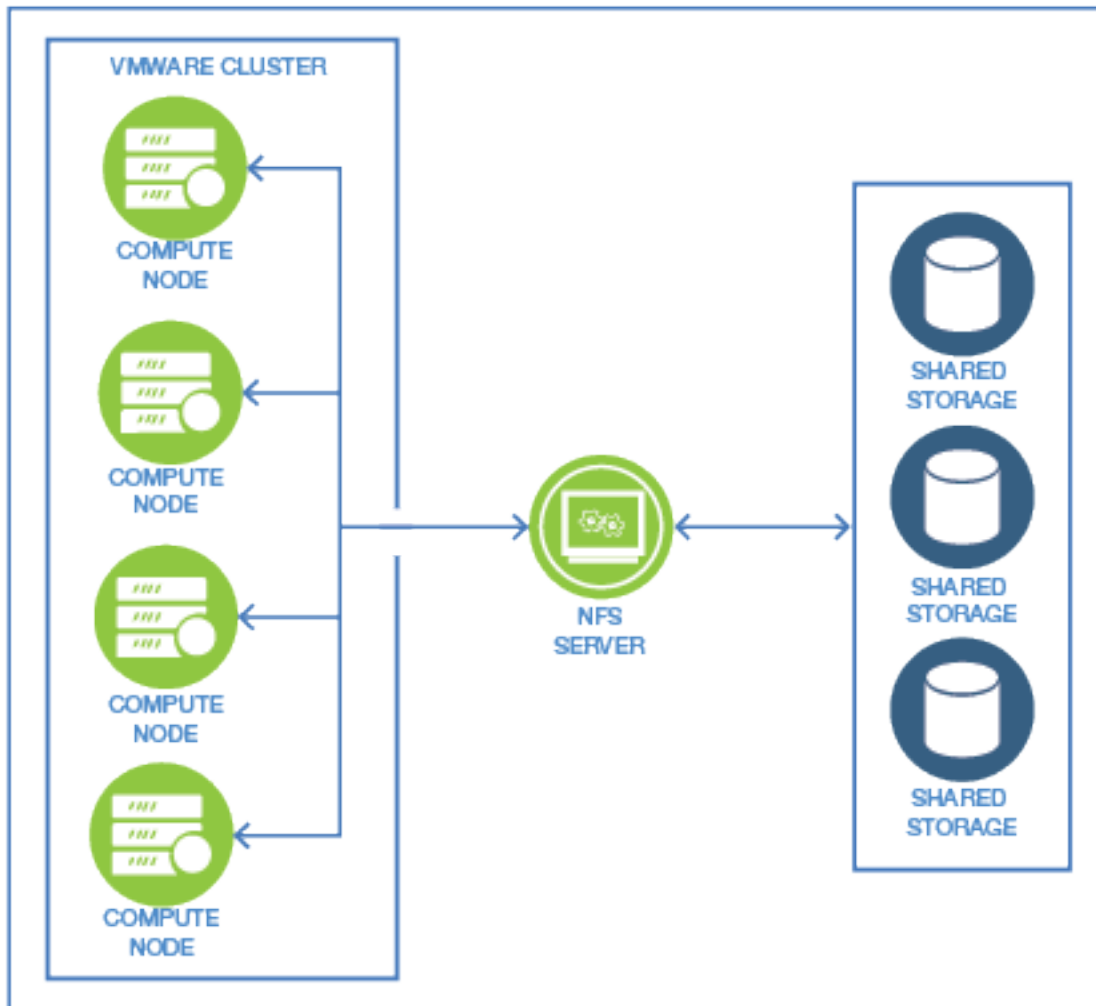
Figure 4. IBM Storage for NFS

The NFS option offers IBM Cloud Endurance NFS storage, which is designed to support high I/O applications requiring predictable levels of performance. It is available in three input-output operations per second (IOPS) performance tiers to support varying application needs, and it supports snapshots, replication, and encryption at rest.

When the need arises to add additional storage to the environment due to insufficient space or high latency, you have the ability to increase the vSAN–based storage capacity of a vSAN cluster by adding more ESXi servers post–deployment or order additional NFS shares to effectively and seamlessly scale out the storage associated with the environment without burdening the end–user with storage–level migrations.

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Scenario 3: Zerto disaster recovery

Businesses depend on IT infrastructures to be available 24x7. The costs of downtime are significant and impact a business's continuity. Downtime can be caused by many factors, including but not limited to natural disasters, power outages, hardware failure, user errors, and cyberattacks. Thorough security and business continuity strategies are crucial for modern businesses to minimize data loss and downtime.

IBM Cloud for VMware Solutions offerings exploit Zerto Virtual Replication technology to help provide near-zero recovery point objective (RPO) and very rapid recovery time objective (RTO). To protect management services and key customer workloads in the case of a complete site failure, create a standby disaster recovery site that can be brought online if the primary site is lost. You can use Zerto Virtual Replication to maintain constantly replicated copies of the protected servers at the disaster recovery site.

Figure 6 illustrates the flow for Zerto disaster recovery.
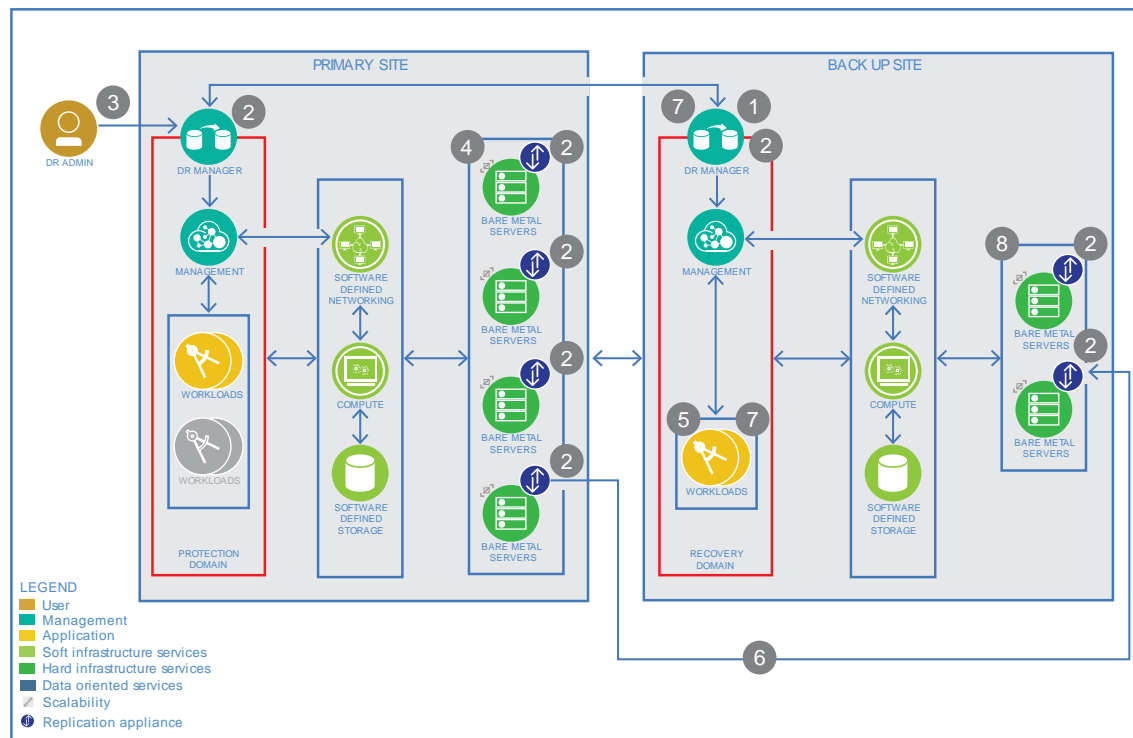
Figure 6. Flow for Zerto disaster recovery

Basic information flow:

1. Provision a disaster recovery (DR) site. You can size it as an exact replica or over–provision it for cost efficiency and scale it up in a DR event.
2. Install Zerto in protected site and DR sites. There is one Zerto Virtual Manager per site and one Zerto Replication Appliance is deployed on each physical host.

3. The DR administrator defines DR policies to the Zerto Virtual Manager, including the workload to be protected and the restore sequence.
4. The replication appliance begins replicating protected workloads to their partner appliances in the disaster recovery site.
5. Identical copies of the protected workloads are replicated from the protected site to the DR site.
6. The replication appliance detects any changes to protected workloads and mirrors these updates to the DR site.
7. When recovery is required, Zerto Virtual Manager at the recovery site begins powering on replicated servers based on policies.
8. You can provision additional hosts to provide additional compute capacity in the DR site to meet demand as more protected servers are brought online.

Scenario 4: IBM Cloud Secure Virtualization

IBM Cloud Secure Virtualization builds on a combination of IBM, VMware, Intel, and HyTrust technologies to help ensure the security of your workloads, simplify regulatory compliance, and guarantee data sovereignty.

Figure 7 illustrates the flow of IBM Cloud Secure Virtualization.
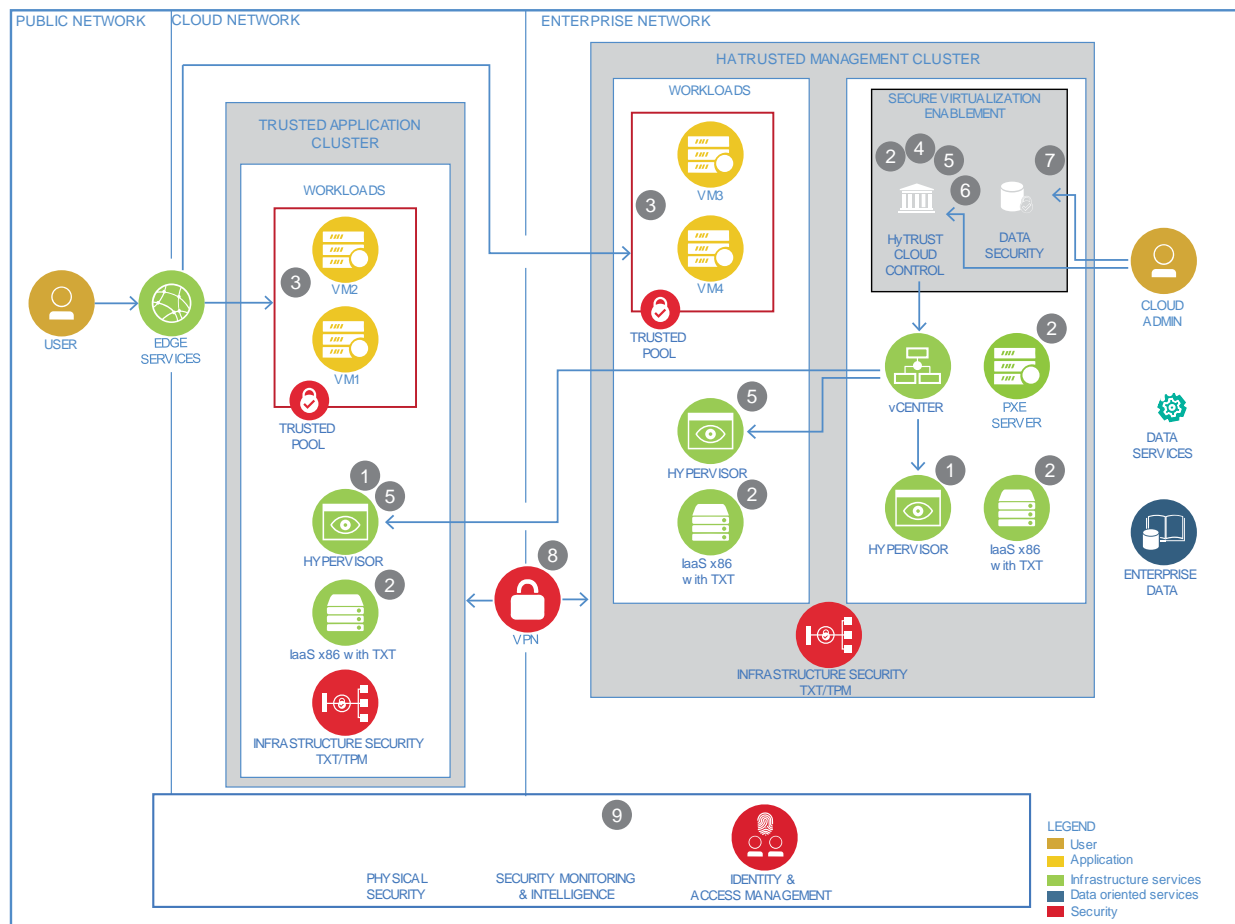
Figure 7. Flow for IBM Cloud Secure Virtualization

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Basic information flow:

1. Attest to trust: during deployment, identify the firmware configurations you will allow and the hypervisor configurations you have approved.
2. Tag assets: accurately identify each physical host and its physical location, creating a snapshot or fingerprint of each trusted host's launch configuration. This is stored in a whitelist of approved assets.
3. If the measurements of a host's BIOS and hypervisor match the measurements stored in the whitelist, the boot environment is attested. The host launches into a state that is considered trusted.
4. Create policies that allow or don't allow certain actions by certain administrators, based on the trust status of the host. You can define policies that allow an administrator to run a sensitive workload, move a workload, decrypt data, and perform other tasks based on whether or not that host started in a state accepted as trusted, or authorized, and grant permission to perform the request.
5. Assign tags to identify the actual location of your physical hosts.
6. Define policies to ensure that workloads are running in appropriate locations.
7. Define policies to ensure that your data is stored only in locations that you approved.
8. A VPN with validated FIPS 140–2 encryption ensures that all data on the move between data centers can satisfy the most stringent regulatory compliance checks.
9. Integrate with your existing security information and event management (SIEM) solution, governance, risk, and compliance (GRC) solution, or other solutions.

Scenario 5: Veeam backup and replication

Businesses depend on backup services to provide data recovery in case of data loss due to natural disasters, infrastructure outage or failure, user errors, and cyberattacks. Planning a backup service strategy is critical to minimize the possibilities of data loss and downtime.

IBM Cloud for VMware Solutions offers Veeam Backup & Replication technology to provide backup, recovery, and replication for your VMware workload on IBM Cloud. To protect your data, use Veeam to create jobs to back up your workload to IBM Cloud Endurance Storage.

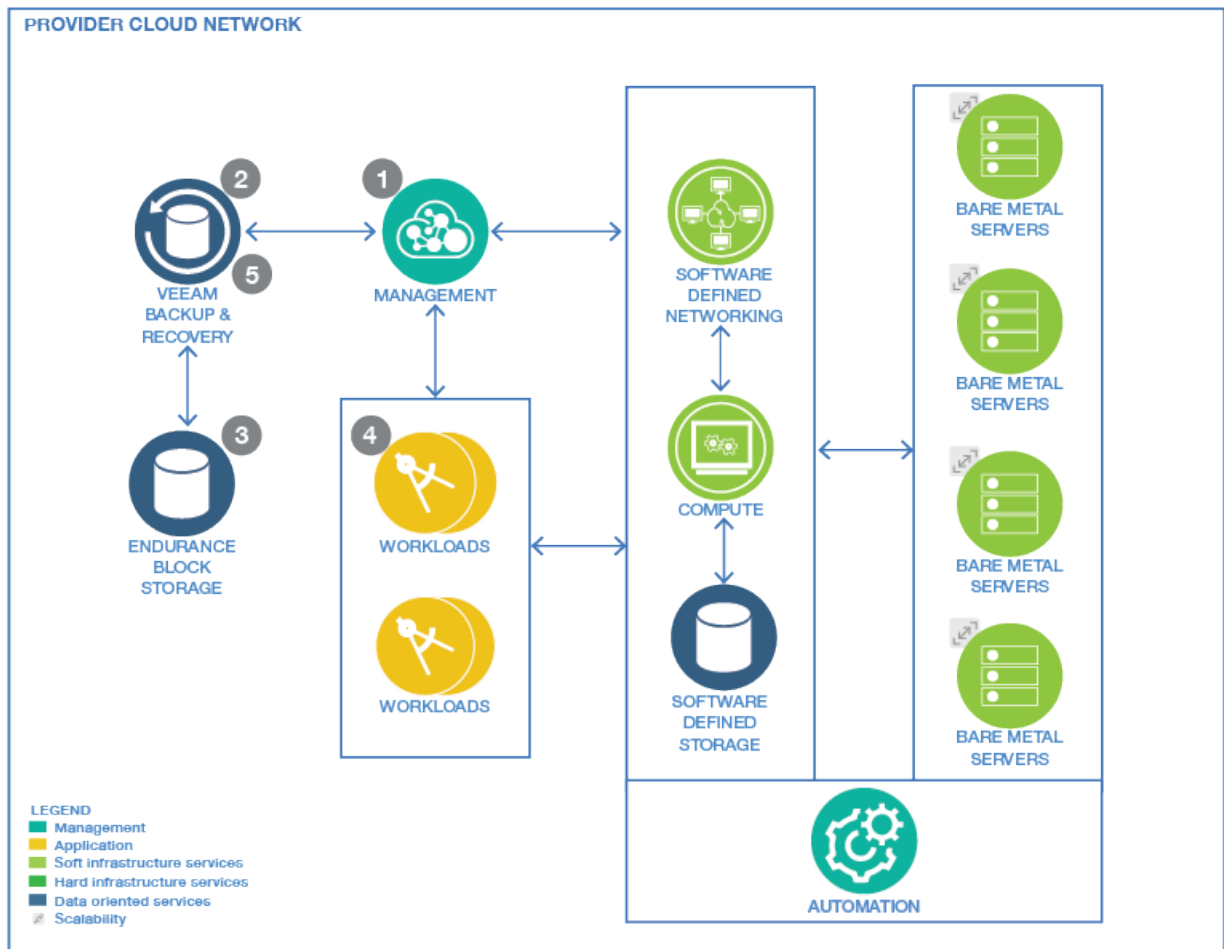Figure 8 illustrates the flow of Veeam backup and replication:

Figure 8. Veeam backup and replication

The following steps are involved in this example:

1. Deploy your IBM Cloud for VMware Solutions instance of vCenter Server or VMware Cloud Foundation.
2. From the IBM Cloud for VMware Solutions portal, deploy an instance of Veeam Backup & Replication. IBM Cloud automation deploys Veeam and connects it to your management infrastructure (VMware vCenter Server) and compute hypervisors (VMware vSphere).
3. The IBM Cloud for VMware Solutions portal orders and attaches Endurance block storage as a disk and backup repository for Veeam.
4. Deploy your workload to be backed up by Veeam into your vSphere cluster.
5. Log in to the Veeam Backup & Replication server and configure a backup job for your workload.

Additional scenarios

The virtualization platform has a number of additional platform extensions beyond the scenarios considered here. For the architectures associated with these extensions, refer to the full list of Virtualization platform extensions [2] in the IBM architecture center (www.ibm.com/cloud/garage/architectures).

Deployment options

IBM Cloud for VMware Solutions provides standardized and customizable deployment choices of VMware virtual environments. The following deployment types are offered.

VMware vCenter Server on IBM Cloud

The vCenter Server offering allows you to deploy a VMware virtual environment by using custom compute, storage, and network resources to best fit your business needs.

VMware vCenter Server on IBM Cloud with Hybridity Bundle

The VMware vCenter Server with Hybridity offering is a hosted private cloud that helps quickly and easily extend your on–premises infrastructure into the cloud. The VMware environment is based on IBM–provided VMware Software–Defined Data Center licenses, and it includes VMware Hybrid Cloud Extension (HCX). Using HCX, you can securely connect a vSphere 5.0+ environment on–premises with IBM Cloud sites for seamless infrastructure hybridity and true application mobility.

VMware Cloud Foundation on IBM Cloud

The VMware Cloud Foundation offering provides a unified VMware virtual environment by using standard IBM Cloud compute, storage, and network resources that are dedicated to each user deployment.

VMware vSphere on IBM Cloud

The VMware vSphere on IBM Cloud offering provides a customizable virtualization service that combines VMware–compatible bare metal servers, hardware components, and licenses, to build your own IBM–hosted VMware environment.

For more information, see IBM Cloud for VMware deployment offerings. [3]

Benefits of the cloud without restructuring

The benefits of VMware solutions are critical to enterprises and can minimize disruption. You can expect the following benefits:

- Global reach: Allows you to expand your hybrid cloud footprint to more than 30 enterprise–class IBM Cloud data centers around the world.

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- Seamless integration: Enables seamless integration across the hybrid cloud with the IBM Cloud infrastructure.
- Rapid provisioning: Automates the deployment and configuration of the VMware environment, which allows you to quickly deploy an enterprise–class VMware environment with on–demand IBM Cloud bare metal servers and virtual servers.
- Simplification: Enables you to consume a VMware cloud platform without the need to identify, procure, deploy, and manage the underlying physical compute, storage, network infrastructure, and software licenses.
- Expansion and contraction flexibility: Allows you to easily expand and contract your VMware workloads according to your business needs.
- Consistent management and governance: Provides a single console to deploy, access, and manage the VMware environments on IBM Cloud with full administrative access, allowing you to preserve your existing VMware tooling, scripts, and investments in training.

Conclusion

This paper offers an overview of the Virtualization reference architecture and how customers can use IBM products and services to support the best practices for architecting virtualization solutions. IBM Cloud for VMware Solutions allows you to easily deploy your VMware virtual environments and manage the infrastructure resources on IBM Cloud. At the same time, you can continue to use your familiar native VMware product console to manage the VMware workloads.

The paper described the advantages of the Virtualization reference architecture in allowing you to solve a wide variety of business challenges using virtualization in the public and hybrid cloud, including: backup and disaster recovery in the cloud, security, cloud migration, and cloud expansion.

Acknowledgements

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References

[1] Post–deployment considerations for your VMware instance enumerates a variety of activities you should plan for in order to fully operationalize your VMware instance.

[2] The virtualization platform has a number of additional platform extensions beyond the scenarios considered here. For the architectures associated with these extensions, refer to the full list of Virtualization platform extensions in the IBM architecture center (www.ibm.com/cloud/garage/architectures).

[3] The IBM Cloud documentation center has a wealth of information on VMware virtualization in the IBM Cloud. Dive in with IBM Cloud for VMware deployment offerings.

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